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Dominion®

September 16, 2011

~~SECURITY-RELATED INFORMATION~~
~~WITHHOLD UNDER 10 CFR 2.390~~

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

Serial No. NA3-11-044R
Docket No. 52-017
COL/DEA

DOMINION VIRGINIA POWER
NORTH ANNA UNIT 3 COMBINED LICENSE APPLICATION
SRP 8.2: RESPONSE TO RAI LETTER 78

On July 14, 2011, the NRC requested additional information to support the review of certain portions of the North Anna Unit 3 Combined License Application (COLA), which consisted of six questions. The responses to the following five Request for Additional Information (RAI) questions are provided in Enclosures 1 through 5:

- RAI 5832, Question 08.02-61 — Switchyard Lightning Protection follow-up question
- RAI 5832, Question 08.02-62 — Cable Monitoring Program follow-up question
- RAI 5832, Question 08.02-63 — Switchyard Support System follow-up question
- RAI 5832, Question 08.02-64 — Switchyard Voltage Limits follow-up question
- RAI 5832, Question 08.02-65 — FEMA of Switchyard Components follow-up question

The responses to the remaining question, requires additional time to prepare. The response to this question will be provided by October 31, 2011. The need for additional time was discussed with C. Patel, the NRC's North Anna Unit 3 Project Manager on September 6, 2011.

ENCLOSURES 3 AND 5 TO THIS LETTER CONTAINS SECURITY-RELATED INFORMATION AND MUST BE PROTECTED ACCORDINGLY. UPON SEPARATION OF ENCLOSURES 3 OR 5, THIS LETTER IS DECONTROLLED.

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NRO

Please contact Regina Borsh at (804) 273-2247 (regina.borsh@dom.com) if you have questions.

Very truly yours,

Eugene S. Grecheck

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 (Dominion Virginia Power). He has affirmed before me that he is duly authorized to execute and file the foregoing document on behalf of the Company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 16th day of September, 2011
My registration number is 7173057 and my
Commission expires: August 31, 2012

Notary Public

WANDA K. MARSHALL
Notary Public
Commonwealth of Virginia
7173057
My Commission Expires Aug 31, 2012

ENCLOSURES 3 AND 5 TO THIS LETTER CONTAINS SECURITY-RELATED INFORMATION AND MUST BE PROTECTED ACCORDINGLY. UPON SEPARATION OF ENCLOSURES 3 OR 5, THIS LETTER IS DECONTROLLED.

Enclosures:

1. Response to NRC RAI Letter No. 78, RAI 5832 Question 08.02-61
2. Response to NRC RAI Letter No. 78, RAI 5832 Question 08.02-62
3. Response to NRC RAI Letter No. 78, RAI 5832 Question 08.02-63
4. Response to NRC RAI Letter No. 78, RAI 5832 Question 08.02-64
5. Response to NRC RAI Letter No. 78, RAI 5832 Question 08.02-65

Commitments made by this letter:

1. This information will be incorporated into a future submission of the North Anna Unit 3 COLA, as described in the enclosures.
2. The response to RAI question 08.02-60 will be provided by October 31, 2011.

cc: U. S. Nuclear Regulatory Commission, Region II
C. P. Patel, NRC
T. S. Dozier, NRC
G. J. Kolcum, NRC

ENCLOSURES 3 AND 5 TO THIS LETTER CONTAINS SECURITY-RELATED INFORMATION AND MUST BE PROTECTED ACCORDINGLY. UPON SEPARATION OF ENCLOSURES 3 OR 5, THIS LETTER IS DECONTROLLED.

ENCLOSURE 1

Response to NRC RAI Letter 78

RAI 5832, Question 08.02-61

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI No.: 5832 (RAI Letter 78)

SRP Section: 08.02 – Offsite Power System

QUESTIONS for Electrical Engineering Branch (EEB)

DATE of RAI issue: 07/14/2011

QUESTION NO.: 08.02-61

In response to RAI 5181, Question 08.02-45, Dominion stated that North Anna switchyard lightning protection system design is not fully compliant with IEEE Std. C62.23 which is endorsed by RG 1.204. Identify the parts of IEEE Std. C62.23 that are not met and provide justification for acceptability of your position.

Dominion Response

The table below provides the justification for the portions of IEEE Standard C62.23 that Dominion does not endorse. In addition, further discussion regarding the application of messenger cables is provided following the table since messenger cables are referred to in several justifications.

IEEE Std C62.23 Section	Title	Justification
4.3.5	Shielding	This Section recommends shielding of distribution lines. The only distribution line exiting the NAPS switchyard is the 342 line used for commercial power to support buildings on site. There is no overhead groundwire on top of the line for this circuit, but there has been no historical need for better shielding for this circuit. The circuit enters the switchyard at the south end and is interconnected at the 34.5 kV level with a metal oxide surge arrester. Multiple surge

IEEE Std C62.23 Section	Title	Justification
		arresters are used on transformers and buses between the 34.5 kV portion of the yard and the 500 kV portion of the yard.
5.3.2	Incoming Surges	The Section references a paper [reference B55] that discusses experiences in the alternate wiring practices allowed by Article 725 when redesigning a chemical plant. The NEC permits, but does not require classification of circuits under Article 725. The article is used when it is desirable to limit hazards and to use less restrictive wiring construction. Dominion does not use this article for switchyard wiring as the NEC does not apply to the switchyard. Also, there is no credit taken in switchyard wiring design for using less restrictive wiring construction. Dominion limits incoming surges to the switchyard by using fiber for communications circuits. Within the switchyard, a grounding system of messenger cables and shielded conductors is used to minimize induced signals.
5.3.2.1	Control Systems	This Section recommends developing circuit separation based on voltage level to prevent coupling between power cables and low-energy, low-voltage, digital, and analog instrumentation and control signals. The NAPS switchyard and control houses do not segregate cable according to voltage level. The highest voltage power cable in the switchyard and control houses is 120 VAC and 125 VDC (note that 277 VAC is used for lighting). Coupling is prevented in low voltage control and instrumentation circuits using shielding and routing with messenger cables or grounded tray. Cables interconnecting microprocessor based relays and equipment are routed in the control house outside of cable tray containing low voltage power and control cable to prevent induced signals.
5.3.3.1	Control Systems	This Section recommends creating a separate radial ground system for control and instrument circuits to minimize electrical noise on these low voltage

IEEE Std C62.23 Section	Title	Justification
		circuits. NAPS does not use a radial ground system, but limits electrical noise on low voltage circuits by using grounded messenger cables in parallel with cable runs and using grounded, shielded cable in control circuits. This effectively prevents stray signals from being induced into control circuits. Microprocessor circuits are routed separately from power and control circuits within the control house. Relay racks and equipment cases are grounded to the substation ground grid.
5.3.3.2	Communications Systems	This Section recommends gathering communication circuit grounds at an isolated ground bus bar located on a communication backboard with the ground bus bar connected to ground by an insulated cable. At NAPS, telecommunications cables and communications/data circuits are gathered at the telephone backboard and grounded to a single isolated ground bar that is connected to the substation ground grid by an uninsulated ground cable. The uninsulated ground cable is equivalent to an insulated ground cable as it does not touch other circuits to create an unintentional ground loop prior to terminating at the switchyard ground.
5.3.3.3	Electrostatic Discharge	This Section recommends using antistatic floor material, computer-tile raised floors with pedestals properly grounded, or some other method of eliminating ion generation to prevent electrostatic discharge from equipment or humans. The NAPS control houses have bare concrete floors. The NAPS control houses have grounded racks with continuous grounds at the floor level and above the racks. Equipment cabinets are grounded to the racks. No problems have been identified warranting increased protection against static discharge.
5.3.4.1	Communication and Power Circuit Coupling	This Section recommends methods for reducing H field coupling for power and telecommunications cables run in parallel, and E field coupling for unshielded data and communication lines. At NAPS,

IEEE Std C62.23 Section	Title	Justification
		shielded control cable with messenger cables is used from switchyard components to the control house. Within the control house, shielded cable is used from electromechanical and solid state devices to data collectors. Shielded twisted pair cable is used from digital devices to data collectors. Fiber, which has no coupling capability, is run from the data collectors to points offsite.
5.3.4.2	Lightning-induced Voltages in Control Cables	This Section recommends use of telecommunications cables with grounded sheaths and grounding both ends of unused conductors for suppressing lightning induced transient voltages. Also, surge suppressors are recommended on power circuits. At NAPS, shielded control cable with messenger cables is used from switchyard components to the control house to provide protection from induced voltages that can result from ground potential rise due to lightning activity. Dominion grounds both ends of cable shields when run with messenger cables. Surge arresters are used on transformers and 34.5 kV circuits.
5.3.5.2	Sources of Interference	This Section identifies sources of noise that can radiate or be induced into switchyard cables and equipment. No specific recommendations for controlling these sources are provided. At NAPS, the use of shielded control cables with messenger cables minimizes induced signals. The messenger cables connect to cable tray internal to the control house to continue the messenger cable effect. Open racks are bonded to the same ground as the trays and messenger cable. The combination of messenger cable/shielded cable/continuously grounded open racks creates an envelope around equipment and conductors that minimizes signals induced from sources. Also, switchyard design specifies the use of corona free connections. Corona shots are periodically taken in the switchyard to identify abnormal localized corona levels and correct deficiencies causing them.

IEEE Std C62.23 Section	Title	Justification
5.3.5.6.2 a)	Grounding – Single-point guidelines for a multipoint grounding system	This sub-Section recommends wiring for computer equipment, communication, and control systems serviced within a control house to be connected to the multipoint ground system in only one place. The grounding system within the switchyard and control houses at NAPS (shielded cable with grounded tray and continuous grounding along the floor and ceiling and around the racks) is a standard Dominion method and provides an effective means of minimizing induced noise on control cables and inputs from yard equipment. Communications cables and data circuits are gathered at a telephone backboard and grounded to a single isolated ground bar that is connected to the substation ground grid by a single ground cable.

Messenger cables

Dominion uses several standard practices within switchyards to minimize the effects of induced signals from EMI and high energy transients. Shielded cables are typically used in control applications to mitigate the effects of high energy transients. EMI is reduced through the use of "messenger cables." Messenger cables are typically 4/0 cables run in parallel with control cable from the point of termination within field equipment back to the control house. The messenger cables are attached to the outside of conduit beginning where the control cable terminates, and run along the conduit to the point where it enters cable trough. The messenger cable then connects to one of two 4/0 messenger cables that run along the outside edges of the trough. Messenger cables inside cable trough are typically tied together and to the ground grid every 100 – 150 feet. At the control house, the messenger cables connect to cable tray within the house and to the copper bus bar above the relay panels. The messenger cables provide a low impedance path to current induced by voltage gradients developed in the ground grid. In the case of a power frequency fault, the messenger cables carry most of the fault currents thereby protecting the control cable shield conductors as they are grounded at both ends.

Proposed COLA Revision

None

ENCLOSURE 2

Response to NRC RAI Letter 78

RAI 5832, Question 08.02-62

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI No.: 5832 (RAI Letter 78)

SRP Section: 08.02 – Offsite Power System

QUESTIONS for Electrical Engineering Branch (EEB)

DATE of RAI issue: 07/14/2011

QUESTION NO.: 08.02-62

In response to RAI 5181, Question 08.02-47, Dominion stated that condition monitoring of underground or inaccessible cables within the scope of maintenance rule will be implemented. Confirm that 230 kV (normal preferred power supply) cable is included in the cable monitoring program.

Dominion Response

Dominion confirms that the 230 kV normal preferred power supply cable will be subject to appropriate monitoring under the maintenance rule, but the condition monitoring methods applied to medium and low voltage cable may be inappropriate for this high voltage cable. As reflected in the NRC's Generic Aging Lessons Learned (GALL) Report, "High voltage (> 35 kV) power cables and connections have unique, specialized constructions and must be evaluated on a plant-specific basis." The response to RAI 08.02-29 in Dominion letter NA3-08-121R dated December 01, 2008, stated that the 230 kV cable used for supplying the reserve station service transformers is specified to include a metallic sheath to prevent moisture ingress into the cable insulation. The response also stated that the metallic sheath is machine-applied to the cable core and mechanically sealed to form a continuous barrier against moisture. Further, the underground cable run is designed to be continuous with no splices to disturb the sheath. As further stated in the response to RAI 08.02-29, Dominion will inspect manholes associated with the normal preferred power supply every 6 months for water accumulation and corrective action will be taken if excessive water accumulation is found. These cable design requirements were added to FSAR Section 8.2.1.2 as indicated in the response to RAI 08.02-29. RAI 08.02-29 has been resolved and closed with no open issues by the NRC.

In accordance with the maintenance rule, the design and effectiveness of preventative maintenance will be assessed to establish the proper method for monitoring the health of this cable.

Proposed COLA Revision

None

ENCLOSURE 4

Response to NRC RAI Letter 78

RAI 5832, Question 08.02-64

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI No.: 5832 (RAI Letter 78)

SRP Section: 08.02 – Offsite Power System

QUESTIONS for Electrical Engineering Branch (EEB)

DATE of RAI issue: 07/14/2011

QUESTION NO.: 08.02-64

Response to RAI 5181, Question 08.02-54, stated that results of the study show that the most limiting maximum and minimum voltage variation of all cases studied is +2.68% (maximum deviation from nominal) to -1.67% (minimum deviation from nominal). Please provide the following information: (a) What is the nominal value? [500 kV nominal gives 491.65 kV as minimum voltage whereas FSAR indicates 505 kV as the minimum voltage] (b)The staff finds that the maximum switchyard voltage is 538.75kV (500x1.0775) per Revised System Impact study dated April 2011. Whereas FSAR specifies 534 kV. Revise FSAR to reflect the new maximum switchyard voltage of 538.75kV. (c) Provide basis for initial conditions of 1.048 and 1.0494 in stability study. Also, explain why the initial condition of 1.0494 is higher for contingency NP3 [Units 1 and 2 in refueling with trip of Unit 3]. (d) Short Circuit Study assumptions for pre-fault voltage is from linear network solution. What is the pre-fault voltage for short circuit analysis and its basis?

<u>Dominion Response</u>

<u>Part (a)</u>

The response to RAI 08.02-54 in letter NA3-11-003RA dated May 12, 2011, provided information regarding the updated system impact study, *PJM Generator Interconnection Q65 North Anna 500 kV (1594 MW Capacity) Revised System Impact Study and Facilities Study Report Resulting from Necessary Studies Agreement,* dated April 2011, that was performed as part of the grid reliability and stability analysis. In the response to RAI 08.02-54, the phrase "deviation from nominal" can be defined as the deviation from initial conditions voltage.

Summary of results tables were provided in the updated system impact study dated April 2011 for the cases of summer light load and summer peak load for contingencies NP1 thru NP5. The results table for each case showed the initial conditions voltage, the final steady state voltage, and the deviation, which is the difference between the two for contingencies NP1 through NP5. Therefore, a review of the Summer Light Load Case results table shows that the nominal voltage (initial condition voltage) is 1.048 per unit (pu) for contingencies NP1, NP2, NP4, and NP5, and is 1.0494 pu for contingency NP3. For the summer peak load cases, a review of the Summer Peak Load Case results table shows a nominal voltage (initial condition voltage) of 1.048 pu for contingencies NP1, NP2, NP3, NP4, and NP5.

Part (b)

FSAR Section 8.2.2.2 will be revised to show a switchyard voltage range of 505 kV to 540 kV.

Part (c)

When developing assumptions for stability cases, units are dispatched at the highest real power output and the least reactive power output as necessary to maintain voltage. This creates a condition that is most challenging for units to maintain stability. Thus, the summer light load case is the most conservative for stability purposes. When preparing the Necessary Studies as part of the updated system impact study, PJM dispatched North Anna Unit 3 at 1.048 pu voltage, which corresponds to maximum real power output and reactive power of -51.4 MVARS (about 0.98 leading on the high side of the GSU). This value was very close, and slightly worse than, the target of unity power factor at the high side of the GSUs. The power flow solution for the NP3 case returned an initial voltage of 1.0494 pu because Units 1 and 2 were initially modeled shut down (in refueling) and their generators were not available to regulate voltage at the North Anna switchyard. For consistency with the light load cases, the peak load cases were run with an initial voltage of 1.048 pu.

Part (d)

The linear network solution calculated pre-fault voltage for cases run in the Short Circuit Study portion of the Necessary Studies was 1.008 pu.

The Aspen One Liner program used by PJM to develop the short circuit studies allows the user to select a pre-fault voltage of 1.0 pu, 1.05 pu, or the results of a linear network solution. Dominion has historically used the "linear network solution voltage" for its fault duty studies. The initial program available to do this calculation, the Philadelphia Fault Study, used the linear network solution voltage as the only option available.

A fault duty study is inherently conservative since the fault levels are based on all known generation on the system (PJM in this case) being on-line at the time of the fault and thus capable of supplying fault current, and all faults are assumed to be bolted faults (zero impedance). The use of 1.05 pu for a pre-fault voltage is representative of a lightly loaded system with high voltage. In such a case, not all generating units would be in service and capable of supplying fault current. The use of 1.0 pu for a pre-fault voltage is representative of a more heavily loaded system that would reasonably expected to have most generating units in service and capable of supplying fault current.

Proposed COLA Revision

FSAR Section 8.2 will be revised as indicated on the attached markup.

Markup of North Anna COLA

The attached markup represents Dominion's good faith effort to show how the COLA will be revised in a future COLA submittal in response to the subject RAI. However, the same COLA content may be impacted by revisions to the DCD, responses to other COLA RAIs, other COLA changes, plant design changes, editorial or typographical corrections, etc. As a result, the final COLA content that appears in a future submittal may be somewhat different than as presented herein.

voltage schedule, these procedures verify the availability of required and contingency equipment and materials, and direct notifications to outside agencies, until the normal voltage schedule can be restored.

The TSO provides analysis capabilities for both Long Term Planning and Real Time Operations. System conditions are evaluated to ensure a bounding analysis and model parameters are selected that are influential in determining the system's ability to provide offsite power adequacy. Elements included in the analysis are system load forecasts (including sufficient margin to ensure a bounding analysis over the life of the study), system generator dispatch (including outages of generators known to be particularly influential in offsite power adequacy of affected nuclear units), outage schedules for transmission elements that have significant influence on offsite power adequacy, cross-system power transfers and power imports/exports, and system modification plans and schedules. A Real Time State Estimator is used to assist in the evaluation of actual system conditions. These capabilities are described in the System Analysis Protocol of the Switchyard Interface Agreement.

8.2.2.1 Applicable Criteria

NAPS DEP 8.2(1) Delete the first bullet line and following paragraph and the second bullet line and following paragraph in this section.

RAI 08.02-45 **NAPS COL 8.2(3)** Add the following sentence at the end of the paragraph following the twelfth bullet line in this section.

The site-specific portion of the offsite power supply design meets alternate standards for the North Anna switchyard lightning protection system design as described in Section 8.2.1.2.1.

NAPS COL 8.2(11) Add the following new subsections after DCD Subsection 8.2.2.1.

8.2.2.2 Grid Reliability and Stability Analysis

RAI 08.02-42
RAI 08.02-43
RAI 08.02-50
RAI 08.02-52
RAI 08.02-55

A system impact study was performed to assess the effects of interconnection of the 1900 MVA US-APWR on the transmission system in the areas of load flow, import/export capability, short circuit analysis, system stability, and voltage sensitivity. (Reference 8.2-201) The study was prepared using the 2013 light load base case and the 2014 summer peak case projections. The analysis was performed using Power Technology International Software PSS/E for load flow, import/export capability and stability evaluation, and ASPEN One-liner for short circuit evaluation.

The equipment considered is from the point of interconnection of Unit 3 at the switchyard out to the 500 kV transmission system. This includes the 230 kV buses and interconnections. The 34.5 kV portion of the North Anna switchyard is not modeled separately, but the 34.5 kV loads are considered at the 500 kV level. Maximum and minimum voltage limits have been established for the 500 kV switchyard at 534 kV and 505 kV, respectively. Maximum and minimum switchyard voltage limits have been established for the 500 kV switchyard at 540 kV and 505 kV, respectively.

RAI 08.02-64

The system was studied for stability and voltage sensitivity based on the following scenarios:

- Close in 3 phase faults cleared in primary time
- Close in 3 phase faults cleared in primary time with prior outage of selected transmission lines
- Close in breaker failure faults with delayed clearing
- Loss of largest generating unit
- Loss of most limiting transmission line
- Sequential loss of all generating units at North Anna
- Loss of North Anna Unit 3 with Units 1 and 2 in refueling
- Accident on North Anna Unit 3 with normal shutdown of Units 1 and 2
- Sudden simultaneous loss of Units 1 and 2 with Unit 3 operating

A separate case was studied and confirmed that after a turbine trip, adequate power to the RCPs is maintained for at least three seconds as required in the transient and accident analysis in Chapter 15.

The study concluded in all cases analyzed that the generator rotor angles and system voltage recover to acceptable operating points, with no unstable frequency deviations during the transients. Although in certain cases the maximum frequency decay rate exceeds 5 Hz/sec, the maximum low frequency variation for the most severe case is –0.585 Hz (minimum frequency of 59.415 Hz) prior to recovery to nominal frequency. Since all cases are stable, and worst case minimum frequency does not approach the minimum RCP speed setpoint of 95 percent (57 Hz), none of the cases result in either a reactor trip or reactor coolant