SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NOS. 166 and 164

TO THE COMBINED LICENSE NOS. NPF-91 AND NPF-92, RESPECTIVELY

SOUTHERN NUCLEAR OPERATING COMPANY, INC.

GEORGIA POWER COMPANY

OGLETHORPE POWER CORPORATION

MEAG POWER SPVM, LLC

MEAG POWER SPVJ, LLC

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CITY OF DALTON, GEORGIA

VOGTLE ELECTRIC GENERATING PLANT UNITS 3 AND 4

DOCKET NOS. 52-025 AND 52-026

1.0 INTRODUCTION

By letter dated May 17, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19137A314), Southern Nuclear Operating Company (SNC) requested that the Nuclear Regulatory Commission (NRC) amend Vogtle Electric Generating Plant (VEGP) Units 3 and 4, Combined License (COL) Numbers NPF-91 and NPF-92, respectively. The License Amendment Request (LAR) 19-008 requested two changes.

First, SNC requested a change to revise the Updated Final Safety Analysis Report (UFSAR) and the COL Appendix A Technical Specifications (TS) definition for Channel Calibration to allow a qualitative check (i.e., sensor resistance and insulation resistance tests) as an acceptable means to perform channel calibration for the reactor coolant pump (RCP) speed sensors. Specifically, the requested amendment proposes a change to the COL Appendix A, TS 1.1 definition of Channel Calibration by identifying RCP speed sensors as instruments that may have calibration performed by an in-place qualitative assessment of the sensor behavior and normal calibration of the remaining adjustable devices in the channel.

Second, SNC requestd a change to the UFSAR to allow the use of a conservatively allocated response time in lieu of measurement for the RCP speed sensors and preamplifiers. In order to describe this change, the requested amendment proposes a change to UFSAR Subsection 7.2.1.1.3 to allow the use of a conservatively allocated response time in lieu of response time measurement for the RCP speed sensors and preamplifiers. To accompany the change, UFSAR Subsection 7.2.4 is revised to add APP-GW-GLR-804, “AP1000® Technical Report to

Support Modification to Response Time and Channel Calibration Testing Requirements for Reactor Coolant Pump Speed," as a secondary reference.

2.0 REGULATORY EVALUATION

The NRC staff considered the following regulatory requirements and guidance in reviewing the proposed changes in LAR 19-008:

Appendix D, Section VIII.B.5.a allows an applicant or licensee who references this appendix to depart from Tier 2 information, without prior NRC approval, unless the proposed departure involves a change to or departure from Tier 1 information, Tier 2* information, or the TS, or requires a license amendment under paragraphs B.5.b or B.5.c of the section.

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, Appendix D, VIII.C.6 states that after issuance of a license, "Changes to the plant-specific TS will be treated as license amendments under 10 CFR 50.90." 10 CFR 50.90 addresses the applications for amendments of licenses, construction permits and early site permits. As discussed above, changes to plant-specific TS (COL Appendix A) are requested. Therefore, NRC approval is required for these plant-specific TS changes.

The staff evaluated the proposed changes to determine whether applicable 10 CFR, Part 50, Appendix A, "General Design Criteria" continue to be met. The staff determined that the proposed changes do not affect conformance with the General Design Criteria (GDC) differently than described in the plant-specific design certification document or UFSAR, as described below:

10 CFR 52.98(f) requires NRC approval for any modification to, addition to, or deletion from the terms and conditions of a COL. This activity involves changes to plant-specific TS (COL Appendix A) to allow a qualitative check (i.e., sensor resistance and insulation resistance tests) as an acceptable means to perform channel calibration for the RCP speed sensors. An additional change is proposed to the UFSAR to allow the use of a conservatively allocated response time in lieu of measurement for the RCP speed sensors and preamplifiers. Therefore, this activity requires a proposed amendment to the COL.

10 CFR 50.36(c)(3), "Surveillance Requirements" are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting condition for operation will be met.

The specific NRC technical requirements applicable to LAR 19-008 are the GDC in Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." In particular, these technical requirements include the following GDC:

10 CFR Part 50, Appendix A, GDC 21, "Protection System Reliability and Testability"-GDC 21 requires, in part, that the protection system be designed to permit its periodic testing during reactor operation, including a capability to test channels independently to determine failures and losses of redundancy that may have occurred. This activity does not propose any change to the protection and safety monitoring system (PMS) design and therefore, there is no effect on the capability for periodic testing during reactor power operation. This activity continues to allow periodic performance of response time testing and channel calibrations by allowing RCP speed

sensor and preamplifier response time allocation in lieu of measurement for satisfying the Response Time Test Surveillance Requirement and in-place qualitative assessments of sensor behavior as an acceptable methodology for RCP speed sensor channel calibration surveillances. Therefore, compliance with GDC 21 is not changed.

UFSAR Appendix 1A requires testing to be in accordance with Regulatory Guide (RG) 1.118, Revision 3 and Institute of Electrical and Electronics Engineers (IEEE) Standard 338-1987. IEEE 338-1987, as endorsed by Regulatory Guide 1.118, Revision 3, states that Response Time Testing is not required if, in lieu of response time testing, the response time of the safety equipment is verified by functional testing, calibration checks or other tests, and if it can be demonstrated that changes in response time beyond acceptable limits are accompanied by changes in performance characteristics which are detectable during other routine periodic tests. The use of a qualitative assessment for RCP speed sensors and allocation of RCP Speed Reactor Trip sensor and preamplifier response times in lieu of actual measurements does not inhibit the performance of the safety function, while continuing to satisfy periodic surveillance testing of the function. This provides confidence that the safety function of the instruments will be satisfied without the need for response time testing, in accordance with IEEE 338, as endorsed by Regulatory Guide 1.118.

3.0 TECHNICAL EVALUATION

3.1 TECHNICAL EVALUATION OF THE REQUESTED CHANGES

In LAR 19-008, SNC proposes changes to the UFSAR and the COL Appendix A TS definition for Channel Calibration to allow a qualitative assessment as an acceptable means to perform channel calibration for the RCP speed sensors. SNC also proposes in this LAR changes to the UFSAR to allow the use of allocated response times in lieu of testing for the RCP speed sensors and their preamplifiers. To reflect this, SNC proposes to add one new paragraph to UFSAR Subsection 7.2.1.1.3, “Core Heat Removal Trips” and one new reference to UFSAR Subsection 7.2.4, “References,” to align with the proposed changes. The technical evaluations of the above proposed changes are discussed below.

3.1.1 TECHNICAL EVALUATION FROM INSTRUMENTATION AND CONTROL PERSPECTIVES

The safety-related PMS in the AP1000 design for VEGP Units 3 and 4 provides detection of off-normal conditions and then actuation of appropriate safety-related functions. There are four redundant divisions in the PMS. The PMS also continuously performs various self-diagnostic functions, which include the inter-channel comparison or check across all four divisions.

The reactor trip is one type of many protective functions performed by the PMS when it anticipates an approach of a parameter to its safety limit. One automatic reactor trip function is based on the RCP speed. This reactor trip function is initiated to protect the reactor core from departure from nucleate boiling in the event of a loss of flow in more than one loop.

There are four RCPs in the AP1000 design for the VEGP Units 3 and 4, each of which is provided with a speed sensor installed in the corresponding steam generator compartment to monitor the RCP rotor revolutions per minute. The RCP speed sensor detects and measures its shaft rotation and converts pump shaft revolutions to output pulses with a pulse frequency proportional to the pump speed. One preamplifier is provided for each speed sensor. The

preamplifier is used to convert the speed sensor's analog signals into variable frequency transistor-transistor logic level signals.

The signal from the RCP speed sensor is passed through the preamplifier and then provided to an input module within the bistable processor logic (BPL) system portion of the PMS. The output from the input module is then processed through the comparator in the BPL to determine the partial reactor trip status for its associated reactor trip division.

The PMS reactor trip protection based on the RCP speed is provided by tripping the reactor when the RCP speed on two out of the four RCPs falls below the Low-2 setpoint. The PMS also performs an automatic, continuous self-diagnostic inter-channel comparison on the RCP speed sensor values across all its four redundant divisions. Specifically, the Interface and Test Processor (ITP) module in the PMS compares the RCP speed sensor inputs received from each of the PMS divisions to ensure that the speed sensor in each of the four PMS divisions is within specified tolerance. An inter-channel check alarm and an associated division fault alarm will be generated in the PMS if a certain number of speed sensor inputs are out of the specified tolerance.

SNC requested the changes in this LAR because the specific design of the RCPs for the AP1000 plants precludes in-situ calibration for the RCP speed sensors and response time testing of the RCP speed sensors and their preamplifiers, as required by current TS surveillance requirements. Performance of the required channel calibration would require removal of the speed sensors and pin connections at watertight compression to test the speed sensors in a laboratory setting. But, periodic removal of the RCP speed sensor for meeting the current surveillance testing requirements could lead to early failure of the device due to connection failure from wire fatigue or connector pin damage. In addition, the specific design of the canned induction RCP motor for the VEGP AP1000 Units 3 and 4 prevents access to any rotating component within the RCP motor. Thus, the inability to monitor RCP speed with a calibrated independent measuring device with the speed sensor installed prevents the completion of the channel calibration for RCP speed sensors to meet the TS surveillance requirements.

Because of the above design reasons SNC proposes in this LAR to modify the channel calibration for the RCP speed sensors and response time testing surveillance requirements for the RCP speed sensors/preamplifiers. Specifically, SNC requests to use qualitative assessments as alternative methods to meet the channel calibration surveillance requirements for RCP speed sensors and use allocated response times to meet the response time testing surveillance requirements for the RCP speed sensors/preamplifiers. The proposed changes are evaluated below.

The current channel calibration of instrument channels with resistance temperature detectors or thermocouple sensors is allowed to use an in-place qualitative assessment of sensor behavior to meet their surveillance requirements for the channel calibration. Due to the unique design features of the RCPs, SNC proposes to also use qualitative assessments as alternative methods for the channel calibration for the RCP speed sensors.

Variable reluctance speed sensors are used for the VEGP Units 3 and 4 RCPs. The variable reluctance speed sensors are passive devices, which do not require any external power. The failure mode with the greatest overall risk for the RCP speed sensors is their loose connections. If a loose connection were to occur on one RCP during operation, it would cause a loss of the speed indication and its related partial reactor trip signal for that RCP. However, the loss of the

RCP speed signal in one PMS division would be detected by the automatic inter-channel check, which is designed as a self-diagnostic function in the PMS. This PMS self-diagnostic function performs a continuous inter-channel comparison to look for deviations in speed signals from the four RCPs and would detect the above failures to alert the operators that there is an issue with the corresponding RCP speed sensor.

There are other postulated failures or degradation mechanisms for these types of speed sensors, which could be effectively identified by the sensor resistance and insulation resistance testing. Therefore, for these reasons, SNC proposes to make the sensor resistance and insulation resistance tests as part of the channel calibration surveillance requirement for RCP speed sensors and also as part of the overall qualitative assessment for the RCP speed sensor behavior, so that any possible failure or degradation would be detected. Therefore, the proposed alternative method to meet the current channel calibration surveillance requirements for the RCP speed sensors consists of the PMS continuous, automatic inter-channel comparison and qualitative assessment by conducting the sensor resistance and insulation resistance tests. From the above evaluations, the NRC staff finds that the proposed alternative methods for the RCP speed sensor could provide a comparable coverage required by its current channel calibration surveillance requirements.

The definition of reactor trip system (RTS) response time from TS states, in part, that In lieu of measurement, response time may be verified for selected components provided that the components and methodology for verification have been previously reviewed and approved by the NRC. IEEE Std. 338-1987, as endorsed by RG 1.118, Revision 3 in the licensing basis for VEGP Units 3 and 4, states, in part, that response time testing is not required if, in lieu of response time testing, the response time of the safety equipment is verified by functional testing, calibration checks or other tests, and if it can be demonstrated that changes in response time beyond acceptable limits are accompanied by changes in performance characteristics which are detectable during other routine periodic tests. Accordingly, SNC proposes in this LAR to use allocated response times in lieu of testing for both the RCP speed sensors and preamplifiers.

For the RCP speed sensor used for VEGP Units 3 and 4, unlike other regular speed sensors, its response time does not depend on moving parts during operation and is only delayed by the transit time for the flow of electric current in the sensor. Its associated preamplifier also provides a very prompt response relative to the overall RTS response time. Its response time is also not expected to degrade because the sensor/preamplifier does not rely on any components that can contribute to changes in the time.

According to SNC, the vendor for the RCP speed sensors and preamplifiers conducted failure modes and effects analyses (FMEAs) to identify degradation mechanisms that could indicate potential failure modes related to these products. However, the analyses show that significant degradation in the sensor and preamplifier response times caused by failures is not anticipated. Additionally, the postulated failure modes described in the FMEAs would be detected during the performance of channel calibrations and by the PMS continuous inter-channel comparison and check.

In the LAR, SNC presented the results of a benchmark test conducted by the vendor to obtain the time responses of the VEGP Units 3 and 4 RCP speed sensors and preamplifiers. Several test runs were performed at different RCP speed sensor probe positions and different RCP speeds. The data from tests demonstrated that the response time of the RCP speed sensor and preamplifier could be conservatively quantified to be less than 0.5 milliseconds (ms) at the

PMS trip actuation setpoint of 91% of rated RCP speed. The total response time for the RCP speed reactor trip protection function is required to be less than 650 ms, which is assumed in the safety analysis. In the PMS Functional Requirements Specification, 18 ms are allocated for the RCP speed sensor and preamplifier, with the remaining response time allocated to the PMS rack, the reactor trip breaker, electromotive force delay, and margin. Therefore, the NRC staff finds that the response times from test data for the RCP speed sensor and preamplifier are much less than allocated response times from the PMS Functional Requirements Specification.

Therefore, from the above evaluation, the NRC staff finds that the proposed approach to use allocated response times, in lieu of actual testing, for the RCP speed sensor and preamplifier response times is acceptable.

During the safety review, the NRC staff found that the RCP speed sensor and its preamplifier, which are industrial products, is "optimized" for use as an IEEE Class 1E Safety device. Because the RCP speed sensor and its preamplifier are industrial products, the NRC staff asked SNC to clarify how and if the RCP speed sensor and its preamplifier are qualified according to relevant regulatory guides as an IEEE Class 1E safety device. SNC made available documentations (References 12, 13, 14, and 15) to show both the RCP speed sensor and its preamplifier are qualified for the AP1000 plants in accordance with the environmental and seismic requirements and specifications identified in the AP1000 plant equipment qualification methodology. The NRC staff observed that qualification was conducted for the RCP speed sensor and its preamplifier in accordance with guidance found in RGs 1.89 rev 1, 1.100 rev 2, and 1.180 rev 1.

The NRC staff observed that "a certain number of speed sensor inputs" logic used to generate an inter-channel check alarm and a related division fault alarm is not clearly stated in the LAR. SNC made documentation available that showed each PMS division has one RCP speed sensor, which is transmitted to the two PMS BPLs in each division. If one sensor is out of tolerance, then the two associated BPLs will also read out of tolerance. For the RCP speed sensor, the inter-channel check performed by the PMS compares a given BPL sensor reading in one PMS division to the other six BPL sensor readings in the other three PMS divisions. If one of the BPL sensor readings in one PMS division differs from three or more of the other six BPL readings in the other three PMS divisions, then a division fault alarm is generated. In the case of a single sensor failure, the associated BPLs in the division would be out of tolerance with the other six BPLs from the other three divisions. This would also cause a division fault alarm (Reference 5). The NRC staff finds that the logic used to generate a division fault alarm is adequate.

In this LAR, SNC proposes to add one new paragraph to UFSAR Subsection 7.2.1.1.3, "Core Heat Removal Trips," under the heading, "Reactor Trip on Low-2 Reactor Coolant Pump Speed," and one new reference to UFSAR Subsection 7.2.4, "References." The NRC staff reviewed the relevant changes to I&C related subsections in UFSAR and found that the new paragraph is added to reflect the two proposed changes to the TS surveillance requirements for the RCP speed sensors. The NRC staff finds that there is no proposed change to the PMS design and other I&C systems in the new paragraph in UFSAR Subsection 7.2.1.1.3. SNC made the new document available for review (Reference 11), and the Staff confirmed through a review that the technical report added in UFSAR Subsection 7.2.4 as a reference provided further background but contained no additional changes to the UFSAR. Therefore, the NRC

staff finds that the proposed changes to UFSAR Subsections 7.2.1.1.3 and 7.2.4 are acceptable.

In the LAR, the NRC staff finds that SNC does not propose any change to either the software and hardware of the PMS design. Therefore, the proposed changes in this LAR do not have any effect on PMS reliability and its capability for periodic testing during reactor power operation. The PMS continues to allow periodic performance of response time testing and channel calibrations. Therefore, approval of the porposed changes in LAR 19-008 does not change the existing compliance with GDC 21 for VEGP Units 3 and 4.

3.1.2 Technical Evaluation from Technical Specifications Perspectives

SNC COL Appendix A, TS 1.1, "Definitions," CHANNEL CALIBRATION states:

> "…Calibration of instrument channels with resistance temperature detector (RTD) or thermocouple sensors may consist of an in place qualitative assessment of sensor behavior and normal calibration of the remaining adjustable devices in the channel."

The Licensee proposed to modify the definition of Channel Calibration to add "reactor coolant pump speed":

> "…Calibration of instrument channels with resistance temperature detector (RTD) or, thermocouple, or reactor coolant pump speed sensors may consist of an in place qualitative assessment of sensor behavior and normal calibration of the remaining adjustable devices in the channel."

The proposed modification identifies RCP speed sensors as instruments that may have calibration performed by an in place qualitative assessment of the sensor behavior and normal calibration of the remaining adjustable devices in the channel. TS Table 3.3.1-1, Reactor Trip System Instrumentation, requires Reactor Trip on Reactor Coolant Pump (RCP) Speed – Low 2 (Function 9) to be OPERABLE and includes requirements to perform Surveillance Requirements for RTS Response Time and Channel Calibration.

The NRC staff reviewed the proposed TS 1.1 definition of CHANNEL CALIBRATION and determined that the addition of "reactor coolant pump speed" does not change the requirement to ensure that a channel calibration shall encompass all devices in the channel, required for OPERABLITY, listed in TS Table 3.3.1-1. Adding "reactor coolant pump speed" to the definition reflects the modification to identify RCP speed sensors as instruments that may have calibration performed by an in-place qualitative assessment, as evaluated in Section 3.1.1 of this SE. As a result, the proposed change to the TS 1.1 definition will continue to meet 10 CFR 50.36(c)(3). Therefore, the NRC staff finds this change acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Georgia State official was notified of the proposed issuance of the amendment on September 25, 2019. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20.

The staff has determined that the amendment involves 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 amendment involves no significant hazards consideration, and there has been no public comment on such finding (*Federal Register*, 84 FR 33989, dated July 16, 2019). Accordingly, the amendment meets 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 amendment.

6.0 CONCLUSION

The staff has concluded, based on the considerations discussed in Section 3.0 that there is reasonable assurance that: (1) 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 amendment will not be inimical to the common defense and security or to the health and safety of the public. Therefore, the staff finds the changes proposed in this license amendment acceptable.

7.0 REFERENCES

1. Southern Nuclear Operating Company, Vogtle Electric Generating Plant Units 3 and 4, Request for License Amendment Regarding Reactor Coolant Pump (RCP) Speed Sensor Channel Calibration and Response Time Test Surveillance Requirement Changes (LAR-19-008), May 17, 2019 (ADAMS Accession No. ML19137A314).

2. Vogtle Electric Generating Plant, Unit 3, Current Facility Combined License NPF-91, Revised September 11, 2018 (ADAMS Accession No. ML14100A106).

3. Vogtle Electric Generating Plant, Unit 4, Current Facility Combined License NPF-92, Revised September 11, 2018 (ADAMS Accession No. ML14100A135).

4. Vogtle Electric Generating Plant, Units 3 and 4 Updated Final Safety Analysis Report, Revision 6 and Tier 1, Revision 5, August 11, 2017 (ADAMS Accession No. ML17172A218).

5. AP1000 Design Control Document, Revision 19, June 13, 2011 (ADAMS Accession No. ML11171A500).

6. Regulatory Guide 1.118, Revision 3, "Periodic Testing of Electric Power and Protection Systems."

7. Regulatory Guide 1.89, Revision 1, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants," June 1984.

8. Regulatory Guide 1.100, Revision 2, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power plants," June 1988.

9. Regulatory Guide 1.180, Revision 1, “Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems,” October 2003.

10. Institute of Electrical and Electronics Engineers (IEEE) Standard 338-1987, “Criteria for the Periodic Surveillance Testing of Nuclear Power Generating Station Safety Systems.”

11. APP-GW-GLR-804, Revision 0, “AP1000® Technical Report to Support Modification to Response Time and Channel Calibration Testing Requirements for Reactor Coolant Pump Speed,” Westinghouse Electric Company, LLC (*not publicly available and contains proprietary information).*

12. APP-JE62-VBR-001, Revision 1, “Equipment Qualification Summary Report for Reactor Coolant Pump Speed Sensor for Use in the AP1000 Plant”, Westinghouse Electric Company, LLC. (*not publicly available and contains proprietary information).*

13. APP-JE62-Z0-001, Revision 4, “AP1000 General Design Specification for Reactor Coolant Pump Speed/Phase Reference Sensor”, Westinghouse Electric Company, LLC. (*not publicly available and contains proprietary information).*

14. APP-JY62-VBR-001, Revision 1, “Equipment Qualification Summary Report for the Reactor Coolant Pump Speed Sensor Preamplifier (JY62) for Use in the AP1000 Plant”, Westinghouse Electric Company, LLC (*not publicly available and contains proprietary information).*

15. APP-JY62-Z0-002, Revision 5, “Class 1E RCP Speed Sensor Preamplifier Specification”, Westinghouse Electric Company, LLC (*not publicly available and contains proprietary information).*