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Dominion®

July 28, 2008

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

Serial No. NA3-08-056R
Docket No. 52-017
COL/JPH

DOMINION VIRGINIA POWER
NORTH ANNA UNIT 3 COMBINED LICENSE APPLICATION
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LETTER 009

On June 13, 2008, the NRC requested additional information to support the review of certain portions of the North Anna Unit 3 Combined License Application (COLA). The responses to the following RAIs are provided in Enclosures 1 through 26:

- RAI Question 08.02-1 Switchyard Figure Discrepancy
- RAI Question 08.02-2 Cable Routing Intermediate
- RAI Question 08.02-3 Intermediate Transformer Rating
- RAI Question 08.02-4 Potential Cable Degradation
- RAI Question 08.02-5 500kV Transmission and Bus Ratings
- RAI Question 08.02-6 Additional Transformer Protection
- RAI Question 08.02-7 Protective Relay Acceptance
- RAI Question 08.02-8 Industry Standards for Switchyard
- RAI Question 08.02-9 Transformer Testing Inclusion
- RAI Question 08.02-10 Multiple Facility Contingencies
- RAI Question 08.02-11 Stability Analysis for 34.5Kv Switchyard
- RAI Question 08.02-12 20 Year Grid Outage History
- RAI Question 08.02-13 Clarify Tech Spec Reference
- RAI Question 08.02-14 System Impact Study-Light versus Heavy Load
- RAI Question 08.02-15 Grid Frequency Variation
- RAI Question 08.02-16 GDC-5 Applicability
- RAI Question 08.02-17 GDC-4 Applicability
- RAI Question 08.02-18 GDC-2 Applicability
- RAI Question 08.02-19 10CFR 50.65(a)(4) Applicability
- RAI Question 08.02-20 BTP 8-3 Applicability
- RAI Question 08.02-21 BTP 8-5 Applicability
- RAI Question 08.02-22 BTP 8-6 Applicability

D089
NRO

- RAI Question 08.02-23 Transmission Reliability Consistent with PRA
- RAI Question 08.02-24 Station Ground Grid Description
- RAI Question 08.02-25 Surge and Lighting Protection Description
- RAI Question 08.02-26 Unit 1 & 2 Grid Stability Impact with Addition of Unit 3

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

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 28th day of July, 2008

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:

1. Response to RAI Letter 009, RAI Question 08.02-1
2. Response to RAI Letter 009, RAI Question 08.02-2
3. Response to RAI Letter 009, RAI Question 08.02-3
4. Response to RAI Letter 009, RAI Question 08.02-4
5. Response to RAI Letter 009, RAI Question 08.02-5
6. Response to RAI Letter 009, RAI Question 08.02-6
7. Response to RAI Letter 009, RAI Question 08.02-7
8. Response to RAI Letter 009, RAI Question 08.02-8
9. Response to RAI Letter 009, RAI Question 08.02-9
10. Response to RAI Letter 009, RAI Question 08.02-10
11. Response to RAI Letter 009, RAI Question 08.02-11
12. Response to RAI Letter 009, RAI Question 08.02-12
13. Response to RAI Letter 009, RAI Question 08.02-13
14. Response to RAI Letter 009, RAI Question 08.02-14
15. Response to RAI Letter 009, RAI Question 08.02-15
16. Response to RAI Letter 009, RAI Question 08.02-16
17. Response to RAI Letter 009, RAI Question 08.02-17
18. Response to RAI Letter 009, RAI Question 08.02-18
19. Response to RAI Letter 009, RAI Question 08.02-19
20. Response to RAI Letter 009, RAI Question 08.02-20
21. Response to RAI Letter 009, RAI Question 08.02-21
22. Response to RAI Letter 009, RAI Question 08.02-22
23. Response to RAI Letter 009, RAI Question 08.02-23
24. Response to RAI Letter 009, RAI Question 08.02-24
25. Response to RAI Letter 009, RAI Question 08.02-25
26. Response to RAI Letter 009, RAI Question 08.02-26

Commitments made by this letter:

1. Incorporate proposed changes in a future COLA submission.

cc: U. S. Nuclear Regulatory Commission, Region II
T. A. Kevern, NRC
J. T. Reece, NRC
J. J. Debiec, ODEC
G. A. Zinke, NuStart/Entergy
T. L. Williamson, Entergy
R. Kingston, GEH
K. Ainger, Exelon
P. Smith, DTE

ENCLOSURE 1

Response to NRC RAI Letter 009

RAI Question 08.02-1

NRC RAI 08.02-1

Staff review of FSAR Chapter 8 Figure 8.2-201 indicates a discrepancy with corresponding DCD Rev. 4 Figure 8.1-1. In Figure 8.1-1, main generator circuit breaker is shown as part of onsite power system while the same breaker is shown in intermediate switchyard in Figure 8.2-201. Also, in Figure 8.1-1, main transformer and unit auxiliary transformers (UATs) are connected at the high voltage side of main transformer; however, in Figure 8.2-201, UATs high side voltage is 230 kV and main transformer's high side voltage is 500 kV and it is not clear how the connection can be made with different voltages. Please clarify the apparent discrepancies.

Dominion Response

Main Generator Circuit Breaker Location

DCD Figure 8.1-1 is a functional depiction of the ESBWR electrical power distribution system. The figure correctly shows the main generator circuit breaker as part of the onsite power distribution system. The main generator circuit breaker is physically located in the NAPS intermediate switchyard. FSAR Figure 8.2-201, which depicts the NAPS 500/230 kV switchyard and also shows certain equipment as within the NAPS intermediate switchyard (including the main generator circuit breaker) will be revised to remove the main generator circuit breaker symbol from the figure. A note will be added to clarify the interface between the DCD Figure 8.1-1 and FSAR Figure 8.2-201.

Transformer Voltages

DCD Figure 8.1-1 is a functional depiction of the ESBWR electrical power distribution system. The figure contains a "match line" dividing the offsite from onsite power systems. The Onsite Power System is that portion of the electrical power distribution system design being certified as part of the DCD (i.e., the standard plant design). The offsite power distribution system, that is, the switchyard design, and the normal and alternate preferred power supplies, is site-specific as indicated in DCD Section 8.2.

As such, the standard plant design does not specify the voltage level on the high side of the unit auxiliary transformers (UATs) or reserve auxiliary transformers (RATs). Rather, this is a site-specific determination. At North Anna, the high voltage side of the UATs and RATs will be at 230 kV and the generator step-up transformers (GSUs) will be at 500 kV on the high side. Because of this, a 500/230 kV transformer bank will be located in the Intermediate Switchyard to step down 500 kV to 230 kV for use by the UATs and RATs, as depicted in FSAR Figure 8.2-201.

A note will be added to FSAR Figure 8.2-201 to clarify that equipment on the Offsite Power portion of FSAR Figure 8.2-201 replaces equipment on the Offsite Power portion of DCD Figure 8.1-1.

In addition to the 2 notes being added to Figure 8.2-201 as a result of this RAI response, the new 500 kV bay, which ties in the new Ladysmith transmission line for Unit 3, has been added to this figure.

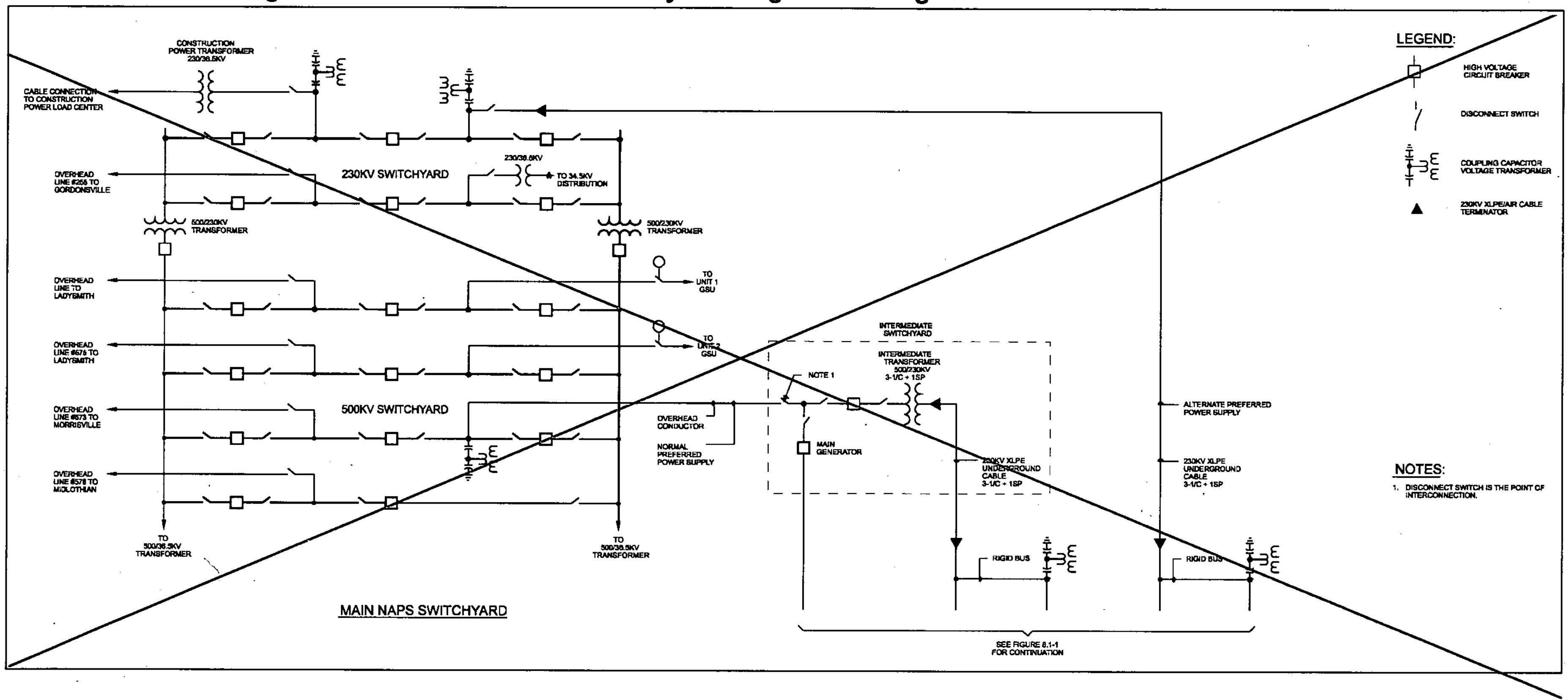
Proposed COLA Revision

FSAR Figure 8.2-201 will be revised as shown in the attached markup.

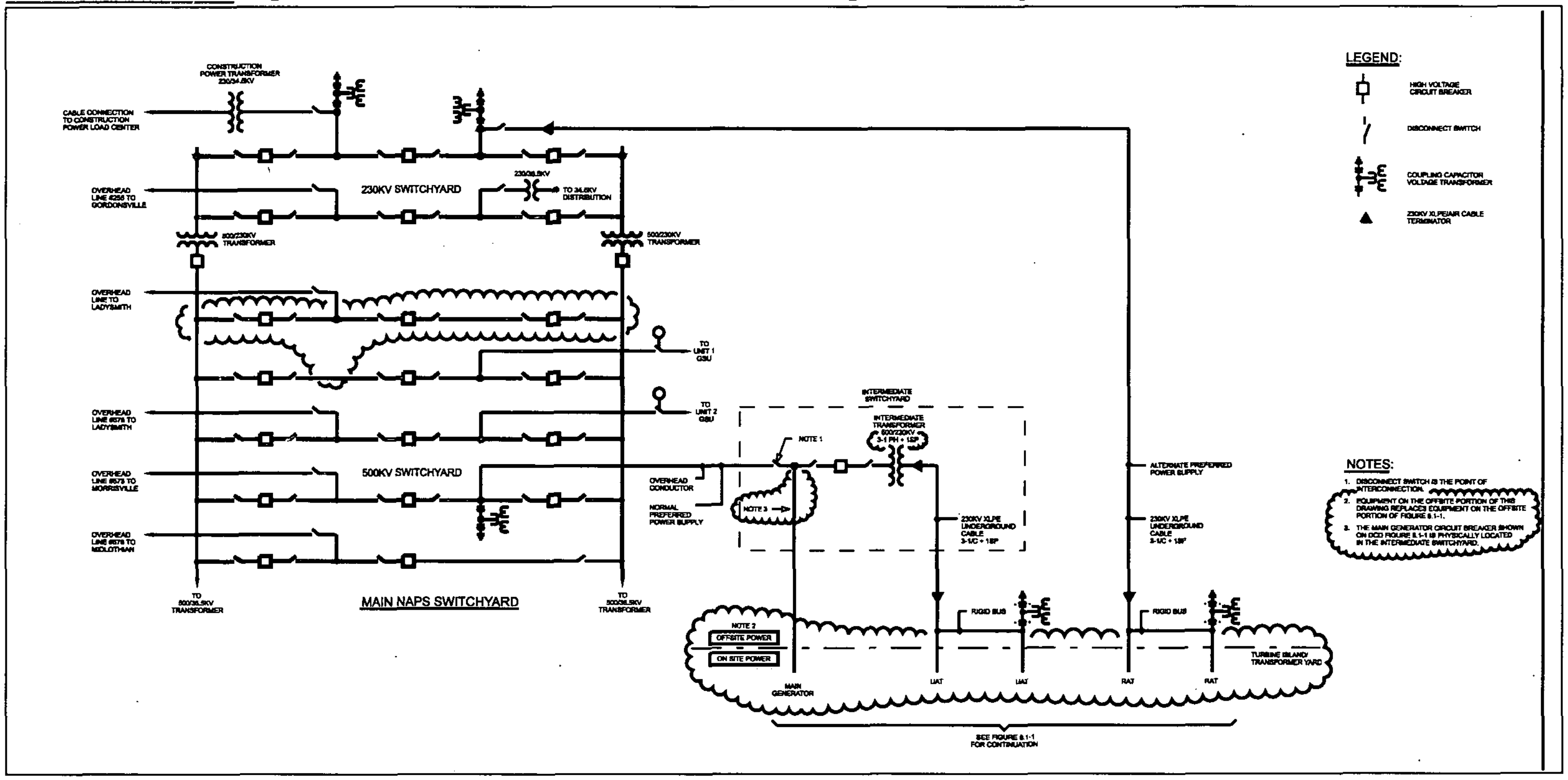
Markup of North Anna COLA

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 ESBWR 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.

~~Figure 8.2-201 500/230 kV Switchyard Single-Line Diagram~~



NAPS COL 8.2.4-A Figure 8.2-201 500/230 kV Switchyard Single-Line Diagram



ENCLOSURE 2

Response to NRC RAI Letter 009

RAI Question 8.02-2

NRC RAI 8.02-2

FSAR Section 8.2.1.2 addresses the routing of power cables. DCD, Rev. 4, Section 8.2.3 states that the normal preferred circuit and alternate preferred circuit are electrically independent and are physically separated from each other. Staff review indicates that Section 8.2.1.2 does not address the independence and separation of control and instrumentation cables. Please provide a discussion regarding the routing of control and instrumentation cables, and miscellaneous power cables associated with normal and alternate preferred circuits, between the switchyard and the power block.

Dominion Response

As described in DCD Section 8.2.3, control, instrumentation, and miscellaneous power cables associated with the normal and alternate preferred circuits are routed in duct bank between the power block and the Intermediate Switchyard. Adequate separation is ensured by either routing cables associated with the normal preferred circuit in a separate duct bank from cables associated with the alternate preferred circuit, or by routing these cables in separate conduits within the same duct bank.

Proposed COLA Revision

FSAR Section 8.2.1.2 will be revised to add a description of the routing of control, instrumentation, and miscellaneous power cables as indicated in 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 ESBWR 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.

lines from offsite power sources is shown in Figure 8.2-202. Figure 8.2-203 maps the offsite transmission lines.

The transmission lines and towers connecting the switchyard to the transmission system are as follows:

- Two 500 kV overhead lines to the Ladysmith substation (approximately 15 miles)
- A 500 kV overhead line to the Midlothian substation (approximately 41 miles)
- A 500 kV overhead line to the Morrisville substation (approximately 33 miles)
- A 230 kV overhead line to the Gordonsville substation (approximately 31 miles)

The two Ladysmith lines (one of which was constructed for Units 1 and 2) utilize a common right-of-way. Each of the other lines utilizes separate rights-of-way. The 230 kV Gordonsville line crosses under the 500 kV Ladysmith and Morrisville lines near the switchyard.

Transmission tower separation, line installation, and clearances are consistent with the National Electric Safety Code (NESC) and Dominion transmission line standards. Basic tower structural design parameters, including the number of conductors, height, materials, color, and finish are consistent with Dominion transmission line design standards. Adequate clearance exists between wire galloping ellipses to minimize conductor or structure damage. (Reference 8.2.202)

8.2.1.2 Offsite Power System

Replace the first paragraph with the following.

NAPS COL 8.2.4-3-A
NAPS COL 8.2.4-4-A

The offsite power system is a nonsafety-related system. Power is supplied to the plant from multiple independent and physically separate offsite power sources. The normal preferred power source is any one of the four 500 kV lines, and the alternate preferred power source is any other one of the four 500 kV lines.

The normal preferred power source is supplied to the UATs through the intermediate transformer, MODs and isolation circuit breakers. The normal preferred power interface with the offsite power system occurs at the incoming disconnect switch of the intermediate switchyard. The MOD feeding a faulted UAT will be opened after the UAT high voltage breaker opens.

Underground cables connect the normal and alternate preferred power sources to the UATs and RATs, respectively. To maintain their independence from each other, the underground cables are routed in duct banks and are physically and electrically separate from each other.

Control, instrumentation, and miscellaneous power cables associated with the normal and alternate preferred circuits are routed in duct bank between the power block and the Intermediate Switchyard. Adequate separation is ensured by either routing cables associated with the normal preferred circuit in a separate duct bank from cables associated with the alternate preferred circuit, or by routing these cables in separate conduits within the same duct bank.

Periodic monitoring of cable insulation for underground medium and high voltage cable will be conducted to detect potential cable degradation from moisture intrusion using one of the following methods: partial discharge testing, time domain reflectometry, dissipation factor testing, or very low frequency AC testing.

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

Transformers	**Voltage Rating**	**MVA Rating**
Transformer	500/230 kV	67.2/89.6/112
Transformer	500/230 kV	112/145

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

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

ENCLOSURE 3

Response to NRC RAI Letter 009

RAI Question 8.02-3

<u>*NRC RAI 8.02-3*</u>

FSAR Section 8.2 Figure 8.2-201 includes an intermediate transformer located in intermediate switchyard. Please provide the MVA rating of the intermediate transformer.

<u>Dominion Response</u>

The intermediate transformer consists of three single-phase autotransformers rated at 112 MVA each.

<u>Proposed COLA Revision</u>

None.

ENCLOSURE 4

Response to NRC RAI Letter 009

RAI Question 8.02-4

NRC RAI 8.02-4

FSAR Section 8.2.1.2 states that underground cables connect the normal and alternate preferred power sources to the UATs and reserve auxiliary transformers (RATs). Since underground cables are susceptible to moisture, please identify the design features and/or in-situ monitoring programs that will be implemented to avoid or arrest the degradation of the cable insulation from the effects of moisture.

Dominion Response

The normal preferred power supply and alternate preferred power supply both use 230 kV cable. This cable is designed for underground application.

Periodic monitoring of cable insulation for underground medium and high voltage cable will be conducted to detect potential cable degradation from moisture intrusion using one of the following methods or an equivalent: partial discharge testing, time domain reflectometry, dissipation factor testing, or very low frequency AC testing.

Proposed COLA Revision

FSAR Section 8.2.1.2 will be revised to add information on cable testing as indicated in 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 ESBWR 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.

lines from offsite power sources is shown in Figure 8.2-202. Figure 8.2-203 maps the offsite transmission lines.

The transmission lines and towers connecting the switchyard to the transmission system are as follows:

- Two 500 kV overhead lines to the Ladysmith substation (approximately 15 miles)
- A 500 kV overhead line to the Midlothian substation (approximately 41 miles)
- A 500 kV overhead line to the Morrisville substation (approximately 33 miles)
- A 230 kV overhead line to the Gordonsville substation (approximately 31 miles)

The two Ladysmith lines (one of which was constructed for Units 1 and 2) utilize a common right-of-way. Each of the other lines utilizes separate rights-of-way. The 230 kV Gordonsville line crosses under the 500 kV Ladysmith and Morrisville lines near the switchyard.

Transmission tower separation, line installation, and clearances are consistent with the National Electric Safety Code (NESC) and Dominion transmission line standards. Basic tower structural design parameters, including the number of conductors, height, materials, color, and finish are consistent with Dominion transmission line design standards. Adequate clearance exists between wire galloping ellipses to minimize conductor or structure damage. (Reference 8.2.202)

8.2.1.2 Offsite Power System

Replace the first paragraph with the following.

NAPS COL 8.2.4-3-A
NAPS COL 8.2.4-4-A

The offsite power system is a nonsafety-related system. Power is supplied to the plant from multiple independent and physically separate offsite power sources. The normal preferred power source is any one of the four 500 kV lines, and the alternate preferred power source is any other one of the four 500 kV lines.

The normal preferred power source is supplied to the UATs through the intermediate transformer, MODs and isolation circuit breakers. The normal preferred power interface with the offsite power system occurs at the incoming disconnect switch of the intermediate switchyard. The MOD feeding a faulted UAT will be opened after the UAT high voltage breaker opens.

Underground cables connect the normal and alternate preferred power sources to the UATs and RATs, respectively. To maintain their independence from each other, the underground cables are routed in duct banks and are physically and electrically separate from each other.

Control, instrumentation, and miscellaneous power cables associated with the normal and alternate preferred circuits are routed in duct bank between the power block and the Intermediate Switchyard. Adequate separation is ensured by either routing cables associated with the normal preferred circuit in a separate duct bank from cables associated with the alternate preferred circuit, or by routing these cables in separate conduits within the same duct bank.

Periodic monitoring of cable insulation for underground medium and high voltage cable will be conducted to detect potential cable degradation from moisture intrusion using one of the following methods: partial discharge testing, time domain reflectometry, dissipation factor testing, or very low frequency AC testing.

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

Transformers	**Voltage Rating**	**MVA Rating**
Transformer	500/230 kV	67.2/89.6/112
Transformer	500/230 kV	112/145

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

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

ENCLOSURE 5

Response to NRC RAI Letter 009

RAI Question 8.02-5

NRC RAI 8.02-5

FSAR Section 8.2.1.2 identifies that the 500 kV transmission line rated current is 3954 amps and the 500 kV bus is rated as 3891 amps. Please explain why the bus rating is less than the transmission line rating and clarify the actual loading of the line and bus.

Dominion Response

Switchyard buswork and transmission lines are rated according to their electrical characteristics. Since the ratings do not match exactly for these two different types of conductors, the switchyard designers select the cable and buswork for the projected load.

The North Anna switchyard is arranged in a breaker and a half scheme such that the power from each transmission line is divided between buses 1 and 2. The exact division is variable depending on the status of the breakers within the switchyard and the connected generation. Hence, the exact load on each bus in the switchyard is also variable.

Each transmission line entering the switchyard has a normal load and an emergency load for planning and operation purposes. The lines are loaded as follows:

Line 573, Morrisville – 2598 A normal load, 3377 A emergency load
Line 575, Ladysmith – 2598 A normal load, 3118 A emergency load
Line 576, Midlothian – 2598 A normal load, 2910 A emergency load

The Regional Transmission Organization (RTO) system operator is responsible for constantly monitoring the transmission system and operating it to maintain the entire system within its normal ratings. The transmission system loading is typically maintained at the normal levels and up to the emergency levels during system upsets. This line loading prevents overload of the buswork in the switchyard.

Both Dominion and PJM, the RTO, perform periodic studies to evaluate changes and proposed additions to the transmission system. These studies verify that infrastructure, such as the buswork and transmission lines at the North Anna switchyard, are capable of being operated within their ratings.

Proposed COLA Revision

None.

ENCLOSURE 6

Response to NRC RAI Letter 009

RAI Question 8.02-6

NRC RAI 8.02-6

FSAR Section 8.2.1.2.2 states that all transformers are protected with differential and over-current relay schemes. Information Notice 2005-15 addresses provision of sudden pressure relay and ground fault protection for transformers. Please discuss provision of such transformer protection. In addition, if the transformer neutrals are high-resistance grounded, please discuss what monitoring schemes are implemented for detection of ground faults in the system.

Dominion Response

Note: A telephone call between Dominion and the NRC on July 1, 2008 deleted Information Notice 2005-015 from RAI question 8.02-6 and substituted IEEE-141 and IEEE-242.

Transformers 1, 2, 3, 5, and 6 in the North Anna switchyard are protected by sudden pressure relays (SPR).

Transformers 1 and 2 have solid grounds on their 500 kV, wye connected windings. The 34.5 kV, delta connected windings have zig-zag transformers connected on the bus creating a ground source. This ground source is monitored by relays for ground fault detection. Differential relays applied across these transformers also provide ground fault protection.

Transformer 3 is not grounded on its 230 kV, delta connected winding as it is connected to transmission equipment only. The 34.5 kV, wye connected winding of Transformer 3 is solidly grounded. A relay monitors this ground for fault detection. A differential relay is also applied around Transformer 3. Since this transformer has no tertiary winding, the differential relay also provides ground fault protection.

Transformer 5 is solidly grounded. Differential relays are applied to the 230 kV winding and the 34.5 kV winding. Since this transformer has no tertiary winding, these differential relays provide ground fault protection.

Transformer 6 is solidly grounded. Differential protection is provided by redundant relays. Since this transformer has no tertiary winding, these differential relays provide ground fault protection.

Transformer protection in the North Anna switchyard is generally in accordance with IEEE C37.91, "Guide for Protective Relay Applications to Power Transformers."

Proposed COLA Revision

None.

ENCLOSURE 7

Response to NRC RAI Letter 009

RAI Question 8.02-7

NRC RAI 8.02-7

FSAR Section 8.2.1.2.2 addresses protective relaying. DCD, Rev.4, Section 8.2.4, Item 8.2.4-5-A identifies that the COL applicant is responsible for switchyard protective relaying and will ensure such relaying is coordinated, reviewed, and accepted by the applicable grid reliability organization. Please discuss how such coordination, review, and acceptance by the applicable grid reliability organization is to be accomplished.

Dominion Response

Dominion is responsible for engineering, constructing, operating and maintaining the electric transmission system and interfacing with the Regional Transmission Organization (RTO), PJM. This responsibility includes the design, maintenance, and operation of the switchyard protective relaying that will be required by the interconnection of Unit 3 to the North Anna switchyard.

PJM studied the interconnection of Unit 3 into the North Anna switchyard and recommended no additional requirements above the typical design requirements used by Dominion in the design of the protective relaying scheme at the North Anna switchyard. Therefore, PJM did not require separate review and approval of the protective relaying scheme for interconnection of Unit 3 at the North Anna switchyard.

Proposed COLA Revision

FSAR Section 8.2.1.2.2 will be revised to explain the coordination, review, and acceptance process for switchyard protective relaying as shown in 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 ESBWR 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.

Bus Work	Rated Current at 100°F
500 kV	3891A
230 kV	2750A

8.2.1.2.1 **Switchyard**

Replace the last paragraph with the following.

NAPS COL 8.2.4-2-A
NAPS COL 8.2.4-6-A
NAPS COL 8.2.4-7-A
NAPS COL 8.2.4-8-A

The NAPS switchyard, prior to the point of interconnection with Unit 3, is a 500/230 kV, air-insulated, breaker-and-a-half bus arrangement. Unit 3 is connected to this switchyard by an overhead conductor circuit.

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

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.

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 2004, "IEEE Guide for the Application of Insulation Coordination," and IEEE C62.22 2003, "IEEE Guide for the Application of Metal Oxide Surge Arrester for Alternating Current Systems." 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 2003, "IEEE Guide for the Application of Metal Oxide Surge Arrestors for Alternating Current Systems," IEEE 988-2000, "Guide to Direct Lightning Shielding of Substations," and "Insulation Coordination for Power Systems."

~~**NAPS SUP 8.2-1**~~
NAPS COL 8.2.4-5-A

8.2.1.2.2 **Protective Relaying**

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

Transformers are protected with differential and over-current relay schemes.

RAI NA3 08.02-7
(Draft 07/24/08)

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.

Breakers are equipped with dual trip coils. Each redundant protection circuit that supplies a trip signal 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 SUP 8.2-2

8.2.1.2.3 **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:

NA3 RAI 08.02-9
(Draft 07/16/08)

- Semiannual dissolved gas analysis on transformers

ENCLOSURE 8

Response to NRC RAI Letter 009

RAI Question 8.02-8

NRC RAI 8.02-8

FSAR Section 8.2. Please discuss the industry (FERC, NERC, and IEEE) standards that will be followed for switchyard protection system, monitoring, maintenance and testing. In addition, please confirm that generator circuit breakers will meet the requirements of IEEE Standard C37.013.

Dominion Response

Monitoring, maintenance and testing of the switchyard protection system are performed under NERC's Standard PRC-005-1, Transmission and Generation Protection System Maintenance and Testing, Standard PRC-008-0, Underfrequency Load Shedding Equipment Maintenance Program, and Standard PRC-017-0, Special Protection System Maintenance and Testing.

IEEE C37.013, "IEEE Standard for AC High Voltage Generator Circuit Breakers Rated on a Symmetrical Current Basis," was written specifically for high current circuit breakers installed between generators and transformer terminals. The proposed Unit 3 at North Anna places the circuit breaker on the high side terminals of the Generator Step Up (GSU) transformers and not between the generator and the GSUs. Thus, IEEE C37.013 does not directly apply. IEEE C37.010, "IEEE Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis," is the directly applicable IEEE document for this application and is the document referenced in the DCD Section 8.3.1.1 for sizing and design.

Proposed COLA Revision

FSAR Section 8.2.1.2.3 will be revised to include a discussion of the industry standards used for monitoring, maintenance, and testing of the switchyard protection system as shown in 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 ESBWR 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.

- 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

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," Standard PRC-008-0, "Underfrequency Load Shedding Equipment Maintenance Program," and Standard PRC-017-0, "Special Protection System Maintenance and Testing."

8.2.2.1 Reliability and Stability Analysis

Replace this section with the following.

~~NAPS COL 8.2.4-5-A~~
NAPS COL 8.2.4-9-A

A system impact study analyzed load flow, transient stability and fault analysis for the addition of Unit 3. (Reference 8.2.201) The study was prepared using 2011 summer light-load and 2014 summer base-case projections.

The analysis was performed using Power Technology International Software PSS/E. The analysis examined conditions involving loss of the largest generating unit, loss of the most critical transmission line, and multiple facility contingencies. The study also examined import/export power flows between transmission system utilities.

NAPS COL 8.2.4-10A

The equipment considered is from the point of interconnection of Unit 3 to the switchyard out to the 500 kV transmission system. This included the 230 kV buses and interconnections. The 34.5 kV portion of the North Anna switchyard is not considered. Maximum and minimum switchyard voltage limits have been established for the 500 kV switchyard at 534 kV and 505 kV, respectively. Normal operating and abnormal procedures

ENCLOSURE 9

Response to NRC RAI Letter 009

RAI Question 8.02-9

NRC RAI 8.02-9

FSAR Section 8.2. Please address inclusion of transformer testing as part of the overall routine switchyard component testing.

Dominion Response

North Anna switchyard transformers have dissolved gas analysis (DGA) performed every 6 months. Additionally, if the transformer has a Load Tap Changer (LTC), DGA analysis is performed on the LTC every 4 years. Infrared scans are performed quarterly on transformers as indicated in FSAR Section 8.2.1.2.3.

Proposed COLA Revision

FSAR Section 8.2.1.2.3 will be revised to include the requirement to conduct semi-annual dissolved gas analysis on transformers and 4-year dissolved gas analysis on load tap changers as shown in 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 ESBWR 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.

Transformers are protected with differential and over-current relay schemes.

Dominion is responsible for engineering, constructing, operating, and maintaining the electric transmission system. Because Dominion is the the switchyard protective relaying scheme designer and the applicable grid reliability organization, the coordination, review, and acceptance of the switchyard relaying scheme associated with the interconnection of Unit 3 is part of the review and approval process during initial design of the protective relaying scheme.

Breakers are equipped with dual trip coils. Each redundant protection circuit that supplies a trip signal 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 SUP 8.2-2

8.2.1.2.3 **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

Monitoring, maintenance, and testing of the switchyard protection system are performed under NERC Standard PRC-005-1, "Transmission and Generation Protection System Maintenance and Testing," Standard PRC-008-0, "Implementation and Documentation of Underfrequency Load Shedding Equipment Maintenance Program," and Standard PRC-017-0, "Special Protection System Maintenance and Testing."

8.2.2.1 **Reliability and Stability Analysis**

Replace this section with the following.

~~**NAPS COL 8.2.4-5-A**~~
NAPS COL 8.2.4-9-A

A system impact study analyzed load flow, transient stability and fault analysis for the addition of Unit 3. (Reference 8.2.201) The study was prepared using 2011 summer light-load and 2014 summer base-case projections.

The analysis was performed using Power Technology International Software PSS/E. The analysis examined conditions involving loss of the largest generating unit, loss of the most critical transmission line, and multiple facility contingencies. The study also examined import/export power flows between transmission system utilities.

NAPS COL 8.2.4-10A

The equipment considered is from the point of interconnection of Unit 3 to the switchyard out to the 500 kV transmission system. This included the 230 kV buses and interconnections. The 34.5 kV portion of the North Anna switchyard is not considered. Maximum and minimum switchyard voltage limits have been established for the 500 kV switchyard at 534 kV and 505 kV, respectively. Normal operating and abnormal procedures exist to maintain the switchyard voltage schedule and address challenges to the maximum and minimum limits. Upon approaching or exceeding a limit, these procedures verify available of required and

ENCLOSURE 10

Response to NRC RAI Letter 009

RAI Question 8.02-10

NRC RAI 8.02-10

FSAR Section 8.2.2.1 states "The analysis examined conditions involving loss of the largest generating unit, loss of the most critical transmission line, and multiple facility contingencies." Please clarify that the analysis addressed multiple facility contingencies (e.g., the analysis included tripping of all three nuclear units).

Dominion Response

The System Impact Study (SIS) referenced in COLA section 8.2.2.1 was performed to verify load flow capability, short circuit capability, and system stability of the local transmission system in the vicinity of the North Anna switchyard. The study was performed in accordance with NERC criteria. Individual cases are run to NERC Categories A, B, and C for No Contingency evaluations, N-1 evaluations, and N-2 evaluations, respectively. This level of detail meets the specific requirements of the Regional Transmission Organization (RTO), PJM, and assures that the local transmission system, including the North Anna switchyard, will continue to be a reliable power source.

NERC Category B includes N-1 contingencies such as a single line to ground fault or a three phase fault on a single transmission circuit, transformer, or generator with normal clearing. NERC Category C includes N-2 contingencies such as successive single line to ground faults or three phase faults with normal clearing, loss of two circuits on a common tower, or single line to ground faults with delayed clearing on a single transmission circuit, transformer, or generator.

The reviewer asks to clarify that the analysis addressed multiple facility contingencies. The reviewer also included an example of a multiple facility contingency event as a trip of all three nuclear units. NERC Category C is considered multiple facility contingencies. A NERC Category C case only considers tripping a single generator in conjunction with a stuck breaker or protection system failure. NERC Category D is considered an extreme event analysis and exceeds N-2. Analysis of a transmission system to NERC Category D is considered unusual. NERC Category D includes a case for loss of all generating units at a single station. The local transmission system that includes the North Anna switchyard has not been evaluated for loss of all generating units as this is considered to be an extreme case and is outside of the requirements of Dominion's transmission planning or the RTO.

A review of NRC Standard Review Plan 8.2, Section III.F indicates that grid stability analyses should consider normal conditions, N-1 events, and N-2 events. Specifically, the SRP states that "the analysis should consider the loss, through a single event, of the largest capacity being supplied to the grid, removal of the largest load from the grid, or loss of the most critical transmission line. This could be the total output of the station, the largest station on the grid, or possibly several large stations if these use a common transmission tower, transformer, or a breaker in a remote switchyard or substation." The generating units at North Anna do not use common transmission towers, transformers, or breakers. Therefore, extreme events represented in NERC Category D analyses are not applicable to North Anna.

Proposed COLA Revision

None.

ENCLOSURE 11

Response to NRC RAI Letter 009

RAI Question 8.02-11

NRC RAI 8.02-11

FSAR Section 8.2.2.1 states that stability analysis did not consider the 34.5 kV portion of the North Anna switchyard. The staff review identified the station auxiliary loads for all three units to be substantial. Please provide the basis, including identifying connected total (three units) station auxiliary loads, for excluding analysis of the 34.5 kV portion of the switchyard.

Dominion Response

The stability analysis discussed in FSAR Section 8.2.2.1 is an angular stability analysis that verifies stability of the transmission system when exposed to loss of selected transmission and generation assets. This study is performed at the transmission voltage level and would, as such, exclude loads operating at distribution voltage levels of 34.5 kV as they have limited ability to cause angular stability difficulties at the transmission level. This is the standard method for performing angular stability analysis by Dominion and PJM, the Regional Transmission Organization (RTO).

Proposed COLA Revision

None.

ENCLOSURE 12

Response to NRC RAI Letter 009

RAI Question 8.02-12

NRC RAI 8.02-12

FSAR Section 8.2.2.1 states that grid availability in the region over the past 20 years was examined and it was confirmed that the system has been highly reliable with minimal outages due to equipment failure. Please provide supporting information for this statement to include the frequency, duration, and causes of outages over the past 20 years for both the transmission system accepting the unit's output and the transmission system providing the preferred power for the unit's load.

Dominion Response

Dominion reviewed equipment failure history for the time period from 1988 to 2008. The major types of equipment that can affect reliability of the North Anna switchyard are transmission lines, transformers, and specific circuit breakers within the switchyard.

Transmission Lines - The North Anna switchyard has experienced 4 transmission line lockouts due to equipment failure in the past 20 years. These lockouts resulted from failure of transmission line components (4 events). The total duration of these line outages was 76 hours and 16 minutes (excluding two of the lockouts that did not have durations recorded). None of these events resulted in lockout of more than a single transmission line.

Transformers - The North Anna switchyard has experienced 3 transformer lockouts due to equipment failure in the past 20 years. These lockouts resulted from failure of substation components (1 event), and failure of protective devices (2 events). The duration of these equipment outages was not recorded. None of these events resulted in the lockout of more than a single transformer.

Circuit Breakers - The North Anna switchyard has experienced 16 circuit breaker lockouts due to equipment failure in the past 20 years. These lockouts resulted from failure of substation components (15 events) and failure of protective devices (1 event). The duration of these equipment outages was not recorded. None of these events resulted in the lockout of more than one breaker. The North Anna switchyard breaker and a half bus configuration is highly reliable and allows for a circuit breaker lockout without adversely impacting the ability of the switchyard to perform its function.

In summary, the switchyard has experienced relatively few equipment lockouts due to equipment failure and the equipment lockouts have been limited to individual pieces of equipment. The North Anna switchyard and local transmission system have not experienced a complete loss of power in the past 20 years.

Proposed COLA Revision

None.

ENCLOSURE 13

Response to NRC RAI Letter 009

RAI Question 8.02-13

NRC RAI 8.02-13

FSAR Section 8.2.2.1 states that "Upon approaching or exceeding a limit, these procedures verify availability of required and contingency equipment and materials, direct notifications to outside agencies and address unit technical specifications (TS) actions until the normal voltage schedule can be maintained." Since the FSAR does not identify TS for the offsite power system, please clarify the reference to TS in this Section 8.2.2.1 statement.

Dominion Response

The operating procedures for controlling the normal voltage schedule for existing Units 1 and 2 reference the associated Units 1 and 2 Technical Specifications (TS) for the offsite power system. Unit 3 will implement similar operating procedures to maintain the switchyard voltage schedule and address challenges to the maximum and minimum limits. However, the Unit 3 procedures will not reference any TS for offsite power, because they are not required. Therefore, Dominion will revise the FSAR Section 8.2.2.1 discussion of the operating procedures to delete the reference to the TS.

Proposed COLA Revision

FSAR Section 8.2.2.1 will be revised to remove the reference to unit technical specification actions as indicated in 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 ESBWR 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.

- 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

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," Standard PRC-008-0, "Underfrequency Load Shedding Equipment Maintenance Program," and Standard PRC-017-0, "Special Protection System Maintenance and Testing."

8.2.2.1 Reliability and Stability Analysis

Replace this section with the following.

~~NAPS COL 8.2.4-5-A~~
NAPS COL 8.2.4-9-A

A system impact study analyzed load flow, transient stability and fault analysis for the addition of Unit 3. (Reference 8.2.201) The study was prepared using 2011 summer light-load and 2014 summer base-case projections.

The analysis was performed using Power Technology International Software PSS/E. The analysis examined conditions involving loss of the largest generating unit, loss of the most critical transmission line, and multiple facility contingencies. The study also examined import/export power flows between transmission system utilities.

NAPS COL 8.2.4-10A

The equipment considered is from the point of interconnection of Unit 3 to the switchyard out to the 500 kV transmission system. This included the 230 kV buses and interconnections. The 34.5 kV portion of the North Anna switchyard is not considered. Maximum and minimum switchyard voltage limits have been established for the 500 kV switchyard at 534 kV and 505 kV, respectively. Normal operating and abnormal procedures exist to maintain the switchyard voltage schedule and address challenges to the maximum and minimum limits. Upon approaching or exceeding a limit, these procedures verify ~~available~~ availability of required and contingency equipment and materials, and direct notifications to outside agencies, ~~and address unit Technical Specifications actions~~ until the normal voltage schedule can be maintained. 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 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.

The study concluded that with the additional generating capacity of Unit 3, the transmission system remains stable under the analyzed conditions, preserving the grid connection and supporting the normal and shutdown power requirements of Unit 3.

The reliability of the overall system design is indicated by the fact that there have been no widespread system interruptions. Failure rates of individual facilities are low. Transmission lines are designed to have less than one lightning flashover per 100 miles per year, and the record shows much better performance, indicating conservative designs. Most lightning-caused outages are momentary, with few instances of line damage. Other facilities do fail occasionally, but these are random occurrences, and experience has shown that equipment specifications are adequate.

ENCLOSURE 14

Response to NRC RAI Letter 009

RAI Question 8.02-14

NRC RAI 8.02-14

FSAR Section 8.2.2.1 states that the system impact study was prepared using 2011 summer light-load and 2014 summer base-case projections. Please provide the basis for using 2011 summer light-load and 2014 summer base-case projections rather than the summer heavy-load projections and clarify whether the summer loads bound winter peak loads.

Dominion Response

The System Impact Study (SIS) consisted of a loadflow analysis, an import/export study, and a stability study. The SIS was conducted by the Regional Transmission Organization (RTO) to evaluate the addition of Unit 3 to the North Anna switchyard.

The loadflow analysis and import/export study portion of the SIS was conducted based on data projected for the timeframe corresponding to Dominion's requested interconnection date of April 2014. The 2014 summer base case was used because it is considered to be the peak load for the transmission system affected and envelopes the peak winter load. The 2014 summer base case also includes proposed load additions and projects evaluated by the RTO ahead of North Anna Unit 3.

The stability study portion of the SIS requires the use of a lighter load to identify any problems with angular stability of the system. Dominion submitted the stability study request to the RTO in 2006. The RTO uses a 5 year horizon for their studies; therefore, the 2011 summer case was selected for the stability study. After 2011, the RTO will perform annual baseline analyses to update the Regional Transmission Expansion Plan and identify potential reliability problems.

Proposed COLA Revision

None.

ENCLOSURE 15

Response to NRC RAI Letter 009

RAI Question 8.02-15

NRC RAI 8.02-15

Staff review of FSAR Section 8.2.2.1 indicates this section does not address the grid frequency variation. Please identify the maximum and minimum grid frequency. In addition, please discuss how the auxiliary power system studies consider the combined effect of frequency and voltage variation on the operation of safety-related loads (safety-related battery chargers and safety-related UPS) and other running motor loads.

Dominion Response

Dominion is a member of PJM and is subject to the operational requirements of PJM Manual 14D, “Generator Operational Requirements.” As stated on page 43 of Manual 14D, Rev. 13, PJM expects generation to be delivered to the transmission system at 60 Hz. Manual 14D also provides the following guidance for generator capability when interconnected with the transmission system:

> Generators and their protective systems (relaying, V/Hz, etc.), larger than 20 MW, must be capable of operating at a frequency of 57.5 Hz for 5 seconds or longer, or 58.0 Hz for 30 seconds or longer, to coordinate with system preservation under-frequency load shedding. Additionally, generators and their protective systems must be capable of operation at overfrequency up to 62 Hz for a limited duration.

Thus, the potential maximum and minimum grid frequency can be 62 Hz to 57.5 Hz, with time restrictions as stated.

The plant auxiliary power system is designed by GEH. The determination of the combined effect of frequency and voltage variations on safety related loads and other motor loads are considered in the auxiliary power system studies conducted by GEH.

Proposed COLA Revision

None.

ENCLOSURE 16

Response to NRC RAI Letter 009

RAI Question 8.02-16

NRC RAI 08.02-16

FSAR Chapter 1, Table 1.9-201, "Conformance with Standard Review Plan" for SRP Section 8.2, indicates GDC-5 is not applicable. DCD, Rev. 4, Section 8.2.2.2 states that the ESBWR Reference Plant is designed as a single-unit plant and, therefore, GDC-5 is not applicable. However, the staff notes that the North Anna Unit 3 switchyard is shared with Units 1 & 2 and, therefore, GDC-5 would be applicable. Please clarify the applicability of, and conformance with, GDC-5.

Dominion Response

GDC 5, "Sharing of structures, systems, and components," applies to structures, systems, and components (SSCs) that are important to safety. It prohibits sharing SSCs that are important to safety at a multi-unit site unless it can be shown that such sharing does not impair the shared SSCs' ability to perform their safety functions.

The North Anna switchyard is not important to safety for Unit 3, and thus, GDC 5 is not applicable. Unit 3 is an ESBWR, which is a passive design, and as such, it does not rely on offsite power to perform any safety-related function, or to support safety-related functions. No credit is taken for the switchyard in the safety analyses for any design basis accidents.

DCD Section 8.2.1.2, "Offsite Power System," states, "The offsite power system is a nonsafety-related system." Also, DCD Section 19A.4.4.4, "At-Power Loss of Preferred Power," states that the components that prevent a loss of offsite power, such as substations, breakers, and protective relays, are not risk significant and do not warrant additional regulatory oversight.

Therefore, the applicability statement for GDC 5 in FSAR Table 1.9-201 is correct as written.

Proposed COLA Revision

None.

ENCLOSURE 17

Response to NRC RAI Letter 009

RAI Question 8.02-17

NRC RAI 08.02-17

FSAR Chapter 1, Table 1.9-201, "Conformance with Standard Review Plan" for SRP Section 8.2, indicates GDC-4 is not applicable. However, RG-1.206 (C.I.8.2.1) states that the FSAR should address conformance with GDC-4. Please provide a discussion to clarify conformance with GDC-4 or the basis for not conforming with GDC-4.

Dominion Response

SRP Section 8.2 addresses offsite power, including the North Anna switchyard. GDC 4, "Environmental and dynamic effects design bases," applies to structures, systems, and components (SSCs) that are important to safety. It requires that these SSCs be designed to accommodate the effects of, and to be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents.

The North Anna switchyard is not important to safety for Unit 3, and thus, GDC 4 is not applicable. Unit 3 is an ESBWR, which is a passive design, and as such, it does not rely on offsite power to perform any safety-related function, or to support safety-related functions. No credit is taken for the switchyard in the safety analyses for any design basis accidents.

DCD Section 8.2.1.2, "Offsite Power System," states, "The offsite power system is a nonsafety-related system." Also, DCD Section 19A.4.4.4, "At-Power Loss of Preferred Power," states that the components that prevent a loss of offsite power, such as substations, breakers, and protective relays, are not risk significant and do not warrant additional regulatory oversight.

Therefore, the applicability statement for GDC 4 in FSAR Table 1.9-201 is correct as written.

Proposed COLA Revision

None.

ENCLOSURE 18

Response to NRC RAI Letter 009

RAI Question 8.02-18

NRC RAI 08.02-18

FSAR Chapter 1, Table 1.9-201, "Conformance with Standard Review Plan" for SRP Section 8.2 indicates that North Anna Unit 3 conforms with GDC-2. However, staff review of Chapter 8 identified no discussion regarding GDC-2. Please clarify conformance with GDC-2.

Dominion Response

FSAR Table 1.9-201 incorrectly states that the North Anna Unit 3 offsite power system conforms with GDC 2. DCD Table 8.1-1, Revision 4, correctly indicates that GDC 2 is only applicable to the ESBWR DC (Onsite) Power System.

In particular, GDC 2, "Design bases for protection against natural phenomena," states:

> Structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions. The design bases for these structures, systems, and components shall reflect: (1) Appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena and (3) the importance of the safety functions to be performed.

Unit 3 is an ESBWR, which is a passive design and, as such, does not rely on offsite power and thus, no credit is taken for offsite power in the event of a design basis accident. Also, the offsite power system is not a safety-related structure, system or component for Unit 3. Therefore, GDC 2 is not applicable to the Unit 3 offsite power system.

Proposed COLA Revision

FSAR Table 1.9-201 will be revised as indicated in 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 ESBWR 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 1.9-3-A

Table 1.9-201 Conformance with Standard Review Plan

SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
BTP 7-19	Guidance for Evaluation of Diversity and Defense-in-Depth in Digital Computer-Based Instrumentation and Control Systems	Rev. 5	Mar-07		Conforms
HCIB-20	Not Used				Not used
BTP 7-21	Guidance on Digital Computer Real-Time Performance	Rev. 5	Mar-07		Conforms
8.1	Electric Power - Introduction	Rev. 3	Mar-07		Conforms
8.2	Offsite Power System	Rev. 4	Mar-07	~~II.1,~~ II.4, II.5, II.6, II.8	Conforms
				II.1, II.2, II.3, II.7	Not applicable. ESBWR is a passive design and does not rely on offsite power.
8.3.1	A-C Power Systems (Onsite)	Rev. 3	Mar-07	II.1, II.2, II.3, II.4.A through II.4.H, II.4.J, II.5, II.6, II.7, II.10	Conforms
				II.4.I	Not applicable. The ESBWR diesel generators are not safety-related.
				II.8	Not applicable. The ESBWR diesel generators are not safety-related, nor is AC power needed to achieve safe shutdown.
				II.9	Conforms. Addressed in DCD Section 17.4 and in Section 17.6.

ENCLOSURE 19

Response to NRC RAI Letter 009

RAI Question 8.02-19

NRC RAI 08.02-19

FSAR Chapter 1, Table 1.9-201, "Conformance with Standard Review Plan" for SRP Section 8.2 indicates that North Anna Unit 3 complies with the requirements of 10 CFR 50.65(a)(4). However, the staff review of Chapter 8 identified no discussion regarding 10 CFR 50.65. Please clarify compliance with the requirements of 10 CFR 50.65(a)(4).

Dominion Response

As indicated in FSAR Table 1.9-201, North Anna Unit 3 complies with the requirements of 10 CFR 50.65(a)(4). In particular, the subject regulation is one aspect of the "Maintenance Rule" (10 CFR 50.65), an operational program, the implementation of which is addressed by Item 17 in FSAR Table 13.4-201 and the content of which is discussed in FSAR Section 17.6. As indicated by the entries for RG 1.206, Section C.III.1, Section 17.6, in FSAR Table 1.9-203, North Anna Unit 3 conforms with the requirements of 10 CFR 50.65(a)(4).

Proposed COLA Revision

None.

ENCLOSURE 20

Response to NRC RAI Letter 009

RAI Question 8.02-20

NRC RAI 08.02-20

FSAR Chapter 1, Table 1.9-201, "Conformance with Standard Review Plan" for SRP Section BTP 8-3, indicates that BTP-8-3, "Stability of Offsite Power System," is not applicable. However, DCD, Rev 4, Section 8.2.4, "COL Information," identifies that the COL applicant will address the stability and reliability of the offsite transmission system. Please revise Table 1.9-201 to indicate applicability of BTP 8-3 or justify that BTP 8-3 is not applicable.

Dominion Response

The stability and reliability of the offsite power transmission system is discussed in FSAR Section 8.2.2.1. Therefore, the entry for BTP 8-3 in FSAR Table 1.9-201 will be revised to state:

> Conforms – Stability studies investigating the loss of off-site generation were performed.

Proposed COLA Revision

FSAR Table 1.9-201 will be revised as shown in 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 ESBWR 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 1.9-3-A

Table 1.9-201 Conformance with Standard Review Plan

SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
8.4	Station Blackout	Initial Issuance	Mar-07	II.1, II.2	Conforms. Addressed in DCD Section 15.5.5.
				II.3	Not applicable. Onsite Class 1E Emergency AC power sources are not required for ESBWR safe shutdown.
				II.4, II.5	Conforms. Addressed in Section 17.6.
Appendix 8-A	General Agenda, Station Site Visits	Rev. 1	Mar-07		Not applicable. Provides guidance to NRC to conduct site visits.
BTP 8-1	Requirements on Motor-Operated Valves in the ECCS Accumulator Lines	Rev. 3	Mar-07		Not applicable. The ESBWR does not have any safety-related motor-operated valves.
BTP 8-2	Use of Diesel-Generator Sets for Peaking	Rev. 3	Mar-07		Not applicable. The ESBWR will not use the non-safety related diesel generators as peaking units.
BTP 8-3	Stability of Offsite Power Systems	Rev. 3	Mar-07		~~Not applicable. The ESBWR onsite and offsite AC power sources are non-safety related and are not relied upon to mitigate an accident.~~ Conforms. Stability studies were performed to investigate the loss of off-site generation.
BTP 8-4	Application of the Single Failure Criterion to Manually Controlled Electrically Operated Valves	Rev. 3	Mar-07		Not applicable. The ESBWR does not use any manually-operated valves to mitigate an accident.

ENCLOSURE 21

Response to NRC RAI Letter 009

RAI Question 8.02-21

NRC RAI 08.02-21

FSAR Chapter 1, Table 1.9-201, "Conformance with Standard Review Plan" for SRP Section BTP 8-5, indicates that BTP 8-5, "Supplemental Guidance for Bypass and Inoperable Status Indication for Engineered Safety Features System" is not applicable. However, DCD, Rev. 4, Section 8.3.2.2.2 indicates that BTP ICSB 21, "Supplemental Guidance for Bypass and Inoperable Status Indication for Engineered Safety Features System," is applicable. Note that the NRC has updated BTP ICSB 21 as BTP 8-5. Please revise Table 1.9-201 to indicate BTP 8-5 is applicable.

Dominion Response

BTP 8-5 is not applicable to North Anna Unit 3. The ESBWR is designed in accordance with ICSB 21, which is the predecessor to BTP 8-5, as indicated in DCD Table 8.1-1 and Section 8.3.2.2.2. Additionally, BTP 8-5 does not provide guidance on any site-specific design, operational aspects of the facility, or siting information in the FSAR that supplements the Site Safety Analysis Report. Therefore, FSAR Table 1.9-201 will be revised to clarify the basis for concluding that BTP 8-5 is not applicable.

Proposed COLA Revision

FSAR Table 1.9-201 will be revised as shown in 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 ESBWR 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 1.9-3-A **Table 1.9-201 Conformance with Standard Review Plan**

SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
BTP 8-2	Use of Diesel-Generator Sets for Peaking	Rev. 3	Mar-07		Not applicable. The ESBWR will not use the non-safety related diesel generators as peaking units.
BTP 8-3	Stability of Offsite Power Systems	Rev. 3	Mar-07		~~Not applicable. The ESBWR onsite and offsite AC power sources are non-safety related and are not relied upon to mitigate an accident.~~ Conforms. Stability studies were performed to investigate the loss of off-site generation.
BTP 8-4	Application of the Single Failure Criterion to Manually Controlled Electrically Operated Valves	Rev. 3	Mar-07		Not applicable. The ESBWR does not use any manually-operated valves to mitigate an accident.
BTP 8-5	Supplemental Guidance for Bypass and Inoperable Status Indication for Engineered Safety Features Systems	Rev. 3	Mar-07		Not applicable. The ESBWR ~~does not rely on safety-related AC power systems. However,~~ is designed in accordance with ICSB 21, the predecessor to BTP 8-5, as stated in DCD Table 8.1-1 and DCD Section 8.3.2.2.2. Also, refer to DCD Table 7.1-1 for conformance to RG 1.47 and BISI for all safety-related systems.

ENCLOSURE 22

Response to NRC RAI Letter No. 009

RAI Question 8.02-22

NRC RAI 08.02-22

FSAR Chapter 1, Table 1.9-201, "Conformance with Standard Review Plan" for SRP Section BTP 8-3, indicates that BTP 8-6, "Adequacy of station Electric Distribution System Voltage" is not applicable. However, DCD, Rev. 4, Section 8.3.1.1.2 indicates that BTP PSB 1, "Adequacy of Station Electric distribution System Voltage," is applicable. Note that the NRC has updated BTP PSB 1 as BTP 8-6. Please revise Table 1.9-201 to indicate BTP 8-6 is applicable.

Dominion Response

BTP 8-6 is not applicable to North Anna Unit 3. The ESBWR is designed in accordance with PSB 1, which is the predecessor to BTP 8-6, as indicated in DCD Table 8.1-1 and Section 8.3.1.1.2. Additionally, BTP 8-6 does not provide guidance on any site-specific design, operational aspects of the facility, or siting information in the FSAR that supplements the Site Safety Analysis Report. Therefore, FSAR Table 1.9-201 will be revised to clarify the basis for concluding that BTP 8-6 is not applicable.

Proposed COLA Revision

FSAR Table 1.9-201 will be revised as shown in 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 ESBWR 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 1.9-3-A

Table 1.9-201 Conformance with Standard Review Plan

SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
BTP 8-6	Adequacy of Station Electric Distribution System Voltages	Rev. 3	Mar-07		Not applicable. The ESBWR ~~does not rely on safety-related onsite AC power sources~~ is designed in accordance with PSB 1, the predecessor to BTP 8-6, as stated in DCD Table 8.1-1 and DCD Section 8.3.1.1.2.
BTP 8-7	Criteria for Alarms and Indications Associated with Diesel-Generator Unit Bypassed and Inoperable Status	Rev. 3	Mar-07		Not applicable. The ESBWR does not use safety-related diesel generators.
9.1.1	Criticality Safety of Fresh and Spent Fuel Storage and Handling	Rev. 3	Mar-07	II.1	Conforms
9.1.2	New and Spent Fuel Storage	Rev. 4	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8, II.9	Conforms
9.1.3	Spent Fuel Pool Cooling and Cleanup System	Rev. 2	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7	Conforms
				II.8	Conforms. EP-ITAAC are addressed in COLA Part 10.
9.1.4	Light Load Handling System (Related to Refueling)	Rev. 3	Mar-07	II.1, II.2, II.3, II.4	Conforms
9.1.5	Overhead Heavy Load Handling Systems	Rev. 1	Mar-07	II.1, II.2, II.3, II.4	Conforms
9.2.1	Station Service Water System	Rev. 5	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6	Conforms

ENCLOSURE 23

Response to NRC RAI Letter 009

RAI Question 8.02-23

NRC RAI 8.02-23

DCD, Rev 4, Section 8.2.3 states that a transmission system reliability and stability review of the site-specific configuration to which the plant is connected will be performed to determine the reliability of the offsite power system and verify that it is consistent with the analysis of Chapter 19. Please clarify the manner in which verification of the reliability of the offsite power system to be consistent with the analysis of Chapter 19 is performed.

Dominion Response

The ESBWR PRA used site-specific PRA information from the North Anna site to develop PRA parameters for Loss of Preferred (LOPP) frequency. The following is related text from the NA3 COLA RAI 19.0-2 response which was submitted to the NRC on July 15, 2008:

> 1) Loss of Preferred Power (LOPP) frequency – to determine if the site has unusual off-site power availability problems. The LOPP frequency is divided into plant-centered, switchyard, grid-related, and weather-related initiating events.

To ensure that the ESBWR PRA is a bounding standard design, the site-specific values for these parameters were used to develop the ESBWR PRA standard values. The ESBWR LOPP frequencies are based on NUREG/CR-6890, "Reevaluation of Station Blackout Risk at Nuclear Power Plants Analysis of Loss of Offsite Power Events: 1986-2004." The North Anna LOPP frequencies were compared to the ESBWR frequencies to identify any outliers. The data shows that grid-related losses of power are significantly more frequent than plant-centered, switchyard, or weather-related losses of power. Although there is a variance in the values for the LOPP frequencies, their range is acceptable because the change in CDF by using the highest frequency is less than 1 E-10 per year. The conclusions in DCD Tier 2 Section 19.2.3.1, Risk from Internal Events, remain valid for the minor variances in LOPP frequencies.

In summary, the ESBWR PRA provides a reasonable representation of the parameters and conditions that are specific to the North Anna site.

In addition to review of the existing grid reliability, the impact of adding North Anna Unit 3 is also reviewed to ensure PRA assumptions remain valid. A System Impact Study (SIS) has been prepared by PJM for the proposed Unit 3. The intent of the SIS was to determine system upgrades and associated costs and construction time estimates required to facilitate the addition of the new generating plant to the transmission system. The system upgrades include the direct connection of the generator to the system and any network upgrades necessary to maintain the reliability of the transmission system.

The SIS has identified the required transmission facility upgrades to ensure reliability is not reduced below the required set standards. When the required upgrades are made, the reliability of the offsite power system will be consistent with the analysis of Chapter 19.

Proposed COLA Revision

None.

ENCLOSURE 24

Response to NRC RAI Letter 009

RAI Question 8.02-24

NRC RAI 8.02-24

DCD Section 8.2.3 states that a station ground grid is provided that consists of a ground mat below grade at the switchyard that is connected to the foundation embedded loop grounding system provided for the entire power block and associated buildings. Please provide a description of the station ground grid.

Dominion Response

A description of the station ground grid is provided in DCD Section 8, Appendix 8A, Miscellaneous Electrical Systems, Section 8A.1, Station Grounding and Surge Protection. This DCD section includes a system description and analysis of regulatory guidance and applicable codes and standards used in the design.

Proposed COLA Revision

None.

ENCLOSURE 25

Response to NRC RAI Letter 009

RAI Question 8.02-25

NRC RAI 8.02-25

SRP 8.2 (III.1.I) identifies the need to address provisions for surge protection and lightning protection. Staff review of Chapter 8 did not identify that these issues were addressed. Please provide a discussion of the adequacy of surge protection and lightning protection of offsite power system.

Dominion Response

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 2004, "IEEE Guide for the Application of Insulation Coordination" and IEEE C62.22 2003, "IEEE Guide for the Application of Metal Oxide Surge Arresters for Alternating Current Systems." 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 Standard 62.22 2003, "IEEE Guide for the Application of Metal Oxide Surge Arresters for Alternating Current Systems," IEEE Standard 988-2000, "Guide to Direct Lightning Shielding of Substations," and the reference book, "Insulation Coordination for Power Systems," by Andrew R. Hileman.

Proposed COLA Revision

FSAR Section 8.2.1.2.1 will be revised to add a description of the switchyard surge and lightning protection as shown in 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 ESBWR 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.

Bus Work	Rated Current at 100°F
500 kV	3891A
230 kV	2750A

8.2.1.2.1 **Switchyard**

Replace the last paragraph with the following.

NAPS COL 8.2.4-2-A
NAPS COL 8.2.4-6-A
NAPS COL 8.2.4-7-A
NAPS COL 8.2.4-8-A

The NAPS switchyard, prior to the point of interconnection with Unit 3, is a 500/230 kV, air-insulated, breaker-and-a-half bus arrangement. Unit 3 is connected to this switchyard by an overhead conductor circuit.

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

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.

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 2004, "IEEE Guide for the Application of Insulation Coordination," and IEEE C62.22 2003, "IEEE Guide for the Application of Metal Oxide Surge Arrester for Alternating Current Systems." 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 2003, "IEEE Guide for the Application of Metal Oxide Surge Arrestors for Alternating Current Systems," IEEE 988-2000, "Guide to Direct Lightning Shielding of Substations," and "Insulation Coordination for Power Systems."

~~**NAPS SUP 8.2-1**~~
NAPS COL 8.2.4-5-A

8.2.1.2.2 **Protective Relaying**

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

ENCLOSURE 26

Response to NRC RAI Letter 009

RAI Question 8.02-26

NRC RAI 8.02-26

SRP 8.2 identifies the need to address grid instability relative to the nuclear unit. Please identify, and provide detailed discussion as applicable, any effects on the operation (e.g., minimum and maximum grid voltage, degraded voltage) of the existing nuclear Units 1 & 2 due to the addition of Unit 3 to the grid.

Dominion Response

The impact of Unit 3 as it relates to grid instability is considered by both the grid operator and by the existing units.

PJM, which is the Regional Transmission Organization responsible for grid stability, performed a system impact study (SIS) to evaluate the impact that the interconnection of Unit 3 would have on import/export capability, short circuit capability, and system stability. The SIS determined that system upgrades will be required prior to interconnecting Unit 3 to the grid to ensure that the transmission system will meet PJM's and Dominion's minimum standards. The SIS is discussed in FSAR Section 8.2.2.1.

Under the existing units' operating licenses (NPF-4 and -7) and applicable NRC regulations, the potential impact of Unit 3 on the existing units will be evaluated under the existing units administrative controls. Changes that could impact the existing units' licensing basis will be evaluated in accordance with 10 CFR 50.59. Changes would be reported to NRC in accordance with 10 CFR 50.71(e).

Proposed COLA Revision

None.