



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NOS. 169 AND 167

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

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 letter dated June 28, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19179A209), Southern Nuclear Operating Company (SNC) requested that the U.S. 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) 19-011 requested changes to the Updated Final Safety Analysis Report (UFSAR) in the form of departures from the incorporated plant-specific Design Control Document (DCD) Tier 2* and Tier 2 information and related changes to the VEGP Units 3 and 4 COLs.

In LAR-19-011, SNC seeks approval to credit the results of the design-specific pre-operational natural circulation (steam generator) test, the Rod Cluster Control Assembly (RCCA) out of bank measurements, the load follow demonstration, and the Passive Residual Heat Removal Heat Exchanger (PRHRHE) test performed in China on the AP1000 power reactor at Sanmen Nuclear Power Station Unit 1 (SM1) for use in developing the licensing bases for SNC's VEGP Units 3 and 4. These tests are used to establish unique phenomenological performance parameters of AP1000 design features beyond testing performed for the Design Certification of the AP600. These tests are required for the first plant only. They would not be required to be performed for subsequent plants, because of the standardization of the AP1000 design.

“First plant only” tests are defined and listed in AP1000 DCD Revision 19, Tier 2 Section 14.2.5. The requested amendment involves changes to COL Conditions 2.D.(4)(b) and 2.D.(5)(b) to credit the previously completed natural circulation (steam generator) test, the RCCA out of bank measurements, the load follow demonstration, and the PRHRHE test performed at the new AP1000 power reactor at SM1 and revises the COLs to delete conditions requiring that the design-specific pre-operational tests be conducted on VEGP Units 3 and 4. Specifically, the proposed changes would revise the COLs and UFSAR to delete requirements for the following first plant only startup tests during pre-operational testing: Natural circulation (steam generator) test, the RCCA out of bank measurements, the load follow demonstration, and the PRHRHE test.

2.0 REGULATORY EVALUATION

The staff considered the following regulatory requirements in reviewing the LAR that included the proposed changes.

Title 10 of the *Code of Federal Regulation* (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 Technical Specifications (TS), or requires a license amendment under paragraphs B.5.b or B.5.c of the section.

10 CFR 52.98(f) requires NRC approval for any modification to, addition to, or deletion from the terms and conditions of a COL. These changes involve a change to COL Conditions 2.D.(4)(b) and 2.D.(5)(b) and changes to the UFSAR. Therefore, NRC approval is required prior to making the plant specific proposed changes in this license amendment request.

10 CFR Part 50, Appendix B requires that licensees apply a quality assurance (QA) program to the design, fabrication, construction, and testing of structures, systems, and components.

3.0 TECHNICAL EVALUATION

3.1 TECHNICAL EVALUATION OF THE REQUESTED CHANGES

The requested amendment seeks to credit four previously completed first plant only startup tests performed in China at SM1 as part of the licensing bases for SNC’s VEGP Units 3 and 4. Specifically, the proposed changes would revise COL Conditions 2.D.(4)(b) and 2.D.(5)(b), and the UFSAR Subsections 14.2.5, 14.2.10.3.6, 14.2.10.4.6, 14.2.10.4.22, and 14.2.10.4.29 by removing the requirements to perform the following tests: Natural circulation (steam generator) test, the RCCA out of bank measurements, the load follow demonstration, and the PRHRHE test. In lieu of performing these four first plant only startup tests, SNC proposes changes which would credit the successful completion of the tests conducted at the first AP1000 unit at SM1.

UFSAR Subsection 14.2.5, “Utilization of Reactor Operating and Testing Experience in the Development of Initial Test Program,” states that “[b]ecause of the standardization of the AP1000 design, these special tests (designated as first plant only tests) are not required on follow plants;” and that for subsequent plants “... justification shall be provided that the results of the first plant only tests or first three plant tests are applicable to the subsequent plant.”

NRC staff performed an audit as part of its review of LAR 19-011. The audit, in part, confirmed SNC's observations of the four SM1 tests as described in LAR 19-011. A summary of the audit is provided in an audit report dated November 22, 2019 (ADAMS Accession No. ML19326A937).

3.1.1 TECHNICAL EVALUATION OF THE QUALITY ASSURANCE PROGRAM

In letter dated January 13, 2012 (ADAMS Accession No. ML120040121), the staff communicated six topics that should be considered in a submittal requesting to credit previously conducted first plant only or first three plant only tests performed in China. SNC provided responses to the six topics in LAR 18-019 dated August 3, 2018 (ADAMS Accession No. ML18215A383). The staff considered the six topics in its review of LAR 18-019. The staff documented its results in the safety evaluation (SE) dated January 22, 2019 (ADAMS Accession No. ML18351A342). In the SE, the staff evaluated applicable QA attributes related to audits, QA program documents, test control program procedures, test specifications, post-test analysis results, QA documents for instrument calibration, adequacy of administrative controls governing the Initial Test Program, and verified the QA documents and procedures were available in English. Additionally, the staff's review of SNC's oversight of activities, through an NRC inspection of Westinghouse Electric Company (Westinghouse), supplemented the information in LAR 18-019 (ADAMS Accession No. ML18176A395).

In LAR 19-011, SNC identified that Westinghouse has a 10 CFR Part 50, Appendix B program and worked directly with the SM1 owners to develop test procedures for the Natural circulation (steam generator) test, the RCCA out of bank measurements, the load follow demonstration, and the PRHRHE tests. SNC observations and reviews concluded that the first plant only startup testing at SM1 was conducted in accordance with the test procedures and that the test results were sufficient for crediting the first plant only startup testing completed at SM1 for Vogtle Units 3 and 4.

Based on the staff's review of the of the quality controls applied to testing activities in support of LAR 19-011, as documented in LAR 18-019, and the staff's SE for LAR 18-019, the staff found that the evaluation and conclusions related to QA addressed in LAR 18-019 were applicable to LAR 19-011. The staff determined, from the objective evidence reviewed, that QA controls for the first plant only startup tests were consistent with 10 CFR Part 50, Appendix B. The staff found that the QA requirements for the first plant only startup tests performed at SM1 were relevant and adequate for deleting conditions requiring SNC to meet the initial test program requirements of COL Conditions for 2.D.(4)(b) and 2.D.(5)(b) for the natural circulation (steam generator) test, the RCCA out of bank measurements, the load follow demonstration, and the PRHRHE tests.

3.1.2 TECHNICAL EVALUATION OF PROPOSED CHANGES ASSOCIATED WITH NATURAL CIRCULATION TEST (STEAM GENERATOR)

In LAR 19-011, SNC described its observations of the SM1 natural circulation test (steam generator). SNC states that "[t]he objective of the [steam generator] natural circulation (first plant only) startup test is to demonstrate the heat removal capability of the steam generators under natural circulation conditions." UFSAR Subsection 14.2.10.3.6 states that the test objective is to "[d]emonstrate that core decay heat can be removed by the steam generators under the conditions of natural circulation (no reactor coolant pumps operating)." The staff

considered that the SNC test objective for SM1 functionally equivalent to those provided in the UFSAR, because the test method provided by SNC included tripping of the four reactor coolant pumps for the test.

SNC describes the test method for SM1 as follows:

The [steam generator] natural circulation test is initiated by using reactor power to simulate decay heat; this is essential as core fission product density is low at the beginning of life. Control rod motion is used to increase reactor power to approximately three percent of full power based on predictions of vessel temperature difference at full power. With reactor coolant pumps running, data is obtained to correlate nuclear flux level and loop temperatures with power. This step is followed by tripping the four [reactor coolant pumps] and confirming that natural circulation commences by observing the response of the hot leg temperature in each loop; the plant is stable under natural conditions when the hot leg temperature as measured by the four protection and safety monitoring system (PMS) divisions is constant. Next, plant data is obtained to characterize the plant under natural circulation conditions. Once the reactor is shut down and isothermal conditions are reached, the reactor coolant pumps are restarted.

The staff found this test method for SM1 functionally equivalent to those provided in the UFSAR Subsection 14.2.10.3.6. SNC noted in LAR 19-011 that core power fluctuated between values below 3 percent and given that a lower power level has a lower average vessel temperature difference (ΔT), a bounding lower value was chosen in evaluating the test results, as the power level realized during the test. The test performance criterion given by SNC is that “the measured average vessel ΔT (temperature difference) under natural circulation conditions is equal to or less than limiting design predictions for the measured reactor power level as specified in the applicable design specifications,” which is the same as the performance criteria provided in the UFSAR for this test (SNC uses the term acceptance criteria to refer to the performance criteria stated in the UFSAR). The staff found that using a bounding lower value for core power during the test was conservative because higher core power increases ΔT , which is lower than the predicted ΔT to meet the test performance criterion.

SNC noted that each hot leg average ΔT measured by the four PMS divisions and the total average ΔT are below the predicted average vessel ΔT and that the maximum divisional average vessel ΔT occurring at any of the recording times during the natural circulation period is also below the predicted value. SNC observed that the average vessel ΔT is below the predicted value which corresponds to the conservative bounding lower power level, and therefore, the test acceptance criterion was met. SNC noted that SM1 successfully demonstrated the heat removal capability of the steam generators under natural circulation conditions with no deficiencies observed during this test. SNC’s review and evaluation of the test data determined the acceptance criterion delineated in the VEGP Units 3 and 4 UFSAR was met.

As discussed in the audit summary report (ADAMS Accession No. ML19326A937), the staff audited the SNC review of the SM1 steam generator natural circulation test procedure, acceptance criteria, and its evaluation of the test to confirm that the Westinghouse evaluation concluded the test met its acceptance criteria. The staff also audited the Westinghouse evaluation and confirmation that any design changes would not affect application of SM1 data to VEGP Units 3 and 4. Based on its review of LAR 19-011 and the supporting audit, the staff determined that SNC provided adequate support for its request in LAR 19-011 to apply the

results of the steam generator natural circulation test performed at SM1 in satisfying the first plant only test requirement for the same test at VEGP Units 3 and 4.

3.1.3 TECHNICAL EVALUATION OF PROPOSED CHANGES ASSOCIATED WITH ROD CLUSTER CONTROL ASSEMBLY OUT OF BANK MEASUREMENTS

The RCCA out of bank measurement test is performed to confirm that the reactor nuclear and thermocouple instrumentation sensors are capable of monitoring core performance and to validate the predicted calculations based on simulated rod-dropped and rod-ejected accident events. SNC describes the AP1000 reactor as “a matrix of fuel rods assembled into mechanically identical fuel assemblies along with control and structural elements.” The fuel assembly is a 17X17 array with 264 fuel rod locations, 1 guide thimble for incore instrumentation at the center location, and 24 guide thimbles that may be used for RCCAs depending on the fuel assembly core location. Also, to supplement the incore instrumentation, there is 1 excore instrumentation for each core quadrant. The incore and excore instrumentation is used to monitor core performance by providing data to determine power distribution and power peaking factors. The test results are compared to the calculated predictions and TS limits. SNC states that the “test is only required for the first plant as it is used to validate calculation tools and the instrumentation’s sensitivity to RCCA misalignment.” To determine “first plant only” applicability of the SM1 test to Vogtle Units 3 and 4, the NRC staff performed an assessment as discussed in the audit summary report. The assessment included an evaluation of each step of the UFSAR test to the corresponding step of the SM1 test. The staff found that all UFSAR steps were included in SM1 test and the steps were completed satisfactorily as determined by SNC and Westinghouse. The audit report assessment is summarized below.

LAR 19-011 states that the “objectives of the RCCA out of bank measurements (first plant only) startup test include demonstrating the sensitivity of the incore and excore instrumentation system to RCCA misalignments, demonstrating the design conservatism for predictive power distributions with a fully misaligned RCCA, and monitoring the power distribution following the recovery of a misaligned RCCA.” UFSAR Subsection 14.2.10.4.6 states that the test objectives are as follows:

- Demonstrate the sensitivity of the incore and excore instrumentation system to rod cluster control assembly (RCCA) misalignments
- Demonstrate the design conservatism for predicted power distributions with a fully misaligned rod cluster control assembly
- Monitor the power distribution following the recovery of a misaligned rod cluster control assembly

The staff considers the SNC test objectives for SM1 functionally equivalent to those provided in the UFSAR because the test method includes manipulating the control rod movement to simulate pseudo-dropped and pseudo-ejected rod events while controlling boration and dilution to compensate for reactivity changes.

SNC states that the prerequisites to the test include “the reactor is operated between 30 and 50 percent of full licensed power until xenon equilibrium is reached; the test is conducted within that power range so the plant does not exceed peaking factor limits. Reactor power level, RCS [reactor coolant system] boron concentration, and RCS temperature are required to be stable before beginning the test. During this time, the control and shutdown banks are positioned as required for the specific measurement; RCCAs will be near fully withdrawn for the insertion test and at their insertion limits for the withdrawal test.” UFSAR Subsection 14.2.10.4.6 states that the test prerequisites are as follows:

- The reactor is operating between 30 and 50 percent of full licensed power and has been at that power for a sufficient time to reach xenon equilibrium.
- The reactor power level, reactor coolant system boron concentration, and temperature are stable.
- The control and shutdown banks are positioned as required for the specific measurement, near fully withdrawn for rod cluster control assembly insertion, and at their respective insertion limits for rod cluster control assembly withdrawal.

The staff considers the prerequisites for SM1 functionally equivalent to those provided in the UFSAR because the reactor is placed in a safe test condition that would allow rod misalignment conditions without exceeding thermal limits.

SNC describes the test method as follows:

For the RCCA insertion test, a group of RCCAs is inserted one at a time. The RCCAs are originally inserted to the limit of misalignment specified in the safety analysis. Next the RCCAs are fully inserted. The full insertion step is followed by restoring the group of RCCAs to the bank position.

Boration and dilution are used to compensate for reactivity changes, as required.

For the RCCA withdrawal test, one or more selected RCCAs is withdrawn, one at a time, to the fully withdrawn position. Boration and dilution are used to compensate for reactivity changes, as required.

During the testing, incore and excore instrumentation signals are recorded to determine the response of the instrumentation and to determine the power distribution and power peaking factors prior to RCCA misalignment, at partial misalignment, at full misalignment, and periodically after restoration to normal position.

UFSAR Subsection 14.2.10.4.6 states that the test method includes the following:

- For the rod cluster control assembly insertion, insert a group of selected rod cluster control assemblies, one at a time, first to the limit of misalignment specified in Subsection 15.0.5, then fully inserted, and finally restored to the bank position. Compensate for reactivity changes by dilution and boration as required.
- For the rod cluster control assembly withdrawal, withdraw one or more selected rod cluster control assemblies, one at a time, to the fully withdrawn position. Compensate for reactivity changes by boration and dilution as required.
- Record incore and excore instrumentation signals to determine their response and to determine the power distribution and power peaking factors prior to rod cluster control assembly misalignment, at partial misalignment, at full misalignment, and periodically after restoration to normal.

The staff found the procedural test method for SM1 functionally equivalent to those provided in the UFSAR because the test method follows the accident transient analysis discussed in UFSAR Chapter 15 regarding rod misalignment during power conditions.

SNC states that the acceptance criteria include the data collected during the “test is evaluated to ensure that the measured power distributions and power peaking factors are within TS limits and are consistent with the predictions. Additionally, the sensitivity of the incore and excore instrumentation, to RCCA misalignment, is demonstrated by examination of the power distribution and power peaking factors measured at each position.” UFSAR Subsection 14.2.10.4.6 states that the test performance criteria include the following:

- Measured power distributions and power peaking factors are within Technical Specification limits and are consistent with the predictions
- The sensitivity of the incore and excore instrumentation to rod cluster control assembly misalignment is demonstrated by examination of the power distribution and power peaking factors measured for each misalignment.

The staff found the test acceptance criteria for SM1 functionally equivalent to those provided in the UFSAR because the evaluated power distributions and power peaking factors data results were verified to be within the TS limits and consistent with the calculated transient predictions. Also, the excore and incore instrumentation sensitivity response to rod misalignment was confirmed throughout the test.

As discussed in the audit summary report, the staff audited SNC’s review and evaluation (formal test observation report) of SM1 RCCA misalignment test procedure and acceptance criteria to confirm that Westinghouse’s evaluation concluded the test satisfied its acceptance criteria. The staff audited the test procedure which included the summary of changes table, startup test report, test narrative log, test procedure log, data collection table, adjustment in rod control system procedure, open items log, reactivity change record, startup quality observation report, and nuclear and thermocouple figures. The staff found no abnormality that would impact the applicability of SM1’s “First Plant Only” test to VEGP Units 3 and 4.

Furthermore, there are other VEGP Units 3 and 4 startup tests, such as the tests listed in UFSAR Subsections 14.2.10.4.2, 14.2.10.4.3, and 14.2.10.4.7, which validate the effects of the RCCA position changes on power peaking factors. Also, the staff confirmed that SM1 fuel design, RCCA design, core configuration, and cycle exposure are identical to VEGP Units 3 and 4. Therefore, the staff concludes that SM1 startup test “first plant only” condition is applicable to VEGP Units 3 and 4 and the proposed changes associated with the RCCA out of bank measurement test are acceptable.

3.1.4 TECHNICAL EVALUATION OF PROPOSED CHANGES ASSOCIATED WITH LOAD FOLLOW DEMONSTRATION

The load follow demonstration test is performed to confirm that the AP1000 plant design is capable of load following between 50 and 100 percent rated thermal power (RTP) without exceeding the core power distribution limits for the purpose of responding to grid frequency changes. Load following capability is achieved by the rod control system without requiring a change in the reactor coolant boron concentration. The gray rod cluster assemblies (GRCA) are used for the purpose of load following and core flux shaping, and these rods are normally fully inserted or fully withdrawn during most full power plant operation. SNC noted that the load follow test is a first plant only startup test, which was successful at SM1. To determine “first plant only” applicability of SM1 test to VEGP Units 3 and 4, the NRC staff performed an assessment as discussed in the audit summary report. The assessment included an evaluation of each step of the UFSAR test to the corresponding step of the SM1 test. The staff found that

all UFSAR steps were included in SM1 test and the steps were completed satisfactorily as determined by SNC and Westinghouse. The audit report assessment is summarized below.

SNC states in LAR 19-011 that the objectives of the load follow test are to demonstrate the ability of the AP1000 plant (1) to follow a design basis daily load follow cycle and (2) to respond to grid frequency changes while in the load follow cycle. UFSAR Subsection 14.2.10.4.22 states that the test objectives are to demonstrate (1) “the ability of the AP1000 plant to follow a design basis daily load follow cycle” and (2) “the ability of the plant to respond to grid frequency changes while in the load follow cycle.” The staff considers the objectives of the SM1 load follow test and UFSAR subsection to be identical. The test method provided by SNC includes turbine load changes to simulate load following events which can be successfully performed with the GRCAs without exceeding the core power distribution limits.

SNC states that the prerequisites include that “the plant is operated at a stable power level of approximately 100 percent power; the plant is operated at that power until an equilibrium xenon condition is reached. In addition, startup testing of the reactor and turbine control and protection systems is verified to be complete. Preoperational and startup testing of the incore instrumentation system is also verified to be complete. During this time, instrumentation and data collection equipment is confirmed to be operational and available for logging plant data.” UFSAR Subsection 14.2.10.4.22 states that the test prerequisites are as follows:

- The plant is operating at a stable power level of approximately 100 percent power and has been at that power for a sufficient length of time to have reached an equilibrium xenon condition.
- Startup testing of the reactor and turbine control and protection systems are completed, and final setpoints are installed.
- The incore instrumentation system, including signal processing software, is operational. All preoperational and startup testing is completed.
- Instrumentation and data collection equipment is operational and available for logging plant data.

The staff considers the SNC test prerequisites for SM1 functionally equivalent to those provided in the UFSAR because the reactor is placed in stable condition to provide initial benchmark data and all required systems are operational to perform the power maneuvers and data collections.

SNC describes the test method as follows:

The load follow demonstration is initiated by obtaining thermal power measurements and statepoint data along with incore power distribution maps to serve as the reference plant condition. Using normal plant procedures, the turbine load is reduced at a rate such that a reactor thermal power level of approximately 50% is achieved linearly in 2 hours. After remaining at 50% RTP for more than 2 hours, but less than 10 hours, the turbine load is increased at a rate such that approximately 100% RTP is achieved linearly in 2 hours. During the test, plant performance is monitored by gathering data from both incore and excore instrumentation at selected times during the power decrease, at reduced power, during the power increase, and after reaching approximately full RTP. While within the load follow maneuver, the ability to respond to grid frequency changes is demonstrated by operators increasing and decreasing load by as much as 10%, at a rate of 2% per minute.

UFSAR Subsection 14.2.10.4.22 states that the test method includes the following:

- Prior to any load reduction, obtain thermal power measurement and statepoint data along with incore power distribution maps to serve as the reference plant condition.
- Using normal plant procedures, reduce turbine load at a rate such that a reactor thermal power level of approximately 50 percent is achieved linearly in 2 hours.
- After remaining at 50 percent rated thermal power for more than 2 hours but less than 10 hours, increase turbine load at a rate such that a reactor power level of approximately 100 percent rated thermal power is achieved linearly in 2 hours.
- At selected times during the power decrease, while at reduced power, during the power increase, and after reaching approximately full rated thermal power, obtain data from both incore and excore instrumentation to monitor plant performance.
- While within the load-follow maneuver, demonstrate the ability to respond to grid frequency changes by increasing and decreasing load by as much as 10 percent, at a rate of 2 percent per minute.

The staff found the procedural test method for SM1 functionally equivalent to those provided in the UFSAR because the test method demonstrates that the plant control system design can accommodate load follow maneuvers including response to grid frequency changes without changes to the reactor coolant boron concentration.

SNC states that the “data collected during the load follow demonstration is evaluated to ensure the core distribution limits, as specified in TSs, are not exceeded when the plant power is varied according to the design basis load-follow cycle, or while in the cycle, responding to load changes simulating grid frequency changes. The test is also used to confirm load follow maneuvers, including response to grid frequency changes, can be accomplished without changes to the reactor coolant boron concentration.” UFSAR Subsection 14.2.10.4.22 states that the performance criteria include (1) “Core power distribution limits, as specified in the plant Technical Specifications, are not exceeded when the plant power is varied according to the design basis load-follow cycle, or while in the cycle, responding to load changes simulating grid frequency changes” and (2) “Load follow maneuvers, including response to grid frequency changes, can be accomplished without changes to the reactor coolant boron concentration.” The staff found the SNC test acceptance criteria for SM1 functionally equivalent to those provided in the UFSAR because the core power distribution data results demonstrate that the plant control system design can accommodate load follow maneuvers and responds to grid frequency changes without exceeding TS core thermal limits while using only the GRCA rods and without the need to change the reactor coolant boron concentration.

As discussed in the audit summary report (ADAMS Accession No. ML19326A937), the staff audited SNC review (Formal Test Observation Report) of SM1’s load follow demonstration test procedure and acceptance criteria to confirm that Westinghouse’s evaluation concluded the test satisfied its acceptance criteria. The staff audited the test procedure which included the summary of changes table, startup test report, test narrative log, test procedure log, data collection table, adjustment in rod control system procedure, open items log, reactivity change record, startup quality observation report, and nuclear and thermocouple figures. The staff found no abnormality that would impact the applicability of SM1’s “First Plant Only” test to VEGP Units 3 and 4.

Furthermore, there are other VEGP Units 3 and 4 startup tests, such as those contained in UFSAR Subsections 14.2.10.4.1, 14.2.10.4.20, 14.2.10.4.21, 14.2.10.4.24, 14.2.10.4.26, and 14.2.10.4.27, which confirm the automatic reactor control systems' ability to respond to reactor power changes. Also, the staff confirmed that these startup tests include 10-20 percent step-load changes at 30 percent, 75 percent, and 100 percent of RTP. The staff concludes that this SM1 "first plant only" Load Follow startup test is applicable to VEGP Units 3 and 4; therefore, the staff finds the proposed changes associated with this test to be acceptable.

3.1.5 TECHNICAL EVALUATION OF PROPOSED CHANGES ASSOCIATED WITH PASSIVE RESIDUAL HEAT REMOVAL HEAT EXCHANGER, NATURAL CIRCULATION TEST

In the LAR 19-011, SNC requests to credit first plant only startup testing of the PRHRHE natural circulation test performed at SM1 for VEGP Units 3 and 4. The staff reviewed the information provided regarding the PRHRHE natural circulation test, which is discussed in UFSAR Subsection 14.2.10.4.29. The staff also conducted an audit of information related to this test, which is summarized in an audit report dated November 22, 2019. In the LAR submittal, the SNC states that a "critical design and construction attribute" for this test is the valve design for the passive residual heat removal system. As indicated in the audit report, the staff's review of the audit material did not identify any performance discrepancies with regards to the valves in the test lineup at SM1. SNC indicates that "standard design and procurement documentation is used for Sanmen Unit 1 and Vogtle Units 3 and 4," and that "[t]he use of standard design documentation confirms that the passive core cooling system and RCS system components used for this test are within the standard AP1000 design parameters." One of the PRHRHE isolation valves is actuated to initiate the test, so these valves are subject to the statements mentioned above. SNC also states that "[a]ny design changes made to any of these standard components are captured in the Westinghouse design change process" and that a "review has confirmed that there are no site-specific design changes for either Sanmen Unit 1 or Vogtle Units 3 & 4 that alter the standard design features for any of the components involved in this test such that the test results would be affected." Based on this information, the staff found it reasonable to conclude that the valves are comparable between SM1 and VEGP Units 3 and 4 and do not invalidate the test results.

LAR 19-011 states that "[t]he objective of the PRHR heat exchanger (first plant only) startup test is to demonstrate the heat removal capability of the heat exchanger with the RCS at prototypic temperatures and natural circulation conditions that include the influence of nuclear decay heat." The staff finds this objective functionally equivalent to the UFSAR Subsection 14.2.10.4.29 test objective to "[d]emonstrate the heat removal capability of the passive residual heat removal heat exchanger with the reactor coolant system at prototypic temperatures and natural circulation conditions," and the test prerequisite where, "[t]he reactor has operated for sufficient time to generate decay heat necessary to perform the test."

SNC describes the test method as follows:

The natural circulation test of the PRHR heat exchanger is initiated by verifying the reactor is in MODE 3 at normal operating temperature and pressure. This step is followed by tripping the running [reactor coolant pumps] and confirming that natural circulation commences with decay heat being removed by the steam generators. Next, one of the two parallel heat exchanger outlet isolation valves is slowly opened to initiate flow through the PRHR heat exchanger; the valve is slowly opened until it is fully open. The steam generator steam dump automatically reduces heat removal by the steam generators in response to

operation of the passive residual heat exchanger. Heat exchanger inlet and outlet temperature, and flow data are obtained. This data is used to characterize the heat removal capability of the PRHR heat exchanger and heat up of the IRWST [in-containment refueling water storage tank] water when one of two parallel isolation valves is open. The heat exchanger test is terminated by closing the open heat exchanger isolation valve. The steam generator steam dump automatically maintains the RCS fluid average temperature constant. The reactor coolant pumps are restarted after the reactor is shut down and isothermal conditions are reestablished.

The staff reviewed the test method in UFSAR Subsection 14.2.10.4.29 and noted that the same steps are described between the UFSAR and the LAR. The staff found that the above test method for SM1 is the same as the UFSAR Subsection 14.2.10.4.29 test method, and therefore, is acceptable.

SNC noted that the test results are evaluated to ensure the PRHRHE heat removal rate is equal to or greater than the heat removal rate predicted in the methodology used in the safety analyses at the measured hot leg and in-containment refueling water temperatures. SNC noted that Westinghouse's post-test analysis, performed by using the safety analysis model with adjustments to account for actual test conditions (e.g., the measured test values for hot leg and IRWST temperatures), compared digitally recorded test data to the predictions generated by the LOFTRAN program. SNC states that the post-test analysis cases provide enough justification that the LOFTRAN model used for predicting the minimum safeguards performance of the PRHR system is bounded by the performance of the prototypical PRHR system tested.

SNC noted that it completed an independent evaluation, using hand recorded data, documented in the test report, to confirm the results of the natural circulation test of the PRHRHE. SNC noted that the calculated heat transfer values compare favorably to the digitally recorded data, and both hand recorded and digitally recorded data sets show margin to the LOFTRAN predictions.

SNC noted that SM1 successfully performed this first plant only test with satisfactory results meeting all acceptance criteria delineated in the SM1 test procedures. SNC noted that Westinghouse reviewed and evaluated the test results to verify acceptability, and documented the evaluation in a test report. SNC reviewed and concurred with Westinghouse's conclusions.

As discussed in the audit summary report, the staff audited (1) the Westinghouse evaluation of SM1's PRHRHE natural circulation test procedure, predictive analysis, data, post-test analysis and the evaluation's conclusion that any design changes would not affect application of SM1 data to VEGP Units 3 and 4; and (2) SNC's evaluation of the test. Based on its review of LAR 19-011 and the supporting audit, the staff determined that SNC has provided adequate support for its request in LAR 19-011 to apply the results of PRHRHE (natural circulation) test performed at SM1 in satisfying the first plant only test requirement for the same test at VEGP Units 3 and 4. Therefore, the staff found the proposed changes associated with the PRHRHE natural circulation test to be acceptable.

3.2 SUMMARY

The NRC staff found that SNC and Westinghouse monitored the four tests (natural circulation (steam generator), RCCA out of bank measurements, load follow demonstration, and PRHRHE) at SM1 to verify that the test procedures were implemented in an acceptable manner. The staff

found that the information provided by SNC as part of this LAR as well as the evaluation performed in connection with LAR 18-019 adequately show the QA program controls for the first plant only tests were consistent with the regulations in 10 CFR Part 50, Appendix B. The staff did not identify any concerns with the application of the results of these tests at SM1 to support completion of the four first plant only test requirements for VEGP Units 3 and 4.

Based on its review, the NRC staff concluded that SNC has provided adequate support for its request in LAR 19-011 to apply the results of the natural circulation test (steam generator), the RCCA out of bank measurements, the load follow demonstration, and the PRHRHE (natural circulation) Test performed at SM1 in satisfying the first plant only test requirement for the above tests at VEGP Units 3 and 4. Therefore, the NRC staff found SNC request in LAR 19-011 to change current licensing basis documents – Combined License Conditions 2.D.(4)(b) and 2.D.(5)(b) and UFSAR Subsections 14.2.5, 14.2.10.3.6, 14.2.10.4.6, 14.2.10.4.22, and 14.2.10.4.29 – based on the successful completion of tests at the first plant only tests at SM1 AP1000, to be 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 November 13, 2019. The State official had no comments.

7.0 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 August 29, 2019 (84 FR 45548). 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.

8.0 CONCLUSION

The staff has concluded, based on the considerations discussed in Section 3.1 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.

9.0 REFERENCES

1. Southern Nuclear Operating Company, Vogtle Electric Generating Plant Units 3 and 4, "Request for License Amendment: Crediting Previously Completed First Plant Only Startup Tests (LAR 19-011)," June 28, 2019 (ADAMS Accession No. ML19179A210).
2. Audit Plan for Vogtle Electric Generating Plant Units 3 and 4, Request for License Amendment: Crediting Previously Completed First Plant Only Startup Tests (LAR 19-011), November 22, 2019 (ADAMS Accession No. ML19326A937).
3. Response to Southern Nuclear Operating Company's Letter on First-Plant-Only Tests and First-Three-Plant-Only Tests for the Vogtle Electric Generating Plant, Units 3 and 4, January 13, 2012 (ADAMS Accession No. ML120040121).
4. Vogtle Electric Generating Plant, Units 3 and 4 - Submittal of Request for License Amendment and Exemption: Crediting Previously Completed First Plant and First Three Plant Tests, August 3, 2018 (ADAMS Accession No. ML18215A383).
5. Vogtle Electric Generating Plant, Units 3 and 4 - Issuance of Amendments and Granting of Exemptions RE: Crediting Previously Completed First Plant and First Three Plant Tests (LAR 18-019), January 22, 2019 (ADAMS Accession No. ML18351A342).
6. Vogtle Electric Generating Plant Units 3 and 4, Updated Final Safety Analysis Report, Tier 1, Technical Requirements Manual and Technical Specifications Bases Annual Submittal, June 14, 2019 (ADAMS Accession No. ML19171A096).
7. AP1000 Design Control Document, Revision 19, June 13, 2011 (ADAMS Accession No. ML11171A500).
8. Combined License NPF-91 for Vogtle Electric Generating Plant Unit 3, Southern Nuclear Operating Company (ADAMS Accession No. ML14100A106).
9. Combined License NPF-92 for Vogtle Electric Generating Plant Unit 4, Southern Nuclear Operating Company (ADAMS Accession No. ML14100A135).