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U.S. NUCLEAR REGULATORY COMMISSION

BRIEFING ON NORTH ANNA

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TRANSCRIPT OF PROCEEDINGS

Public Meeting

Before the U.S. Nuclear Regulatory Commission:

Gregory B. Jaczko, Chairman

Kristine L. Svinicki, Commissioner

George Apostolakis, Commissioner

William D. Magwood, IV, Commissioner

William C. Ostendorff, Commissioner

APPEARANCES

PARTICIPANTS:

Dominion Nuclear

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Gene Grecheck
Vice President of Nuclear Development,
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NRC Staff:

Bill Borchardt
Executive Director for Operations

Victor McCree
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Eric Leeds
Director, Office of Nuclear Reactor Regulation

P R O C E E D I N G S

CHAIRMAN JACZKO: Good morning, this morning the Commission meets to discuss the restart readiness of the North Anna Nuclear Power Plant. On August 23, the North Anna facility became the first operating nuclear power plant in the United States to experience an earthquake beyond its design-basis parameters, it was probably not the one we would have ever picked, would have that experience.

Under our regulations the NRC will require a plant to shutdown if a serious earthquake occurs and also requires that the licensee demonstrate that the plant is in a condition to safely restart. The earthquake that affected the North Anna site was beyond the minimum what would have required the plant to shut down, and in fact, the earthquake was even beyond the plant's design parameters. Because of these unprecedented circumstances the staff is conducting a broader safety review than would typically be done. And while the staff has done a great deal of work so far, the staff evaluation of whether the North Anna plant is ready, from a safety perspective restart remains ongoing.

During today's briefing we will hear from Dominion regarding the company's restart activities at North Anna and from the staff on the status of our inspections and review. I would note that this is inherently a responsibility for Eric Leeds to make the restart determination, but several of my colleagues on the Commission, Commissioner Apostolakis and Commissioner Ostendorff had come to me and were interested in having a meeting and I know my other colleagues were as well, so we are having this meeting as an opportunity to hear from all of you. The way I look at it is this is a chance to see if we have the right kind of structure to address this kind of situation if it were to happen in the future and this is a good opportunity for us to get some awareness and visibility on what's happening, but this shouldn't be, I think, taken as a replacement for Eric's efforts to make the determination, ultimately, about the readiness; that responsibility will fall to him unless the Commission changes that, but as it stands right now that's the way forward. So with that, would any of my colleagues like to make any remarks? I guess we'll start with Dominion.

DAVID HEACOCK: Good morning, if I could make a couple introductions, if I could. First, I'm Dave Heacock, the president and chief nuclear officer with Dominion. To my left here is Gene Grecheck, he's the vice-president of nuclear development. We have Larry Lane site vice-president; Eric Hendrixson next to him, he's the director of nuclear engineering at North Anna, Divakar Bhargava, the principle engineer and seismic expert with us and Dave Sommers, supervisor of licensing. Good morning, we appreciate the opportunity to be here today to discuss North Anna. Dominion and NRC share a common goal here: the objective to make sure North Anna is safe, before it's allowed restart. Public safety is always first in our minds. As you know, this is the first time -- and you mentioned already Chairman -- that a plant has been shut down as a result of the seismic event in excess of the design-basis earthquake. The original design-basis earthquake spectrum was established with an 84 percent confidence level, which means that some cases would exceed that, in fact, one in six strong earthquakes could exceed the design-basis earthquake. We had that earthquake at North Anna.

The plant did experience -- did not experience any significant damage because there are substantial safety margins built into the design, in our design process for the plant and the energy imparted on the plant was significantly below that considered in the design.

The NRC has provided very specific guidance to return a power plant to service that's been shut down as a result of a seismic event. The guidance defines a protocol and we are following that protocol. The first step is to determine the amount of energy that was imparted on the station. Gene will describe how the accelerations were measured at the site and he will also discuss how the accelerations when combined with the durations determines the damage potential for any earthquake.

The best way to determine the effects of an earthquake is to examine the components at the station. You look at the most susceptible components first; these are called indicators. Components like unreinforced block walls, un-anchored water tanks, ceramic components are the first things to be damaged in an earthquake. Those indicators then establish the intensity level, which then determines the scope of inspections and testing required for that event.

Shortly after the August 23 event, Dominion began doing inspections, examinations and testing. We did a number of areas, we did pump testing, we verified the flow, pressure, vibrations, et cetera and assured they didn't have a declining trend from previous inspections. We did weld inspections, we did snubber, both visual inspections, over 700 of those. We did a number of functional tests as well on snubbers -- these are the hydraulic devices that dampen pipe movement in the event of an earthquake. We did steam generator inspections on one steam generator on Unit 1, and two steam generators on Unit 2; over 10,000 tubes were inspected, did secondary side inspections on the steam generators as well.

We also, on Unit 2, opened up the reactor vessel and inspected all the fuel assemblies, did drag tests on the control rods, we inspected all the reactor internals, we also excavated significant portion of our buried piping; about 10 percent of our piping that could contain reactor material was actually exposed and inspected on the outside. We did pressure testing of a number of a significant portion of the remainder of that piping as well. And we didn't find any damage in any of the buried piping, we didn't find any damage in any of the equipment. We found no damage whatsoever that could preclude operation of the plant. No functional damage.

After nearly two months of comprehensive inspections over 100,000 person hours of activity, Dominion has concluded that consistent with Part 100, Appendix A, there is no functional damage to any safety systems, structures or components. I'm confident that the units have been thoroughly inspected and tested and they pose no undue risk to health and safety. We have demonstrated the units are ready to restart. Now Gene will walk through a number of these areas I just talked about and give you more detail on each.

GENE GRECHECK: Thank you Dave and good morning. We'll go to slide four please? I thought we would start out with looking at the actual data that was recorded from the event, which actually created the conclusion that North Anna had exceeded its design-basis on the basis of certain exceedances of measured peak accelerations at various frequencies across the spectrum. This graph is relatively complex, so let me just work through it for you just to make sure we're all looking at the same data. The two curves that are at the bottom of the graph, the ones that look like a small hill, there's a red line that represents the operation basis earthquake; that represents the calculated spectrum of accelerations versus frequencies for which the plant was licensed. Above that, in purple, is the operational basis earthquake, or the safe shutdown earthquake, basically the OBE, the operational basis earthquake is established at 50 percent of the design-basis earthquake.

You can see, in orange and blue are the measured horizontal spectra that we experienced on August 23 and you can see that at certain frequencies the measured accelerations do exceed the curves that were in the licensing basis. It's also important to note the green line above. The green line represents the spectrum that was used for the IPEEE A46 effort back during the 1990s. At that time the NRC and the industry did an overall evaluation of the entire nuclear plant population to determine the ability of plants to successfully shut down in the event of an event significantly above the design-basis. As you can see, that green IPEEE curve does bound what we saw during the August 23rd event. So based on that evaluation, we would have expected, even without doing any additional calculations, we would have expected that the plant would have endured the August 23rd event without undue damage, since it had already been evaluated to a spectrum that exceeded the measured values.

My next slide is the same data for the vertical component of the three axes and, again, this is a similar situation here with the blue line that has the various peaks in it at certain levels does exceed the accelerations that were previously assumed. Next slide.

We've been looking at accelerations versus frequency; that's called a seismic acceleration response spectrum. That spectrum is very valuable for design. The designers take that information, they process it, creating a composite seismic accelerations for the various components analyses and they apply that for various time levels usually for -- in excess of fifteen seconds, if you're doing a shaker table test it would be for even longer than that, typically about 30 seconds. So the equipment and the analyses in the plant were subjected to the maximum accelerations that you saw on that curve, but for an extended period of time. That is what the designers use this curve for.

The curve, however, is a very, very poor predictor of plant damage. If you actually have an actual event and you measure peak accelerations, since that curve is in no way reflecting how long the accelerations or the strong motion was actually present, it does not tell you anything at all about what damage to expect or what damage you would predict that the plant would experience. But what does do that is a value called the cumulative absolute velocity that has been well-accepted in the industry with work done by EPRI and endorsed by the Nuclear Regulatory Commission that takes both the duration and the acceleration into account. It has been determined to be the best single indicator of the actual energy imparted to the plant structures, and as a result it is the best single indicator of what expected damage should be.

Before we get into the CAV calculation, I would like to show you what actually was measured, in terms of the time history on August 23rd. The three plots you see here, again, are the plots in the three directions that were measured by the accelerometers. The top curve is the vibration in the east-west direction, the vertical accelerations are in the middle and then the north-south is on the bottom. Now a couple things jump out at you when you look at this. Number one you can see that the vast majority of the strong motion occurred in a very, very short time, at the very beginning of the event. As a matter of fact, affective strong motion is defined when 70 percent of the total energy is imparted to the structure, so range is between the point where five percent of the energy has been imparted all the way up to 75 percent. So that calculation of 70 percent of the total energy from the event was delivered to the plant in the times that you see up on the graph. So for example in the north-south direction, the one at the bottom, all of that energy was imparted to the plant in only one second.

Similarly, if you look up at the red line at the top, the east-west, which also had some exceedances, that took longer and was 3.1 seconds. Now there's an interesting inverse relationship that you can notice there; on the bottom where you had what looks like larger accelerations, it was also over a shorter period of time. In the east-west direction, you had less peak acceleration but it took over a slightly longer period of time. It turns out that when you integrate that the CAV values are not that different, although you'll see on the next slide that there was a difference. But the fact is that for a given value of energy that that event has, then you're going to see a trade-off between acceleration and duration. If you have both high acceleration and long duration, that is a much higher energy event, so for any given energy, one or the other is going to be trading off.

So when you use that data and you compare it against the design, the shaded portions on these graphs is the actual effective earthquake that the plants have been analyzed or tested to. Superimposed on top of that is what we actually measured. So what does that show you is that the total energy that was assumed during the analysis, or during the testing, is substantially larger than the total energy if you integrate over the very short duration peaks that we experienced on August 23rd.

The other piece that's important to note when we look at measured accelerations, is that these accelerations that are being quoted -- next slide -- occur at the containment base mat. The containment base mat is at the very bottom of containment; it is founded on bedrock at the North Anna site and if you calculate the postulated accelerations as you go up in a building, then you expect to have amplified response as you go up higher. And indeed, we did have an additional detector up at what we call the operating deck, the elevation 291 on the graph there. So if you compare the calculated design-basis acceleration which is in that upper graph you can see that there is a very, very large peak that far exceeds the values that were actually measured at that elevation. Why is that significant? It’s because at the plant, when you are calculating the effects on various components, all those components are distributed among various levels within the containment; they're not all down at the containment base mat, as a matter of fact there's not really all that much equipment at the containment base mat.

So you actually have to look at each elevation within your buildings, compared to either the calculated or measured accelerations at those levels, against what was originally put into the design when the equipment was installed at that level. And as you can see, what we saw in this event is that even though we did have some frequency, or acceleration versus frequency exceedances at the containment base mat, the design assumed -- at the operating deck, for example -- significantly higher peak acceleration than what was actually measured.

Let's talk a little bit more about cumulative absolute velocity and we'll focus for a moment on the top row of this chart. The August 23rd event, when you actually look at the effective strong motion that was experienced and you do the CAV calculation you can see the numbers listed in the top row. In the north-south direction, which turned out to be -- remember that was the bottom trace on that previous graph, which had the highest peaks, we calculated a cumulative absolute velocity of .17. In the other two directions, they are substantially below .16.

What's the significance of .16? The Electric Power Research Institute, EPRI, in the development of the guidance for seismic response, many years ago had spent a long effort looking at hundreds of earthquakes around the world and not on nuclear plants but on conventional engineered structures. They attempted to -- what they were trying to is to find a correlation-- could you come up with a correlation that says “If I measure certain values, can I predict what kind of damage am I going to see?” And with looking at these hundreds of various events, again, not on seismically designed buildings, but on conventional structures, they determined that with a great deal of margin, if you established a cut off value of .16, then you could predict with almost complete certainty that no substantial functional damage would be experienced in an engineered structure. Clearly, if you have a seismically designed structure, it's going to be significantly above that, but purely as an ability to be able to do a quick calculation, do I have something here that I should be concerned about, .16 was chosen as the value that says, I know I don't have anything above that.

As you can see, in two of the directions we were substantially below .16, in the third direction we were only 10 percent above it. So purely from a number perspective, you can say I suspect, just based on this, that when I actually go out and look at my plant, I'm not going to find any damage.

Just as a means of comparison, we also included here some synthetic time histories that correspond to both the design-basis earthquake and also to the reference level earthquake that was used for IPEEE. So the CAV numbers that are calculated here is if you simulate a time history corresponding to those larger events, what would the CAVs turn out to be for those? As you can see, for the design-basis you're talking about numbers that are substantially larger; about four times the magnitude of what we actually measured.

So again, when you start taking into account the energy imparted, not just this single peak acceleration, but looking at the entire event, you can see that the plant was designed for a cumulative absolute velocity that is on the order of four times the event that was actually measured. And in terms of the IPEEE, as you can see, it is almost an order of magnitude lower.

That same data is presented on Slide 11, this just made -- puts it in pictorially. You can see again the .16 value that comes from the Reg Guide and again you compare those three values and again you can see what we actually measured at the site was just, either below or just barely above the .16 value as compared to what had previously been analyzed for the plant.

In addition to the CAV calculation there are significant design margins in the analysis that was used to design North Anna. There is substantial conservatism in the analytical methods; there is the instructure response spectra that we described before, the damping that is actually in present for equipment is conservatively assumed. Using the calculational techniques that existed back during the 1970s when this plant was designed and licensed, the calculational techniques tended to be linear, they tended to be simplistic models and as a result of that were much more conservative, simply as a reason -- as a basis that there was not the detailed calculational techniques that became available later.

When we compare the limits, when we say we design a plant to a particular limit, that is a limit based in the ASME code, the ASME code has substantial conservatisms built into it again, between what is considered allowable and where you actually expect to see equipment failure.

Another important fact is that when you calculate maximum stresses in components, those stresses are calculated not for a typical static condition with the units running at normal, 100 percent power, but they are calculated for an accident condition. And in almost every case, the loads that are created by an accident, whether it's a loss of coolant accident or a main steam line break, are much greater than the loads that are created by an earthquake.

In addition, the maximum loads on a component include the dead weight of the component itself, they include the pressure inside the component, they include thermal effects, when the unit is hot. So when you combine all of that, the seismic portion to the overall calculated maximum stress level on a component is usually dominated by factors that are not seismic. So even if you increase the seismic loading, that is usually a very small component of the overall stress; and, therefore, you would not expect under a steady state condition as we saw on August 23 that you would see a stress exceedance.

And again, the seismic test standards, when a component is tested on a shaker table then it is not simply a single event. Usually, what the standard requires is that the component is subjected to five consecutive OBE events, followed by a DBE event. So the component has already been -- already experienced substantially more shaking than what we would see during a single event. And again, as we mentioned before, something between 15 and 30 seconds of strong motion as opposed to the one or three seconds we saw here.

One further comment on seismic margin, as I mentioned during the 1990s the plant did perform an IPEEE evaluation. We inspected around 1,800 safe shutdown components; these were components that were selected to be important to the ability to safely shut down the unit in the event of a seismic event. The reference peak acceleration that was chosen for that is .3g; that's the value that is anchored at the 100 hertz level on the graph. And we demonstrated that safe shutdown could be successfully accomplished at North Anna with an event significantly higher than the design basis.

There are about 50 components in the plant; they were evaluated to have high confidence levels slightly below .3. They ranged from .16, which was a particular water storage tank, all the way up to values just below .3. In many cases during the IPEEE effort modifications were made to the plant to increase the capacities of those components, but we have a list of those and as Dave mentioned at the beginning one of the ways you can quickly determine the effect of an earthquake on your plant is to look at the components that are known to have the smallest seismic margins. These components were clearly identified during the IPEEE analysis as being more susceptible to seismic damage than perhaps others and they were one of the first areas to look at during our inspection. We looked at all of those and found no seismic damage.

Ultimately, on Slide 14 the plant tells the story. We've shown that analytically, when you do the calculations you would predict that there would be no damage to safety related structures, so with that analytical background we can now go into the plant and say, do our actual observations confirm what our analysis tells us.

So I'm going to show you a few pictures of damage at the plant.

This first picture is taken in the Unit 2 turbine building. The Unit 2 turbine building is a non-seismic structure; this is up on the operating deck of the turbine building so it is quite high up in the air, again, it will be experienced to seismic acceleration. And you can see a series of tanks there; these are vertical filtration – condensate polishing tanks -- filled with water, so you have a large lump mass on the highest level of the turbine building. If you look very carefully at those pictures, you'll see that the tanks are supported with four relatively small vertical angle type supports; those supports are bolted down to concrete base plates that are on the floor.

If you go to the next slide, you can see an example of damage, as a matter of fact, this picture represents the most substantial recorded damage to any structure that we saw at North Anna power station following the event. Again, it did not affect the functionality of this support but we did have some concrete spalling on that corner, so this picture here represents the most notable damage that was observed. Again, it clearly did not affect the function of this support, but it is visually, the worst damage we saw.

Another indicator, as we described before is what is the effect of the event on unreinforced concrete block walls. Here is a concrete block wall in the turbine building, again, this is not a seismically designed structure and you can see what is a classic, seismically induced crack in this wall, that's the stair step that you can see in the grout as you go down the wall. So, probably, this crack did result from the seismic event but it, again, did not affect the functionality of this wall. This wall is not displaced; it is still structurally sound; it does not require repair; it is simply an example, again, of how small the event actually occurred within the plant.

And finally, and we observed a horizontal crack on an interior wall in the Unit 1 containment. If you look very carefully at that, at the very top of that picture you can see a horizontal crack that seems to run through that wall. Upon investigation of this what we discovered is that during construction of this wall, in containment, many, many years ago what you had was a concrete pour, which stopped at the level of that crack, that was allowed to cure and then a second pour was done above that. The joint was then covered with mortar in order to make a smooth surface which then could be painted; that wall there was painted so in order to make a nice smooth surface to paint, you had a mortar joint there, similar to what you would do in your home if you had two slabs of sheetrock and you used the paste to cover over the crack. The crack is only in that mortar joint; it is not in the concrete structure at all. So once again this is a cosmetic defect, this is not a structural defect. North Anna does have a dry cask used fuel storage facility. That pad that you see there is seismically designed. It has 27 vertical casks on it, each containing spent fuel assemblies. When we examine this pad in detail, we did note that 25 of the 27 casks did move slightly from their original position. In the worst case, it was about a 4 and a half inch movement.

If you go to the next slide, you can see the ring on the concrete pad where the cask had originally been and you can see that it moved over slightly. It is important to note that these casks are not bolted down to the pad in any way, they are free to move, they are obviously very heavy but they simply sit on the pad and simply friction between the concrete pad and the bottom of -- the smooth bottom of this cask gives the only restraining force that it has on that.

We did do extensive review of the condition of the ISFSI; we measured to radiation levels before and after the event, each one of these has a pressure monitoring system in it to verify that the seals are intact. That pressure monitoring system stayed in operation throughout the event and showed no change; so therefore, we know there's no leaks or any changes in the pressure integrity of the vessel. So the cask did move, but their existing position is acceptable and again, no damage was observed.

So you have a sense there of what we actually saw, so the next step was to determine what steps did we need to take in order to demonstrate to the staff's satisfaction that the plants were acceptable to restart. The regulatory guidance comes from 10 CFR 100, Appendix A, this is Slide 22. And in the regulation it says, "Prior to resuming operations the licensee will be required to demonstrate to the Commission that no functional damage has occurred to those features necessary for continued operation without undue risk of the health and safety of the public."

If you go onto the next slide, during the 1990s EPRI did extensive work on developing guidance, which I'll show you on the next slide. But the NRC -- if you go back one, the NRC did endorse the EPRI guidance, in two Reg Guides, 1.166 and 1.167. As a matter of fact, the title of Reg Guide 1.167 is particularly appropriate; it's entitled, "Restart of a Nuclear Power Plant Shut Down by a Seismic Event."

So the guidance has been in place for many, many years. This guidance was developed during a period not in the heat of battle, not at a time when a plant needed it, so it had a lot of time for consultation between the industry and the NRC staff. Essentially, what the guidance tells you, in the Reg Guide is follow the protocol that is in the EPRI document.

The EPRI document, as you go to the next page, is EPRI NP 6695, you'll hear lots of references to that in both our presentation today and also I believe the staff will refer to it. Again, it's guidelines for a nuclear plant response to an earthquake, this is about 100 pages long, it is extremely detailed, it provides detail on how to do the damage evaluation, what to look at, how to categorize it, what kind of inspection process you should use and even discusses after the plant has restarted what kinds of actions should take place. We have used this as our guidance throughout the investigation of the event.

One of the words that pops up in many of the guidance is the definition of functional damage. I've already mentioned that a few times, in terms of cosmetic damage is not functional damage. This is the definition in the EPRI guidance, it says, "That in order to be functional, it has to be significant damage, either physical or other that impairs the operability or reliability of the item to perform it's intended function. Minor damage, such as slight or hairline cracking of concrete elements is not functional damage."

And again, the comment in the Reg Guide, or in the EPRI guidance was that the plant itself and not any information that you may gather from nearby communities, or any recorded motion that may have been measured somewhere else other than at the power station, the best indicator is what actually happened at the plant and not what may have happened at some other location.

Very quickly, just run -- this is Slide 27 -- as I said there is some very detailed guidance in the EPRI document, I'll just run through a couple of these flow charts just to show you how this process works. In this first one, it talks about short term actions, in terms of what do the operators do immediately after a seismic event. So you feel the earthquake, the operators at North Anna definitely did feel the earthquake at the time it happened, and of course one of the first decision points is did the plant trip or did it not? In North Anna's case, both units did trip. So the operators have their procedures, which they run through in order to safely verify that the plant has shut down.

There are some immediate near-term operator walk downs that are performed that the operators will immediately, after the plant is stable, they will go out and look in the plant just to verify at a very, very high level that there is no damage that they need to be aware of. And in parallel with that, the effort to determine the extent of ground motion begins. That is not something the operators can do, that is something that you need engineering support in order to perform that and a lot of that is dependent on the instrumentation that you have available.

So you have at the very early stage of the event, two parallel paths, the operators are making sure that they don't see anything that they need to respond to, on the other hand the engineering folks begin to the do the analysis.

One of the first decisions that needs to be made is have you exceeded the operational basis earthquake or not. In North Anna's case we made that determination and we reported it to the staff.

So if you go to the next slide, at this point you've determined the fact that you've exceeded the OBE so what you now have to do is determine, on a plant basis, not on analytical basis, what kind of damage are you observing. EPRI provides guidance for four damage intensity levels, ranging from 0 to 3, that range from essentially no damage at all to relatively significant damage at level 3. We were able to determine that North Anna experienced level 2 damage intensity. We brought in external experts to independently verify our assessments and in all cases they agreed with us, that what we saw at North

Anna was a level 0. And if you follow this chart, if you have a level 0 event then essentially what it suggests is that you need to do a set of surveillance tests to verify that your equipment is in good shape. Clearly, you would need NRC approval to restart, but from a physical standpoint there are no other actions required.

We chose, conservatively, to apply the situation that we had a level 1 intensity. Again, there was no question, there was no debate about whether there was a level 0 or level 1 but we chose, conservatively, to just assume for the sake of plant response that we did have a level 1. The major difference between level 0 and level 1 is the yellow box at the very top that talks about expanded inspections. This -- at this point drives you into a more extensive inspection, detailed inspection, of the plant beyond what was done immediately after the event.

And on the next slide I give you some examples of what expanded inspections included. This included structural inspections, it included inspections of these the low HCLPF items on there as a reference to that list of components in the IPEEE that we knew had lower seismic margins. We look at electrical components, we consider hidden damage. One of the lessons that the industry has learned from some of the events in Japan, including the Kashiwazaki-Kariwa event from several years ago is what kinds of things should you look at in order to determine if there is hidden damage. Clearly, the experts will tell us that visually you're able to tell a lot, because you're able to determine whether the component is moved. That's relatively easy typically because you have paint on a support or paint on a component. That paint will typically break and you'll see a crack in the paint, and even if there was no structural damage, you can tell that some movement occurred. The question is, even if movement did not occur, or you don't see any potential damage, how do you know that something did not potentially happen in a weld or a component? A lot of the information was gathered from the Kashiwazaki event, in terms of what kinds of things to look at, what things do seem to be susceptible, and what are not. And we use that to guide our selection of, for example, weld inspections that we did in the plant, and I'll talk about that shortly.

We looked at our main dam for the plant. The main dam at North Anna is not seismic, it is not safety-related. The cooling water lake is not required; it is not part of the ultimate heat sink for the plant. But clearly it is an important feature of the plant and was inspected. We do have a service water reservoir, which is the ultimate heat sink that again is a impoundment that was inspected in detail. We did many system inspections, a great deal of surveillance and functional testing. We looked at the fuel, we looked at the vessel internals, and we also, as I mentioned, looked at the spent fuel storage.

We put all that together into a demonstration plan, which we presented to the staff in this room back on September 8th. We put -- listed the process that we would go through to inspect and test the plant, all based on the fact that, again, we have determined that we had an EPRI damage intensity zero event, but we chose to apply the guidance from a level 1. In the two months that have gone by, almost two months, since that we have had extensive interactions with the NRC staff. The staff here at headquarters has been sending us extensive RAIs. We're up to over 130 already, which we have answered. As a matter of fact, last night, we answered the last of the short-term questions that were outstanding. So, the staff now has all of the information that they have asked for.

On site, we had both an augmented inspection team, and a restart readiness inspection team come in and look at many of the inspections that we had performed. And the staff will report the results of those. And we also completed the root cause evaluation of what actually caused the reactor trip. Overall, once we had completed the demonstration plan, which we described for you, we evaluated everything in the corrective action system that was identified during the last several months that could be associated with the earthquake, and made sure that we had this position on all of those. And finally, our facility safety review committee, this is the on-site safety review committee, reviews all of that information, all the evaluations, the engineering evaluations that were performed, and makes a determination or a recommendation to the plant management that the plan indeed is ready for restart. This review has been completed for Unit 1, and will be completed for Unit 2 in the next several days.

Next slide on Page 32, what did we actually inspect and test? Go to Page 33. This shows you person hours that were expended as of October 9th. These are direct Dominion hours, it does not -- the numbers do not include the contractor resources that were used. And as Mr. Heacock mentioned a few moments ago, we're estimating that about 100,000 person hours have been expended over the last two months in the effort to inspect, evaluate, and determine the acceptability of the power station. This is, obviously, a very extensive effort. It represents a huge amount of documentation; and so between the hours that have been spent in the plant, and the hours that have been spent answering the staff's questions, we believe that we've performed a very thorough review of the plant condition. Matter of fact, this binder I have next to me represents the submittals that we've made to the staff over the last several months, and as you can see, it's a substantial amount of information in there. We also used multiple external consultants. These are the people that, you know, the leaders in the industries and seismic experts. People who are -- have developed much of the theory and methodology around calculating effects of -- seismic effects on buildings.

Let me show you a couple of pictures of some of the things we looked at during the inspection effort. This is the chemical addition tank. This turns out to be one of the items on that low seismic margin list. And interestingly, this particular component was calculated to have a susceptibility to tip-over, and not at the point where you would expect. If you look at that and you see those anchor bolts that anchor the tank down to the concrete pad, you would expect that the vulnerability there would be in those anchor bolts. It turns out it's actually the pad itself that is the weak link here. So the calculated effect here is that this tank would tip over and take the pad with it. As you can -- we did inspect that pad in detail, found no cracks, no evidence of any seismic distress to it. So this again is one of the lowest margin components in the plant and did not experience any damage.

Another example of that is the boric acid tank. You can see a seismic support there. Again, that seismic support was calculated to have a relatively low margin. And you can see again there was no damage there.

The next example is actually an opportunity. This is the inside of the circulation water discharge tunnel on Unit 2. Normally this tunnel is full of water. This is the water that is being pumped from the lake through the condenser, and then back into the discharge. So normally this tunnel is full of water. What makes this tunnel interesting is that it is a square tunnel, and it is underground, and therefore it could be susceptible to a seismic event. But again, it's a concrete structure so if you have some sort of excessive shaking, you'd expect to find some cracking, or distress in that. Again, this was inspected in detail. As you can see, we strung lights up, we had people in there looking at the structure in great detail, and again found no seismically induced damage to the tunnel.

A great deal of pump inspections. Again, we've listed some of the examples, we've looked at all of our safety-related pumps, performed the surveillance testing on them, measured current and vibration and flow and discharge pressure. And again not simply to verify that they were acceptable, but to compare those values against the recorded values for these components prior to the event to show that there was no degradation. So it's not simply to say I ran it and said it's okay -- I'm comparing it to what the component did before, and show that there was no change in the characteristics.

As Mr. Heacock mentioned, we did do extensive snubber testing. We have here about 700 visual inspections of snubbers throughout the plant. A great deal of functional testing again verified that there was no damage as a result of the event. We did look at the nuclear fuel. As you know, on Unit 2 -- Unit 2 was scheduled to go into a refueling outage within several weeks after the event. We decided to enter that refueling outage as part of the restart. And so therefore we had opportunities to inspect all of the fuel on Unit 2. As part of the evolution, we defueled the unit, put all the fuel in the spent fuel pool, had the opportunity to perform visual inspections, control rod drag testing. All of those inspections were satisfactory.

In addition, new fuel had been delivered to the station in anticipation of the Unit 2 refueling. That new fuel was in dry storage; that's new fuel storage racks. We examined that fuel, made sure again that there was no observed damage there, measured the control rod insertion force into those assemblies as well, looked in the spent fuel pool, examined fuel that was both from the previous cycle, and is scheduled to go into the new cycle. Again, observed no damage.

Buried piping: There is a significant amount of interest as to what potentially could have occurred for piping that is buried in the earth. There are about 1,100 feet of piping at North Anna that either contains or potentially contain radioactive fluid. That 1,100 feet is split up about 700 feet or so of that normally has water in it. The other 400 feet is drain piping that, you know, may drain water from the floor of the building that could have radioactive fluid in it but is not normally wet.

So, 400 feet of piping normally has radioactive fluid in it. What? You said something – 700? What is particularly significant from a buried piping standpoint is where piping travels between one building and another because the buildings may be moving independently in a seismic event and, if you had piping that bridges from one building to the other, again, that would be a postulated place to look for possible damage.

The left-hand picture on Slide 41 represents one of those cases. This is the, this is an area right next to the refueling water storage tank on Unit 1 where it moves into the safeguards area. You can see a lot of piping that's labeled there. You can see some safety injection piping. You can see some containment spray piping, high head safety injection. This is a relatively critical area and, as you can see also, that there's a relatively small area between the two buildings. This could be, potentially, a high stress area if indeed these buildings had been moving.

So, we exposed this piping, completely dug the dirt out, went down there, and looked at the piping, and, again, observed no damage to this piping. In total, we looked at about 100 feet of safety-related buried pipe, both visually inspected it and used ultrasonics in cases to verify wall thickness and, again, confirmed that no damage was found.

Next slide shows you a fire protection pipe. Fire protection pipe is particularly susceptible to seismic shaking. It is typically cast iron. It is not, doesn't have quite the same resilience, for example, as stainless steel safety-related piping. We exposed about 50 feet of fire protection piping, looked at it. We also pressure-tested this system. The fire protection system is a system that has an automatic pumping pressure control process in it and verified again that there was no leaking or no new leakage being identified in this system beyond what had been seen before.

Steam generator inspections, as mentioned before, we did three steam generators between the two units, one on Unit 1 and 2 on Unit 2. Over 10,000 tubes were inspected using eddy current. We also used video examination of the channel heads to verify that we saw no damage in there. The eddy current of over 10,000 tubes did not identify any new flaws or indications that we had not seen before. Also did extensive inspections of the secondary, the steam drum, feedring, J tubes, upper support blades. No evidence of degradation was found.

And, finally, a great deal of NDE inspections and testing on welds.

You can see the numbers on the charts between the liquid penetrant tests and ultrasonics and visual testing, we did an extensive sample. And this was not just random sampling of welds. What we did is we looked at, again, what would be calculated to be high-stress areas, and also areas where indications had been previously seen and evaluated as being acceptable. We went back and looked at those same locations to verify that those indications that had been previously detected before the event had not changed. Again, no seismic damage.

So, in summary, on Slide 45, we completed 134 system inspections. These are detailed, walk-down inspections of systems, reviewed 141 structures, looked at 46 low-margin components, and have completed 445 surveillance tests per unit. These are the tests that can be performed in cold shutdown mode, Mode 5, where the units are presently at. Each unit has about 29 additional tests that we will perform during the heat up process that's, once the determination is made, that it is acceptable for us to start heating up the plants. We have additional testing in our program that will be performed as the units get warmer. For example, we will do hot rod drop testing when the units are at temperature to verify that the control rods are free to move and are within their proper timing.

All the inspections confirm the EPRI damage intensity of zero. So, going forward, we've made a number of modifications to the plant as a result of the event. One of the first is that we have installed a temporary, free-field seismic monitor at the site location. As I've mentioned before, the seismic monitors that we had at North Anna were located inside the containment. Some questions have been asked about whether measurements that we take down on the containment basement -- again, the containment basement is founded on rock, and it is widely, it is believed to be very, very close to the free field -- but in order to address the question about, you know, is this exactly the best measurement you can do, we have installed a temporary free-field monitor in an area clear of all the buildings that we will, in the future, will be able to use.

What makes this particularly interesting is that this temporary monitor has the capability to plug a laptop into it and very, very quickly after an event, create the seismic spectra curves that we saw before, and, also, the CAV calculation can now be performed very, very quickly after an event as opposed to taking the many days that it took us to use the existing instrumentation.

One of the incidents that occurred during the event is that the alarms that the operators have available to them for the seismic event are powered from our emergency buses -- this is emergency AC power. As you know, we did lose off-site AC power for several seconds following the reactor trips, and in the eight seconds or so that it took for the diesels to start and load on the buses and restore that power, the alarm processes were not available. So, in the immediate post-recovery from the event, the operators did not have any alarms locked in that said that they indeed had a seismic event, and that did, in some ways, complicate the review initially in the first few hours. We have now installed a qualified, uninterruptible power supply to that panel, so that alarm function now will be able to tolerate a loss of AC power.

We haven't had an existing station procedure, abnormal procedure 36, that provided guidance for what to do post a seismic event. We've extensively revised that procedure to provide additional guidance to the operators, and also to reference the use of the new free-field monitor that, again, the engineering people can get out to that monitor within a very short time after the event and evaluate any future events. And, clearly, we need to complete the start-up surveillances.

In the longer term, we are reviewing what the permanent free-field seismic instrumentation should look like. There may be additional locations that could use a monitor. We are investigating what it would take to have those instruments read out into the control room. Right now, those are local. That instrument we installed is a local instrument, and we need to go out and look at it. We're looking at what it would take to bring that into the control room. We are continuing to reevaluate the low margin components from the IPEEE list. One of the things our consultants told us is that they believe that in many cases either the evaluation was excessively conservative, that established that below .3 level, and that they thought that it, with very, very small modifications, we would be able to increase the seismic capacity of those complements. So, we are evaluating the entire list of IPEEE low margin components to see if it is possible to increase their seismic capacity.

And, finally, the Reg Guide guidance, in 1.166 and 167 is currently not referenced in our license base. Those Reg Guides were produced substantially after the licensing of these plants, and we think there is some very useful information in those that probably would be useful in a future event, and we are evaluating, incorporating those into the licensing bases for the plant.

On an analysis standpoint, the EPRI guidance, EPRI NP 6695, does have guidance in there about after the plant is restarted, after we have demonstrated that there is no functional damage, and that the plant is ready for restart, to do some seismic evaluations to evaluate the overall analytical impact on the plant. What it suggests to do, and this is what we are going to do, is to develop floor spectra -- these, again, are, at the various elevations of the plant, you're going to have calculated responses different than what would be expected at the containment base mat -- will develop those floor response spectra at various building levels based on the actual recorded motion that we observed. We will assess that those new calculated floor spectra against the design basis spectra, and, if exceedances are found, then we'll evaluate equipment at those levels, at those particular floor levels, for any possible effect on the analysis. Typically, what happens is is that equipment at that level will have a particular resonant frequency that will be affected by the event only at those frequencies, so we'll, once we identify if there is a spectrum exceedance, we'll then examine what equipment is at that level and evaluate any potential issues there.

Typically, what the guidance tells you is that if you identify an exceedance, then go inspect it in more detail. I think that we performed that inspection in great detail, so we really do not expect that we will have any issues there. But, we will follow up on any exceedances we find.

And, finally, we will revise our UFSAR to document the fact that this recorded event did occur, what the results of the seismic analysis were, and, also, we are putting into effect design controls that will ensure that the margin that clearly this plant has demonstrated that it does have, that that margin is not degraded by any potential or future modifications. The plant demonstrated it for the event that occurred. Obviously, substantial margin existed between the calculated design basis and what was actually occurring. So, we will put measures in place to evaluate that for any modifications made in the future, that we will take into account both the design basis, which is what the, is in the FSAR, and also the actual recorded event. And, as I mentioned, we'll evaluate the, we'll put in a commitment to using these Reg Guides. In the longer time frame, as the NRC determines the path forward on GI-199, then we will obviously participate in that as well.

So, quick summary, we do know that OBE and DBE acceleration criteria were exceeded in certain directions and for certain frequencies by a very short duration event. However, the CAV calculations indicate that unequivocally no significant damage should have been expected, and the review of effective strong motion also tells us that no damage should have been expected, and that, indeed, was confirmed. We had a level zero event.

The IPEEE and A46 evaluations during the 1990's demonstrated, even before the event, that the safe shutdown SSC's were capable of peak accelerations in excess of the design basis. No safety related SSC's have been identified that required any repair as a result of the earthquake. And, so, the expanded inspections and the expanded testing, which we endeavor to perform, have confirmed the expectations that the analysis tells us.

DAVID HEACOCK: All right. Thank you, Gene. You know, many times, with a natural event, there are precursors. You have warning that a tornado or hurricane is coming to the plant. With a seismic event, there's no such warning. It happens without any warning. I have to comment that the station's staff responded quite well to a dual unit trip, responded promptly, no issues were identified. And then, many support people showed up. there were no lights on in the plant anywhere, so there's no place to be except for where there was light either outside or in the control room of one of the other facilities. So, the emergency responders did quite well as well. The local, state, and NRC responders performed flawlessly. My boss gave me the strongest compliment possible. He said, "It sounds just like a drill." So, it worked just like it was supposed to in all respects.

In summary, if I can say, the original design requirements contemplated that some earthquakes could exceed the design basis. This was just such an earthquake. As Gene pointed out, some of the spectra were exceeded at some frequency. But, overall, the energy in part of the station was well below that the station was designed for. The plant has substantial design margins above those required by the original design, and, the bottom line is the plant tells the story. We have gone over North Anna very systematically. Every safety system, structure, and component, and found only cosmetic damage. The seismic, thermal, and mechanical stress margins designed in all of our safety system piping, equipment, and structures, made it more than able to withstand this earthquake.

Dominion is confident that we have demonstrated that the units are safe to restart. We have established an enhanced process to provide additional testing and oversight during power ascension once restart is authorized. As part of our long-term actions, as Gene just delineated, we'll do a seismic analysis of the plant based on the actual seismic floor spectra in accordance with the NRC protocol. We'll revise our safety analysis report to incorporate and document the new analysis and the modification process will be revised to make sure we've maintained existing margins. Mr. Chairman, that concludes our remarks.

CHAIRMAN JACZKO: Well, thank you very much for very interesting and detailed presentation. Over to staff.

BILL BORCHARDT: Thank you. Good morning. When the earthquake occurred on August 23rd, the NRC staffed our operations center to monitor the activities at all the plants that were potentially affected by this earthquake. The automatic reactor shutdown of both units at North Anna was the only shutdown, automatic shutdown as a result of this event. North Anna also declared an alert based upon the activities at North Anna. In addition to the alert, there were 12 reactors, operating reactors, that declared an unusual event, and two research test reactors that declared an unusual event. However, North Anna was the only plant to experience any actual impact from the earthquake.

Since the earthquake, the NRC's conducted a number of inspections and has ongoing technical reviews and inspections underway. The initial inspection had to do with the licensee's immediate response to the event, and the ongoing technical reviews will form the basis for any decision regarding restart. That, in coordination with the special inspections being conducted by regional and headquarter staff.

The bottom line is that the NRC will not authorize restart until we are satisfied that the plant can be operated while protecting public health and safety. So, with that, I will turn the presentation over to Vic.

VICTOR MCCREE: Thanks, Bill. Morning, Mr. Chairman, Commissioners. When the earthquake occurred on the afternoon of August 23rd the senior resident inspector for North Anna was in the control room, observing activities there. So, he was strategically positioned to observe the plant and operator response to the earthquake. Another NRC inspector who specialized in emergency preparedness was also on site at the time of the earthquake and assisted in the response. When the agency entered monitoring mode shortly after the event, the resident inspectors were key to the effectiveness of communications, when the Region II incident response center as well as the headquarters operations center were staffed. Later, on August the 23rd, Region II dispatched an additional inspector to the site to assist the inspections being conducted by the residents. Also, seismologists and structural experts from the Offices of Nuclear Reactor Regulation and the Office of New Reactors were also directed to the site within days of the event.

Immediately following the event, it was uncertain whether the ground motion from the earthquake had exceeded the plant's design. However, the U.S. Geological Survey data, based upon that, we determined that the best estimate of the peak ground acceleration at North Anna may have exceeded the safe shutdown earthquake ground motion design limits of 0.12g for structure system and components. SSCs located on top of rock, and 0.12g for SSCs located on top of soil. As a result of that and because of the heightened risk associated with the loss of off-site power and the malfunctioning of one of the sites, one of the four emergency diesel generators, an augmented inspection team was formed and dispatched to the site to better understand the circumstances of the earthquake and Dominion’s response. The AIT team was led by an experienced region supervisor who is here today, Mark Franke, and included four inspectors from Region II and three experts from NRR and NRO. The team possessed significant technical expertise, covering seismology, structural engineering, operations, as well as electrical engineering.

AIT was tasked to collect facts related to a number of areas, including human and plant performance in response to the event, ground motion strength experienced at the site, the condition of the plant following the earthquake, and any safety or generic issues. The team's findings were communicated to the licensee during a public meeting on October 3rd near the site. During the meeting, we informed Dominion as well as members of the public who were there of the results of the inspection. In the area of human and plant performance, when the earthquake occurred, the plant's systems responded automatically to shut down both units and all safety systems functioned as designed. All four emergency diesel generators did start as required and powered emergency buses when off-site power was lost. A fifth backup diesel also automatically started in the standby mode. When the two hotel, one of the emergency diesel generators experienced a cooling jacket, water leak plant operators shut it down, and aligned the standby diesel to power the associated emergency safety bus.

North Anna operators responded to the event in accordance with established procedures, and in a manner that protected public health and safety. As for the ground motion at the site, based on the seismic ground motion monitoring equipment at North Anna, the ground motion, as you heard from Mr. Grecheck and Mr. Heacock did exceed the licensing design basis at some frequencies

Following the earthquake, as, also as Mr. Heacock and Mr. Grecheck mentioned, Dominion walked down and conducted inspections of plant structures and systems and performed functional tests in accordance with the EPRI guidelines. The AIT observed some of Dominion’s inspections and conducted a number of independent walk-downs of the plant. That team also reviewed Dominion’s tests and evaluations of important equipment and, based on those walk-downs and reviews, significant damage to plant equipment was not apparent.

Some equipment issues were revealed as a result of the event, as, again, Mr. Grecheck described. I won't go into those details again, but there were some minimal damage to several, non safety-related structures. The seismic ground motion caused movement of spent fuel storage casts as was noted. The team also identified two potential generic issues that are being evaluated for generic applicability The first has to do with the location of monitoring equipment. The instruments are located in plant buildings as opposed to being directly in the ground, free-field detectors. So, the earthquake motion experienced in the building may be different than what's experienced on the ground because the plant design is based on certain ground motion locating instruments in a building may not provide the best indication of whether actual ground motion exceeded design.

Secondly, the team noted that some functions of an important earthquake monitoring panel failed during the event, and Mr. Grecheck mentioned that-- the kinematic system. The panel's power supply did not maintain power at the panel alarms during the event. Also, some performance issues were noted with the Ingdal scratchplate recording system. At this point, I’ll turn it over to Eric Leeds.

ERIC LEEDS: Thank you, Vic. Good morning. The regulatory requirements governing this event are delineated in 10 CFR Part 100, Appendix A, as we heard previously from the licensee. It states that vibratory ground motion exceeds that of the operating basis earthquake, shutdown of the nuclear power plant is required. Obviously, that occurred. The operating basis earthquake is approximately half of that of the safe shutdown or design basis earthquake. The regulations also state that prior to resuming operations, the licensee is required to demonstrate to the NRC that no functional damages occurred to those features necessary for continued operation without undue risk of health and safety of the public. And, as the Chairman noted at the beginning, the regulatory decision to approve restart rests with me, the Director of the Office of Nuclear Reactor Regulation. Next slide, please.

As you can see from the licensee's presentation, the regulatory review guidance that the staff is following was actually established in the late 1990's. That was Reg Guide 1.167, Restart of a Nuclear Power Plant Shut Down by a Seismic Event, which endorses the EPRI guidance that has been referred to, Guidelines for nuclear plant response to an earthquake. The EPRI document also provides guidance on what to do if the plant exceeds its design basis earthquake.

In addition to this guidance, staff is also incorporating operating experience that have occurred since this guidance was published. The July 2007 earthquake at the Kashiwazaki-Kariwa Nuclear Power Plant in Japan, that plant actually experienced a 6.6 magnitude earthquake, which was beyond that plant's design basis. And the lessons learned from that event were published in an International Atomic Energy Agency Safety Report Number 66.

In addition to using operating experiences, staff is also utilizing its experience on changes that have been made to these plants since the time frame that we established this guidance; a notable issue has to do with fuel design. There have been changes in fuel design, and that's one of the things that the staff asked the licensee to review, and that's why we've done a very thorough audit of the fuel in the Unit 2 reactor at North Anna.

As you heard from Vic and you've heard from the licensees, significant level of staff effort is being placed on this initiative. Almost every technical branch in the Office of Nuclear Reactor Regulation is involved in the review with coordination from the other offices, such as Region II, the Office of Research, and the Office of New Reactors. The reviews are in progress; however, to date, the staff has not identified any significant issues. Key technical areas of the review have included the reactor vessels and internals, the reactor fuel, instrumentation, off-site power, piping, and associated support, such as snubbers and hangers, pumps and valves, and steam generators.

The overall review and evaluation will assess the scope and adequacy of the licensee's inspections, walk-downs, surveillance testing, and evaluations. The reviews are also being informed by the results of the inspections that Vic's folks are doing down at the plant. Next slide, please.

The inspection is still in progress. Region II is leading that inspection with support from NRR, from Research, and from New Reactors. NRR staff is providing feedback to the region, and the inspectors, regarding the confirmatory walk-downs, in order to obtain reasonable assurance that the structure systems and components are functional. The inspection team is focusing on corrective action follow-up, the licensee's evaluation of the current plant condition, and review of actions required to support the start-up

As discussed by Dominion, the EPRI guidance identified pre-startup short-term and post-startup longer term activities, based on the overall EPRI damage intensity observed at the plant. The licensee indicated that North Anna experienced a damage state intensity of zero, but they are taking a more conservative tack in implementing actions for damage state one. In evaluating the licensee short-term actions to date, the NRC inspections team has not identified any damage that would indicate a higher damage state. The inspection has not been completed, however, and there are several outstanding issues that the staff is continuing to evaluate

The NRC's restart readiness inspection team has identified a number of valuated issues. Just a couple of examples for the Commission, one of those is inspections of the reactor vessel’s supports were not originally conducted by the licensee, neither for the event or the in-service inspection requirements of the ASME code, so the licensee is going back and conducting those. Based on, also, based on a large number of the observations by the inspectors, the licensee is assessing the need to re-perform certain portions of inspections at walk-downs that have been completed.

Now, going to the next slide, a moment on our path forward, as you just heard, the staff is conducting our safety review in accordance with established acceptance criteria. The review is ongoing. The technical review will confirm that the restart decision is in accordance with Appendix A to Part 100 requirements. The staff plans to issue a safety evaluation that will comprehensively address all the staff review activities.

The restart decision will include the staff assessment of reasonable assurance for the structure systems and components functionality and the licensee's commitments to perform walk-downs and analyses during the heatup and power assentions to ensure the functionality of those structure systems and components.

The public has expressed a great interest in this event. We had significant public attendance at our September 8th meeting here in White Flint, and at the augmented inspection team exit at the site on October 3rd. That meeting was held about in the afternoon in the middle of the week, and approximately 200 people attended that meeting. Both Vic and I were in attendance at that public meeting. Because of the public interest in the event, we plan to hold another public meeting in the vicinity of this site to discuss the status of the review and the status of our work to date. That public meeting is currently scheduled for November 1st. Next slide, please.

Should the results of our review determine that the plant may be restarted safely, the staff will perform enhanced inspections during start-up and after start-up. These inspections will assess the licensee's operations, additional surveillance testing, and other activities. As you heard previously, the licensee is committed to performing the long-term evaluations in accordance with the EPRI guidelines. We will review and follow up on those evaluations. And, also, as you heard previously, the licensee has committed to updating its final safety analysis report to include the new seismic response spectra reflected in the Mineral, Virginia earthquake.

And, with that, that concludes my portion of this presentation.

BILL BORCHARDT: Staff's presentation is complete

CHAIRMAN JACZKO: Okay. We'll start with Commissioner Apostolakis.

COMMISSIONER APOSTOLAKIS: Thank you, Mr. Chairman. The licensee made a strong argument that the safe shutdown earthquake by itself is not a good measure of the plant's ability to absorb an earthquake, and that this new measure -- I don't know how new it is, but -- the cumulative absolute velocity, which takes into account the duration of the event, is better. So, I’m wondering why we're still using the safe shutdown earthquake idea in the regulations when it creates such a big problem with perceptions. I mean, you know, you read in the papers and so on that the nuclear plant, the design basis was exceeded, and people get scared when, apparently, the experts feel that the plant was safe.

So, let's not forget that the, you know, perceptions are very important. I mean, we have a situation here like Caesar's wife. She has to be not only honest but also be perceived as honest. So, here, we don't really have to be safe. We have to be perceived as safe. So, is there any move to change the SSC concept and move to something more realistic, perhaps?

ERIC LEEDS: Commissioner, if I can, I heard two different issues that you raised there, and very good issues, but let me address both of them. The first one is the challenge of communicating with the public on this type of an issue, and we've experienced that for years here at the NRC. The public understand the Richter scale, the magnitude of the earthquake. It's a 6.6, it's a 7.3, it's a 5.8, and then they ask the question, is the plant designed to withstand that? Well, engineers and scientists, the Richter scale provides a magnitude of energy. It doesn't provide the engineering or the science behind how you design that plant. Engineers will take that information, and we translate it into something that we can use -- horizontal and vertical ground motion. But, to express that to the layman is very, very difficult. How do you understand? So, we're constantly having to make that translation from that safe shutdown earthquake versus what was actually felt at the site, what was experienced at the site, and so that's a challenge that we have going forward. It's been there, and I think we're getting better at it as it goes along, but it's tough for the public to understand. The problem with public communication is a challenge for us.

The second issue that you talked about, are we using the right parameters? Should we be talking about safe shutdown earthquakes? Should we be talking about cumulative, absolute velocity? But one of the things that I, that we wanted to get out, the staff wanted to get out of this and, you know, very important to us is that, in light of the recent task force report on Fukushima, the information that we're gaining from this event and the learnings that we're gaining from that will hopefully help focus our review and inform us going forward in responding to the issue of earthquakes that was identified by the near-term task force in the Fukushima report. These learnings will inform us going forward, and evolve our thinking about how to best make sure that these plants are protected from earthquakes. So, I'm answering your question, but we need to evaluate that.

COMMISSIONER APOSTOLAKIS: I understand that, but I'm not sure that the Fukushima recommendations dealt with the change in the SSC, the concept, and use something else. I mean, they talked about design basis and walk-downs and so on, but there may be some opportunity there to do that. But, it seems to me that based on what I heard, the safe shutdown earthquake is only part of the story. There is more to it.

Now, turning to you, Mr. Grecheck, on slide 10, I must say it confuses me a little bit. This is where you have the CAV comparisons. So, the first role is the actual calculated cumulative absolute velocity. Is that correct?

GENE GRECHECK: That is correct.

COMMISSIONER APOSTOLAKIS: Correct. Then you said that EPRI did this work reviewing many, many earthquakes, and they concluded that if you are below 16 percent of g you don't expect to see anything, and you argued that the .172 was a little bit higher. What confuses me is the other two rows. If we look at the design basis earthquake, and you say .588, is that a calculated value? Does it play the role of .16g? What is it? Is it a limit?

GENE GRECHECK: It is not a limit. It is a synthetic time history that is created by assuming that you had an event at the DBE, with the accelerations that were assumed for the DBE curve, over the entire design period. And, so, you create a synthetic time history, and you say if we had this postulated synthetic event and calculated the CAV for that postulated event, these are the numbers that would be representative of such an earthquake.

COMMISSIONER APOSTOLAKIS: And I'm supposed to compare this .588 to what?

GENE GRECHECK: To the calculated numbers that occurred on August 23rd, which is the top row.

COMMISSIONER APOSTOLAKIS: Which is which number? .17 --

GENE GRECHECK: .172, 125, and 112 --

COMMISSIONER APOSTOLAKIS: Okay. What does this tell me now? That .58 is much bigger?

GENE GRECHECK: Yes.

COMMISSIONER APOSTOLAKIS: So --

GENE GRECHECK: So, it says that a representative calculation for the actual design basis would result in a CAV that is represented on that second row, and that number roughly is something on the order of four, five times the CAV that we showed for the August 23rd event.

COMMISSIONER APOSTOLAKIS: So, therefore, I shouldn't expect to see any damage.

GENE GRECHECK: Well, we shouldn't, you shouldn't expect to see any damage because what we saw was below or very close to .16. so, the .16 is this theoretical number that says that we know based on inspections of many, many events that if you calculate a CAV from an actual event that is .16 or below, you're not going to see any damage. That's not to say that you're going to see damage at some higher number, but with a very high level of assurance, you know that if it's at .16, then you know that --

COMMISSIONER APOSTOLAKIS: I understand the .16. It's the .588 --

GENE GRECHECK: All right. That is typically a representative value for a time history based on the design basis accelerations over the entire period of the event, not just this very short --

COMMISSIONER APOSTOLAKIS: So, as long as my actual value is smaller than this, then I shouldn't --

GENE GRECHECK: Then you should feel that you have met the design basis requirements.

COMMISSIONER APOSTOLAKIS: But, this .58 does not, is not based on actual earthquakes, like the .16?

GENE GRECHECK: That is correct.

COMMISSIONER APOSTOLAKIS: Okay. One broader question, and, in fact, in some of the slides, I mean, slide 25, for example, quoting from the EPRI guidance, significant damage to plant systems components, either physical or other, which impairs the operability or reliability of the damaged item. I wonder how one can conclude that the reliability has not been impaired, I mean, that's a probability. So, how does one conclude that? I mean, or, a broader question, is there margin that we had before the earthquake the same now, or has there been some permanent, maybe minor, but still permanent damage, some crack grew some place a little bit, and then, of course, it didn't shrink. Do we know anything about it? I mean, can we say something about it?

GENE GRECHECK: We can say something, because as I noted in the presentation, we did look for places where we had noted previous indications. For example, we had welds where we had previously seen an indication that was evaluated as acceptable. We went back and looked at those locations again after this event, and demonstrated that there was no change in those conditions.

COMMISSIONER APOSTOLAKIS: Now, you use the word look, and one thing that, as I was looking at the slides and the documents, you did visual inspections, that's for sure.

GENE GRECHECK: Yes.

COMMISSIONER APOSTOLAKIS: But, the visual inspection has limitations, especially if you have an earthquake and so on. So, what else did you do to make sure that there was no damage that was not visible?

GENE GRECHECK: Well, in the case of the welds, we did both liquid penetration inspections and ultrasonic. And, as I mentioned, in terms of the functional testing of pumps and valves, we performed extensive reviews of the parameters of those components and compared them to the performance of those same components prior to the event. So, if we had a recorded vibration level or we had a recorded pump curve, we compared that data post-event to prior to the event to show that there was no degradation in the performance of the component. It may have still been acceptable, but beyond just demonstrating acceptability, one wanted to show that there was no degrading trend in that performance.

So, systematically, in many of the examples, it was a comparison of pre event to post event recorded data. And, in the case of the steam generator tubes or welds, we examined known prior indications and compared those to verify that there had been no change.

COMMISSIONER APOSTOLAKIS: One last question. This is to Eric. On slide, well, eight, we all agreed that it's within your authority to authorize restart, does the Commission get involved at all in that decision, or, and the second is, the second part is, on slide nine, there is all of a sudden this 10 CFR 50.59 that is mentioned. Can you elaborate a little bit on it?

ERIC LEEDS: With regard to authority to grant the restart, that, according to regulations, rests with me. The Commission, whenever the Commission believes that there is a policy issue, the Commission can make that decision and take the issue up to them, up to yourselves, to make that decision. So, otherwise, in absence of the Commission weighing in, it’s my decision.

COMMISSIONER APOSTOLAKIS: Now, I’m about to make this decision. Is that how it works? How would I know that you're about to do that?

BILL BORCHARDT: Yeah. The normal practice is we would inform you, that --

COMMISSIONER APOSTOLAKIS: Okay.

BILL BORCHARDT: -- about ready to --

COMMISSIONER APOSTOLAKIS: Fine.

BILL BORCHARDT: -- inform the licensee

COMMISSIONER APOSTOLAKIS: So, how about this 50.59 business? That's part of the notes, at slide nine. I mean, it seems to me this is pretty --

ERIC LEEDS: Well, let me respond to it anyway. It's not in my notes, and I didn't mention it, but that's all right, Commissioner. When the licensee mentioned that we've been in discussion, how do we go forward from here? You experienced an earthquake which was in excess to the design basis earthquake for that plant. And when you go forward from that, what our concern is is when you make changes to the plant, what are you going to analyze those changes to? You know, you change pumps, valves, piping, whatever. Well, what the staff is looking for is that the licensee updates their final safety analysis report such that it reflects this new earthquake, but the new earthquake exceeded the design basis earthquake at high frequencies, not at low frequencies. So, the design basis earthquake for low frequencies, needs to remain. For high frequencies, we want the licensee to evaluate against these new values from this earthquake that actually occurred.

And, in my conversations with the licensee, there's an agreement, a conceptual agreement. Now, how do you make that change? Well, 50.59 is one process that the licensee may use to make changes and update their final safety analysis report. When you go through that process, and that's something the licensee has to do, it tells them whether they can make that change without coming to the regulator or whether they need to come to the regulator for approval. If they need to come to us, they would submit a license amendment request, and we would process it.

COMMISSIONER APOSTOLAKIS: I find it a bit strange, but -- Thank you, Mr. Chairman.

CHAIRMAN JACZKO: Commissioner Magwood?

COMMISSIONER MAGWOOD: Good morning, and thank you for your presentations this morning, I particularly appreciate Mr. Grecheck's very comprehensive and detailed tutorial on the matter. I appreciate you going through all that for us.

Let me pick up on a couple of issues Commissioner Apostolakis raised. One, I am, I'm a bit unsure about what exactly the licensee is proposing to do regarding the FSAR. On Dominion's slide 50, they've listed that they intend to revise the UFSAR to document the recorded event, the seismic analysis of the recorded event, design controls on seismic margin, and commitment to the reg guides. And, in the staff presentation, the staff says something a bit more, what sounded to me to be a little bit different, that they were going to make, adjust the licensing basis effect to reflect the new spectra, and that's what I thought I heard. Can you reconcile those two for me? Did I hear correctly as to what Dominion, what you think Dominion is going to do?

ERIC LEEDS: Well, Commissioner, I liked what I heard from Dominion this morning about what they plan to do, and I think conceptually that we're in agreement with what they need to do. But, until, you know, you see the paperwork and you see what the commitment actually is, the devil's always in the details. But, what basically, what I think is important for the public to understand is that when this plant going forward, when this plant makes a change or modification to its site, it's going to analyze it to make sure that it addresses this actual earthquake that occurred and that this plant can operate safely going forward.

COMMISSIONER MAGWOOD: And is that, when you say that, I want to make sure I understand what you, what that means when you say that. Does that require a full reanalysis of the design basis to make that change to this order, or is it simply incorporating the fact that this earthquake took place? I mean, what are we actually saying?

ERIC LEEDS: It's not a backwards look. We're not requiring that they go through and take a look at every seismic calculation that was ever done on this plant previously. What the EPRI guidance acknowledges is that, based on the damage, there's margin, so we know that those system structures and components have margin and can withstand this new earthquake, this actual earthquake that occurred.

Now, there are long-term evaluations that the EPRI guidance requires, so there's two parts of it. They're going to longer-term evaluations to make sure that the reliability of the equipment that went through this experience, this earthquake, will be able to perform their function going forward for the whatever the life of the equipment itself. There's that part of it. And then, combined with that, you have this idea of any new modifications would need to be analyzed to a different spectrum that had previously been done. Did that answer the question?

BILL BORCHARDT: Yeah. As a non-seismic expert, let me tell you, it's, the plant demonstrated that there is margin beyond the established design basis because it withstood this seismic event. We want to make sure that any changes made to the facility that don't require NRC approval through the 50.59 criteria be used as the basis for that, the seismic event that just happened, so that we don't erode the margin that existed on August 23rd, down to what the licensing design basis would have been.

COMMISSIONER MAGWOOD: All right. Okay. Mr. Hancock, or Mr. Grecheck any comment?

DAVID HEACOCK: I think that was said exactly right. That's what we intend to do to ensure that we maintained existing ordinances in the plant going forward.

COMMISSIONER MAGWOOD: Let me also pick up a bit on the, I think Mr. Heacock mentioned during his presentation that the design basis earthquake was anticipated to be exceeded, and I think he used a number like 84 percent confidence level. I just wanted to say, does that comport with the staff's understanding of design basis earthquake?

ERIC LEEDS: Well, if you don't mind, I'm going to bring one of our seismic experts up to the -- or, one of our -- [laughter]

PAT HILAND: Hi. Pat Hiland, the director of engineering in the office of NRR. Yes. That's correct. The original safe shutdown earthquake or design basis earthquake is a 84th percentile level.

COMMISSIONER MAGWOOD: So, does that, when I heard Dominion say that therefore it was expected that this might be exceeded at some point, and that --

PAT HILAND: Well, I'm not sure I would use the word expected, but there certainly was a -- I'm using the word probability loosely. There was a probability that there was some percentage if they had an earthquake in this area, that there was a chance that it could exceed and, as we saw, in certain frequencies, the design basis. That's correct.

COMMISSIONER MAGWOOD: So, this gets to the first question, I think, Commissioner Apostolakis asked. It makes, really, I think it raises the question, when we say the design we are referring to the design basis of the plant. Most people in hearing that think that if you go beyond a design basis you either have to fix the plant or change the design basis. You can't have the design basis stay in place and have it exceeded. So, in this case, is there some gray area in this particular case of a design basis where, well, yes, we've exceeded it, but it's okay because we have all this margin so we can continue to operate? I mean, that's effectively what we're saying. I'm trying to understand from a regulatory standpoint, what all this means. Something that I've been worrying about for this whole episode.

PAT HILAND: Well I think the-- again, Pat Hiland, director of engineering in NRR. I think that the discussion on the cumulative acceleration velocity, the CAV, and the work that had been done in the past and our assessment of that, which was published in a reg guide, which endorsed this effort, is a measure that would tell you, for this event, what was the integrated impact, or deposition of energy on the plant. I would look at that first, to answer your question, is there something in between a design-basis earthquake and a no damaging seismic event and I think I would look there because of the short durations of those peaks. The total deposition on the plant is relatively small compared to the CAV.

COMMISIONER MAGWOOD: Let me say, I think that Mr. Grecheck's presentation was very thorough and I've talked with the staff about this and there seems to be a great deal of confidence that there was no significant damage to the plant and that this plant, certainly is safe to operate on the same basis it operated at before. The question is, whether we have such a-- we have a design-basis issue. I think the question isn't a question of physical condition of the plant, it's a question of what the design-basis is and what our regulatory posture is regarding this plant. I'm still struggling with where are we now? If we know the design-basis has been exceeded, how do you continue to operate unless you make that change in the design-basis?

NILESH CHOKSHI: Nilesh Chokshi, Office of New Reactors. I think this concept of design-basis, let me just give a little bit of background -- ground motion -- type of time history in order to do a design, so the design-basis should be at ground motion. If you go to the revision of the Appendix A of Part 100, the new definition which we are using in New Reactors, is safe shutdown ground motion. It takes a -- earthquake, because people then associate a certain magnitude and those sort of things. I think the communication difficulty Eric described, because a magnitude 5 point at the source, it's the--

COMMISSIONER MAGWOOD: That's a different issue.

NILESH CHOKSHI: So what you need for design is the ground motion and the way THE design-basis on one of the previous presentation slide the spectra, the design spectra and the spectra from the earthquake. If you look at that design spectra, it's really broad band. It's not a real earthquake, the spectra itself, because they're not using the 36 western time actual earthquake records in 1970s. And 84 percentile comes from accidents of that, when you to the response vector from reaching the real time history that 84 percent which is referred to is 84 percentile of that statistic, so I would say that you would expect the ground motion to exceed, but that's how the design-basis was drawn up and because of that broad frequency content, that's why you see a lot of energy in that time history, that designed time history.

COMMISSIONER MAGWOOD: Let me cut you off and ask-- I appreciate your input, that's a sort of a different question, this-- the dam on Lake Anna, can you tell me a little more about that, I don't know very much about the situation with that. What kind of hazard does that present to the plant? Is that something that-- I know the licensee did mention it was-- they looked at it but what can you tell us about that?

ERIC LEEDS: George Wilson, he's our dam safety officer.

COMMISSIONER MAGWOOD: He's our dam guy? Okay.

[laughter]

GEORGE WILSON: Actually, the main dam at North Anna is regulated by the Federal Energy Regulatory Commission. The dam that we regulate is actually the ultimate heat sink dam, so the dam, the main dam that they're talking about is actually regulated by FERC and they actually do inspections of it, so the licensee and you can correct me if I'm wrong, does have to evaluate that in their abnormal operating procedures, but that is not something we regulate, for the licensee.

COMMISSIONER MAGWOOD: Does the dam-- if the dam were to fail, would that present a hazard to the facility other than the loss of the heat sink?

GEORGE WILSON: No, the ultimate heat sink is the dam, that's the little reservoir that is a different body of water. The main dam is that's a hydro dam, it's regulated by FERC. So the ultimate heat sink would provide the cooling, that's the one that we look at.

COMMISSIONER MAGWOOD: I see, thank you. Appreciate it.

CHAIRMAN JACZKO: Commissioner Ostendorff.

COMMISSIONER OSTENDORFF: Thank you Mr. Chairman, I'd like to add my thanks to Commissioner Magwood's to the licensee for doing a very nice job of explaining a fairly complex topic in step-wise fashion, so thank you for that session. I just want to start out with the licensee with a couple questions here, specifically on inspections and I want to kind of follow up on where Commissioner Magwood was headed, I think. Can you talk a little more about the dam inspection, do you use divers, do you look for visual cracks? I'm curious as to how that inspection was done.

GENE GRECHECK: Eric, do you want to address that? This is Eric Hendrixson, he's the director of engineering at North Anna.

ERIC HENDRIXSON: The dam, for the most part, is an earthen dam. In the center of the dam there is a concrete structure. You do visual inspections of the downside of the dam and then there are certain inspections, you check groundwater internal to the dam structure itself. Those inspections were performed and we saw no changes from the normal operation of the dam. You really can't put any divers in front of the dam because it's an earthen structure.

COMMISSIONER OSTENDORFF: You may want to stay at the podium. Two more inspection questions. Can you talk about how you did your electrical inspections, specifically circuit breakers and instrumentation?

GENE GRECHECK: Go ahead.

ERIC HENDRIXSON: Two different ways. The electrical components were de-energized, you go in, open up the breakers, do a visual exam, check for tightness and bolt checks, that kind of thing. Typically, check resistance, checks between bolted connections, then as we put the equipment back together, perform the normal functional test verified breakers close, contacts made up.

COMMISSIONER OSTENDORFF: You do that under voltage, trip tests?

ERIC HENDRIXSON: Every single test, yes.

COMMISSIONER OSTENDORFF: Same question for the reactor vessel internals, what are you looking at there?

ERIC HENDRIXSON: The vessel internals, on Unit 2, we defueled Unit 2, then opened it up and did a visual exam with cameras and submarines, looking at the upper internals as well as the internals to the reactor vessel. The visual exam was with submarine and cameras.

COMMISSIONER OSTENDORFF: Do I understand you didn't find anything there?

ERIC HENDRIXSON: That is correct, we found no damage.

COMMISSIONER OSTENDORFF: Last inspection question, how about your emergency diesels?

ERIC HENDRIXSON: Same thing with emergency diesels besides the obvious visuals, we performed the various, what we refer to as blackout tests, where we de-energize the emergency bus, watch the diesel come up, take the loads and then there are other surveillances you do to verify the various functions to the diesel generators, including 24 hour diesel runs.

COMMISSIONER OSTENDORFF: Thank you. Let me go back to the licensee with a separate question, getting back into the cumulative absolute velocity and I was not familiar with that phrase until this event occurred, I learned a lot more about it the last couple of months. I want to get a better understanding from the licensee, then I want to get a question from the staff on the same topic, as to what experience is out there in the civil engineering community, the seismic community, in using CAV outside of the application for a nuclear power plant, for bridge assessments, for stadiums, et cetera. Can you talk about that, or can somebody in your group discuss that aspect?

GENE GRECHECK: I can give you a little background. As we did research on this concept, because again, I'm sure the seismic experts were very familiar with this before, but the rest of us were not. You can see there are even commercial vendors that sell devices that are used for commercial buidlings because this evaluation of the .16 and knowing that in a commercial building that if you have CAV rate at below the .16 you would not expect to find any damage. That is apparently available commercially for normal office buildings to have-- they suggest that you have that in your office building, that you can quickly calculate following a seismic event as whether you should be concerned about your structure or not. So this is well-known out in the seismic community as a way of rapidly evaluating the potential for damage in your structure.

COMMISIONER OSTENDORFF: So let me ask you a very pointed question. So I'm in the state of California and I'm a bridge inspector and you have an earthquake out-- you know you had one 20 some years ago in Oakland, that damaged the Oakland bridge. Is this CAV concept being actually applied by civil engineers and bridge inspectors to apply that after an event to assess usability or functionality?

GENE GRECHECK: That I don't know.

COMMISSIONER OSTENDORFF: Does anybody know about that?

GENE GRECHECK: I don't know.

COMMISSIONER OSTENDORFF: I'd appreciate some follow up on that, I'm just curious as to how-- I mean, we're getting mired down in the nuclear applications here I think it would be helpful for us to know where else in the civilian engineering community or other disciplines is CAV being applied as a concept to evaluate post earthquake functionality and useability of structures.

DAVID HEACOCK: Mr. Bhargava might be able to answer a part of this question.

COMMISSIONER OSTENDORFF: If you want to talk about this.

DIVAKAR BHARGAVA: Very quickly, I'm Divakar Bhargava. The only other application that I'm familiar with the use the CAV is the 2007 Kashiwazaki-Kariwa earthquake and they calculated CAV from the recorded motions to determine what kind of damage, and hidden damage and their CAVs were actually about five to six times higher than the North Anna event, so that is one application where they have developed CAV to determine what sort of inspections and what kind of damage they might have expected. That's the only example I know.

COMMISSIONER OSTENDORFF: That's very helpful. Let me stay in this topic of CAV and shift over to the staff and I'll ask Eric, Bill and Vic. Eric I'll start with you. Prior to this event, has the staff had any experience in using CAV to assess something like this?

ERIC LEEDS: Commissioner, let’s get Nilesh up here.

COMMISSIONER OSTENDORFF: Sure.

NILESH CHOKSHI: I think yes, we have used the CAV, it's an empirical measure, it teaches, similar to modified -- intensity, there are many measures civil engineers use. Areas intensity and if you're reading that research you'll see that. This is a similar and empirical measure of assessing damage and that the scale was established by looking at the actual events and observing the damage. And then correlating, calculating CAV and defining threshold, that's how we came up with the .16 threshold which is for basically a non-engineered structure. It was defined – the cut off was much more conservatively, so that's the CAV. Now the CAV is being used for several other applications, primarily in nuclear. IAEA has also adopted a CAV and it's in their safety guides and many other countries are using that. We also used CAV for the new reactor siting in the probabilistic hazard analysis to filter the non-damaging earthquakes. One of the things that you have to be careful of with small magnitude earthquakes, you can predict hazard if you do it systematically. So we use CAV concept in that filtering. The concept is now widely used both in the geosciences field and engineering field. Still, to my knowledge, it's still primarily in the nuclear industry.

COMMISSIONER OSTENDORFF: Let me follow that up, stay on the podium. You can, Eric, I'll ask you and feel free to use your podium expert here. I know he said the devils in the details and the analysis by the licensee is still ongoing and so forth. To date, as far as the general approach, the assumptions being used by the licensee to evaluate the cumulative absolute velocity, is the staff in general in alignment with the approach the licensee has taken to document the CAV and its application here?

ERIC LEEDS: Yes. The short answer is yes, the staff is in alignment, the staff has reviewed what the licensee has done and so far we haven't seen significant areas of disagreement. Now, the licensee has just responded to a number of our last requests for additional information that came yesterday, so the staff has more work to do but thus far I don't have any significant disagreements between where the staff is and the licensee.

COMMISSIONER OSTENDORFF: Okay, follow up question, with respect to reg guide 1.167 I know that this is something that's not used on a regular basis and sometimes we get into using something after an event occurs when there's not been a lot of experience with using that particular document. You learn there may be some gaps, maybe some inconsistencies. Are there any significant issues that you or your team have discovered in trying to apply 1.167 to this event?

ERIC LEEDS: Nothing significant to report at this time. There are a couple areas that we may want to go back and revisit, one I mentioned before was fuels. Between the reg guide and the EPRI guidance it's silent on fuels and fuel design has changed, the current fuel that they’re using at North Anna has swirl veins that we were concerned about. Now, the licensee examined those and they turned out to be fine but certainly there will be lessons learned from this that we may want to go back and reexamine that EPRI guidance. Nilesh was actually one of the NRC folks that were instrumental in us endorsing that guidance.

COMMISSIONER OSTENDORFF: Thank you. Vic, I'm going to ask you a question here in the few seconds remaining. What's been the hardest communications challenge you've seen between your team and the public with respect to the meetings that have been held to date.

VICTOR MCCREE: Thank you for your question. As Eric indicated, we've held one public meeting at North Anna, that was the AIT exit. The greatest challenge, I think, was what Eric alluded to and that is the 5.8 magnitude on the Richter scale earthquake occurred, what does it mean? It is beyond the design-basis, the licensing basis of the plant, why is it safe for that plant to operate? Developing terminology, developing a layman's, laypersons terminology of what the actual energy deposition, what the impact on the plant was, has been and is an extraordinary challenge.

COMMISSIONER OSTENDORFF: Have the public understood the CAV concept?

VICTOR MCCREE: I don't believe we have shared that with them. Have they derived meaning from it to the point that they understand it, I don't believe we're there yet. We'll have another opportunity next Tuesday. Eric and I and the staff, we're going to try again to communicate it in terms they can better understand.

COMMISSIONER OSTENDORFF: Thank you. Thank you Mr. Chairman.

CHAIRMAN JACZKO: Commissioner Svinicki.

COMMISSIONER SVINICKI: Thank you all for your presentations. I begin with a question for Dominion. Did both units safely shut down as designed and were there any complications with the unit trips?

DAVID HEACOCK: Yes, both units shut down as designed, now you know there's no seismic trip directly, so they shut down for other reasons but they shut down as intended and there was no complications with the reactor shutdown. The reactor shut down as it did. Victor mentioned the only issue that we had about 50 minutes into the event, one of the diesel generators failed.

COMMISSIONER SVINICKI: Victor or Eric, I believe that you mentioned that just coincidentally, we had either the resident inspector, the senior resident, in the control room in one of the units at the time of the event?

VICTOR MCCREE: Yes ma'am. The senior resident inspector was

Greg Kolcum, was in the control room when the earthquake occurred and we had another inspector, an emergency preparedness inspector that was on site. He also assisted. I would mention that the two hotel emergency diesel generator, which did fail, failed because of a gasket leak and the operator shut the diesel down. At this point, based on the information we have seen, that the licensee has inspected, evaluated that gasket failure was not due to the seismic event, but due to an installation error, if you would.

COMMISSIONER SVINICKI: I had heard that it was perhaps improperly seated, in some prior maintenance --

VICTOR MCCREE: That's correct.

COMMISSIONER SVINICKI: -- evolutions of some kind. Okay, thank you. Mr. Grecheck, you had explained, at least partially, how in terms of buried piping, how did you go about selecting, for your enhanced inspections areas of buried pipe, I think you indicated piping runs between structures is something that would be probably useful in terms of selecting that as part of a sample to inspect. But could you elaborate a bit in terms of, you showed us pictures, you had excavated and there was inspection of various types but other than runs between buildings, how or even of the piping runs between buildings how did you go about targeting and selecting piping, buried piping to inspect?

GENE GRECHECK: Well, again the primary selection was where can you do an excavation and in an area of high interest and also see many different examples of piping in a small area. Excavation, as I'm sure you can appreciate, is not an easy thing to do and so therefore you want to find a location where you can see the many different piping systems in a relatively small area and that was for example that picture that we showed you. It is important to note that in addition to the visual inspections that we performed we did pressure testing on as many piping systems as we were capable of doing then. Then we verified that once these pipes were pressurized that we saw no pressure decreases or leakage in the piping. So we have a very high level of confidence that even if we did not visually look at a pipe, that that piping system is intact.

COMMISSIONER SVINICKI: Okay, thank you for that elaboration. For the NRC staff, Eric I was listening to your presentation and of course Dominion has presented that even though they assessed an EPRI damage state or damage level of zero they elected to perform enhanced inspections to a EPRI damaged state of one and when I was listening to you present the staff's assessment you said NRC has not observed indication of a higher damage state and you ended your sentence there. I assume you mean NRC has not observed indications of a higher damaged state than zero. Is that correct?

ERIC LEEDS: That's correct, Commissioner.

COMMISSIONER SVINICKI: Thank you. And there has been some discussion, Eric, about the delegation that the restart authorization resides with the director of NRR, and there's been a lot of discussion of other issues, but I would -- I guess I'd ask you very simply that this isn't an event where we've had to go in and invoke and exercise our regulatory framework for this type of event. So, when this occurred, and you had to go and basically assess what our regulations require, the guidance that's invoked, and, in this case, there's an endorsement of an EPRI document that's embedded in that framework -- do you assess in looking at the regulations, the guidance, and other technical documents that are endorsed or invoked as part of this process, do you find that to be a complete framework? Is it thorough? Have you identified anything that you feel are areas of gaps in that framework in terms of invoking this rather unique and novel regulatory process for an authorization for restart after this type of seismic event, having gone through this at least to this level, you haven't gotten to a restart authorization step yet, but, to date, have you or members of your staff identified that there's anything incomplete about what we're doing?

ERIC LEEDS: Commissioner, so far, the guidance has served us extremely well. In fact, I applaud the people who developed this guidance so long ago and the foresight that they had, because it has directed the staff on a complete path. I think that there are a couple of things that we may need to update on the guidance, and I think that Commissioner Apostolakis makes an interesting point, and I want my folks to go back and take a look at the cumulative absolute velocity and see if that -- if there's something there. Certainly, the lessons learned from the Kincaid Nuclear Power Plant event, I want to take a look at that. Also, the fuels issue. But those, you know, those are -- would be enhancements going forward. The process that we have in place I think has served us very well.

COMMISSIONER SVINICKI: Can you help me in light of that understand why, what is the nature of the 130 requests for additional information that the staff has generated? I think you also responded that the last batch of responses from Dominion for those 130 requests for additional information were received very recently, perhaps as recently as yesterday, and are there responses to those requests for additional information necessary in order to complete a restart inspection? Do you need to have those answers in hand and evaluated before -- because I'm interested, I think you testified that the staff's restart readiness inspection began on October 5th, so we didn't have all the responses to the RAIs in hand. Help me understand the sequence of events there.

ERIC LEEDS: Well, I'm hearing two different questions, Commissioner, and I'll try to get to both of them. The first one, the amount of questions, this event was unprecedented here in the United States for an operating nuclear power plant to experience an earthquake beyond its design basis. The staff's doing a very deliberate, thorough review. We don't' have practice at this. This hasn't occurred before. So, the staff is being very thorough in its review. And when you've got a lot of smart people looking at something, that's where you get at the thoughts of, "Well, wait a minute, why isn't the fuels discussed here?" Or, "What's changed since 1997 when that guidance has come out, and should we look at that?" And that generates those types of questions, and you want the staff to have that questioning type attitude. And, frankly, the licensee has been very responsive, and, you know, I think there's been a number of "ah ha" moments on both sides. Yes, it's a good idea. We better go take a look at the fuels. We better go look at the reactor vessel supports and things like that.

COMMISSIONER SVINICKI: And that part of the question was meant to get to, you said that the process established by others in the past, there was a lot of foresight there and it served us well. So, what I'm trying to say is do the 130 RAI's somehow indicate that there were gaps, or we had an incomplete framework for moving forward?

ERIC LEEDS: Oh, I don't think so.

COMMISSIONER SVINICKI: I hear you saying that that's not the case.

ERIC LEEDS: I don't think so. I think that that's just the staff being deliberate and thorough and going through and making sure that we have answers to each one of these issues as we follow the EPRI guidance. I believe the licensee is doing the same thing.

COMMISSIONER SVINICKI: Okay. And the second part of the question was how do you start the restart readiness inspection without having all of the responses to the RAI's in hand? Do the, are the issues not coupled?

VICTOR MCCREE: Well, they are coupled, Commissioner, and very well integrated. In fact, as a result of the augmented inspection team, there were some open items, if you would, and the restart readiness team picked up from those open items to continue that review. For example, it wasn't known when we exited the AIT on October 3rd the reason for the reactor trip, which turned out to be a negative flux rate trip, but those kinds of issues were, have been followed up on by the restart readiness team, again, which is still ongoing. And, again, it does complement the questions that have been asked because there is a need for independent verification of the information that was provided. That team is continuing the walk-downs, observations, that Dominion has done and has conducted some independent walk-downs as well. But the focus, unlike the augmented inspection, is on the readiness for the plant to restart, integrated with the questions that are being asked by NRR.

COMMISSIONER SVINICKI: Okay. Thank you. Eric and Bill, did you want to add something with that?

ERIC LEEDS: Yes. To start with Bill, and one of the things, the response that the licensees provide us help the staff write our safety evaluation for the public so they can understand how we got from one place to the final determination.

COMMISSIONER SVINICKI: Okay. Thank you. That's helpful. Thank you, Mr. Chairman.

CHAIRMAN JACZKO: Well, a couple questions, Dave, for you. The first one, the staff indicated that you did not initially look at the reactor vessel supports. Can you just give me a kind of a quick answer on why that was not considered?

DAVID HEACOCK: Yes. For the intensity level zero, they would not -- you would not normally look at the reactor vessel supports. As I mentioned earlier, you look for indicators first, things that would be damaged that were not seismic, not structurally sound, and we saw very few of those. And as we moved into the more structural almost we saw none in that category. So, the reactor vessel's obviously a class one very strong vessel. You heard it mentioned there's really two reasons. One's for the seismic event, and one was an ISI question. So, ultimately, we looked at it. Be sure we satisfied both of those at the same time.

CHAIRMAN JACZKO: So, you are doing it?

DAVID HEACOCK: Yes, sir. We have all 12 of them already.

CHAIRMAN JACZKO: Okay. Thank you. The -- you also indicated, and I think as I -- and I may have misunderstood this -- there is -- the scratchplates do have some indications in the control room or the back panel somewhere where they do indicate if you exceed at the various frequencies of design basis earthquake. I think what I understand is because of the power loss, those indicators never illuminated. Is that correct, or is that --

DAVID HEACOCK: That's correct. One of the scratchplate devices also has remote indication in the control room for each of the three planes and 12 frequencies in each plane, and that's the Ingdal device that lost power for 8.1 seconds. It would have alarmed in each individual frequency in the base mat of Unit 1 containment had it had power.

CHAIRMAN JACZKO: Okay. So, it didn’t get an alarm. And, as you said, I mean --

DAVID HEACOCK: It did not receive alarm because it lost power during the effect of strong motion duration.

CHAIRMAN JACZKO: Okay. And you indicated that, I mean, nonetheless, there's not a trip signal on that particular, or there's not a trip tied to that particular signal, but, is there -- or let me ask you, I mean, should there be or at least a procedural or manual pursuit, because I think, again, there wouldn't have been a manual trip if even the operators had seen indications of that from a procedural standpoint? Is that correct, or --

DAVID HEACOCK: It wouldn't, and, in fact, in this case, there was almost a manual trip anyway.

CHAIRMAN JACZKO: Right.

DAVID HEACOCK: The manual trip was within a second or so of the automatic trip that occurred, so the strong motion was sensed in the control room sufficiently to cause the operators to decide to trip the unit at that point.

CHAIRMAN JACZKO: Okay. And, I guess what I’m trying to get at, is that proceduralized, that if you do -- or was that kind of a judgment call just based on, I mean, operator action or kind of --

DAVID HEACOCK: A judgment.

CHAIRMAN JACZKO: A judgment. Okay. Thanks. So, I mean, as a follow-up, I guess the question is this something that should be proceduralized? I mean, is, should we be looking at a procedure? I don't know, maybe this is something for Eric and the staff to think about. You know, is it appropriate to have either an automatic trip or a manual trip proceduralized if in fact when you get the better indications, you've got a warning signal or an alarm. I mean, I guess it was alarm on this --

GENE GRECHECK: Mr. Chairman, what is proceduralized is guidance that says that if you'd exceeded your operational basis earthquake you're required to shut the units down.

CHAIRMAN JACZKO: Okay.

GENE GRECHECK: So, if there is no pending equipment problem that requires a trip, it is much better to be able to shut the unit down in a deliberate manner than it is to trip the reactor.

CHAIRMAN JACZKO: That procedure, it could be more of a controlled shut down.

GENE GRECHECK: Right. So, if, the procedure says that if you evaluate the event and conclude that you've exceeded the OBE, then you need to shut the units down.

CHAIRMAN JACZKO: Okay. And, again, I guess probably part of the corrective action is to make sure that you have good control room indication of that state. I couldn't not ask a question about the CAV, but I mean, we'll get there in a second. I did have a question about your Slide Number 9. The, one of the, if there's anything that I take away from this is we probably never really modeled earthquakes very well, or maybe it's just really hard to do. It's probably just really hard to do, and because I find it interesting that the elevation 291, the design basis earthquake shows a large acceleration on the frequency of about 7 or 8 hertz, which tells me that there's some resonant structure in there, or component, that has got a resonant frequency around 7 hertz, and you're getting that large peak there. What's interesting is that seems to be completely on a phase with where the actual resonances appear to be, which is a little bit lower in the 2 to 3 hertz range and a little bit higher into the 10 hertz range. Have you all taken a look at that? Is that telling you anything? You know, it seems, it just seems not real accurate, I guess, so.

GENE GRECHECK: Well, there's a couple pieces to that. One the idea that there's a resonance at above 10 hertz is an artifact or something that is becoming apparent from the overall investigation of central eastern United States earthquakes that there clearly are higher frequency contributors to that overall spectrum beyond what was previously anticipated. So, the idea that we're seeing things at higher frequencies is not unexpected based on that modeling. The other piece is that clearly the modeling techniques are conservative. They tend to be relatively simple, and they probably do not, in all aspects, properly characterize things, and I think that's part of the overall evolution of the technology.

CHAIRMAN JACZKO: Well, I appreciate that. I mean, I probably would look at that, and, again, it's hard to say whether that's telling me a conservative thing or non-conservative thing, and I think it's just telling me a wrong thing. And that's the challenge, I think, because, you know, you can perhaps design your plan, then, to deal with those frequencies. And if they're really not the actual frequencies you're seeing, you may be missing and actually inducing resonances in higher frequencies where it actually is more significant. But I just thought that was interesting.

Now, getting back to the CAV. It is, you know, and I think

Commissioner Apostolakis raised a good question about whether this is a better metric. But, you know, what's interesting to some extent is it seems to me this puts us back almost to, you know, to Richter scales because we're back to energy deposition, kind of, which is in essence, you know, a scale or quantity as opposed to the accelerations which are giving you more of a kind of an actual impact on the facility. And one of the things that I found interesting and I guess I had a question for you is that there were at least two aftershocks, two significant, well, two aftershocks, I believe, that were felt in the control room. One, I think, later the day of, and one two or three days later. And one was a 4.2 magnitude, one was about 4.5. did you include those in your calculation of the CAV?

GENE GRECHECK: Well, this CAV is specific for this particular event as the specific time history for this event. So that's not a cumulative edition over multiple events.

DAVID HEACOCK: All right. We did it in our note case, an usually event on two of those events.

CHAIRMAN JACZKO: So, you didn't incorporate. So, they're not in the CAV calculation?

DAVID HEACOCK: No.

CHAIRMAN JACZKO: And, if I just do, you know, a back of the envelope here, and, looking at, I mean, effectively, I mean, the CAV is a measure of energy deposition which is, to some extent, going to be capped by whatever the magnitude of the event is, because, I mean, the Richter scale magnitude give you -- and I'm not a seismologist -- but just thinking of this from what I know, I mean, that gives you essentially some type of measure effectively of what your original energy deposition is, or energy releases to some extent. Well, I guess there's a logarithmic scale. Is that right? Okay, so, because your aftershocks then were around 4.5, 4.2. so, they're about a factor of 10 lower, at least in the theoretical maximum of the energy deposited. So, I guess you could have contributions to the CAV, let's just say conservatively, maybe they would be a factor 20 percent more additional or not. You're shaking your head. Explain it to me.

ERIC HENDRIXSON: There is a threshold for CAV, and the aftershocks were below that. So, mathematically, the CAVs of the aftershock would be zero.

CHAIRMAN JACZKO: Okay. So, and that's a calculational threshold? That's a physical, there's a physical basis for the threshold?

ERIC HENDRIXSON: Yeah. There’s a cutoff, if you will, to reduce minor --

DAVID HEACOCK: And the acceleration below 0.025g where not counted.

CHAIRMAN JACZKO: Okay. And they’re -- so, I mean, in essence then, the CAV doesn't, this is essentially if you have lots and lots of little things, you don't ever accumulate anything?

DAVID HEACOCK: You don't add up. No, sir.

CHAIRMAN JACZKO: But, I mean, if it is a measure of energy deposition, there is energy deposition as a result of those events in the structures. I mean, so, I mean, to what extent, I mean, is there a cumulative effect, I mean, if you have now, enough, I mean, let's say I have another earthquake, which has a CAV, well, let's say that has accelerations are above the threshold and gives me a CAV of .2, does the equipment in the plant now have experienced a CAV of .37? I mean, is there a cumulative lifetime impact to that?

DIVAKAR BHARGAVA: Well, you're absolutely correct, that even a smaller point, 4.5 Richter, would produce some CAV if you didn't use that cutoff acceleration. The original definition of CAV for the threshold which would not be expected to cause damage was not .16, it was .3, which would have accounted for all the small accelerations. Then that was revised to .16g seconds to, with the screening criteria that smaller magnitude earthquakes would not contribute. So, if you take into account the smaller, 4.5 Richter earthquakes, and you calculate CAV from those to add to this, then you would probably use the .3g second criterion --

CHAIRMAN JACZKO: Okay.

DIVAKAR BHARGAVA: which is equivalent to .16, so, with that, we would have much more margin.

CHAIRMAN JACZKO: Okay. And you wouldn't, given that it's, I mean, Richter's scale is a logarithmic scale, so I wouldn't assume that a .4, or a 4.2, 4.5 would contribute --

DIVAKAR BHARGAVA: You are absolutely right.

CHAIRMAN JACZKO: -- anything on a large. But, I mean, and you could just, I mean, that last question, I mean, let's say we have another earthquake today. Is there a cumulative impact, you know, and we got a CAV again that was .74, or .174, again, does it matter then that there was a previous earthquake that gave you a CAV of .174?

DIVAKAR BHARGAVA: Well, we do look at the impact of a future event in terms of durations.

CHAIRMAN JACZKO: Yeah.

DIVAKAR BHARGAVA: Our testing, for instance, accounts for, as Gene mentioned earlier, five OBs and one DB event of 30 seconds each. So, we have qualified equipment for much larger durations that, in general, which are qualified by testing, so. Since this event, the effect of strong motion duration was about three seconds. If you look at the duration and the impact of additional earthquake with some durations, you could easily accommodate another event of this magnitude or higher, because we have qualified our equipment to significantly larger durations by seismic testing or shake table.

CHAIRMAN JACZKO: But, does it matter, I guess that's what I'm asking. I mean, next time there's an earthquake at North Anna, what's --

[laughter]

-- because I'm not going to say there's never going to be one.

GENE GRECHECK: Lightning doesn't strike twice. What's the date?

CHAIRMAN JACZKO: They -- well, I won't tell you. But, will you come back to us when you're doing your presentation on restart and say we previously had a CAV of .174, this CAV was point -- this latest earthquake was a CAV of .3, and based on the EPRI guidance, we know that a CAV of .3, we don't expect anything, or will you come back and say, so, the CAV was .3, and the previous CAV was .174, so the CAV is, on this equipment, assuming some of the equipment hasn't been exchanged or changed out, is .4?

DIVAKAR BHARGAVA: I think the concept of CAV was not derived in this -- in the manner that you described. It was based on CAV's determined from hundreds of earthquakes, each individually.

CHAIRMAN JACZKO: Individually, okay.

DIVAKAR BHARGAVA: And it was a metric of damage, if the threshold was within, no damage was seen, and that's how the criteria was developed. So, I’m not sure whether you would add the CAV from another event --

CHAIRMAN JACZKO: Yeah.

DIVAKAR BHARGAVA: -- and I’m not sure. Maybe somebody else could elaborate on that.

NILESH CHOKSHI: This is Nilesh Chokshi from the Office of New Reactors. The CAV is associated with that particular event, and it's a local thing, you know, because at different locations, you will measure different based on the history you measure, you will have a different CAV value. Now, the CAV, the -- one of the reasons for the long-term evaluation is to see whether you exceeded your elastic limits -- that's what’s important what happens in the next earthquake, if you didn't experience that, you haven't used already your capacity.

CHAIRMAN JACZKO: Okay. So, the previous CAV doesn’t matter.

NILESH CHOKSHI: So it doesn't matter, right. So, that's the value of the long-term. That needed to make sure you restore enough margin, that you have the same capacity --

CHAIRMAN JACZKO: Yeah. And that's what you'll then largely do with your longer-term assessment is determine whether kind of, what the baseline is going forward, then. Okay. Well, thank you very much. Any other questions or comments? Okay. Well, thank you both for your presentation. I know the staff has a lot of work in front of it as well as all the other work they have in front of it, and I know you'll do a nice, through job. Thank you.

[Whereupon, the proceedings were concluded]