SAFETY EVALUATION BY THE OFFICE OF NEW REACTORS

RELATED TO AMENDMENT NO. 65

TO THE COMBINED LICENSE NOS. NFP-91 AND NFP-92

SOUTHERN NUCLEAR OPERATING COMPANY, INC.

GEORGIA POWER COMPANY

OGLETHORPE POWER COMPANY

MEAG POWER SPVM, LLC

MEAG POWER SPVJ, LLC

MEAG POWER SPVP, LLC

CITY OF DALTON, GEORGIA

VOGTLE ELECTRIC GENERATING PLANT, UNITS 3 AND 4

DOCKET NOS. 52-025 AND 52-026

1.0 INTRODUCTION

By application dated May 27, 2016, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16148A631), Southern Nuclear Operating Company (SNC or the licensee) submitted license amendment request (LAR) 16-007 requesting the U.S. Nuclear Regulatory Commission's (NRC or the Commission) approval for amendments to the Vogtle Electric Generating Plant (VEGP) Units 3 and 4 combined licenses (COLs) NPF-91 and NPF-92, respectively.

This license amendment request (LAR) proposed to depart from the approved AP1000 Design Control Document (DCD) Tier 2 information, Revision 19 (as incorporated into the Updated Final Safety Analysis Report (UFSAR) as plant-specific DCD information).

This LAR also included associated changes to the plant-specific Technical Specifications (TS). Specifically this LAR requested approval to modify the Reactor Coolant System (RCS) flow signal, which is an input to the low trip function of the Reactor Trip System (RTS). The RCS flow signal would be modified to account for changes in the density of reactor coolant because of changes in the temperature of the coolant. Accounting for such density changes is called "density compensation." In addition, this LAR proposed to add existing TS Surveillance Requirement (SR) 3.3.1.3 to the surveillances required for the RCS flow low reactor trip in TS Table 3.3.1-1, Function 7.

2.0 REGULATORY EVALUATION

The regulatory requirements related to this LAR are as follows:

Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(h)(3), "Protection and Safety Systems," requires COLs under 10 CFR Part 52 to comply with the requirements for safety systems in Institute of Electrical and Electronics Engineers (IEEE) Std. 603-1991 and the correction sheet dated January 30, 1995. The proposed change to add density compensation to the RCS flow signal is related to the requirements in IEEE Std. 603-1991 on automatic control for safety systems.

10 CFR 52.98(f) requires prior NRC approval for any modification to, addition to, or deletion from the terms and conditions of a COL. This LAR proposes a change to TS in the COL Appendix A; therefore, this change requires an amendment to the COL. Accordingly, prior NRC approval is required before making the plant-specific changes proposed in this LAR.

10 CFR Part 52, 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. The change proposed in this LAR involves a modification to the plant-specific TS, and thus requires prior NRC approval for the TS change and associated Tier 2 departures.

10 CFR Part 52, Appendix D, Section 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.

10 CFR Part 50, Appendix A, General Design Criterion (GDC) 10, "Reactor design" requires that the reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences. The staff assessed whether the proposed changes to the RCS flow signal by incorporating density compensation and to COL Appendix A, Table 3.3.1-1, still maintain the design capability and margin of the low reactor coolant flow reactor trip to assure that the specified acceptable fuel design limits are not exceeded during normal operations and anticipated operational occurrences.

10 CFR Part 50, Appendix A, GDC 20, "Protection system functions" requires that the protection system shall be designed (1) to initiate automatically the operation of appropriate systems including the reactivity control systems, to assure that specified acceptable fuel design limits are not exceeded as a result of anticipated operational occurrences and (2) to sense accident conditions and to initiate the operation of systems and components important to safety. The staff assessed whether the proposed changes to the low reactor coolant flow trip input signal by incorporating density compensation and to COL Appendix A, Table 3.3.1-1, still assure the continued ability of the low RCS flow reactor trip to provide protection system inputs of RCS flow anomalies and initiate the operation of the RTS to protect the reactor from departure from nucleate boiling (DNB).

10 CFR 50.36(c)(3) requires TS to have surveillance requirements, which 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 conditions for operation will be met.

3.0 TECHNICAL EVALUATION OF PROPOSED CHANGES

The reactor trip is a protective function performed by the safety-related protection and safety monitoring system (PMS) in AP1000 plants when it anticipates an approach of a parameter or process signal to its safety limit. The reactor trip functions keep the reactor within the safe region by shutting down the reactor whenever safety limits are approached. Low RCS flow can lead to a reactor trip, and the RCS flow signal is sent as an input to the RTS for the low RCS flow reactor trip function. This LAR proposed changes to add density compensation due to temperature changes to the RCS flow signal. This LAR also proposed associated changes to add existing SR 3.3.1.3 to the surveillances required for the low RCS flow reactor trip in TS Table 3.3.1-1. The technical and safety evaluations of these proposed changes are provided below.

3.1 TECHNICAL EVALUATION FROM INSTRUMENTATION AND CONTROL PERSPECTIVES

The reactor trip on low reactor coolant flow mentioned in this LAR is designed to protect against DNB. This safety-related reactor trip function is part of the AP1000 PMS core heat removal trips. This reactor trip function based on the low RCS flow in the reactor coolant system hot legs is automatically blocked for the VEGP Units 3 and 4 when reactor power is below the P-10 permissive setpoint. This reactor trip function is also automatically reset when the reactor power exceeds the P-10 permissive setpoint and is credited with providing protection for the spectrum of events involving decrease in RCS flow.

In VEGP Units 3 and 4, the coolant flow is measured at the hot leg elbow taps for the low reactor coolant flow reactor trip, instead of measured at elbow taps in the RCS cold leg as in some previous Westinghouse Electric Company’s (Westinghouse’s) PWR plants, because there is no elbow tap in the RCS cold legs in the AP1000 plant design. The reactor coolant entering in the cold legs gets heated before entering the hot legs. Therefore, in order to account for changes in reactor coolant density due to variations in reactor coolant hot leg temperature, the licensee proposed to add density compensation to the reactor coolant flow signal, which is an input to the low reactor coolant flow-based automatic reactor trip function. The NRC staff found that this proposed change to add density compensation provides more accurate measurement of the RCS flow signal. The NRC staff also found that the RCS flow signal derived from the elbow tap on its hot legs should be compensated or corrected for density differences due to temperature changes.

To accommodate uncertainties, such as process noise, instrument drift, and occasional electrical noise spikes, there should be an adequate difference between RCS normal average flow and its low flow trip setpoint. However, in the current design the RCS flow signal derived from the RCS hot leg elbow taps does not include density compensation and will therefore be close to the reactor trip setpoint at zero power. Thus, the margin of setpoints for tripping or alarming (and the margin of setpoints for partial tripping and pre-trip alarming) is very small for the RCS flow signal in the current design. The proposed change to account for the density compensation would provide more accurate measurement of the RCS flow signal and hence improve the margin for tripping or alarming. Therefore, the change proposed should reduce the potential for spurious reactor trips and alarms at low power conditions.

The NRC staff found that there is no proposed change found in this LAR which involves a procedure or method of control. With the proposed changes, the low RCS flow reactor trip will continue to protect the reactor core from DNB conditions. No system design function as specified in the plant-specific UFSAR is adversely affected. The change proposed in this LAR does not modify any functional control logic. There is no change to the reactor trip response time values assumed in the accident analyses. The proposed change would improve the performance of the reactor trip function because of the low RCS flow, but does not include any additional function or feature used for the prevention and mitigation of accidents. Hence, the NRC staff found that the proposed changes are adequate and acceptable from instrumentation and control perspectives.

3.2 TECHNICAL EVALUATION FROM REACTOR SYSTEM PERSPECTIVES

The NRC staff reviewed the impact of the density compensated reactor coolant flow trip on the safety analysis by investigating the form of the compensation and reviewing the impact on applicable accident analyses in Chapter 15. The licensee presented a density compensation equation for the pressure differential that decreases linearly with power to determine the reactor coolant mass flow rate. Additionally, the licensee clarified that the coefficients in the equation are selected such that the compensation factor is 1.0 at rated thermal power and at programmed no-load conditions. The NRC staff performed a confirmatory hand calculation to clarify the impact of linear density compensation. The results of the calculation were consistent with the licensee's claim that the form of the compensation factor is suitable for capturing the density effect on measured reactor coolant mass flow rate at rated thermal power and programmed no-load conditions. Additionally, the calculation showed that the linear density compensation would provide a conservative estimate of the coolant mass flow rate at intermediate powers. Based on the form of the compensation factor providing an accurate or conservative estimate of the coolant mass flow rate, the NRC staff found the form of the density compensation factor acceptable.

The NRC staff reviewed the applicable accident analyses to investigate any potential impacts of implementing a density compensation for the low reactor coolant flow trip. The licensee's analyses that credit the low reactor coolant flow trip are provided in Section 15.3 of the UFSAR. The NRC staff observed that the analyzed events show no noticeable decrease in reactor power and a slight increase in reactor coolant system pressure before the reactor coolant low flow trip is reached. The NRC staff performed confirmatory calculations to determine the impact of the increased system pressure on the density compensated reactor coolant system flow signal. The results of the calculation showed that the increased system pressure had a negligible impact on the calculated value for ΔT (delta Temperature) power. Since ΔT power is used for the density compensated reactor coolant flow signal, the impact on the reactor coolant flow signal is likewise negligible for the events analyzed in Section 15.3 of the UFSAR. Based the discussion in this paragraph, the NRC staff finds that the addition of density compensation to the low reactor coolant flow trip does not adversely impact the licensee's accident analyses.

3.3 TECHNICAL EVALUATION FROM TECHNICAL SPECIFICATION PERSPECTIVES

The NRC staff reviewed the impact of the density compensated reactor coolant flow trip, specifically as it applies to the TS and TS Bases. The proposed activity adds existing TS SR 3.3.1.3 to the surveillances required for the Reactor Coolant Flow-Low reactor trip in TS Table 3.3.1-1, Function 7. The low flow trip uses the RCS hot leg dP (differential pressure) as an input signal and this signal is compensated for reactor coolant density using the calculated ΔT power, since pressure and temperature are related to density, and temperature in turn is related

to power. SR 3.3.1.3 compares the calorimetric heat balance to the calculated ΔT power in each PMS division every 24 hours to assure acceptable ΔT power calibration. As such, the surveillance is also required to support operability of the Reactor Coolant Flow-Low trip function, as required by limiting condition for operation (LCO) 3.3.1.

The LAR proposes two changes related to TS:

- COL Appendix A Table 3.3.1-1, "Reactor Trip System Instrumentation" Function 7, "Reactor Coolant Flow-Low"
- Associated TS Bases B3.3.1, "Reactor Trip System (RTS) Instrumentation," Function 7, "Reactor Coolant Flow-Low"

The NRC staff found that since the density compensation addition is consistent with the licensee's accident analysis, the change to the TS is acceptable. The NRC staff also reviewed the change to the TS Bases and found that the change made to the Bases is consistent with the change made to the TS.

Based on the evaluation in Sections 3.1, 3.2, and 3.3, the NRC staff concludes that the proposed amendment complies with 10 CFR 50.36(c)(3), 10 CFR 50.55a(h)(3), GDC 10, and GDC 20.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations in 10 CFR 50.91(b), the George State official was notified of the proposed issuance of the amendment. 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, *Standards for Protection Against Radiation* and changes a surveillance requirement. The NRC 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*, 81 FR 50729, published on August 2, 2016). 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 NRC staff has concluded, based on the review and evaluation discussed in Sections 3.0 through 5.0 above, 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) such activities will be conducted in compliance with the Commission's regulations; and (3) the issuance of the proposed amendment will not be inimical to the common defense and security or to the health and safety of the public. Therefore, the NRC staff found that the changes proposed in this LAR to add density compensation to the RCS mass flow signal and add existing SR 3.3.1.3 to TS Table 3.3.1-1, Function 7 are acceptable.

7.0 REFERENCES

1. Southern Nuclear Operating Company Vogtle Electric Generating Plant Units 3 and 4 Request for License Amendment: Addition of Density Compensation to Reactor Trip System (RTS) Reactor Coolant Flow Signal (LAR-16-007) dated May 27, 2016 (ADAMS Accession No. ML16148A631).

2. VEGP Updated Final Safety Analysis Report, Revision 5, dated June 22, 2016 (ADAMS Accession No. ML16180A413).

3. IEEE 603-1991, “IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations.”

4. Westinghouse Advanced Passive 1000 (AP1000) Design Control Document (DCD), Rev. 19, dated June 21, 2011 (ADAMS Accession Number No. ML11171A500).