

October 27, 2016

MEMORANDUM TO: Jennifer Dixon-Herrity, Chief
Licensing Branch 4
Division of New Reactor Licensing
Office of New Reactors

FROM: Bruce Baval, Project Manager **/RA/**
Licensing Branch 4
Division of New Reactor Licensing
Office of New Reactors

SUBJECT: REGULATORY AUDIT PLAN FOR THE REVIEW OF REQUEST
FOR LICENSE AMENDMENT AND EXEMPTION REGARDING
AUTOMATIC DEPRESSURIZATION SYSTEM STAGES 2, 3,
AND 4 VALVE FLOW AREA CHANGES FOR THE VOGTLE
ELECTRIC GENERATING PLANT UNITS 3 AND 4 AND
VIRGIL C. SUMMER NUCLEAR STATION, UNITS 2 AND 3

By letter dated July 25, 2016, Southern Nuclear Operating Company submitted a request for a license amendment and exemption (LAR 16-012) for the Vogtle Electric Generating Plant (VEGP) Units 3 and 4, respectively. Audit results will also be applicable to a similar request submitted on September 2, 2016, by the licensee of the Virgil C. Summer Nuclear Station, (Summer) Units 2 and 3, (LAR 16-08).

Subsequently, the U.S. Nuclear Regulatory Commission staff would like to perform an audit in support of its review of LAR 16-012 and LAR 16-08.

Docket Nos.: 52-025
52-026
52-027
52-028

Enclosure:
Regulatory Audit Plan

CONTACT: Bruce Baval, NRO/DNRL/LB4
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**AUDIT OF FLOW TEST REPORTS AND CALCULATIONS IN SUPPORT OF REQUEST FOR
LICENSE AMENDMENTS AND EXEMPTIONS RELATED TO AUTOMATIC
DEPRESSURIZATION SYSTEM STAGES 2, 3 AND 4 VALVE FLOW AREA CHANGES**

**SOUTHERN NUCLEAR OPERATING COMPANY
VOGTLE ELECTRIC GENERATING PLANT, UNITS 3 AND 4
Docket Nos. 52-025 and 52-026**

**SOUTH CAROLINA ELECTRIC AND GAS COMPANY
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
VIRGIL C. SUMMER NUCLEAR STATION, UNITS 2 AND 3
Docket Nos. 52-027 and 52-028**

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Purpose:

The purpose of the audit is to verify that the flow test reports and calculations referenced in the Request for License Amendment and Exemption LAR 16-012 (dated July 25, 2016), "Automatic Depressurization System (ADS) Stages 2, 3 and 4 Valve Flow Area Changes and Clarifications," submitted by the licensee of Vogtle Electric Generating Plant (Vogtle), Units 3 and 4, support the proposed flow area reductions for the ADS Stages 2, 3, and 4 valves. Although this audit plan describes LAR 16-012 submitted by the Vogtle Units 3 and 4 licensee, the audit results will also be applicable to a similar request submitted by the licensee of the Virgil C. Summer Nuclear Station (Summer), Units 2 and 3, in LAR 16-08 on September 2, 2016.

Background:

In LAR 16-012, the licensee of Vogtle Units 3 and 4 proposes to provide corrected information related to the flow areas for the ADS Stages 2 and 3 motor-operated valves (MOVs) and ADS Stage 4 pyrotechnic-actuated valves (squib valves) in its licensing documentation. In particular, LAR 16-012 proposes changes to the Vogtle Units 3 and 4 updated final safety analysis report (UFSAR) in the form of departures from the plant-specific Design Control Document (DCD) Tier 2 licensing information in Table 14.3-2, "Design Basis Accident Analysis," and Table 15.6.5-10, "AP1000 ADS Parameters." LAR 16-012 also proposes changes to the inspections, tests, analyses, and acceptance criteria (ITAAC) in Appendix C to the Vogtle Units 3 and 4 combined license (COL), and associated plant-specific DCD Tier 1 information in Table 2.1.2-4,

Enclosure

“Inspections, Tests, Analyses, and Acceptance Criteria.”

The Office of New Reactors (NRO) Projects staff determined that an audit of these flow test reports and calculations is the appropriate method to verify the proposed flow area reductions in LAR 16-012 rather than by requests for additional information (RAIs).

Regulatory Audit Basis:

The NRC regulations in 10 CFR 52.98(f) specify that any modification to, addition to, or deletion from the terms and conditions of a COL including any modifications to, addition to, or deletion from the ITAAC contained in the license is a proposed amendment to the license. In LAR 16-012, the licensee proposes changes to Vogtle Units 3 and 4 COL Appendix C ITAAC, with corresponding changes to the associated plant-specific DCD Tier 1 information. Therefore, NRC approval is required prior to making the plant-specific proposed changes described in LAR 16-012.

In an AP1000 reactor, the ADS provides depressurization of the reactor coolant system (RCS) to allow the Passive Core Cooling System (PXS) to supply gravity-driven cooling water from the In-containment Refueling Water Storage Tank (IRWST) to mitigate a design-basis accident. The ADS Stages 1 through 4 valves open in sequence based on Core Makeup Tank level and time delays to allow a controlled RCS depressurization. The flow rates through the valves in each stage of the ADS control the rate of RCS depressurization. Therefore, the minimum flow areas through the valves in each ADS stage affect the RCS depressurization rate, and subsequently the core uncover time and fuel rod heat-up during a design basis accident. LAR 16-012 reports that the flow testing for the ADS Stages 2, 3 and 4 valves found the actual flow areas for these valves to be less than the minimum flow areas assumed in the accident analyses. LAR 16-012 summarizes the revised accident analyses with the reduced flow areas for the ADS valves to demonstrate adequate reactor core cooling in the event of a design basis accident. LAR 16-012 describes the evaluation of several safety analyses with primary focus on the postulated small break loss-of-coolant accident (LOCA) analysis.

The specific NRC technical requirements applicable to this LAR are the general design criteria (GDC) in Appendix A to Title 10 of the *Code of Federal Regulations*, Part 50 (10 CFR Part 50). In particular, these technical requirements include GDC 2, “Design bases for protection against natural phenomena,” GDC 4, “Environmental and dynamic effects design bases,” GDC 35, “Emergency core cooling,” and GDC 37, “Testing of emergency core cooling system.”

During this audit, the staff will review the specified documentation to confirm that the proposed changes to the Vogtle Units 3 and 4 COL and ITAAC related to the minimum flow areas for the ADS Stages 2, 3 and 4 valves will continue to provide reasonable assurance of adequate reactor core cooling in the event of a design basis accident.

The staff will follow NRO Office Instruction NRO-REG-108 (Revision 0), “Regulatory Audits,” in performing the audit of the flow test reports and calculations referenced in LAR 16-012.

Regulatory Audit Scope:

The primary scope of this audit is the review of the flow test reports and calculations referenced in LAR 16-012 to support the proposed reductions in the minimum flow areas for the ADS Stages 2, 3, and 4 valves in Vogtle Units 3 and 4. The specific items of review are listed below:

1. LAR 16-012 indicates that testing was performed to determine the flow coefficient C_v for a sample valve similar to the ADS Stages 2 and 3 MOVs. LAR-16-012 asserts that the test resulted in an as-manufactured flow area of 19.5 in² at 85% and 100% full open stroke, which does not meet the minimum effective flow area of 21 in² specified in the valve data sheet. The NRC staff will review the flow test report for the ADS Stages 2 and 3 MOVs to verify that the flow area reduction assumed in the LAR is appropriate.
2. LAR 16-012 proposes the use of a 19 in² minimum flow area for the ADS Stages 2 and 3 MOVs based on the flow test results. LAR 16-012 describes the results of the evaluation of the reduced flow area on the RCS depressurization rate and reactor core heat-up. The NRC staff will review the referenced flow calculation for the ADS Stages 2 and 3 valves to verify that it reflects the appropriate minimum flow area based on the flow test results.
3. As noted in LAR 16-012, the NRC staff identified an issue with the small margin in the manufactured diameter of the shear cap for the ADS Stage 4 squib valves during an inspection of the valve vendor in February 2012. See NRC Inspection Report No. 99900080/2012-201, dated June 6, 2012. Subsequently, the NRC staff identified the reduction in flow area below the manufactured value for the ADS Stage 4 squib valve during an inspection of the ASME QME-1 flow test in December 2013. See NRC Inspection Report No. 99900905/2013-201, dated January 22, 2014. AP1000 Calculation APP-PXS-M3C-038 (Revision 6), "Squib Valve Functional Requirements for Reactor Coolant System (RCS) Automatic Depressurization System Stage 4 (ADS-4) Valves," established the parameters for the ADS Stage 4 squib valves based, in part, on the assumed flow area. The NRC staff will verify that the flow calculation for the ADS Stage 4 valves (and associated flow calculations) has been updated to reflect the appropriate minimum flow area based on the flow test results.
4. LAR 16-012 indicates that a sensitivity analysis was performed on the most recent limiting small-break LOCA safety analysis case to estimate the effect of the proposed changes. Based on the proposed changes, the updated calculations resulted in an increase of approximately 13°F peak cladding temperature. The NRC staff will review and verify the sensitivity analysis and all related calculations to evaluate the impact on LOCA Safety Analyses does not result in a maximum fuel element cladding temperature exceeding 2200°F.
5. LAR 16-012 indicates that the changes do not result in: (1) the calculated total oxidation of the cladding at any point exceeding 0.17 times the total cladding thickness before oxidation; (2) the calculated total amount of hydrogen generated from the chemical reaction of the cladding with water or steam exceeding 0.01 times the hypothetical amount that would be generated if all the metal in the cladding cylinders surrounding the fuel, excluding the cladding surrounding the plenum volume, were to react; and (3) the calculated core temperature not being maintained at an acceptably low value after any successful initiation operation of the PXS, and does not adversely affect decay heat being removed for the extended period of time required by the long-lived radioactivity remaining in the core. The NRC staff will review and verify the analysis and all related calculations used to provide the above results are acceptable.

The staff also identified two statements in LAR 16-012 that will be clarified as part of discussions with licensee representatives during the audit. The clarifications are as follows:

1. LAR 16-012 states that the proposed change to the minimum effective flow area for the ADS Stage 4 valves has minimal impact on the flow rate through the ADS Stage 4 valves and resulting RCS depressurization. However, LAR 16-012 indicates that the QME-1 flow test of the ADS Stage 4 valve determined an adequate flow rate with a reduced flow area. The staff will discuss with the licensee the basis for reducing the flow rate for the ADS Stage 4 valve in light of the QME-1 flow test results that demonstrated an acceptable flow rate through the reduced flow area.
2. LAR 16-012 states that inadvertent operation or failure of the ADS Stage 2 and 3 MOVs and ADS Stage 4 squib valves are considered as accident initiators, or part of an initiating sequence of events for an accident previously evaluated. However, Vogtle Units 3 & 4 UFSAR (Revision 5) incorporates AP1000 DCD Tier 2, Section 15.6.1, "Inadvertent Opening of a Pressurizer Safety Valve or Inadvertent Operation of the ADS," which describes inadvertent opening of the ADS Stage 1 valves as the accident initiator. The staff will discuss with the licensee the different statements in LAR 16-012 and UFSAR Section 15.6.1 regarding ADS valves as accident initiators.

Documents and Information Necessary for the Audit:

The following documents are to be made available to the NRC staff either at a local office or in the electronic reading room:

1. ADS Stages 2 and 3 MOV flow test report referenced in LAR 16-012
2. ADS Stages 2 and 3 MOV flow calculation referenced in LAR 16-012
3. AP1000 Calculation APP-PXS-M3C-038, "Squib Valve Functional Requirements for Reactor Coolant System (RCS) Automatic Depressurization System Stage 4 (ADS-4) Valves," and associated flow calculations, as updated to reflect LAR 16-012.
4. Sensitivity analyses for the small break LOCA safety analysis case, the new calculated base case associated with AP1000 Core Reference Report WCAP-17524-P-A, and related calculations and analyses performed in support of the evaluation of the effects of the ADS Stages 2, 3 and 4 valve flow area changes.

Appropriate handling and protection of proprietary information shall be acknowledged and observed throughout the audit.

Audit Staff:

Thomas G. Scarbrough, Senior Mechanical Engineer (NRC)
John Budzynski, Reactor Systems Engineer (NRC)
Bruce Baval, Project Manager (NRC)

Licensee Contact:

Amy C. Chamberlain

Audit Activities and Deliverables:

The NRC staff will address the technical areas identified in the Regulatory Audit Scope of this audit plan.

The audit will be conducted in support of the schedule for completion of the LAR 16-012 review with entrance and exit dates to be determined. The level of effort is estimated to be a total of 40 hours to complete the audit.

Depending on the availability of the licensee's documentation, the audit is planned to be conducted between October 18 and November 29, 2016. The audit is intended to be conducted from the NRC Headquarters via the licensee's electronic reading room; however, the audit may be performed at a local office of the licensee, if the technical information is only retained in hard copy.

The NRC staff acknowledges the proprietary nature of the information requested. It will be handled appropriately throughout the audit. While the NRC staff will take notes, the staff will not remove hard copies or copy electronic files.

At the completion of the audit, the NRC staff will prepare an audit report within 45 days that will be declared and entered as an official agency record in the NRC's Agencywide Documents Access and Management System (ADAMS) records management system. The audit outcome may be used to identify any additional information to be submitted for making regulatory decisions, and will assist the NRC staff in the issuance of RAIs (if necessary) in completing its review of LAR 16-012. With the planned exit telecom on November 29, 2016, the audit summary will be completed by January 30, 2017.

If necessary, any circumstances related to the performance of the audit will be communicated to Bruce Bavol (NRC) at 301-415-6715 or Bruce.Bavol@nrc.gov.

References:

1. Southern Nuclear Operating Company, Vogtle Electric Generating Plant Units 3 and 4, Request for License Amendment and Exemption LAR 16-012, "Automatic Depressurization System (ADS) Stage 2, 3 and 4 Valve Flow Area Changes and Clarifications," dated July 25, 2016.
2. South Carolina Electric & Gas Company, Virgil C. Summer Units 2 and 3, Request for License Amendment and Exemption LAR 16-08: "Automatic Depressurization System (ADS) Stage 2, 3 and 4 Valve Flow Area Changes and Clarifications," dated September 2, 2016.
3. NRO-REG-108, "Regulatory Audits," ADAMS Accession Number ML081910260, dated April 2, 2009.
4. Vogtle Units 3 and 4 Combined Operating License, Appendix C, and UFSAR (plant-specific Design Control Document).
5. ASME *Boiler and Pressure Vessel Code*, Section III, Division 1, "Rules for Construction of Nuclear Facility Components."

6. NRC Standard Review Plan Section 3.9.6, "Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints."
7. NRC Inspection Report No. 99900080/2012-201, dated June 6, 2012, ADAMS Accession No. ML12158A154.
8. NRC Inspection Report No. 99900905/2013-201, dated January 22, 2014, ADAMS Accession No. ML14016A447.

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Revised (09/28/2016)

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