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

November 22, 2019

MEMORANDUM TO: Victor E. Hall, Chief  
Vogtle Project Office  
Office of Nuclear Reactor Regulation

FROM: Jennivine Rankin, Project Manager /RA/  
Vogtle Project Office  
Office of Nuclear Reactor Regulation

SUBJECT: AUDIT REPORT FOR VOGTLE ELECTRIC GENERATING  
PLANT UNITS 3 AND 4, REQUEST FOR LICENSE  
AMENDMENT: CREDITING PREVIOUSLY COMPLETED FIRST  
PLANT ONLY STARTUP TESTS (LAR-19-011)

By letter dated June 28, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession Number ML19179A209), Southern Nuclear Operating Company (the licensee) requested an amendment to Combined License (COL) Numbers NPF-91 and NPF-92, for Vogtle Electric Generating Plant (VEGP) Units 3 and 4.

The requested amendment requires changes to the Updated Final Safety Analysis Report (UFSAR) in the form of departures from the incorporated plant-specific Design Control Document Tier 2\* and Tier 2 information and related changes to the VEGP Units 3 and 4 COLs.

The requested amendment includes changes to credit previously completed first plant only startup testing described in licensing basis documents, including License Conditions 2.D.(4)(b) and 2.D.(5)(b) of the COLs. The first plant only startup testing deliberated in the proposed amendment includes the Natural Circulation (Steam Generator) Test, the Rod Cluster Control Assembly Out of Bank Measurements, the Load Follow Demonstration, and the Passive Residual Heat Exchanger Test.

CONTACT: Jennivine Rankin, NRO/VPO  
301-415-1530

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V. Hall

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The Nuclear Methods, Systems and New Reactor Branch (NRR/DSS/SNRB), the Mechanical Engineering and Inservice Testing Branch (NRR/DEX/EMIB), and the Quality Assurance Vendor Inspection Branch (NRR/DRO/IQVB) conducted an audit from August 5 – October 16, 2019. The purpose of the audit was to gain better understanding of the proposed changes and to review related documentation and non-docketed information to evaluate conformance with the Standard Review Plan or technical guidance.

Docket Nos.: 52-025 and 52-026

Enclosure:  
Proprietary Regulatory Audit Report

cc: See next page

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SUBJECT: AUDIT REPORT FOR VOGTLE ELECTRIC GENERATING PLANT  
UNITS 3 AND 4, REQUEST FOR LICENSE AMENDMENT: CREDITING  
PREVIOUSLY COMPLETED FIRST PLANT ONLY STARTUP TESTS  
(LAR-19-011) DATED: November 22, 2019

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**ADAMS Accession Nos.: ML19309E508 (Proprietary Audit Report)**  
**ML19326A937 (Non-Proprietary Audit Report)**  
**\*via e-mail NRR-008**

OFFICE	VPO/PM	VPO/LA	DRO/IQVB	DEX/EMIB
NAME	JRankin	RButler	KKavanagh*	SBailey*
DATE	11/7/2019	11/6/2019	11/8/2019	11/12/2019
OFFICE	DSS/SNRB	VPO/BC	VPO/PM(s)	
NAME	BKaras*	VHall*	JRankin*	
DATE	11/6/2019	11/15/2019	11/22/2019	

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Vogtle Mailing List

(Revised 11/06/2019)

cc:

Resident Manager  
Oglethorpe Power Corporation  
Alvin W. Vogtle Nuclear Plant  
7821 River Road  
Waynesboro, GA 30830

Resident Inspector  
Vogtle Plant Units 3 & 4  
8805 River Road  
Waynesboro, GA 30830

Office of the Attorney General  
40 Capitol Square, SW  
Atlanta, GA 30334

Mr. Barty Simonton  
Team Leader  
Environmental Radiation Program  
Air Protection Branch  
Environmental Protection Division  
4244 International Parkway, Suite 120  
Atlanta, GA 30354-3906

Southern Nuclear Operating Company, Inc.  
Document Control Coordinator Bin N-226-EC  
3535 Colonnade Parkway  
Birmingham, AL 35243

Brian H. Whitley  
3535 Colonnade Parkway, Bin N-226-EC  
42 Inverness Center Parkway, BIN B237  
Birmingham, AL 35243

Anne F. Appleby  
Oglethorpe Power Corporation  
2100 East Exchange Place  
Tucker, GA 30084

Mr. Michael Yox  
Site Regulatory Affairs Director  
Vogtle Units 3 & 4  
7825 River Road, Bin 63031  
Waynesboro, GA 30830

County Commissioner  
Office of the County Commissioner  
Burke County Commission  
Waynesboro, GA 30830

Mr. Wayne Guilfoyle  
Commissioner District 8  
Augusta-Richmond County Commission  
4940 Windsor Spring Rd  
Hephzibah, GA 30815

Gwendolyn Jackson  
Burke County Library  
130 Highway 24 South  
Waynesboro, GA 30830

Mr. Reece McAlister  
Executive Secretary  
Georgia Public Service Commission  
Atlanta, GA 30334

## Vogtle Mailing List

### Email

aagibson@southernco.com (Amanda Gibson)  
acchambe@southernco.com (Amy Chamberlian)  
awc@nei.org (Anne W. Cottingham)  
becky@georgiawand.org (Becky Rafter)  
bhwhitley@southernco.com (Brian Whitley)  
Bill.Jacobs@gdsassociates.com (Bill Jacobs)  
corletmm@westinghouse.com (Michael M. Corletti)  
crpierce@southernco.com (C.R. Pierce)  
dahjones@southernco.com (David Jones)  
david.hinds@ge.com (David Hinds)  
david.lewis@pillsburylaw.com (David Lewis)  
dlfulton@southernco.com (Dale Fulton)  
drculver@southernco.com (Randy Culver)  
durhamdc@westinghouse.com (David Durham)  
ed.burns@earthlink.net (Ed Burns)  
edavis@pegasusgroup.us (Ed David)  
fhwillis@southernco.com (Fred Willis)  
G2NDRMDC@southernco.com (SNC Document Control)  
George.Taylor@opc.com (George Taylor)  
graysw@westinghouse.com (Scott W. Gray)  
harperzs@westinghouse.com (Zachary S. Harper)  
james1.beard@ge.com (James Beard)  
jantol1dj@westinghouse.com (David Jantosik)  
jenmorri@southernco.com (Jennifer Buettner)  
JHaswell@southernco.com (Jeremiah Haswell)  
jim@ncwarn.org (Jim Warren)  
John.Bozga@nrc.gov (John Bozga)  
Joseph\_Hegner@dom.com (Joseph Hegner)  
jpredd@southernco.com (Jason R. Redd)  
karen.patterson@ttnus.com (Karen Patterson)  
karlg@att.net (Karl Gross)  
kmstacy@southernco.com (Kara Stacy)  
kroberts@southernco.com (Kelli Roberts)  
kroberts@southernco.com (Kelli Roberts)  
KSutton@morganlewis.com (Kathryn M. Sutton)  
kwaugh@impact-net.org (Kenneth O. Waugh)  
markus.popa@hq.doe.gov (Markus Popa)  
mdmeier@southernco.com (Mike Meier)  
media@nei.org (Scott Peterson)  
Melissa.Smith@Hq.Doe.Gov (Melissa Smith)  
mike.price@opc.com (M.W. Price)  
MKWASHIN@southernco.com (MKWashington)  
mlgraves@southernco.com (Michelle Graves)  
mphumphr@southernco.com (Mark Humphrey)

## Vogtle Mailing List

MSF@nei.org (Marvin Fertel)  
myox@southernco.com (Mike Yox)  
myox@southernco.com (Mike Yox)  
nirsnet@nirs.org (Michael Mariotte)  
Nuclaw@mindspring.com (Robert Temple)  
Paul@beyondnuclear.org (Paul Gunter)  
pbessette@morganlewis.com (Paul Bessette)  
r.joshi15@comcast.net (Ravi Joshi)  
Ronald.Jones@scana.com (Ronald Jones)  
rwink@ameren.com (Roger Wink)  
sabinski@suddenlink.net (Steve A. Bennett)  
sara@cleanenergy.org (Sara Barczak)  
sblanton@balch.com (Stanford Blanton)  
Shiva.Granmayeh@hq.doe.gov (Shiva Granmayeh)  
sjackson@meagpower.org (Steven Jackson)  
sjones@psc.state.ga.us (Shemetha Jones)  
skauffman@mpr.com (Storm Kauffman)  
slieghty@southernco.com (Steve Leighty)  
sroetger@psc.state.ga.us (Steve Roetger)  
syagee@southernco.com (Stephanie Agee)  
TomClements329@cs.com (Tom Clements)  
Vanessa.quinn@dhs.gov (Vanessa Quinn)  
vcsummer2n3@gmail.com (Brian McIntyre)  
wasparkm@southernco.com (Wesley A. Sparkman)  
wayne.marquino@gmail.com (Wayne Marquino)  
weave1dw@westinghouse.com (Doug Weaver)  
William.Birge@hq.doe.gov (William Birge)  
X2edgran@southernco.com (Eddie R. Grant)  
x2gabeck@southernco.com (Gary Becker)  
X2hagge@southern.com (Neil Haggerty)  
x2kmseib@southernco.com (Kristin Seibert)  
X2wwill@southernco.com (Daniel Williamson)

**Report of Regulatory Audit  
License Amendment Related to  
Crediting Previously Completed First Plant Only Startup Tests  
Vogtle Electric Generating Plant, Units 3 and 4  
License Amendment Request (LAR 19-011)**

**A. Background**

By letter dated June 28, 2019 (Reference 1), Southern Nuclear Operating Company (SNC or the licensee) requested an amendment to Combined License (COL) Numbers NPF-91 and NPF-92, for Vogtle Electric Generating Plant (VEGP) Units 3 and 4 (References 2 and 3).

The requested amendment requires changes to the Updated Final Safety Analysis Report (UFSAR) in the form of departures from the incorporated plant-specific Design Control Document Tier 2\* and Tier 2 information and related changes to the VEGP Units 3 and 4 COLs.

The requested amendment includes changes to credit previously completed first plant only startup testing described in licensing basis documents, including License Conditions 2.D.(4)(b) and 2.D.(5)(b) of the COLs. The first plant only startup testing deliberated in the proposed amendment includes the Natural Circulation (Steam Generator) Test, the Rod Cluster Control Assembly Out of Bank Measurements, the Load Follow Demonstration, and the Passive Residual Heat Exchanger Test.

The purpose of this audit is to gain a better understanding of the test results and quality assurance aspects of the testing.

**B. Bases**

This regulatory audit is based on the following:

- VEGP Unit 3, Current Facility Combined License NPF-91, Revised June 12, 2019, License Condition 2.D.(4)(b) and 2.D.(5)(b) (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14100A106).
- VEGP Unit 4, Current Facility Combined License NPF-92, Revised June 12, 2019, License Condition 2.D.(4)(b) and 2.D.(5)(b) (ADAMS Accession No. ML14100A135).
- VEGP Units 3 and 4 UFSAR Tier 1, Revision 7, June 14, 2019 (ADAMS Accession No. ML19171A045).
- VEGP Units 3 and 4 UFSAR Tier 2, Section 14.2.5 and 14.2.10, Revision 8, June 14, 2019 (ADAMS Accession No. ML19171A073).

The audit plan is available in ADAMS under Accession No. ML19211C835.

C. Logistics

Date: August 5, 2019 – October 16, 2019

Location: The audit was conducted through the Westinghouse Electric Company's (Westinghouse) electronic reading room (ERR). A meeting with Westinghouse subject matter experts was conducted on September 10 and October 8, 2019, by telephone conference.

D. Audit Team Members

The following U.S. Nuclear Regulatory Commission (NRC) staff members participated in substantive discussions during the audit:

Harry Wagage, Senior Safety and Plant Systems Engineer, Technical Reviewer  
John Budzynski, Nuclear Engineer, Technical Reviewer  
Nicholas Hansing, Mechanical Engineer, Technical Reviewer  
Aaron Armstrong, Reactor Operations Engineer, Technical Reviewer  
Jennivine Rankin, Project Manager

E. Applicant and Industry Staff Participants

Pamela Fergen (SNC)  
Karen Bobkowski (SNC)  
Nick Kellenberger (SNC)  
Karen Bobkowski (SNC)  
Jeffrey Hausaman (SNC)  
Steve Unikewicz (SNC)  
Mark Wilson (SNC)  
Anthony Schoedel (Westinghouse)

F. Documents Audited

- Westinghouse APP-PXS-M3C-509, "AP1000 PRHR [Passive Residual Heat Removal] Plant Startup Test Criteria Development," Revision 1, September 30, 2016.
- Westinghouse APP-RCS-GEF-428, "Update to AP1000 Natural Circulation Startup Test Specification and Procedure Acceptance Criteria," Revision 0, February 26, 2018.
- Westinghouse APP-RCS-T1-606, "AP1000 Natural Circulation Startup Test Specification," Revision 0, March 26, 2013.
- Westinghouse APP-RCS-T1P-606, "AP1000 Natural Circulation Startup Test Procedure," Revision 0, March 26, 2013.
- Westinghouse APP-SSAR-GSC-195, "AP1000 Steam Generator Natural Circulation Startup Test Acceptance Criteria Generation," Revision 1, October 7, 2016.
- Comparison of China's Regulatory Quality Assurance Program to US 10 CFR Appendix B, dated February 15, 2018.
- SNC ND-CX-001-F04, "China Testing Observation Plan and Report," Version 1.0, June 11, 2019.
- SNC ND-EN-006-F01, "Vendor Document Acceptance – LAR 19-011," Revision 3.
- Review of Sanmen and Haiyang Administration Manual Procedures to NRC Inspection



Manual 72401.

- Westinghouse ND-Vogtle34-RFI-1055, "A LAR is being written to propose crediting previously completed First Plant Only Startup Tests," June 19, 2019.
- Westinghouse SM1-PXS-T2C-018, "Sanmen Unit 1 PXS Startup Test Results and Validation of PRHR Performance," Revision 0, December 20, 2018.
- Westinghouse Letter SMG\_CSM\_001587, "Westinghouse Preliminary Evaluation on Test Data of SM1-PXS-T1P-602," September 10, 2018.
- SNC Engineering Review - PRHR and SG [Steam Generator], ND-EN-006-F001 for LAR 19-011, June 17, 2019.

G. Description of Audit Activities and Summary of Observations

The NRC audit team reviewed SNC documentation and calculations, and quality assurance (QA) provisions, that provide technical support for the request in LAR-19-011 to apply the results of the following tests performed at the Sanmen Nuclear Power Plant Unit 1 (SM1) to VEGP Units 3 and 4: Natural Circulation Test (Steam Generator), Rod Cluster Control Assembly (RCCA) Out of Bank Measurements, Load Follow Demonstrations, and Natural Circulation Test (Passive Residual Heat Removal Heat Exchanger). In the paragraphs below, the audit team describes the results of its review of the applicable SNC documentation and calculations, and QA provisions; and the discussions with SNC and Westinghouse subject matter experts related to this audit.

The NRC audit team reviewed SNC ND-CX-001-F04, "China Testing Observation Plan and Report," which states that personnel from SNC observed startup testing at SM1, including the following first plant only startup tests that SNC requests crediting for VEGP Units 3 and 4: Natural Circulation Test (Steam Generator), RCCA Out of Bank Measurements, Load Follow Demonstrations, and Natural Circulation Test (Passive Residual Heat Removal Heat Exchanger). The SNC observations included the following activities for the above tests: performance of pre-test requirements, confirmation of measuring and test equipment usage; adherence to the approved procedure; execution of test changes; handling of anomalies, problems, and/or interruptions; handling of deficiencies; recording of data; maintenance of the test narrative log; and maintenance of operator logs.

SNC noted that its personnel first reviewed SM1 test procedures and test acceptance criteria and then observed the first plant only startup tests from within the SM1 Control Room Envelope. Following completion of the tests, SM1 provided test reports, for each startup test listed above, to both Westinghouse and SNC for review. The SNC personnel compared the completed test packages to NRC inspection procedures developed for use by the NRC inspectors during startup testing of AP1000 units and provided a record of comparison in the Test Report Review for each test. SNC noted that testing at SM1 was completed satisfactorily and with minimal deviations from expected results.

SNC determined that the tests have been performed successfully and the tests have been completed in such a way that the results are acceptable and applicable to SNC and that SNC standards and acceptance criteria were met.

### Quality Assurance

The staff reviewed the documentation associated with quality assurance testing and documentation for the referenced first plant only startup tests. NRC staff requested clarification regarding the procedures used at Haiyang for when an instrument was found to be out of calibration. SNC responded that those identified instruments procured were not used in crediting the applicable First Plant Only Startup Tests. The NRC staff also requested clarification on the SMI-GW-TIP-620, "AP1000 Rod Cluster control Assembly out of bank measurement startup test procedure" as the M&TE Usage Log of that test procedure had the appendix labeled as "N/A". SNC responded that the plant instrumentation was used for measurement and had been calibrated for the test. The staff did not note any discrepancies during the review and determined the documentation supported the submitted LAR.

### Steam Generator, Natural Circulation Test

The NRC audit team reviewed ND-EN-006-F01 for LAR 19-011, which provided the SNC evaluation of the SM1 first plant only startup test for the SG natural circulation test. SNC had reviewed the following documents:

- SM1-CV5-T2R-60028, "AP1000 Steam Generator Natural Circulation Test Procedure," Revision 2.
- APP-RCS-GEF-428, "Update to AP1000 Natural Circulation Startup Test Specification and Procedure Acceptance Criteria," Revision 0, February 26, 2018.
- Westinghouse APP-RCS-T1-606, "AP1000 Natural Circulation Startup Test Specification," Revision 0, March 26, 2013.
- Westinghouse APP-RCS-T1P-606, "AP1000 Natural Circulation Startup Test Procedure," Revision 0, March 26, 2013.
- Westinghouse APP-SSAR-GSC-195, "AP1000 Steam Generator Natural Circulation Startup Test Acceptance Criteria Generation," Revision 1, October 7, 2016.
- Westinghouse ND-Vogle34-RFI-1055, "A LAR is being written to propose crediting previously completed First Plant Only Startup Tests," June 19, 2019.

VEGP Units 3 and 4 UFSAR Section 14.2.10.3.6 states that the Natural Circulation (First Plant Only) 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)," and the performance criterion as "[t]he measured average vessel  $\Delta T$  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." As stated in ND-EN-006-F01 for LAR 19-011, the SNC review included confirming that the SM1 test met this criterion. **[[**

**]]**. SNC concluded that the Steam Generator Natural

Circulation Test performed at the SM1 AP1000 Plant successfully showed that the AP1000 design meets the test acceptance criteria specified by the Plant Design Authority to show Steam Generator Natural Circulation cooling of the plant. SNC stated that the SM1 design and the VEGP Units 3 and 4 design are the same with respect to the primary system and steam generators, and there is enough justification to credit the testing performed at SM1 as first plant only startup testing as specified in the VEGP UFSAR.

The NRC audit team reviewed ND-Vogtle34-RFI-1055, "A LAR is being written to propose crediting previously completed First Plant Only Startup Tests," which responds to an SNC request for Westinghouse to review AP1000 design changes which were made at one site (either SM1 or VEGP Units 3 and 4), and were not also made applicable to the other site, which could have affected a standard plant design feature such that the results of tests, including SG Natural Circulation Test, would be potentially impacted. In addition, SNC requested Westinghouse to (a) verify that the test specification APP-RCS-T1-606 and test procedure APP-RCS-T1P-606, Revision 0 are consistent regarding the acceptance criteria and (b) provide the rationale for the slight difference in the acceptance criteria used in the SG Natural Circulation test report and test specification, and the updated table provided for APP-SSAR-GSC-195 in APP-RCS-GEF-428. Westinghouse noted that its review of SG Natural Circulation test procedure APP-RCS-T1P-606 and design changes did not identify any non-conformances. Regarding additional request (a), Westinghouse noted that test procedure SM1-GV5-T2R-60028 incorporated APP-RCS-GEF-428 and the acceptance criteria are appropriate based on the change made in the E&DCR (Engineering & Design Coordination Report). Regarding additional request (b), Westinghouse noted that the acceptance criteria values presented in Section 5.2 of APP-SSAR-GSC-195 Revision 1 are consistent with those presented in APP-RCS-GEF-428 and the startup test report.

#### Rod Cluster Control Assembly Out of Bank Measurements

With respect to the "RCCA Out of Bank Test," the NRC staff reviewed the SM1 first plant only startup test procedural steps and test results to ensure it is applicable to SNC's VEGP Units 3 and 4 UFSAR Chapter 14, Test 14.2.10.4.6. The startup test consisted of a pseudo-dropped test event and a pseudo-ejected test event. The staff reviewed the following documents:

- Summary Startup Test Report (SM1-GV5-T2R-60056)
- Startup Test Procedure (SM1-GW-T1P-620)
  - Test Procedure Attachment Log,
  - Test Narrative Log,
  - Pre-Job/Post-Job Brief Record,
  - Data Collection Table,
  - Open Items Report,
  - Test Report Change Form, and
  - Reactivity Change Record.
- Startup Quality Observation Report (SM1-JE92-GQR-6002)
- Chapter 14 Applicability

#### Summary Startup Test Report

The summary startup test report contains a description of significant related steps of the pseudo-dropped/ejected tests, predicted to actual data deviations, open items, and acceptance

criteria results. The tests were performed between 30% and 50% Reactor Thermal Power (RTP) to provide sufficient margin such that the tests did not challenge the design basis limits of the fuel. During the tests where rod movements were conducted, boron concentrations were adjusted by boration or dilution operations to compensate for reactivity changes to maintain a constant power level.

Core power distribution was continuously monitored by the on-line power distribution monitoring system (OPDMS) to alarm the operator to any potential technical specification (TS) LCO 3.2.5 event. The NRC staff noted that there were no OPDMS alarms during the tests which indicated the power distribution remained within the TS limits.

Also, the tests were completed with no open or incomplete items noted during the testing. However, there was a sensitivity concern with Channel B ex-core detector when the final total current dropped below the initial total current when RCCA withdraw motion stopped. Westinghouse evaluated the data and concluded that the Channel B response was acceptable. The NRC agreed with Westinghouse's conclusion.

The NRC staff confirmed that all acceptance criteria requirements were satisfied. This included the following parameters:

- Measured power distributions and power peaking factors within TS 3.2.5 limits,
- Measured power distributions from self-powered neutron detector data maps consistent with predictions,
- In-core instrumentation sensitivity to RCCA misalignment confirmed through power distribution and power peaking measurements,
- Ex-core instrumentation sensitivity to RCCA misalignment confirmed through power distribution measurements, and
- Core exit thermocouples sensitivity to RCCA misalignment confirmed through core exit temperature measurements.

#### Startup Test Procedure

A preliminary assessment of the VEGP Test 14.2.10.4.6 to the SM1 startup test indicate (1) no anomalous result was identified that would impact or invalidate the first plant only startup test, and (2) the SM1 test is applicable to the VEGP test.

All of the VEGP test sections were included and consistent in the SM1 first plant only startup test.

An assessment summary is included in Table 1 below.

**Table 1: Assessment of Sanmen Unit 1 Startup Test to Vogtle Units 3/4 UFSAR  
Chapter 14 Test 14.2.10.4.6**

<b>Rod Cluster Control Assembly Out of Bank Measurements (First Plant Only)</b>		
<b>Vogtle Startup (S/U) Test Section Requirements</b>	<b>SM1 S/U Test Step</b>	<b>VEGP &amp; SM1 S/U Tests Assessment</b>
<u>Objectives</u> - Demonstrate the sensitivity of the	-1.2.1	Objectives are consistent, and a Scope

<b>Rod Cluster Control Assembly Out of Bank Measurements (First Plant Only)</b>		
<b>Vogtle Startup (S/U) Test Section Requirements</b>	<b>SM1 S/U Test Step</b>	<b>VEGP &amp; SM1 S/U Tests Assessment</b>
<p>incore and excore instrumentation system to RCCA misalignments</p> <ul style="list-style-type: none"> <li>- Demonstrate the design conservatism for predicted power distributions with a fully misaligned rod cluster control assembly</li> <li>- Monitor the power distribution following the recovery of a misaligned rod cluster control assembly</li> </ul>	<p>-1.2.2</p> <p>-1.2.3</p>	<p>section is included in the S/U Test that provides supplemental information supportive of the test, such as rod location and movement for dropped rod and, for ejected rod, all RCCAs near the Hot Full Power (HFP) is aligned with the insertion limit and one rod location for full withdraw from the core.</p>
<p><u>Prerequisites</u></p> <ul style="list-style-type: none"> <li>- The reactor is operating between 30 and 50% of full licensed power and has been at that power for a sufficient time to reach xenon equilibrium.</li> <li>- The reactor power level, reactor coolant system boron concentration, and temperature are stable.</li> <li>- The control and shutdown banks are positioned as required for the specific measurement, near fully withdrawn for RCCA insertion, and at their respective insertion limits for rod cluster control assembly withdrawal.</li> </ul>	<p>-6.2, 6.7</p> <p>-6.2 – 6.7</p> <p>-7.2.4 - 7.2.5, 7.4.4 - 7.4.5</p>	<p>Prerequisites are consistent with the Initial Conditions section and Procedure Section. A Precautions and Limitations section is added to include other test limitations such as core average burnup limit, TSs, neutronic and thermohydraulic monitoring systems, operational restrictions on systems required during the test.</p>

<p><u>Test Method</u></p> <ul style="list-style-type: none"> <li>- For the RCCA 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.</li> <li>- For the RCCA 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.</li> <li>- 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.</li> </ul>	<p>-7.2.8 - 7.2.20</p> <p>-7.4.8 – 7.4.18</p> <p>-7.2.3, 7.2.7, 7.2.11, 7.2.17, 7.2.19, 7.2.21, 7.2.23, 7.4.3, 7.4.7, 7.4.15, 7.4.17, 7.4.27</p>	<p>Test Method section is consistent with Procedure section. Steps are documented and clearly contain the information required to perform the pseudo-dropped and pseudo-ejected rod tests. Changes made to the procedure section was in accordance to Optimization of the Sequence for RCCA out of Bank Test Specification Procedure and Acceptance Criteria Clarifications for Power Ascension Testing Procedure based on Westinghouse predictions.</p>
<p><u>Performance Criteria</u></p> <ul style="list-style-type: none"> <li>- Measured power distributions and power peaking factors are within TS limits and are consistent with the predictions.</li> <li>- 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.</li> </ul>	<p>-9.1, 9.2</p> <p>-9.3, 9.4</p>	<p>Performance Criteria are consistent with SM1 test. SM1 test results were within the TS limits and were consistent with Westinghouse predictions with no anomalies. Preliminary review indicates the excore/incore instrumentation sensitivity to rod misalignment is acceptable as illustrated by power distribution &amp; peaking factors measure for each misalignment.</p>

### Load Follow Demonstration

With respect to the “Load Follow Test,” the NRC staff reviewed the SM1 first plant only startup test procedural steps and test results to ensure applicability to SNC’s VEGP Units 3 and 4 UFSAR Chapter 14, Test 14.2.10.4.22. The startup test consisted of reducing the reactor power to approximately 50% RTP plateau and performing additional power maneuvers at +/- 5% RTP around the plateau. The staff reviewed the following documents:

- Summary Startup Test Report (SM1-GV5-T2R-60087)
- Startup Test Procedure (SM1-GW-T1P-634)
  - Test Procedure Attachment Log,
  - Test Narrative Log.
  - Pre-Job/Post-Job Brief Record,
  - Data Collection Table,
  - Open Items Report,
  - Test Report Change Form, and
  - Field deviation report.
- Startup Quality Observation Report (SM1-PLS-GQR-5015)
- Chapter 14 Applicability

### Startup Test Procedure

A preliminary assessment of VEGP’s Test 14.2.10.4.22 to SM1 S/U Test indicate (1) no anomalous result was identified that would impact or invalidate the first plant only startup test, and (2) the SM1 test is applicable to the VEGP test. All of VEGP’s test sections were included and consistent in the SM1 first plant only startup test. An assessment summary is included in Table 2 below.

**Table 2: Assessment of Sanmen Unit 1 Startup Test to Vogtle Units 3/4 UFSAR Chapter 14 Test 14.2.10.4.22**

<b>Load Follow Demonstration (First Plant Only)</b>		
<b>VEGP S/U Test Section Requirements</b>	<b>SM1 S/U Test Step</b>	<b>VEGP &amp; SM1 S/U Tests Assessment</b>
<u>Objective</u> <ul style="list-style-type: none"><li>- Demonstrate the ability of the AP1000 plant to follow a design basis daily load follow cycle.</li><li>- Demonstrate the ability of the plant to respond to grid frequency changes while in the load follow cycle.</li></ul>	<ul style="list-style-type: none"><li>-1.1.1</li><li>-1.1.2</li></ul>	Objectives are consistent, and a Scope section is included in the S/U Test that provides supplemental information supportive of the test, such as initial power condition and the plant control system (PLS) automatic control.
<u>Prerequisites</u> <ul style="list-style-type: none"><li>- The plant is operating at a stable power level of approximately 100% power and has been at that power for a sufficient length of time to have reached an equilibrium xenon condition.</li></ul>	<ul style="list-style-type: none"><li>-6.1</li></ul>	Prerequisites are consistent.  An Initial Conditions section is added to include confirmation that the reactor control systems maintain

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<b>VEGP S/U Test Section Requirements</b>	<b>SM1 S/U Test Step</b>	<b>VEGP &amp; SM1 S/U Tests Assessment</b>
<ul style="list-style-type: none"> <li>- Startup testing of the reactor and turbine control and protection systems are completed, and final setpoints are installed.</li> <li>- The incore instrumentation system, including signal processing software, is operational. All preoperational and startup testing is completed.</li> <li>- Instrumentation and data collection equipment is operational and available for logging plant data.</li> </ul>	<p>-5.17 (5.16 corrected)</p> <p>-5.11</p> <p>-5.13</p>	<p>reactor conditions at equilibrium between 99.5 – 100% RTP and confirmation that the thermohydraulic data is within limits.</p> <p>A Precautions and Limitations section is added to include other test limitations such as changes to boron concentration or any manual operation that impacts reactivity will invalidate the test. Core power distribution continuously monitor during test.</p>
<p><u>Test Method</u></p> <ul style="list-style-type: none"> <li>- 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.</li> <li>- 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.</li> <li>- After remaining at 50% 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% rated thermal power is achieved linearly in 2 hours.</li> <li>- 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.</li> <li>- While within the load-follow maneuver,</li> </ul>	<p>-7.1.10 – 7.1.21</p> <p>-7.2.1 – 7.2.5</p> <p>-7.3.7, (7.4.1 corrected)</p> <p>-7.1.10 – 7.1.14</p> <p>-7.3.3 – 7.3.6</p>	<p>Test Method is consistent with the procedure steps. Initial data conditions recorded and data collection systems setup.</p> <p>Reduce and maintain reactor power between 49.5 – 50.5% RTP for at least 2 but less than 10 hours while obtaining data at appropriate time.</p> <p>After the power maneuvers, power is raised to 100% while obtaining data at appropriate time.</p> <p>Data collection.</p> <p>Maneuver reactor power around the 50% RTP plateau +/- 5% at 2%/minute turbine load, record appropriate data, and confirm the plant responds to grid changes.</p>



<b>Load Follow Demonstration (First Plant Only)</b>		
<b>VEGP S/U Test Section Requirements</b>	<b>SM1 S/U Test Step</b>	<b>VEGP &amp; SM1 S/U Tests Assessment</b>
demonstrate the ability to respond to grid frequency changes by increasing and decreasing load by as much as 10%, at a rate of 2% per minute.		
<u>Performance Criteria</u> - 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.  - Load follow maneuvers, including response to grid frequency changes, can be accomplished without changes to the reactor coolant boron concentration	-9.1          -9.2	Performance Criteria are consistent with the SM1 test. SM1 test results were within the TS limits and were consistent with Westinghouse predictions with no anomalies. Load follow maneuvers, including response to grid frequency changes, were performed without changes to the reactor coolant boron concentration. SM1 test includes step 9.3 to confirm no manual operation during load follow maneuvers.

**Passive Residual Heat Removal Heat Exchanger, Natural Circulation Test**

The staff reviewed the documentation associated with the Passive Residual Heat Removal Heat Exchanger (PRHRHE) Natural Circulation Test. During this test, actuation of one of the heat exchanger isolation valves is necessary to initiate flow through the heat exchanger. The staff's review did not identify any performance discrepancies with regards to the valves in the test lineup at SM1. The staff sought additional information regarding the similarity of the SM1 valves to those at VEGP Units 3 and 4. During a clarification call with the licensee, SNC indicated that the valves were manufactured using the same design specification and are procured to the same quality requirements imposed by the design specification, but the word "valves" had been omitted from the LAR submittal. Through discussion and context from the rest of the submittal, the staff inferred that general references in the LAR such as "system components used for this test" could reasonably be understood to include the valves that are actuated to initiate the test, despite their omission from the list of components in the submittal.

SNC provided Westinghouse Letter SMG\_CSM\_001587, "Westinghouse Preliminary Evaluation on Test Data of SM1-PXS-T1P-602 Nuclear Island Contract for Nuclear Power Self-reliance Program Supporting Projects (Contract No. 07HT10500000293)," dated September 10, 2018, available for audit. Noticing that the document provides only a "preliminary" evaluation on test data, the NRC audit team asked SNC to provide an evaluation of test data for audit, during an audit call on October 8, 2019. In response, SNC stated that the letter to the owner was preliminary in the sense that it provided immediate confirmation to the owners that the test was properly executed and the correct data collected. Therefore, the evaluation did not need to be re-performed. SNC also stated that the final calculation note is available on the ERR as

SM1-PXS-T2C-018, "Sanmen Unit 1 PXS Startup Test Results and Validation of PRHR Performance," and that the Observation Report, also available on the ERR, includes an independent evaluation of the test data performed by SNC engineering. The NRC audit team found the SNC response satisfactory.

The NRC audit team reviewed SM1-PXS-T2C-018 that provided Westinghouse verification that the test acceptance criteria for the AP1000 PRHR performance startup test was met. Westinghouse noted that it prepared this report according to the Westinghouse Global Management System. Westinghouse noted that key conditions reflected in the steps of the Sanmen-specific test procedure, SM1-PXS-T1P-602, "AP1000 Passive Residual Heat Removal Heat Exchanger Startup Test Procedure," include the following: [[

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SM1-PXS-T2C-018 describes that Westinghouse adjusted the inputs developed in its predictive analysis to better match the actual test conditions to evaluate the test results against the PRHR acceptance criteria heat transfer versus time curves that were developed in the predictive analysis, which served as the initial go/no-go acceptance criterion used by the Sanmen owner immediately following the test. Westinghouse noted that following the test, it performed an initial LOFTRAN calculation. The calculation provided confidence that the test passed and that the LOFTRAN models are conservative, and the analysis provided in SM1-PXS-T2C-018 gave additional detail and sensitivity cases against the base case.

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The NRC audit team reviewed ND-EN-006-F01 for LAR 19-011, which provided SNC's evaluation of first plant only startup testing of SM1 PRHRHE natural circulation test. SNC had reviewed the following documents:

- SM1-PXS-T1P-602, "AP1000 Passive Residual Heat Removal Heat Exchanger Startup Test Procedure," Revision 2.
- SM1-GV5-T2R-60091, "Startup Test Report for AP1000 Passive Residual Heat Removal Heat Exchanger Startup Test Procedure," Revision 0
- Westinghouse SM1-PXS-T2C-018, "Sanmen Unit 1 PXS Startup Test Results and Validation of PRHR Performance," Revision 0
- Westinghouse APP-PXS-M3C-509, "AP1000 PRHR Plant Startup Test Criteria Development," Revision 1
- Westinghouse Letter SMG\_CSM\_001587, "Westinghouse Preliminary Evaluation on Test Data of SM1-PXS-T1P-602," September 10, 2018.

SNC noted that the test results were acceptable for concluding that the PRHR system performed as well, or better, than predicted by the safety analysis model with regards to the test acceptance criteria.

The NRC audit team reviewed ND-Vogtle34-RFI-1055, which responded to an SNC request for Westinghouse to review AP1000 design changes. These changes were made at one site (either SM1 or Vogtle Units 3&4) and were not also made applicable to the other site, which could have affected a standard plant design feature, such that the results of tests, including PRHRHE Natural Circulation Test, would be potentially impacted. Westinghouse noted that its review of PRHRHE Natural Circulation test procedure APP-PXS-T1P-602 and design changes did not identify any non-conformances.

#### H. Exit Briefing

The staff conducted an exit briefing on October 16, 2019. The licensee and staff discussed that there was no need for any additional information to be provided.

#### I. Requests for Additional Information (RAI) Resulting from Audit

No RAIs were issued as a result of this audit.

#### J. Open Items and Proposed Closure Paths

There were no open items as a result of this audit.

#### K. Deviations from the Audit Plan

The duration of the audit was extended in order to allow staff additional time to examine documents that were added to the electronic reading room.

#### L. References

1. Southern Nuclear Operating Company, Vogtle Electric Generating Plant Units 3 and 4, Request for License Amendment Regarding Crediting Previously Completed First Plant Only

Startup Tests (LAR-19-011), June 28, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession Number ML19179A209).

2. Vogtle Electric Generating Plant, Unit 3, Current Facility Combined License NPF-91, Revised 09/11/2018 (ADAMS Accession No. ML14100A106).
3. Vogtle Electric Generating Plant, Unit 4, Current Facility Combined License NPF-92, Revised 09/11/2018 (ADAMS Accession No. ML14100A135).