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Dominion®

March 17, 2011

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

Serial No. NA3-11-003R
Docket No. 52-017
COL/MWH

DOMINION VIRGINIA POWER
NORTH ANNA UNIT 3 COMBINED LICENSE APPLICATION
SRP 08.02: RESPONSE TO RAI LETTER 54

On February 3, 2011, the NRC requested additional information to support the review of certain portions of the North Anna Unit 3 Combined License Application (COLA). Of the nineteen questions, the responses to the following thirteen Request for Additional Information (RAI) Questions are provided in Enclosures 1 through 13:

- RAI 5181 Question 08.02-40 — Technical Specifications
- RAI 5181 Question 08.02-41 — Switchyard Interface Agreement
- RAI 5181 Question 08.02-43 — Switchyard Equipment Ratings (parts a, b, and c)
- RAI 5181 Question 08.02-44 — High Voltage Equipment Qualification
- RAI 5181 Question 08.02-46 — NERC Standards
- RAI 5181 Question 08.02-47 — Cable Monitoring Program
- RAI 5181 Question 08.02-48 — Transformer Fire Barriers
- RAI 5181 Question 08.02-49 — Switchyard Support Systems
- RAI 5181 Question 08.02-51 — Switchyard Protection Schemes
- RAI 5181 Question 08.02-53 — Anti-motoring Protective Relaying
- RAI 5181 Question 08.02-56 — Transmission System Reliability
- RAI 5181 Question 08.02-57 — FMEA of Switchyard Components
- RAI 5181 Question 08.02-58 — Switchyard Voltage Limits

This information will be incorporated into a future submission of the North Anna Unit 3 COLA, as described in the enclosures.

Responses to RAI 5181, Question 08.02-43, parts (d) and (e), and Questions 08.02-42, 45, 50, 52, 54, and 55 will be provided by May 15, 2011.

D089
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 17th day of March, 2011
My registration number is 7173057 and my
Commission expires: August 31, 2012

Wanda K. Marshall
Notary Public

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

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

Enclosures:

1. Response to NRC RAI Letter Number 54, RAI 5181 Question 08.02-40
2. Response to NRC RAI Letter Number 54, RAI 5181 Question 08.02-41
3. Response to NRC RAI Letter Number 54, RAI 5181 Question 08.02-43 (parts a, b, and c)
4. Response to NRC RAI Letter Number 54, RAI 5181 Question 08.02-44
5. Response to NRC RAI Letter Number 54, RAI 5181 Question 08.02-46
6. Response to NRC RAI Letter Number 54, RAI 5181 Question 08.02-47
7. Response to NRC RAI Letter Number 54, RAI 5181 Question 08.02-48
8. Response to NRC RAI Letter Number 54, RAI 5181 Question 08.02-49
9. Response to NRC RAI Letter Number 54, RAI 5181 Question 08.02-51
10. Response to NRC RAI Letter Number 54, RAI 5181 Question 08.02-53
11. Response to NRC RAI Letter Number 54, RAI 5181 Question 08.02-56
12. Response to NRC RAI Letter Number 54, RAI 5181 Question 08.02-57
13. Response to NRC RAI Letter Number 54, RAI 5181 Question 08.02-58

Commitments made by this letter:

1. Incorporate proposed changes in a future COLA submission.
2. Provide responses to RAI 5181, Question 08.02-43, parts (d) and (e), and Questions 08.02-42, 45, 50, 52, 54, and 55 by May 15, 2011.

ENCLOSURE 1

Response to NRC RAI Letter 54

RAI 5181 Question 08.02-40

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5181 (RAI Letter 54)

SRP SECTION: 08.02 – OFFSITE POWER SYSTEM

QUESTIONS for Electrical Engineering Branch (EEB)

DATE OF RAI ISSUE: 02/03/2011

QUESTION NO.: 08.02-40

FSAR Subsection 8.2.1.2.3 states that "Upon approaching or exceeding a limit, 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 maintained." Upon approaching or exceeding a limit, unit Technical Specification should be addressed. Please modify above statement to include "and address unit Technical Specifications."

Dominion Response

The intent of the referenced statement from FSAR Section 8.2.1.2.3 is that operating procedures are used to maintain switchyard voltage within the limits of the normal voltage schedule. These normal voltage schedule limits provide a margin to the minimum and maximum voltage required for operability of the offsite power source. The operating procedures implement actions to restore normal voltage schedule in advance of reaching any offsite power source operability limits. FSAR Section 8.2.1.2.3 will be clarified to indicate that the limits are in reference to the normal voltage schedule.

In addition, operating procedures provide guidance for addressing unit Technical Specifications associated with the offsite power source. Therefore, it is not necessary to provide guidance to address Technical Specifications within FSAR Section 8.2.1.2.3.

Proposed COLA Revision

FSAR Section 8.2.1.2.3 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.

Routine switchyard testing activities include, but are not necessarily limited to, the following:

- Semiannual dissolved gas analysis on transformers
- Biennial circuit breaker profile or timing tests
- Biennial 500 kV relay testing
- Triennial 230 kV relay testing
- 4-year dissolved gas analysis on transformer load tap changers
- 5-year battery discharge testing
- 8-year PT testing
- 8-year ground grid testing
- 10-year CCVT testing
- 10-year arrester testing
- 10-year wave trap testing

RAI 08.02-46

Switchyard protection system monitoring, maintenance, and testing are performed in accordance with North American Electric Reliability Corporation (NERC) Standard PRC-005-1, ~~"Transmission and Generation Protection System Maintenance and Testing,"~~ (Reference 8.2-207) Standard PRC-008-0, ~~"Underfrequency Load Shedding Equipment Maintenance Program,"~~ (Reference 8.2-208) and Standard PRC-017-0, ~~"Special Protection System Maintenance and Testing."~~ (Reference 8.2-209).

NAPS COL 8.2(1)

8.2.1.2.3 Communication with PJM

RAI 08.02-41

Dominion has established a Switchyard Interface Agreement and protocols for Maintenance, Communications, Switchyard Control, and System Analysis sufficient to safely operate and maintain the power station interconnection to the transmission system. The switchyard interface agreement and protocols were established to address INPO SOER 99-1 (Reference 8.2-212) and to implement the requirements of NERC NUC-001 (Reference 8.2-213). The Nuclear Switchyard Interface Agreement document provides the overall guidance to establish clear lines of ownership, responsibility, and interface between Dominion Electric Transmission, the Dominion Market Operations Center (responsible for communication and coordination with PJM), and North Anna Unit 3 during normal, potentially degrading, or degraded station or grid electrical voltage or frequency conditions.

Dominion Electric Transmission is the owner of transmission facilities within the Dominion retail service territory and is responsible for the reliable and safe operation of the system under the direction and control of PJM. The responsibilities include engineering, construction and maintenance of the switchyard components. Dominion Electric Transmission has the responsibility for coordinating switchyard work. Within the switchyard, Dominion Electric Transmission normally performs switching operations above 34.5 kV. The switchyard interface agreement specifies the required notifications that the Dominion Electric Transmission system operations center (SOC) must provide to North Anna Unit 3 regarding the status of the transmission system. Notification to the operations shift manager is required when the normal or emergency voltage or frequency limits will be exceeded if a single contingency occurs and the SOC cannot effectively mitigate the conditions to avoid the violation, or the SOC has lost the ability to assess the condition of the offsite electrical distribution system.

The operations shift manager has the responsibility for the safe operation of North Anna Unit 3, including authorizing the operation and maintenance of switchyard equipment.

RAI 08.02-40

~~Normal operating and abnormal~~ Operating procedures exist to maintain the switchyard voltage within the limits of the normal voltage schedule ~~and address challenges to the maximum and minimum limits~~. Upon ~~approaching or exceeding a limit~~ deviation from the normal 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 ~~maintained~~ 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

ENCLOSURE 2

Response to NRC RAI Letter 54

RAI 5181 Question 08.02-41

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5181 (RAI Letter 54)

SRP SECTION: 08.02 – OFFSITE POWER SYSTEM

QUESTIONS for Electrical Engineering Branch (EEB)

DATE OF RAI ISSUE: 02/03/2011

QUESTION NO.: 08.02-41

FSAR Section 8.2.1.2.3 states that Dominion has established a switchyard interface agreement and protocols for maintenance, communication, switchyard controls and system analysis sufficient to safely operate and maintain the power station interconnection to the transmission system. Provide in the FSAR details of such agreement and the split of responsibilities among the entities regarding operation, maintenance and engineering pertaining to the transmission system, including the control of the 500 kV and 230 kV breakers located at the switchyard. In addition, does the interface agreement require that the operators be notified of periods when the system operator is unable to determine if offsite power voltage and capacity is inadequate?

Dominion Response

As stated in FSAR Section 8.2.1.2.3, Dominion has established a switchyard interface agreement and protocols for maintenance, communications, switchyard control, and system analysis sufficient to safely operate and maintain the power station interconnection to the transmission system. The switchyard interface agreement and protocols were established to address INPO Significant Operating Experience Report (SOER) 99-1, Loss of Grid, and to implement the requirements of NERC Standard NUC-001-1, Nuclear Plant Interface Coordination. The Nuclear Switchyard Interface Agreement document provides the overall guidance to establish clear lines of ownership, responsibility, and interface between Dominion Electric Transmission, the Dominion Market Operations Center (responsible for communication and coordination with PJM), and North Anna Unit 3 during normal, potentially degrading, or degraded station or grid electrical voltage or frequency conditions.

Dominion Electric Transmission is the owner of transmission facilities within the Dominion retail service territory and is responsible for the reliable and safe operation of the system under the direction and control of PJM. The responsibilities include engineering, construction and maintenance of the North Anna switchyard components. Dominion Electric Transmission has

the responsibility for coordinating switchyard work. Within the switchyard, Dominion Electric Transmission normally performs switching operations above 34.5 kV. The switchyard interface agreement specifies required notifications that the Dominion Electric Transmission system operations center (SOC) must provide to North Anna Unit 3 regarding the status of the transmission system. Notification to the operations shift manager is required when the normal or emergency voltage or frequency limits will be exceeded if a single contingency occurs and the SOC cannot effectively mitigate the conditions to avoid the violation, or the SOC has lost the ability to assess the condition of the offsite electrical distribution system.

The operations shift manager has the responsibility for the safe operation of North Anna Unit 3, including authorizing the operation and maintenance of switchyard equipment.

Proposed COLA Revision

FSAR Section 8.2.1.2.3 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.

Routine switchyard testing activities include, but are not necessarily limited to, the following:

- Semiannual dissolved gas analysis on transformers
- Biennial circuit breaker profile or timing tests
- Biennial 500 kV relay testing
- Triennial 230 kV relay testing
- 4-year dissolved gas analysis on transformer load tap changers
- 5-year battery discharge testing
- 8-year PT testing
- 8-year ground grid testing
- 10-year CCVT testing
- 10-year arrester testing
- 10-year wave trap testing

RAI 08.02-46

Switchyard protection system monitoring, maintenance, and testing are performed in accordance with North American Electric Reliability Corporation (NERC) Standard PRC-005-1, ~~"Transmission and Generation Protection System Maintenance and Testing,"~~ (Reference 8.2-207) Standard PRC-008-0, ~~"Underfrequency Load Shedding Equipment Maintenance Program,"~~ (Reference 8.2-208) and Standard PRC-017-0, ~~"Special Protection System Maintenance and Testing."~~ (Reference 8.2-209).

NAPS COL 8.2(1)

8.2.1.2.3 Communication with PJM

RAI 08.02-41

Dominion has established a Switchyard Interface Agreement and protocols for Maintenance, Communications, Switchyard Control, and System Analysis sufficient to safely operate and maintain the power station interconnection to the transmission system. The switchyard interface agreement and protocols were established to address INPO SOER 99-1 (Reference 8.2-212) and to implement the requirements of NERC NUC-001 (Reference 8.2-213). The Nuclear Switchyard Interface Agreement document provides the overall guidance to establish clear lines of ownership, responsibility, and interface between Dominion Electric Transmission, the Dominion Market Operations Center (responsible for communication and coordination with PJM), and North Anna Unit 3 during normal, potentially degrading, or degraded station or grid electrical voltage or frequency conditions.

Dominion Electric Transmission is the owner of transmission facilities within the Dominion retail service territory and is responsible for the reliable and safe operation of the system under the direction and control of PJM. The responsibilities include engineering, construction and maintenance of the switchyard components. Dominion Electric Transmission has the responsibility for coordinating switchyard work. Within the switchyard, Dominion Electric Transmission normally performs switching operations above 34.5 kV. The switchyard interface agreement specifies the required notifications that the Dominion Electric Transmission system operations center (SOC) must provide to North Anna Unit 3 regarding the status of the transmission system. Notification to the operations shift manager is required when the normal or emergency voltage or frequency limits will be exceeded if a single contingency occurs and the SOC cannot effectively mitigate the conditions to avoid the violation, or the SOC has lost the ability to assess the condition of the offsite electrical distribution system.

The operations shift manager has the responsibility for the safe operation of North Anna Unit 3, including authorizing the operation and maintenance of switchyard equipment.

RAI 08.02-40

~~Normal operating and abnormal~~ Operating procedures exist to maintain the switchyard voltage within the limits of the normal voltage schedule ~~and address challenges to the maximum and minimum limits~~. Upon ~~approaching or exceeding a limit~~ deviation from the normal 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 ~~maintained~~ 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

8.2(12) ***Deleted from the DCD.***

8.2.5 References

8.2-201 PJM Generator Interconnection Q65 North Anna 500 kV System Impact Study, June 2007

8.2-202 VA PJM Design and Application of Overhead Transmission Lines 69kV and above, May 20, 2002

8.2-203 IEEE Std 1313.2-1999 (R2005), "IEEE Guide for the Application of Insulation Coordination"

8.2-204 IEEE Std C62.22-2009, "IEEE Guide for the Application of Metal-Oxide Surge Arresters for Alternating-Current Systems"

8.2-205 IEEE Std 998-1996 (R2002), "IEEE Guide for Direct Lightning Stroke Shielding of Substations"

8.2-206 Hileman, A. R.: Insulation Coordination for Power Systems; Taylor & Francis, Inc., Boca Raton, FL, 1999

RAI 08.02-46 8.2-207 NERC Standard PRC-005-1, "Transmission and Generation Protection System Maintenance and Testing," May 1, 2006

RAI 08.02-46 8.2-208 NERC Standard PRC-008-0, "Implementation and Documentation of Underfrequency Load Shedding Equipment Maintenance Program," April 1, 2005

RAI 08.02-46 8.2-209 NERC Standard PRC-017-0, "Special Protection System Maintenance and Testing," April 1, 2005

RAI 08.02-49 8.2-210 IEEE Std 485-1997, "IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications"

RAI 08.02-49 8.2-211 IEEE Std 80-2000, "IEEE Guide for Safety in AC Substation Grounding"

RAI 08.02-41 8.2-212 INPO Significant Operating Experience Report (SOER) 99-1, "Loss of Grid," dated December 27, 1999 and SOER 99-1 "Loss of Grid – Addendum," dated December 9, 2004

RAI 08.02-41 8.2-213 NERC Standard NUC-001, Revision 1, "Nuclear Plant Interface Coordination"

ENCLOSURE 3

Response to NRC RAI Letter 54

RAI 5181 Question 08.02-43 (parts a, b, and c)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5181 (RAI Letter 54)

SRP SECTION: 08.02 – OFFSITE POWER SYSTEM

QUESTIONS for Electrical Engineering Branch (EEB)

DATE OF RAI ISSUE: 02/03/2011

QUESTION NO.: 08.02-43

FSAR Subsection 8.2.1.2.1 provides ratings of transformers, breakers, transmission lines and bus work. Please provide the following in the FSAR: (a) The ratings of disconnect switches, (b) identifiers for transformers in the text of FSAR Subsection 8.2.1.2.1, (c) the switchyard bus bracing values, (d) the maximum available fault current from the system and confirm that the breaker interrupting ratings, both symmetrical and asymmetrical, are consistent with the available fault, and (e) statements of assumptions and results of short circuit analysis.

Dominion Response

Part (a)

FSAR 8.2.1.2.1 will be revised to indicate the ratings of the disconnect switches located in the North Anna switchyard.

Part (b)

FSAR 8.2.1.2.1 will be revised to identify the transformers located in the switchyard consistent with the identifiers used in FSAR Figure 8.2-201. FSAR Section 8.2.1.2.1 will also be revised to clarify the types of protection relays provided for the transformers.

Part (c)

FSAR 8.2.1.2.1 will be revised to indicate the switchyard bus bracing values for bus work located in the North Anna switchyard.

Parts (d) and (e)

As stated in FSAR Section 8.2.2.2, Dominion has requested a new study of grid reliability and stability from PJM to verify that the change in technology from the ESBWR to the US-APWR does not adversely affect any system capabilities. PJM is expected to complete this study in the

first quarter of 2011 and Dominion will provide the response to parts (d) and (e) of the question following review of the results of the study.

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.

NAPS COL 8.2(4)
NAPS COL 8.2(5)

Add the following information after the last sentence of the second paragraph in DCD Subsection 8.2.1.2.

Neither the grid stability analysis in Subsection 8.2.2.2 nor the failure modes and effects analysis (FMEA) in Subsection 8.2.2.3 identified the non-safety related offsite power system as risk-significant during any mode of plant operation.

STD* COL 8.2(10)

Replace the last sentence of the fifteenth paragraph in DCD Subsection 8.2.1.2 with the following.

In case of a sudden pressure relay operation, the transformer is isolated.

NAPS COL 8.2(4)
NAPS COL 8.2(5)

Replace the second sentence of the eighteenth paragraph in DCD Subsection 8.2.1.2 with the following

Minimum one-hour fire barriers are provided between all transformers. Cables associated with the normal and alternate PPS between the switchyard and the electrical room in the T/B are routed in separate underground duct bank. Normal and alternate PPS cables are physically separated which minimizes the chance of simultaneous failure. The underground duct bank for these circuits is sealed to prevent degradation in wetted or submerged condition.

8.2.1.2.1 **Switchyard**

NAPS COL 8.2(3)

Replace the content of DCD Subsection 8.2.1.2.1 with the following.

The NAPS switchyard, is a 500/230 kV, air-insulated, breaker-and-a-half bus arrangement. Unit 3 is connected to this switchyard by an overhead 500 kV circuit for the alternate preferred power supply and an underground 230 kV circuit for the normal preferred power supply. The two circuits are physically and electrically independent.

The physical location and electrical interconnection of the switchyard is shown on Figure 8.2-201 and Figure 8.2-202.

RAI 08.02-49 **NAPS COL 8.2(8)**
NAPS COL 8.2(9)

~~Control and relay protection systems are provided. Support systems, such as grounding, raceway, lighting, AC/DC station service, and switchyard lightning protection, are also provided.~~

AC Power is fed to the 500 kV and 230 kV switchyard control houses from switchyard service transformers. Each switchyard service

transformer is a 19.9 kV/120-240V transformer and is aligned using manual throw switches. Multiple switchyard service transformers can be aligned to both the 500 kV and 230 kV control houses.

DC power for the 500 kV switchyard controls is provided by two systems from separate and completely independent batteries and chargers. Each DC system in the 500 kV house consists of a single lead-acid storage battery maintained by two chargers (one as normal and one as backup). The batteries are located in separate, ventilated rooms of the control house. The chargers are located in the same room in the central part of the control house and are separated to minimize interaction. The 500 kV control house battery chargers can be fed from any of the AC power sources supplying the 500 kV control house, but are typically powered from separate sources.

DC power for the 230 kV switchyard controls is provided by a separate system located in the 230 kV switchyard control house. This system consists of a single lead-acid storage battery maintained by two chargers (one as normal and one as backup). The 230 kV control house battery chargers are fed from the AC power source supplying the 230 kV control house.

The batteries are sized in accordance with Dominion substation engineering standards and the sizing is verified using the manufacturer's sizing program that adheres to battery sizing methodologies found in IEEE 485 (Reference 8.2-210). Battery charger sizing is verified in accordance with Dominion substation engineering standards.

The switchyard grounding system, which overlays an older grounding system, was designed and installed in accordance with the Dominion Substation Engineering Manual and IEEE 80 (Reference 8.2-211). In accordance with IEEE 80, the switchyard ground grid resistance is less than 1 ohm.

The North Anna switchyard uses surge suppressors on the high and low sides of Transformers 1, 2, 3, 5, and 6. The insulation coordination and surge protective devices are applied in compliance with IEEE 1313.2 (Reference 8.2-203) and IEEE C62.22 (Reference 8.2-204). The surge protective devices are maintained according to NEMA requirements and manufacturer's recommendations.

A shield wire arrangement is designed for lightning abatement in the switchyard in accordance with IEEE 62.22 (Reference 8.2-204),

IEEE 998 (Reference 8.2-205), and reference book entitled "Insulation Coordination for Power Systems"(Reference 8.2-206).

RAI 08.02-43

The capacity and electrical characteristics for switchyard equipment are as follows:

Transformers	Voltage Rating	MVA Rating
~~Transformer~~ 1 and 2	500/~~230~~ 36.5 kV	~~67.2/89.6/112~~ 60/80/100/112
3	230/36.5 kV	67.2/89.6/112
~~Transformer~~ 5 and 6	500/230 kV	~~112/145~~ 67.2/89.6/112

Breakers	Max Design ~~(kV)~~ Voltage	Rated Current ~~(A)~~	Interrupting Current at Max kV
500 kV	550 kV	3000A	50 kAIC
230 kV	242 kV	2000A	40 kAIC

Disconnect Switch	Maximum Voltage	Basic Impulse Insulation Level	Continuous Current Rating
500 kV	550 kV	1550 kV	3000A
230 kV	242 kV	900 kV	2000A

Transmission Lines	Rated Current at 100°F
500 kV	3954A
230 kV	2190A

Bus Work	Rated Current at 100°F	Short Circuit Current (Bus Bracing Limit)
500 kV	3891A	50 kA
230 kV	2750A	40 kA

NAPS COL 8.2(7)

The 500 kV transmission lines are protected with redundant high-speed relay schemes with re-closing and communication equipment to minimize line outages. The 500 kV switchyard buses have redundant bus differential protection using separate and independent current and control circuits. Generating unit tie-lines and auxiliary transformer underground

RAI 08.02-43

cable circuits are protected with redundant high-speed relay schemes. ~~Transformers are protected with differential and over-current relay schemes.~~ Transformers 1 and 2 are protected with differential relays. Transformer 3, 5, and 6 are protected with differential relays and overcurrent relays.

Dominion is responsible for engineering, constructing, operating, and maintaining its electric transmission system, and for interfacing with PJM, the Regional Transmission Organization (RTO). Dominion's responsibility includes designing, maintaining, and operating all switchyard protective relaying associated with connecting Unit 3 to the North Anna switchyard. PJM studied the interconnection of Unit 3 to the North Anna switchyard and recommended no additional design requirements above those typically used by Dominion in the design of the protective relaying scheme at the switchyard.

500 kV breakers are equipped with dual trip coils. Each redundant protection circuit is powered from its redundant DC power load group and connected to a separate trip coil. Equipment and cabling associated with each redundant system is physically separated from its redundant counterpart. Breakers are provided with a breaker failure scheme that isolates a breaker that fails to trip due to a malfunction.

NAPS COL 8.2(3)

8.2.1.2.2 Switchyard and Transmission lines Testing and Inspection

Transmission lines are inspected via an aerial inspection program approximately twice per year. The inspection focuses on such items as right-of-way encroachment, vegetation management, conductor and line hardware condition, and the condition of supporting structures.

Routine switchyard inspection activities include, but are not necessarily limited to, the following:

- Daily transformer inspections
- Periodic inspections of circuit breakers and batteries
- Quarterly infrared scans
- Semi-annual infrared scans (relay panels)
- Semi-annual inspection of substation equipment
- Annual infrared scans
- Annual corona camera scan

ENCLOSURE 4

Response to NRC RAI Letter 54

RAI 5181 Question 08.02-44

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5181 (RAI Letter 54)

SRP SECTION: 08.02 – OFFSITE POWER SYSTEM

QUESTIONS for Electrical Engineering Branch (EEB)

DATE OF RAI ISSUE: 02/03/2011

QUESTION NO.: 08.02-44

US-APWR DCD, Rev.2, Subsection 8.2.1.2 states that high voltage circuit breakers are sized and designed in accordance with IEEE Std. C37.010 and C37.06. The US-APWR DCD further states that high voltage disconnect switches are sized and designed in accordance with IEEE Std. C37.32. Confirm that high voltage circuit breakers and disconnect switches will meet above qualifications. Discuss why these IEEE Standards are not included in North Anna 3 FSAR.

Dominion Response

The content of DCD Section 8.2.1.2, Offsite Power System, that references IEEE Standards C37.010, C37.06, and C37.32 (i.e., the fourteenth paragraph) for the sizing and design of high voltage circuit breakers and disconnect switches is incorporated by reference into the FSAR as stated in FSAR Section 8.2. The content of DCD Section 8.2.5, References, which lists IEEE Standards C37.010, C37.06, and C37.32, is also incorporated by reference into the FSAR. Therefore, North Anna Unit 3 high voltage circuit breakers and disconnect switches will meet requirements of the cited IEEE Standards and these standards are included in the North Anna Unit 3 FSAR.

Proposed COLA Revision

None

ENCLOSURE 5

Response to NRC RAI Letter 54

RAI 5181 Question 08.02-46

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5181 (RAI Letter 54)

SRP SECTION: 08.02 – OFFSITE POWER SYSTEM

QUESTIONS for Electrical Engineering Branch (EEB)

DATE OF RAI ISSUE: 02/03/2011

QUESTION NO.: 08.02-46

FSAR Subsection 8.2.1.2.2 states that switchyard protection system monitoring, maintenance, and testing are performed in accordance with NERC Standards (PRC-005-1, PRC-008-0, and PRC-017-0). Please include these standards in Section 8.2.5, "Reference."

Dominion Response

The NERC Standards (PRC-005-1, PRC-008-0, and PRC-017-0) identified in FSAR Section 8.2.1.2.2 will be included in FSAR Section 8.2.5, References.

Proposed COLA Revision

FSAR Sections 8.2.1.2.2 and 8.2.5 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.

cable circuits are protected with redundant high-speed relay schemes.

RAI 08.02-43

~~Transformers are protected with differential and over-current relay schemes.~~ Transformers 1 and 2 are protected with differential relays. Transformer 3, 5, and 6 are protected with differential relays and overcurrent relays.

Dominion is responsible for engineering, constructing, operating, and maintaining its electric transmission system, and for interfacing with PJM, the Regional Transmission Organization (RTO). Dominion's responsibility includes designing, maintaining, and operating all switchyard protective relaying associated with connecting Unit 3 to the North Anna switchyard. PJM studied the interconnection of Unit 3 to the North Anna switchyard and recommended no additional design requirements above those typically used by Dominion in the design of the protective relaying scheme at the switchyard.

500 kV breakers are equipped with dual trip coils. Each redundant protection circuit is powered from its redundant DC power load group and connected to a separate trip coil. Equipment and cabling associated with each redundant system is physically separated from its redundant counterpart. Breakers are provided with a breaker failure scheme that isolates a breaker that fails to trip due to a malfunction.

NAPS COL 8.2(3)

8.2.1.2.2 Switchyard and Transmission lines Testing and Inspection

Transmission lines are inspected via an aerial inspection program approximately twice per year. The inspection focuses on such items as right-of-way encroachment, vegetation management, conductor and line hardware condition, and the condition of supporting structures.

Routine switchyard inspection activities include, but are not necessarily limited to, the following:

- Daily transformer inspections
- Periodic inspections of circuit breakers and batteries
- Quarterly infrared scans
- Semi-annual infrared scans (relay panels)
- Semi-annual inspection of substation equipment
- Annual infrared scans
- Annual corona camera scan

Routine switchyard testing activities include, but are not necessarily limited to, the following:

- Semiannual dissolved gas analysis on transformers
- Biennial circuit breaker profile or timing tests
- Biennial 500 kV relay testing
- Triennial 230 kV relay testing
- 4-year dissolved gas analysis on transformer load tap changers
- 5-year battery discharge testing
- 8-year PT testing
- 8-year ground grid testing
- 10-year CCVT testing
- 10-year arrester testing
- 10-year wave trap testing

RAI 08.02-46

Switchyard protection system monitoring, maintenance, and testing are performed in accordance with North American Electric Reliability Corporation (NERC) Standard PRC-005-1, ~~"Transmission and Generation Protection System Maintenance and Testing,"~~ (Reference 8.2-207) Standard PRC-008-0, ~~"Underfrequency Load Shedding Equipment Maintenance Program,"~~ (Reference 8.2-208) and Standard PRC-017-0, ~~"Special Protection System Maintenance and Testing."~~ (Reference 8.2-209).

NAPS COL 8.2(1)

8.2.1.2.3 **Communication with PJM**

RAI 08.02-41

Dominion has established a Switchyard Interface Agreement and protocols for Maintenance, Communications, Switchyard Control, and System Analysis sufficient to safely operate and maintain the power station interconnection to the transmission system. The switchyard interface agreement and protocols were established to address INPO SOER 99-1 (Reference 8.2-212) and to implement the requirements of NERC NUC-001 (Reference 8.2-213). The Nuclear Switchyard Interface Agreement document provides the overall guidance to establish clear lines of ownership, responsibility, and interface between Dominion Electric Transmission, the Dominion Market Operations Center (responsible for communication and coordination with PJM), and North Anna Unit 3 during normal, potentially degrading, or degraded station or grid electrical voltage or frequency conditions.

8.2(12) ***Deleted from the DCD.***

8.2.5 References

8.2-201 PJM Generator Interconnection Q65 North Anna 500 kV System Impact Study, June 2007

8.2-202 VA PJM Design and Application of Overhead Transmission Lines 69kV and above, May 20, 2002

8.2-203 IEEE Std 1313.2-1999 (R2005), "IEEE Guide for the Application of Insulation Coordination"

8.2-204 IEEE Std C62.22-2009, "IEEE Guide for the Application of Metal-Oxide Surge Arresters for Alternating-Current Systems"

8.2-205 IEEE Std 998-1996 (R2002), "IEEE Guide for Direct Lightning Stroke Shielding of Substations"

8.2-206 Hileman, A. R.: Insulation Coordination for Power Systems; Taylor & Francis, Inc., Boca Raton, FL, 1999

RAI 08.02-46 8.2-207 NERC Standard PRC-005-1, "Transmission and Generation Protection System Maintenance and Testing," May 1, 2006

RAI 08.02-46 8.2-208 NERC Standard PRC-008-0, "Implementation and Documentation of Underfrequency Load Shedding Equipment Maintenance Program," April 1, 2005

RAI 08.02-46 8.2-209 NERC Standard PRC-017-0, "Special Protection System Maintenance and Testing," April 1, 2005

RAI 08.02-49 8.2-210 IEEE Std 485-1997, "IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications"

RAI 08.02-49 8.2-211 IEEE Std 80-2000, "IEEE Guide for Safety in AC Substation Grounding"

RAI 08.02-41 8.2-212 INPO Significant Operating Experience Report (SOER) 99-1, "Loss of Grid," dated December 27, 1999 and SOER 99-1 "Loss of Grid – Addendum," dated December 9, 2004

RAI 08.02-41 8.2-213 NERC Standard NUC-001, Revision 1, "Nuclear Plant Interface Coordination"

ENCLOSURE 6

Response to NRC RAI Letter 54

RAI 5181 Question 08.02-47

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5181 (RAI Letter 54)

SRP SECTION: 08.02 - OFFSITE POWER SYSTEM

QUESTIONS for Electrical Engineering Branch (EEB)

DATE OF RAI ISSUE: 02/03/2011

QUESTION NO.: 08.02-47

Chapter 8 of the applicant's Combined License Application did not discuss the cable monitoring program for underground and inaccessible cables within the scope of the maintenance rule. 10 CFR 50.65(a)(1) which states that, "Each holder of a license to operate a nuclear plant ... shall monitor the performance or condition of structures, systems, or components... in a manner sufficient to provide reasonable assurance that such structures, systems, and components... are capable of fulfilling their intended functions." Additionally, Standard Review Plan Section 8.2.III.1.L, states, "Operating experience has shown that undetected degradation of underground ...could result in multiple equipment failures. Underground or inaccessible power and control cable runs that are susceptible to protracted exposure to wetted environments or submergence... should be reviewed." Guidance providing an acceptable means of meeting 10 CFR 50.65(a)(1) requirements with respect to the selection of electric cable condition monitoring can be found in Sections 3 and 4.5 of NUREG/CR-7000.

Also, as stated in COL Information Item 17.6(1):

> *The COL applicant must provide in its FSAR a description of the maintenance rule program, and its implementation, for monitoring the effectiveness of maintenance necessary to meet the requirements of 10 CFR 50.65.*

Since the staff did not find a discussion of a cable monitoring program for underground and inaccessible cables within the scope of the maintenance rule as required by 10 CFR 50.65(a)(1), describe the monitoring program for underground and inaccessible cables (power, control and instrumentation) under the maintenance rule and revise the FSAR to reflect this information.

Dominion Response

Cable monitoring will be considered as part of 10 CFR 50.65 maintenance rule program implementation. Maintenance rule implementation is discussed in FSAR Section 17.6. The

maintenance rule program will not be implemented until prior to Fuel Load (refer to FSAR Table 13.4-201); as such, specific information necessary to determine appropriate inspections, tests and monitoring is not available at this time. In order to determine the method and frequency, a review of detailed design and procurement information is needed. NUREG/CR-7000 provides detailed recommendations on implementing a cable condition monitoring program. This NUREG was released in January of 2010 and is under evaluation by industry. However, the latest industry experience and other available information, including consideration of Generic Letter 2007-01, *Inaccessible or Underground Power Cable Failures That Disable Accident Mitigation Systems or Cause Plant Transients*, and NUREG/CR-7000, will be followed in developing a cable condition monitoring program as part of the maintenance rule program.

To supplement the existing FSAR text addressing COL Item 17.6(1), a description of the cable monitoring aspect of the maintenance rule program will be added to FSAR, Section 17.6.

Proposed COLA Revision

FSAR Section17.6 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.

The text of the template provided in NEI 07-02A is generically numbered as "17.X" and "17.Y." When the template is incorporated by reference into this FSAR, section numbering is changed from "17.X" to "17.6.2" and from "17.Y" to "17.4."

Descriptions of the programs listed in Subsection 17.6.2.3 of NEI 07-02A are provided in the following FSAR chapters/sections or Part 4:

- Maintenance Rule Program (Section 17.6)
- Quality Assurance Program (Chapter 17)
- Inservice Inspection Program (Sections 5.2 and 6.6)
- Inservice Testing Program (Sections 3.9 and 5.2)
- Technical Specifications Surveillance Test Program (Part 4)

Condition monitoring of underground or inaccessible cables is incorporated into the maintenance rule program. The cable condition monitoring program incorporates lessons learned from industry operating experience, addresses regulatory guidance, and utilizes information from detailed design and procurement documents to determine the appropriate inspections, tests and monitoring criteria for underground and inaccessible cables within the scope of the maintenance rule (i.e., 10 CFR 50.65).

17.6.3 **Reference**

17.6-201 *Generic FSAR Guidance for Maintenance Rule Program Description for Plants Licensed Under 10 CFR Part 52*, NEI 07-02A, Revision 0, NEI, March 2008.

ENCLOSURE 7

Response to NRC RAI Letter 54

RAI 5181 Question 08.02-48

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5181 (RAI Letter 54)

SRP SECTION: 08.02 – OFFSITE POWER SYSTEM

QUESTIONS for Electrical Engineering Branch (EEB)

DATE OF RAI ISSUE: 02/03/2011

QUESTION NO.: 08.02-48

FSAR Subsection 8.2.1.2 states that "Minimum one-hour fire barriers are provided between all transformers." This appears to conflict with the US-APWR DCD, Rev.2, Subsection 8.2.1.2 requirements of three-hour rated barriers. Either clarify this or provide justification for the departure.

Dominion Response

US-APWR DCD, Revision 2, Section 8.2.1.2 description of fire barriers associated with main transformer (MT), unit auxiliary transformers (UATs) and reserve auxiliary transformers (RATs) refers to the 3-hour rated fire barriers between the area where the MT and UATs are located and the area where the RATs are located to ensure separation requirements are met for the normal and alternate preferred power supplies. The requirement for a fire-rated barrier between individual transformers is stated in DCD Table 9.5.1-2, US-APWR Fire Protection Program Conformance with NFPA 804, Sheet 48 of 54, as "A minimum 1-hour rated fire barrier or a distance of 30 ft. shall be provided between adjacent transformers," which is in accordance with NFPA 804, Paragraph 10.23.1.1.

FSAR Section 8.2.1.2 states that a minimum one-hour fire barrier is provided between transformers, which is consistent with DCD Table 9.5.1-2 and NFPA 804 requirements.

Proposed COLA Revision

None

ENCLOSURE 8

Response to NRC RAI Letter 54

RAI 5181 Question 08.02-49

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5181 (RAI Letter 54)

SRP SECTION: 08.02 – OFFSITE POWER SYSTEM

QUESTIONS for Electrical Engineering Branch (EEB)

DATE OF RAI ISSUE: 02/03/2011

QUESTION NO.: 08.02-49

COL Items 8.2(8) and (9) are not described adequately. The FSAR states that support systems, such as grounding, raceway, lighting, AC/DC station service, and switchyard lightning protection are also provided. Describe in the FSAR AC/DC station service and grounding in detail, including physical location, duty cycle of DC system, total ground resistance for grounding system, and how they meet applicable industry standards and regulatory guides, etc.

Dominion Response

AC power is fed to the 500 kV and 230 kV switchyard control houses from switchyard service transformers. Each switchyard service transformer is a 19.9 kV/120-240V transformer and is aligned using manual throw switches. Multiple switchyard service transformers can be aligned to both the 500 kV and 230 kV control houses.

DC power for the 500 kV switchyard controls is provided by two systems from separate and completely independent batteries and chargers. Each DC system in the 500 kV control house consists of a single lead-acid storage battery maintained by two chargers (one as normal and one as backup). The batteries are located in separate, ventilated rooms of the control house. The chargers are located in the same room in the central part of the control house and are separated to minimize interaction. The 500 kV control house battery chargers can be fed from any of the AC power sources supplying the 500 kV control house, but are typically powered from separate sources.

DC power for the 230 kV switchyard controls is provided by a separate system located in the 230 kV switchyard control house. This system consists of a single lead-acid storage battery maintained by two chargers (one as normal and one as backup). The 230 kV control house battery chargers are fed from the AC power source supplying the 230 kV control house.

The batteries are sized in accordance with Dominion substation engineering standards and the sizing is verified using the manufacturer's sizing program that adheres to battery sizing methodologies found in IEEE 485-1997, *IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications*. Battery charger sizing is verified in accordance with Dominion substation engineering standards.

The switchyard grounding system, which overlays an older grounding system, was designed and installed in accordance with the Dominion Substation Engineering Manual and IEEE 80-2000, *IEEE Guide for Safety in AC Substation Grounding*. In accordance with IEEE 80, the switchyard ground grid resistance is less than 1 ohm.

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.

NAPS COL 8.2(4)
NAPS COL 8.2(5)

Add the following information after the last sentence of the second paragraph in DCD Subsection 8.2.1.2.

Neither the grid stability analysis in Subsection 8.2.2.2 nor the failure modes and effects analysis (FMEA) in Subsection 8.2.2.3 identified the non-safety related offsite power system as risk-significant during any mode of plant operation.

STD* COL 8.2(10)

Replace the last sentence of the fifteenth paragraph in DCD Subsection 8.2.1.2 with the following.

In case of a sudden pressure relay operation, the transformer is isolated.

NAPS COL 8.2(4)
NAPS COL 8.2(5)

Replace the second sentence of the eighteenth paragraph in DCD Subsection 8.2.1.2 with the following

Minimum one-hour fire barriers are provided between all transformers. Cables associated with the normal and alternate PPS between the switchyard and the electrical room in the T/B are routed in separate underground duct bank. Normal and alternate PPS cables are physically separated which minimizes the chance of simultaneous failure. The underground duct bank for these circuits is sealed to prevent degradation in wetted or submerged condition.

8.2.1.2.1 **Switchyard**

NAPS COL 8.2(3)

Replace the content of DCD Subsection 8.2.1.2.1 with the following.

The NAPS switchyard, is a 500/230 kV, air-insulated, breaker-and-a-half bus arrangement. Unit 3 is connected to this switchyard by an overhead 500 kV circuit for the alternate preferred power supply and an underground 230 kV circuit for the normal preferred power supply. The two circuits are physically and electrically independent.

The physical location and electrical interconnection of the switchyard is shown on Figure 8.2-201 and Figure 8.2-202.

RAI 08.02-49 **NAPS COL 8.2(8)**
NAPS COL 8.2(9)

~~Control and relay protection systems are provided. Support systems, such as grounding, raceway, lighting, AC/DC station service, and switchyard lightning protection, are also provided.~~

AC Power is fed to the 500 kV and 230 kV switchyard control houses from switchyard service transformers. Each switchyard service

transformer is a 19.9 kV/120-240V transformer and is aligned using manual throw switches. Multiple switchyard service transformers can be aligned to both the 500 kV and 230 kV control houses.

DC power for the 500 kV switchyard controls is provided by two systems from separate and completely independent batteries and chargers. Each DC system in the 500 kV house consists of a single lead-acid storage battery maintained by two chargers (one as normal and one as backup). The batteries are located in separate, ventilated rooms of the control house. The chargers are located in the same room in the central part of the control house and are separated to minimize interaction. The 500 kV control house battery chargers can be fed from any of the AC power sources supplying the 500 kV control house, but are typically powered from separate sources.

DC power for the 230 kV switchyard controls is provided by a separate system located in the 230 kV switchyard control house. This system consists of a single lead-acid storage battery maintained by two chargers (one as normal and one as backup). The 230 kV control house battery chargers are fed from the AC power source supplying the 230 kV control house.

The batteries are sized in accordance with Dominion substation engineering standards and the sizing is verified using the manufacturer's sizing program that adheres to battery sizing methodologies found in IEEE 485 (Reference 8.2-210). Battery charger sizing is verified in accordance with Dominion substation engineering standards.

The switchyard grounding system, which overlays an older grounding system, was designed and installed in accordance with the Dominion Substation Engineering Manual and IEEE 80 (Reference 8.2-211). In accordance with IEEE 80, the switchyard ground grid resistance is less than 1 ohm.

The North Anna switchyard uses surge suppressors on the high and low sides of Transformers 1, 2, 3, 5, and 6. The insulation coordination and surge protective devices are applied in compliance with IEEE 1313.2 (Reference 8.2-203) and IEEE C62.22 (Reference 8.2-204). The surge protective devices are maintained according to NEMA requirements and manufacturer's recommendations.

A shield wire arrangement is designed for lightning abatement in the switchyard in accordance with IEEE 62.22 (Reference 8.2-204),

8.2(12) ***Deleted from the DCD.***

8.2.5 References

8.2-201 PJM Generator Interconnection Q65 North Anna 500 kV System Impact Study, June 2007

8.2-202 VA PJM Design and Application of Overhead Transmission Lines 69kV and above, May 20, 2002

8.2-203 IEEE Std 1313.2-1999 (R2005), "IEEE Guide for the Application of Insulation Coordination"

8.2-204 IEEE Std C62.22-2009, "IEEE Guide for the Application of Metal-Oxide Surge Arresters for Alternating-Current Systems"

8.2-205 IEEE Std 998-1996 (R2002), "IEEE Guide for Direct Lightning Stroke Shielding of Substations"

8.2-206 Hileman, A. R.: Insulation Coordination for Power Systems; Taylor & Francis, Inc., Boca Raton, FL, 1999

RAI 08.02-46 8.2-207 NERC Standard PRC-005-1, "Transmission and Generation Protection System Maintenance and Testing," May 1, 2006

RAI 08.02-46 8.2-208 NERC Standard PRC-008-0, "Implementation and Documentation of Underfrequency Load Shedding Equipment Maintenance Program," April 1, 2005

RAI 08.02-46 8.2-209 NERC Standard PRC-017-0, "Special Protection System Maintenance and Testing," April 1, 2005

RAI 08.02-49 8.2-210 IEEE Std 485-1997, "IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications"

RAI 08.02-49 8.2-211 IEEE Std 80-2000, "IEEE Guide for Safety in AC Substation Grounding"

RAI 08.02-41 8.2-212 INPO Significant Operating Experience Report (SOER) 99-1, "Loss of Grid," dated December 27, 1999 and SOER 99-1 "Loss of Grid – Addendum," dated December 9, 2004

RAI 08.02-41 8.2-213 NERC Standard NUC-001, Revision 1, "Nuclear Plant Interface Coordination"

ENCLOSURE 9

Response to NRC RAI Letter 54

RAI 5181 Question 08.02-51

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5181 (RAI Letter 54)

SRP SECTION: 08.02 – OFFSITE POWER SYSTEM

QUESTIONS for Electrical Engineering Branch (EEB)

DATE OF RAI ISSUE: 02/03/2011

QUESTION NO.: 08.02-51

US-APWR DCD, Rev. 2, Subsection 8.2.1.2.1 states that all relay systems used for protection of offsite power circuits and transformers are provided with primary and backup protection. FSAR Subsection 8.2.1.2.1 discusses protective relaying. Identify the relays associated with primary and backup protection scheme in the FSAR. What is meant by high-speed relay schemes?

Dominion Response

Primary and backup line protection relays for transmission lines in the 500 kV switchyard are generally of diverse types. Each 500 kV transmission line, with the exception of the line to Midlothian shown on FSAR Figure 8.2-201, is protected by a primary relay that is either solid state or electromechanical, and a backup relay that is of the other type. Adding to this diversity, these relays are provided by different manufacturers. The Midlothian line has both primary and backup protection by redundant microprocessor based relays. The 230 kV transmission line has both primary and backup protection by redundant microprocessor based relays.

Primary and backup differential relays for transformers 1 and 2 are solid state units. Transformer 3 has an electromechanical primary differential relay and a solid state backup differential relay. Transformer 5 has a solid state primary relay and a microprocessor based backup differential relay. Primary and backup differential relays for transformer 6 are microprocessor based relays.

Primary and backup differential relays for 500 kV busses 1 and 2 are solid state units. The 230 kV bus differential protection is provided by a single solid state relay. FSAR Section 8.2.2.3.3 will be revised to clarify that the 230 kV bus is provided with primary protection features only.

Primary and backup relays for the 500 kV switchyard are powered by redundant DC batteries. Primary and backup relays for the 230 kV switchyard are powered by a single DC battery.

The discussion above provides details of the relays associated with primary and backup protection scheme related to the NAPS switchyard. However, inclusion of this detailed information in the FSAR is not considered to be necessary since FSAR Sections 8.2.1.2.1 and 8.2.2.3.3 provide an adequate description of the primary and backup protection relaying.

"High-speed relay schemes" in FSAR Section 8.2.1.2.1 refers to the use of primary line protection relays that are designed to initiate a tripping operation with no intentional time delay. This type of scheme minimizes equipment damage and preserves system stability in the event of a fault.

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.

8.2.2.3.2 Transmission System Evaluation

Unit 3 is connected to the Dominion transmission system via four 500 kV and one 230 kV overhead transmission lines. The normal preferred power source is any one of the four 500 kV lines. (See Section 8.2.1.1 and Section 8.2.1.2.) The alternate preferred power source is one of the other three 500 kV lines.

Each transmission line occupies a separate right-of-way, except the two parallel Ladysmith lines, which share the same right-of-way. The 500 kV towers provide clearances consistent with the NESC. The towers are grounded with either ground rods or a counterpoise ground system. Failure of any one tower due to structural failure can at most disrupt and cause a loss of power distribution to itself and the adjacent line.

Failure of a line conductor would cause the loss of one of the four 500 kV lines, with the other three lines remaining available as normal and alternate preferred power sources.

8.2.2.3.3 Switchyard Evaluation

A breaker-and a-half scheme is incorporated in the design of the switchyard. The equipment in the switchyard is rated and positioned within the bus configuration according to the following criteria in order to maintain incoming and outgoing load flow from Unit 3.

- Equipment continuous current ratings are such that no single contingency in the switchyard (e.g., a breaker being out of service for maintenance) results in current exceeding 100 percent of the continuous current rating of the equipment.
- Interrupting duties are such that no faults occurring on the system exceed the equipment rating.
- Momentary ratings are such that no fault occurring on the system exceeds the equipment momentary rating.
- Voltage ratings for the equipment are specified to be greater than the maximum expected operating voltage.

The breaker-and-a-half switchyard arrangement offers the following flexibility to control a failed condition within the switchyard:

- Any faulted transmission line into the switchyard can be isolated without affecting any other transmission line.
- Either bus can be isolated without interruption of any transmission line or other bus.

RAI 08.02-51

- ~~All relay~~ Relay schemes used for protection of the offsite power circuits and the switchyard equipment, with the exception of the 230 kV bus, include primary and backup protection features. The relay scheme used for protection of the 230 kV bus includes primary protection features. All 500 kV breakers are equipped with dual trip coils. Each protection circuit that supplies a trip signal is connected to a separate trip coil.

RAI 08.02-57

Within the switchyard at North Anna, simultaneous failure of both the 500 kV and 230 kV offsite circuits associated with Unit 3 as a result of a single event is prevented by the layout of the switchyard and the design of the protection and control systems. The NAPS switchyard is designed in a breaker and a half scheme to allow for selective isolation of any faulted transmission line, bus, transformer, or station interconnection.

For the condition of a circuit breaker not operating during a fault condition, switchyard relaying employs breaker failure protection to trip all breakers adjacent to the failed breaker necessary to isolate the failed breaker. The most limiting location would be a fault on bus 1 with the failure of the 500 kV breaker between bus 1 and the Unit 3 main transformer leads, or a fault on the 230 kV bus connected to transformer 6 with the failure of the 230 kV breaker between the bus and the RAT feeder. In either case, one of the preferred power sources would be lost as the breaker adjacent to the failed breaker opened to clear the fault. Therefore, the worst result would be isolation of either the normal preferred power supply on Unit 3 or the alternate preferred power supply on Unit 3, but not both.

A fault on a 500 kV switchyard bus will be isolated by opening of the 500 kV and 34.5 kV breakers associated with that bus. The opposite 500 kV bus remains energized and connected to the offsite power sources and the alternate preferred power source for Unit 3. The normal preferred power source remains energized from its 230 kV bay that is connected to the unaffected 500 kV bus. A single faulted 230 kV bus would be isolated by operation of the 230 kV and 500 kV breakers associated with that bus. The Unit 3 normal preferred power supply would remain energized from the unaffected 230 kV bus, and the Unit 3 alternate preferred power supply would remain energized from either 500 kV bus.

A fault on a transformer would cause isolation of the affected transformer only for transformers 3, 5, and 6. A fault on transformer 1 or 2 would

ENCLOSURE 10

Response to NRC RAI Letter 54

RAI 5181 Question 08.02-53

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5181 (RAI Letter 54)

SRP SECTION: 08.02 – OFFSITE POWER SYSTEM

QUESTIONS for Electrical Engineering Branch (EEB)

DATE OF RAI ISSUE: 02/03/2011

QUESTION NO.: 08.02-53

FSAR Section 8.2.2.2 states that "Stability of the grid will be studied to confirm 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." Confirm that anti-motoring protective relaying for the main generator will open the generator output breaker after a time delay of at least 15 seconds, during which time the rotating generator will provide voltage support to the grid. An ITAAC is needed to verify the 15 seconds time delay associated with anti-motoring protective relaying to trip generator output breaker. Please provide one. Also, confirm that the analyses in Chapter 15 do not assume (credit) operation of the RCPs following the turbine trip if the initiating event is an electrical system failure.

Dominion Response

FSAR Section 8.2.2.2 states that "Stability of the grid will be studied to confirm 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." This FSAR requirement addresses the COL applicant item in DCD Section 8.2.3 that states "The COL applicant is to perform grid stability analysis to confirm the assumption in Chapter 15."

The Chapter 15 assumption referred to in DCD Section 8.2.3 is located in DCD Section 15.0.0.7, and assures that control rods are fully inserted into the core by the time a loss of offsite power occurs and a corresponding loss of forced coolant flow is initiated. This ensures that the portion of the transient following a postulated loss of offsite power occurs after the limiting departure from nucleate boiling ratio (DNBR) and, thus, the minimum DNBR is the same with offsite power available or unavailable.

DCD Section 15.0.0.7 identifies two cases that address the time delays supporting continued operation of RCPs. The first is a time delay between turbine and generator trips, allowing power

to the reactor coolant pumps (RCPs) to be maintained for a period of time following a turbine trip. This is stated to be a feature of plant design, but is also stated to be conservatively ignored in the accident analyses. The second case is an assumption that a reactor trip/turbine trip/generator trip causes a disturbance in the grid that conservatively causes a loss of offsite power. The accident analyses assume this loss of offsite power event occurs a minimum of 3 seconds following the reactor trip due to the time it would take for a grid instability caused by loss of the generating unit to propagate through the grid and result in loss of offsite power at the generating unit. This 3 second time delay is credited in the accident analyses and is reflected in both the grid stability discussion in DCD Section 8.2.3 and in FSAR Section 8.2.2.2.

There is no connection between any electrical generator protection feature (such as anti-motoring protective relaying) and the commitment in FSAR Section 8.2.2.2 to verify continued power to the RCPs following a turbine trip. The FSAR commitment is strictly addressing capability of the offsite power source to provide sufficient power to the RCPs for a minimum of 3 seconds following loss of the generating unit as required by DCD Section 15.0.0.7. Grid stability is being studied and results that support the 3 second requirement addressed in DCD Section 8.2.3 and FSAR Section 8.2.2.2 will be provided in the response to RAI 5181 Question 08.02-50. There is no requirement to address anti-motoring relay protection in conjunction with continued operation of RCPs following loss of the generating unit. Consequently, there is no requirement for an ITAAC to verify anti-motoring protective relay operation.

Confirmation that the accident analyses in Chapter 15 do not assume (credit) operation of the RCPs following the turbine trip if the initiating event is an electrical system failure is the responsibility of the US-APWR DC applicant.

Proposed COLA Revision

None

ENCLOSURE 11

Response to NRC RAI Letter 54

RAI 5181 Question 08.02-56

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5181 (RAI Letter 54)

SRP SECTION: 08.02 – OFFSITE POWER SYSTEM

QUESTIONS for Electrical Engineering Branch (EEB)

DATE OF RAI ISSUE: 02/03/2011

QUESTION NO.: 08.02-56

US-APWR DCD, Revision 2, Section 8.2.3 states that transmission system reliability is consistent with the condition of the probability risk analysis of Chapter 19. Confirm that transmission system reliability is consistent with the condition of the probability risk analysis of Chapter 19.

Dominion Response

FSAR Section 8.2.3 states that a transmission system reliability analysis is provided in Subsection 8.2.2.2. As discussed in FSAR Section 8.2.2.2, the site-specific offsite power transmission system is addressed in FSAR Table 1.8-1R as a system interface for the US-APWR electrical power system with the potential to affect the probabilistic risk assessment (PRA) results. As described in FSAR Section 19.1.1.2.1, for the site-specific design interfaces identified in FSAR Section 1.8, only the ultimate heat sink (UHS) and emergency service water system (ESWS) have the potential to influence the results of the PRA.

Therefore, the transmission system reliability is consistent with the conditions assumed for the PRA.

Proposed COLA Revision

None

ENCLOSURE 12

Response to NRC RAI Letter 54

RAI 5181 Question 08.02-57

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5181 (RAI Letter 54)

SRP SECTION: 08.02 – OFFSITE POWER SYSTEM

QUESTIONS for Electrical Engineering Branch (EEB)

DATE OF RAI ISSUE: 02/03/2011

QUESTION NO.: 08.02-57

FMEA discussed in FSAR Subsection 8.2.2.3 is inadequate. RG-1.206 states that the COL applicant should perform a FMEA of the switchyard components to assess the possibility of simultaneous failure of both circuits as result of a single events, such as a breaker not opening during fault conditions, a spurious relay trip, a loss of a control circuit power supply, or a fault in a switchyard bus or transformer.

In order for the NRC staff to evaluate the FMEA, describe in detail in the FSAR, how each event (a breaker not operating during a fault on an offsite line; fault on a switchyard bus; a spurious relay trip; and a loss of control power) in the FMEA was evaluated to conclude that the offsite power to each unit is not lost.

Additionally, FSAR Subsection 8.2.1.2.1 indicates that 500 kV breakers are equipped with dual trip coils. The NRC staff understands that 500 kV and 230 kV breakers are equipped with one closing coil. Provide a discussion in the FSAR on how offsite power will be recovered to the unit after an SBO event of eight hour duration with loss of one switchyard dc power system.

Dominion Response

Within the switchyard at North Anna, simultaneous failure of both the 500 kV and 230 kV offsite circuits associated with Unit 3 as a result of a single event is prevented by the layout of the switchyard and the design of the protection and control systems. The NAPS switchyard is designed in a breaker and a half scheme to allow for selective isolation of any faulted transmission line, bus, transformer, or station interconnection.

For the condition of a circuit breaker not operating during a fault condition, switchyard relaying employs breaker failure protection to trip all breakers adjacent to the failed breaker necessary to isolate the failed breaker. The most limiting location would be a fault on bus 1 (bus 1 is shown on FSAR Figure 8.2-201 between transformer 1 and transformer 6, bus 2 is shown on the figure

between transformer 2 and transformer 5) with the failure of the 500 kV breaker between bus 1 and the Unit 3 main transformer leads, or a fault on the 230 kV bus connected to transformer 6 with the failure of the 230 kV breaker between the bus and the RAT feeder. In either case, one of the preferred power sources would be lost as the breaker adjacent to the failed breaker opened to clear the fault. Therefore, the worst result would be isolation of either the normal preferred power supply on Unit 3 or the alternate preferred power supply on Unit 3, but not both.

A fault on a 500 kV switchyard bus will be isolated by opening of the 500 kV and 34.5 kV breakers associated with that bus. The opposite 500 kV bus remains energized and connected to the offsite power sources and the alternate preferred power source for Unit 3. The normal preferred power source remains energized from its 230 kV bay that is connected to the unaffected 500 kV bus. A single faulted 230 kV bus would be isolated by operation of the 230 kV and 500 kV breakers associated with that bus. The Unit 3 normal preferred power supply would remain energized from the unaffected 230 kV bus, and the Unit 3 alternate preferred power supply would remain energized from either 500 kV bus.

A fault on a transformer would cause isolation of the affected transformer only for transformers 3, 5, and 6. A fault on transformer 1 or 2 would result in isolation of both the affected transformer and its associated 500 kV bus and would be similar to the faulted bus case previously evaluated. However, loss of a single transformer, or transformer and associated bus, would not cause a loss of either the normal or alternate preferred power source.

Spurious operation of a relay would cause similar effects as previously evaluated. Spurious operation of a line protection relay would cause isolation of a single line. Spurious operation of a bus protection relay would cause isolation of a single bus, and spurious operation of a transformer relay would cause isolation of a single transformer (transformers 3, 5, and 6) or a single transformer and associated bus (transformer 1/bus 1 or transformer 2/bus 2). In all cases, as previously demonstrated, spurious operation of a relay would not cause the loss of both the normal and alternate preferred power sources.

On loss of a control power source in the 500 kV control house, the backup control power source provides for protection and tripping of associated 500 kV components. A loss of control power in the 230 kV control house is identified by loss of communications to the systems operations center (SOC). The loss of communications initiates an alarm in the SOC and an investigation into the problem at the site. There is no false operation of any 230 kV breakers resulting from loss of 230 kV control power.

<u>Offsite power restoration following a SBO event of eight hour duration with loss of one switchyard DC supply</u>

Each of the 500 kV transmission lines and the 230 kV transmission line connected to the NAPS switchyard individually has sufficient capacity to supply the total required auxiliary loads for Unit 3 under any station condition. Circuit breaker closing coil power to each of the 500 kV circuit breakers is fed from one or the other of the two batteries in the 500 kV control house. Circuit breaker closing coil power for the 230 kV circuit breakers is fed from the battery in the 230 kV control house.

In order to restore power to Unit 3 following a station blackout event it is necessary to restore at least one transmission circuit and the interconnections from the switchyard to the unit. Loss of a

DC power system in conjunction with a station blackout event will not prevent restoration of power as described in the following scenarios:

1. Loss of 500 kV control house battery 1

   Power is recovered by closing 500 kV breakers using control power from battery 2 to reenergize the switchyard from a 500 kV transmission line. The 230 kV switchyard is repowered from the 230 kV transmission line by closing breakers using control power from the 230 kV control house battery. Unit 3 power can then be restored by closing breakers associated with either the UAT feeder or the RAT feeder.

2. Loss of 500 kV control house battery 2

   Power is recovered by closing 230 kV breakers using control power from the 230 kV control house battery to reenergize the 230 kV switchyard from the 230 kV transmission line. Unit 3 power can then be restored by closing 230 kV breakers associated with the RAT feeder.

3. Loss of 230 kV control house battery

   Power is recovered by closing 500 kV breakers using control power from battery 1 or battery 2 to reenergize the switchyard from a 500 kV transmission line. Unit 3 power can then be restored by closing breakers associated with the UAT feeder.

Proposed COLA Revision

FSAR Sections 8.2 and 8.4 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.

8.2.2.3.2 Transmission System Evaluation

Unit 3 is connected to the Dominion transmission system via four 500 kV and one 230 kV overhead transmission lines. The normal preferred power source is any one of the four 500 kV lines. (See Section 8.2.1.1 and Section 8.2.1.2.) The alternate preferred power source is one of the other three 500 kV lines.

Each transmission line occupies a separate right-of-way, except the two parallel Ladysmith lines, which share the same right-of-way. The 500 kV towers provide clearances consistent with the NESC. The towers are grounded with either ground rods or a counterpoise ground system. Failure of any one tower due to structural failure can at most disrupt and cause a loss of power distribution to itself and the adjacent line.

Failure of a line conductor would cause the loss of one of the four 500 kV lines, with the other three lines remaining available as normal and alternate preferred power sources.

8.2.2.3.3 Switchyard Evaluation

A breaker-and a-half scheme is incorporated in the design of the switchyard. The equipment in the switchyard is rated and positioned within the bus configuration according to the following criteria in order to maintain incoming and outgoing load flow from Unit 3.

- Equipment continuous current ratings are such that no single contingency in the switchyard (e.g., a breaker being out of service for maintenance) results in current exceeding 100 percent of the continuous current rating of the equipment.
- Interrupting duties are such that no faults occurring on the system exceed the equipment rating.
- Momentary ratings are such that no fault occurring on the system exceeds the equipment momentary rating.
- Voltage ratings for the equipment are specified to be greater than the maximum expected operating voltage.

The breaker-and-a-half switchyard arrangement offers the following flexibility to control a failed condition within the switchyard:

- Any faulted transmission line into the switchyard can be isolated without affecting any other transmission line.
- Either bus can be isolated without interruption of any transmission line or other bus.

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- ~~All relay~~ Relay schemes used for protection of the offsite power circuits and the switchyard equipment, with the exception of the 230 kV bus, include primary and backup protection features. The relay scheme used for protection of the 230 kV bus includes primary protection features. All 500 kV breakers are equipped with dual trip coils. Each protection circuit that supplies a trip signal is connected to a separate trip coil.

RAI 08.02-57

Within the switchyard at North Anna, simultaneous failure of both the 500 kV and 230 kV offsite circuits associated with Unit 3 as a result of a single event is prevented by the layout of the switchyard and the design of the protection and control systems. The NAPS switchyard is designed in a breaker and a half scheme to allow for selective isolation of any faulted transmission line, bus, transformer, or station interconnection.

For the condition of a circuit breaker not operating during a fault condition, switchyard relaying employs breaker failure protection to trip all breakers adjacent to the failed breaker necessary to isolate the failed breaker. The most limiting location would be a fault on bus 1 with the failure of the 500 kV breaker between bus 1 and the Unit 3 main transformer leads, or a fault on the 230 kV bus connected to transformer 6 with the failure of the 230 kV breaker between the bus and the RAT feeder. In either case, one of the preferred power sources would be lost as the breaker adjacent to the failed breaker opened to clear the fault. Therefore, the worst result would be isolation of either the normal preferred power supply on Unit 3 or the alternate preferred power supply on Unit 3, but not both.

A fault on a 500 kV switchyard bus will be isolated by opening of the 500 kV and 34.5 kV breakers associated with that bus. The opposite 500 kV bus remains energized and connected to the offsite power sources and the alternate preferred power source for Unit 3. The normal preferred power source remains energized from its 230 kV bay that is connected to the unaffected 500 kV bus. A single faulted 230 kV bus would be isolated by operation of the 230 kV and 500 kV breakers associated with that bus. The Unit 3 normal preferred power supply would remain energized from the unaffected 230 kV bus, and the Unit 3 alternate preferred power supply would remain energized from either 500 kV bus.

A fault on a transformer would cause isolation of the affected transformer only for transformers 3, 5, and 6. A fault on transformer 1 or 2 would

result in isolation of both the affected transformer and its associated 500 kV bus and would be similar to the faulted bus case previously evaluated. However, loss of a single transformer, or transformer and associated bus, would not cause a loss of either the normal or alternate preferred power source.

Spurious operation of a relay would cause similar effects as previously evaluated. Spurious operation of a line protection relay would cause isolation of a single line. Spurious operation of a bus protection relay would cause isolation of a single bus, and spurious operation of a transformer relay would cause isolation of a single transformer (transformers 3, 5, and 6) or a single transformer and associated bus (transformer 1/bus 1 or transformer 2/bus 2). In all cases, as previously demonstrated, spurious operation of a relay would not cause the loss of both the normal and alternate preferred power sources.

On loss of a control power source in the 500 kV control house, the backup control power source provides for protection and tripping of associated 500 kV components. A loss of control power in the 230 kV control house is identified by loss of communications to the systems operations center (SOC). The loss of communications initiates an alarm in the SOC and an investigation into the problem at the site. There is no false operation of any 230 kV breakers resulting from loss of 230 kV control power.

8.2.3 Design Bases Requirements

NAPS COL 8.2(11)

Replace the first sentence of the second paragraph in DCD Subsection 8.2.3 with the following.

A failure modes and effects analysis is provided in Subsection 8.2.2.3 and the offsite power system conforms to the following requirements.

STD* COL 8.2(11)

Replace the last sentence of the third paragraph in DCD Subsection 8.2.3 with the following.

Grid stability analysis is addressed in Subsection 8.2.2.2.

NAPS COL 8.2(11)

Replace the last sentence of the fourth paragraph in DCD Subsection 8.2.3 with the following.

A transmission system reliability analysis is provided in Subsection 8.2.2.2.

8.4 Station Blackout

RAI 08.02-57

~~This section of the referenced DCD is incorporated by reference with no departures or supplements.~~ This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

RAI 08.02-57 **NAPS SUP 8.4(1)**

8.4.1.4 Recovery from SBO

Add the following information prior to the first paragraph.

Each of the 500 kV transmission lines and the 230 kV transmission line connected to the NAPS switchyard individually has sufficient capacity to supply the total required auxiliary loads for Unit 3 under any station condition. Circuit breaker closing coil power to each of the 500 kV circuit breakers is fed from one or the other of the two batteries in the 500 kV control house. Circuit breaker closing coil power for the 230 kV circuit breakers is fed from the battery in the 230 kV control house.

In order to restore power to Unit 3 following a station blackout event it is necessary to restore at least one transmission circuit and the interconnections from the switchyard to the unit. Loss of a DC power system in conjunction with a station blackout event will not prevent restoration of power as described in the following scenarios:

1. Loss of 500 kV Control House Battery 1

   Power is recovered by closing 500 kV breakers using control power from battery 2 to reenergize the switchyard from a 500 kV transmission line. The 230 kV switchyard is repowered from the 230 kV transmission line by closing breakers using control power from the 230 kV control house battery. Unit 3 power can then be restored by closing breakers associated with either the UAT feeder or the RAT feeder.

2. Loss of 500 kV Control House Battery 2

   Power is recovered by closing 230 kV breakers using control power from the 230 kV control house battery to reenergize the 230 kV switchyard from the 230 kV transmission line. Unit 3 power can then be restored by closing 230 kV breakers associated with the RAT feeder.

3. Loss of 230 kV Control House Battery

   Power is recovered by closing 500 kV breakers using control power from battery 1 or battery 2 to reenergize the switchyard from a 500 kV transmission line. Unit 3 power can then be restored by closing breakers associated with the UAT feeder.

ENCLOSURE 13

Response to NRC RAI Letter 54

RAI 5181 Question 08.02-58

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5181 (RAI Letter 54)

SRP SECTION: 08.02 – OFFSITE POWER SYSTEM

QUESTIONS for Electrical Engineering Branch (EEB)

DATE OF RAI ISSUE: 02/03/2011

QUESTION NO.: 08.02-58

FSAR Section 8.2.2.2, "Reliability and Stability Analysis," NAPS COL 8.2 (11), identified maximum and minimum switchyard voltage limits of 534 kV and 505 kV. Explain how these limits were established and confirm that these voltage limits are acceptable for auxiliary power system equipment operation, during different operating conditions. The confirmation should include assumptions, acceptance criteria, and summary of results for the following: load flow analysis (bus and load terminal voltages of the station auxiliary system), short-circuit analysis, equipment sizing studies, protective relay setting and coordination, and motor starting with minimum and maximum grid voltage conditions. A separate set of calculations should be performed for each available connection to offsite power supply. In addition, discuss how the results of the calculations will be verified.

Dominion Response

The voltage limits specified in FSAR Section 8.2.2.2 were established based on the North Anna Units 1 and 2 voltage limits for the switchyard. As described in FSAR Section 8.2.2.2, a new grid reliability and stability study will be performed by the regional transmission organization that will analyze the system for impacts on load flow, import/export capabilities, short circuit capability, and system stability resulting from interconnection of the US-APWR. This new study will contain a voltage sensitivity analysis that will either confirm these voltage limits or establish new voltage limits for the switchyard. As stated in FSAR Section 8.2.2.2, the FSAR will be revised to reflect the results of the new study as part of a subsequent FSAR update.

Additionally, as part of ITAAC closure, analyses of the as-built offsite and onsite power systems will be performed. These analyses will, in part, specify required power, voltage, frequency, and interrupting capability necessary for the offsite power system to support operation of Unit 3 loads during design basis operating modes. These analyses will ensure that each as-built offsite circuit has sufficient capacity and capability. The applicable COLA and US-APWR DCD ITAAC include:

- COLA Part 10, Table A4-1, Item 2 requires analysis of the as-built offsite transmission network voltage variability and steady state load requirements.
- DCD, Tier 1, ITAAC Table 2.6.1-3, Item 10 requires analyses to verify the UATs and RATs power sources are sized for worst case loading conditions for all modes of plant operation and accident conditions.
- DCD, Tier 1, ITAAC Table 2.6.1-3, Item 11, requires analyses to verify the Class 1E distribution equipment and circuits are sized to carry the worst case load currents, to withstand the maximum fault currents, and to provide minimum design basis voltage at load terminals to support accomplishment of their safety functions.
- DCD, Tier 1, ITAAC Table 2.6.1-3, Item 12, requires an analysis to verify interrupting ratings of the Class 1E circuit breakers and fuses are adequate for maximum available fault currents.
- DCD, Tier 1, ITAAC Table 2.6.1-3, Item 18, requires an analysis to verify the Class 1E equipment is protected from sustained degraded voltages conditions.
- DCD, Tier 1, ITAAC Table 2.6.1-3, Item 21, requires an analysis of Class 1E ac electrical distribution system overcurrent protection to verify proper coordination.

The new grid stability analysis and the above referenced ITAAC analyses will demonstrate compliance with BTP 8-6, *Adequacy of Station Electric Distribution System Voltages*, as required by DCD Section 8.2 and Table 8.1-1. Compliance with BTP 8.6 also provides for verification of analytical techniques and assumptions used in the voltage analyses by actual measurement.

Proposed COLA Revision

None