VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

October 10, 2011

10 CFR 100, Appendix A

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Serial No.:	11-577
NL&OS/GDM	R2
Docket Nos.:	50-338 50-339
License Nos.:	NPF-4 NPF-7

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
NORTH ANNA POWER STATION UNITS 1 AND 2
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
RESTART READINESS DETERMINATION PLAN

By letters dated September 26, 28, and 30 and October 6, 2011, the NRC requested additional information (RAI) regarding Dominion's Restart Readiness Determination Plan for North Anna Power Station following the August 23, 2011 Central Virginia earthquake. By letters dated September 27, 2011 (Serial Nos. 11-520A and 11-544) and October 3, 2011 (Serial Nos. 11-544A and 11-566), Dominion responded to several of the RAI questions provided by the NRC technical review branches. However, the responses to a number of RAI questions were being developed and were therefore not included in the previous responses. As a result, Dominion is providing its responses to several of the remaining questions in the enclosure to this letter. The specific technical review areas and the associated questions being answered are provided below for reference:

Engineering Mechanics and Civil (Piping)	Questions 2 - 6
License Renewal	Question 1
Engineering Mechanics and Civil	Questions 1, 2, 4 - 9, 11, 18, 25, 28 - 31

Dominion's response to the remaining unanswered RAI questions will be provided in subsequent correspondence.

A001
NRR

If you have any questions or require additional information, please contact Mr. Gary D. Miller at (804) 273-2771 or Mr. Thomas Shaub at (804) 273-2763.

Sincerely,

E. S. Grecheck
Vice President – Nuclear Development

Enclosure:

Response to Request for Additional Information – North Anna Restart Readiness Determination Plan

There are no commitments made in this letter.

COMMONWEALTH OF VIRGINIA)

COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by E. S. Grecheck who is Vice President – Nuclear Development, of Virginia Electric and Power Company. He has affirmed before me that he is duly authorized to execute and file the foregoing document in behalf of that Company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 10th day of October, 2011.

My Commission Expires: 4/30/2015.

Ginger Lynn Rutherford
NOTARY PUBLIC
Commonwealth of Virginia
Reg. # 310847
My Commission Expires 4/30/2015

Notary Public

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Enclosure

**Response to Request for Additional Information
North Anna Restart Readiness Determination Plan**

**Virginia Electric and Power Company
(Dominion)
North Anna Power Station Units 1 and 2**

Response to NRC Request for Additional Information
Restart Readiness Determination Plan
North Anna Power Station Units 1 and 2

Background

By letters dated September 26, 28, and 30, and October 6, 2011, the NRC requested additional information (RAI) regarding Dominion's Restart Readiness Determination Plan for North Anna Power Station following the August 23, 2011 Central Virginia earthquake. By letters dated September 27, 2011 (Serial No. 11-544) and October 3, 2011 (Serial Nos. 11-544A and 11-566), Dominion provided responses to several of the RAI questions provided by the NRC technical review branches. However, the responses to a number of the RAI questions were still being developed and were therefore not included in the previous responses. As a result, Dominion is providing responses to several of the remaining questions below, as well as by letter dated October 10, 2011 (Serial No. 11-566A).

NRC Request for Information

PIPING

The information requested below is focused on the scope of the licensee's assessment of the existing pipe stress analyses and inspection of the piping and associated support systems, including inspection/evaluation methods, acceptance criteria, results, and corrective actions. The intent of the questions is to determine whether the American Society of Mechanical Engineers (ASME) Class 1, 2, and 3 piping systems and any nonsafety-related systems that connect to safety-related systems satisfy the design basis so as to demonstrate that their structural integrity is maintained after the recent earthquake.

2. *Discuss the piping systems that have and have not been inspected, the inspection technique and its effectiveness, specific piping components examined (e.g., welds, nozzles, flanges, attachment lugs, and couplings), whether the pipe insulation is removed prior to inspection, how the structural integrity can be verified for the inaccessible (to inspection) portion of the pipe, acceptance criteria, inspection results, and corrective actions.*

Dominion Response

Comprehensive inspections of both non-safety related and safety related plant piping systems were performed on over eighty (80) systems for Unit 1 (which includes common systems) and over fifty (50) systems for Unit 2. These inspections were performed in accordance with station procedure 0-GEP-30, "Post Seismic Event System Engineering Walkdown," which was developed using the guidance provided in EPRI NP-6695, "Guidelines for Nuclear Plant Response to an Earthquake." Inspection results were documented in procedure inspection logs, and discrepancies were entered into the Corrective Action System. The inspections were performed by qualified engineering personnel trained on identifying seismic related damage. The inspections did not identify any physical or functional damage to the piping systems as a result of the August 23, 2011 earthquake that would render them incapable of performing their design functions.

While not specifically identified in the inspection procedure, piping system inspections encompassed pipe welds, nozzles, flanges, attachment lugs, couplings, etc. In addition, inspection procedure 0-GEP-30 includes the following specific guidance for performing piping inspections:

Piping-

- Check for snubber damage; i.e., snubbers pulled loose from foundation bolts, leakage of hydraulic fluid and bent piston rods
- Check for damage at rigid supports; i.e., deformation of support structure, deformation of pipe due to impact to support structure
- Check for damage of expansion joints
- Check for damage or leakage of piping and branch lines
- Check for damage to pipe at building joints and interfaces between buildings

Inaccessible and insulated portions of piping systems were dispositioned based on inspections of associated system components that resulted in no significant damage attributable to the recent seismic event and / or other piping in the same building or structure with similar supports that was inspected with satisfactory results.

3. *In Enclosure 2 to the licensee's submittal dated September 17, 2011, the licensee stated that buried piping system pressure tests are being (or have been) performed on the buried portions of quench spray, recirculation spray, and service water system piping. Discuss the details of the system pressure tests for safety-related buried piping (e.g., pressure used, hold time on the pressure, how leakage would be observed, and the length of pipe that is being pressure tested), acceptance criteria and results. The system pressure test can demonstrate whether a pipe is leaking, but will not be able to determine whether cracks have been initiated by the earthquake. Discuss the likelihood of crack initiation due to the earthquake. Justify how a system pressure test will ensure the structural integrity of the buried pipes without nondestructive examinations. For those safety-related buried pipes that have not and will not be tested, discuss how their structural integrity can be ensured.*

Dominion Response

The following is a summary of the post-earthquake buried pipe testing and inspections that have been performed following the August 23, 2011 earthquake:

Testing

- Quench Spray (QS), Recirculation Spray (RS) and Safety Injection (SI) Systems

The two Periodic Tests (PTs) listed below were used to perform pressure drop tests using the head of the Refueling Water Storage Tanks (RWST) or Casing Cooling Tanks as the test pressure.

- o 1/2-PT-302QS, "RWST and Refueling Water Cooling System Pressure Test" (QS and SI)
- o 1/2-PT-305RS, "Casing Cooling Pump 1-RS-P-3A System Pressure Test" (RS)

RWST/Casing Cooling Tank level was monitored and recorded for a minimum of 8 hours. Any decrease in tank level would be indicative of a piping leak. This method was used in accordance with Section XI, IWA-5244 of the ASME Code. The testing addressed the buried QS, RS and SI piping for both units. The portions of the PTs associated with the pressure drop tests were performed with satisfactory results.

- Service Water (SW) System

The Auxiliary SW buried piping was tested using the unimpaired flow test section of the PTs listed below in accordance with Section XI, IWA-5244 of the ASME Code. These tests were completed with satisfactory results.

- o 1/2-PT-301SW, "Service Water Pump 1-SW-P-4 System Pressure Test"

In addition, Periodic Test 1-PT-302SW, "'A' and 'B' Service Water Supply and Return Headers System Pressure Test," was completed in its entirety with satisfactory results. This test includes the majority of the Service Water system piping, including the section of buried pipe, and satisfies the System Pressure Test program.

Total Buried Pipe Tested

Tested Lengths of Buried Safety Related Pipe (ft)			
System	**Unit 1**	**Unit 2**	**Common**
Service Water System(SW)	1000	450	5200
Quench Spray System(QS)	110	140	
Recirculation Spray System (RS)	160	200	
Safety Injection System(SI)	35	0	

Note: Piping lengths are approximate values

Potential Hidden Damage

Since these tests provide an indication of gross leakage and do not completely address potential hidden damage, industry insights from EPRI research related to the effect of the Niigata Chuetsu-Oki (NCO) earthquake of 2007 on the Kashiwazaki-Kariwa Nuclear Power Station (K-K) in Japan were reviewed. Three areas of concern were identified as potential non-visible damage sources for buried piping: 1) coatings damage, 2) cathodic protection integrity, and 3) fragility of Victaulic couplings. Any damage to coatings would be from significant ground motion relative to the buried piping. Based on the limited damage to any structures, damage to buried pipe coatings is not expected. Buried piping will continue to be monitored in accordance with the NEI buried piping initiative that was previously incorporated into station procedure ER-AA-BPM-101, "Underground Piping and Tank Integrity Program." Cathodic protection is checked frequently (multiple times per year) as part of the preventive maintenance program. Any degradation of the cathodic protection system would be identified well in advance of the development of any long-term piping integrity issues and would be addressed accordingly. North Anna does not currently have Victaulic couplings associated with buried piping, although the Fire Protection (FP) piping contains bell and spigot connections that are also susceptible to significant ground motion that could cause leakage. This is discussed in greater detail below. Additional actions were taken regarding buried piping as well. For example, areas where piping systems penetrate the soil or penetrate building walls into the soil were reviewed during system walkdowns and inspections with no signs of stress on the penetrations or movement of the pipes within the soil. No ground settlement issues or cracks in the soil or roadways were noted around the station.

Excavated Fire Protection (FP) Piping Inspections

The FP piping system has historically been an area of concern for underground piping leaks due to the bell and spigot jointed cast iron construction of the piping. Consequently, it was considered to be the most susceptible piping to seismic conditions. Shortly after the earthquake, two areas of the FP buried piping system that had been excavated for the North Anna Unit 3 site separation activities were inspected for leakage. No leaks or discrepancies were noted. A formal, post-earthquake inspection was completed for one of the fire protection piping areas and compared to the formal buried pipe program inspection that was completed four (4) days prior to the earthquake. The inspection results confirmed that no seismically related damage/leakage resulted from the event. The other excavated area of FP piping was photographed prior to the area being backfilled for protection of the main FP system loop and to allow access through the area for outage activities. The photographs were reviewed and no issues were identified. A third fire protection piping section has since been excavated for site separation activities and was also inspected. No post-earthquake related issues were identified.

A summary of the specific FP system buried piping inspections performed is provided below:

- Direct inspection of the FP system piping going to the Warehouse 5 FP Pump House.

  (Note: This line was previously inspected as part of the Buried Pipe Program on August 19, 2011, and those inspection results were used for comparison. No anomalies associated with the August 23, 2011 earthquake were identified by comparison of the inspection results.)

- Indirect inspection for leakage by review of detailed pictures of the FP main loop near the West Security Gate within a few days following the seismic event. (Excavation area has since been backfilled due to outage activities.)
- Direct inspection of FP piping going to the North Anna Nuclear Information Center.

A picture of excavated FP system piping is provided below.

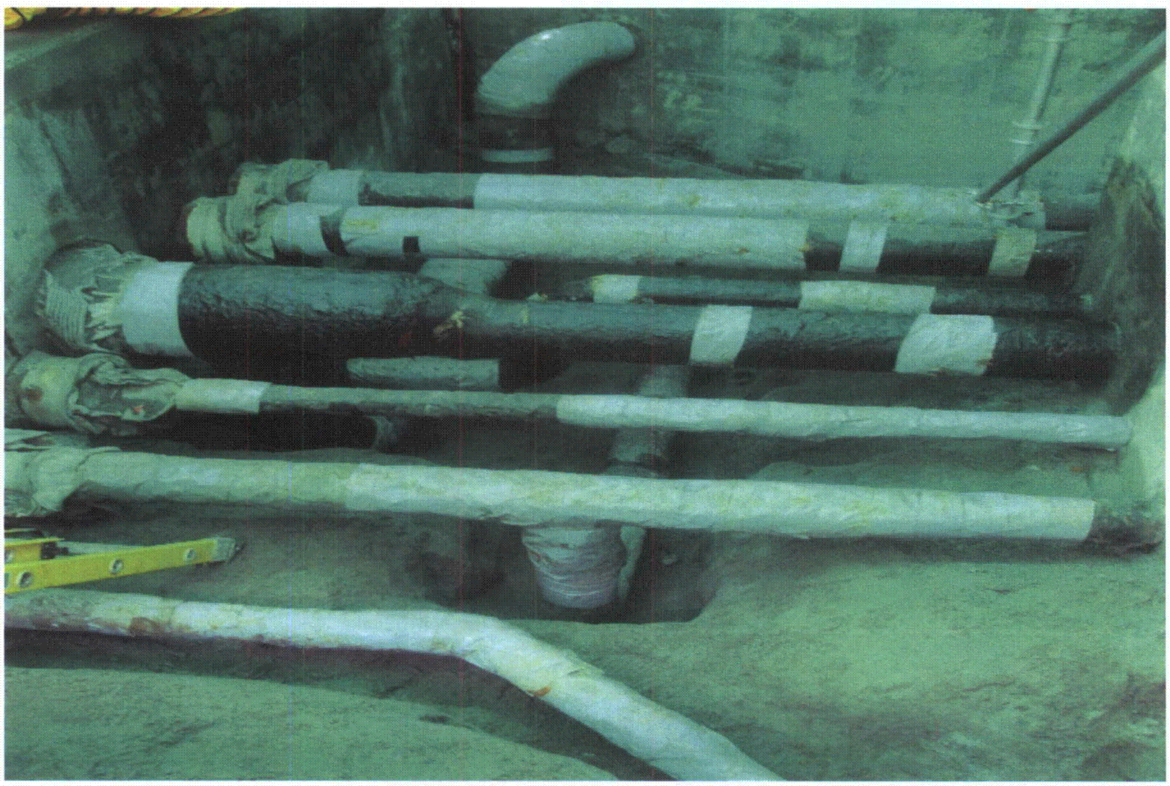
FP Piping to the North Anna Nuclear Information Center
(Pipe in the top right corner is for North Anna 3 Site Separation)

Excavated Unit 1 RWST Piping

Safety related buried piping associated with the Unit 1 RWST was excavated and formally inspected, and no issues were found. Several individual pipes were inspected, including ultrasonic testing (UT) of the pipe wall thickness. Areas where the pipes were anchored through wall penetrations were also examined, and there were no indications of high stress at the penetrations nor were any cracks present. This piping was inspected since it is considered to be high risk consequence piping by the Underground Piping and Tank Integrity Program. Piping inspections included:

- Direct inspection of the Unit 1 Refueling Water Storage Tank (RWST) piping located between the Auxiliary Feedwater tunnel and Quench Spray Pump House (see pictures below). Inspected piping sections included the following systems:
    - Quench Spray piping to the Quench Spray pumps' suction,
    - Quench Spray pump recirculation piping,
    - Safety Injection system piping to the High Head and Low Head Safety Injection pumps' suction,
    - RWST recirculation pumps' suction and discharge piping, and
    - Refueling Purification and blender make-up piping to the RWST.

Pictures of excavated QS, SI and RS piping are provided below:



<u>Other Inspections</u>

In addition, the Unit 2 Circulating Water (CW) discharge tunnel and an associated liquid waste line were also inspected. The discharge tunnel and piping had no relevant issues associated with the earthquake.

Buried piping segments were inspected in accordance with the guidance contained in procedure ER-AA-BPM-101 and were additionally inspected for any potential issues that could have resulted from the earthquake. The inspected piping was in satisfactory condition, and no relevant issues were found. A review of the buried piping inspection schedule created for the NEI buried pipe initiative has determined the frequency of the inspections is adequate, and no changes to the program are required as a result of the seismic event.

In summary, since system pressure testing of safety related buried piping and direct and indirect inspection of sections of safety related and non-safety related buried piping did not identify any seismically related cracking, damage or leakage, it is reasonable to conclude that the portions of buried piping that were not inspected have similarly not experienced any seismically related cracking, damage or leakage.

4. *A pipe support system includes spring and rigid hangers, rigid lateral struts, snubbers, clamps, I-beams, lugs welded to pipe, and base plates that are anchored to the building structures or walls either by bolting and/or welding. Discuss which pipe system's supports were inspected, inspection technique and its effectiveness, what parts of the supports were and were not inspected, acceptance criteria, and corrective actions. Discuss the reevaluation of the pipe support structural analyses considering the earthquake effect, including acceptance criteria, results, and corrective actions.*

Dominion Response

As noted in the response to Question No. 2 above, piping system inspections, including supports, were performed in accordance with station procedure 0-GEP-30, which was developed using the guidance provided in EPRI NP-6695. Every plant piping system was inspected to the extent possible and no significant pipe support damage was identified due to the earthquake that would have prevented the pipe from performing its design function.

Procedure 0-GEP-30 included the following inspection criteria for pipe supports:

- Check for damage to anchorage, i.e., stretching or loosening of anchor bolts or nuts, rocking or sliding of base plates on concrete
- Made up properly, aligned correctly and have sufficient hydraulic fluid levels
- No signs of hydraulic fluid leakage
- Properly installed and no signs of damage
- No signs of excessive vibration or movement
- Check for deformation of dead weight supports and sway bracing.

Detailed discussion of the comprehensive snubber inspections that have been and are being performed is provided in Dominion letters dated October 3 and 10, 2011 (Serial Nos. 11-566 and 11-566A, respectively).

Re-evaluation of the pipe support structural analyses considering the earthquake effect is not considered necessary due to the short duration and low energy of the earthquake, as well as the fact that no seismically related damage was identified to any plant structures, systems, or components (SSCs), including associated supports, that would render them unable to perform their design functions. During a conference call with the NRC on October 7, 2011, Dominion discussed additional justification that it will be providing in support of this conclusion. This information will be provided to the NRC in subsequent correspondence.

5. *The NRC staff understands that a leak was observed on control rod drive mechanism N2-18 canopy seal weld on the Unit 2 reactor vessel head. The staff understands that this leak may have occurred prior to the earthquake. Discuss whether the leakage occurred before or after the earthquake. If the leakage occurred before the earthquake, discuss the effect of the earthquake on the through wall flaw in the canopy seal weld. Discuss the repair method and the schedule for completion. Also, identify any pipe systems that contain flaws in service prior to the earthquake. Discuss whether these flaws will be inspected by ultrasonic testing (UT) to ensure the flaw(s) has not grown as a result of the earthquake prior to restart. If UT will not be performed, discuss how the flaw(s) can be demonstrated to remain within the acceptance standards of the ASME Code, Section XI, IWB-3000, as a result of the earthquake.*

Dominion Response

Unit 2 CRDM N2-18 Canopy Seal Weld - The subject control rod drive mechanism (CRDM) pressure housing is a spare, capped CRDM pressure housing. Spare CRDM pressure housings are fitted with an adapter plug that accommodates mounting of a "dummy can" assembly that mimics the resistance to cooling air flow that would otherwise be provided by an active CRDM. The design of this adapter plug relies on a robust threaded connection to provide the structural support, as well as the primary pressure boundary for the joint, while the associated canopy seal weld provides a seal for leakage past the threads. The loading associated with this joint and experienced by the canopy seal weld would be primarily due to pressure/thermal cycles and not associated with inertial loading from a transient or seismic event. This conclusion is supported by Framatome ANP Stress Analysis 32-5023016-01, "NAPS Unit 2 CRDM Plug Analysis". While it cannot be definitively determined whether the canopy seal weld leak occurred before or after the earthquake, it is not anticipated that the loading associated with the seismic event would have either initiated a flaw or resulted in any crack growth associated with any existing flaws.

The method used to repair the canopy seal weld leak was the installation of a Westinghouse Canopy Seal Clamp Assembly. This design uses a Garfoil Seal ring to provide leak tight integrity. Additionally, the compressive loading applied across the canopy seal, combined with the compressive loads applied to the face of the canopy seal weld from the Garfoil packing material, tends to result in crack tip closure, thereby arresting any further crack propagation.

Piping Systems - Three locations were selected for UT or liquid penetrant (PT) examination that had pre-existing flaws. These locations are listed below:

NDE Examinations of Pre-existing Flaws			
Flaw Location	**Drawing**	**NDE Exam**	**Results**
U2 Outside Recirculation Spray Suction Piping	12050-WMKS-0104DA/12-RS-407 / 6A	PT	Completed Sat 10/3/11 (No Change)
U2 Pressurizer Girth Weld	12050-WMKS-RC-E-2 / Weld 4	UT	Completed Sat 10/4/11 (No Change)
U2 'B' Steam Generator Girth Weld	12050-WMKS-RC-E-1B.1 / Weld 6	UT	Not yet performed, scheduled following core on-load

Note that these locations are part of North Anna's Risk-Informed ISI Program and have been performed as 'owner elective' examinations.

These results are directly applicable to Unit 1 as the overall loading environment would have been the same during the earthquake. Pending satisfactory results for the last weld of this group of pre-existing Unit 2 flaws showing no change in flaw characteristics, it can be concluded that no pre-existing flaw growth occurred at North Anna Units 1 and 2 as a result of the August 23, 2011 earthquake.

6. *For ASME Class 1 piping, Section XI, IWB-2410 requires that system pressure tests be performed during plant outages such as refueling shutdowns. For Class 2 and 3 piping, Table IWC-2500-1 and Table IWD-2500-1 require system pressure testing once per inspection period. The system pressure tests in the aforementioned ASME Code, Section XI articles may not be required because the shutdown was due to the earthquake and not as a scheduled refueling outage. Discuss whether a system leakage test will be performed on all ASME Class 1, 2, and 3 piping to demonstrate the structural integrity of the piping systems prior to restart. Discuss whether visual examination will be performed for each piping system as part of the system pressure test. For piping that is safety-related, but not ASME Code components or non-safety related piping that is connected to safety-related piping,*

discuss whether this piping will be undergoing a system leakage test to demonstrate its structural integrity.

Dominion Response

The station will be performing Periodic Tests 1/2 PT-46.21, "RCS Pressure Boundary Components Affected by Boric Acid Accumulation," to address Code Class 1, 2 and 3 components that are pressurized inside containment. This procedure is being performed to satisfy ASME XI System Pressure Testing requirements and will be performed by qualified VT-2 examiners. This PT also addresses Main Steam and Feedwater systems outside of containment.

Following the August 23, 2011 earthquake, numerous in service plant systems were walked down and inspected for damage by plant operations staff in accordance with Station Abnormal Procedure 0-AP-36, "Seismic Event," and by plant engineering staff in accordance with procedure 0-GEP-30. No leakage was identified that was attributable to the earthquake. In addition, in support of the Operability Determinations that were prepared to ensure that plant systems required for entry into Modes 5 and 6 were capable of performing their required design functions, an operability / functionality evaluation was performed. Fluid systems evaluated include the Unit 1 and Unit 2 Service Water System, Component Cooling Water System, Residual Heat Removal System, Reactor Coolant System, Safety Injection System, Fuel Pit Cooling System, and EDG Fuel Oil System among others. No indication of system leakage was identified as a result of the earthquake.

In addition, as part of the preparation for unit restart, prior to entering Mode 4, system engineers will perform system walkdowns in accordance with station procedure ER-AA-SYS-1002, "System Engineering Walkdowns," to ensure their assigned system is ready for mode change. The purpose of the walkdown inspections is to identify any equipment problems or discrepancies prior to unit operation. If system leakage were present, it would be identified during these walkdown inspections.

LICENSE RENEWAL

These requests for information focus on the period of extended operation. Unless specifically stated in the question, the following questions apply to all systems, structures, and components within the scope of license renewal.

Inspection/follow-up

Enclosure 2 of the VEPCO summary report dated September 17, 2011 states that the structural component inspections were performed by qualified engineering personnel as defined in ER-NA-INS-104, "Monitoring of Structures North Anna Power Station." However, 10 CFR 50.55a states that the personnel that examine containment concrete *surfaces and tendon hardware, wires, or strands must meet the qualification provisions in ASME Code Section XI, IWA-2300. The "owner-defined" personnel qualification provisions in IWL-2310(d) are not approved for use. In addition, American Concrete Institute (ACI) 349.3R states that the personnel performing the inspections or testing at the plant, under the direction of the responsible-in-charge engineer, should meet one of the following qualifications:*

a) *Civil or structural engineering graduate of an ABET (accreditation board for engineering and technology) accredited college or university who has over 1 year of experience (or are ACI inspector certified) in the evaluation of inservice concrete structures or quality assurance related to concrete structures; or*

b) *Personnel possessing at least 5 years experience (or are ACI inspector certified) in the inspection and testing of concrete structures and having qualifications acceptable to the responsible-in-charge engineer.*

Confirm if the personnel qualification requirements specified in the VEPCO procedure meet the requirements of IWA-2300 and ACI 349.3R.

Dominion Response

The post-earthquake structure inspections were performed in accordance with ER-NA-INS-104, Attachment 8, which uses EPRI "Guidelines for Nuclear Plant Response to an Earthquake," EPRI-NP-6695. Inspection teams that consisted of two members had at least one member meeting the requirements of an ER-NA-INS-104 inspector, which are equivalent to an ACI 349.3R qualified inspector. The qualifications of the inspectors were reviewed and approved by the Responsible Civil Engineer (RCE). Inspection results were reviewed by the RCE and the Supervisor - Civil Design Engineering. With regard to containment concrete inspections, the governing procedure used had no requirements to ensure the inspector was qualified in accordance with IWL. However, the engineer who performed the exterior containment concrete inspections was qualified in accordance with IWL requirements.

The inspector qualification requirements contained in procedure ER-NA-INS-104 are excerpted below:

7.2.2 **Responsible Civil Engineer (RCE)**

The RCE is responsible for evaluating the inspection results, determining corrective actions, and ensuring all structures can meet their intended function. The RCE shall possess one of the following sets of qualifications:

a. Licensed Professional Engineer, knowledgeable in the design, evaluation, in-service inspection, and performance requirements of nuclear power station structures.

b. Civil/Structural Engineering graduate (4 year) of an accredited college or university with at least 5 years experience in the design, construction and inspection of structures, and with knowledge of the performance requirements of nuclear power station structures and potential degradation processes.

7.2.3 **Inspector**

The Inspector is responsible for performing inspections of plant structures and shall meet one of the following qualifications, or equivalent:

a. Civil / Structural Engineering graduate (4-year) of an accredited college or university who has over 1 year of experience in the evaluation of in-service structures or quality assurance related to nuclear plant structures.
b. Personnel knowledgeable in the performance requirements of nuclear plant structures and potential degradation processes and having qualifications acceptable to the Supervisor, Corporate Civil Engineering, Innsbrook.

EMCB QUESTIONS

Considering the information presented in Virginia Electric and Power Company's (VEPCO) report dated September 17, 2011, additional information is requested in the mechanical and civil engineering area regarding the planned inspections, evaluations and testing of systems, structures, and components (SSCs).

1. *Provide (1) a summary result of inspections of the NAPS Units 1 and 2 SSCs listed below; (2) assessment of possible root cause and the extent of condition for any identified damage; and (3) a discussion on the corrective actions (if any) that will be implemented, prior to restart, to demonstrate that the affected SSCs will continue to perform their required design functions:*
   a. *Exterior of the containment structure. Also, please confirm that the results of this inspection have been compared with the IWL inspection history to identify any anomaly.*
   b. *Containment liner plate. Also, confirm that the results of this inspection have been compared with the IWE inspection history to identify any anomaly.*
   c. *Containment internal structures, steel and reinforced concrete.*
   d. *Support structures, including anchor bolts and surrounding concrete, for major equipment (e.g., reactor vessel, steam generators, pressurizer, and reactor coolant pumps).*
   e. *All seismic Category I structures other than containment and those SSCs that could adversely affect seismic Category I SSCs.*
   f. *All masonry walls.*
   g. *Turbine building and turbine pedestal structure.*

Dominion Response

The containment structural components (including the containment concrete shell, liner plate, and other internal structures), other seismic Category 1 structures, including those that could adversely affect seismic Category I SSCs, the turbine building structural components including the turbine pedestal, and masonry walls were inspected on each unit as noted below. Reference Dominion letter dated October 3, 2011 (Serial No. 11-566, Responses to Containment Questions 1, 2, 3 and 5) for additional information associated with the containment inspection effort. The containment structural components, other seismic Cat 1 structures, the turbine building structural components, including the turbine pedestal, and masonry walls were inspected on each unit.

The structural component inspections consisted of safety related and non-safety related structural components that meet regulatory requirements for Maintenance Rule and contribute to the operation of the station. These components are identified in procedure ER-NA-INS-104, "Monitoring of Structures North Anna Power Station," and the inspections were performed in accordance with this procedure. Attachment 8 of ER-NA-INS-104 was created based on EPRI NP-6695 guidance and details the inspections to be performed on concrete structures, steel structures, and low pressure tanks. The inspection team looked for damage caused by the earthquake that exceeded the acceptance criteria defined in ER-NA-INS-104. The inspection results were documented on Attachment 1, Inspection Log, of ER-NA-INS-104 and were performed by qualified engineering personnel as defined in ER-NA-INS-104.

As noted above, the inspections performed following the seismic event were performed in accordance with the Maintenance Rule Structures program, not to the requirements of ASME XI, Subsection IWL. The Code IWL inspection is only required every five (5) years, and the last five (5) year interval was completed just prior to the seismic event. There are no requirements in Subsection IWL that direct IWL concrete inspections to be performed following a seismic event. However, the inspection guidance that was used during the post-earthquake inspections was detailed and provided assurance that no changes had occurred from the last IWL inspection. Any differences between the IWL examinations completed prior to the earthquake and the structures inspections conducted following the earthquake were evaluated and dispositioned by the IWL responsible engineer.

The inspections (both pre and post-earthquake) on the containment dome concrete were conducted by the IWL responsible engineer. During the IWL containment concrete inspections performed just prior to the seismic event, only one suspect crack was noted on Unit 1 that was just at or above the IWL acceptance criterion of 0.04". The crack was identified as not active and evaluated as acceptable. Inspection following the seismic event determined that this crack had not changed. Furthermore, the inspection performed following the seismic event did not identify any cracks that exceeded the EPRI NP-6695 acceptance criterion of 0.06".

An IWE inspection of the containment liner was conducted on each unit and compared with previous inspection results. No issues resulting from the earthquake were identified.

In fact, no damage was noted during any of the structural inspections that were performed that would have affected the structural integrity of the components inspected. Identified damage was minimal and primarily consisted of cosmetic concrete / grout spalling that only required grout or caulk repairs.

2. *Enclosure 2 to the September 17, 2011, report states that additional inspections of the switchyard are currently being performed. Prior to restart, provide the results of these inspections and a discussion on any identified damage and the repairs (if any) that will be implemented, to demonstrate that the affected SSCs will continue to perform their required design functions.*

Dominion Response

In response to the August 23, 2011 earthquake, Dominion initiated an inspection program of the North Anna Switchyard and Large Power Transformers, based on guidance provided by industry documentation and Operating Experience (OE). The documents referenced are NRC Reg. Guide 1.167, EPRI NP-6695, EPRI NP-5607, and EPRI NP-5616. The program was developed to comprehensively inspect the entire Switchyard for conditions resulting from the seismic event.

The inspection program includes: Switchyard equipment, the Generator Step-up Units, Station Service Transformers, Reserve Station Service Transformers, and the disconnect switches located in the Mini-Switchyard, as well as line zone equipment one substation away from North Anna. Detailed inspection checksheets were created for each equipment type using guidance from the Equipment Manufacturer, as well as OE from the industry in the United States and Japan. In parallel with the inspection being performed on site and one substation out, Dominion is evaluating the seismic profiles of substations in the proximity of the event to determine if additional locations should be included in this inspection program. Attachment 1 shows a summary of testing performed and inspections included on the checksheets for each equipment type in the North Anna Switchyard including the large power transformers. A sample checksheet for the 500kV live tank SF6 circuit breakers has been provided in Attachment 2.

To ensure nuclear safety and the reliable supply of off-site power to North Anna, switchyard equipment outage windows were scheduled and aligned with station outage windows. Switchyard equipment was weighted based on the potential impact to off-site power and scheduled with priority granted to the most vital equipment. A significant portion of the switchyard and large power transformer inspections have been completed.

A current list of conditions identified as resulting from the August 23, 2011 earthquake is provided in Attachment 3.

Each of the identified conditions have received health evaluations and were repaired prior to the equipment returning to service. The details of these corrective actions are included in Attachment 3, where applicable. The conditions identified, across a sampling of various equipment types, have been minor and do not present immediate equipment reliability challenges.

To ensure the integrity of off-site power to an operating unit, equipment has been designated as to whether inspections are recommended prior to moving a unit to Mode 1 and syncing to the transmission system. Based on present scheduling, every item recommended for inspection prior to a unit start-up will be completed by October 14, 2011. The remaining items may be inspected with the units on-line based on grid conditions.

4. *Provide plans to demonstrate leak tightness of the containment penetrations, prior to restart.*

Dominion Response

A discussion of the 10 CFR 50, Appendix J, Type B and C containment penetration testing that has been and is scheduled to be performed for Units 1 and 2 is provided in Dominion letter dated October 3, 2011 (Serial No. 11-566).

5. *Confirm that the inspection of the operational gaps to allow thermal movement of major equipment and piping systems, in both NAPS Units 1 and 2, have been performed and discuss the results of these inspections.*

Dominion Response

As noted above, comprehensive inspections of both non-safety related and safety related plant systems were performed on over eighty (80) systems for Unit 1 (which includes common systems) and over fifty (50) systems for Unit 2. These inspections were performed in accordance with station procedure 0-GEP-30, which was developed using the guidance provided in EPRI NP-6695. Inspection results were documented in procedure inspection logs, and discrepancies were entered into the Corrective Action System. The inspections were performed by qualified engineering personnel trained on identifying seismic related damage.

The inspections specifically looked for evidence of:

- Differential horizontal and vertical movement between adjacent and/or interconnecting building and structures,
- Damage to anchorage,
- Signs of excessive vibration or movement of equipment and pipe support components or deformation of dead weight supports and sway bracing,
- Damage due to expansion joints and flexible joints,
- Damage to passive barriers,
- Damage to components due to attached piping, ducts, conduits, and ground straps, and
- Damage to pipe at building joints and interfaces between buildings.

These damage indicators would identify if operational gaps to allow thermal movement of major equipment and piping systems had been affected by the August 23, 2011 earthquake. In addition, seismic gaps between structures (i.e., rattle spaces) were also inspected as discussed in Question 6 below. No concerns with operational gaps were identified during the plant system inspection, nor did they identify any physical or functional damage to plant systems attributable to the earthquake that would render them incapable of performing their design functions.

6. *Confirm that the inspection and verification of all seismic gaps between structures (e.g., the minimum 2-inch rattle space as noted in Section 3.8.1.1 of the NAPS UFSAR) in both NAPS Units 1 and 2 have been performed and provide the summary results of these inspections.*

Dominion Response

The North Anna rattle space inspection requirements were accomplished during post-seismic inspections performed in accordance with Dominion procedure ER-NA-INS-104. No specific gap deviations were discovered.

Each rattle space is covered by a structural angle or steel plate. Since no visible indication of movement (e.g., paint scrapes) to these angles and plates was found, permanent covers were not removed for further inspection of the gap. In most locations, the Rodofoam is visible from the bottom of the joint; however, no effort to erect scaffold for a closer review was made since the cover angles and plates show no sign of damage/distortion.

Additional evidence that North Anna rattle spaces have not undergone movement due to the August 23, 2011 earthquake is available on the 291' level of the Auxiliary Building, northeast corner at the rattle space against the Service Building. A baseplate for a diagonal brace for the Auxiliary Building ventilation exhaust fans (1-HV-F-9A/B/C) support frame is anchored to the Auxiliary Building concrete with only 1/4" horizontal clearance to the Service Building concrete. This previously identified "tight spot" was inspected following the earthquake, and there was no evidence of contact between the baseplate and the Service Building concrete.

In summary, there were no adverse findings regarding seismic gaps between structures.

7. *Discuss the inspection and verification of all components crossing seismic gaps in both NAPS Units 1 and 2, to confirm the relative motion during the recent earthquake was accommodated without any damage or loss of function.*

Dominion Response

Inspections performed in accordance with station procedure 0-GEP-30, included those systems that cross the boundaries between independent buildings. In addition, as discussed in the response to Question 6 above, North Anna rattle spaces (i.e., seismic gaps between structures) were inspected and no seismically related damage due to the August 23, 2011 earthquake was identified. Consequently, no instances of damage were identified that would render any system nonfunctional.

8. *Confirm that inspection of all NAPS Units 1 and 2 load handling systems (cranes, monorails, movable platforms with hoist, etc.) that could potentially affect safety related SSCs has been performed and discuss the results of these inspections.*

Dominion Response

No seismically related structural damage or operational issues were identified on station load handling systems that were inspected by civil engineering personnel, or during the compliance inspections that were performed on the systems prior to their use.

9. *As indicated in Tables 1 and 2 of Enclosure 1 to the September 17, 2011, report, the Individual Plant Examination of External Events (IPEEE) program identified several safety-related components that had a high confidence low probability of failure (HCLPF) capacity lower than 0.3g. Also, the summary report indicates that a thorough inspection of these components is being performed and the capacities of these components will be reviewed for potential improvements.*

   Provide the results of these inspections and discuss if any upgrades have been implemented to increase the component's capacities.

Dominion Response

The inspection results for the small number of structures and components that were determined to have high-confidence-of-low-probability-of-failure (HCLPF) capacities below 0.3g were provided in Dominion letter dated September 27, 2011 (Serial No. 11-520A). As noted in that letter, the detailed inspection of the structures and components with HCLPF capacity <0.3g has been completed, and no physical or functional seismic related damage was identified that would have prevented a structure/component from performing its design function. In addition, as noted in Enclosure 9 to Dominion's letter dated September 17, 2011 (Serial No. 11-520), Dominion committed to re-evaluate plant equipment identified in the IPEEE review with HCLPF capacity <0.3g as a long-term commitment. This effort is ongoing at this time.

11. *Enclosure 2 of the September 17, 2011, report states that nondestructive examinations (NDE) are planned for the ongoing Unit 2 refueling outage and additional Unit 1 and 2 sample weld inspections are planned for piping and pipe supports. Prior to restart, provide the results of completed NDE activities and discuss any identified damage and/or repairs that will be implemented, to confirm functionality of affected components. In addition, provide the methodology for selecting the critical sample welds or components for NDE.*

Dominion Response

The U2 NDE examinations have been completed and the results are being evaluated and documented. The examination results will be provided in subsequent correspondence once this effort has been finalized and documented appropriately.

A discussion of the NDE examinations performed on a sample of Unit 1 and Unit 2 pipe welds and pipe supports is provided in Dominion letter dated September 27, 2011 (Serial No. 11-520A), including the specific welds/supports that were examined, the examination methods used, the examination results obtained and the applicable ASME Code category. As noted in that letter, to select the pipe welds for inspection, a review of industry earthquake experience was performed to identify piping vulnerabilities (Reference EPRI LR-2008-008, EPRI-1019199). Pipe welds were then selected in areas that had potential for strong anchor movements, and, as a result, pipe welds were selected in RCS loop drain piping, containment penetration area piping, and Service Water (SW) tie-in vault piping. A number of safety related welds and supports in these areas were then selected for NDE examination. No seismically related damage was identified on any of the welds or supports examined.

18. *As stated in Section 3.8.5 of the NAPS UFSAR, the differential settlement of the service building with respect to the main steam valve house/quench spray pump house are the only settlements in the main plant that are currently being monitored.*

Also, as stated in Section 3.8.5.4 of the NAPS UFSAR, the current differential settlement between the service building and the main steam valve room/quench spray pump house has essentially stabilized. However, monitoring of movement between the two buildings will continue to assure that the differential settlement between them will not exceed 9/16-inch to maintain the stresses in the safety related service water buried piping within the design basis code acceptance criteria.

Enclosure 8 to the summary report dated September 17, 2011, does not list the inspection or evaluation of service water buried piping as a near term action prior to restart. Discuss VEPCO's plan for the evaluation and the inspection, prior to restart, of service water buried piping to confirm its functionality following the recent earthquake.

Dominion Response

The Auxiliary Service Water buried piping was tested using the unimpaired flow test section of the PTs listed below in accordance with Section XI, IWA-5244 of the ASME Code. These tests were completed with satisfactory results.

- 1/2-PT-301SW, Service Water Pump 1-SW-P-4 System Pressure Test

In addition, Periodic Test 1-PT-302SW, "'A' and 'B' Service Water Supply and Return Headers System Pressure Test," was completed in its entirety for the SW system with satisfactory results. This test is for the majority of the Service Water piping, including the section of buried pipe, and satisfies the System Pressure Test program.

Visual inspections were also performed of the SW system, including inspection of piping transitions into buildings / vaults from soil, and no concerns were identified. In addition, NDE was performed on selected pipe welds in the SW expansion joint enclosure with satisfactory results (Reference Dominion letter dated September 27, 2011, Serial No. 11-520A, Section D of the Attachment).

Finally, the change in differential settlement between the Quench Spray Pump House and the Service Building prior to and following the August 23, 2011 earthquake was determined to be 0.036 inches. This differential settlement value was compared to the Technical Requirements Manual (TRM) limits used to establish the upper bound SW pipe stress limits. The post-earthquake differential settlement value was calculated to be 0.24 inches, which is below the TRM limit of 0.564 inches (0.047 ft).

25. *As stated in the NAPS IPEEE submittal, a relay chatter review was not performed since low ruggedness relays were not found at NAPS during the resolution of unresolved safety issue (USI) A-46 relays. Considering the operating experience during the recent earthquake with relays, discuss your plan and provide further information to confirm the functionality and seismic qualification of relays, in both NAPS Units 1 and 2, prior to restart.*

Dominion Response

Dominion has determined that plant relays performed in accordance with their design functions in response to the August 23, 2011 earthquake. Dominion's letter dated September 27, 2011 (Serial No. 11-520A), Attachment 1, Section III, details the response of the nuclear instrumentation as evaluated by the Root Cause Team for the dual unit trip following the earthquake. As part of the Root Cause Evaluation, unexpected instrumentation responses were evaluated, and an investigation determined that the alarms received were valid for the existing plant conditions. No Engineered Safety Features Actuation System (ESFAS) or Reactor Protection System (RPS) relay chatter was noted during the event.

28. *VEPCO stated in its submittal of September 17, 2011, that the submittal was based on the guidance contained in Regulatory Guide 1.166, "Pre-Earthquake Planning and Immediate Nuclear Power Plant Operator Post-Earthquake Actions," and EPRI NP-6695, "Guidelines for Nuclear Power Plant Response to an Earthquake," but does not indicate whether VEPCO is implementing the methods described in the RG on a complete or partial basis. RG 1.166 assumes that the nuclear power plant has operable seismic instrumentation, including the computer equipment and software required to process the data within 4 hours after an earthquake. As stated in September 8, 2011, public meeting, there were no on-site resources, at NAPS, to interpret the instrumentation data and the time required for data interpretation using an outside vendor significantly exceeded 4 hours. Also, during the earthquake, there was no annunciation in the NAPS main control room that the design basis SSE was exceeded. Considering this operating experience, please discuss your plan for modernization of the seismic instrumentation at both NAPS Units 1 and 2, for both rock and soil supported structures, to provide a reliable system and to accommodate on-site data interpretation:*

Dominion Response

The plan for modernization of the seismic instrumentation at North Anna Units 1 and 2 consists of completed and scheduled work. First, an uninterruptible power source (UPS) was seismically qualified and installed in the control room in September 2011. This UPS provides backup power to the Kinemetrics equipment and Engdahl peak shock alarms in the control room. The seismic switch event alarm and peak shock alarms provide control room operators with immediate feedback regarding whether the operating basis earthquake has been exceeded. Second, an autonomous, temporary free-field seismic monitor was installed inside the North Anna Owner Controlled Area, east of the Training Building, in September 2011. This location was chosen because, as a result of recent soil borings for the Unit 3 site separation project, the soil composition is known.

In addition, the Station Abnormal Procedure for seismic events was updated to include reference and use of the free-field monitor. Also, a procedure is in place for obtaining and evaluating free-field seismic data as it relates to Cumulative Average Velocity (CAV) and an OBE or DBE exceedance determination. Although the station has not formally adopted RG 1.166 into its licensing basis, both of these actions facilitate the station's ability to assess earthquake data within 4 hours of an earthquake as described in RG 1.166.

A project has been initiated to replace the existing seismic equipment and main control room indication with more modern equipment. Permanent, free-field seismic equipment will be installed to facilitate the performance of CAV calculations. The project will also install seismic recording instrumentation at the station Independent Spent Fuel Storage Installation (ISFSI) pad. The project is currently scheduled to begin equipment installation during the spring 2012 refueling outage.

29. *Confirm that visual inspections were conducted of the penetration assembly to the liner plate areas. Specially, equipment hatch, personnel air-lock, and the emergency air-lock.*

Dominion Response

As noted in Dominion letter dated October 3, 2011 (Serial No. 11-566), the containment liner and both hatches (personnel and equipment) were inspected on each unit and no damage was identified that would affect the structural integrity of the components inspected. Specifically, readily accessible areas of the containment liner were thoroughly inspected for seismic defects during the post earthquake system inspections and none were identified. Potential high stress areas inside and outside of Unit 1 and 2 Containments were inspected and included the following:

- Electrical Penetration area
- Mechanical Penetration area
- Equipment Hatch
- Personnel Hatch
- Main Steam and FW Line Penetrations in Main Steam Valve House (MSVH)
- Safeguards Building Penetrations

Appendix J testing will be completed prior to Unit 1 and 2 restart for the following components in accordance with Technical Specification requirements:

- Equipment Hatch
- Personnel and Escape Hatches
- Containment Purge Valves

30. *Discuss if visual inspections were conducted of the transformer supporting pads and its fire protection walls for cracking, tilting, and spalling. If not, discuss the reason for not inspecting these locations.*

Dominion Response

The support pads and fire walls for the Main Generator Step-Up Transformers, the Station Service Transformers, and the Reserve Station Service Transformers were completed with only cosmetic damage identified possibly resulting from the earthquake. No damage was observed that would affect the structural integrity of the components inspected. Attachment 3 includes inspection results for the transformer support pads.

31. *Confirm that the radwaste storage tank area (near the bottom of the building, including the hold down bolts) has been inspected. If not, discuss the reason for not inspecting these locations.*

Dominion Response

The High Level Liquid Waste Tank area in the basement of the Auxiliary Building (244' elevation) was not entered due to high personnel dose concerns. However, as documented in the station inspection procedure, the area could be seen through the floor grating from the level above (i.e., 259' elevation). The liquid waste tanks (both the Low Level and High Level tanks – 1-LW-TK-2A/B and 3A/B, respectively) are suspended through the floor between the 259' and 244' elevations, with the tank supports attached to the floor of the 259' elevation. The tanks do not reach the floor of the 244' level. The tanks' supports were inspected with no issues noted. Not entering the high dose area under the High Level Liquid Waste Tanks was determined to be acceptable because inspections of associated system components had identified no damage attributable to the recent seismic event. Furthermore, other piping in this area of the Auxiliary Building with a similar support structure was inspected with satisfactory results.

Attachment 1: Inspection Plan Summary by Equipment Type
North Anna Power Station Post-Seismic Switchyard Inspection

Switchyard - General

- Infrared inspection
- Corona scan
- Foundation inspection
- Micro-ohm high voltage connections
- North Anna switchyard inspection from helicopter including backbone structure
- Climbing inspection of the switchyard backbone structure and the core towers between the turbine building and the switchyard
- Generator leads inspection

Large Power Transformers (500kV – 22kV)

- Detailed inspection of transformer exterior plus; leads, lugs, foundation(s), control wiring & components, oil leaks, arresters, signs of movement
- Micro-ohm high voltage connections
- Power Factor test
- SFRA test
- RSST A, B, C, TX 3 tap changer maintenance/inspection
- Tap changer maintenance on Unit 2 Station Service transformers

High Voltage Circuit Breakers

- Detailed inspection of circuit breaker exterior plus; leads, lugs, foundation(s), control wiring & components
- Micro-ohm high voltage connections
- Leak check using SF6 camera
- Test SF6 for decomposition byproducts
- Timing & power factor testing
- Micro-ohm breaker contacts

Free Standing 500 kV Current Transformers (CTs)

- Detailed inspection of CT exterior plus; leads, lugs, foundation(s), control wiring & components, oil leaks, oil level, bellows assembly
- Micro-ohm high voltage connections
- Power factor testing

Attachment 1: Inspection Plan Summary by Equipment Type
North Anna Power Station Post-Seismic Switchyard Inspection

Coupling Capacitor Voltage Transformers (CCVT)

- Detailed inspection of CCVT exterior plus; leads, lugs, foundation(s), control wiring & components, oil leaks
- Micro-ohm high voltage connections

Disconnect Switches

- Detailed inspection of Switch plus; leads, lugs, foundation(s)
- Operational check
- Micro-ohm switch and high voltage connections

Rigid Bus Work

- Detailed inspection of the Bus work plus; leads, lugs, welds, expansion joints, bus supports
- Micro-ohm high voltage connections

Batteries

- Detailed inspection of Battery
- Cellcorder test
- Discharge test
- Install seismic battery racks in 500 Battery 1, 500 Battery 2, & 230 Battery (Discuss FO, Microwave, Microwave Repeater, NANIC, PBX)

Battery Chargers

- Detailed inspection of chargers including; settings, outputs, internal components/wiring

Wave Traps

- Detailed inspection of Wave Trap exterior

Arresters

- Detailed inspection of Arrester plus; leads, lugs
- Micro-ohm high voltage connections

Attachment 1: Inspection Plan Summary by Equipment Type
North Anna Power Station Post-Seismic Switchyard Inspection

Control Houses

- Detailed visual inspection of house including; panels, panel mounts, control wiring, ground bus, cable tray supports/wires, etc
- Structure inspection for cracks, water ingress, etc

34.5 kV – 240/120 volt Transformers

- Detailed inspection

Blinding CTs

- Detailed inspection

QMB's and Throw Switches

- Inspect for movement/broken internal components, wiring

Circuit Switcher

- Detailed inspection of circuit switcher exterior plus; leads, lugs, foundation(s), control wiring & components
- Micro-ohm high voltage connections
- Leak check using SF6 camera
- Micro-ohm main contacts

First Station Out Line Zone

- Inspect "Line Zone" CCVT's, Insulators, Switches, and Circuit Breakers of all lines that originate from North Anna

Transmission Lines Originating from North Anna

- Lines inspection from Helicopter

Under Ground Cable

- Detailed inspection of cable, mounting hardware, structures, and foundations
- Micro-ohm high voltage connections
- Perform Very Low Frequency (tan delta) test

Attachment 2: Sample Checksheet – 500kV Mitsubishi Live Tank SF6 Circuit Breaker North Anna Power Station Post-Seismic Switchyard Inspection

Dominion

Nuclear Switchyard Post Seismic Event
MI Type 500-SFM Circuit Breaker Inspection Checksheet

Dominion Operating # ____________________ Xref # ____________________

Breaker Serial # ____________________ Date ____________________

SAP Work Order # ____________________

Verify Initial Conditions

Have Supervision verify that the following conditions are met:

- Breaker Failure for the associated breaker has been defeated

Verification completed by: ____________________ Date: ____________________

1.0 General Breaker Inspection **Completed by**

1.1 Personal Protective grounds installed on both sides of the equipment being tested. ____________

1.2 Porcelain free of cracks and chips ____________

Note: The porcelain at the base of the breaker and at the central connection for each arm are the points of highest vulnerability and should be given additional focus.

1.3 External hardware, Torque marks aligned, bolts tight ____________

1.4 Ground terminals tight (with calibrated torque wrench) ____________

Torque Wrench Serial # ____________________

Calibration Date ____________________

Calibration Due Date ____________________

1.5 All mounting hardware tight, no hardware missing ____________

Note: The mounting bolts at the base of the breaker and at the central connection for each arm are the points of highest vulnerability and should be given additional focus.

1.6 Inspect control cabinet and mechanism components for damage, deformation, or movement ____________

1.7 Check all terminal block screws for tightness ____________

1.8 Check that all control-wiring terminals are secure ____________

**Attachment 2: Sample Checksheet – 500kV Mitsubishi Live Tank SF6 Circuit Breaker
North Anna Power Station Post-Seismic Switchyard Inspection**

Dominion

Nuclear Switchyard Post Seismic Event
MI Type 500-SFM Circuit Breaker Inspection Checksheet

	Completed by
1.9 Panel shock mounts in good condition	______
1.10 Inspect all points where control wiring enters/exits conduit for signs of friction or abrasion to the insulation jacket	______
1.11 Door gasket secure	______
1.12 Doors sealing properly	______
1.13 Check for evidence of water leakage in cabinets	______
1.14 Verify air pressure is correct ______psi	______
1.15 SNOOP entire Air system for signs of leakage including interconnection piping between poles Leaks Detected ☐ Yes ☐ No	______
1.16 Inspect interconnection wiring between poles	______
1.17 Condensation drained from Reservoir(s)	______
1.18 Air Compressor Oil Level acceptable	______
1.19 Air Compressor Belts Tight and in Good Condition	______
1.20 SF6 Gas Decomposition (0%) A ϕ______% B ϕ______% C ϕ______% Test Equipment Manufacturer ______ Serial # ______ Calibration Date ______ Calibration Due Date ______	______
1.21 Verify SF6 gas pressures are correct A ϕ______psi B ϕ______psi C ϕ______psi	______
1.22 Perform SF6 gas leak check on tubing/fittings/components located in the 3 mechanism cabinets with SNOOP. Leaks Detected ☐ Yes ☐ No	______

**Attachment 2: Sample Checksheet – 500kV Mitsubishi Live Tank SF6 Circuit Breaker
North Anna Power Station Post-Seismic Switchyard Inspection**

Dominion

Nuclear Switchyard Post Seismic Event
MI Type 500-SFM Circuit Breaker Inspection Checksheet

Completed by

1.23 Contact resistance ____________

Test Equipment Manufacturer ____________________

Serial # ____________________

Calibration Date ____________________

Calibration Due Date ____________________

	As Found	Corrected	Temperature	Specification
A ϕ				≤ 90 micro-ohms
B ϕ				Note: Fast Close the breaker before test.
C ϕ				Use a 100 amp test set.

Comments Section 1.0

____

____

____

2.0 Operations Testing

2.1 Perform a de-energized operation of circuit breaker and document any abnormality with mechanism or linkages. ____________

2.2 Time breaker. Test results satisfactory per chart on next 2 pages. ____________

Ensure test plan transducer ratio is: 140 mm at transducer/230 mm at contacts.

Test Equipment Manufacturer: ____________________

Serial #: ____________________

Calibration Date: ____________________

Calibration Due Date: ____________________

2.3 Mechanism Stroke, attain from Timing Results ____________

____________mm

2.4 Contact Wipe, attain from Timing Results. ____________

____________mm

Attachment 2: Sample Checksheet – 500kV Mitsubishi Live Tank SF6 Circuit Breaker North Anna Power Station Post-Seismic Switchyard Inspection

Dominion

Nuclear Switchyard Post Seismic Event
MI Type 500-SFM Circuit Breaker Inspection Checksheet

2.0 Operations Testing Continued

Note: Trip and close times are to be measured from energization of the coils until contact part or touch.

	PRIMARY TRIP OPERATION		
	CONTACTS OPEN SPEC. 14 - 18 ms	VELOCITY SPEC. 7.8 – 12.8 m/s	CONTACT SYNC SPEC. < 2 ms
A ϕ			
B ϕ			
C ϕ			

	BACK – UP TRIP OPERATION		
	CONTACTS OPEN SPEC. 14 - 18 ms	VELOCITY SPEC. 7.8 – 12.8 m/s	CONTACT SYNC SPEC. < 2 ms
A ϕ			
B ϕ			
C ϕ			

	CLOSE OPERATION		
	CONTACTS OPEN SPEC. 70 – 105 ms	VELOCITY SPEC. 1.8 – 4.2 m/s	CONTACT SYNC SPEC. < 4 ms
A ϕ			
B ϕ			
C ϕ			

Attachment 2: Sample Checksheet – 500kV Mitsubishi Live Tank SF6 Circuit Breaker North Anna Power Station Post-Seismic Switchyard Inspection

Dominion

Nuclear Switchyard Post Seismic Event
MI Type 500-SFM Circuit Breaker Inspection Checksheet

3.0 Power Factor Insulation Test (Doble Test) — **Completed by**

3.1 Power Factor test breaker. Results acceptable. ____________

(Attach copies of the Doble results to this document.)

Test Equipment Manufacturer ____________________
Serial # ____________________________________
Calibration Date ____________________________
Calibration Due Date __________________________

Test Verified by Technical Specialist ____________________ Date: ________________

Comments Section 3.0

____
____
____

4.0 Return to Service Checks — **Completed by**

4.1 Micro ohm all connections per *Nuclear Switchyard Micro-ohm Testing for High Voltage Primary Connections* ____________

4.2 When released by Supervision, remove personal protective grounds ____________

5.0 Inspection Checksheet Reviewed by Electrical Equipment Specialist:

______________________________________ Date: ____________________

6.0 Inspection Checksheet Reviewed by Technical Specialist or Lead Electrical Equipment Specialist and Equipment is Released for Service:

______________________________________ Date: ____________________

Attachment 3: Summary of Identified Conditions Resulting From Seismic Event
North Anna Power Station Post-Seismic Switchyard Inspection

Below is a list of issues identified so far during post seismic inspections at North Anna. Identified issues have been repaired/corrected prior to return to service unless otherwise noted:

- Generator Step-Up Units (GSU) bushings
  - The eight, 500kV bushings on the GSUs shifted on their respective flanges. The bushings have been replaced on the six in-service transformers. Bushings have not been installed to the spare units as man-power resources are allocated to the inspection of in-service equipment.
  - The bushings for the spare GSU transformers are being stored until a comprehensive evaluation has been completed with the manufacturer. After the evaluation has been completed, the bushings will be installed when resources are available.
- Switchyard Transformer #5/6 spare – 500kV bushing cracked near the flange and began leaking oil. The bushing required replacement, and this activity has been completed
- Switchyard Transformer #5 conditions
  - 230kV arrestors: A & C phase 3 ½" support tube bus section had broken 4-bolt pad connections.
  - 500kV bushing on A phase unit shifted & gasket out of place. No oil leaking and transformer tested SAT. Transformer will be returned to service and a future outage will be scheduled to replace the bushing.
- Switchyard Transformer #2 – 34.5kV low-side bushing X1 was identified as having high power factor test results. In response to this finding, all three 34.5kV low-side bushings are being replaced.
- Reserve Station Service Transformer "B" – The neutral resistor tested high, out of specification. Based on visual inspection, this condition may not be related to the seismic event. The resistor was replaced with an on-site spare, and the out of spec equipment is being transported for investigation and repair.
- 230kV House Batteries
  - Apparent torquing/shifting of the battery cells and mechanical stresses on intercell straps. These batteries will be re-strapped and tested as resources allow.
  - Cellcorder testing reviewed by Subject Matter Experts – no operating concerns identified. Discharge testing not yet complete.
  - Projects are being planned to replace these batteries and to install seismic battery racks

Attachment 3: Summary of Identified Conditions Resulting From Seismic Event
North Anna Power Station Post-Seismic Switchyard Inspection

- 500kV House Batteries #1 & #2
  - Hairline cracking identified on the lids of battery jars due to mechanical stresses (Both Batteries)
  - Noticeable shifting on Battery #1 cells 16 – 30 after the earthquake
  - Cellcorder testing reviewed by Subject Matter Experts – no operating concerns identified. Discharge testing not yet complete.
  - Projects are being planned to replace these batteries and to install seismic battery racks
- H502 Circuit Breaker hardware had fallen off of the aux stack
  - A phase: 1 nut
  - B phase: 2 nuts
- 57508 Disconnect Switch was found out of adjustment
- L105 Disconnect Switch had high micro-ohm (μΩ) resistance readings from the Lead to Switch
  - A pad: 45.6μΩ – 1.6 μΩ corrected
  - C pad: 54.6 μΩ – 8.1 μΩ corrected
- 352 Disconnect Switch had high micro-ohm resistance readings from the Switch to Breaker
  - A pad: 41.8 μΩ – 12.8 μΩ corrected
  - B Pad: 76.6 μΩ – 11.3 μΩ corrected
- T343 Disconnect Switch had high micro-ohm resistance readings
  - A pad to Bus: 44 μΩ – 4 μΩ corrected
  - B pad to Bus: 69 μΩ – 5 μΩ corrected
  - C pad to Bus: 114 μΩ – 6 μΩ corrected
  - B phase of switch: 250 μΩ – 34 μΩ corrected (CM work order in place after hurricane winds)

Attachment 3: Summary of Identified Conditions Resulting From Seismic Event
North Anna Power Station Post-Seismic Switchyard Inspection

- 334 Disconnect Switch had high micro-ohm readings resistance from the Lead to Switch
    - B pad: 36 μΩ – 2 μΩ corrected
- G2T575 Circuit Breaker - An air leak was identified and repaired
- G202: C phase – damaged freestanding current transformer (CT) bellows
- G202: B phase – Oil leak required epoxy seal
- Mini-Switchyard Disconnect Switches G106M & G206M
    - Needed to pour new foundations and reset switches. These foundations are of an old vintage, and this may not be a result of the seismic event. (May have exacerbated the situation, but not the primary cause.)
- Switchyard foundation inspection
    - ~Fifteen to twenty concrete foundations in the switchyard require repair, replacement and/or sealant (extent of actions to be taken are to be determined on case by case basis). Vintage of these foundations are the same approximate age as the Mini-switchyard and the identified conditions may not be a result of the seismic event. (May have exacerbated the situation, but not the primary cause.)