November 8, 2011

The Honorable Edward J. Markey
United States House of Representatives
Washington, D.C. 20515

Dear Congressman Markey:

On behalf of the U.S. Nuclear Regulatory Commission (NRC), I am responding to your letter of August 26, 2011, regarding seismic safety at the North Anna Power Station in central Virginia. The NRC is continuing its evaluation of the recent earthquake and its effect on North Anna; however, based on the licensee's collection and analysis of seismic data the agency is able to offer preliminary responses to your specific questions.

Shortly after the earthquake occurred, the NRC and the licensee (Virginia Electric and Power Company (VEPCO)) independently concluded based on partial data that the facility may have exceeded the ground motion for which it was designed. Enclosed, as requested, is the NRC's preliminary analysis (Enclosure 1). On September 8th, after a complete evaluation of earthquake seismic data, the licensee reported to the NRC that the facility's Operating Basis Earthquake and Design Basis Earthquake (DBE) were exceeded. Specifically, for some aspects of the earthquake, VEPCO's analysis also concluded that exceedance beyond the seismic design basis for the plant did not occur across the entire spectrum of frequencies for which the plant was designed. That is, the earthquake ground motion was lower than the design basis at some frequencies. VEPCO obtained third party peer review of its analysis by industry experts to confirm its findings. A copy of the licensee's briefing provided to the NRC in a recent public meeting is enclosed (Enclosure 2).

Regarding the question of whether the current requirements for the North Anna Power Station incorporate "modern geologic information," the NRC is currently evaluating this issue as part of a project started in 2005 known as Generic Issue-199, "Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants," which evaluated the effect of updated seismic hazard estimates for operating nuclear power plants. Data and models developed in this project suggest that the probability of earthquake ground shaking above the seismic design basis at certain frequencies for some nuclear power plants in the central and eastern U.S. is greater than previous estimates. Later this year, the NRC expects to provide licensees of existing facilities a seismic analysis tool based on work related to applications for new plants (which use a "probabilistic" approach to determining seismic hazards), along with the latest information on earthquake sources, so that these plants can perform an updated review of their current risk from seismic events. Based on the information collected from these required analyses, the NRC will determine whether there is a need to take additional action at specific sites.

Please be assured that the NRC is carefully examining the effects of the recent earthquake at the North Anna Power Station. On October 3, the NRC conducted a public exit meeting to discuss the preliminary results from its augmented inspection team that was charted to understand the effects of the earthquake on North Anna, and to gather information for further evaluation. Additionally, the agency is conducting a restart readiness inspection of both units. The Commission held public meetings on October 21 and November 1 to learn about the actions taken by the licensee and NRC staff to determine restart readiness of the North Anna nuclear plant. Currently, both units are shut down, and will remain so until VEPCO demonstrates to the NRC that no functional damage has occurred to those features necessary for continued operation without undue risk to the health and safety of the public.

Regarding your request that the Commission adopt the Near-Term Task Force recommendation related to seismic and flooding hazards, the Commission approved the staff's proposed actions to implement without delay the Near-Term Task Force recommendations. The Commission directed the NRC should strive to complete and implement the lessons learned from the Fukushima accident within five years – by 2016.

If you have any questions, please contact me or Ms. Rebecca Schmidt, Director of the Office of Congressional Affairs, at (301) 415-1776.

Sincerely,

/RA/

Gregory B. Jaczko

Enclosures:
As stated

Summary of Earthquake Information for the North Anna NPP as of August 24, 2011

The North Anna Nuclear Power Plant (NANPP) has two Safe Shutdown Earthquake (SSE) ground motions, one for structures, systems, and components (SSCs) located on top of rock, which is anchored at 0.12 g, and the other is for SSCs located on top of soil, which is anchored at 0.18 g. The NANPP has two corresponding Operating Basis Earthquake (OBE) ground motion spectra, anchored at 0.09 g for soil and 0.06 g for rock. The figure below shows a comparison between the SSE and OBE for Units 1 and 2, the Unit 3 Combined License (COL) application Ground Motion Response Spectrum (GMRS), the current best estimate of the August 24, 2011 earthquake ground motions from the USGS (ShakeCast version 7), and predicted median and standard deviation earthquake motions using the EPRI ground motion prediction equations.

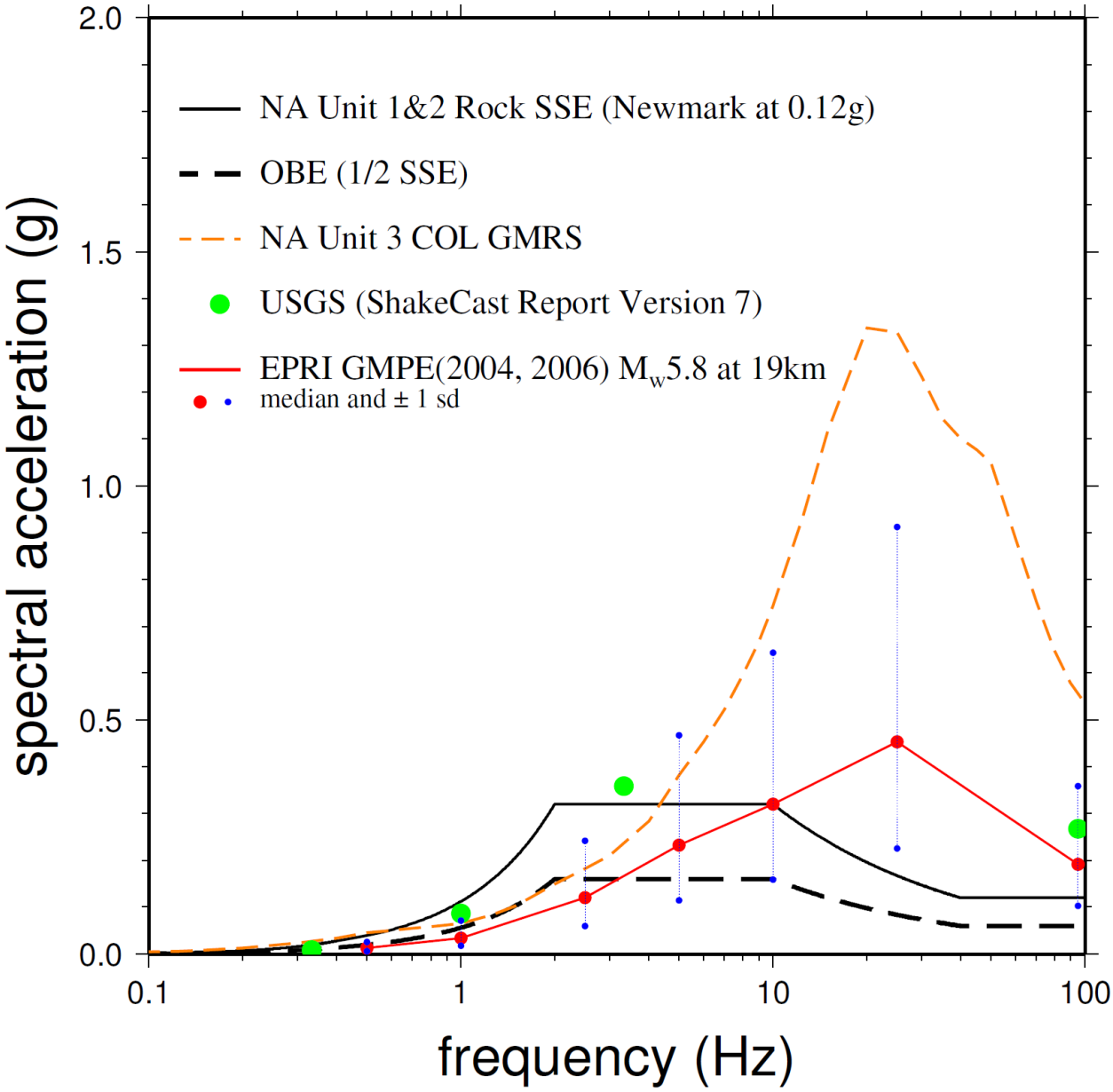
The recent earthquake occurred at a close distance (18 km) to the plant with a magnitude of 5.8 at a relatively shallow depth (6 km). USGS estimates of the maximum ground motion at the plant evolved as new data become available. The current best estimate of the Peak Ground Acceleration (PGA) for the NANPP site is 0.26g, which contains uncertainty and may be updated later. This estimate indicates that the ground motion likely exceeded the SSE response spectra for NANPP Units 1 and 2 (0.12g) over a considerable frequency range, as shown by the green and red points in the figure. The estimated ground motion from the earthquake was not a surprise based on the combined operating license application (COLA) ground motion response spectrum for NANPP Unit 3. This preliminary estimate appears to validate the NRC's current seismic hazard assessment approaches and models for new reactors, as well as the basis for GI-199 reviews.

The USGS ground motion estimate values for the plant site are developed based on two types of input. The principal input is from using ground motion prediction equations (also called attenuation relationships) that were specifically developed for the Central and Eastern United States. This prediction ground motion is then modified based on intensity information that comes from the USGS "Did You Feel It?" (DYFI) system. The DYFI system is a method for using large numbers of inputs from affected persons to develop intensity maps that are used as a "ground truth." Currently, the USGS has received nearly 123,000 submitted reports.

NRC staff performed an independent analysis using the best estimate of the earthquake location and magnitude together with the EPRI ground motion prediction equations. The median and ±1 standard deviation curves are shown. It can be seen that the 84th percentile ground motions calculated by the staff are close to the USGS predictions. This makes sense because the USGS theoretical values were increased due to the intensity information that came out of the DYFI system.

Currently, the licensee is retrieving its seismic instrumentation recordings from within the plant and processing the information. However, we do not yet know the type and quality of the recording data that will be available to the NRC. Information from the NANPP will be used to evaluate the USGS estimates of ground motion and will be compared against the FSAR design basis. The data will be used to inform the staff whether additional analysis is needed.

The licensee has indicated that it will perform plant walk downs in accordance with RG 1.167, "Restart of a Nuclear Power Plant Shutdown by a Seismic Event," which endorses EPRI's "Guidelines for Nuclear Plant Response to an Earthquake" with conditions. If the SSE is exceeded at certain frequencies, the staff will assess the licensee's evaluation of SSCs that are most sensitive to ground motion in that frequency band.


NA Unit 1&2 Rock SSE (Newmark at 0.12g)
OBE (1/2 SSE)
NA Unit 3 COL GMRS
USGS (ShakeCast Report Version 7)
EPRI GMPE(2004, 2006) M_w5.8 at 19km
median and ± 1 sd
spectral acceleration (g)
frequency (Hz)
2.0
1.5
1.0
0.5
0.0
0.1
1
10
100

Dominion

Overview of 08/23/11 Earthquake Response and Restart Readiness Demonstration Plan

North Anna Power Station Units 1 and 2

Dominion

Introduction and Agenda

Gene Grecheck
Vice President, Nuclear Development

Agenda

- Overview of Event
  - Station
  - ISFSI
- Seismic Results
- Restart Readiness Demonstration Plan
- Results to Date
- Restart Schedule
- Summary
- Questions

Dominion

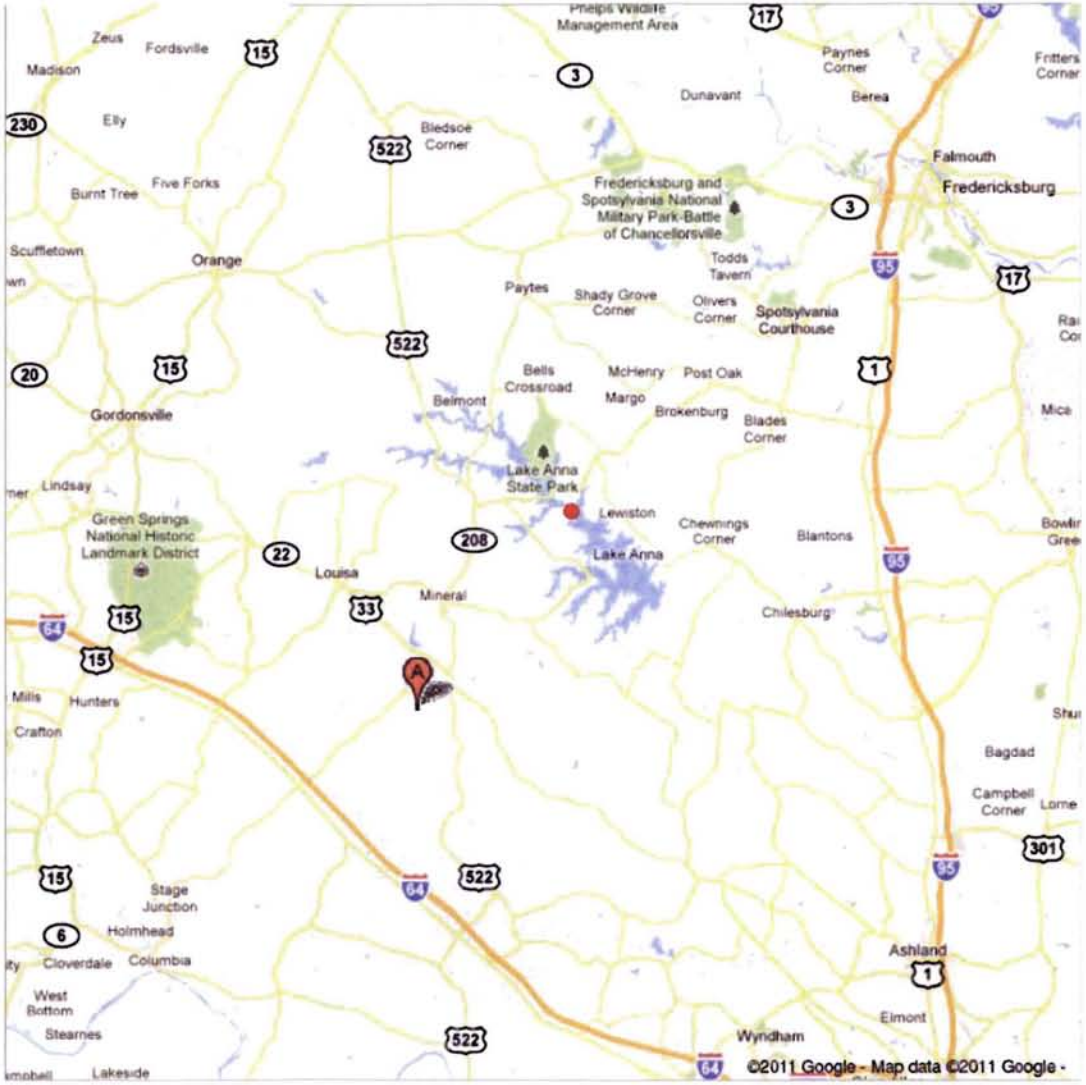
Overview of Event

Fred Mladen
Director, Station Nuclear Safety and Licensing

Overview of Event

Quake Epicenter

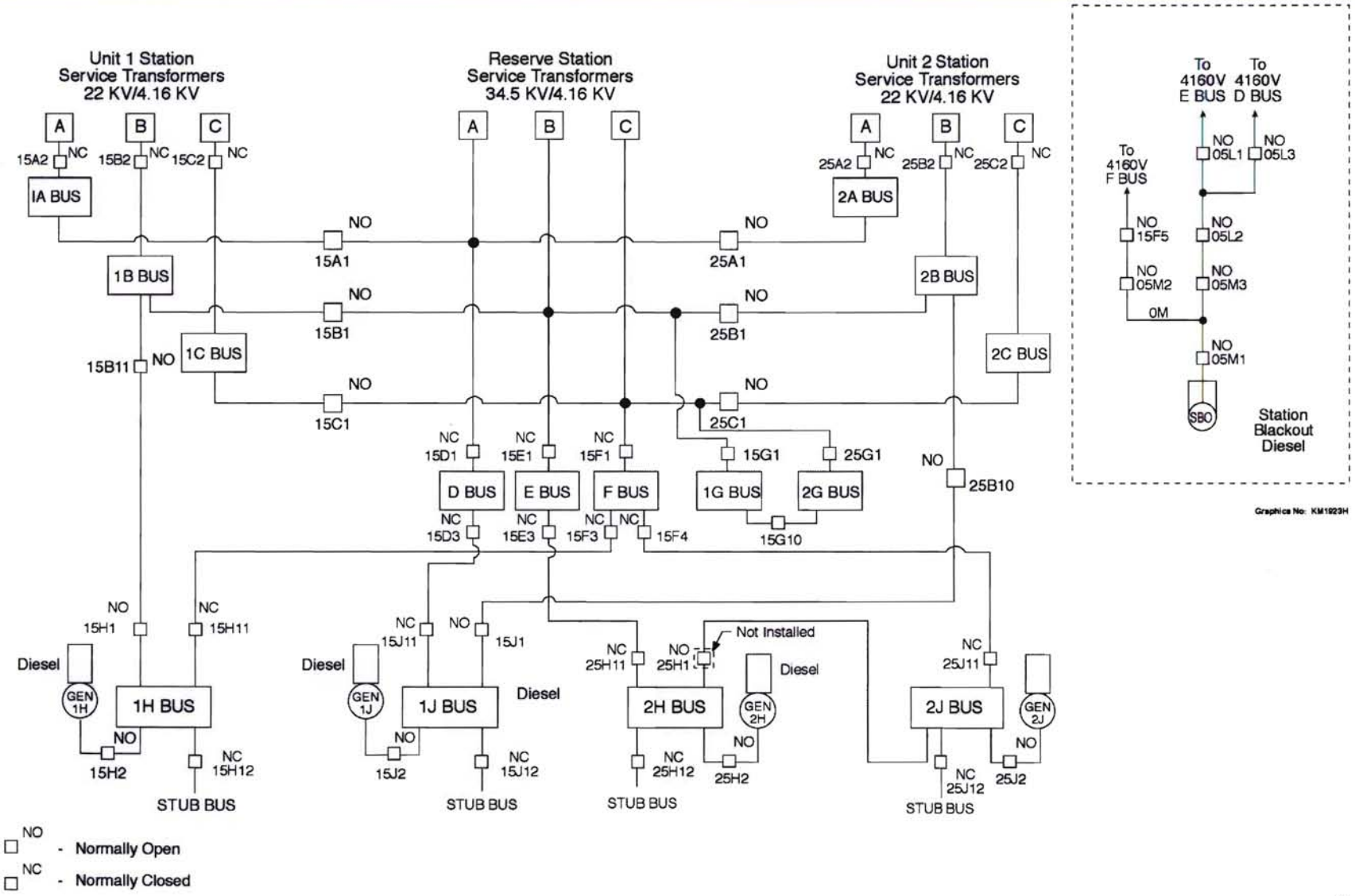
(~Eleven miles southwest of North Anna Power Station)



Sequence of Events

08/23/11	Both units at 100% power; U1 Turbine Driven AFW pump removed from service for scheduled surveillance test
13:51:00	Magnitude 5.8 earthquake with epicenter near Mineral, Va.
13:51:11	Reactor Trip Breakers open on negative flux rate trip (Both Units Mode 3)
13:51:12	Transformers 1-EP-MT-1A, 2-EP-MT-1A,1B, 1C, all RSSTs, 1-EP-SST-1C and Switchyard Transformer #2 tripped due to sudden pressure relay actuations (Loss of offsite power)
13:51:20	All four EDGs auto start and energize their respective emergency buses

North Anna Electrical Distribution System



Sequence of Events

14:03	ALERT declared Tab HA6.1, Shift Manager judgment
14:19	1-FW-P-2 available (flowing to "A" S/G)
14:40	2H EDG manually tripped on coolant leak 2H Emergency Bus de-energized
14:55	ALERT declared Tab SA1.1 U2 AC capability reduced to a single source (2J EDG)
15:18	2H Emergency Bus re-energized by the Station Blackout (SBO) Diesel

Sequence of Events

17:23	Energized C RSST and F transfer bus
17:40	2J emergency bus transferred to C RSST
17:48	1H energized from F transfer bus, securing 1H EDG
20:03	B RSST energized
20:17	A RSST energized
22:58	Offsite power supplying Emergency Busses, 3 EDGs and SBO diesel in 'Auto' and available

Sequence of Events

8/24/11

08:51 Commenced Unit 1 cooldown

11:16 Downgrade to NOUE under Tab HU1.1

13:15 NOUE terminated

13:34 Unit 1 in Mode 4, Hot Shutdown

21:26 Unit 1 in Mode 5, Cold Shutdown

Sequence of Events

8/25/11

01:08 NOUE declared under Tab HU1.1(aftershock)

11:37 Commenced Unit 2 cooldown

16:22 Unit 2 in Mode 4, Hot Shutdown

8/26/11

14:05 NRC notification EP criteria seismic activity >OBE met but not declared (EAL HA6.1 versus HA1.1)

16:23 NRC notification of potential unanalyzed condition (DBE above 5 Hz)

20:38 Unit 2 in Mode 5, Cold Shutdown

Sequence of Events

8/28/11

15:36 NOUE terminated

9/1/11

05:18 NOUE Declared, tab HU1.1 (aftershock)

12:23 NOUE terminated

U2 Turbine Building

Powdex Demineralizer Tanks

(Non-safety Related)

U2 Turbine Building

Powdex Demineralizer Tanks Base Pedestal

(Non-safety Related)

Unit 1 Containment Seal Table Room (Interior Wall)

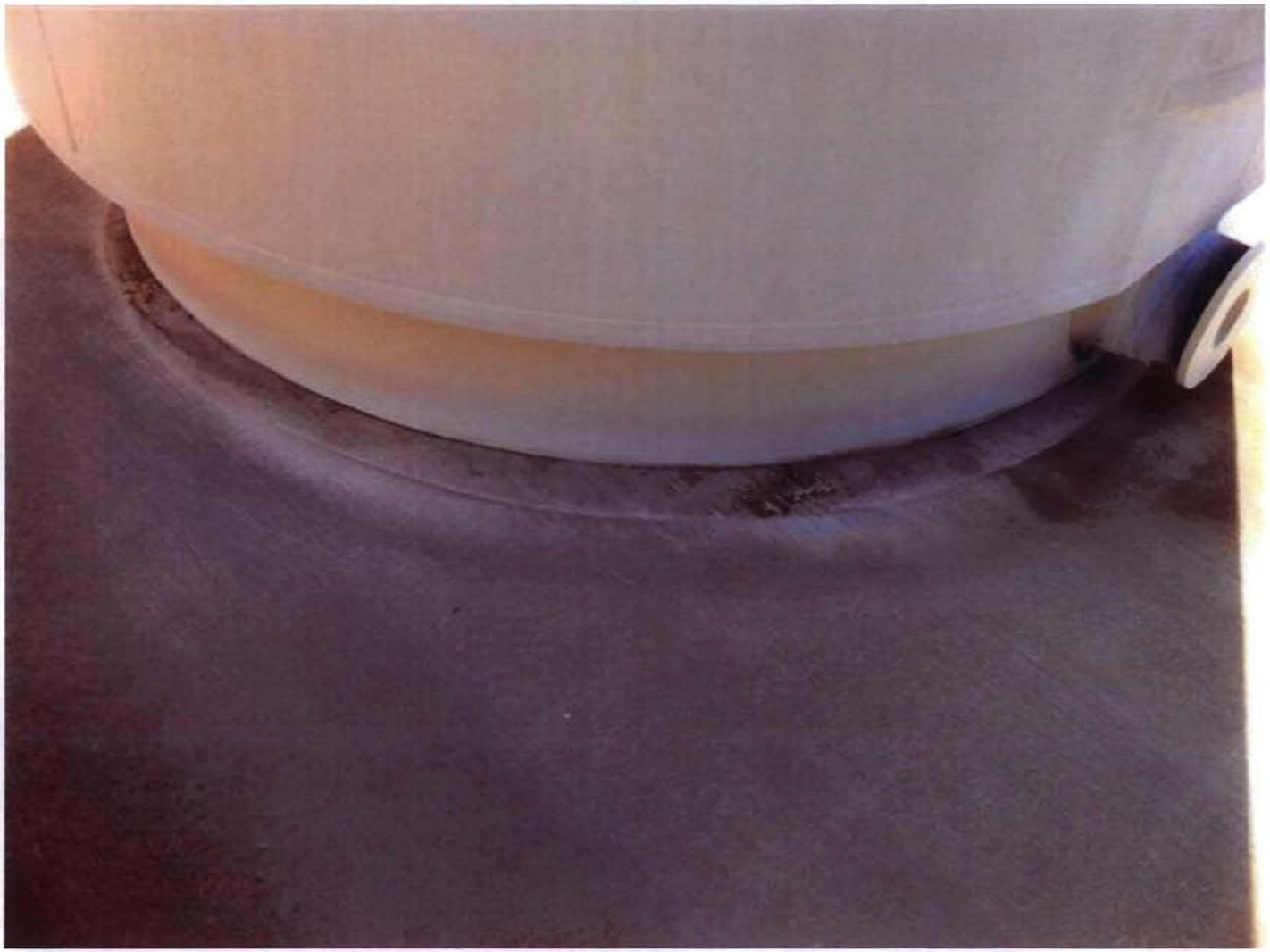
Unit 1 Containment Seal Table Room – Excavated Section

Dry Cask Storage Pad No.1

- 25 of 27 TN-32 casks shifted during earthquake
- Largest shift was 4.5″ on TN-32.21
- No alarms were received, alarm panel test sat
- Radiological conditions were normal
- 6 pairs of casks <16′ center to center
- Confirmed all cask heat loads <27.1 KW, therefore, minimum 16′ spacing requirement not applicable
- Evaluating possible cask movement following aftershocks

Dry Cask Storage Pad No. 1

TN-32.21 Cask Movement



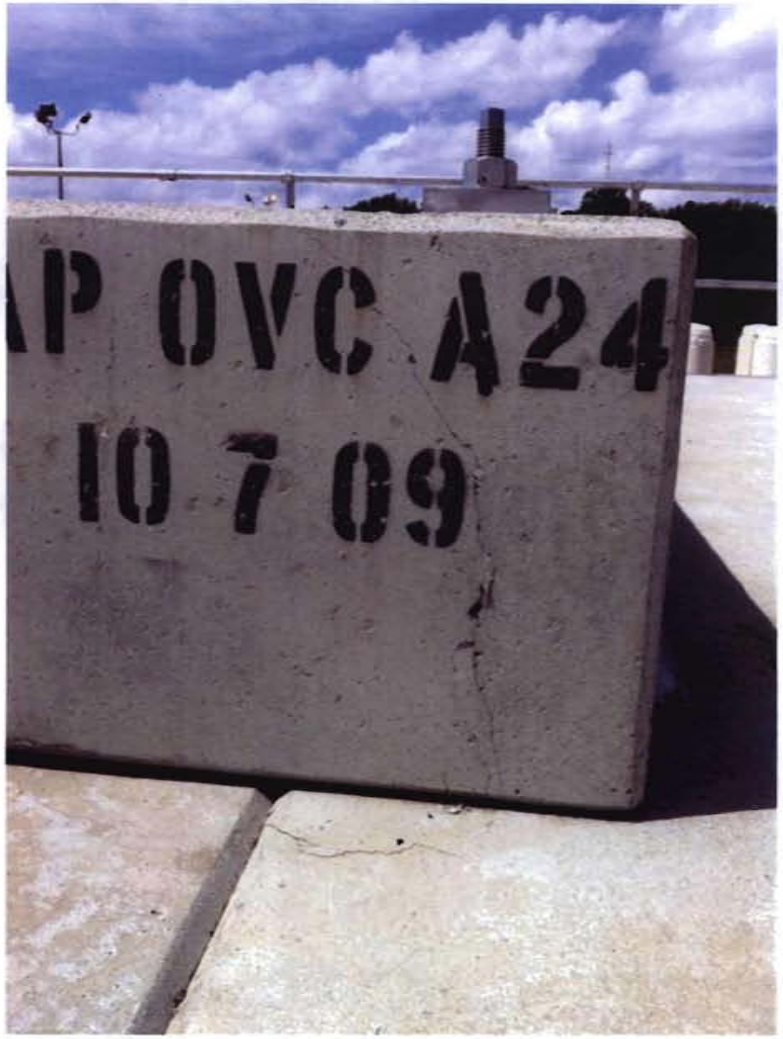
Dominion Dry Cask Storage Pad No. 2

- NUHOMS Horizontal Storage Module
  - Gaps noted
  - Limited concrete damage (non-structural)
- HSMs were intact and capable of performing their intended function
- Radiological conditions were normal

Dry Cask Storage Pad No. 2

NUHOMS HSM

NUHOMS HSM



Roof Vents

NUHOMS HSM Roof Vent Screen

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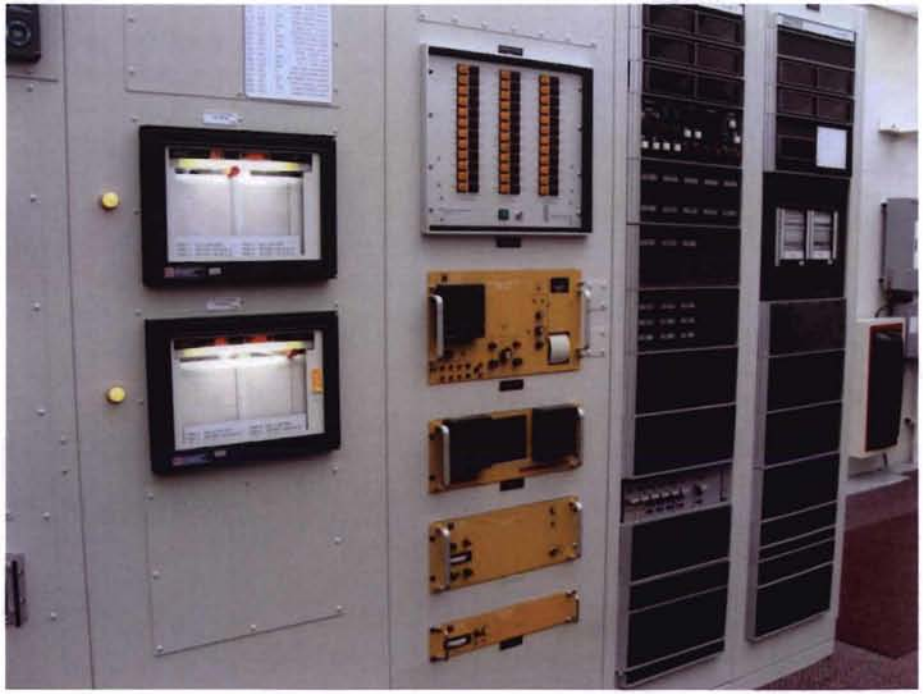
Seismic Results

Eric Hendrixson
Director, Nuclear Engineering

Plant Seismic Instrumentation

- The station has two separate recording systems, an active system (provided by Kinemetrics Inc.) and a primarily passive system (provided by Engdahl)
- Both systems provide input to the Main Control Room (MCR) via a common instrumentation panel

MCR Seismic Instrumentation Panel



Plant Seismic Instrumentation

- Kinemetrics
  - Triaxial Seismic Trigger
  - Triaxial Seismic Switch
  - Triaxial Time History Accelerograph
- Engdahl
  - Triaxial Response Spectrum Recorder
  - Triaxial Peak Accelerograph

Plant Seismic Instrumentation (Kinemetrics - Active)

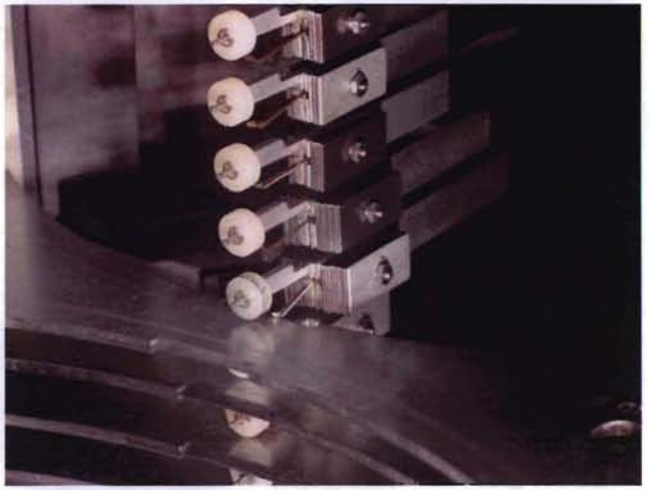
Sensor Type	Location/Elevation	Equipment Mounting
Triaxial Time History Accelerograph	Unit 1 Containment 216'	U1 Containment Mat
Triaxial Seismic Trigger	Unit 1 Containment 216'	U1 Containment Mat
Triaxial Seismic Switch	Unit 1 Containment 216'	U1 Containment Mat
Triaxial Time History Accelerograph	Unit 1 Containment 291'	U1 Containment Operating Deck

Plant Seismic Instrumentation (Engdahl - Passive)

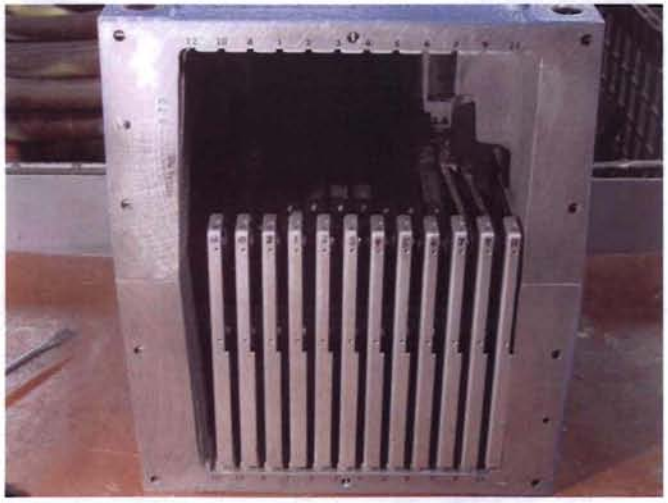
Sensor Type	Location/Elevation	Equipment Mounting
Triaxial Response Spectrum Recorder	Unit 1 Containment 216'	Unit 1 Containment Mat
Triaxial Response Spectrum Recorder	Unit 1 Containment 231'	Unit 1 Residual Heat Removal (RHR) pump and heat exchanger area
Triaxial Response Spectrum Recorder	Aux Building 244'	In between Unit 1 and Unit 2 Component Cooling (CC) pumps
Triaxial Response Spectrum Recorder	Aux Building 274'	Near Unit 1 "A" CC heat exchanger
Triaxial Peak Accelerograph	Unit 1 Containment 218'	On Unit 1 "C" Safety Injection Accumulator discharge piping
Triaxial Peak Accelerograph	Unit 1 Containment 241'	On Unit 1 "B" RHR heat exchanger
Triaxial Peak Accelerograph	Aux Building 279'	On Unit 1 "A" CC heat exchanger,

Triaxial Response Spectrum Recorder

Triaxial Response Spectrum Recorder



Recorder Scratch Plates Styluses

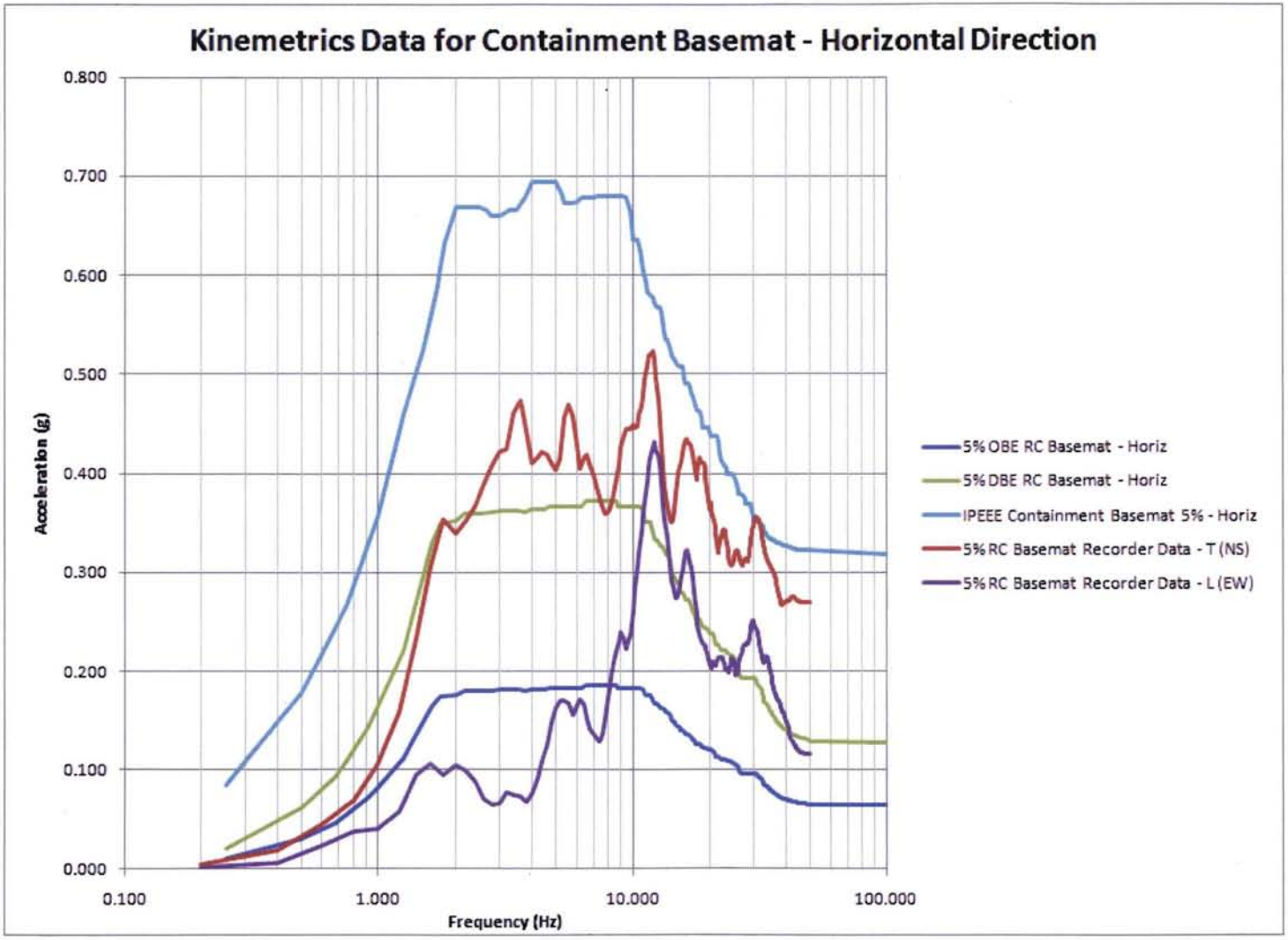


Recorder Scratch Plates

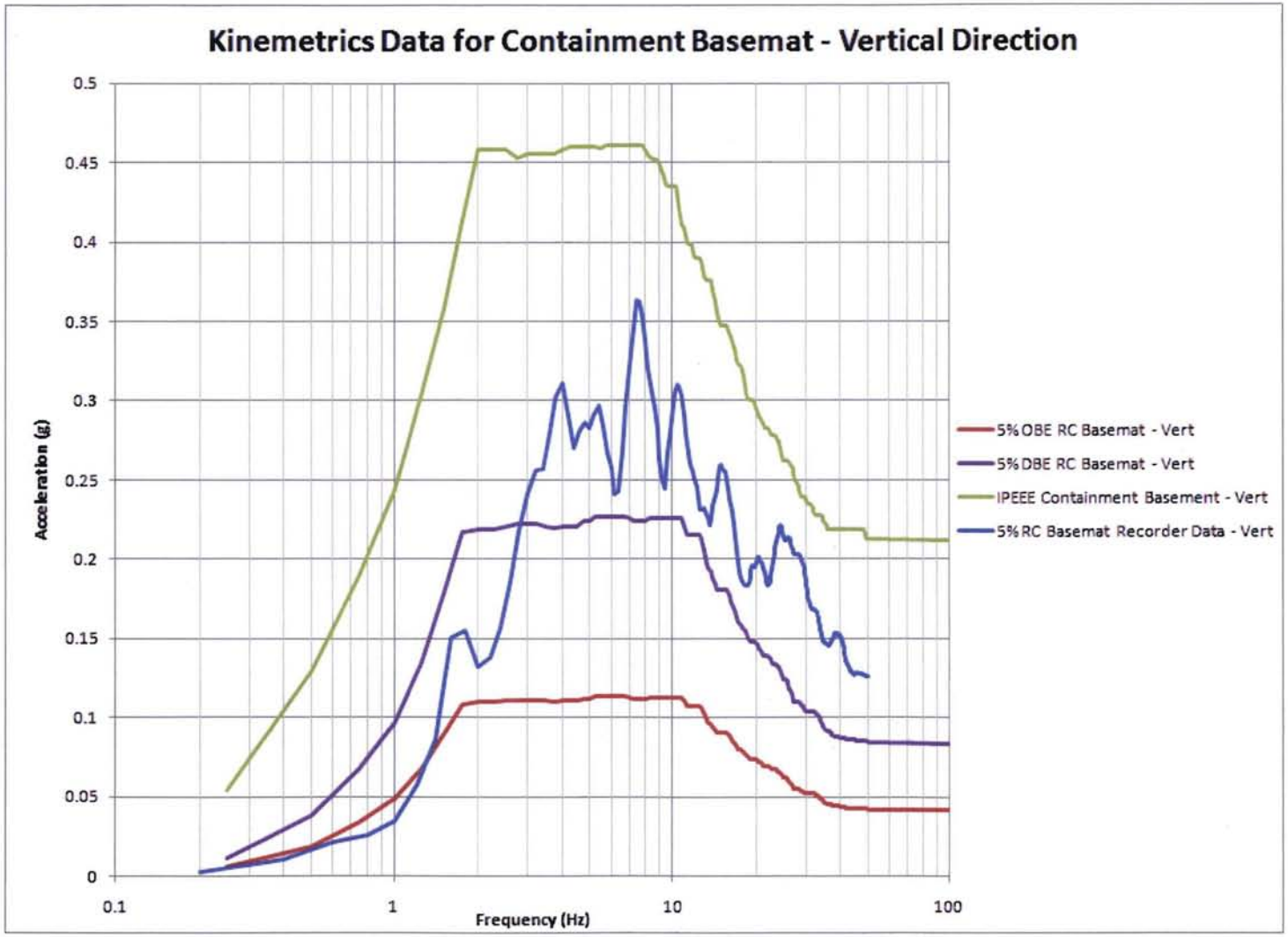
North Anna Design Basis Seismic Criteria (Station and ISFSI)

	Horizontal Peak Ground Acceleration (g) Rock	Vertical Peak Ground Acceleration (g) Rock	Horizontal Peak Ground Acceleration (g) Soil	Vertical Peak Ground Acceleration (g) Soil
OBE	0.06	0.04	0.09	0.06
DBE	0.12	0.08	0.18	0.12

Comparison of Kinemetrics Data – Horizontal Direction



Comparison of Kinemetrics Data – Vertical Direction



Cumulative Absolute Velocity (CAV)

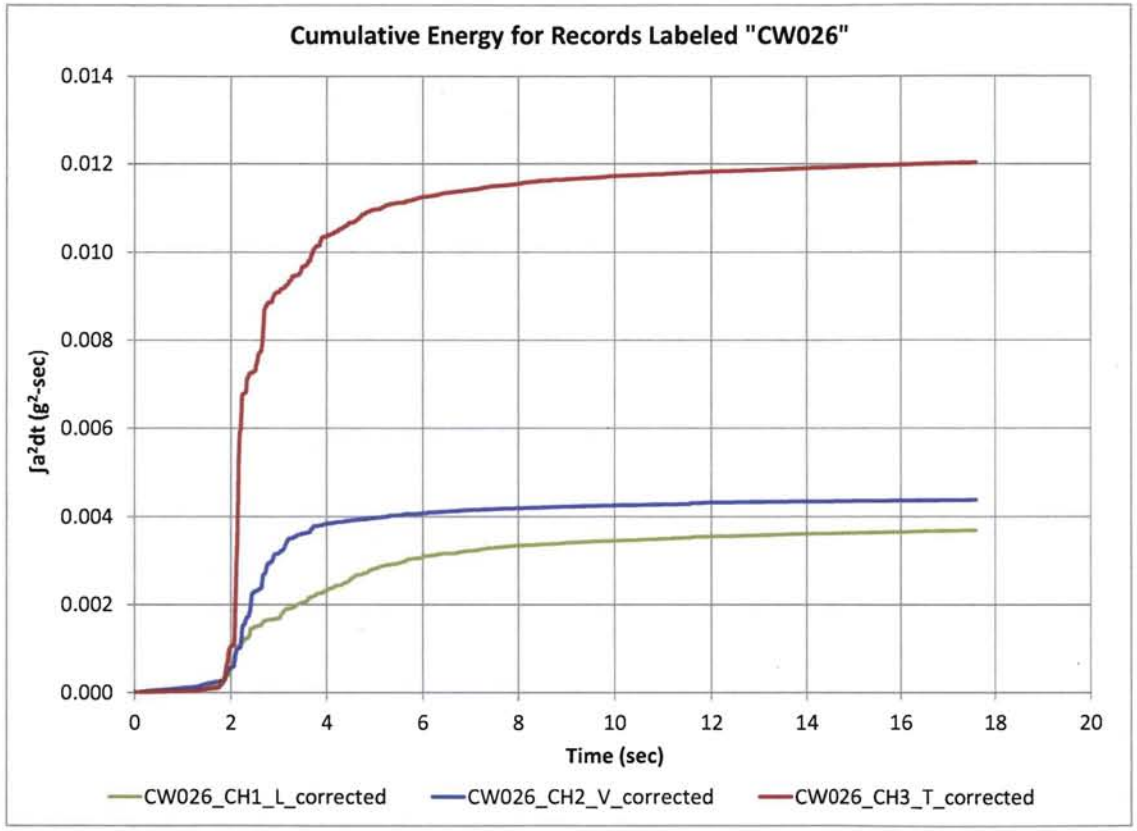
- Concept used by EPRI to address OBE Exceedance in 1988 (EPRI NP-5930)
- Indicator of damage based on analysis of 263 time-histories from 42 earthquakes
- OBE Exceedance criterion is CAV <0.16 g-sec (EPRI TR-100082 and RG 1.166)
- Criterion is conservative and has a minimum factor of three

Plant Seismic Response Results

	East-West (g-sec)	North-South (g-sec)	Vertical (g-sec)
Kinemetrics	0.137	0.175	0.118
SGH	0.118	0.169	0.105
Bechtel	0.134	0.181	0.113
Average	**0.130**	**0.175**	**0.112**

(CAV limit = 0.16 g-sec, per NRC RG 1.166)

Husid Function Plot – Representation of Cumulative Energy



Cumulative Energy (HUSID Plot) for the Containment Basemat Records

Effective Strong Motion Duration for Records Labeled "CW026"

Time History	Effective Strong Motion Duration (sec)
CW026_CH1_L_corrected	3.1
CW026_CH2_V_corrected	1.5
CW026_CH3_T_corrected	1.0

Seismic Margin

As part of response to GL 88-20 (IPEEE) and GL 87-02 (USI-A46), the following actions were completed:

- Extensive inspections of 1800 safe shutdown components assuming an earthquake peak acceleration of 0.3g for IPEEE
- With few exceptions, components evaluated could withstand 0.3g or higher
- Worst case capacity of 0.16g, which exceeds 0.12g DBE
- Modifications provided additional seismic ruggedness
- Comprehensive peer review walkdown of 20% sample

Consequently, safe shutdown components are capable of surviving seismic accelerations in excess of the DBE design criteria

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Restart Readiness Demonstration Plan

North Anna UFSAR – Section 3.7.4.6

Use of Data from Seismic Instrumentation - In accordance with paragraph V(a) of Appendix A to 10 CFR 100, an orderly and sequential shutdown of the North Anna units will be carried out according to detailed written station procedures if a seismic event with vibratory ground motion equal to or exceeding that of the operational-basis earthquake occurs. **Prior to resuming operations, it will be demonstrated to the NRC that no functional damage has occurred to those features necessary for continued operation without undue risk to the health and safety of the public, or that the necessary repairs to those features have been completed.** *[emphasis added]*

Restart Readiness Demonstration Plan

Based on exceeding the station OBE and DBE seismic criteria and the CAV limit, the station restart readiness assessment actions were based on the guidance contained in the following documents:

- RG 1.166, *Pre-earthquake Planning and Immediate Nuclear Power Plant Operator Post-earthquake Actions,* dated March 1997
- RG 1.167, *Restart of a Nuclear Power Plant Shut Down by a Seismic Event,* dated March 1997
- EPRI NP-6695, *Guidelines for Nuclear Plant response to an Earthquake,* dated December 1989

EPRI NP-6695 Figure 3-1

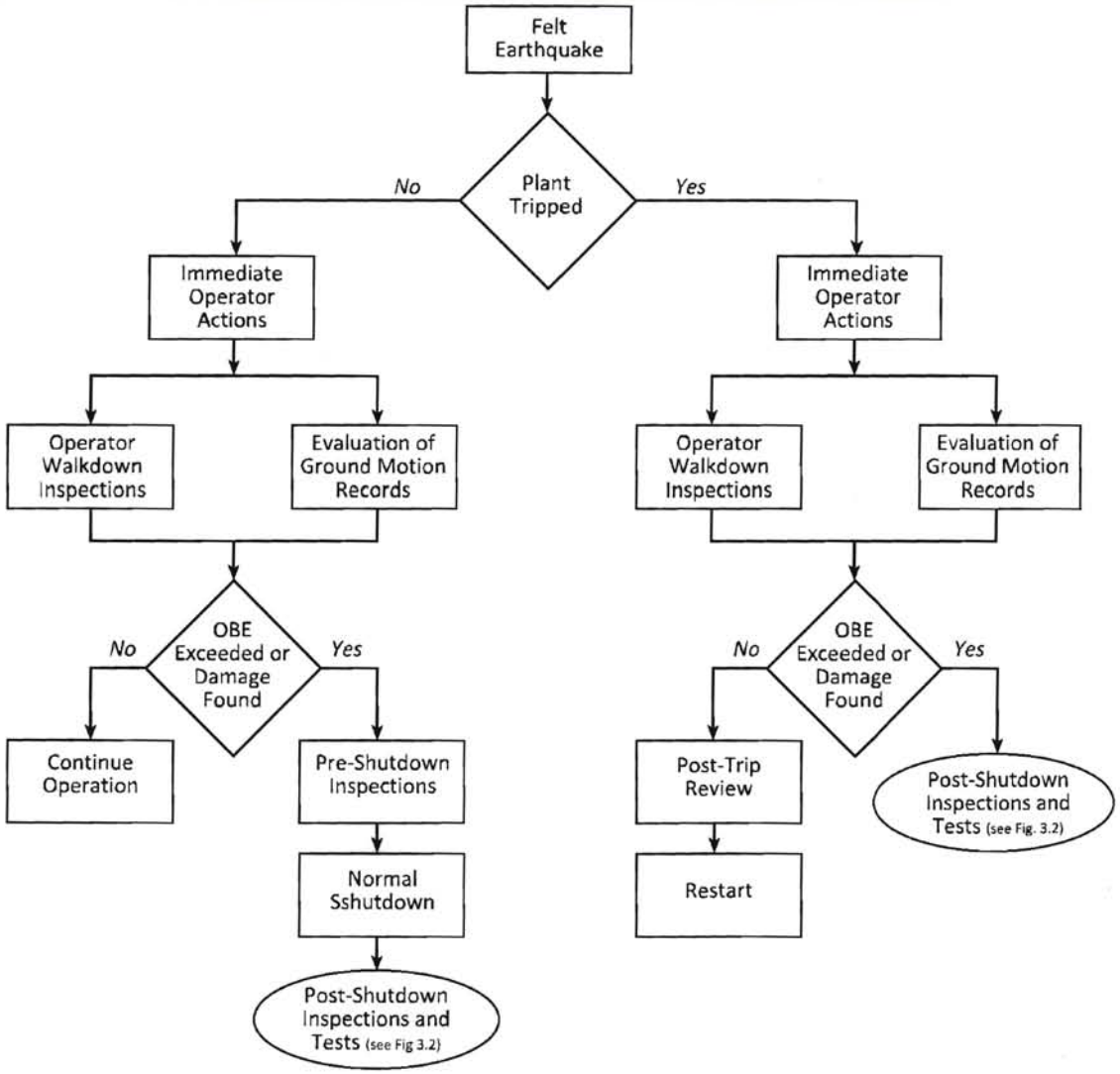

Figure 3-1. Flow Diagram of Short-Term Actions

EPRI NP-6695 Figure 3-2

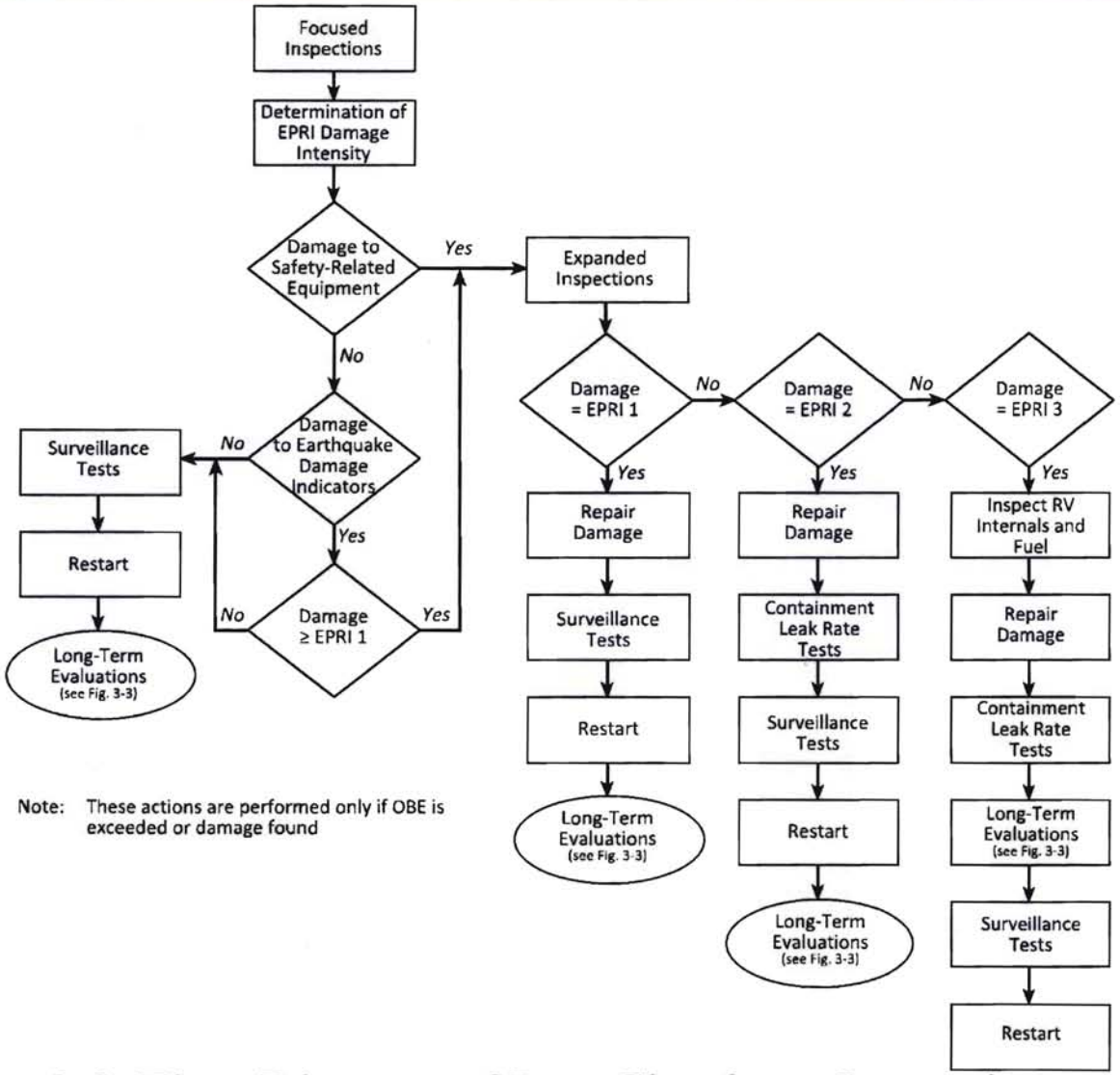

Figure 3-2. Flow Diagram of Post-Shutdown Inspections and Tests

EPRI NP-6695 Figure 3-2

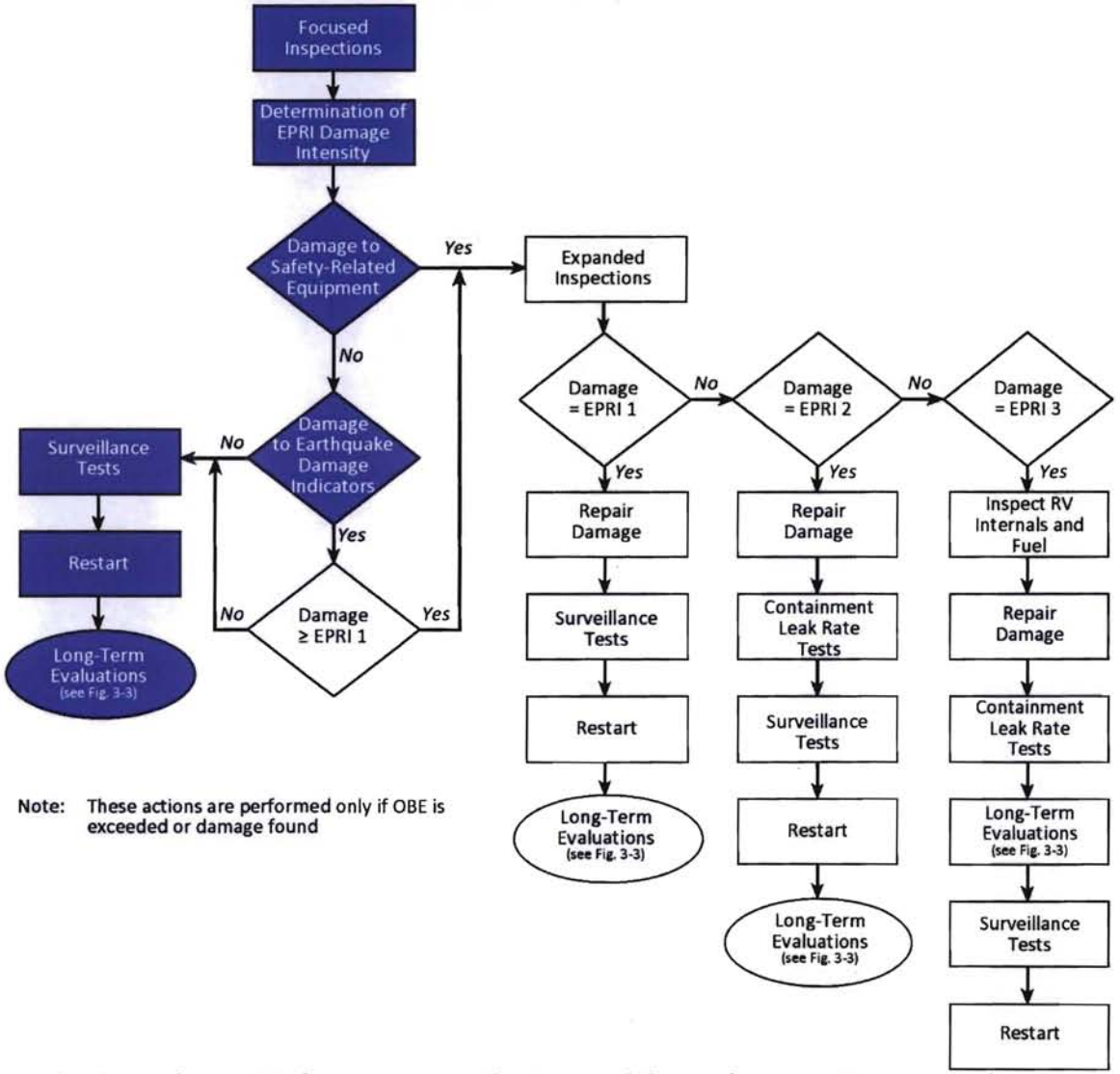

Figure 3-2. Flow Diagram of Post-Shutdown Inspections and Tests

EPRI NP-6695 Figure 3-2

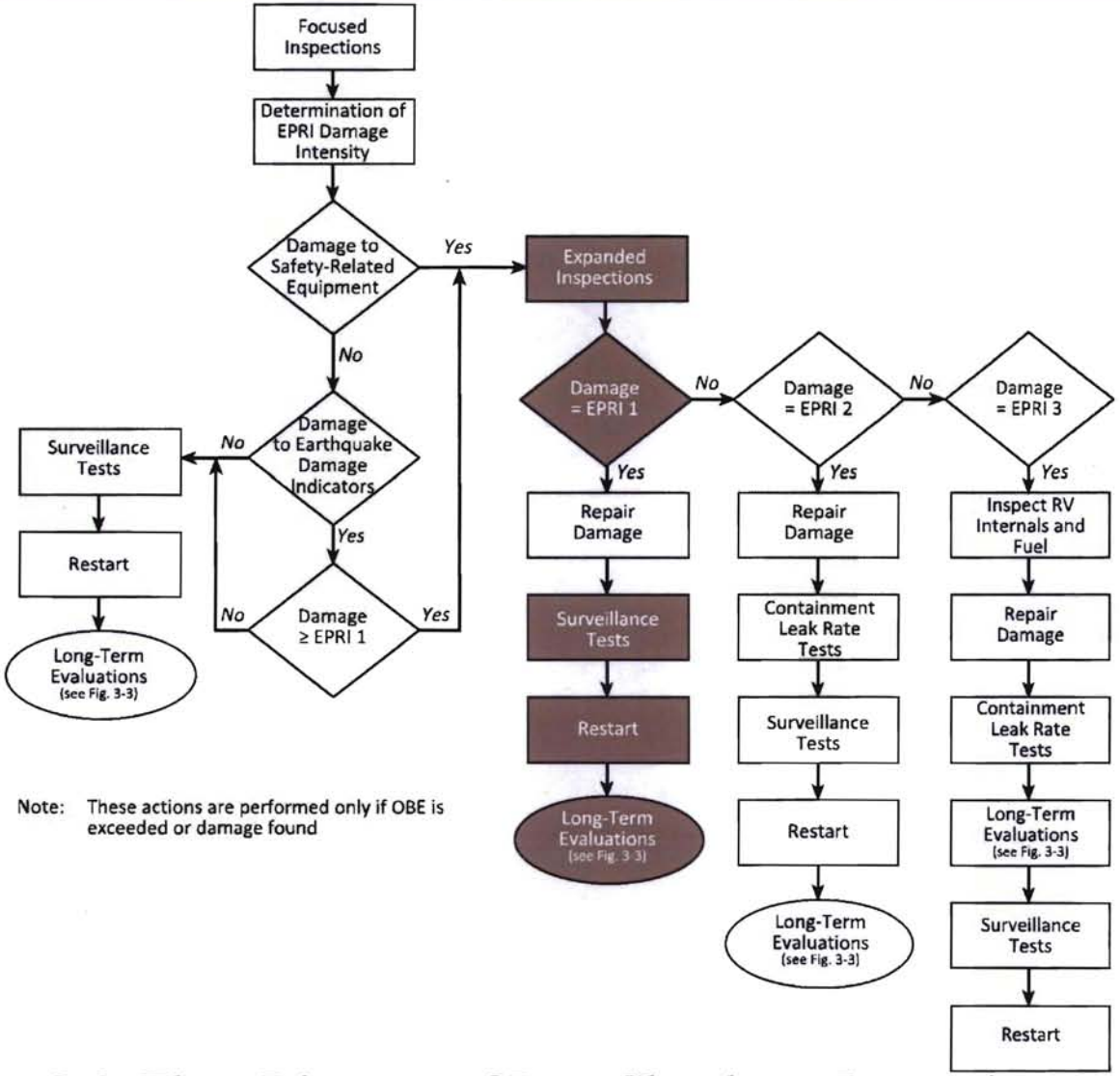

Figure 3-2. Flow Diagram of Post-Shutdown Inspections and Tests

Restart Readiness Demonstration Plan

- Seismic Data Collection and Analysis
- Damage Assessment and Evaluation
- Restart Assessment
- Long-Term Actions

Seismic Data Collection and Analysis

- Perform data collection/analysis of earthquake seismic data to quantitatively define earthquake magnitude - **Complete**
- Compare results with the station design basis OBE and DBE criteria to determine if they were exceeded - **Complete**
- Obtain 3rd party peer reviews of analysis by industry experts

Damage Assessment and Evaluation

- Perform post-earthquake walkdowns/inspections of plant structures, systems and components (SSCs) consistent with regulatory and industry guidance (includes North Anna Spillway dam and SG tube inspections)
- Perform comprehensive surveillance testing to validate SSC operability/performance
- Perform comprehensive inspections and evaluations of ISFSI pads and casks
- Perform evaluations of reactor vessel internals and fuel in the core, Spent Fuel Pool and New Fuel Storage Area
- Complete Root Cause Evaluation of reactor trip
- Document assessments/evaluations in appropriate engineering technical evaluations

Restart Assessment

- Complete inspections, evaluations, testing and repair, if necessary, of SSCs to ensure they are capable of performing their intended design functions
- Finalize and obtain FSRC review and approval of Engineering technical documents demonstrating SSC restart readiness
- Review and disposition open Condition Reports, as necessary, to ensure that no outstanding issues exist that would preclude restart

Long-Term Actions

- Installation of free-field seismic instrumentation
- Permanently re-power Seismic Monitoring Panel in MCR from an Uninterruptible Power Supply
- Coordinate update of the station seismic design and licensing bases with ongoing GI-199 resolution effort

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Results to Date

Mark Walker
Manager, Nuclear Site Engineering

Results to Date

Although evaluations are continuing, to date, SSCs inspections have only identified superficial damage and Surveillance Tests have not identified any safety-related SSC operability issues related to the seismic event

- Inspector Training and Inspection Process
- Inspection results indicate North Anna in the "0" category of the EPRI Damage Intensity Scale
- As of 9/7/11
  - 82% of 134 system inspections completed
  - 97% of 141 structure inspections completed
  - 28% of 448 Surveillance Tests completed (Unit 1)
  - 20% of 50 High Confidence Low Probability of Failure (HCLPF) component SQUG inspections completed

Dominion

Restart Schedule

N. Larry Lane
Site Vice President – North Anna Power Station

NAPS U1 Restart Timeline

09/07	Facility Safety Review Committee (FSRC) approval of Safe Shutdown System Operability Determination
09/16	Engineering Final Technical Evaluation review by FSRC
09/18-20	Comprehensive ESF functional testing complete
	Comprehensive post-event testing and inspections complete
	Start-up Assessment by FSRC
09/22	Containment close-out complete and unit ready to enter Mode 4

NAPS U2 Planned Refueling Restart Timeline

09/07	FSRC approval of the Safe Shutdown System OD
09/12	FSRC approval of the Mode 6 System OD
09/12-15	Reactor Disassembly- Inspections
09/15-17	Reactor Core Off-load to the SFP
09/16	Secondary activities complete
	Engineering Final Technical Evaluation review by FSRC
09/17-30	Defueled Primary Maintenance
10/01-02	Reactor Core Reload
10/02-06	Reactor Reassembly
10/06-13	Comprehensive ESF functional testing complete
	Comprehensive post-event testing and inspections complete
	Containment close-out complete
	Start-up Assessment by FSRC
10/13	Ready for Mode 4

Dominion

Summary

Gene Grecheck
Vice President, Nuclear Development

Summary

- OBE and DBE criteria were exceeded; however, CAV calculations indicate that significant damage would not be expected
- Extensive actions are underway to inspect, evaluate, test and repair, if necessary, SSCs to ensure they are capable of performing their required design basis functions - Results are confirming the CAV expectations
- To date, no safety related SSCs have been identified that require repair
- IPEEE and USI-A46 results demonstrate that safe shutdown SSCs are capable of withstanding peak accelerations in excess of DBE
- Unit will be ready for restart when we establish confidence that SSCs will perform as designed
- Long-term actions are planned to improve plant seismic monitoring capability and to re-evaluate plant OBE and DBE criteria in conjunction with resolution of GI-199

Dominion

Questions?

List of Acronyms

AC	Alternating Current
AFW	Auxiliary Feedwater
DBE	Design Basis Earthquake
EAL	Emergency Action Level
EDG	Emergency Diesel Generator
EP	Electric Power or Emergency Plan
EPRI	Electric Power Research Institute
ESF	Engineered Safety Features
FSRC	Facility Safety Review Committee
FW	Feedwater
GI	Generic Issue
HSM	Horizontal Storage Module
IPEEE	Individual Plant Examination External Events
KW	Kilowatts
MT	Main Transformer
NRC	Nuclear Regulatory Commission
NOUE	Notification of Unusual Event
NUHOMS	Nuclear Horizontal Modular Storage System
OBE	Operating Basis Earthquake
OD	Operability Determination
P	Pump
RSST	Reserve Station Service Transformer
SBO	Station Blackout
SGH	Simpson Gumpertz & Heger
SFP	Spent Fuel Pool
SSC	Systems, Structures and Components
SST	Station Service Transformer
TN	Transnuclear
U1	Unit 1
U2	Unit 2
USI	Unresolved Safety Issue