September 8, 2015

MEMORANDUM TO: Larry Burkhart, Chief
Licensing Branch 4
Division of New Reactor Licensing
Office of Nuclear Reactor Regulation

FROM: Jacob I. Zimmerman, Chief ***/RA/***
Electrical Engineering Branch
Division of Engineering
Office of Nuclear Reactor Regulation

SUBJECT: AUDIT REPORT FOR THE METHODOLOGY OF CALCULATIONS SUPPORTING THE DESIGN OF THE MAIN GENERATOR CIRCUIT BREAKER OF VOGTLE ELECTRICAL GENERATING PLANT UNITS 3 AND 4 (TAC NO. RP9498)

The Electrical Engineering Branch (EEEB) staff conducted a regulatory audit in support of the U.S. Nuclear Regulatory Commission staff review for the Southern Nuclear Operating Company license amendment request for Vogtle Electrical Generating Plant Units 3 and 4 provided in letter dated August 14, 2014 (Agencywide Documents Access and Management System Accession Number ML14227A707). The proposed amendment would revise the updated final safety analysis report in the form of departures from the plant-specific licensing basis documents. Specifically, the change would remove an air supply line from the compressed and instrument air system to the generator breaker package as a result of the change from an air-blast type generator circuit breaker (GCB) to a sulfur hexafluoride (SF6) gas type GCB.

The EEEB staff audited the methodology of calculations for the required ratings and capabilities of the GCB, and the design tests to be performed for the GCB. The staff considered the guidance in the Institute of Electrical and Electronics Engineers Standard C37.013 (IEEE Std.), "IEEE Standard for AC High Voltage Generator Circuit Breakers Rated on a Symmetrical Current Basis," and in NUREG-0800, "Standard Review Plan (SRP)," Section 8.2, Appendix A. The staff confirms that the methodology including assumptions and the design tests to be performed meet the guidance in IEEE Std. C37.013 and the SRP.

Docket Nos. 52-025 and 52-026

Enclosure:
Audit Report

CONTACT: Adakou Foli, NRR/DE/EEEB
301-415-1984

MEMORANDUM TO: Larry Burkhart, Chief
Licensing Branch 4
Division of New Reactor Licensing
Office of Nuclear Reactor Regulation

FROM: Jacob I. Zimmerman, Chief
Electrical Engineering Branch
Division of Engineering
Office of Nuclear Reactor Regulation

SUBJECT: AUDIT REPORT FOR THE METHODOLOGY OF CALCULATIONS SUPPORTING THE DESIGN OF THE MAIN GENERATOR CIRCUIT BREAKER OF VOGTLE ELECTRICAL GENERATING PLANT UNITS 3 AND 4 (TAC NO. RP9498)

The Electrical Engineering Branch (EEEB) staff conducted a regulatory audit in support of the U.S. Nuclear Regulatory Commission staff review for the Southern Nuclear Operating Company license amendment request for Vogtle Electrical Generating Plant Units 3 and 4 provided in letter dated August 14, 2014 (Agencywide Documents Access and Management System Accession Number ML14227A707). The proposed amendment would revise the updated final safety analysis report in the form of departures from the plant-specific licensing basis documents. Specifically, the change would remove an air supply line from the compressed and instrument air system to the generator breaker package as a result of the change from an air-blast type generator circuit breaker (GCB) to a sulfur hexafluoride (SF6) gas type GCB.

The EEEB staff audited the methodology of calculations for the required ratings and capabilities of the GCB, and the design tests to be performed for the GCB. The staff considered the guidance in the Institute of Electrical and Electronics Engineers Standard C37.013 (IEEE Std.), "IEEE Standard for AC High Voltage Generator Circuit Breakers Rated on a Symmetrical Current Basis," and in NUREG-0800, "Standard Review Plan (SRP)," Section 8.2, Appendix A. The staff confirms that the methodology including assumptions and the design tests to be performed meet the guidance in IEEE Std. C37.013 and the SRP.

Docket Nos. 52-025 and 52-026

Enclosure:
Audit Report

CONTACT: Adakou Foli, NRR/DE/EEEB
301-415-1984

DISTRIBUTION:
DE R/F RMartin SWilliams CPatel NRR_DE_DPR RidsNRRPMVogtle RidsNRRDEEEEB

ADAMS ACCESSION NO: ML15246A370

OFFICE	NRR/DE/EEEB	NRR/DE/EEEB	NRR/DE/EEEB BC
NAME	AFoli	SRay	JZimmerman
DATE	09/04/2015	09/04/2015	09/08/2015

OFFICIAL RECORD COPY

AUDIT REPORT
METHODOLOGY OF CALCULATIONS SUPPORTING
THE DESIGN OF THE MAIN GENERATOR CIRCUIT BREAKER
VOGTLE ELECTRICAL GENERATING PLANT, UNITS 3 AND 4
DOCKET NOS. 52-025 AND 52-026

I. PURPOSE

The purpose of the audit was to review the methodology of calculations for the ratings and capabilities of the sulfur hexafluoride (SF6) gas type generator circuit breaker (GCB), and verify a summary of the design tests performed for the GCB, for Vogtle Electrical Generating Plant (VEGP) Units 3 and 4.

The audit follows the guidelines in the Office of New Reactors (NRO) Office Instruction NRO-REG-108 (Revision 0), "Regulatory Audits."

II. BACKGROUND

By letter dated August 14, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession Number ML14227A707), Southern Nuclear Operating Company (the licensee) requested an amendment to Combined License (COL) Numbers NPF-91 and NPF-92, for VEGP Units 3 and 4. The proposed amendment would revise the Updated Final Safety Analysis Report (UFSAR), both Tier 1 and 2, from the plant-specific licensing basis documents, in regard to removing an air supply line that was designed into the compressed and instrument air system to support an air-blast type GCB. The air supply line is no longer needed as a result of SF6 gas type GCB being utilized. The change of GCB would require changes to the UFSAR in the form of departures from the incorporated plant-specific Design Control Document Tier 2 information, and changes to related plant-specific Tier 1 information with corresponding changes to associated COL Appendix C information.

The Electrical Engineering Branch (EEEB) staff reviewed the proposed changes to the GCB and requested the licensee to provide a summary of the evaluation that shows that the SF6 gas type GCB ratings and capabilities are consistent with the conditions as defined in the IEEE Std. C37.013, "IEEE Std. for AC High Voltage Generator Circuit Breakers Rated on a Symmetrical Current Basis," and meet the performance tests and capabilities as stated in NUREG-0800, SRP, Section 8.2, Appendix A.

In its response letter dated January 16, 2015 (ADAMS ML15016A416), the licensee stated that the GCB is designed and tested in accordance with IEEE C37.013, and no change in compliance to NUREG-0800 is made with the change from an implied air-blast to a SF6 technology breaker. The licensee further stated that calculations for determining the required ratings of the GCB and the design specifications for the GCB can be made available for U.S. Nuclear Regulatory Commission (NRC) review.

The EEEB staff determined that an audit was necessary to assess the methodology of the calculations and the design tests provided in the design specifications documents.

ENCLOSURE

III. OBJECTIVES

The objectives of the staff's audit were to:

- Confirm that the methodology for determining the ratings and capabilities of the SF6 gas type GCB conforms to the guidance in the Institute of Electrical and Electronics Engineers Standard (IEEE Std.) C37.013, "IEEE Std. for AC High Voltage Generator Circuit Breakers Rated on a Symmetrical Current Basis."

- Confirm that the design tests performed to demonstrate the ability of the GCB to meet its assigned ratings conform to the guidelines in NUREG-0800, "Standard Review Plan (SRP)," Section 8.2, Appendix A.

III. SCOPE OF AUDIT

The scope of the audit was to review the methodology used to determine the ratings and capabilities of the SF6 gas type GCB, and verify the design tests performed to demonstrate the ability of the GCB to meet its required ratings. The reviewers were to focus the audit on the key assumptions, the methodology for determining short circuit currents, and the results of the design tests performed.

IV. PURPOSE OF THE GCB

In Section 8.2 of the VEGP 3&4 UFSAR, the licensee stated that the main generator is connected to the offsite power system via three single-phase main step-up transformers (MSTs). The normal power source for the plant auxiliary AC loads is provided from the isophase generator bus through the two unit auxiliary transformers (UATs). When the main generator is not available, the power is maintained without interruption from the preferred power supply by an auto-trip of the main GCB and a backfeed of power through the MSTs and UATs.

In the license amendment request, the licensee stated that the main GCB is capable of carrying and interrupting the normal load current, and interrupting the maximum available root mean square symmetrical and asymmetrical fault current produced by the main generator or the sum of the bolted three-phase fault currents associated with the plant motor house loads and the switchyard. The SF6 gas type GCB uses SF6 gas to quench and cool the arc as well as prevent flashover.

In Section 8.2 of the SRP, Appendix A recommends that the GCB be designed to perform its intended function during steady-state operation, power system transients and major faults. The ratings and required capabilities of the GCB are the designated limits of operating characteristics based on definite conditions as defined in IEEE Std. C37.013. This standard describes design test procedures and methods that should be performed to demonstrate the ability of a GCB to meet the assigned ratings when operating at rated maximum voltage and power frequency under specified conditions. In addition, Appendix A recommends that specific performance tests and capabilities from IEEE Std. C37.013 be demonstrated.

V. AUDIT ACITIVITIES AND SUMMARY FINDINGS

The audit was conducted by the NRC EEEB staff, Adakou Foli, Sheila Ray, and Swagata Som from the Office of Nuclear Reactor Regulation, Division of Engineering. The audit was performed on June 10th, 2015 in Rockville, MD. The following Westinghouse documents, which were provided for the staff during the audit and after the audit via Westinghouse SharePoint site, are applicable to VEGP Units 3 and 4:

1. Document 1: A calculation: APP-ZAS-EOC-003, Revision 3, "Generator Circuit Breaker and Isolated Phase Bus (IPB) Duct Continuous and Short Circuit Current Ratings." This document determines the continuous and short circuit current ratings for the GCB and IPB commensurate with the project design criteria and generator, main step-up transformer, and auxiliary system characteristics.

2. Document 2: A specification: APP-ES03-Z0-001, Revision 1, "Design Specification" for the Main GCB. This document provides the technical requirements for design, manufacture, testing, qualification, and delivery of the GCB.

3. Document 3: A single line diagram: B-E030-024-NG5, Revision 3, "Process & Instrument Diagram Generator/Neutral Forced Air Cooling System."

4. Document 4: A single line diagram: B-E030-023-NG5, Revision 6, "Process & Instrument Diagram Isolated Phase Bus Duct Forced Air Cooling System."

5. Document 5: A single line diagram: APP-ZAS-E3-001, Revision 0, "Main Step-Up Transformer and Main generator Protective Relay and Metering Single Line Diagram."

Document 1 includes (1) the acceptance criteria and assumptions for sizing the GCB, (2) results of the calculations for voltage and continuous current ratings, symmetrical and asymmetrical short circuit current capabilities at the instant of GCB contact parting time for the generator source and system-plus-auxiliary source, and close-latching capability for the generator source and system-plus auxiliary source, and (3) detailed calculations to determine the ratings, and conclusions of the calculations. The staff only reviewed the methodology including assumptions and not the details of the calculations. The staff notes that the GCB continuous current rating is determined based on the indoor/outdoor ambient temperatures that are within specified ranges. Also, the GCB short circuit current rating is based on the system-plus-auxiliary source short circuit current, which is higher than the generator-source short circuit current. The maximum MST impedance is a limiting parameter for the maximum GCB short circuit current ratings. All assumptions, including ambient temperature limits, are bounding for VEGP Units 3 and 4.

Document 2 includes the specification and design tests to be performed for the GCB. The specifications mentioned that the GCB is capable of clearing the following faults as well as normal switching duty associated with the VEGP 3&4: fault in main generator or between generator and GCB, fault in MST or between MST and GCB, fault in switchyard, fault in UAT or between UAT and GCB, fault in excitation transformer and excitation cubicle. The design, production and after delivery tests will be performed in accordance with IEEE Std. C37.013.

The staff verified the diagrams in Documents 3, 4, and 5. Document 3 show the air cooling path for the GCB.

VI. CONCLUSION

In summary, the staff finds that the conditions and methods for determining the ratings and capabilities as recommended by IEEE Std. C37.013 have been considered, and the performance tests and capabilities listed in the SRP Section 8.2, Appendix A will be performed in accordance with IEEE Std. C37.013. Therefore, based on the audit, the staff finds that the methodology of the calculations and design tests for the GCB are conformed to the recommendations of IEEE Std. C37.013 and the SRP Section 8.2.

VII. REFERENCES

1. NRO Office Instruction NRO-REG-108 (Revision 0), “Regulatory Audits.”

2. IEEE Std. C37.013-1997, “IEEE Standard for AC High-Voltage Generator Circuit Breakers Rated on a Symmetrical Current Basis.”

3. NUREG-0800 (SRP) Section 8.2, “Offsite Power System,” Appendix A, “Guidelines For Generator Circuit Breakers/Load Break Switches.”