UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

October 19, 2021

Mr. Daniel G. Stoddard
Senior Vice President and Chief Nuclear Officer
Innsbrook Technical Center
5000 Dominion Blvd.
Glen Allen, VA 23060-6711

SUBJECT: NORTH ANNA POWER STATION, UNIT NOS. 1 AND 2 – ISSUANCE OF AMENDMENT NOS. 288 AND 271 TO REVISE TECHNICAL SPECIFICATIONS BATTERY SURVEILLANCE TESTING (EPID L-2020-LLA-0275)

Dear Mr. Stoddard:

The U.S. Nuclear Regulatory Commission (the Commission) has issued the enclosed Amendment Nos. 288 and 271 to Renewed Facility Operating License Nos. NPF-4 and NPF-7 for the North Anna Power Station (North Anna), Unit Nos. 1 and 2, respectively. These amendments were issued in response to your application dated December 17, 2020, as supplemented by letters dated May 6, 2021, and August 26, 2021.

The amendments revise North Anna Technical Specifications Surveillance Requirements 3.8.4.2 and 3.8.4.5 to include verification of total battery connection resistance.

A copy of the related Safety Evaluation is also enclosed. A Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

/RA/

G. Edward Miller, Project Manager
Special Projects and Process Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-338 and 50-339

Enclosures:
1. Amendment No. 288 to NPF-4
2. Amendment No. 271 to NPF-7
3. Safety Evaluation

cc: Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

VIRGINIA ELECTRIC AND POWER COMPANY

DOCKET NO. 50-338

NORTH ANNA POWER STATION, UNIT NO. 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 288
Renewed License No. NPF-4

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Virginia Electric and Power Company (the licensee) dated December 17, 2020, as supplemented by letters dated May 6, 2021 and August 26, 2021, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by page changes to the Technical Specifications, as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Renewed Facility Operating License No. NPF 4 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 288, are hereby incorporated in the renewed license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance and shall be implemented within 90 days.

FOR THE NUCLEAR REGULATORY COMMISSION

John G. Lamb

Digitally signed by John G. Lamb
Date: 2021.10.19 10:06:13 -04'00'

Michael T. Markley, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Operation

Attachment:
Changes to Renewed Facility
Operating License No. NPF-4
and Technical Specifications

Date of Issuance: October 19, 2021

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

VIRGINIA ELECTRIC AND POWER COMPANY

DOCKET NO. 50-339

NORTH ANNA POWER STATION, UNIT NO. 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 271
Renewed License No. NPF-7

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Virginia Electric and Power Company (the licensee) dated December 17, 2020, as supplemented by letters dated May 6, 2021 and August 26, 2021, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by page changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Renewed Facility Operating License No. NPF-7 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 271, are hereby incorporated in the renewed license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance and shall be implemented within 90 days.

FOR THE NUCLEAR REGULATORY COMMISSION

John G. Lamb

Digitally signed by John G. Lamb
Date: 2021.10.19 10:06:52 -04'00'

Michael T. Markley, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Operation

Attachment:
Changes to Renewed Facility
Operating License No. NPF-7
and Technical Specifications

Date of Issuance: October 19, 2021

ATTACHMENT TO

NORTH ANNA POWER STATION, UNIT NOS. 1 AND 2

LICENSE AMENDMENT NO. 288

RENEWED FACILITY OPERATING LICENSE NO. NPF-4

DOCKET NO. 50-338

AND LICENSE AMENDMENT NO. 271

RENEWED FACILITY OPERATING LICENSE NO. NPF-7

DOCKET NO. 50-339

Replace the following pages of the Renewed Facility Operating Licenses with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

Remove	Insert
NPF-4, page 3	NPF-4, page 3
NPF-7, page 3	NPF-7, page 3

Replace the following pages of the Appendix A Technical Specifications with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

Remove	Insert
3.8.4-2	3.8.4-2
3.8.4-3	3.8.4-3
3.8.4-4	3.8.4-4

(2) Pursuant to the Act and 10 CFR Part 70, VEPCO to receive, possess, and use at any time special nuclear material as reactor fuel, in accordance with the limitations for storage and amounts required for reactor operation, as described in the Updated Final Safety Analysis Report;

(3) Pursuant to the Act and 10 CFR Parts 30, 40, and 70, VEPCO to receive, possess, and use at any time any byproduct, source, and special nuclear material as sealed neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;

(4) Pursuant to the Act and 10 CFR Parts 30, 40, and 70, VEPCO to receive, possess, and use in amounts as required any byproduct, source, or special nuclear material, without restriction to chemical or physical form, for sample analysis or instrument calibration or associated with radioactive apparatus or component; and

(5) Pursuant to the Act and 10 CFR Parts 30 and 70, VEPCO to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility.

C. This renewed operating license shall be deemed to contain and is subject to the conditions specified in the following Commission regulations in 10 CFR Chapter I; Part 20, Section 30.34 of Part 30, Section 40.41 of Part 40, Sections 50.54 and 50.59 of Part 50, and Section 70.32 of Part 70; is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

VEPCO is authorized to operate the North Anna Power Station, Unit No. 1, at reactor core power levels not in excess of 2940 megawatts (thermal).

(2) Technical Specifications

Technical Specifications contained in Appendix A, as revised through Amendment No. 288 are hereby incorporated in the renewed license. The licensee shall operate the facility in accordance with the Technical Specifications.

(3) Pursuant to the Act and 10 CFR Parts 30, 40, and 70, VEPCO to receive possess, and use at any time any byproduct, source, and special nuclear material as sealed neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;

(4) Pursuant to the Act and 10 CFR Parts 30, 40, and 70, VEPCO to receive, possess, and use in amounts as required any byproduct, source, or special nuclear material, without restriction to chemical or physical form, for sample analysis or instrument calibration or associated with radioactive apparatus or component; and

(5) Pursuant to the Act and 10 CFR Parts 30, 40, and 70, VEPCO to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility.

C. This renewed license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations as set forth in 10 CFR Chapter I and is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

VEPCO is authorized to operate the facility at steady state reactor core power levels not in excess of 2940 megawatts (thermal).

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 271 are hereby incorporated in the renewed license. The licensee shall operate the facility in accordance with the Technical Specifications.

(3) Additional Conditions

The matters specified in the following conditions shall be completed to the satisfaction of the Commission within the stated time periods following the insurance of the condition or within the operational restrictions indicated. The removal of these conditions shall be made by an amendment to the renewed license supported by a favorable evaluation by the Commission:

a. If VEPCO plans to remove or to make significant changes in the normal operation of equipment that controls the amount of radioactivity in effluents from the North Anna Power Station, the

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. --------NOTE---------- Separate Condition entry is allowed for each DC subsystem. ---------- One or more required LCO 3.8.4.c DC electrical power subsystem(s) inoperable.	D.1 Declare associated shared component(s) inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE			FREQUENCY
SR	3.8.4.1	Verify for each required Station and EDG battery, terminal voltage is ≥ 129 V on float charge.	In accordance with the Surveillance Frequency Control Program

SURVEILLANCE REQUIREMENTS

<table>
<tr><th colspan="2">SURVEILLANCE</th><th>FREQUENCY</th></tr>
<tr><td>SR 3.8.4.2</td><td>Verify for each required Station and EDG battery, there is no visible corrosion at battery terminals and connectors.

OR

Verify battery connection resistance is ≤ 1.5E-4 ohm for inter-cell connections, ≤ 1.5E-4 ohm for inter-rack connections, ≤ 1.5E-4 ohm for inter-tier connections, and ≤ 1.5E-4 ohm for terminal connections.

AND

Verify total connection resistance for each Station battery is less than or equal to the value listed below.

<table><tr><th colspan="2">Total Battery Connection Resistance</th></tr><tr><td>Station Battery</td><td>Maximum Allowable Total Battery Connection Resistance</td></tr><tr><td>1-I, 1-III, 2-I, 2-III</td><td>≤ 2.5E-3 ohm</td></tr><tr><td>1-II</td><td>≤ 0.9E-3 ohm</td></tr><tr><td>1-IV, 2-II, 2-IV</td><td>≤ 1.5E-3 ohm</td></tr></table></td><td>In accordance with the Surveillance Frequency Control Program</td></tr>
<tr><td>SR 3.8.4.3</td><td>Verify for each required Station and EDG battery, cells, cell plates, and racks show no visual indication of physical damage or abnormal deterioration that could degrade battery performance.</td><td>In accordance with the Surveillance Frequency Control Program</td></tr>
<tr><td>SR 3.8.4.4</td><td>For each required Station and EDG battery, remove visible terminal corrosion, verify battery cell to cell and terminal connections are clean and coated with anti-corrosion material.</td><td>In accordance with the Surveillance Frequency Control Program</td></tr>
</table>

SURVEILLANCE REQUIREMENTS

<table>
<tr><th colspan="2">SURVEILLANCE</th><th>FREQUENCY</th></tr>
<tr><td>SR 3.8.4.5</td><td>Verify for each required Station and EDG battery, connection resistance is
≤ 1.5E-4 ohm for inter-cell connections,
≤ 1.5E-4 ohm for inter-rack connections,
≤ 1.5E-4 ohm for inter-tier connections,
and ≤ 1.5E-4 ohm for terminal connections.

<u>AND</u>

Verify total connection resistance for each Station battery is less than or equal to the value listed below.

<table>
<tr><th colspan="2">Total Battery Connection Resistance</th></tr>
<tr><td>Station Battery</td><td>Maximum Allowable Total Battery Connection Resistance</td></tr>
<tr><td>1-I, 1-III, 2-I, 2-III</td><td>≤ 2.5E-3 ohm</td></tr>
<tr><td>1-II</td><td>≤ 0.9E-3 ohm</td></tr>
<tr><td>1-IV, 2-II, 2-IV</td><td>≤ 1.5E-3 ohm</td></tr>
</table>
</td><td>In accordance with the Surveillance Frequency Control Program</td></tr>
<tr><td>SR 3.8.4.6</td><td>Verify each required Station battery charger supplies ≥ 270 amps at ≥ 125 V for ≥ 4 hours.</td><td>In accordance with the Surveillance Frequency Control Program</td></tr>
<tr><td>SR 3.8.4.7</td><td>Verify each required EDG battery charger supplies ≥ 10 amps at ≥ 125 V for ≥ 4 hours.</td><td>In accordance with the Surveillance Frequency Control Program</td></tr>
</table>

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO

AMENDMENT NO. 288 TO RENEWED FACILITY OPERATING LICENSE NO. NPF-4

AND

AMENDMENT NO. 271 TO RENEWED FACILITY OPERATING LICENSE NO. NPF-7

VIRGINIA ELECTRIC AND POWER COMPANY

NORTH ANNA POWER STATION, UNIT NOS. 1 AND 2

DOCKET NOS. 50-338 AND 50-339

1.0 INTRODUCTION

By application dated December 17, 2020 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML20352A394), as supplemented by letters dated May 6, 2021 (ADAMS Accession No. ML21126A315) and August 26, 2021 (ADAMS Accession No. ML21238A255), Virginia Electric and Power Company (the licensee) requested changes to the Technical Specifications (TSs) for North Anna Power Station (North Anna, NAPS), Unit Nos. 1 and 2.

The supplements dated May 6 and August 26, 2021, provided additional clarifying information that did not change the scope of the proposed changes as described in the U.S. Nuclear Regulatory Commission (NRC, the Commission) staff's original proposed no significant hazards consideration determination dated January 26, 2021 (86 FR 7117).

The proposed changes would revise North Anna TS Surveillance Requirements (SRs) 3.8.4.2 and 3.8.4.5 by adding new acceptance criteria that confirm that the total battery connection resistance for each direct current (DC) battery is within preestablished limits. Specifically, the maximum allowable inter-cell connection resistance value of 1.5E-4 ohm is non-conservative if all, or a considerable number, of the inter-cell connections are at their maximum resistance value, since the acceptable total battery resistance value would be exceeded. The proposed SR changes would verify that the total connection resistance for each DC battery is less than the maximum allowable total battery connection resistance. The proposed changes would add new acceptance criteria that would confirm that the total battery connection resistance is within preestablished limits and would ensure that the batteries can perform their specified safety function by maintaining required battery terminal voltage under design basis load conditions.

1.1 System Description

The North Anna Unit No. 1 and Unit No. 2 DC power systems provide a reliable source of power for the operation of vital safety and non-safety-related equipment necessary for the proper and safe operation of the plant, as well as safe reactor shutdown under postulated accident conditions. Each unit has four independent and identical 125 volt (V) DC systems that supply power to emergency lighting, DC motor-driven pumps, Alternating Current (AC) inverters, and control power to 480 V and 4160 V AC breakers. The DC power source in each unit consists of four independent Class 1E batteries, six battery chargers, and four battery distribution switchboards. Each battery is located in individual missile-protected battery rooms. Four of the battery chargers are normal battery chargers and two of the battery chargers are swing battery chargers, which can be used as an installed spare for either of the two normal battery chargers in its respective safeguards train. The distribution switchboards supply 125 V DC power to safety system trains A and B and each switchboard supplies power to its respective vital bus inverter. Each battery room has its own ventilation fan to ensure that hydrogen does not build up to the explosive limit.

During normal operation, the 125 V DC load is fed from the battery chargers with the batteries “floating” on the system, ensuring that the batteries remain in a fully charged condition by maintaining a zero charge/discharge rate. On loss of normal power to the battery chargers, the DC load is automatically fed from the station batteries, after which standby generation will be available to energize the battery chargers as described in the North Anna Updated Final Safety Analysis Report (UFSAR) (ADAMS Accession No. ML20309A590), Section 8.3.2.1. Additionally, each battery can operate all the required loads for a 4-hour station blackout (SBO) event, after which standby generation power will be available to energize the battery chargers. The batteries are rated at 225 amperes for an 8-hour period or 1800 ampere-hours. During the two-hour design basis event (DBE) and the 4-hour SBO, overall battery terminal voltage (combination of all 60 individual cell voltages), never drops below 105 V (a minimum of 1.75 V per cell).

Each of the eight (four for each unit) Class 1E batteries is a 60-cell lead calcium battery where each of the cells are connected in series. Each battery cell has 11 positive plates to meet the duty cycle requirements, and each cell is contained in a sealed, heat-resistant, shock-absorbent, clear plastic jar. Lead-plated copper is used for series inter-cell connections. Each of the 60-cell batteries includes 56 inter-cell connections and 8 connections to cables (two leads, two connections to the ends of each of the two inter-rack cables, and two to the ends of the inter-tier jumpers).

2.0 REGULATORY EVALUATION

2.1 Proposed Change

Institute of Nuclear Power Operations Operating Experience dated November 28, 2006 (Experience ID #299289, formerly OE23813), identified a condition at Quad Cities Nuclear Power Station, Units 1 and 2 where if all the inter-cell connections for a battery were to degrade to the TS SR limit value of 1.5E-4 ohm, the battery would not be able to perform its safety function.

Based on this operating experience, the licensee determined that at North Anna the battery inter-cell connection resistance value of 1.5E-4 ohm in TS SRs 3.8.4.2 and 3.8.4.5 is non-

conservative because the maximum allowable total battery resistance value could be exceeded. In accordance with NRC Administrative Letter 98-10,[1] the proposed revision would add new acceptance criteria for total battery connection resistance in SRs 3.8.4.2 and 3.8.4.5.

The proposed total battery connection resistance values are currently documented in the North Anna surveillance requirements test procedures as administrative controls to ensure that the total connection resistance of the battery bank remains within the analytical design limits and to ensure that the batteries remain capable of performing their design basis function when needed.

The licensee proposed the following changes to two SRs in TS 3.8.4, "Electrical Power Systems, DC Sources - Operating," applicable in modes 1, 2, 3, and 4.

Current TS SR 3.8.4.2:

> Verify for each required Station and EDG [Emergency Diesel Generator] battery, there is no visible corrosion at battery terminals and connectors.
>
> OR
>
> Verify battery connection resistance is ≤ 1.5E-4 ohm for inter-cell connections, ≤ 1.5E-4 ohm for inter-rack connections, ≤ 1.5E-4 ohm for inter-tier connections, and ≤ 1.5E-4 ohm for terminal connections.

Proposed TS SR 3.8.4.2:

> Verify for each required Station and EDG battery, there is no visible corrosion at battery terminals and connectors.
>
> OR
>
> Verify battery connection resistance is ≤ 1.5E-4 ohm for inter-cell connections, ≤ 1.5E-4 ohm for inter-rack connections, ≤ 1.5E-4 ohm for inter-tier connections, and ≤ 1.5E-4 ohm for terminal connections.
>
> AND
>
> Verify total connection resistance for each Station battery is less than or equal to the value listed below:

Total Battery Connection Resistance	
Station Battery	Maximum Allowable Total Battery Connection Resistance
1-I, 1-III, 2-I, 2-III	≤ 2.5E-3 ohm

[1] The NRC staff notes that in its application, the licensee references Administrative Letter 98-10 (AL 98-10), "Dispositioning of Technical Specifications that are Insufficient to Assure Plant Safety," dated December 29, 1998 (ADAMS Accession No. ML031110108). AL-98-10 was withdrawn in the issuance of Regulatory Guide 1.239 (85 FR 78879).

1-II	≤ 0.9E-3 ohm
1-IV, 2-II, 2-IV	≤ 1.5E-3 ohm

Current TS SR 3.8.4.5:

Verify for each required Station and EDG battery, connection resistance is ≤ 1.5E-4 ohm for inter-cell connections, ≤ 1.5E-4 ohm for inter-rack connections, ≤ 1.5E-4 ohm for inter-tier connections, and ≤ 1.5E-4 ohm for terminal connections.

Proposed TS SR 3.8.4.5:

Verify for each required Station and EDG battery, connection resistance is ≤ 1.5E-4 ohm for inter-cell connections, ≤ 1.5E-4 ohm for inter-rack connections, ≤ 1.5E-4 ohm for inter-tie connections, and ≤ 1.5E-4 ohm for terminal connections.

AND

Verify total connection resistance for each Station battery is less than or equal to the value listed below:

Total Battery Connection Resistance	
Station Battery	Maximum Allowable Total Battery Connection Resistance
1-I, 1-III, 2-I, 2-III	≤ 2.5 E-3 ohm
1-II	≤ 0.9E-3 ohm
1-IV, 2-II, 2-IV	≤ 1.5E-3 ohm

2.2 Applicable Regulatory Requirements

The following regulatory requirements are applicable to the NRC staff's review of this application:

- According to Section 3.1 of the North Anna UFSAR, the construction permits were issued in February 1971, based on the plant's design being in compliance with the General Design Criteria for Nuclear Power Plants published in 1966. However, to facilitate review by the Atomic Energy Commission, UFSAR, Chapter 3 also discusses the design of the plant relative to the general design criteria (GDC) published in 1971 at Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix A.

- The regulation at GDC 17, "Electric power systems," which requires, in part, that an onsite electric power system and an offsite electric power system shall be provided to permit functioning of structures, systems, and components important to safety. It also requires that the onsite electric power supplies, including the batteries, and the onsite electric distribution system, shall have sufficient independence, redundancy,

and testability to perform their safety functions assuming a single failure. Section 3.1.13 of the North Anna Updated Final Satefy Analysis Report discusses conformance with this criterion.

- The regulation at GDC 18, "Inspections and testing of electric power systems," which requires, in part, that electric power systems important to safety shall be designed to permit appropriate periodic inspection and testing of important areas and features, such as wiring, insulation, connections, and switchboards, to assess the continuity of the systems and the condition of their components. Section 3.1.14 of the North Anna Updated Final Satefy Analysis Report discusses conformance with this criterion.

- The regulation at 10 CFR 50.36(c)(3), "Surveillance requirements," which requires that TSs include SRs, which are requirements relating to test, calibration, or inspection to ensure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met.

- The regulation at 10 CFR 50.63, "Loss of all alternating current power," which requires, in part, that each light-water cooled nuclear power plant licensed to operate must be able to withstand for a specified duration and recover from an SBO.

2.3 Applicable Licensing Basis, Guidance, and Precedence

In its review of this application, the NRC staff considered the following:

- North Anna UFSAR, Section 8.3
- Regulatory Guide (RG) 1.129, Revision 1, "Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Nuclear Power Plants" (ADAMS Accession No. ML003740104)
- Institute of Electrical and Electronics Engineers (IEEE) Standard (Std.) 450-1975, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Generating Stations and Substations"
- IEEE Std. 308-1975, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations"
- IEEE Std. 485-1997, "IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications"
- Fermi 2 – Issuance of Amendment to Revise TS SRs for DC Batteries (ADAMS Accession No. ML15057A297)
- Quad Cities Nuclear Power Station, Units 1 and 2 – Issuance of Amendments to Revise TS SRs for DC Batteries (ADAMS Accession No. ML15056A772)
- Millstone Power Station, Unit No. 3 – Issuance of Amendment to Revise TS SRs for DC Batteries (ADAMS Accession No. ML21043A162)

3.0 TECHNICAL EVALUATION

In its initial request dated December 17, 2020, the licensee stated, in part:

> North Anna voltage profile calculations for the Class 1E batteries provide a basis for the maximum allowable total connection resistance values (to

include the inter-cell, inter-jar, and cable termination connectors) that would ensure proper operation of the 125V DC Vital Bus in Design Basis Accident (DBA) and SBO scenarios. The inter-rack and inter-tier cable resistance is not included within the basis of total connection resistance values. The periodic tests measure from the cell post to the cable termination for the cable termination connectors. The inter-rack and inter-tier cables are separately included in the calculation analysis, and any configuration change that would impact these cables would require an update to the analysis. The table below summarizes calculation results for the total allowable connection resistance for various class 1E batteries.

Class 1E Battery	Maximum Allowable Total Connection Resistance (Analyzed)
1-I, 1-III, 2-I, 2-III	≤ 2.502E-3 ohm
1-II	≤ 0.9E-3 ohm
1-IV, 2-II, 2-IV	≤ 1.502E-3 ohm

Maintaining the total battery connection resistance at or below the maximum allowable resistance analyzed in the calculations ensures DC related loads fed from 125V DC distribution panels will have adequate voltage to perform their design basis function. The Loss of Off-Site Power (LOOP) event coincident with the EDG failing to start and power its related emergency bus and station battery charger apply to two-hour DBA, and four-hour SBO events. The above analyzed values also provide a design basis for the maximum allowable total connection resistance of the Class 1E batteries and supports the proposed Technical Specifications Surveillance Requirements change.

The licensee also provided that the battery chargers are capable of charging the batteries from the maximum discharged condition to full charge in 24 hours while supplying the normal or emergency steady-state loads. According to the licensee, the selection criteria for battery capacity and reliability meets IEEE Std. 308-1975 and GDC 17. The batteries are sized using the methods from IEEE Std. 485-1997. The reliability of the batteries is assured by periodic discharge testing at a frequency specified by the North Anna Surveillance Frequency Control Program (SFCP) in accordance with IEEE Std. 450. The licensee stated that the performance and service tests ensure the quality of the equipment and comply with RG 1.129.

3.1 Voltage Drop Analysis

The NRC staff reviewed the proposed changes and requested that the licensee provide additional information on assumptions, design basis, and margins considered for total circuit resistances including battery internal resistance, battery system connection resistance, and external conductor and conductor connection resistances. In its supplement dated May 6, 2021, the licensee stated that calculations EE-0857, “NAPS Station Battery 1-III Voltage Profile Calculation,” and EE-0858, “NAPS Station Battery 1-II Voltage Profile Calculation,” were performed using the Electrical Transient Analyzer Program (ETAP) software.

In its supplement dated May 6, 2021, the licensee also stated that the margin for overall battery connection resistance is not included in the analyses performed in calculations EE-0857 and EE-0858. Instead of including battery connection margin, a small margin load is included in EE-0857. Calculation EE-0858 credits a small margin for 2-II, 1-IV, and 2-IV 125 V DC systems but does not include any margin for 1-II 125 V bus voltage analysis results. The ETAP battery model considered the resistance of connection end plates in series with the battery cables to include their effects on voltage drop within the North Anna 125 V DC battery model between the modeled battery source and the main distribution panel.

The battery cables within the North Anna battery rooms are rated at 75 degrees Celsius and the highest expected battery room temperature is 29.4 degrees Celsius, which allows the cables 45.6 degrees Celsius of temperature rise during operation. The impact of temperature rise on cable resistances has been included in the calculations.

Calculation EE-0857 provides an allowable maximum inter-cell resistance (ICR) of 2.502E-3 ohm based on the results of ETAP voltage drop analysis for the 1-III 125V DC Vital Bus. The licensee stated that this analysis is considered bounding for batteries 1-I, 2-I, and 2-III based on battery duty cycle loading and control circuit lengths. The licensee stated that Calculation EE-0857 has shown that the new TS resistance value is adequate to support the safety-related equipment's safety functions.

Calculation EE-0858 provides an allowable maximum ICR of 0.902E-3 ohm based on the results of ETAP voltage drop analysis for the 1-II 125V DC Vital Bus. Addendum G to this calculation provides an allowable maximum ICR of 1.502E-3 ohm based on the results of ETAP voltage drop analysis for the 2-II 125V DC Vital Bus. The licensee stated in its supplement dated May 6, 2021, that the analysis of the 2-II 125V DC Vital Bus is considered bounding for batteries 1-IV and 2-IV based on battery duty cycle loading. The licensee stated that Calculation EE-0858 has shown that the new TS resistance values are adequate to support the safety-related equipment's safety functions.

The NRC staff notes that the cable resistance calculation is considered as a separate element of the ETAP model. The licensee's proposed "Maximum Allowable Total Battery Connection Resistance" values (total sum of the inter-cell, inter-jar, and end connector plate resistance) in proposed TS SRs 3.8.4.2 and 3.8.4.5 are bounded by the analyzed values listed in Section 3.2.1 of the licensee's submittal dated December 17, 2020.

In its submittal, the licensee stated that the Enersys/Exide 2GN-23 stationary batteries at North Anna are rated at 225 amperes for an 8-hour period and consist of sixty cells residing in thirty jars (2 cells in one jar) secured to four battery racks. Each battery has 56 connections and 8 connections to cables (two leads, two connections to the ends of each of the two inter-rack cables, and two to the ends of the inter-tier jumpers).

The licensee performed design basis calculations for the maximum allowable total connection resistance values (to include the inter-cell, inter-jar, and cable termination connectors) that would ensure proper operation of the 125V DC Vital Bus in DBE and SBO scenarios. The licensee stated that the inter-rack and inter-tier cable resistances are not included within the total battery connection resistance values. The effects of cables are considered as a separate element of the NAPS 125V DC battery ETAP model. During performance of periodic tests that measure battery resistance, the connection cables are not included in field measurements. For cells at the end of each rack, measurements are taken from the battery post to the bolted lug connecting the battery cable.

The NRC staff reviewed the proposed changes and verified that the proposed SR 3.8.4.2 and SR 3.8.4.5 allowable total resistance values are bounded by the maximum total ICR values of 2.502E-3 ohm, 0.902E-3 ohm, and 1.502E-3 ohm, as calculated in EE-0857 and EE-0858, for various Class 1E batteries. The resistance of connector end plates is included as part of the overall battery system connection resistance and is not included as part of the assumed inter-cell and inter-jar connection resistance. Therefore, the NRC staff finds the methodology used by the licensee to calculate the proposed "Maximum Allowable Total Battery Connection Resistance" in the revised TS SRs 3.8.4.2 and 3.8.4.5 to be acceptable.

3.2 Summary

The NRC staff reviewed the proposed changes in conjunction with the applicable IEEE Std. 450-1975, IEEE Std. 485-1997, IEEE Std. 308-1975, and RG 1.129, Revision 1. Calculations EE-0857 and EE-0858 are based on the maximum allowable total connection resistance for various 125V DC batteries. The total connection resistance values (sum of inter-cell, inter-jar, and end connector plate resistance) as proposed in the TS SRs are bounded by the values considered in the analysis performed in calculations EE-0857 and EE-0858.

The NRC staff finds that the proposed TS changes will confirm that the total measured battery connection resistance is within the allowable limits and ensures that each battery can perform its specified safety function by maintaining required battery terminal voltage under design basis load conditions. Based on the above discussion, the NRC staff finds that the proposed TS changes will continue to satisfy the requirements in 10 CFR 50.36(c)(3) because the revised SR testing criteria will ensure that the necessary quality of the safety-related batteries is maintained. The NRC staff also finds that the proposed changes to TS SRs 3.8.4.2 and 3.8.4.5 provide reasonable assurance of the continued availability of the required electrical power to shut down the reactor and to maintain the reactor in a safe condition after an anticipated operational occurrence or a postulated design-basis accident in accordance with 10 CFR 50.63 and GDCs 17 and 18. Therefore, the NRC staff concludes that the proposed changes are acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Commonwealth of Virginia official was notified of the proposed issuance of the amendments on August 19, 2021. The official confirmed that the Commonwealth had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendments change requirements with respect to the installation or use of facility components located within the restricted area as defined in 10 CFR Part 20 and change surveillance requirements. The NRC staff has determined that the amendments involve no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendments involve no significant hazards consideration, and there has been no public comment on such finding published in the *Federal Register* on January 26, 2021 (86 FR 7117). Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or

environmental assessment need be prepared in connection with the issuance of the amendments.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributors: H. Kodali, NRR

Date: October 19, 2021

SUBJECT: NORTH ANNA POWER STATION, UNIT NOS. 1 AND 2 – ISSUANCE OF AMENDMENT NOS. 288 AND 271 TO REVISE TECHNICAL SPECIFICATIONS BATTERY SURVEILLANCE TESTING (EPID L-2020-LLA-0275) DATED OCTOBER 19, 2021

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