

VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

October 17, 2011

10 CFR 100, Appendix A

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

Serial No.: 11-544B
NL&OS/ETS R1
Docket Nos.: 50-338/339
License Nos.: NPF-4/7

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
NORTH ANNA POWER STATION UNITS 1 AND 2
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING THE
EARTHQUAKE ON AUGUST 23, 2011 AND RESTART READINESS
DETERMINATION PLAN

By letter dated September 14, 2011, the NRC requested additional information (RAI) regarding the August 23, 2011 Central Virginia earthquake. By letters dated September 27, 2011 (11-544), and October 3, 2011 (Serial No. 11-544A), Dominion responded to several of the questions provided by the NRC technical review branches. However, the response to one of the RAI questions was being developed and was therefore not included in the previous responses. As a result, Dominion is providing a response to the remaining question, Fuels Question 1, in Attachment 1 to this letter.

Attachment 1 contains information proprietary to AREVA, and is supported by an AREVA Application for Withholding Proprietary Information for Public Disclosure and the accompanying Affidavit signed by AREVA, the owner of the information, and is provided in Attachment 3. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR 2.390 of the Commission's regulations.

Accordingly, it is respectfully requested that the information, which is proprietary to AREVA NP, be withheld from public disclosure in accordance with 10 CFR 2.390. Correspondence with respect to the copyright or proprietary aspects of Section 4, Table 1, entitled "Advanced Mark-BW Fuel Design Margin (seismic and Normal Operating)," in Attachment 1 of this letter or the supporting AREVA NP affidavit should be addressed to Ms. Gayle F. Elliott, Manager, Product Licensing, AREVA NP, Inc., 3315 Old Forest Road, P.O. Box 10935, Lynchburg, VA 24506-0935. A redacted (non-proprietary) version of Attachment 1 has been included as Attachment 2 for public disclosure.

**ATTACHMENT 1 CONTAINS PROPRIETARY INFORMATION THAT IS BEING WITHHELD FROM
PUBLIC DISCLOSURE UNDER 10 CFR 2.390. UPON SEPARATION OF ATTACHMENT 1, THIS
DOCUMENT IS DECONTROLLED.**

AOO1
NRC

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

Sincerely,



E. S. Grecheck
Vice President – Nuclear Development

Attachment

1. Response to Request for Additional Information Regarding the Earthquake on August 23, 2011 and Restart Readiness Determination Plan - Proprietary
2. Response to Request for Additional Information Regarding the Earthquake on August 23, 2011 and Restart Readiness Determination Plan – Non-Proprietary
3. Affidavit

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 Eugene 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 on 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 17th day of October, 2011.

My Commission Expires: 4/30/2015



Notary Public

Ginger Lynn Rutherford
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My Commission Expires 4/30/2015

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Attachment 2

NON-PROPRIETARY

**Response to Request for Additional Information
Regarding the Earthquake on August 23, 2011
and Restart Readiness Determination Plan**

Fuels Question 1

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

BACKGROUND

To facilitate review, Dominion provided responses to individual NRC questions contained in the NRC letter dated September 14, 2011. Specifically, Dominion responded to questions in letter dated September 27, 2011 (Serial No. 11-544) and October 3, 2011 (Serial No. 11-544A). Dominion's response to Fuels Question 1 is provided below.

4.0 Fuels

2. *FANP Topical Report, BAW-10239(P)(A), Revision 0 (Reference 2), provides an evaluation of the Advanced Mark-BW fuel assembly in a sample reactor against the criteria defined in the Section 4.2 of the Standard Review Plan (SRP). Section 5.3.4 of the topical report discusses fuel assembly structural damage from external forces, such as the operating basis earthquake (OBE), the safe shutdown earthquake (SSE), as well as SSE + loss-of-coolant-accident (LOCA) loads. The evaluation of faulted conditions also addresses both horizontal (LOCA and seismic) and vertical LOCA effects. Based on the availability of information to date from VEPCO's presentation and the Advanced Mark-BW fuel mechanical design report, the Nuclear Regulatory Commission (NRC) staff is unable to verify the operability condition for the core internals, specifically for the fuel assemblies (grids, fuel rods, guide tubes) and control rods.*

- c) Please provide a comprehensive strategy and qualifying criteria for determining the operability of these components.*

- d) Provide a comparison of the predicted design basis loads (e.g., local acceleration) on the core internals and fuel assemblies against the predicted loads derived from the measured ground motion data during the seismic event. In addition, compare these predicted loads against the measured yielding load and deflection from the fuel assembly grid crush testing.*

- c) Describe all sources of technical information considered in determining the operability and integrity of the fuel, including involvement of the fuel vendors*

Dominion Response to Part a)

Fuel Assemblies

The strategy for determining the operability of the fuel assemblies and insert components was to thoroughly inspect a sampling of fuel assemblies and insert components that were in the new fuel storage area, in the spent fuel pool, and in the Unit 2 core. Details of the fuel assembly and insert component inspections performed and their qualifying criteria are provided in the attachment to Dominion's letter dated September 27, 2011 (Serial No. 11-544 – Fuels RAI No. 2). Rod cluster control assembly (RCCA) drag testing was also performed in the spent fuel pool following the

Unit 2 core offload to confirm the integrity of the fuel assembly guide tubes. The details of the RCCA drag testing and the qualifying criteria are provided in the attachment to Dominion's letter dated October 3, 2011 (Serial No. 11-544A – Fuels RAI No. 2). No indications of damage to any fuel or insert components were observed during the fuel assembly inspections and RCCA drag testing.

The fuel assemblies and insert components in North Anna Unit 1 are of the same design as the Unit 2 fuel and insert components that were inspected. Further, Unit 2 is in close proximity to Unit 1 and is oriented 180 degrees from the Unit 1 core. Due to the symmetric characteristics of the core and fuel assemblies, directionally dependent forces or motions would impact the Unit 1 and Unit 2 cores in the same manner. Therefore, the effect of the seismic loads on the Unit 1 fuel and inserts would be similar to the effect on the Unit 2 fuel and inserts. No damage to the Unit 2 fuel or inserts was identified by the visual inspections and tests that were performed, so it is concluded that the North Anna 1 fuel and inserts were similarly not damaged as a result of the August 23, 2011 earthquake and they will continue to perform their design function.

In addition to the inspections mentioned above, the loads experienced by the fuel assemblies in the Units 1 and 2 cores during the August 23, 2011 earthquake were modeled by AREVA. The in-core fuel assembly stresses (generated from the August 23, 2011 earthquake loads) were compared to an operability limit (OBE) for each fuel assembly component listed in Table 7.3-2 of the North Anna Advanced Mark-BW Design Report (BAW-2414P, Revision 7). The calculation results indicate that none of the fuel assembly components experienced plastic deformation during the August 23, 2011 earthquake.

Rod Cluster Control Assemblies (RCCAs)

The strategy for determining the operability of the RCCAs was to perform visual inspections and functional testing. To confirm the RCCA hubs and associated welds were not damaged during the August 23, 2011 earthquake, inspections of the Unit 2 RCCAs were performed as described in the attachment to Dominion's letter dated September 27, 2011 (Serial No. 11-544 – Fuels RAI No. 2). In addition, RCCA drag loads using fuel assemblies in the Unit 2 core at the time of the August 23, 2011 earthquake were measured in the spent fuel pool to confirm that there was no distortion of the RCCA rodlets or the fuel assembly guide tubes, and that the RCCAs could still travel freely within the fuel assembly guide tubes. The details of the RCCA drag testing and the qualifying criteria are provided in the attachment to Dominion's letter dated October 3, 2011 (Serial No. 11-544A – Fuels RAI No. 2). No indications of damage to the fuel or RCCAs were identified during the RCCA drag load measurements performed in the spent fuel pool.

Per the normal refueling outage scope, Unit 2 RCCA drag load measurements were performed after the core was loaded and the RCCAs latched to their respective control rod drive-shaft. These drag load measurements are performed to verify the RCCAs are

latched properly and move freely in the fuel assembly guide tubes and upper internals guide structure. The post-latch drag load values were compared to pre-existing AREVA criteria and determined to be acceptable.

The RCCAs in North Anna Unit 1 are of the same design as the Unit 2 RCCAs that were inspected, and are constrained in the core in the same manner as the Unit 2 RCCAs. Further, Unit 2 is in close proximity to Unit 1 and is oriented 180 degrees from the Unit 1 core. Due to the symmetric characteristics of the core and RCCAs, directionally dependent forces or motions would impact the Unit 1 and Unit 2 cores in the same manner. The effect of the seismic loads on the Unit 1 RCCAs would therefore be similar to the effect on the Unit 2 RCCAs. No damage to the Unit 2 RCCAs was identified by the visual inspections that were performed, and the RCCA drag load measurements were acceptable. It is therefore concluded that the North Anna Unit 1 RCCAs were similarly not damaged as a result of the August 23, 2011 earthquake and they will continue to perform their design function.

As discussed in the attachment to Dominion's letter dated September 27, 2011 (Serial No. 11-544 – Fuels RAI No. 4), the control rod drive system will also undergo surveillance testing to verify Technical Specification compliance. RCCA drop time measurements of the Unit 1 and Unit 2 RCCAs will be performed in accordance with station procedures (full RCS flow conditions) as confirmation of the full functionality of the RCCAs and will verify compliance with Technical Specification Surveillance Requirement 3.1.4.3. This surveillance verifies that the RCCAs drop into the core in less than or equal to 2.7 seconds. Units 1 and 2 will also perform control rod operability testing as part of startup to confirm compliance with Technical Specification Surveillance Requirement 3.1.4.2, which verifies rod freedom of movement. The performance of these surveillance tests will be used to further validate the conclusion made from inspections and surveillance tests already performed, which is that the RCCAs were not damaged as a result of the August 23, 2011 earthquake and they will continue to perform their design function.

Reactor Vessel Internals (RVIs)

The strategy for determining the operability of the reactor vessel internals was to perform a margin assessment of the key interface components and confirmatory video inspections. The details of the margin assessment were provided in Enclosure 3 of Dominion's letter dated September 17, 2011 (Serial No. 11-520). A list of the reactor vessel internals inspections was provided in the attachment to Dominion's letter dated October 3, 2011 (Serial No. 11-544A – Fuels RAI No. 8). Further details of the inspections were provided in the attachment to Dominion's letter dated October 10, 2011 (Serial No. 11-566A – Vessel and Internals RAI No. 2). The margin assessment and inspections support the conclusion that the August 23, 2011 earthquake resulted in no physical or functional damage to the RVIs, and that the RVIs remain capable of performing their design bases functions.

Dominion Response to Part b)

Fuel Assemblies

In order to evaluate the impact of the August 23, 2011 earthquake on the AREVA Advanced Mark-BW fuel assemblies in the North Anna cores, Dominion provided Westinghouse (the NSSS vendor) with the recorded time-history accelerations from the August 23, 2011 earthquake. Westinghouse used these accelerations to generate core plate motions, which were provided to AREVA. These core plate motions were then used by AREVA to calculate the loads and stresses on the fuel assembly components listed in Table 7.3-2 of the North Anna Advanced Mark-BW Design Report (BAW-2414P, Revision 7). AREVA's calculations show that the fuel assembly component stresses/loads were within the allowable limits. Table 1 below provides a subset of the components analyzed and the calculated stresses resulting from the August 23, 2011 earthquake.

Table 1: Advanced Mark-BW Fuel Design Margin (Seismic and Normal Operation)

Component	Design Basis ¹	Calculated Stress/Load	Allowable Limit	% Margin

(b), (c)

¹ Pm = Membrane Stress
Pb = Bending Stress
P(crit) = Allowable Impact load

The Guide Thimble and Fuel Rod stresses resulting from the seismic event resulted primarily from bending moments imposed on the fuel. Bending moments are typically higher at beginning of life, because the assembly structure is stiffer. As the spacer grids relax during operation, the fuel assembly's lateral stiffness decreases, which results in a proportional decrease in the stresses imposed on the fuel. In addition, the stress calculations are performed with beginning of life (unirradiated) material properties. Using beginning of life material properties is conservative as no credit is taken for irradiation hardening of the components, which would increase the fuel components' yield strength. Therefore, the Guide Thimble and Fuel Rod were conservatively evaluated at beginning of life conditions.

As the above table shows, the Intermediate Spacer Grid was analyzed at beginning of life and end of life conditions. End of life conditions are limiting because the grid-to-fuel rod contact force relaxes with burnup, which decreases the strength of the grid. The Mid Span Mixing Grid is fabricated with no contact force between the grid and fuel rod, and therefore relaxation does not impact the strength of the grid. Thus, the Mid Span Mixing Grid was analyzed at beginning of life conditions.

Based on AREVA's calculations, the Advanced Mark-BW fuel assembly components, and therefore the fuel assembly itself, did not yield or permanently deform as a result of the August 23, 2011 earthquake. This analytical result is consistent with the results of the fuel inspections described in the attachment to Dominion's letter dated September 27, 2011 (Serial No. 11-544 – Fuels RAI No. 2). Therefore, it is concluded that the August 23, 2011 earthquake did not cause any component in the Advanced Mark-BW fuel assembly to yield and that the fuel assemblies in North Anna Units 1 and 2 cores maintain their ability to perform their design functions.

The evaluation of the combined Design Basis Earthquake (DBE) plus LOCA core plate motions was compared to the evaluation of the combined August 23, 2011 earthquake plus LOCA core plate motions. AREVA concluded that the evaluation of the current DBE plus LOCA core plate motions bounds the evaluation of the August 23, 2011 earthquake plus LOCA core plate motions. DBE plus LOCA is bounding due to the maximum LOCA load occurring primarily in the East/West direction and the August 23, 2011 earthquake occurring primarily in the North/South direction.

Although the Westinghouse RFA-2 fuel product has not yet been introduced at North Anna, Westinghouse also evaluated the RFA-2 fuel design with the August 23, 2011 core plate motions. Their calculations concluded that the RFA-2 fuel design would remain within the yield limits for the mid grid, IFM grid, fuel rod, and guide tubes, if RFA-2 fuel had been in the North Anna cores during the August 23, 2011 earthquake. Therefore, the RFA-2 fuel assembly's structural integrity is maintained for an earthquake similar to the August 23, 2011 earthquake. Westinghouse also concluded that the combined DBE plus LOCA core plate motions bound the August 23, 2011 earthquake plus LOCA core plate motions for the RFA-2 fuel product due to the maximum LOCA load being primarily in the East/West direction and the August 23, 2011 earthquake being primarily in the North/South direction.

Reactor Vessel Internals

As stated in Enclosure 2 of the submittal dated September 17, 2011 (Serial No. 11-520), evidence of the inspections is consistent with Damage Intensity 0 on the EPRI seismic damage scale. No specific inspections of reactor internals or associated components are specified in EPRI NP-6695 for Intensity 0 earthquakes. Since the earthquake did not produce any significant physical or functional damage to safety related plant SSCs and only limited damage to non-safety related, non-seismically designed plant SSCs, there is a reasonable assurance that there is no physical or functional damage to the

reactor vessel internals (RVIs), and that the RVIs remain functional and capable of performing their design functions. Additional evaluations of the RVI design margins, as discussed in Enclosure 3 of Dominion's letter dated September 17, 2011 (Serial No. 11-520), and the attachment to the October 3, 2011 letter (Serial No. 11-566 – Vessel and Internals RAI No. 1), have been performed based on existing design analyses of the structural integrity of the RVIs. These evaluations, in addition to providing the reasonable assurance of continued functionality described above, support the conclusion that the earthquake resulted in no physical or functional damage to the RVIs, and that the RVIs remain capable of performing their design bases functions.

Although not required by EPRI NP-6695, Dominion, in collaboration with Westinghouse (the NSSS vendor), identified certain inspections of the RVIs to supplement the above conclusion that the RVIs remain capable of performing their design bases functions. These inspections are listed in the attachment to Dominion's letter dated October 3, 2011 (Serial No. 11-544A – Fuels RAI No. 8). Further details of the RVIs inspections were provided in the attachment to Dominion's letter dated October 10, 2011 (Serial No. 11-566A – Vessel and Internals RAI No. 2). The results of the RVI inspections showed no anomalous conditions caused by the August 23, 2011 earthquake.

Dominion Response to Part c)

The following is a list of sources used to determine the operability of the fuel.

1. EPRI Report NP-6695, "Guidelines for Nuclear Plant Response to an Earthquake," December 1989.

This document only mentions fuel and control rods briefly. Results of physical inspections of the plant indicate the seismic event damage is consistent with Intensity 0 on the EPRI seismic damage scale. NP-6695 describes how prescribed inspections and tests are keyed to the severity of the earthquake. No specific inspections of fuel or associated components are specified in NP-6695 for Intensity 0 earthquakes.

2. EPRI Report No. 1016317, "EPRI Independent Peer Review of the TEPCO Seismic Walkdown and Evaluation of the Kashiwazaki-Kariwa Nuclear Power Plants," January 2008.

This document indicates that during the seismic walkdown following the Kashiwazaki-Kariwa earthquake, TEPCO reported no evidence of any fuel damage. This was confirmed by inspection on a sampling of fuel elements. EPRI recommended that one or more of the reactor vessels be opened for examination of the fuel and internals prior to determination of the plant readiness for restart.

This report was used as the basis for inspecting a sampling, rather than all, of the fuel assemblies. The EPRI panel recommendation to TEPCO is also consistent with Dominion's use of the Unit 2 fuel examinations to determine the condition of the fuel in Unit 1 (without explicit examination of the fuel in both units).

3. IAEA Safety Guide 66, "Earthquake Preparedness and Response for Nuclear Power Plants," 2011.

This report does not specifically recommend disassembly of the reactor and inspection of the fuel unless there is significant damage to structures, systems, and components (SSCs) important to safety. Since the earthquake did not produce any significant physical or functional damage to safety related plant SSCs and only limited damage to non-safety related, non-seismically designed plant SSCs, Dominion's approach of inspecting a sample of components goes beyond the recommended guidance in this report.

4. AREVA Report BAW-2414P, "North Anna Design Report for Units 1 and 2," April 2007.

This document was reviewed to determine the design limitations and current analysis of record for the AREVA Advanced Mark-BW fuel.

5. AREVA

AREVA staff members were consulted in generating the list of fuel assembly and insert component inspections necessary to show operability. AREVA provided Dominion with recommendations on the scope of the fuel inspections, and was contracted to assist in the fuel and component inspections. Lastly, AREVA was contracted to perform a fuel assembly stress analysis based on time-histories of the August 23, 2011 earthquake.

6. Westinghouse

Westinghouse was contacted to determine if any RCCA inspections were recommended. Westinghouse personnel were contracted to support the RCCA drag testing, the generation of reactor vessel internals inspections, and the margin assessment performed for key interface components. In addition, Westinghouse was contracted to generate the core plate motions discussed above in response to RAI 1.b.

ATTACHMENT 3

AREVA AFFIDAVIT

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

requested qualifies under 10 CFR 2.390(a)(4) "Trade secrets and commercial or financial information."

6. The following criteria are customarily applied by AREVA NP to determine whether information should be classified as proprietary:

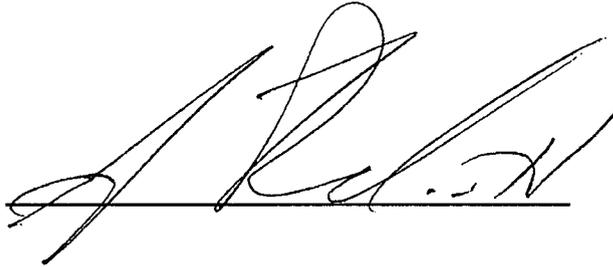
- (a) The information reveals details of AREVA NP's research and development plans and programs or their results.
- (b) Use of the information by a competitor would permit the competitor to significantly reduce its expenditures, in time or resources, to design, produce, or market a similar product or service.
- (c) The information includes test data or analytical techniques concerning a process, methodology, or component, the application of which results in a competitive advantage for AREVA NP.
- (d) The information reveals certain distinguishing aspects of a process, methodology, or component, the exclusive use of which provides a competitive advantage for AREVA NP in product optimization or marketability.
- (e) The information is vital to a competitive advantage held by AREVA NP, would be helpful to competitors to AREVA NP, and would likely cause substantial harm to the competitive position of AREVA NP.

The information in this Document is considered proprietary for the reasons set forth in paragraphs 6(b) and 6(c) above.

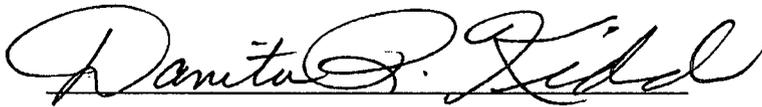
7. In accordance with AREVA NP's policies governing the protection and control of information, proprietary information contained in this Document has been made available, on a limited basis, to others outside AREVA NP only as required and under suitable agreement providing for nondisclosure and limited use of the information.

8. AREVA NP policy requires that proprietary information be kept in a secured file or area and distributed on a need-to-know basis.

9. The foregoing statements are true and correct to the best of my knowledge, information, and belief.

A handwritten signature in black ink, appearing to be 'A. R. Kidd', written over a horizontal line.

SUBSCRIBED before me this 14th
day of October 2011.

A handwritten signature in black ink, reading 'Danita R. Kidd', written over a horizontal line.

Danita R. Kidd
NOTARY PUBLIC, STATE OF VIRGINIA
MY COMMISSION EXPIRES: 12/31/12
Reg. # 205569

