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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

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590TH MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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FRIDAY

JANUARY 20, 2012

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ROCKVILLE, MARYLAND

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The Advisory Committee met at the Nuclear
Regulatory Commission, Two White Flint North, Room
T2B3, 11545 Rockville Pike, at 8:30 a.m., J. Sam
Armijo, Chairman, presiding.

COMMITTEE MEMBERS:

- J. SAM ARMIJO, Chairman
- JOHN W. STETKAR, Vice Chairman
- HAROLD B. RAY, Member-at-Large
- SANJOY BANERJEE, Member
- DENNIS C. BLEY, Member
- CHARLES H. BROWN, JR. Member
- MICHAEL L. CORRADINI, Member
- DANA A. POWERS, Member

1 COMMITTEE MEMBERS (CONT.)

2 JOY REMPE, Member

3 MICHAEL T. RYAN, Member

4 STEPHEN P. SCHULTZ, Member

5 WILLIAM J. SHACK, Member

6 JOHN D. SIEBER, Member

7 GORDON R. SKILLMAN, Member

8

9 NRC STAFF PRESENT:

10 DEREK WIDMAYER, Designated Federal Official

11 ALLEN HOWE, NRR/DORL

12 MEENA KHANNA, NRR/DE/EMCB

13 KAMAL MANOLY, NRR/DE

14 GERALD McCOY, R-II/DRP/RPB5

15 JOHN TSAO, NRR/DE/EPNB

16

17 ALSO PRESENT:

18 GENE GRECHECK, Dominion Energy

19 ERIC HENDRIXSON, Dominion Energy

20 DAVID SUMMERS, Dominion Energy

21

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P R O C E E D I N G S

8:30 a.m.

CHAIR ARMIJO: Good morning. The meeting will now come to order. This is the second day of the 590th meeting of the Advisory Committee on Reactor Safeguards. During today's meeting, the Committee will consider the following: Augmented Inspection Team Report on North Anna and preparation of ACRS reports.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Mr. Derek Widmayer is the Designated Federal Official for the initial portion of the meeting.

We have received no written comments or requests for time to make oral statements for members of the public regarding today's sessions. There will be a phone bridge line. To preclude interruption of the meeting, the phone will be placed on a listening mode during the presentations and Committee discussion.

A transcript of portions of the meeting is being kept and it is requested that the speakers use one of the microphones, identify themselves, and speak with sufficient clarity and volume so that they can be

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1 readily heard.

2 Now I'd like to turn the meeting over to
3 staff and I believe that would -- Dana is going to
4 leave us through that, sorry.

5 Dana?

6 MEMBER POWERS: You do it so well. Thank
7 you. This is an information briefing. I was asked to
8 prepare any documents based on this briefing. I
9 suppose if we want to, we can.

10 Most of you are aware -- what was it,
11 August 23rd -- that there was an earthquake. Those of
12 us who have experienced in California think that a 5.8
13 earthquake is not something to get too excited about,
14 that East Coast earthquakes are a little different.
15 It occurred near Mineral, Virginia, close to the North
16 Anna Nuclear Power Station. The earthquake caused
17 Units 1 and 2 to automatically shut down. There was
18 a loss of offsite power. No damage was reported to
19 the system. But it was the first instance of an
20 operating reactor exceeding its design basis
21 earthquake.

22 Consequently, there has to be a fairly
23 extensive inspection prior to restart and what we're
24 going to hear about is both what the licensee and the
25 staff have done in connection with that inspection and

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1 restart process.

2 To begin our discussions, I guess Allen
3 Howe is going to give us an opening statement and then
4 we will move to the licensee.

5 MR. HOWE: Thank you, and good morning.
6 I'm Allen Howe, Deputy Director, Division of Operating
7 Reactor Licensing in the Office of Nuclear Reactor
8 Regulation. We appreciate the opportunity to brief
9 the ACRS on the actions that were taken following the
10 earthquake that occurred near North Anna last August.

11 As you said, the licensee will provide an
12 overview of their activities and then that will be
13 followed by a staff presentation of the inspection and
14 technical review activities that were performed
15 following the seismic event.

16 Just very quickly, following the
17 earthquake, NRC staff did complete numerous activities
18 including an augmented inspection which evaluated the
19 licensee's performance during the event. And we also
20 conducted restart readiness inspections. In addition,
21 we completed a comprehensive technical evaluation of
22 the actions taken by the licensee to demonstrate that
23 it was acceptable the units to restart.

24 Our inspection and technical evaluations
25 covered a wide spectrum of technical disciplines and

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1 there was very close coordination among the
2 organizations that were involved in the review.

3 At this time, I'd like to quickly
4 introduce the staff leads for the inspection and the
5 technical review activities. To my left is Gerry
6 McCoy. He's a Branch Chief in the Division of Reactor
7 Projects in Region II and responsible for the Dominion
8 Units. Gerry led the inspection efforts on behalf of
9 Region II and he'll be speaking about the inspection
10 activities, including the AIT, the restart readiness
11 inspection and the start-up monitoring. Meena Khanna,
12 to the left of Gerry is a Branch Chief in the Office
13 of Nuclear Reactor Regulation. She led the effort on
14 technical review in the Office of NRR. She will also
15 be providing the presentation describing the technical
16 review efforts that took place during the activities
17 leading up to the restart decision. We also have
18 staff here in the audience should questions come up
19 that can provide answers to any of the technical
20 issues that may come up.

21 At this point, I'd like to turn the
22 presentation over to Mr. Gene Grecheck from Dominion.

23 MEMBER POWERS: Gene, welcome.

24 MR. GRECHECK: Thank you. Good morning.

25 As Allen said, I'm Gene Grecheck. I'm Vice President

1 of Nuclear Development for Dominion. And I've met
2 some of you in what is normally my role. I'm normally
3 in charge of our new reactor projects, North Anna III
4 in specific, but very soon after the August 23rd
5 earthquake I was asked to take leadership role in the
6 recovery and the licensing efforts to -- first to
7 determine what the extent of damage at North Anna was
8 and then to work with the NRC staff to obtain the
9 necessary restart.

10 With me, I have Eric Hendrixson. Eric is
11 the Director of Engineering at North Anna. And as a
12 matter of fact, at the time of the earthquake, he was
13 the Director of Engineering for the corporate office
14 and was in the process of transitioning out to the
15 North Anna site. So he was in a unique position, both
16 from a corporate engineering standpoint and the
17 station engineering standpoint to guide the
18 engineering efforts.

19 Also with me is David Summers over in the
20 corner. David is head of our licensing organization
21 and was our primary point of contact with the NRC
22 staff during your review.

23 So a little bit of a summary -- between
24 August 23rd and November 11th when we received
25 permission to restart the units, we devoted more than

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1 100,000 hours of effort, both in on-site inspections
2 and engineering analysis. As you can see, we spent
3 over \$21 million in this process, so this was an
4 extraordinarily comprehensive and complete review of
5 the North Anna Station and its seismic response.
6 We'll talk a little bit in a few minutes about NRC-
7 endorsed guidance, but we exceeded the requirements of
8 the Regulatory Guide that we published some --

9 MEMBER POWERS: Why did you feel a need to
10 exceed?

11 MR. GRECHECK: I'll get to that in a
12 moment, Dana. I think you'll see it because there's
13 a flow chart and I'll show you how we did --

14 CHAIR ARMIJO: Yes, I'd be interested to
15 see that. Does that \$21 million include the cost of
16 repair of the damage?

17 MR. GRECHECK: To the extent that there
18 was repair, yes.

19 CHAIR ARMIJO: Yes, I know it was minimal.
20 I just wanted to know --

21 MR. GRECHECK: It does, but as we'll see,
22 there was very little to repair. This is mostly
23 inspection, walk downs, analysis.

24 CHAIR ARMIJO: So it wasn't any hardware
25 repair, replaced --

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1 MR. GRECHECK: No.

2 CHAIR ARMIJO: Thank you.

3 MR. GRECHECK: So the primary finding was
4 that there was no functional damage to any safety-
5 related systems at the station.

6 Part of what we're going to talk about and
7 part of what was interesting and I think was
8 educational for all of us in this is that we are very
9 used to talking about the design basis and as was
10 pointed out North Anna was the first station in the
11 United States to exceed its design basis earthquake
12 while in operation.

13 What we found is that that terminology of
14 design basis earthquake is useful and it's useful in
15 the purpose of design. It is a necessary underpinning
16 of designing a plant to respond to a postulated event.
17 But it is not very useful in terms of determining
18 actual damage to a station after an event has
19 occurred.

20 The key factors in what caused seismic
21 damage are the acceleration which is typically what we
22 consider about the ground motion response. It's also
23 important to know what frequency that vibration is
24 occurring at and it is also very important to note how
25 long that strong motion was in place.

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1 Now frequency and acceleration are taken
2 into account on the typical graph and you'll see that
3 in a moment, but duration is not. So when you have an
4 actual event without knowing the duration and without
5 looking at that duration it's not possible to simply
6 say oh, I had such and such acceleration at such and
7 such a frequency and be able to directly say what
8 response I expected at the plant.

9 As I said, seismic acceleration response
10 spectra are used to conservatively design plants, but
11 don't take duration into account. But there is a
12 factor which has been in the literature for some time
13 now called cumulative absolute velocity which attempts
14 to do both. It attempts to integrate essentially the
15 energy that is imparted by the vibration over the
16 period of time that that strong motion existed and
17 then with a great deal of empirical evidence, it has
18 been correlated, the CAV values against what has been
19 observed over hundreds of earthquakes around the world
20 in terms of what actually happens when you have this
21 particular event. And we'll talk about that.

22 MEMBER BLEY: Are you going to talk about
23 that in some detail?

24 MR. GRECHECK: Yes.

25 MEMBER BLEY: Okay, I'll wait until you're

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1 done then.

2 MR. GRECHECK: Well, some detail.

3 MEMBER BLEY: Let me pose my question
4 ahead of time. Maybe you can address it as you go
5 through it. For some seismic analyses associated with
6 risk assessments I've seen a lot of work looking at
7 complete time histories of the -- all these factors
8 over time and multiple cases of those to examine the
9 capability of the equipment. If you can explain how
10 well this single parameter does -- play it against
11 those kinds of detailed kind of history
12 considerations, I'd really appreciate it.

13 MR. GRECHECK: I'll try to do that. So
14 this graph here is -- first should be familiar.
15 We've seen this a lot, graphs similar to this and it
16 is also what caused the initial concern right after
17 the event after this data became available. There's
18 a number of curves on this, so let's walk through
19 them. The bottom two, there's a red line and a purple
20 line. Both of them look like a little trapezoid,
21 those are the operational basis earthquake and the
22 design basis earthquake for North Anna as described in
23 the North Anna FSAR.

24 The purple one is the design basis
25 earthquake. You can see it starts -- the axes on this

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1 thing is frequency. This is a logarithmic scale and
2 frequency, runs from essentially zero to 100 hertz and
3 then the acceleration is measured as a fraction of
4 gravity on the vertical scale.

5 We also hear a lot about a number and
6 everybody wants to know what was the design basis
7 number a plant was designed to and by convention that
8 is the number anchored at 100 hertz. So it's whatever
9 the value happens to be at the far right-hand side of
10 the scale. So that purple graph you can see goes up
11 to a peak of perhaps .36 or so G and then comes down
12 and ends at .12 and so if you look at the literature
13 you'll see that North Anna 1 and 2 have a design basis
14 of .12G. So that's the first thing that when you're
15 trying to explain to the public what the design basis
16 of a plant is, and they read that it's .12G and then
17 they hear that well, at some frequency, for example,
18 that the acceleration was .4, they say well, you were
19 four times the design basis and that's not at all
20 correct because as you can see it varies by
21 frequency.

22 The OBE, the operational basis earthquake,
23 is just arbitrarily set at 50 percent of the DBE, so
24 that's that lower curve.

25 The green curve up at the top represents

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1 the synthesized curve for the IPEEE effort that was
2 done some years ago when the NRC staff asked all
3 plants to look at what were the -- to the ability of
4 plants to survive in events significantly larger than
5 the design basis. For North Anna that green curve
6 represents what the IPEEE looked at the North Anna
7 plants for and you can see that that is quite a bit in
8 excess of both the design basis and the blue and
9 orange lines which represent the actual measured
10 accelerations from this earthquake.

11 MEMBER CORRADINI: Gene, can you just say
12 that again? The green is what now?

13 MR. GRECHECK: The green was the basis for
14 the IPEEE review of the North Anna plants back during
15 the 1990s.

16 MEMBER CORRADINI: So it was the source
17 input to see if you'd serve the pot?

18 MR. GRECHECK: Right.

19 MEMBER BANERJEE: What was the basis on
20 which that line was constructed?

21 MR. GRECHECK: Eric, do you remember?

22 MR. HENDRIXSON: It was guidance given by
23 the NRC a number of years ago and I can't recall the
24 Reg. Guides on what to apply to the power station.

25 MEMBER BANERJEE: So it looks like it's

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1 about a factor of two almost.

2 MR. GRECHECK: A little over two.

3 MR. HENDRIXSON: Two and a half.

4 MEMBER BANERJEE: Well, whatever it is,
5 but how did they arrive at that factor?

6 MR. GRECHECK: I really don't recall.

7 MEMBER CORRADINI: Can we ask the staff?

8 MEMBER BANERJEE: Yes, can we get that
9 answer. How was that curve established, the green
10 one?

11 MEMBER CORRADINI: The green one, yes. If
12 not now, eventually.

13 MEMBER BANERJEE: If not now, later.

14 MEMBER SHACK: Well, there were lots of
15 discussions in the '90s of what the seismic margin
16 should be and I think EPRI proposed one and a half.
17 The staff proposed two, maybe two and a half. And the
18 Commission came down with 1.67 as -- so my guess is
19 it's one of those floating numbers at the time.

20 MEMBER RAY: It was looking for
21 vulnerabilities that could be addressed. That was the
22 whole point of the exercise.

23 MEMBER BANERJEE: But there must be some
24 basis.

25 MEMBER CORRADINI: It's essentially two

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1 and a half. I was just curious if it was just an
2 engineering judgment or if there was some technical
3 basis.

4 MEMBER POWERS: I don't know that it's two
5 and a half, Mike.

6 MEMBER CORRADINI: Based on Gene's
7 description, the red is 50 percent lower than the
8 purple and the green is 2.5 times bigger than the
9 purple --

10 MEMBER BANERJEE: On the extreme right.

11 MEMBER CORRADINI: At the extreme right.

12 MR. HENDRIXSON: And that particular
13 curve is a function of your particular strata and
14 seismic activity and analysis.

15 MEMBER CORRADINI: So the green dependent
16 on the region of the country and geology and all kinds
17 of stuff.

18 I guess what I'm asking is the purple was
19 the one that was developed on region. Everything else
20 is a scale up is the way I interpreted it.

21 CHAIR ARMIJO: We have a staff member.

22 MR. HOWE: Good morning, this is Allen
23 Howe again. And we understand the question is what
24 was the basis for the development of the curve for the
25 IPEEE. And we're looking for someone to respond to

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1 that question to you. So we'll take that one right
2 now and try to get back to you before the end of the
3 meeting today.

4 MR. MANOLY: This is Kamal Manoly with the
5 Division of Engineering NRR. The RLE, the Review
6 Level Earthquake, that's based on seismic margin
7 assessment that was done as part of IPEEE. In the
8 simple explanation it really reflects the capacities
9 for the safe one shutdown path and that is based on
10 the HCLFPF 95.5 percent and basically it tells you
11 that that's the kind of capacity you expect in
12 components in the one safe shutdown path. Some
13 components did not meet that review of earthquake and
14 they were evaluated independently as part of the
15 restart effort.

16 MEMBER RAY: It was the form abilities
17 identification that was the point of the exercise.

18 MEMBER POWERS: For our purposes, we can
19 let that one float. Gene, just go ahead.

20 MEMBER BANERJEE: What were the other
21 curves?

22 MR. GRECHECK: So the blue and the orange,
23 the ones that are more irregular, those were the
24 actual measured data from our seismic instrumentation
25 in the Unit 1 containment.

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1 MEMBER BANERJEE: So what's the orange and
2 what's the blue?

3 MR. GRECHECK: Orange is the -- we
4 measured in three directions, so east-west, north-
5 south and vertical. So the orange is the east-west
6 direction and the blue is the north-south direction.

7 MEMBER CORRADINI: And where is the
8 vertical?

9 MR. GRECHECK: The vertical is not on this
10 graph. It's a different graph because actually the
11 design values are different, so I just chose to use
12 those.

13 MEMBER BANERJEE: So the purple and the
14 reds were for horizontal acceleration?

15 MR. GRECHECK: Correct. There's a similar
16 graph for vertical. I just didn't --

17 MEMBER BANERJEE: Is it the same order of
18 magnitude?

19 MR. GRECHECK: Yes.

20 MEMBER BANERJEE: It's sort of more or
21 less isotropic at acceleration, that's the assumption?

22 MR. GRECHECK: Presumption.

23 MEMBER BANERJEE: Presumption.

24 MR. GRECHECK: So a couple of things jump
25 out at you here is that certainly at some frequencies

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1 the actual measured acceleration exceeded what the
2 design basis curve showed, but you can see that it was
3 enveloped by the IPEEE curve so we had this data right
4 at the beginning, so we said okay, it exceeded the
5 design basis. It was less than IPEEE so we would have
6 expected at a very, very first level that we should
7 not expect to see significant damage to the plant, but
8 this was very early.

9 A couple of other things to point out is
10 that one of the lessons that is coming out of the work
11 that has been done on East Coast earthquakes over the
12 years that is part of the central and eastern United
13 States' effort and part of the foundation for what may
14 be Generic Letter 199 is that the frequency
15 distribution of an earthquake on an East Coast
16 earthquake at least is not at all what this curve
17 predicts. You can see peaks at higher frequencies
18 typically around 20 hertz. This is what the models
19 are predicting.

20 So even with this event, we were able to
21 see these peaks at higher frequencies that previously
22 at least during the initial licensing of North Anna 1
23 and 2 were not part of the model.

24 Any other questions on this graph?

25 All right, so now let's talk a little bit

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1 about the actual event. Here again, we're looking at
2 accelerations in the three directions, east-west,
3 vertical, and north-south. This is an actual time
4 history of the event as measured. The shaded area
5 represents the design basis acceleration. And so you
6 can see that right at the beginning of the event, at
7 about two seconds into the event, we had a peak
8 acceleration, but that peak acceleration was very
9 short. The numbers on the side, you can east-west,
10 the 3.1 seconds, 1.5, and 1.0, that is the definition
11 of strong motion which I think represents 70 percent
12 of all the energy was released during that period.
13 That's a standard definition of strong motion.

14 You can see that that strong motion
15 essentially was something between one and three
16 seconds. And the actual peaks, for example, in the
17 north-south direction you can see some very, very
18 sharp peaks that exceed the design basis level, but
19 there's essentially one point there. So what you had
20 was a single event where something had a single sharp
21 acceleration, but then for the vast majority of this
22 event was essentially background.

23 This surprises many people because, for
24 example, my office is at our Innsbruck office about 40
25 miles from the plant and I felt this event and it was

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1 a long time. I mean you stood there and you were very
2 much aware of the fact that something was happening.
3 But the thing that struck me after I saw this is that
4 by the time you were aware that something was
5 happening, the event was over, the event of
6 significance. So for 20 or 30 seconds or so you felt
7 vibration, but the strong motion was long gone by the
8 time that you were even aware that something had
9 really happened because it was a very, very short
10 event in terms of strong motion.

11 MEMBER CORRADINI: And that's a definition
12 that the staff uses as part of licensing or is that
13 something more scientifically --

14 MR. GRECHECK: It's not part of the
15 license. The license is based on the design spectrum
16 which is what we were talking about before.

17 MEMBER CORRADINI: So this is just
18 analyzing --

19 MR. GRECHECK: This is analyzing actual
20 measures --

21 MEMBER CORRADINI: That's the definition.
22 If somebody said what is strong motion -- okay.

23 MEMBER POWERS: So one of the problems of
24 our design basis evaluation is just what Gene brought
25 up is we do frequency and acceleration. We don't do

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1 duration. And that's something for us to think about.

2 MR. GRECHECK: Now for the purpose of
3 design, a duration has to be assumed and depending,
4 for example, if you're going to do a shaker table
5 test, and you have to shake it for some period of time
6 and typically those times are in the 30-second range
7 or so. So what you do is you shake your test object
8 at the maximum design acceleration for that entire
9 time period. So there is a duration that is part of
10 the design effort, but that duration is a very long
11 duration and so you can't say it has nothing to do
12 with duration. But the thing is is that in order to
13 be able to say how does what actually happen compare
14 to what I tested for, what I designed for, you need to
15 look at duration and that is not -- that's not part of
16 the quoted design basis.

17 MEMBER POWERS: We have very long
18 durations in Pacific Rim earthquakes.

19 MR. GRECHECK: Yes.

20 MEMBER POWERS: Thirty seconds is not a
21 long time for the Pacific Rim. Again, it's a function
22 of where you are and what the geology -- do you know
23 what geological source the earthquake was from?

24 MR. GRECHECK: No, not specifically.
25 There is no identified -- as I said, two is not

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1 uncommon.

2 (Laughter.)

3 MR. GRECHECK: There's no identified
4 seismic fault or anything that this was identified
5 with. And again, I'm getting off into non-scientific
6 things here, but in general, what I understand about
7 East Coast events is that, of course, there are no
8 tectonic, active tectonic plates on the East Coast,
9 but there were a long time ago. And the seismic
10 event, the action that created say the Appalachian
11 Mountains way, way back left a lot of residual stress
12 in the rock. And what we're seeing is just this
13 relieving of residual stress somewhere in the rock
14 that is there. But there's no identified feature
15 that's associated with that.

16 MEMBER CORRADINI: But Dana said something
17 I didn't hear. So Dana, your point was the 30 seconds
18 is an assumed and that given historical things could
19 be considered short or long.

20 MEMBER POWERS: Depends on where you are
21 and what kind of earthquake you have.

22 MEMBER CORRADINI: But from a testing
23 standpoint that's a pretty typical order of magnitude
24 that people test at.

25 MEMBER POWERS: I'm not familiar enough

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1 with shaker table to tell you a definitive answer.

2 MEMBER CORRADINI: I just didn't hear what
3 you said.

4 MEMBER BLEY: I think that's correct.
5 That's about right.

6 MEMBER RAY: They go as long as 45
7 seconds. I did a shaker table.

8 MR. GRECHECK: Certainly for our testing
9 that we were able to go back and look at, but that's
10 the time frame.

11 So to put this cumulative absolute
12 velocity in some perspective, the blue bars on this
13 graph represent the calculated CAVs for the three
14 directions for the North Anna event. The cumulative
15 absolute velocity, if you calculated one for the
16 design basis, would be the yellow bars. And the green
17 bars represent again a calculated CAV if you assumed
18 the IPEEE event over the time period.

19 So --

20 MEMBER BANERJEE: And the yellow and the
21 green are integrated over 30 seconds?

22 MR. GRECHECK: Yes.

23 MEMBER BANERJEE: And the other one is --

24 MR. GRECHECK: -- what we measured.

25 CHAIR ARMIJO: So it's the negative

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1 acceleration and the positive acceleration are all --

2 MR. GRECHECK: It's all integrated.

3 MEMBER CORRADINI: So it's the absolute --

4 MEMBER RAY: Does the licensing basis give
5 you the duration that you use here for the DVE, the
6 yellow bar?

7 MR. GRECHECK: Yes, well, it does in the
8 embedded Reg. Guides that are subtiered to the higher
9 level.

10 MEMBER RAY: But I would suppose those
11 post-date North Anna's design, don't they?

12 MR. GRECHECK: Probably not. I think
13 probably some of this was already there.

14 MEMBER CORRADINI: I didn't understand
15 your question. Are you talking about the black line
16 or the yellow --

17 MEMBER RAY: The yellow line. I just
18 wondered where they got the duration from because my
19 experience is those durations that they would have
20 used came after North Anna was licensed.

21 MR. GRECHECK: There had to be a basis for
22 the testing that was done for the North Anna equipment
23 which, like I said, was in that 30-second range. So
24 I'm assuming there was some regulatory basis.

25 MEMBER RAY: Yes. That's fine.

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1 MR. GRECHECK: There's a line here called
2 the regulatory limit and that number is extracted out
3 of the Reg. Guide that was issued and we'll talk about
4 that Reg. Guide in a few minutes. That Reg. Guide
5 specified a level of .16 as a cumulative absolute
6 velocity number. And that Reg. Guide is based on EPRI
7 document. And the EPRI document says that if you show
8 that it was .16, then you're using this empirical
9 evidence that I was mentioning before where they
10 looked at all of these earthquakes, hundreds of
11 earthquakes around the world.

12 It was stated that no observed structural
13 damage had ever been seen to an engineered structure
14 at that level. So you have a very, very high
15 confidence that you're not going to see damage
16 certainly to a seismically-designed structure when
17 what they call a commercially-designed structure had
18 never seen any damage at that level.

19 Now there's a number of CAV limits out
20 there that are talked about. The .16 value was
21 specified by the staff when they endorsed the EPRI
22 document. EPRI had originally proposed a value of
23 .3, looking at a longer event. The staff had some
24 questions about that so they limited the scope of the
25 event and said well, with a shorter time period we're

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1 going to use .16.

2 In our conversations with EPRI subsequent
3 to this event, they're saying that our time history
4 looks more like what they were thinking about in terms
5 when they specified this .3 number. And so from their
6 perspective, the more appropriate number --

7 MEMBER SHACK: I thought the .16 was also
8 based on a filtering that you threw out accelerations
9 that were too low.

10 MR. GRECHECK: That's correct, yes. Too
11 low over a --

12 MEMBER SHACK: Point three --

13 MR. GRECHECK: Had all of that.

14 MEMBER SHACK: Had everything.

15 MR. GRECHECK: But if you looked at our
16 entire event and you looked at all of that low --

17 MEMBER SHACK: I guess that was my
18 question, was yours computed with the filtering?

19 MR. GRECHECK: This was. What you see
20 here was calculated with the filtering and was
21 compared against the .16 value.

22 The reason I bring that up is because it
23 is --

24 MEMBER BANERJEE: The filtering is a
25 threshold?

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1 MR. GRECHECK: It's a threshold.

2 MR. HENDRIXSON: The way it works is you
3 calculate, integrate over all the time the absolute
4 value and you exclude the tail end if over a duration
5 of one second all the vibrations were less than
6 0.025Gs. So you have to go whole second with less
7 than 0.025Gs.

8 CHAIR ARMIJO: If you didn't have the
9 filtering, how much greater would the regulatory limit
10 be in your --

11 MR. HENDRIXSON: About .23 for the worst
12 vibration which was the north-south which is the one
13 on the furthest --

14 MEMBER CORRADINI: So the blue would have
15 gone from whatever it is to about .23?

16 MR. GRECHECK: It would have gone from .17
17 to about .23.

18 MEMBER CORRADINI: And when you do the
19 filtering, you do it with the yellow and the green.
20 You did it just with the actual data?

21 MR. HENDRIXSON: Correct.

22 MR. GRECHECK: But again, that .23 would
23 be compared against a .3. Why is that comparison
24 important? Because the Reg. Guide basically states
25 that if you are below that limit, then by definition

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1 you have not exceeded the OBE. Not the BBE, the OBE.
2 By definition, you have not exceeded the OBE. So in
3 the case that we were having here, we barely exceed
4 the OBE value in one direction and that's what led to
5 this entire discussion.

6 MEMBER BANERJEE: Now when you talk about
7 this, maybe you perhaps clarify. You said that no
8 seismically-designed structure had failed below this?

9 MR. GRECHECK: No commercially --

10 MEMBER BANERJEE: Or no commercially --

11 MR. GRECHECK: No commercially-designed
12 structure had failed above -- below .16.

13 MEMBER BANERJEE: Below .16. So a
14 building which has been designed to normal building
15 codes would survive this?

16 MR. GRECHECK: Yes, without structural
17 damage. You would have cosmetic damage, but you would
18 not have structural damage. And it has never been
19 observed. So it's with all of this data. The attempt
20 was to be able to come up with an empirical,
21 predictive value to say I can measure this very
22 quickly. You can measure this within an hour or so
23 after the event. You know what the CAV number was,
24 and you can immediately predict what you expect to be
25 able to find.

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1 MEMBER BLEY: Gene, you just said
2 something that I can't been aware of. I thought the
3 focus came from Figure 4 with the spectra showing the
4 frequencies at which you exceeded. And you just said
5 that it was the CAV point here where you exceeded it
6 that really set this off. So can you clarify a little
7 bit?

8 MR. GRECHECK: Okay, from a legal
9 standpoint --

10 MEMBER BLEY: Yes.

11 MR. GRECHECK: The regulations state that
12 if you exceed the design basis, then you have to prove
13 and I think Part 100 has some words in it that you
14 have to prove that no functional damage occurred.

15 MEMBER BLEY: And those words are based on
16 the spectra?

17 MR. GRECHECK: They are.

18 MEMBER BLEY: Okay.

19 MR. GRECHECK: However, the words are in
20 the Reg. Guide that says that if you're below .16 then
21 you have not exceeded the OBE.

22 MEMBER BLEY: I didn't know that was there
23 or not.

24 MR. GRECHECK: It's not easy to reconcile.

25 MEMBER BLEY: Maybe we can ask the staff.

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1 (Laughter.)

2 MR. GRECHECK: But I am pointing out that
3 that statement is there and I think that our -- it
4 would have been a different exercise perhaps if this
5 value had been 10 percent lower.

6 MEMBER BANERJEE: Is there a scientific
7 basis for this? Because essentially it's a velocity.
8 It's not an energy, right? So what is the scientific
9 basis of using that, rather than some form of an
10 energy spectra?

11 MEMBER CORRADINI: It's not a velocity.
12 It's an impulse.

13 MEMBER BANERJEE: It's a velocity.

14 MEMBER CORRADINI: If there's some fixed
15 mass that's being whipped around like this, it's an
16 impulse.

17 MEMBER BANERJEE: Well, under repeated
18 forcing. But eventually it's the velocity, that's
19 what it is.

20 MEMBER CORRADINI: Perhaps.

21 MEMBER SHACK: You have acceleration, you
22 get a velocity.

23 MR. GRECHECK: And I think that's why the
24 term is in there, but again, I don't -- it is a weird
25 criterion --

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1 MEMBER BANERJEE: I can't see any obvious
2 scientific basis for it. There must be some.

3 MR. GRECHECK: If you read the EPRI
4 document, they do say it's empirical. It is not some
5 sort of fundamental value.

6 MEMBER CORRADINI: I mean, if it's an
7 impulse, you can make it look like an energy if you
8 put your mind to it.

9 MEMBER BANERJEE: No, you can't. You have
10 to square the velocity.

11 MR. HENDRIXSON: I believe the basis is
12 the amount of -- the time it takes and the amount of
13 energy it takes to start a structure into a harmonic
14 when you can start causing damage. So if it's a short
15 pulse, then your entire systems and structures won't
16 start moving in a harmonic and causing damage to those
17 structures. So time is of interest, as well as the
18 magnitude of the acceleration. And if you integrate
19 that over time, that gives you a feel for how much
20 energy the structures are beginning to display.

21 And the .16 or .3, depending upon how one
22 calculates CAV is based on going out and looking at
23 engineered, non-nuclear, non-safety related, but
24 engineered structures and how they behaved for various
25 earthquakes. For the most part in the Pacific Basin

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1 is where most of the data is from.

2 MR. GRECHECK: All right, I'm going to
3 move ahead and there was significant design margin.
4 We knew a lot of margin existed in the plant before we
5 started, but this is just some of the examples of
6 that. So the plant told the story. So here's all the
7 analytical things. The analytics told us we should be
8 in good shape. We don't really expect to see very
9 much, but let's go and look.

10 So here's the first example. This is from
11 the turbine building. This is on the turbine deck.
12 The turbine building is a non-seismic structure at
13 North Anna. This is on the top floor. As you know,
14 as you go up in elevation, the accelerations are
15 magnified and you get higher effects. There are these
16 demineralizer tanks to give you a sense of the scale.
17 You can see a man standing next to one of them, so
18 these are pretty tall tanks, high center of gravity,
19 high center of mass. They are supported on some
20 relatively spindly angle iron supports that you can
21 see there.

22 And on the right-hand picture is a
23 magnified view of the bottom of one of them. This
24 represents the most serious structural damage that was
25 seen at North Anna.

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1 MEMBER POWERS: This was it?

2 MR. GRECHECK: This is it. I had a New
3 York Times reporter, Matt Wald, who came to the site
4 about a week after the event, and he had a photograph
5 with him. The photographer was looking forward to
6 being able to take Pulitzer Prize winning pictures of
7 the damage. And he was very disappointed when I
8 pointed to this and said that's it.

9 MEMBER BANERJEE: Was he able to spin this
10 into some horror story?

11 MR. GRECHECK: Actually, it was a very
12 positive story.

13 MEMBER SHACK: Is this 12 inches by 12
14 inches, this pedestal?

15 MR. HENDRIXSON: I believe it's a 6 by 6
16 pedestal, and 3 by 3 web steel above it.

17 MR. GRECHECK: And so clearly, there was
18 movement and there was some spalling of the corner of
19 the concrete here, but this is it.

20 The next represents what was reported in
21 Bloomberg this day as a crack in the North Anna
22 containment wall. This is an interior wall. And the
23 crack that you can see running horizontally across the
24 top of the picture is a crack in grout across two
25 pored concrete slabs. This was simply a grout that

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1 was placed during construction, but you could paint
2 the wall. The grout did crack along -- a pretty long
3 distance, probably maybe 20 feet or so, a horizontal
4 distance. But this was not structural. It was not in
5 the concrete. It was in the grout.

6 MEMBER BANERJEE: How did Bloomberg News
7 report this?

8 MR. GRECHECK: It was reported as a crack
9 discovered in North Anna containment wall.

10 Finally, we have dry-cask storage at North
11 Anna and these are -- at least partially, are these
12 vertical casks that you can see in the upper picture.
13 A few days after the event, we did go out to the pad
14 to look and saw evidence that the casks had actually
15 moved. You can see there's a ring there on the
16 concrete. That's where the cask had been originally.
17 That's about four and a half inches or so of
18 horizontal displacement. These casks are about 100
19 tons, but they're not restrained in any way. They're
20 just sitting on the pad.

21 Your first glance is oh, why did this
22 move? But again, you're talking about a smooth bottom
23 tank on a concrete -- relatively smooth concrete pad.
24 The pad itself is seismically designed. The pad
25 didn't see any damage. The casks are monitored for

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1 leakage across their seal. There was nothing detected
2 there. But it did actually --

3 MEMBER SKILLMAN: How many of the casks
4 moved?

5 MR. GRECHECK: Out of the 27 casks there,
6 I think 24.

7 MR. HENDRIXSON: All but two.

8 MR. GRECHECK: Two or three.

9 MR. HENDRIXSON: Four and a half inches
10 was the maximum, somewhere --

11 CHAIR ARMIJO: And they all moved semi-
12 uniformly or did they vary?

13 MR. GRECHECK: It was just -- the example
14 that a lot of people have given us, some of us will
15 remember the old football games where you had the
16 vibrating table. That's exactly what happened.

17 MEMBER SKILLMAN: I'd like to go back to
18 your first slide, 9 here, please. Four years ago, NRC
19 published Reg. Guides 148, 160, and 161. And that was
20 the industry's introduction to active seismic. And as
21 Harold said, you could shaker table at 45 seconds and
22 people made their way to Alabama to use the shaker
23 tables down there.

24 One of the tricks we all learned was we
25 had a component with a high natural frequency and

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1 you'll find those tanks have a very high natural
2 frequency. The way you protected them was by putting
3 them on spindly legs. And if you could drop below
4 three or above 30 hertz, you could actually make the
5 large components become insulated from the ground
6 motion and they wouldn't dance.

7 I would just offer what you see there on
8 that connection which is the angle iron to the floor
9 is how the concrete reacted to the bending that came
10 down from a large overburden from the high mass above
11 it. But what we did for all the NSSSs is try to go to
12 either extremely strong structures or extremely
13 fragile legs that would let the ground motion move
14 under the components. And it appears as though a
15 number of these images that you've shown identify
16 components that have effectively been insulated from
17 the ground motion because the legs are so spindly and
18 those took the movement. But I believe that that's
19 what we're seeing here.

20 MEMBER STETKAR: Gene, did you see any in-
21 plant electrical effects?

22 MR. GRECHECK: No.

23 MEMBER STETKAR: Does North Anna have
24 still pretty much old style relays or have they been
25 replaced with solid state --

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1 MR. GRECHECK: It's been replaced. It has
2 the original Westinghouse solid state protection
3 system that was --

4 MEMBER STETKAR: Okay, so your protection
5 system is solid state. What about switch gear and
6 stuff?

7 MR. HENDRIXSON: It's a combination of
8 both technologies. Relays and lots of solid state
9 devices.

10 MEMBER STETKAR: Are the relays that you
11 still have pretty small light-weight relays?

12 MR. HENDRIXSON: A combination of both --
13 I call them the ice cube relays as well as the
14 Westinghouse.

15 MEMBER STETKAR: Your peaks are kind of 15
16 and 30 hertz or so. Thanks.

17 MR. GRECHECK: All right, regulatory
18 guidance. We talked about this a little bit, but
19 we'll talk now about the process that we went through
20 to determine what we needed to do at the plant post-
21 event.

22 Again, the EPRI during the 1980s developed
23 NP-6695 with guidelines for nuclear plant response to
24 an earthquake. It was an excellent document, about a
25 100-page manual essentially. You open it at the

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1 beginning and you follow it. It was an excellent
2 document for the case we had.

3 We have been working with EPRI now to
4 provide them some OE on this and I think they're going
5 to make some changes to it based on some of the
6 experience because again, this was the first time we
7 were able to place this document into actual use at an
8 operating plant.

9 During the 1990s, the staff endorsed this
10 document in two Reg. Guides, 1.166, Pre-Earthquake
11 Planning and Immediate Actions Post-Earthquake; and
12 then the 1.167 which was really the most useful one,
13 Restart of the Plant Shutdown by a Seismic Event. And
14 for the most part with some very, very minor
15 exceptions endorse the use of the EPRI document.

16 All right, so if you go into the EPRI
17 document, I'm going to show you two flow charts that
18 basically take you through what EPRI says you should
19 do post-event. So here's the immediate actions. We
20 start up at the top. You feel the earthquake. Does
21 the plant trip or not? Again, contrary to, for
22 example, this is not -- these are not the Japanese
23 units. There are no seismic trips in this plant.
24 There are no seismic sensors that can cause a reactor
25 trip. So a reactor trip will be caused by some thing

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1 that is a result of the vibratory motion.

2 In North Anna's case, the plant tripped on
3 a negative rate flux, nuclear instrumentation trip and
4 we could get into a lengthy discussion about that --

5 MEMBER STETKAR: You dropped rods.

6 MR. GRECHECK: We did not drop rods.

7 MEMBER STETKAR: You didn't drop rods?

8 MR. GRECHECK: We did not drop rods, but
9 we had differences occurring because of the vibration
10 of both the core internals and the water inside the
11 core were causing differences between the NIs on the
12 four sides. And the NIs interpreted that as a
13 negative flux.

14 Interestingly enough, the two units
15 tripped simultaneously and they both tripped on the
16 same two NIs showing the same differential.

17 CHAIR ARMIJO: Very interesting.

18 MEMBER BLEY: You have no seismic trips?

19 MR. GRECHECK: We have no --

20 MEMBER SKILLMAN: All of your NIs were
21 operating?

22 MR. GRECHECK: All of the NIs were
23 operating and both units saw the exact same
24 accelerations in the same direction and the same two
25 NIs saw the same --

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1 MEMBER SKILLMAN: That's remarkable.

2 CHAIR ARMIJO: Is there anyone following
3 up on that to really nail it down on the cause and
4 explain it?

5 MR. HENDRIXSON: Yes, we actually went
6 through a detailed root cause evaluation which is
7 docketed. It goes through the various things that can
8 create that trip.

9 MEMBER STETKAR: That's the first
10 indication is you got from those two channels.

11 MR. GRECHECK: That's what tripped the
12 plant. Within a second or so of that --

13 MEMBER RAY: Excuse me, before you go on,
14 have you yet had a chance to reconcile that with the
15 impression one would have had from the CAV numbers you
16 put up there? In other words, you'd think this had to
17 propagate all the way down into the core internals and
18 so on, would have perhaps required a longer duration
19 event.

20 MR. GRECHECK: No, because we -- actually,
21 we were fortunate that we have some very high
22 resolution records on these NIs. They had a very,
23 very short time slice. And you can see the seismic
24 wave propagating through

25 the core at the time where it came

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1 through. It's a pretty interesting graph to look --

2 MEMBER RAY: The thing that's interesting
3 at this point in my mind is just that there's a lot of
4 damping and so on that has to be overcome and I would
5 have thought it required more duration. But that's
6 fine.

7 MR. GRECHECK: It's a very short event.
8 It comes and goes. The oscillations stop very
9 quickly, but by that time you've already met the trip
10 and --

11 MEMBER RAY: There's a huge amount of
12 damping involved. So as soon as the excitation is
13 removed, it will stop like that.

14 MEMBER SKILLMAN: What consideration did
15 you give to relative motion inside the reactor vessel
16 of the reactor internals against the reactor vessel
17 bumpers or core catcher?

18 MR. GRECHECK: It was looked at and it was
19 inspected.

20 MEMBER SKILLMAN: And evaluated?

21 MR. GRECHECK: And evaluated.

22 MEMBER SKILLMAN: Thank you.

23 MR. GRECHECK: Just to follow up on the
24 question about -- what the operators were aware of as
25 this occurred was not so much what they were aware is

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1 that about a second later we lost offsite power
2 because our over-pressure protection relays in our
3 transformers picked up the vibration, saw that as a
4 sudden pressure in the transformer, and tripped the
5 transformers offline. So about a second after the
6 reactor trip, we lost offsite power.

7 MEMBER CORRADINI: So regardless of the
8 source of all this --

9 MR. GRECHECK: We would have tripped
10 anyway.

11 MEMBER CORRADINI: I guess I wanted to ask
12 it differently. In terms of -- if the first event
13 didn't cause the trip, when you do some sort of
14 analysis, what do you think would cause the trip? The
15 offsite would have been the one you would have judged
16 would be the first thing that would have sensed it?

17 MR. GRECHECK: As a matter of fact, we
18 believe that was -- the initial response.

19 MEMBER CORRADINI: Initially, that's what
20 you thought was causing it until you investigated it
21 further.

22 MR. HENDRIXSON: The turbine trip was the
23 loss of offsite power. The reactor trip was the NIs.
24 The reactor trip signals didn't get to the turbine
25 trip before it tripped. The turbine trip signal

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1 didn't get to the reactor protection before the NI.

2 MEMBER SKILLMAN: In this case, were the
3 sudden pressure switches your friend or your enemy?

4 MR. GRECHECK: Well, in this case, I think
5 they were our enemy, but you don't want to lose sudden
6 pressure protection either because they're there to
7 protect the transformer.

8 MEMBER SKILLMAN: Some units have gotten
9 rid of them.

10 MEMBER STETKAR: Did you see any damage to
11 insulators out in the switchyard, ceramic insulators?

12 MR. GRECHECK: There was some.

13 MR. HENDRIXSON: The real damage wasn't to
14 the insulators themselves, the ceramic. They moved,
15 they rocked and they -- I don't want to say broke the
16 seal, but the rubber seal, a gap was made and oil came
17 out.

18 MEMBER STETKAR: On the transformers?

19 MR. HENDRIXSON: On the transformers
20 themselves.

21 MEMBER STETKAR: Without break?

22 MR. HENDRIXSON: So they were still
23 intact, but we lost some oil as a result of that and
24 had to obviously reset the seals.

25 MR. GRECHECK: I think that's a very good

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1 question in terms of the switchyard itself when they
2 did --

3 MEMBER STETKAR: The switchyard itself --

4 MR. HENDRIXSON: There was some damage.
5 There was some damage.

6 MEMBER SIEBER: What's the kV of the
7 switchyard?

8 MR. HENDRIXSON: It's 500, 345, and 230.

9 MEMBER SIEBER: So they're pretty big?

10 MR. HENDRIXSON: Yes.

11 MR. GRECHECK: All right, so following
12 this flow chart, you take the immediate operator
13 actions. You do operator walkdowns, and then the next
14 gate that you have to decide is did you exceed the OBE
15 or not? Obviously, we concluded that we did, so you
16 move to the next chart.

17 Here's where the differentiation occurred.
18 The blue on the left is where you start. And EPRI has
19 some definitions in their document about different
20 levels of intensity of damage. They go from zero to
21 three. Three is essentially catastrophic, you know,
22 massive structural damage. Zero has a number of
23 definitions, but basically says nothing significant
24 found.

25 You can do a walkdown of the plant and

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1 make that determination very quickly. So very, very
2 quickly, we did walk down the plant. We said we're in
3 a zero case. And if you follow the chart for zero,
4 you can -- you go down in that area and say do you see
5 any damage to safety-related equipment? No. Do you
6 see any damage to earthquake damage indicators which
7 are the most susceptible equipment in the plant? No.
8 And you're done. You do your surveillance tests and
9 you start up the plant. That's pretty much the path.

10 MEMBER CORRADINI: The second diamond,
11 damaged earthquake damage indicators, does that mean
12 there's actually instrumentation on --

13 MR. GRECHECK: You have equipment which
14 you have evaluated previously as being most
15 susceptible.

16 MEMBER CORRADINI: So some pre-analysis
17 says go look here, there, okay.

18 MR. GRECHECK: As a matter of fact, we
19 were talking about the IPEEE before. When you did the
20 IPEEE walkdowns, there were certain equipment that did
21 not -- you could not demonstrate 100 percent
22 confidence that they would survive that higher event.
23 So you know that these are the ones that are going to
24 be most susceptible.

25 MEMBER CORRADINI: And that's where you go

1 look.

2 MR. GRECHECK: That's where you go look.

3 MEMBER CORRADINI: Visual inspection,
4 okay.

5 MR. GRECHECK: So if you followed this
6 flow chart for a damage intensity zero event, then
7 this is essentially what you would do. This is a
8 relatively short inspection. It doesn't take a great
9 deal of effort. But this is what the EPRI document
10 suggests is necessary for an intensity zero or damage
11 intensity zero event.

12 However, if you evaluate it as being one,
13 two, or three, then you go off on to the right-hand
14 side. So what we did is we, just from the beginning,
15 we just arbitrarily said let's assume we're in a Level
16 1. And that's what leads to this expanded inspection
17 so everything else that you're going to hear about
18 today, from us and from what the staff described is
19 this expanded inspection effort where we just looked
20 at everything we could think of and to verify that
21 there was no damage.

22 MEMBER BLEY: Dana asked you in the
23 beginning why you went beyond NRC requirement and you
24 just again said you did. You haven't yet told us what
25 led you to do that?

1 MR. GRECHECK: We did because we wanted --
2 again, this is the first time this has ever happened
3 and we believed that for ourselves and anticipating
4 what the staff would need, we decided that we needed
5 more evidence than what this would suggest we would
6 have derived.

7 Remember, for us, again, we were in the
8 same mindset as everyone else. We exceeded our design
9 basis. We didn't see anything. But we had no prior
10 experience with this and we're saying what do we need
11 to do to prove to ourselves, even not considering what
12 the staff's questions were going to be, that we don't
13 have any damage. And so we decided to do a Level 1
14 inspection.

15 So again, we went beyond this
16 classification. We started providing the staff, I
17 think about -- the event occurred on August 23rd. On
18 September 7th we met with the staff, provided the plan
19 of what we were going to do to discuss this process.
20 Of course we, at that time, said that we had several
21 weeks of inspections ahead of us before we were going
22 to be done, but we presented that all to the staff and
23 said here's what we're intending to do.

24 Over the next couple of months we had a
25 great deal of interaction with the staff. As you can

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1 see, we got about 130 requests for additional
2 information, in many cases asking us for inspections
3 and analyses beyond even what we had originally
4 proposed and in many cases we did those. The staff
5 will talk to you about the inspection teams and we've
6 already talked about the root cause evaluation. All
7 of this was part of this overall effort to get ready
8 to restart the plant.

9 I'll give you a few more pictures and then
10 we'll be done. Part of the inspection was to go look
11 again, as we just talked about, where -- if we were
12 going to find damage, where would you expect to find
13 it?

14 This is a picture of the Unit 2
15 circulating water tunnel. This is a picture that
16 you're not going to often see because normally there's
17 hundreds of millions of gallons a minute traveling
18 through here. But this is basically a horizontal
19 concrete box that is underground. Again, if there was
20 going to be lateral motion you would see it here
21 because you've got this rectangular box here that
22 would be susceptible to damage. There was no damage
23 found in this tunnel. But we did take the opportunity
24 of the outage to be able to go in here and do a very
25 extensive inspection of this tunnel.

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1 MEMBER SKILLMAN: Did you have to clean
2 this before you could make these images?

3 MR. GRECHECK: Actually, if you see the
4 white spaces there, that's the cleaning that we did
5 for detailed inspections. That's what it looks like
6 without cleaning for the majority of the wall.

7 MEMBER SKILLMAN: So it was not filled
8 with slime and mussels and mud?

9 MR. GRECHECK: No.

10 MEMBER SKILLMAN: Thank you.

11 MR. GRECHECK: They had both units down.
12 Unit 2 was scheduled for refueling -- a refueling
13 outage about three weeks after the event, so we
14 entered into the refueling outage early, defueled the
15 Unit 2 reactor, looked at all the fuel assemblies as
16 they came out. Looked at fuel assemblies in the spent
17 fuel pool. Looked at new fuel assemblies which had
18 been delivered to the site in anticipation of the
19 refueling. Did not see any fuel damage.

20 Buried piping, there was a lot of
21 speculation again about what could be in buried
22 piping. The picture that you see on the left here is
23 a transition. It is very close to the safeguards
24 building. It's a transition between several buildings
25 and again, if you were going to have buried piping

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1 damage, you would expect it to be in these relatively
2 short transitions between buildings. If the buildings
3 were going to be moving, this is where you expect high
4 stress locations to be. This is maybe what, ten feet
5 down or so?

6 MR. HENDRIXSON: Yes, I'd say more like
7 six or eight feet.

8 MR. GRECHECK: But anyway, we excavated
9 all the way down there to look at these locations
10 where we would have expected to see damage. Again,
11 did not see any damage to any of this.

12 CHAIR ARMIJO: Is that buried piping
13 inspection called for if you're under the EPRI damage
14 1 category or is that --

15 MR. GRECHECK: I don't believe so.

16 CHAIR ARMIJO: So you actually went beyond
17 the EPRI 1.

18 MEMBER SIEBER: Do you have a way to
19 measure differential movement between buildings?

20 MR. HENDRIXSON: Yes. There's a survey
21 that we do and there's survey markers and we do that
22 also.

23 MEMBER SIEBER: Did you do the surveys?

24 MR. HENDRIXSON: Oh, yes.

25 MEMBER SIEBER: You do that periodically?

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1 MR. HENDRIXSON: Correct, six months or a
2 year. I forget the frequency.

3 MR. GRECHECK: And there's many other
4 inspections that we are not even describing here. I
5 mean we put people up in man baskets and inspected the
6 entire exterior of the containment ball, looking for
7 anything there. I mean we did a lot of visual
8 inspections throughout the plant looking for anything
9 that could be interpreted as damage.

10 MEMBER SIEBER: Did you test or inspect
11 penetration?

12 MR. HENDRIXSON: Yes.

13 MEMBER SIEBER: Pressure test them?

14 MR. HENDRIXSON: Yes, the Type C test.

15 MR. GRECHECK: Here's an example of one of
16 those earthquake indicators. This tank is one of the
17 susceptible tanks that came out of the list of the
18 IPEEE. This has this high confidence, low probability
19 failure HCLFPF value of only .19. So this would be
20 anticipated to be something that would be done of the
21 first things to show damage. And again, there was
22 nothing see here.

23 This is another low HCLFPF component
24 again. This is an as-found picture. You can see that
25 there is not even any disruption to the insulation.

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1 MEMBER CORRADINI: Just so I understand.
2 So when you did the green curve and you did that
3 analysis, did you tend to find large mass components
4 that would be the things that worried you or were
5 there small mass components like electrical relays or
6 cabinets or things that aren't as heavy, but if they
7 got wiggled at a different frequency, would really
8 cause a problem. Do you know what I mean?

9 MR. GRECHECK: Yes. We did corrective
10 actions to some of them, like for example, one of the
11 anticipated issues was that the suspended ceiling in
12 the control room which has one of those egg crates
13 diffuser panels, those could fall. So we fastened all
14 those together such that they would be less
15 susceptible to fall during an event.

16 There were cabinets that by tying the
17 cabinets together you were able to change their
18 frequency. There was a series of things that were
19 done in the post-IPEEE environment to try to fix those
20 things that could be.

21 MEMBER REMPE: When you started the diesel
22 generator, it had a leak and what was the cause of the
23 leak?

24 MR. GRECHECK: It was improper
25 maintenance. The flange had been improperly

1 installed.

2 MEMBER REMPE: Okay.

3 MR. GRECHECK: And that leak occurred into
4 its run. It was not right at start up.

5 MEMBER BROWN: Right.

6 MR. GRECHECK: All right, so summary, we
7 looked at 134 systems. We looked at 141 structures.
8 Forty-six of these susceptible components were
9 specifically looked at. Surveillance testing. We did
10 a comprehensive set of surveillance testing that
11 include MOV stroking, motor runs, just about anything
12 again. And again, not just looking for go, no go, but
13 looking for trending because we could look at the data
14 from the previous pre-earthquake test and say did we
15 see any change in behavior from pre-earthquake and
16 post-earthquake.

17 CHAIR ARMIJO: If you would go to your
18 fuel examination, Slide 18, the picture there. Was it
19 all visual or was there any kind of measurements, gaps
20 between the fuel assemblies?

21 MR. HENDRIXSON: It was a visual and an
22 enhanced visual and then with the close-up camera you
23 get those dimensions.

24 MEMBER CORRADINI: And you were looking
25 for some sort of bowing or --

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1 MR. HENDRIXSON: Yes, or deformation of
2 the ridge and things of that nature.

3 MEMBER BANERJEE: Did you go in with
4 endoscopic examinations, anything like that?

5 MR. HENDRIXSON: Most of it was face-on.

6 MEMBER BANERJEE: Face-on.

7 MR. GRECHECK: So a few short-term actions
8 that we completed before start up. One of the issues
9 we discovered is that our seismic instrumentation
10 dates essentially back to the early 1970s. It was not
11 designed for rapid analysis and it is not a free-field
12 instrument. It's based in buildings. The primary
13 data that we've been presenting to you here is from a
14 sensor that is in the basement of the Unit 1
15 containment right on the base map.

16 So some people have asked some questions
17 about was that truly free field and can you really
18 compare it? I think we were able to demonstrate that
19 it was close enough. But subsequent to the event, we
20 have installed a temporary free-field monitor on site,
21 away from any buildings. One of the nice things about
22 this is that you can see it's relatively small. It's
23 digital. It provides you the capability of
24 calculating CAV, for example, very quickly after an
25 event. And so in the future we'll be able to do the

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1 preliminary analysis much faster. And we've revised
2 our procedures specifically to tell the operators and
3 engineers how to use this equipment.

4 MEMBER SCHULTZ: Where did you locate it?

5 MR. GRECHECK: It's close to our training
6 center, so it's on the site, but it's in an open area
7 away from any buildings that could alter its response.

8 MEMBER SCHULTZ: Where there any other
9 findings related to the operational response, the
10 response of the operators, the response of the site
11 crew?

12 MR. GRECHECK: Actually, the site crew
13 performed in exemplary fashion. It was very, very,
14 very good response.

15 I think the staff will describe to you
16 some of the actions we agreed to and so I won't go
17 through these in detail. There's a Confirmatory
18 Action Letter which was issued to discuss some of
19 these long term --

20 MEMBER SIEBER: Before you jump to that,
21 part of the story of the event was that you started
22 four diesel, had to shut down one of them because of
23 a leak. What caused the leak?

24 MR. GRECHECK: Joy just asked that
25 question. The flange had been improperly installed.

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1 There was a gasket and a flange and that -- clearly --

2 MEMBER SIEBER: That event did not cause
3 the --

4 MR. GRECHECK: It was a prior maintenance
5 action that had caused the --

6 MEMBER SIEBER: You have an extra diesel,
7 right?

8 MR. GRECHECK: And we started that diesel
9 and that diesel functioned.

10 MEMBER SKILLMAN: Let me go back to
11 Steve's question The way your Operating and
12 Maintenance teams performed, was the trigger for their
13 actions you're having entered the unusual event and
14 then having followed your procedures from the ground
15 motion to giving instructions to your people? Was
16 that the flow or did the shift supervisor say oh, my
17 goodness, I've got a problem. I need everybody in
18 here right now with their flashlight.

19 MR. GRECHECK: Well, it occurred on day
20 shift on a Tuesday. So the shift manager, of course,
21 everybody felt the earthquake so he -- and we had a
22 dual-unit trip, so enter E0 appropriately. The AP
23 for seismic event and we actually went into an alert
24 so we -- the emergency response team then directed the
25 damage control team to actually recover a steam-driven

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1 aux feed pump that was out of service in the middle of
2 a surveillance test. And then the shift manager, of
3 course, directed his crew to secure the diesel. It
4 was a coolant leak -- and load the SBODs all on to
5 that bus.

6 MEMBER SKILLMAN: I'm asking a larger
7 question. You were in a situation where you had a UE
8 and you were following your procedures for the UE and
9 it turned out what triggered the UE was an earthquake.

10 MR. HENDRIXSON: Actually, were in alert.

11 MEMBER SKILLMAN: Or an alert, I'm sorry.

12 MR. HENDRIXSON: And the alert was
13 actually called based on shift manager discretion
14 because he said I felt an earthquake. I've got do a
15 unit trip. Something serious is happening here and I
16 need to activate the emergency response organization.

17 MEMBER SKILLMAN: So you called your
18 people up.

19 MR. HENDRIXSON: Right. Thank you.

20 MEMBER SIEBER: I want to go back to the
21 diesel one more time. When you do maintenance on the
22 diesel when you're on the surveillance test crew, no
23 leak at that time, right? How long was that
24 surveillance test?

25 MR. HENDRIXSON: It was at least three

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1 runs. Each is an hour long, plus --

2 MEMBER SIEBER: It's a start, load, and
3 run for an hour.

4 MR. HENDRIXSON: Exactly.

5 MEMBER SIEBER: You did not do anything
6 beyond that when you did the maintenance, right?

7 MR. HENDRIXSON: Those were the basic
8 post-maintenance tests.

9 MEMBER SIEBER: Didn't leak then.

10 MR. HENDRIXSON: Correct.

11 MEMBER SIEBER: Only leaked when the
12 seismic event, you concluded the seismic event didn't
13 cause it?

14 MR. HENDRIXSON: It actually didn't leak
15 for about 45 minutes. And then after that period of
16 time it began to leak.

17 MEMBER SIEBER: I guess operation is a
18 sort of a seismic event in and of itself as far as
19 it's concerned.

20 (Laughter.)

21 MEMBER SHACK: Gene, on North Anna 3,
22 there's a picture safe shutdown earthquake based on
23 our best modern knowledge and all our methods. It's
24 been reported that you even exceeded the safe shutdown
25 spectrum there, too. Is that right?

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1 MR. GRECHECK: At low frequencies, yes.
2 I pointed out before that the new models tended to
3 focus at higher frequency. The model that was in use
4 at the time of the early site permit which is not the
5 CEUS model that is now being released, but at the time
6 the early site permit which is in the 2003 time frame,
7 that model was -- did correctly predict an envelope,
8 the high-frequency vibrations, but it appears to have
9 under predicted the low frequency. So we are
10 examining that now and we are going to apply the CEUS
11 model to North Anna 3.

12 MEMBER BLEY: When you say "low
13 frequencies" what --

14 MR. GRECHECK: Two to three hertz.

15 MEMBER BANERJEE: The curve in the
16 spectrum that you've shown, you said I think that most
17 of the systems that you examined would not have been
18 damaged even by that green curve. What -- were there
19 some systems that would have been and which ones would
20 be?

21 MR. GRECHECK: So we get into this seismic
22 margin confidence type thing that HCLFPF value that I
23 was pointing out before. So analytically, we came up
24 with a list of about 50 items that you could not say
25 you had 100 percent confidence that they would survive

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1 that event.

2 MEMBER BANERJEE: Typically, what were
3 these things, important things?

4 MR. GRECHECK: Yes. Many of them are
5 tanks. You have again high center of mass tanks. You
6 look at the way they're anchored to the ground. And
7 you say well, some of these might fail under those
8 kinds of accelerations. So I think it was mostly
9 tanks and --

10 MR. HENDRIXSON: Invertors were in there.

11 MEMBER STETKAR: Did you look at end beds
12 on your --

13 MR. HENDRIXSON: Yes.

14 MEMBER STETKAR: Are your switch gear up
15 high in the building?

16 MR. HENDRIXSON: We basically hand-over-
17 handed the entire switchyard and actually in-depth
18 inspections of the switch gear. The energizer go in
19 and hand-over-hand --

20 MEMBER STETKAR: I don't know how they're
21 anchored.

22 MEMBER BANERJEE: Were these particularly
23 vulnerable to what part of that spectrum? Because if
24 you looked at it, the high frequency end was quite a
25 bit higher than the lower frequency. So was this

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1 vulnerability coming from the low frequency part, the
2 high frequency part?

3 MR. GRECHECK: I think it was equipment
4 dependent. You would compare each piece of equipment
5 against its vulnerability, whether it's high or low.

6 MEMBER BANERJEE: And you could identify
7 this based on the frequency?

8 MR. GRECHECK: You can calculate what the
9 natural frequency of that particular item is, so
10 again, you would know where the harmonics would occur.
11 So things that are very massive, may have a lower
12 harmonic frequency than some of these smaller items.

13 So to wrap up again, acceleration criteria
14 were very briefly exceeded in certain directions, but
15 this was a very short direction earthquake. We had,
16 based on previous evaluations, we had established the
17 safe shutdown systems, could handle accelerations
18 above the design basis and I think this confirmed it.
19 No safety-related systems or structures or components
20 required any repair due to this event that we saw and
21 basically we did an extraordinarily comprehensive
22 review of the station and didn't find any damage.

23 And so on the basis of that and like I
24 said in a very extensive review by the staff and many,
25 many questions answered, we ended up receiving

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1 permission to restart the units September 11th and in
2 the week or so subsequent to that, we restored both
3 units to 100 percent where they are today.

4 MEMBER SKILLMAN: I've got a question. I
5 see in your first slide was 21 million at inspection.
6 What was your lost generation for the time you were --

7 MR. GRECHECK: Actually, that's a very
8 difficult question to answer because by pure
9 happenstance, this was a very mild period. Late
10 August, early September, well, most of September in
11 Virginia was much cooler than it normally is. The
12 loads were down, so therefore it's kind of difficult
13 to specify what the financial, what the replacement
14 power cost was for that time period. Obviously, it
15 was substantial, but it was not as bad as it could
16 have been.

17 July was very hot and had it happened in
18 the months before, it would have been a much more
19 serious economic impact.

20 MEMBER SKILLMAN: Thank you.

21 MR. GRECHECK: Thanks.

22 CHAIR ARMIJO: Any other questions for the
23 speaker? In that case, we'll turn to the staff.

24 (Pause.)

25 MR. McCOY: Good morning. My name is

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1 Gerald McCoy and I am the Branch Chief for Region 2
2 for the Dominion plants. And I led the inspection
3 response to the earthquake in Mineral, Virginia.

4 When the earthquake occurred, the Senior
5 Resident Inspector, Greg Kolcum, was in the control
6 room at the North Anna Power Station and he was
7 observing the recently completed surveillance Mr.
8 Grecheck was talking about on the turbine-driven
9 auxiliary feedwater pump. We also had another NRC
10 inspector on site. His specialization was emergency
11 planning. He was on site during the earthquake and he
12 assisted in the response there on the site.

13 These inspectors observed the plant's
14 response during the event and immediately notified
15 Region 2. At the same time North Anna was declaring
16 an alert, 14 other nuclear licensees were declaring
17 NUES due to the same earthquake. In response to these
18 notifications, the NRC activated its Operations Center
19 and the Regional Instant Response Centers to monitor
20 the affected plants.

21 North Anna was the only site to experience
22 reactor trip following the earthquake. The NRC
23 subsequently learned that the ground movement during
24 the earthquake exceeded the levels to which the plant
25 was originally designed at certain specific

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1 frequencies.

2 Later, on August 23rd, Region 2 dispatched
3 an additional inspector to the site to assist in the
4 inspection effort. Also, a seismologist and a
5 mechanical engineer from here at White Flint were also
6 sent to the site within days of the event.

7 Because of the elevated risk from the loss
8 of offsite power from the failed diesel generator, an
9 evaluation was performed in accordance with Management
10 Directive 8.3 which is entitled "NRC Incident
11 Investigation Program." And it resulted in the
12 formation and dispatch of an augmented inspection team
13 to the site on August 29th. And their goal was to
14 better understand the circumstances of the event and
15 Dominion's response.

16 In addition to the augmented inspection,
17 a restart readiness inspection, and a start-up
18 monitoring inspection were also conducted to assess
19 the licensee's inspection process and to determine the
20 condition of the plant after the earthquake.

21 Mr. Mark Franke, DR's Branch Chief from
22 Region 2 led a team of seven inspectors, including a
23 seismologist, two structural engineers, two electrical
24 engineers, and two resident inspectors. The
25 inspection was conducted during the period of August

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1 30th through October 3rd, 2011. The purpose of the
2 inspection was to conduct an independent review,
3 collect factual information and evidence of what
4 occurred at the plant as a result of the earthquake,
5 to assess the licensee's response and identify any
6 generic issues.

7 The team's primary focus was on the
8 plant's response to the event itself, rather than on
9 the evaluation of the plant to support eventual
10 restart. However, during the time period covered by
11 this inspection, Dominion was conducting tests and
12 inspections of plant structures and components.
13 Members of the augmented inspection team observed some
14 of these inspections and documented their observations
15 as part of the restart assessment process.

16 The results of the augmented inspection
17 team were provided at a public meeting held near the
18 North Anna Power Station on October 3, 2011. The
19 team's observations of the event included the
20 observation of the ground motion from the earthquake
21 exceeded the plant's license design basis at certain
22 frequencies.

23 At this point, no damage had been noted to
24 any safety-related systems of the plant. The safety
25 system functions were maintained during the

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1 earthquake. The operators responded to the event in
2 accordance with their established procedures and North
3 Anna responded to the event in a manner which
4 protected public health and safety.

5 MEMBER STETKAR: Gerry, your third bullet
6 there says some equipment issues. Is that limited to
7 the diesel or were there other items that you
8 identified?

9 MR. McCOY: There were other items. It's
10 the diesel itself. There was issues with the seismic
11 monitors. In particular, I'm thinking about there was
12 an issue caused by the power to the seismic monitors
13 and the alarms. That's why they had to declare the
14 alert on a call from the shift manager's advice from
15 the earthquake itself because they didn't get the
16 annunciator they were supposed to get, so we looked at
17 that, too.

18 There was one Juliet diesel was exhibiting
19 frequency oscillation, so the team noted that and we
20 looked into that further. The alph auxiliary
21 feedwater pump terry turbine lube oil level switch had
22 an issue that we wanted to look at and it turned out
23 just to be an alarm issue with an alarm that wasn't
24 expected, so we looked into it and it made sense in
25 the end.

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1 MEMBER STETKAR: There were other things,
2 but those are things that other than the power for the
3 seismic monitor, those are other things that could
4 occur during any what's called a plain vanilla trip.

5 MR. McCOY: Correct.

6 MEMBER STETKAR: Thanks.

7 MR. McCOY: The next inspection the NRC
8 conducted was what we called the restart readiness
9 inspection. This inspection was of Dominion's
10 readiness to restart the North Anna units and have
11 occurred from October 5th to November 7th, 2011. The
12 objectives of this inspection was independent evaluate
13 Dominion's assessment that no functional damage had
14 occurred to safety systems which included evaluation
15 of the licensee's walkdown, their corrective action
16 follow up and the review of their actions to support
17 start up.

18 This team was led by Mr. Andy Sabisch.
19 Mr. Sabisch is the NRC Senior Resident Inspector at
20 the Oconee Nuclear Power Station. He led a team of
21 eight inspectors including participation from other
22 NRC regional and headquarters offices with experience
23 in structures, piping, electrical components and plant
24 operations.

25 The inspection included an independent

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1 assessment of Dominion's inspections and testing of
2 systems and components. A risk-informed sample of the
3 plant systems or walkdown by NRC inspectors and these
4 observations were compared with those made by
5 Dominion. The team reviewed the evaluation so what
6 was found during Dominion's walkdowns to determine if
7 the issues were properly categorized. The team also
8 reviewed the licensee's plan for starting up the
9 plant. The results of this inspection provided an
10 input into the eventual NRC approval to restart the
11 plants.

12 The conclusions reached by this inspection
13 team was that the licensee's inspection process was
14 adequate to identify any damage which had occurred to
15 the safety significant systems in the plant. The team
16 members performed a limited number of inspections of
17 risk-significant systems in areas and no significant
18 damage was identified. The team conducted spot checks
19 to verify that the licensee properly evaluated any
20 damage which was identified during the license's
21 inspection. The team did not identify any damage to
22 safety-related equipment from the seismic event.
23 Minor issues identified by the restart readiness team
24 such as the identification and non-earthquake related
25 damage which had not been entered into the licensee's

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1 corrective action process and enhancements which could
2 be made to the two hotel emergency diesel generator
3 root cause evaluation.

4 MEMBER SCHULTZ: Excuse me, what are the
5 examples you might give for the items that were not in
6 the Corrective Action Program?

7 MR. McCOY: Not in the Corrective Action
8 Program. There were cases that the inspectors, I
9 mean, you send inspectors out in the plant and they're
10 going to find things. That's what we encourage them
11 to do. The things they found were like they found
12 corkboard in odd places. They found damage to
13 insulation. It wasn't related to the earthquake
14 itself. It wasn't the case where two pipes were
15 hitting, but it's just damaged stuff and they talk to
16 the guy who is beside him and said hey, is this in the
17 corrective action system? And they said no, and they
18 said why not? Isn't that the process?

19 So it was just a case of me sending
20 inspectors out and finding issues and making sure
21 licensees got it on their list of things to correct.
22 But it wasn't related to the earthquake, so we just
23 put it in their process and carried on with our
24 inspection.

25 MEMBER BROWN: Did you question why it

1 wasn't there? Did they answer that?

2 MR. McCOY: The licensee -- there was
3 concern. There was a concern in the discussion
4 between myself and the licensee and it was -- it's not
5 something we usually see with Dominion, so I was kind
6 of concerned that the fact that all of a sudden now
7 you guys aren't putting things in your corrective
8 action process, what's the problem? And they did stop
9 and have a rebrief for their employees and say we are
10 having issues. We are here specifically to look at
11 the earthquake damage, but we still have to follow
12 regular processes. So I think -- I attributed it to
13 the loss of focus on their part. They were focusing
14 on the earthquake. They didn't quite see the other
15 things our inspectors coming in with new eyes were
16 seeing about their plant.

17 Next is a start-up monitoring inspection.
18 NRC continued the inspection process while the
19 licensee was in the process of restarting the plant.
20 The inspection was conducted during the start up of
21 both Unit 1 and Unit 2 from November 11th through
22 November 29th, 2011. The objective of this inspection
23 was to independently evaluate Dominion's assessment
24 that no functional damage had occurred to safety
25 systems through the observation of control room

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1 activities, surveillance tests, and inspections of
2 important plant systems as conditions change during
3 start up.

4 This inspection was led by Mr. Rodney
5 Clagg. Mr. Clagg is the NRC's resident inspector at
6 North Anna Power Station. He led a team of seven
7 resident inspectors from other nuclear power plants.
8 This team concluded that the licensee's process
9 ensured that the structure systems and components of
10 the North Anna Power Station could perform their
11 safety functions following the earthquake and would
12 support a return to the safe power operation without
13 undue risk of health and safety to the public.

14 This inspection team completed this
15 verification through the observation of control room
16 activities and direct inspection of start-up
17 activities including mode changes, heat up, reactor
18 start up, power extension for cold shutdown to rated
19 thermal power. It also included direct inspection of
20 surveillance testing, operability determinations,
21 maintenance risk assessments, emergent work control,
22 modifications, post-maintenance testing, and a review
23 of Corrective Action Program documents, partial
24 inspection walkdowns of selected systems, structures,
25 and components including secondary systems and other

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1 activities as applicable. No additional earthquake-
2 related damage was identified to the plant systems
3 during the start-up process.

4 I now invite Ms. Meena Khanna, the Branch
5 Chief for the NRC's Office of Nuclear Reactor
6 Regulation to discuss the Agency's technical review
7 efforts.

8 MS. KHANNA: Thank you, Gerry. Again, my
9 name is Meena Khanna and I did lead the technical
10 review efforts out of NRR.

11 There was a question earlier that I just
12 wanted to touch base on. There was a question about
13 the IPEEE curve. And we found the guidance document.
14 It's NUREG-1407. So I just wanted to mention that to
15 you. So hopefully that will address it. And if you
16 need any additional information, we can ask our
17 seismic expert, Dr. Nilesh Chokshi, to help us out
18 with that as well. Okay?

19 The restart requirements. The regulatory
20 requirements governing this event are delineated in 10
21 CFR Part 100 Appendix A. Basically this states that
22 if the vibratory ground motion exceeds that of the
23 operating basis earthquake, then the shutdown of the
24 nuclear power plant will be required.

25 In addition to that prior to resuming

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1 operations, the licensee will need to demonstrate to
2 the Commission that no functional damage has occurred
3 to those features necessary for the continued
4 operation without the undue risk to the health and
5 safety of the public.

6 I'd like to take a second here to also
7 indicate that I will be interchangeably using the
8 terminology of safe shutdown earthquake and design
9 basis earthquake. They mean the same for North Anna.
10 So if you near me say SSE, safe shutdown earthquake.
11 That is the same as design basis earthquake.

12 As far as the technical review, the
13 regulatory review guidance that the NRC followed was
14 established in the mid-1990s. As you heard Mr.
15 Grecheck address the Reg. Guide 1167 which is entitled
16 "Restart of a Nuclear Power Plant Shut Down by a
17 Seismic Event" which is endorsed by the EPRI NP6695 --
18 I'm sorry, which endorses the EPRI NP6695 guideline
19 was also used. And that's entitled "Guidelines for
20 Nuclear Plant Response to an Earthquake."

21 I'd also like to note that the EPRI
22 guidelines does talk about guidance on what to do if
23 the plant exceeds the OBE as well as design basis
24 earthquake. Both short-term and long-term actions are
25 addressed in the EPRI guidelines. In addition to the

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1 EPRI guidelines and the Reg. Guide, we also took it
2 one step further and used the IAEA Safety Report No.
3 66 which also addresses lessons learned from the
4 International Plant which was the Kashiwazaki plant in
5 Japan and this plant had also exceeded its design
6 basis earthquake. So this provided valuable
7 information to us in conducting our reviews,
8 especially with respect to hidden defects.

9 MEMBER CORRADINI: So if I might just ask,
10 so in the conversation with Gene, there was -- I don't
11 want to call it an inconsistency, a difference between
12 10 CFR 100 and the Reg. Guide which points to the EPRI
13 document in terms of -- maybe I'm misinterpreting, so
14 I'm not sure if it's inconsistent or it's just a
15 different term. Are you going to address that here?

16 MS. KHANNA: Yes, just the 10 CFR Part 100
17 basically just indicates that if you do exceed the
18 OBE, then the plant will be required to be shut down
19 and NRC approval needs to be addressed, needs to be
20 sought from the licensee. However, the EPRI
21 guidelines goes into what the plant needs to do to
22 address what actions need to be taken once it's
23 exceeded the OBE in licensing. Is that what you were
24 getting at?

25 MEMBER CORRADINI: I'm probably going to

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1 do this wrong, so let me try again. So the way you
2 just explained it is we looked at this multi-colored
3 set of curves and then given the fact that they
4 exceeded what they were designed for, that puts them
5 in a situation they have to look at things. But then
6 they look at the Reg. Guide to decide what they have
7 to do in terms of -- Gene had a decision matrix.

8 MS. KHANNA: That's right and that comes
9 out of the EPRI guideline so the Reg. Guide endorsed
10 the EPRI guidelines.

11 MEMBER CORRADINI: Let me posit one thing.
12 So in the north-south -- I don't remember what
13 direction it was, the blue bar was slightly above the
14 black line. That black line comes out of the Reg.
15 Guide. Am I correct in understanding that? And that
16 points to the EPRI document. So you -- based on some
17 natural event, you exceed what is their design base,
18 but then once you go in terms of this only if that
19 blue bar gets above the black line do -- any more than
20 a zero corridor inspection.

21 Am I interpreting that correctly? I want
22 to make sure I get this right.

23 MS. KHANNA: I think you've got it
24 correct. The EPRI guidelines will indicate to you
25 that the level, based on the amount of damage the

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1 plant sees at the site, that basically tells them what
2 level they need to go and when we're talking about the
3 various levels that going to be in the EPRI
4 guidelines. Does that help? Okay.

5 Okay, so in addition to the IAEA safety
6 report, obviously we have great technical expertise
7 here, so we also utilized the technical expertise that
8 we had and that was really helpful with the area of
9 fuels and on the evaluation as well, which I'll get
10 into a little bit more detail later.

11 Like I indicated, significant level of NRC
12 effort was placed to independently evaluate the impact
13 of the seismic event including structural and seismic
14 experts throughout the Agency. We also dedicated a
15 special restart team. We had several senior level
16 advisors as part of this team dedicated project
17 managers, so we took this very seriously and had a
18 separate team that was working basically on this 24 --
19 I'm not going to say 24/7, but around the clock and
20 doing what we needed to do.

21 The overall review and evaluation assessed
22 the scope and the adequacy of the licensee's
23 inspections, as Gerry had indicated, as well as the
24 testing and the evaluations and the technical reviews
25 were also informed by the inspections that Gerry had

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1 mentioned earlier. And again, the staff did not
2 identify any significant safety issues stemming from
3 the seismic event.

4 As Allen had indicated earlier, the NRC's
5 inspection assessment activities did involve a wide
6 spectrum of technical disciplines and there was
7 definitely coordination among the reviews and the
8 inspection activities across the offices with the
9 Agency.

10 Also, as part of this, I'd like to mention
11 that we did come up with an action plan. We developed
12 an action plan. There were so many activities going
13 on. As you heard, the inspection activities -- there
14 were audits done on the fuels that I'll talk about
15 later. We have 2.206 petitions. As you can imagine
16 there were quite a few public meetings, Commission
17 briefings. And also what we wanted to do was make
18 sure that we captured the short-term actions as well
19 as the long-term actions and Gerry had mentioned that
20 there were -- I don't know if he had mentioned it, but
21 there were two generic issues that were identified out
22 of the AIT inspection report and those were both with
23 respect to the seismic monitoring instrumentation. So
24 what we've got in place right now is we're putting
25 together an information notice to address those two

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1 generic issues. So again, all these items are being
2 tracked within our action plan. We also developed a
3 com. plan because we believe that was important.

4 The NRC performed a comprehensive
5 independent technical review to ascertain whether it
6 was acceptable for the North Anna plant to restart.
7 This slide lists many of the technical areas that were
8 reviewed which includes reactor vessel internals as
9 well as mechanical structural engineering and
10 electrical engineering. I won't go through all of
11 this, but based on this list, you can see that almost
12 every single technical branch in NRR was impacted and
13 was involved in this review.

14 I'd like to highlight a few examples to
15 demonstrate the independent nature of our review. To
16 address the integrity of the fuels, we did conduct
17 audits of the fuel and I believe Tony Mendiola, his
18 group actually went to the site and reviewed
19 Dominion's efforts for confirming the integrity of the
20 fuel. In response to our review of Dominion's
21 efforts, Dominion also performed additional
22 calculations to demonstrate the integrity of the fuel
23 assembly components to ensure that they were not
24 compromised as a result of the earthquake.

25 With respect of our review of the piping

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1 systems, Dominion performed additional analyses as
2 well as to provide the NRC staff confidence that the
3 earthquake did not adversely impact the piping and to
4 ensure that the previous analyses were not invalidated
5 as a result of the earthquake. For example, a leak
6 before a break, and just ensuring that any prior
7 existing flaws were not impacted by the earthquake as
8 well.

9 Also, I'd like to mention that with
10 respect to inspections of snubbers, Dominion had
11 committed to doing functional testing of the snubbers
12 with respect to Unit 2 and as a result of our
13 questioning attitude, they also completed functional
14 testing of the snubbers for Unit 1 as well.

15 And then later on in the presentation I'll
16 talk about the long-term activities, long-term items
17 that were addressed in the CAL and that was also due
18 to the questioning attitude of the staff license
19 renewal, was heavily involved in that because as you
20 know, there was a license renewal issue for this
21 plant. So there were several activities that came out
22 of that that will be addressed in that Confirmatory
23 Action Letter.

24 NRC staff conducted a safety review in
25 accordance with the established acceptance criteria.

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1 This was a first of a kind review. The staff -- this
2 was very basically new to the staff. It was a complex
3 review, so we wanted to ensure that we had consistent
4 technical reviews across the office. So before we
5 started a review, we came and developed some
6 acceptance criteria and really what helped us
7 Inspection Manual Chapter 9900. That gave us good
8 guidance and that's basically the operability
9 determinations and functionality assessments for
10 resolution of degraded or nonconforming conditions.
11 So that was the basis of our acceptance review
12 criteria. And that really helped out. We made sure
13 that we had Office of General Counsel involved and
14 made sure that in every step that we were doing that
15 they were watching what we were doing and making sure
16 that we weren't doing anything illegal.

17 The NRC ensured that Dominion demonstrated
18 that the plant is safe to operate prior to approving
19 restart. And as we indicated earlier, the staff did
20 not identify anything from our inspections or the
21 technical review to preclude plant operations as a
22 result of the seismic event. The results that were
23 reviewed determined that the plants may be restarted
24 safely and the bottom line was that the NRC was not
25 going to allow plant restart until we were confident

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1 that it would be operated safely.

2 And as Mr. Grecheck indicated, on November
3 11, 2011, after the plant was shut down for
4 approximately 80 days, the Office Director of the
5 Office of Nuclear Reactor Regulation issued the
6 restart approval decision for both North Anna Units 1
7 and 2. The decision was based on the staff's
8 independent assessment which concluded that Dominion
9 had acceptably demonstrated that no functional damage
10 occurred to those features necessary for continued
11 operation as a result of the August 23rd earthquake,
12 thereby ensuring that there was no undue risk to the
13 health and safety of the public.

14 I'm sure you've read our safety
15 assessment. You can find that it's extremely
16 comprehensive. We tried to make sure that we captured
17 everything. Again, this was a one time -- this was a
18 first of a kind event and we wanted to make sure we
19 captured our technical review in case we needed it for
20 knowledge transfer later on in the future. Also, we
21 issued a confirmatory action letter to address the
22 licensee's commitments for long-term actions.

23 The next few slides, I'm not going to go
24 through each of the ten long-term actions that were
25 identified in the CAL. However, I do want to

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1 highlight a few items here. Dominion did commit to
2 perform the long-term evaluations in accordance with
3 the NRC endorsed guidance, so the EPRI guidelines do
4 talk about long-term actions and that's what Dominion
5 committed to. We completed our reviews regarding
6 these evaluations and the long-term commitments are
7 addressed in the NRC CAL which is also dated November
8 11, 2011.

9 As indicated earlier, as a result of the
10 earthquake, the plant exceeded its design basis
11 earthquake ground motion. To address this issue,
12 Dominion committed to update their final safety
13 analysis report to include this new seismic ground
14 motion as reflected in the August 23rd earthquake
15 which is also addressed in Item 3 of the Confirmatory
16 Action Letter and that's identified as multiple due
17 dates.

18 With regards to Item 10 --

19 MEMBER RAY: Could you back up? Item 2 up
20 there isn't very far off, March 31, 2012. And is
21 there any insight at all on the source
22 characterization? Does the NRC have any work in
23 progress to look at that or are you waiting for a
24 submittal?

25 MS. KHANNA: Kamal?

1 MR. MANOLY: This is Kamal Manoly with
2 NRC. That started to be addressed as part of the
3 50.54f letter that will be issued some time which
4 essentially is an extension of GI-199.

5 MEMBER RAY: Okay, so basically, it's not
6 going to be something special for this event.

7 MR. MANOLY: That's correct.

8 MEMBER RAY: Given all else that's going
9 on in that area.

10 MR. MANOLY: Dominion committed that they
11 would follow whatever action comes out of the GI-199
12 effort.

13 MEMBER RAY: Okay, it's just an
14 interesting action item to have in a Confirmatory
15 Action Letter.

16 MS. KHANNA: You bring up a good point as
17 well. There was close coordination with the Near-Term
18 Task Force on the Fukushima and actually the seismic
19 monitoring instrumentation, that was one issue that
20 they were going to be addressing as part of the
21 lessons learned, but they thought it would be more
22 appropriate for us to address it, so that's why we're
23 pursuing the information notice.

24 As Kamal indicated the GI-199 efforts, all
25 of that we're making sure that everything is tied --

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1 MEMBER RAY: It's just the date seems
2 awfully close. That's why I asked.

3 MS. KHANNA: I just wanted to highlight,
4 so item ten, the long-term commitment entails that
5 Dominion will use the recent ground motion spectrum
6 from the August 23rd earthquake in conjunction with
7 the original design basis earthquake seismic
8 qualification of new and replacement equipment. So
9 this was one item that we -- the staff was requesting
10 of the licensee and wanted to make sure that for new
11 and replacement equipment that they were considering
12 the response spectra from the existing design basis
13 earthquake as well as from the as-felt earthquake that
14 was seen from the August 23rd earthquake.

15 Again, the long-term commitments were
16 consistent with those identified in the EPRI
17 guidelines. However, you'll note that in the list
18 there are a few that stem from the license renewal
19 folks because there is a license renewal application
20 that was approved. So there are a few license renewal
21 commitments included. For example, MRP-227. And
22 again, as I mentioned the staff did issue an action
23 plan and that's where we're going to be tracking the
24 closure of all these CAL action items.

25 That concludes our presentation. I'll now

1 open it up for questions.

2 CHAIR ARMIJO: Item 7, you want them to
3 do comparative calculated loads from the earthquake
4 and the existing leak before break analysis. What
5 drove that request in view of the condition of the
6 plant?

7 MS. KHANNA: I'll give a high level -- I
8 don't know if we have the appropriate person, but I
9 believe what they want to do is any analyses that had
10 been done for license renewal, they wanted to make
11 sure that they were still valid. So I think they
12 wanted to make sure that if there were any different
13 stresses, but -- do you guys want to help me out,
14 please?

15 CHAIR ARMIJO: Is anybody else -- well,
16 I'm just wondering.

17 MR. TSAO: This is John Tsao from Division
18 of Engineering. The reason we ask licensee to do
19 recalculation of leak before break analysis is that
20 leak before break is to satisfy GDC-4 and GDC-4
21 requires a Commission-approved leak before break
22 analysis. Because of the seismic event we think that
23 the loads, the seismic loads may increase and we are
24 wondering whether the current leak before break
25 analysis approved for North Anna still satisfies the

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1 staff's recommended safety margin in the Standard
2 Review Plan 363. So this is a confirmatory analysis
3 to make sure that leak before break application is
4 still valid for North Anna.

5 CHAIR ARMIJO: Okay. It just seems like
6 the condition of the plant and leak before break --

7 MEMBER SHACK: Remember, with leak before
8 break you have to postulate a big flaw that doesn't
9 really exist, so they're looking for that margin. So
10 with the higher loads and the postulated big flaws, it
11 has to demonstrate a margin. Even though it looks
12 fine, you still need the analysis.

13 MEMBER RAY: Higher loads resulting from
14 this event or --

15 MEMBER SHACK: Just the seismic loading
16 now seems to be somewhat higher than originally -- the
17 spectrum has been exceeded.

18 MEMBER RAY: By this event.

19 MEMBER SHACK: By this event.

20 MEMBER RAY: You're talking about this
21 event though.

22 MEMBER SHACK: Right.

23 MEMBER RAY: Not some other change in the
24 design basis.

25 MS. KHANNA: This is specific to this

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1 event, right.

2 CHAIR ARMIJO: Okay, thank you.

3 MEMBER SHACK: That they advise, too,
4 Harold.

5 MEMBER RAY: I understand. But I'm trying
6 to keep them separate in my mind anyway.

7 MEMBER STETKAR: Meena, as part of the
8 lessons learned from this, do you anticipate any
9 revisions to Reg. Guide 166 and 167?

10 MS. KHANNA: That's a good question. Yes.
11 Research, right now is going through a revision of
12 Reg. Guide 1.667 and we're actually providing a lot of
13 feedback to that. The Reg. Guide does need to be
14 updated. It's been a while since it's been updated,
15 so there are a lot of lessons learned that we gain
16 from this review. Probably more robust than the Reg.
17 Guide. I think you'll see a lot of the RAIs that we
18 asked -- the staff is doing a great job.

19 MEMBER STETKAR: Anything on 1.166 as far
20 as planning and operations?

21 MS. KHANNA: To be honest with you, I'm
22 not aware of any. We haven't seen an update.

23 MEMBER STETKAR: Thank you.

24 MR. WIDMAYER: Meena, the Reg. Guides are
25 -- the Reg. Guides promote the EPRI document. Is

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1 there's something going on where they're being
2 reevaluated and updated?

3 MS. KHANNA: I'm not sure about that, but
4 what we will do is when we put the Reg. Guide out, if
5 we do any updates, obviously that would precede what's
6 in the EPRI guidelines. So I haven't heard of any
7 updates of the EPRI guidelines, but I would think that
8 once we -- I don't know, David, if you would know, but
9 --

10 MR. MANOLY: In the Reg. Guides that
11 endorses the EPRI 6.695, it endorses conditions and my
12 expectation is if EPRI does not revise the document,
13 we will add more conditions in the Reg. Guide.

14 MEMBER BLEY: There was a discussion
15 earlier when the licensee was here about the
16 regulation requiring that you meet the design spectra
17 or that the spectra is met and the Reg. Guide making
18 a definition based on CAV that if you're within that
19 value of CAV you don't exceed the OBE.

20 Is that an actual conflict? How is that
21 to be resolved and is this leading to any thoughts
22 about how the design basis will be formulated or
23 defined in the future for new reactors?

24 MR. MANOLY: This is Manoly again. When
25 you talk about design spectra, that is what's used for

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1 the design of the structures and components and the
2 Reg. Guide talks about exceedance when you have an
3 earthquake that's felt. So what is the design tool?
4 I think we tried to articulate that point. The CAV is
5 a measure to determine the threshold beyond which you
6 should consider that you exceed the OBE.

7 MEMBER BLEY: So that is the basis for
8 staff looking at an actual earthquake and deciding if
9 you exceed the OBE.

10 MR. MANOLY: Yes, that's the Reg. Guide.
11 That's in the record. But the design for the plant is
12 the design spectra, the ASME, that's for the actual
13 design structure and components with the margins that
14 exist in the design process.

15 MEMBER BLEY: How is the requirement for
16 how long -- if the component is tested on a shake
17 table for the duration of the shaking arrived at and
18 is that something that NRC approves or is that
19 something that the licensee decides?

20 MR. MANOLY: Typically, the equipment are
21 tested by -- qualified by testing, some are qualified
22 by analysis. When you qualify equipment by testing,
23 you do it to one SSC and five OBEs.

24 MEMBER BLEY: And for what duration.

25 MR. MANOLY: The duration is usually

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1 around 30 seconds typically.

2 MEMBER BLEY: It's not a requirement?

3 MR. MANOLY: I believe it's in the IEEE
4 44, but I believe the duration is around 30 seconds.

5 MEMBER BLEY: It's not something you
6 regulate other than may be referring to the IEEE?

7 MR. MANOLY: In Reg. Guide 100 Rev. 3, it
8 endorses the EPRI 344 for electrical equipment and now
9 it endorses the ASME fuel made for qualification of
10 the technical equipment.

11 MEMBER BLEY: It's a little more complex
12 than I can completely understand here on the fly.

13 MEMBER CORRADINI: But just to follow up
14 Dennis' question, given the fact you're going to have
15 lessons learned from his from how you connect the Reg.
16 Guides to the requirements, I think at least some of
17 us like to understand how all this is going to --

18 MEMBER BLEY: That's kind of where I was
19 coming from.

20 MEMBER CORRADINI: Is that a fair way to
21 putting it?

22 MS. KHANNA: Yes.

23 MEMBER POWERS: Are there any other
24 questions?

25 MEMBER BLEY: Just a quick comment. Since

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1 you pointed us to a NUREG for understanding the IPEEE
2 spectrum, actually that Reg. Guide tells how the
3 IPEEEs were done and says you can either do a seismic
4 PRA which would develop a site specific hazard curve,
5 or you can do an EPRI margin study or an NRC margin
6 study. The NRC margin study refers you to another
7 NUREG CR that develops kind of a generic spectrum for
8 mild or moderate rock or soil site. I suspect it's
9 over there, but that's not on the website.

10 MEMBER SKILLMAN: Mr. Chairman, I would
11 like to make a comment. I'd like to compliment the
12 staff and the Dominion team for really taking to heart
13 an abundance of caution when it might have been
14 another utility that would have arm wrestled, would
15 have said we're so close to the CAV we really don't
16 have to do anything. Independent of how much money
17 was spent, this exercise has shown in this particular
18 case how robust this machine is. But it has also
19 demonstrated a nuclear safety attitude that at least
20 I for one am very pleased to be around. So I want to
21 say thank you.

22 MEMBER SIEBER: Well, I think that
23 compliment should extend to the licensee also.

24 MEMBER SKILLMAN: Oh, yes. That's what I
25 was trying to say to the Dominion team. Thank you.

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1 MEMBER POWERS: Sure.

2 CHAIR ARMIJO: All right. Thank you,
3 Dana. Thank the staff. We're now going to take a
4 break and we'll reconvene at 10:30.

5 (Whereupon, the above-entitle matter went
6 off the record at 10:17 a.m.)

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