VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

September 5, 2013

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

Serial No. 12-519A
NL&OS/ETS R3
Docket Nos. 50-338/339
License Nos. NPF-4/7

Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
NORTH ANNA POWER STATION UNITS 1 AND 2
REVISED RESPONSE TO NRC BULLETIN 2012-01 - DESIGN VULNERABILITY IN ELECTRIC POWER SYSTEM – ITEMS 1 and 2.d

On July 27, 2012, the NRC issued NRC Bulletin 2012-01, "Design Vulnerability in Electric Power System," to 1) request information regarding the facilities' electric power system design in light of the recent operating experience that involved the loss on one of the three phases of the offsite power circuits at Byron Station Unit 2 and 2) require a comprehensive verification of the facilities' compliance with the regulatory requirements of GDC 17, "Electric Power Systems," in Appendix A, General Design Criteria (GDC) for Nuclear Power Plants to 10 CFR Part 50, or the applicable principal design criteria in the updated final safety analysis report. In an October 24, 2012 letter (Serial No. 12-519), Dominion provided North Anna's response to the Bulletin.

During a review of the INPO Event Report (IER) and North Anna's response to the Bulletin, inaccurate information was identified in the Bulletin response. Specifically, 1) an incorrect annunicator was included and 2) the method for the daily verification of bus/phase voltage was incorrectly cited. The attachment to this letter corrects these discrepancies and provides a revised response for these two items.

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

Sincerely,

Eugene S. Grecheck
Vice President – Nuclear Engineering and Development

Enclosure:

1. Revised North Anna Response to NRC Bulletin 2012-01 – Items 1 and 2.d

Commitments made in this letter: None

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

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

Acknowledged before me this 5TH day of September, 2013.

My Commission Expires: 5-31-14

Vicki L. Hull
Notary Public

VICKI L. HULL
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140542
My Commission Expires May 31, 2014

IE76
NRR

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NRC Senior Resident Inspector
North Anna Power Station

ATTACHMENT

Revised North Anna Response to NRC Bulletin 2012-01 – Items 1 and 2.d

North Anna Power Station Units 1 and 2

Virginia Electric and Power Company
(Dominion)

Revised North Anna Response to NRC Bulletin 2012-01

Within this section, portions of the original North Anna Response to NRC Bulletin 2012-01 have been provided. Changes have been identified as bolded, italicized, and underlined text.

System Protection

Items 1, 1.a, 2.b, 2.d request information regarding electrical system protection and will be addressed in this section:

1. Given the requirements above, describe how the protection scheme for ESF buses (Class 1E for current operating plants or non-Class 1E for passive plants) is designed to detect and automatically respond to a single-phase open circuit condition or high impedance ground fault condition on a credited offsite power circuit or another power sources.

Consistent with the current licensing basis and 10CFR50, Appendix A, GDC-17, the existing safety related protective circuitry will separate the ESF buses from a connected failed source due to a loss of voltage or a sustained, balanced degraded grid voltage.

Although the protection scheme at NAPS was not designed to detect and automatically respond to a single-phase open circuit condition on a credited offsite power circuit, preliminary analysis has shown that in some cases evaluated, the protection schemes will separate the ESF buses in an open phase condition and isolate the affected offsite power source, automatically transferring power to an onsite alternate supply (i.e., Emergency Diesel Generator).

An evaluation of the Byron event has been performed to determine the capability of existing NAPS safety related under voltage relays to detect and automatically respond to single-phase open circuit conditions of off-site power supplies to 4.16kV Class 1E vital buses. Regarding the ability of the NAPS ESF power distribution system UV relays to detect and respond to an open phase condition, the evaluation is based on analysis performed using EMPT based computer modeling software (PSCAD). Engineering has evaluated the results of the PSCAD analysis using published materials and the ETAP computer code, where possible, to ensure that the results are reasonable.

The NAPS under voltage relay scheme is similar to that described in IEEE Standard 741. The first level of under voltage protection is provided by the loss of voltage relays whose function is to detect and disconnect the Class 1E buses from the preferred power source upon a total loss of voltage. The UV relay setting equals 50.8V-SEC x 35/1 equals 1778-VPRI (phase-to-neutral voltage). Two-of-three UV relays are required to sense the loss of voltage condition to initiate tripping of the preferred offsite power supply after 2 seconds.

The second level of under voltage protection is provided by the degraded voltage (DV) relays, which are set to detect a low-voltage condition. The DV relay setting equals 61.8V-SEC x 35/1 equals 2163-VPRI (phase-to-neutral voltage). Two-of-three DV relays are required to sense the low voltage condition to initiate tripping of the preferred offsite power source after 56 seconds, or after 7.5 seconds coincident with a safety injection signal. The under voltage/degraded voltage relays are connected phase-to-neutral on the secondary of wye-grounded/wye-grounded connected 4200-120V potential transformers.

To determine the ability to detect an open phase from the preferred offsite power source, the phase-to-neutral voltage for each phase was required to be modeled for that condition. Three scenarios were analyzed to determine the vulnerability at NAPS of an open primary transformer phase condition. A summary of the results is as follows:

1. An open phase on the primary of one of the 34.5-4.16kV RSSTs will actuate the applicable ESF bus 74% UV relay circuit and separate from offsite power in 2 seconds. The Station Service Transformers (SSTs) utilized for the cross ties (1H to 1B & 1J to 2B) are connected similarly to the normal supply RSSTs (delta-wye low resistance grounded). In a cross tie configuration, the loss of a phase will be similar for either alignment. The SST primaries are supplied via the 22kV main generator isolated phase buses and are not subject to a loss of phase. Due to the connection similarities, the effect of a loss of a primary phase of either an SST or RSST would be similar. The results are unchanged assuming that the open transformer terminal is solidly grounded.

2. An open phase on the primary of 230-34.5kV XFMR 3 will result in a voltage imbalance on the applicable ESF bus that will not be automatically isolated by the UV or DV relays. The loss of phase would immediately render the offsite power source and applicable ESF inoperable. Like Byron, the voltage imbalance would impact operation of loads on the affected bus and would ultimately be self revealing. Unlike the Byron event, only one of two ESF buses per unit would potentially be affected. 230-34.5kV XFMR 3 in the switchyard normally supplies 34.5kV Bus 5. Bus 5 normally supplies the local 34.5kV distribution circuit and 34.5-4.16kV RSST-A, which is the preferred source for ESF Bus 1J. XFMR 3 is connected delta/wye-grounded and RSST-A is connected delta/wye-low resistance-grounded. The loss of one phase supplying the 230-34.5kV XFMR 3 will result in imbalanced voltages at the 34.5kV bus which, will in-turn, impact the 1J 4160-Volt ESF Bus. XFMR 3 was originally installed as a backup to XFMR 1 or XFMR 2. As stated, it normally supplies RSST-A. However, it is permissible to supply RSST-A and RSST-B or RSST-C from XFMR 3 at any time. It is not permissible to supply both ESF buses for an operating unit from a common offsite source. The open phase condition applies to the leads from the 230kV bus to the transformer. The bus design ensures that an open phase on the bus or beyond the switchyard does not impact the transformer voltage.

   Considering the A-phase opens (other single phase open is similar), the summary provided below describes the UV/DV relay sensing abilities. It should be noted that due to phase winding configurations, an open 230kV A-Phase results in 4.16kV B-Phase dropout.

   UV Relays [50.8 x 35/1 equals 1778V-PRIMARY LN]
   The B-Phase UV relay will drop-out due to the loss of voltage on that phase. However, the A-Phase and C-Phase UV relays will not drop-out and the trip circuit will not actuate since only 1 of 3 relays will drop-out (2 of 3 required).

   DV Relays [61.8 x 35/1 equals 2163V-PRIMARY LN]
   The B-Phase DV relay will drop-out due to the loss of voltage on that phase. The A-Phase and C-Phase DV relays will also drop-out starting the 60 second (non-SI) timer before tripping the preferred source circuit breaker. Prior to completion of the 60 second timer the RSST automatic load tap changer (LTC) is expected to correct the overall low voltage and likely

prevent the automatic circuit breaker trip; the A-Phase and C-Phase DV relays will pick-up and the circuit will not actuate since only 1 of 3 relays will remain dropped out (2 of 3 required).

Expected Control Room Annunciator alarms include both the 4kV Bus Blown Fuse Alarm and ESF Bus UV/DV Alarm (after 15 second time delay). The RSST automatic LTC is expected to attempt to correct the low voltage and will likely clear the ESF Bus UV Alarm. However due to the very low voltage on one phase, the 4kV Bus Blown Fuse Alarm is expected to remain in alarm.

Identification of the 4kV Bus Blown Fuse Alarm in the above paragraph was based on review of Unit 2 documents and is referring to the 4kV bus potential transformer blown fuse alarm. The above statement regarding the expected alarms is correct for Unit 2. However, the 4kV bus potential transformer blown fuse alarm is not included in the Unit 1 design. Following identification of this discrepancy alternate annunicators (alarms) were identified and the annunciator response procedures were modified accordingly. These changes equivalently addressed the concern for Unit 1.

For an open phase, the voltage magnitudes on the 480VAC buses are such that the following annunciators are expected as well. Thus, the annuciator response procedures have been revised with the required instruction to aid in the diagnosis of a condition similar to the Byron event.

480V BUSES 2H-2H1-2J-2J1 BLOWN FUSE: 2-AR-D-B6
480V BUSES 1H-1H1-1J-1J1 BLOWN FUSE: 1-AR-D-B6

EMER BUS 2H PT FUSE BLOWN: 2-AR-J-F6
EMER BUS 2J PT FUSE BLOWN: 2-AR-J-F7

2.d. Do the plant operating procedures, including off-normal operating procedures, specifically call for verification of the voltages on all three phases of the ESF buses?

Daily Station Operations rounds procedures verify the presence of each of the three phases of voltage on the ESF buses. Station Operations annunciator response procedures are being modified to include instruction for phase verification when control room annunciator alarms "4kV Bus Blown Fuse Alarm" and "Emergency Bus UV" actuate. The control room annunciators are expected to alarm when there is an open phase in the switchyard. The additional instruction is intended to assist Operations personnel with diagnosing the open phase condition and further instructs Operations personnel to manually separate from the affected offsite source. Furthermore, as a result of the Byron event, the weekly walk down procedure for switchyard inspections is being revised with specific instruction for inspecting the high-side connections to the offsite sources in the switchyard.

As noted in the original response, verifying the presence of voltage on each of the three phases of the ESF buses was not being completed on a daily basis during operator rounds. In addition, the indication that was identified to address this issue and perform this task was erroneously noted as use of plant installed phase lamps. Specifically, the lamps noted within the original response only verified the presence of DC power to the undervoltage circuits and thus, retrospectively would not aid in the diagnosis of an open phase condition.

Since this issue was identified, a modification to the Plant Computer System (PCS) has been implemented. The plant computer continuously monitors emergency bus voltages and a software modification has been created to calculate the absolute phase-to-phase voltage imbalance with an alarm at 3.5%. The PCS voltage imbalance points will be included in the operator rounds and logged twice per shift with instruction similar to the annunciator response procedures identified for item 1 above.

As identified by the engineering analysis performed for this event, presence of elevated percent voltage imbalance levels is directly correlated to a possible open phase condition. Therefore, institution of these points has provided a method for continuous monitoring for an open phase event.