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ND-17-0443
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U.S. Nuclear Regulatory Commission
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Washington, DC 20555-0001

Southern Nuclear Operating Company
Vogtle Electric Generating Plant Units 3 and 4
Request for License Amendment and Exemption:
PXS/ADS Line Resistance Changes (LAR-17-009)

Ladies and Gentlemen:

Pursuant to 10 CFR 52.98(c) and in accordance with 10 CFR 50.90, Southern Nuclear Operating Company (SNC), the licensee for Vogtle Electric Generating Plant (VEGP) Units 3 and 4, requests an amendment to Combined License Numbers NPF-91 and NPF-92, for VEGP Units 3 and 4, respectively. The requested amendment proposes to depart from approved AP1000 Design Control Document (DCD) Tier 2 information (text and tables) as incorporated into the Updated Final Safety Analysis Report (UFSAR) as plant-specific DCD information, and also proposes to depart from involved plant-specific Tier 1 information (and associated COL Appendix C information). Pursuant to the provisions of 10 CFR 52.63(b)(1), an exemption from elements of the design as certified in the 10 CFR Part 52, Appendix D, design certification rule is also requested for the plant-specific Tier 1 material departures.

The requested amendment proposes changes to UFSAR Tier 2 and COL Appendix C (and plant-specific Tier 1) in regards to the passive core cooling system (PXS) low pressure injection and fourth-stage automatic depressurization system (ADS) flow resistances. This includes proposed changes to ITAAC and UFSAR information in various locations. The proposed changes consist of the following:

1) Revising licensing basis text in COL Appendix C (and plant-specific Tier 1) and UFSAR Tier 2 that describes the inspection and analysis of, and specifies the maximum calculated flow resistance acceptance criteria for, the fourth-stage ADS loops,
2) Revising licensing basis text in COL Appendix C (and plant-specific Tier 1) and UFSAR Tier 2 that describes the testing of, and specifies the allowable flow resistance acceptance criteria for, the IRWST injection line,

3) Revising licensing basis text in COL Appendix C (and plant-specific Tier 1) and UFSAR Tier 2 that describes the testing of, and specifies the maximum flow resistance acceptance criteria for, the containment recirculation line,
4) Revising licensing basis text in COL Appendix C (and plant-specific Tier 1) and UFSAR Tier 2 that specifies acceptance criteria for the maximum flow resistance between the IRWST drain line and the containment, and
5) Removing licensing basis text from UFSAR Tier 2 that discusses the operation of swing check valves in current operating plants.

Enclosure 1 provides the description, technical evaluation, regulatory evaluation (including the Significant Hazards Consideration Determination), and environmental considerations for the proposed changes in the License Amendment Request (LAR).

Enclosure 2 provides the background and supporting basis for the requested exemption.

Enclosure 3 provides the proposed changes to the VEGP 3&4 licensing basis documents.

This letter contains no regulatory commitments. This letter has been reviewed and confirmed to not contain security-related information.

SNC requests staff approval of this license amendment by November 22, 2017, to support development of the PXS preoperational testing specifications and procedures. Approval by this date will allow sufficient time to implement the licensing basis changes needed to support development of the PXS preoperational testing specifications and procedures. SNC expects to implement this proposed amendment (through incorporation into the licensing basis documents; e.g., the UFSAR) within 30 days of approval of the requested changes. SCE&G has indicated the requested approval date for the Virgil C. Summer Nuclear Station (VCSNS) Units 2 and 3 license amendment request for this topic is October 29, 2017.

In accordance with 10 CFR 50.91, SNC is notifying the State of Georgia of this LAR by transmitting a copy of this letter and enclosures to the designated State Official.

Should you have any questions, please contact Mr. Adam G. Quarles at (205) 992-7031.

(oath and affirmation provided on the following page)

Ms. Amy G. Aughtman states that: she is the Nuclear Development Licensing Director of Southern Nuclear Operating Company; she is authorized to execute this oath on behalf of Southern Nuclear Operating Company; and to the best of her knowledge and belief, the facts set forth in this letter are true.

Respectfully submitted,

SOUTHERN NUCLEAR OPERATING COMPANY

Amy G. Aughtman

Amy G. Aughtman

CYNTHIA R. MCCOMBS MY COMMISSION EXPIRES OCTOBER 11, 2020 NOTARY PUBLIC STATE OF ALABAMA

AGA/AGQ/ljs

Sworn to and subscribed before me this 31st *day of* March, *2017*

Notary Public: Cynthia R. McCombs

My commission expires: October 11, 2020

Enclosures: 1) Vogtle Electric Generating Plant (VEGP) Units 3 and 4 – Request for License Amendment: PXS/ADS Line Resistance Changes (LAR-17-009)

2) Vogtle Electric Generating Plant (VEGP) Units 3 and 4 – Exemption Request: PXS/ADS Line Resistance Changes (LAR-17-009)

3) Vogtle Electric Generating Plant (VEGP) Units 3 and 4 – Proposed Changes to the Licensing Basis Documents (LAR-17-009)

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Southern Nuclear Operating Company

ND-17-0443

Enclosure 1

Vogtle Electric Generating Plant (VEGP) Units 3 and 4

Request for License Amendment:

PXS/ADS Line Resistance Changes

(LAR-17-009)

(Enclosure 1 consists of 24 pages, including this cover page.)

Table of Contents

Pursuant to 10 CFR 52.98(c) and in accordance with 10 CFR 50.90, Southern Nuclear Operating Company (SNC, or the "Licensee") hereby requests an amendment to Combined License (COL) Nos. NPF-91 and NPF-92 for Vogtle Electric Generating Plant (VEGP) Units 3 and 4, respectively.

1. SUMMARY DESCRIPTION

The proposed changes affect the Combined License (COL) concerning the Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for the fourth-stage automatic depressurization system (ADS) valves and associated piping; the in-containment refueling water storage tank (IRWST) injection and drain lines; and containment recirculation lines. The proposed change for flow resistances of the fourth-stage ADS sub-loop valves and associated piping; IRWST Injection lines; Containment recirculation lines; and IRWST to Containment drain lines involve revisions to COL Appendix C (and plant-specific DCD Tier 1) Table 2.1.2-4, ITAAC 2.1.02.08d.ii (fourth-stage ADS sub-loop valves and piping flow resistance); Table 2.2.3-4, ITAAC 2.2.03.08c.i (IRWST injection and containment recirculation flow resistances); and Table 2.2.3-4, ITAAC 2.2.03.09a.i (IRWST to containment drain line flow resistance) information. The acceptance criteria for these ITAAC items are proposed to be changed to use revised calculated flow resistance values due to the changes in the methods for calculating the flow resistances and the check valves in the IRWST injection lines and containment recirculation lines not fully opening. The proposed changes also affect Updated Final Safety Analysis Report (UFSAR) Subsection 14.2.9.1.3 by revising the allowable calculated flow resistance for IRWST injection lines and IRWST drain and containment recirculation lines. The proposed changes to UFSAR Subsection 14.2.9.1.3 also revise the acceptance criteria for flow resistance from that for two fourth-stage ADS loops, by dividing the two fourth-stage ADS loops into four sub-loops and changing the acceptance criteria for the four fourth-stage ADS sub-loops, and designating the sub-loops. Additional changes are made to the UFSAR to reflect the use of revised flow resistance in the analysis of small-break loss-of-coolant accidents (LOCAs). The as-analyzed flow resistance is a bounding value based on the calculated flow resistance of the selected fourth-stage ADS valves and associated piping, IRWST injection and drain lines, and the containment recirculation lines.

The requested amendment requires changes to the UFSAR in the form of departures from the plant-specific Design Control Document (DCD) Tier 2 information (as detailed in Section 2), and involves changes to plant-specific Tier 1 information, with corresponding changes to the associated COL Appendix C information. This enclosure requests approval of the license amendment necessary to implement the Tier 2 and COL Appendix C changes. Enclosure 2 requests the exemption necessary to implement the involved changes to the plant-specific Tier 1 information.

2. DETAILED DESCRIPTION

As described in UFSAR Subsections 5.4.6 and 6.3.2.2.8.5, the ADS valves are part of the reactor coolant system (RCS) and interface with the passive core cooling system (PXS).

Twenty ADS valves are divided into four depressurization stages. These stages connect to the reactor coolant system (RCS) at three different locations. The ADS valves are required to open for the PXS to function to provide emergency core cooling following postulated accident conditions.

2.1 IRWST Injection and Containment Recirculation Check Valves

The PXS final design review identified there is insufficient flow in the IRWST injection and containment recirculation lines to fully open check valves in these lines when flow decreases as injection continues. Check valves PXS-PL-V122A/B and PXS-PL-V124A/B (IRWST injection) and PXS-PL-V119A/B (containment recirculation) not opening fully increases the flow resistance of these lines. The flow resistance in the IRWST injection and containment recirculation lines are inputs to safety analyses and are ITAAC acceptance criteria.

2.2 IRWST Drain and Fourth-stage ADS lines

As described in UFSAR Section 6.3, the primary function of the PXS is to provide emergency core cooling following postulated design basis events by providing emergency core decay heat removal, RCS emergency makeup and boration, safety injection, and containment pH control.

As described in COL Appendix C (and plant-specific Tier 1) Table 2.2.3-4, the Design Commitment for ITAAC 2.2.03.08c is that the PXS provides RCS makeup, boration, and safety injection during design basis events. The acceptance criteria for ITAAC 2.2.03.08c currently state:

- The calculated flow resistance for each IRWST injection line between the IRWST and the reactor vessel is:
    - Line A, $\geq 5.53 \times 10^{-6}$ ft/gpm^2 and $\leq 9.20 \times 10^{-6}$ ft/gpm^2;
    - Line B, $\geq 6.21 \times 10^{-6}$ ft/gpm^2 and $\leq 1.03 \times 10^{-5}$ ft/gpm^2.
- The calculated flow resistance for each containment recirculation line between the containment and the reactor vessel is:
    - Line A, $\leq 1.11 \times 10^{-5}$ ft/gpm^2;
    - Line B, $\leq 1.04 \times 10^{-5}$ ft/gpm^2.

As described in COL Appendix C (and plant-specific Tier 1) Table 2.2.3-4, the Design Commitment for ITAAC 2.2.03.09a is that the PXS provides a function to cool the outside of the reactor vessel during a severe accident. The acceptance criterion for ITAAC 2.2.03.09a currently states:

- The calculated flow resistance for each IRWST drain line between the IRWST and the containment is $\leq 4.07 \times 10^{-6}$ ft/gpm^2.

In addition to the final design review, other reviews identified a significant change in the method for calculating flow resistance for piping tees (pipes joined in a “T” configuration). Previously, calculations used loss factors of 20 for the through portion and 60 for the branch of the tee. A new and more representative methodology (from "Pipe Flow: A Practical and Comprehensive Guide" by Donald C. Rennels and Hobart

M. Hudson) exists that provides formulae for the loss factor depending on the tee configuration and the flow split. This new methodology resulted in changes to the calculated resistance values for the IRWST drain line, injection line, containment recirculation lines, and the fourth-stage ADS piping. This new methodology accounts for the specific geometry and flow split of each tee. The results are essentially the same and slightly more conservative using the more representative methodology for flow through a branch tee. The proposed calculated resistance values are shown in Tables 2-1 and 2-2, below.

Table 2-1 – Current and Proposed Flow Resistance

Tier 1 Table and ITAAC Number	Line	Current ITAAC Max. Flow Resistance (ft/gpm^2)	Proposed ITAAC Max. Flow Resistance (ft/gpm^2)	Current ITAAC Min. Flow Resistance (ft/gpm^2)	Proposed ITAAC Min. Flow Resistance (ft/gpm^2)
2.2.3-4 2.2.03.08c.i.03[1]	IRWST Injection Line A	$\leq 9.20 \times 10^{-6}$	$\leq 9.09 \times 10^{-6}$	$\geq 5.53 \times 10^{-6}$	$\geq 5.35 \times 10^{-6}$
2.2.3-4 2.2.03.08c.i.03[1]	IRWST Injection Line B	$\leq 1.03 \times 10^{-5}$	$\leq 1.05 \times 10^{-5}$	$\geq 6.21 \text{ X } 10^{-6}$	$\geq 6.15 \text{ X } 10^{-6}$
2.2.3-4 2.2.03.08c.i.04[1]	Containment Recirc Line A	$\leq 1.11 \times 10^{-5}$	$\leq 1.33 \times 10^{-5}$	NA	NA
2.2.3-4 2.2.03.08c.i.04[1]	Containment Recirc Line B	$\leq 1.04 \times 10^{-5}$	$\leq 1.21 \times 10^{-5}$	NA	NA
2.2.3-4 2.2.03.09a.i	IRWST Drain	$\leq 4.07 \times 10^{-6}$	$\leq 4.44 \times 10^{-6}$	NA	NA

[1]The change also clarifies during the test, sufficient flow will be provided to open check valves, not "fully" open check valves.

Table 2-2 – Current and Proposed Fourth-Stage ADS Flow Resistance

Fourth-stage ADS Sub-Loop Valves and Piping			
ITAAC Number	**ADS Loop**	**Current ITAAC Max. Flow Resistance (ft/gpm^2)**	**Proposed ITAAC Max. Flow Resistance (ft/gpm^2)**
2.1.2-4 2.1.02.08d.ii[1]	Fourth-stage ADS Loop 1	$\leq 1.70 \times 10^{-7}$	Sub-loop A: $\leq 5.91 \times 10^{-7}$ Sub-loop C: $\leq 6.21 \times 10^{-7}$
2.1.2-4 2.1.02.08d.ii[1]	Fourth-stage ADS Loop 2	$\leq 1.57 \times 10^{-7}$	Sub-loop B: $\leq 4.65 \times 10^{-7}$ Sub-loop D: $\leq 6.20 \times 10^{-7}$

[1]The proposed change also aligns the Inspections, Tests, and Analyses column with sub-loop acceptance criteria.

2.3 Fourth-Stage ADS Test Methodology

On-site preparation for the performance of the localized fourth-stage ADS line flow resistance test revealed that the test methodology presented several challenges to successful completion. As currently written, this test is performed by replacing the fourth-stage ADS valves (RCS-PL-V004A/B/C/D) with flow venturis instrumented with differential pressure detectors. After establishing the normal residual heat removal system (RNS) pumps' flow at 3000 gpm, the fourth-stage ADS isolation valves (RCS-PL-V014A/B/C/D) are opened until a steady differential pressure is established. Both PXS accumulators, which are filled to 50% and pressurized with 350 psig of nitrogen, are injected into the system by opening the accumulator isolation valves (PXS-PL-V027A/B). When the contents of the accumulator have been emptied, the fourth-stage ADS isolation valves are closed and data taking ceases. However, the capacity of the RNS pumps is too low to obtain a readable pressure drop and maintain the line resistance of each ADS loop (with both valves open). It is therefore necessary to change the fourth-stage ADS line flow resistance test from requiring testing of all flow path combinations with all valves open, to testing each valve flow path individually as sub-loops, using only the RNS pumps to provide flow.

As described in UFSAR Subsections 5.4.6 and 6.3.2.2.8.5, the fourth-stage ADS valves are part of the RCS and interface with the PXS. Twenty valves are divided into four depressurization stages. These stages connect to the RCS at three different locations. The ADS valves are required to open for the PXS to function as required to provide emergency core cooling following postulated accident conditions. The first, second, and third stage ADS control valves and isolation valves actuate at discrete core makeup tank (CMT) levels, as either tank's level decreases during injection or from spilling out through a broken injection line. The first, second, and third stage valves are opened in a sequence to provide a controlled depressurization of the RCS.

As described in UFSAR Subsection 5.1.3.7, the fourth-stage ADS valves connect to the hot leg of each reactor coolant loop. The fourth-stage ADS valves are configured as two sets of two 14-inch squib valves arranged in parallel lines, each in series with normally open, dc-powered, motor-operator gate isolation valves. The fourth-stage ADS valves are interlocked so that they cannot be opened until RCS pressure has been substantially reduced.

As presented in COL Appendix C (and plant-specific Tier 1) Table 2.1.2-4, the Design Commitment for ITAAC 2.1.02.08d is that the RCS provides automatic depressurization during design basis events. The acceptance criterion for ITAAC 2.1.02.08d currently states:

- The calculated flow resistance for each group of fourth-stage ADS valves and piping with all valves open is:
  - Loop 1, ≤ $1.70\text{x}10^{-7}$ ft/gpm^2;
  - Loop 2, ≤ $1.57\text{x}10^{-7}$ ft/gpm^2.

Fourth-stage ADS Loops 1 and 2 will be tested as four sub-loops. (Loop 1, sub-loops A and C; Loop 2 sub-loops B and D).

Proposed Licensing Basis Changes

UFSAR Tier 2 Changes

Text, Table, or Figure	**Description of the Proposed Change**
Table 3.9-17, "System Level Operability Test Requirements," Note 5	Revises the allowable calculated flow resistance from the IRWST to each injection line with the corresponding IRWST injection line flow resistance range values provided in Table 2-1. Changes the note to indicate the check valves are open, not "fully" open and clarifies the test is of the direct vessel injection line, not the check valve, aligning the note with UFSAR Subsection 14.2.9.1.3.
Subsection 6.3.2.2.8.6, "Low Differential Pressure Opening Check Valves"	Removes the last paragraph discussing operational history of check valves similar to the check valves used in PXS.
Subsection 14.2.9.1.3, "Passive Core Cooling System Testing"	Item n): Revises the allowable calculated flow resistance for IRWST injection lines with the corresponding IRWST injection line flow resistance range values provided in Table 2-1. Item o): Revises the allowable calculated flow resistance for IRWST drain and containment recirculation lines with the corresponding maximum resistance values provided in Table 2-1. Item q): Changes the acceptance criteria for flow resistance from that for two fourth-stage ADS loops, to the acceptance criteria for four fourth-stage ADS sub-loops provided in Table 2-2.

COL Appendix C (and plant-specific Tier 1) ITAAC Changes

Text, Table, or Figure	Description of the Proposed Change
Tier 1 Table 2.1.2-4	Revise ITAAC No. 2.1.02.08d.ii by identifying that the inspections and analyses are conducted on sub-loops and replacing the current maximum flow resistance for fourth-stage ADS Loops 1 and 2 with the proposed maximum flow resistance sub-loop values provided in Table 2-2.
Tier 1 Table 2.2.3-4	Revise ITAAC No. 2.2.03.08c.i.03 by replacing the calculated flow resistance range for IRWST Injection Lines A and B with the corresponding IRWST injection line flow resistance range values provided in Table 2-1, and indicating that the check valves are not required to open fully during this low-pressure injection test.
Tier 1 Table 2.2.3-4	Revise ITAAC No. 2.2.03.08c.i.04 by replacing the maximum calculated flow resistance values for Containment Recirculation Lines A and B with the corresponding containment recirculation line flow resistance values provided in Table 2-1, and indicating that the check valves are not required to open fully during this low-pressure injection test.
Tier 1 Table 2.2.3-4	Revise ITAAC No. 2.2.03.09a.i by replacing the maximum calculated flow resistance value for IRWST drain line with the proposed maximum flow resistance value provided for this line in Table 2-1.

3. TECHNICAL EVALUATION

During controlled depressurization via the ADS, the accumulators and CMTs maintain RCS inventory. Once the RCS depressurizes, injection from the IRWST maintains long-term core cooling. For continued injection from the IRWST, the RCS must remain depressurized. Design maximum resistance values for the IRWST delivery lines are used to model this condition conservatively.

As described in UFSAR Subsection 15.6.5.4B.3.1, the small-break loss-of-coolant accident (LOCA) safety design approach is to provide for a controlled depressurization of the primary system if the break cannot be terminated, or if the nonsafety-related charging system is postulated to be lost or cannot maintain acceptable plant conditions. The CMT level activates primary system depressurization. The CMT provides makeup to help compensate for the postulated break in the RCS. As the CMT level drops, the first through fourth stages of the ADS valves are ramped open in sequence. The ADS valve descriptions are presented in UFSAR Table 15.6.5-10. The RCS depressurizes due to the break and opening of the ADS valves, while subcooled water from the CMTs and accumulators enters the reactor vessel downcomer to maintain system inventory and keep the core covered. Design basis maximum values of PXS resistances are applied to obtain a conservative prediction of system behavior during the small-break LOCA events.

As described in UFSAR Subsection 15.6.5.4B.2.1, the NOTRUMP computer code is used in the analysis of LOCAs due to small breaks in the RCS. In NOTRUMP, the RCS is nodalized into volumes interconnected by flow paths. The transient behavior of the system is determined from the governing conservation equations of mass, energy, and momentum applied throughout the system. A steady-state input deck is set up to comply, where appropriate, with the standard AP1000 small-break LOCA Evaluation Model methodology. One of the major features of the modeling is based on ADS actuation signals generated on low CMT levels and the ADS timer delays. A list of the ADS parameters is given in UFSAR Table 15.6.5-10. Active single failures of the passive safeguards systems are considered.

The limiting failure is one out of four fourth-stage ADS valves failing to open on demand; this failure most severely affects depressurization capability. The safety design approach is to depressurize the RCS to the containment pressure in an orderly fashion such that the large reservoir of water stored in the IRWST is operable for core cooling. The mass inventory plots provided for the breaks show the minimum inventory condition generally occurs at the start of IRWST injection. Penalizing the depressurization is the most conservative approach in postulating the single failure for such breaks.

As described in UFSAR Table 15.6.5-10, analysis of LOCAs due to small breaks in the RCS assumes that the first fourth-stage ADS valve (one of the two Stage 4A valves, assuming a single failure) opens at a CMT level of 20% coincident with a time delay of 128 seconds after the actuation of the first-stage ADS control valves. The second set of fourth-stage ADS valves (both of the Stage 4B valves) is then assumed to open 60 seconds after the actuation of the first fourth-stage ADS valve.

As described in UFSAR Subsection 15.6.5.4C.1 the purpose of the long-term cooling analysis is to demonstrate that the passive systems provide adequate emergency core cooling system performance during the IRWST injection/containment recirculation time scale. The long-term cooling analysis is performed using the WCOBRA/TRAC computer code to verify that the passive injection system is providing sufficient flow to the reactor vessel to cool the core and to preclude boron precipitation.

3.1 IRWST Injection and Containment Recirculation Check Valves

The injection lines from the IRWST and the containment sump are each essential flow paths needed for long-term core cooling. The valves affected by this LAR are the containment recirculation (PXS-PL-V119A/B) and IRWST injection (PXS-PL-V122A/B and PXS-PL-V124A/B) check valves. These swing check valves isolate the containment sump and IRWST, respectively, and open due to a differential pressure across the valve disk. The driving head of the sump or IRWST provide injection when the RCS is at lower pressures following the actuation of fourth-stage ADS. If sufficient differential pressure is provided by flow from the IRWST or containment sump, the disc of the swing check valves will fully open. However, the flows in which each of these valves will operate are lower than the prescribed fully open flow rates in their functional requirements documents when flow decreases as injection continues. The check valves in the IRWST lines are fully opened by flow at the start of injection. The containment recirculation valves will be partially open during events in which containment recirculation is initiated. Each functional requirement document requires an equivalent length factor of 50L/D as the maximum loss factor for the full open check valve. At lower flows, the disc sags to a partially open position, increasing the resistance of the valve, resulting in a higher loss factor. Data provided by the valve supplier correlates a loss factor based on the flow rate in the line. This data was incorporated into the valve data sheets as performance requirements and was used in the PXS line resistance calculation and safety analyses.

The ITAAC associated with the IRWST injection and containment recirculation check valves and line resistances are used to show that the assumptions of the safety analyses bound the as-built plant. The current ITAAC states that the test will be performed and that sufficient flow will be provided to fully open the check valves. The acceptance criteria of the test is a range of line resistances listed in the ITAAC that are not bounding due to the discovery of this issue.

Performance test data for the IRWST injection check valves exceeds the performance curves in the valves' functional requirements document. The current calculated resistances for the IRWST injection lines are conservative and bounding.

Computational Fluid Dynamics (CFD) analysis was performed to determine if the resistance characteristics (e.g. C_v) of the containment recirculation check valves meet the performance requirements in the valve data sheets. The lower bound of the data falls outside the acceptable range of the performance curve provided in the valves' functional requirements document. Due to constraints with testing these valves (fabricating a test valve, cost/schedule associated with obtaining the test facility, performing the test, etc.), the performance requirements, line resistance calculation, and safety analyses were updated to bound the lower uncertainty curve of the valves' C_v determined in the CFD analysis.

The new maximum resistance for each IRWST injection line was selected by iteration using the expected flow from the IRWST with the Technical Specification minimum water level of 28.3 ft. This water level was selected as it is the current level used in the preoperational test procedure for this resistance test. Results show that the new ITAAC maximum resistance for Train A is lower than the current ITAAC acceptance criteria. This drop in resistance is due to revised tee methodology used in the calculation. Since the safety analysis uses the variable resistance curve (based on the check valves), lowering the ITAAC maximum line resistance value aligns the ITAAC flow resistance acceptance criteria with the variable resistance curve.

The proposed minimum resistances for the IRWST injection lines were calculated using the full-open resistances for the check valves. The full-open check valve resistances provide a conservative minimum resistance for the line as a whole. The proposed resistance values for both IRWST Injection lines are shown in Table 2-1.

For the containment recirculation lines, a similar process was performed using the minimum containment recirculation flood-up level (107'-10"), which was selected to align with the flood-up level used in the safety analysis. The proposed minimum resistances for the containment recirculation lines were also calculated using the full-open resistances for the check valves. The proposed resistance values for the containment recirculation lines are shown in Table 2-1.

The last paragraph of UFSAR Subsection 6.3.2.2.8.6 is removed because the application of these particular valves is different than current operating plants as the valves will not be fully open due to the low flows associated with a passive system, and will cycle open and closed based on the injection flows predicted by the safety analysis. Fatigue testing performed on these valves (PXS-PL-V122A/B and PXS-PL-V124A/B) shows insignificant wear after 165,000 cycles.

3.2 IRWST Drain and Fourth-Stage ADS lines

The changed methodology for calculating the piping tee loss factor resulted in an increase in the calculated maximum line resistance values for the fourth-stage ADS valves and associated piping, and IRWST drain lines. This methodology accounts for the specific geometry and flow split of each tee. Because the resistance values increased (more resistance equals less flow), the values listed in the ITAAC for the fourth-stage ADS and IRWST drain lines are no longer conservative. The proposed resistance values for IRWST drain lines are shown in Table 2-1 and fourth-stage ADS lines are shown in Table 2-2.

3.3 Impact on LOCA Safety Analyses

The changes to the ADS Stages 1 – 4 and IRWST injection line resistances have been considered in the small-break LOCA safety analysis. The ADS Stages 1 – 4 lines are important because they provide a means to depressurize the RCS enough for sufficient passive core cooling system injection to occur. The IRWST injection lines are important because they provide the long-term safety injection flow to the RCS after the RCS has depressurized. A sensitivity analysis was performed on the most recent limiting small-break LOCA safety analysis case to conservatively estimate the effect of the proposed changes. The changes to the ADS Stages 1 – 3 and IRWST injection lines have a relatively minor influence on the overall transient results while the increase in the line resistance of the fourth-stage ADS paths has a relatively large impact on the analysis results because a critical period in the small-break LOCA transient is the transition from CMT injection to IRWST injection, which relies substantially on the depressurization provided by the fourth-stage ADS flow paths. Overall, prior to fourth-stage ADS actuation, small shifts in timing occur but the reduced venting capability of the fourth-stage ADS system results in delayed IRWST injection and a longer and deeper core uncover. The current analysis of record for the SBLOCA event documented in UFSAR Subsection 15.6.5.4B.4 results in a peak clad temperature (PCT) of 663.5°F. An additional PCT penalty of 32°F due to the NOTRUMP Bubble Rise/Drift Flux Model Inconsistencies was reported in Westinghouse's 2016 Annual 10 CFR 50.46 Report (Reference 1) (DCP_NRC_003287). And, a reduction in the second and third stage ADS control valves and fourth-stage ADS squib valve minimum effective flow areas results in a 13°F increase in PCT documented in Southern Nuclear Operating Company, Inc. LAR-16-012 (Reference 2) (ND-16-0984).

With the addition of the 144°F PCT penalty due to the proposed line resistance changes, the current licensing basis PCT will be 852.5°F, which continues to demonstrate significant margin to the 2200°F PCT 10 CFR 50.46 acceptance criterion.

The impact of the increased IRWST, sump recirculation, and fourth-stage ADS line resistances was qualitatively evaluated for the large break LOCA (LBLOCA) analyses as having no impact on analysis results, and updated WCOBRA/TRAC calculations show that all acceptance criteria continue to be met with respect to long-term core cooling (LTCC). While the fourth-stage ADS valves are included in the LBLOCA model, the transient is terminated before the CMT low-6 level setpoint; therefore, the opening of fourth-stage ADS and subsequent IRWST injection is not modeled. With respect to LTCC, the increase in IRWST, sump recirculation, and fourth-stage ADS line resistances could result in a reduction in injection flow from the sump and reduced venting capacity from fourth-stage ADS, respectively. Updated WCOBRA/TRAC LTCC calculations confirm reduced fourth-stage ADS venting and injection flow; however, acceptance criteria continue to be met as continuous post-LOCA decay heat removal is observed and no fuel rod heatup is predicted. It is therefore concluded that the changes in IRWST and fourth-stage ADS line resistances remain acceptable with respect to the LBLOCA and LTCC safety analyses.

As described in UFSAR Subsection 6.3.2.1.3, containment recirculation initiates when the recirculation line valves are open and the containment floodup level is sufficiently high. When the IRWST level decreases to a low level, the containment recirculation squib valves automatically open to provide redundant flow paths from the containment to the reactor.

These recirculation flow paths can also provide a suction flow path from the containment to the normal residual heat removal pumps, when they are operating after containment flood-up. In addition, the squib valves in the recirculation paths containing normally open motor-operated valves can be manually opened to intentionally drain the IRWST to the reactor cavity during severe accidents.

The LTCC analysis described in UFSAR Subsection 15.6.5.4C have been evaluated and still show sizeable margin with respect to acceptance criteria.

3.4 Impact on Containment Safety Analysis

The fourth-stage ADS line resistance increase does not impact the LBLOCA containment integrity (peak pressure) calculations due to the use of the standard methodology with a conservative boil-off without regard to the more realistic fourth-stage ADS line resistance. There is no impact to the LBLOCA containment integrity analysis due to fourth-stage ADS actuation not occurring prior to termination of the limiting case. Therefore, these increases in the line flow resistance for the IRWST injection and drain lines, the containment recirculation lines, and the fourth-stage ADS valves and associated piping does not adversely affect the containment safety analysis results.

3.5 Impact on Non-LOCA Safety Analyses

The safety analyses for non-LOCA transients and events are not adversely affected by these proposed changes. In the safety analysis of the inadvertent operation of the ADS described in UFSAR Subsection 15.6.1, multiple failures and or errors are assumed which actuate both first-stage ADS paths. This results in the most severe RCS depressurization due to ADS operation with the reactor at power. Actuation of the fourth-stage ADS valves does not occur because the CMTs reach a minimum level above the fourth-stage ADS actuation set point. The results of the transient analysis provide input to the corresponding containment safety analysis for this event, including first, second and third stage ADS mass flow rate and enthalpy to the IRWST which are not adversely impacted by these changes, and PRHR heat exchanger heat transfer to the IRWST, which is also not adversely affected by these changes. Therefore, these reductions in the flow resistance for fourth-stage ADS valves and associated lines, do not adversely affect the non-LOCA safety analyses results.

3.6 Impact on Loss of Normal Residual Heat Removal System (RNS) During Normal Shutdown Safety Analysis

During shutdown modes, initiating events such as the loss of the nonsafety-related normal residual heat removal system (RNS) are postulated. UFSAR Subsection 19E.4.8.2 discusses the safety analysis for a loss of RNS in Mode 4 with the RCS intact. The Mode 4 plant conditions assumed for the analysis are more limiting than Mode 5 conditions and the assumed equipment availability is representative of the more restrictive Mode 5 equipment, and as a result this analysis is also applicable for a loss of RNS cooling in Mode 5 when the RCS is intact. During the transient, the first, second, third and fourth stage ADS valves are assumed to open at the applicable core makeup tank (CMT) levels (with applicable time delays). The fourth-stage ADS valve actuation is required to achieve stable IRWST injection. The IRWST injection provides the necessary flow to maintain sufficient two phase mixture level to continue cooling the core.

UFSAR Subsection 19E.4.8.3 discusses an additional analysis for a loss of RNS in Mode 5 with the RCS open. The analysis is performed with only the equipment required in the Technical Specifications to be operable. For this analysis the first, second and third stage ADS valves are open at the beginning of the transient. The ADS stage 4 actuation again allows for stable IRWST injection, which prevents core heat-up.

The changes to the ADS stages 1 through 4 and IRWST injection piping resistances have been considered in the loss-of-RNS safety analysis. The ADS and IRWST both form important parts of the mitigation strategy for loss-of-RNS events in Modes 4 and 5. The changes in ADS stage 4 line resistances have the largest impact on the Mode 4 RCS intact cases but updated simulations show that acceptance criteria continue to be met, the core continues to be cooled by two phase mixture. The changes to piping resistances have a smaller impact on the Mode 5 RCS open case due to the single ADS stage 4 flow path modeled in that case and the updated simulation considering the changes shows that the two phase mixture level is maintained in the upper plenum and no core heat-up occurs.

3.7 Impact on Severe Accidents

AP1000 employs an in-vessel retention (IVR) of molten core debris severe accident management strategy. The RCS is depressurized and the reactor cavity is flooded with IRWST water to submerge the reactor vessel. Should PXS fail to fill the reactor vessel cavity automatically and RNS fail to inject water into the reactor cavity, Operators are instructed by emergency operating procedure to manually flood the reactor cavity by opening PXS-PL-V118A and PXS-PL-V118B, draining the IRWST water through the PXS sump screens into the cavity.

The failure of cavity flooding is dominated by the failure of the operator action and common cause software failures in the instrumentation and control (I&C) system, not by independent hardware failures. Therefore, the as-tested line resistances provide adequate flooding capability for IVR and reducing the line resistance to reduce the flooding time will neither improve nor reduce the success of IVR in the PRA quantification.

3.8 Fourth-Stage ADS Test Methodology

On-site preparation for the performance of the localized fourth-stage ADS line flow resistance test revealed that the test methodology presented several challenges to successful completion. As currently written, this test is performed by replacing the fourth-stage ADS valves (RCS-PL-V004 A/B/C/D) with flow venturis instrumented with differential pressure detectors. After establishing the normal residual heat removal system (RNS) pumps' flow at 3000 gpm, the fourth-stage ADS isolation valves (RCS-PL-V014A/B/C/D) are opened until a steady differential pressure is established. Both PXS accumulators, which are filled to 50% and pressurized with 350 psig of nitrogen, are injected into the system by opening the accumulator isolation valves (PXS-PL-V027A/B). When the contents of the accumulator have been emptied, then the fourth-stage ADS isolation valves are closed and data taking ceases. The capacity of the RNS pumps is too low to obtain a readable pressure drop and maintain the line resistance of each ADS loop (with both valves open). The fourth-stage ADS line flow resistance test was changed from requiring testing of all flow path combinations with all valves open, to testing each valve flow path individually. RNS pumps continue to be used to provide flow for the test.

The fourth-stage ADS line flow resistance test is critical to demonstrate sufficient venting capability through the fourth-stage ADS lines driving natural circulation flow after fourth-stage ADS valve opening. The test will be changed to:

- Each of the four fourth-stage ADS flow paths are tested separately with RNS pumps providing flow.
    - Loop 1, valves RCS-PL-V004A and RCS-PL-V004C
    - Loop 2, valves RCS-PL-V004B and RCS-PL-V004D

Fourth-stage ADS Loops 1 and 2 will be tested as four sub-loops. (Loop 1, sub-loops A and C; Loop 2 sub-loops B and D). UFSAR Subsection 14.2.9.1.3 item q) acceptance criteria will be changed from a loop based total resistance to an individual branch/valve test configuration. The new acceptance criteria is based on combining the calculated line resistance from a common line with either the calculated line resistance from valves RCS-PL-V004A/C, or with the calculated resistance from valves RCS-PL-V004B/D, assuming single failure (flow through the applicable branch/valve). Separating the total resistance from loop-based to an individual branch/valve test configuration requires changing COL Appendix C (and plant specific Tier 1) Table 2.1.2-4 to reflect the change in the calculated line resistances.

The test methodology revision does not impact the safety analysis. The new test method verifies individual flow path configurations that would occur in the event of an assumed single failure (one valve did not open). Design documents calculated acceptable line resistances for both parallel path and for single failure conditions, which are inputs to the safety analyses. The individual flow path test (single failure) provides a more comprehensive test in that any fabrication/construction deviations from the assumed design configuration for each flow path (that would affect the measured line resistances of each flow path) are identified. Testing each path separately allows proper measurement of the pressure drop as well as providing insight into the resistance of each flow path.

It is acceptable to test each fourth-stage ADS valve separately for the following reasons:

- The RNS pumps do not provide adequate flow to test with two valves open per loop. In this configuration, the test is unable to obtain meaningful and measurable pressure drops across the lines.
- The single valve test method is in keeping with accident assumptions of single failure where one valve in the loop fails to open. The method verifies the assumptions used for a single valve failure by more accurately determining the flow resistance through each valve instead of two valves in parallel. This is the limiting single failure for the AP1000 and, as such, testing each individual valve would confirm the resistances used in safety analyses for the single failure case.
- The information obtained from testing each valve separately will confirm that the calculation method is accurate.
- The single flow path configuration provides a more comprehensive test that enhances the ability to detect piping configuration deviations from the assumed design.
- The single flow path configuration provides an order of magnitude greater pressure drop that can be easily measured by the test instrumentation to get accurate data to compare against the applicable analyses.

3.9 Summary

The proposed changes revise UFSAR information, which involve changes to COL Appendix C, Table 2.1.2-4, ITAAC 2.1.02.08d.ii for calculated flow resistance for fourth-stage ADS valves and associated piping; Table 2.2.3-4, ITAAC 2.2.08.08c.i for calculated flow resistance for IRWST injection lines and containment recirculation lines; and Table 2.2.3-4, ITAAC 2.2.03.09a.i for calculated flow resistance for IRWST drain line, with corresponding changes to the associated plant-specific DCD Tier 1 information. The proposed changes also affect UFSAR Table 3.9-17 revising the allowable calculated flow resistance for the IRWST injection lines in Note 5, and clarifying that the check valves are not fully opened and the test is of the injection line and not of just the check valves. The proposed changes also revise UFSAR Subsection 14.2.9.1.3 revising the allowable calculated flow resistance for IRWST injection lines and IRWST drain and containment recirculation lines. The proposed changes to UFSAR Subsection 14.2.9.1.3 also revise the acceptance criteria for flow resistance from that for two fourth-stage ADS loops, (Loop 1 and Loop 2) to acceptance criteria for four fourth-stage ADS sub-loops, and designates the sub-loops. The proposed changes revise the necessary information to verify the IRWST injection and drain lines, the containment recirculation lines, and the fourth-stage ADS lines are constructed in accordance with the design certification as provided in COL Appendix C (and plant-specific DCD Tier 1) ITAAC.

The proposed changes maintain the required design function of the fourth-stage ADS valves of allowing the RCS to depressurize, and allowing IRWST injection, following a design basis accident. Therefore, the previously evaluated and approved RCS and PXS safety-related and nonsafety-related design functions described in the UFSAR, and the results and consequences of the small-break LOCA safety analysis, large-break LOCA and long-term core cooling safety analyses, containment safety analysis, non-LOCA safety analyses, and loss of RNS during shutdown safety analysis described in the UFSAR, are not adversely affected by these proposed changes to COL Appendix C Subsections 2.1.2 and 2.2.3.

The proposed changes do not adversely affect any safety-related equipment or function, design function, radioactive material barrier or safety analysis.

4. REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

10 CFR 52.98(c) requires NRC approval for any modification to, addition to, or deletion from the terms and conditions of a COL. The proposed changes involve a change to COL Appendix C (and plant-specific DCD Tier 1) Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) information. Therefore, NRC approval is required prior to making the plant-specific proposed changes in this license amendment request.

10 CFR 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, or requires a license amendment under paragraphs B.5.b or B.5.c of the section. The proposed changes for the fourth-stage ADS sub-loop valves and associated piping flow resistance; IRWST injection, containment recirculation, and IRWST to containment drain flow resistances, includes changes to UFSAR Table 3.9-17 and Subsections 6.3.2.2.8.6 and 14.2.9.1.3, involve a change to plant-specific Tier 1 (and COL Appendix C) Table 2.1.2-4, ITAAC 2.1.02.08d.ii and Table 2.2.3-4, ITAAC 2.2.03.08c.i and 2.2.03.09a.i. Therefore, NRC approval is required for the Tier 2 and involved Tier 1 departures.

10 CFR 50.46(b) requires:

1. The maximum fuel element cladding temperature not exceed 2200°F;
2. The calculated total oxidation of fuel cladding shall not exceed 0.17 times the total cladding thickness before oxidation;

3. The calculated total amount of hydrogen generated from the reaction of cladding with steam or water not exceed one percent of the amount of hydrogen generated should the entirety of fuel cladding react;
4. The reactor core remain amenable to cooling; and
5. The calculated core temperature be maintained at an acceptably low value for the extended time required by long-lived radioactivity decay heat.

The proposed changes to the flow resistances of the ADS, IRWST, and sump recirculation line resistances result in a 852.5°F peak cladding temperature should a small-break loss of coolant accident occur, which is below the 2200°F maximum peak cladding temperature (PCT) acceptance criterion and below the temperature at which the cladding-water reaction begins to generate hydrogen. The reactor core continues to be cooled by two-phase mixture. Long-term core cooling is maintained and accelerated fuel cladding oxidation does not occur. Therefore, the acceptance criteria of 10 CFR 50.46 for emergency core cooling systems are met.

10 CFR Part 50, Appendix A, General Design Criterion (GDC) 2 requires that structures, systems and components important to safety be designed to withstand the effects of natural phenomena, such as earthquakes. The proposed change for flow resistances of the fourth-stage ADS sub-loop valves and associated piping; IRWST Injection; Containment Recirculation; and IRWST to Containment drain lines includes changes to UFSAR Table 3.9-17 and UFSAR Subsections 6.3.2.2.8.6 and 14.2.9.1.3, which involve a revision to COL Appendix C and plant-specific Tier 1 Table 2.1.2-4 ITAAC 2.1.02.08d.ii (fourth-stage ADS sub-loop valves and piping flow resistance); Table 2.2.3-4 ITAAC 2.2.03.08c.i (IRWST injection and containment recirculation flow resistances); and Table 2.2.3-4 2.2.03.09a.i (IRWST to containment drain line flow resistance) information. The proposed changes do not involve physical modifications or addition of systems, structures, and components, and do not affect the existing seismic design requirements. Therefore, the proposed changes comply with the requirements of GDC 2.

10 CFR Part 50, Appendix A, GDC 4 requires that systems structures and components can withstand the dynamic effects associated with missiles, pipe whipping, and discharging fluids, excluding dynamic effects associated with pipe ruptures, the probability of which is extremely low under conditions consistent with the design basis for the piping. The proposed change for flow resistances of the fourth-stage ADS sub-loop valves and associated piping; IRWST injection; containment recirculation; and IRWST to containment drain lines includes changes to UFSAR Table 3.9-17 and UFSAR Subsections 6.3.2.2.8.6 and 14.2.9.1.3, which involve a revision to COL Appendix C and plant-specific Tier 1 Table 2.1.2-4 ITAAC 2.1.02.08d.ii (fourth-stage ADS sub-loop valves and piping flow resistance); Table 2.2.3-4 ITAAC 2.2.03.08c.i (IRWST injection and containment recirculation flow resistances); and Table 2.2.3-4 2.2.03.09a.i (IRWST to containment drain line flow resistance) information, maintain the physical design capability of the fourth-stage ADS sub-loop valves and associated piping; IRWST Injection; containment recirculation; and IRWST to containment drain lines to withstand dynamic effects associated with missiles, pipe whipping, and discharging fluids as required by this criterion. The proposed changes do not change the requirements for anchoring safety-related components and supports to seismic

Category I structures. Therefore, the proposed changes comply with the requirements of GDC 4.

10 CFR Part 50, Appendix A, GDC 35 requires that a system to provide abundant emergency core cooling be provided. The system safety function shall be to transfer heat from the reactor core following any loss of reactor coolant at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) clad metal-water reaction is limited to negligible amounts. The proposed change for flow resistances of the fourth-stage ADS sub-loop valves and associated piping; IRWST injection; containment recirculation; and IRWST to containment drain lines, involve revisions to:

- UFSAR Table 3.9-17;
- UFSAR Subsections 6.3.2.2.8.6 and 14.2.9.1.3;
- COL Appendix C (and plant-specific Tier 1) Table 2.1.2-4, ITAAC 2.1.02.08d.ii (fourth-stage ADS sub-loop valves and piping flow resistance);
- COL Appendix C (and plant-specific Tier 1) Table 2.2.3-4, ITAAC 2.2.03.08c.i (IRWST injection and containment recirculation flow resistances); and
- COL Appendix C (and plant-specific Tier 1) Table 2.2.3-4, ITAAC 2.2.03.09a.i (IRWST to containment drain line flow resistance).

The proposed changes maintain the physical design capability of the fourth-stage ADS sub-loop valves and piping, IRWST injection, containment recirculation, and IRWST to containment drain to perform the safety-related design functions of the PXS, including providing adequate core cooling to ensure that regulatory requirements are met. The change to flow resistance of PXS and ADS lines is used to verify PXS and ADS provide the necessary flow conditions required for the automatic depressurization design function of allowing the RCS to depressurize, allowing IRWST injection and containment recirculation for emergency and long-term core cooling following a design basis accident. Therefore, the proposed changes comply with the requirements of GDC 35.

10 CFR Part 50, Appendix A, GDC 36 requires that the emergency core cooling system be designed to permit appropriate periodic inspection of important components, such as spray rings in the reactor pressure vessel, water injection nozzles, and piping, to assure the integrity and capability of the system. The proposed changes for flow resistances of the fourth-stage ADS sub-loop valves and associated piping; IRWST injection; containment recirculation; and IRWST to containment drain lines, involve revisions to:

- UFSAR Table 3.9-17;
- UFSAR Subsections 6.3.2.2.8.6 and 14.2.9.1.3;
- COL Appendix C (and plant-specific Tier 1) Table 2.1.2-4, ITAAC 2.1.02.08d.ii (fourth-stage ADS sub-loop valves and piping flow resistance);

- COL Appendix C (and plant-specific Tier 1) Table 2.2.3-4, ITAAC 2.2.03.08c.i (IRWST injection and containment recirculation flow resistances); and

- COL Appendix C (and plant-specific Tier 1) Table 2.2.3-4, ITAAC 2.2.03.09a.i (IRWST to containment drain line flow resistance).

The proposed changes maintain the capability to inspect the affected fourth-stage ADS valves and associated piping, IRWST and associated injection and draindown valves and piping, and containment recirculation valves and piping in compliance with regulatory requirements. Therefore, the proposed changes comply with the requirements of GDC 36.

10 CFR Part 50, Appendix A, GDC 37 requires that the emergency core cooling system be designed to permit appropriate periodic pressure and functional testing to assure (1) the structural and leak tight integrity of its components, (2) the operability and performance of the active components of the system, and (3) the operability of the system as a whole and, under conditions as close to design as practical, the performance of the full operational sequence that brings the system into operation, including operation of applicable portions of the protection system, the transfer between normal and emergency power sources, and the operation of the associated cooling water system. The proposed changes for flow resistances of the fourth-stage ADS sub-loop valves and associated piping; IRWST injection; containment recirculation; and IRWST to containment drain lines involve revisions to:

- UFSAR Table 3.9-17;

- UFSAR Subsections 6.3.2.2.8.6 and 14.2.9.1.3;

- COL Appendix C (and plant-specific Tier 1) Table 2.1.2-4, ITAAC 2.1.02.08d.ii (fourth-stage ADS sub-loop valves and piping flow resistance);

- COL Appendix C and (plant-specific Tier 1) Table 2.2.3-4, ITAAC 2.2.03.08c.i (IRWST injection and containment recirculation flow resistances); and

- COL Appendix C and plant-specific Tier 1 Table 2.2.3-4 ITAAC 2.2.03.09a.i (IRWST to containment drain line flow resistance).

The proposed changes maintain the capability to test the affected fourth-stage ADS valves, IRWST injection and draindown, and containment recirculation in compliance with regulatory requirements. Therefore, the proposed changes comply with the requirements of GDC 37.

4.2 Precedent

No precedent is identified.

4.3 Significant Hazards Consideration Determination

The proposed changes would revise the COLs in regard to acceptance criteria for calculated flow resistances for the fourth-stage ADS sub-loop valves and associated piping; IRWST Injection; Containment Recirculation; and IRWST to Containment drain lines, includes changes to UFSAR Table 3.9-17 and UFSAR Subsections 6.3.2.2.8.6 and 14.2.9.1.3, which involve a revision to COL Appendix C (and plant-specific Tier 1) Table 2.1.2-4, ITAAC 2.1.02.08d.ii (fourth-stage ADS sub-loop valves and piping flow resistance); Table 2.2.3-4, ITAAC 2.2.03.08c.i (IRWST injection and containment recirculation flow resistances); and Table 2.2.3-4, ITAAC 2.2.03.09a.i (IRWST to containment drain line flow resistance).

The proposed changes maintain the required design functions of the fourth-stage ADS valves and the associated piping, the IRWST injection and drain lines, and the containment recirculation lines of depressurizing the reactor coolant system (RCS), allowing IRWST injection, and allowing long-term reactor cooling following a design basis accident. A sensitivity analysis demonstrates that the results and consequences of the small-break loss-of-coolant accident (LOCA) safety analysis, large-break LOCA and long-term core cooling safety analyses, containment safety analyses, non-LOCA safety analyses, and evaluation of loss of normal residual heat removal system (RNS) during shutdown safety analysis described in the UFSAR are not adversely affected by these proposed changes. Therefore, the previously evaluated and approved RCS passive core cooling system (PXS) safety-related and nonsafety-related design functions described in the UFSAR, and the results and consequences of the small-break LOCA transient analyses, non-LOCA transient and event analyses, and containment analyses described in the UFSAR are not adversely affected by the proposed changes to COL Appendix C (and plant-specific Tier 1) Subsections 2.1.2 and 2.2.3. The requested amendment proposes changes to UFSAR information, which involve change(s) to the plant-specific Tier 1, and corresponding changes to COL Appendix C, information.

An evaluation to determine whether or not a significant hazards consideration is involved with the proposed amendment was completed by focusing on the three standards set forth in 10 CFR 50.92, “Issuance of amendment,” as discussed below:

4.3.1 Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No

The proposed changes do not adversely affect the operation of any systems or equipment that initiate an analyzed accident or alter any structures, systems, and components (SSCs) accident initiator or initiating sequence of events. The proposed changes do not adversely affect the physical design and operation of the in-containment refueling water storage tank (IRWST) injection, drain, containment recirculation, or fourth-stage automatic depressurization system (ADS) valves, including as-installed inspections and maintenance requirements as described in the Updated Final Safety Analysis Report (UFSAR). Inadvertent operation or failure of the fourth-stage ADS valves are considered as an accident initiator or part of an initiating sequence of events for an accident previously evaluated. However, the proposed change to the test methodology and calculated flow resistance for the fourth-stage ADS lines does not adversely affect the probability of inadvertent operation or failure. Therefore, the probabilities of the accidents previously evaluated in the UFSAR are not affected.

The proposed changes do not adversely affect the ability of IRWST injection, drain, containment recirculation, and fourth-stage ADS valves to perform their design functions. The designs of the IRWST injection, drain, containment recirculation, and fourth-stage ADS valves continue to meet the same regulatory acceptance criteria, codes, and standards as required by the UFSAR. In addition, the proposed changes maintain the capabilities of the IRWST injection, drain, containment recirculation, and fourth-stage ADS valves to mitigate the consequences of an accident and to meet the applicable regulatory acceptance criteria. The proposed changes do not adversely affect the prevention and mitigation of other abnormal events, e.g., anticipated operational occurrences, earthquakes, floods and turbine missiles, or their safety or design analyses. Therefore, the consequences of the accidents evaluated in the UFSAR are not affected.

Therefore, the proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

4.3.2 Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No

The proposed changes do not affect the operation of any systems or equipment that might initiate a new or different kind of accident, or alter any SSC such that a new accident initiator or initiating sequence of events is created. The proposed changes do not adversely affect the physical design and operation of the IRWST injection, drain, containment recirculation, and fourth-stage ADS valves, including as-installed inspections, and maintenance requirements, as described in the UFSAR. Therefore, the operation of the IRWST injection, drain, containment recirculation, and fourth-stage ADS valves is not adversely affected. These proposed changes do not adversely affect any other SSC design functions or methods of operation in a manner that results in a new failure mode, malfunction, or sequence of events that affect safety-related or nonsafety-related equipment. Therefore, this activity does not allow for a new fission product release path, result in a new fission product barrier failure mode, or create a new sequence of events that result in significant fuel cladding failures.

Therefore, the proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

4.3.3 Does the proposed amendment involve a significant reduction in a margin of safety?

Response: No

The proposed changes maintain existing safety margins. The proposed changes verify and maintain the capabilities of the IRWST injection, drain, containment recirculation, and fourth-stage ADS valves to perform their design functions. The proposed changes maintain existing safety margin through continued application of the existing requirements of the UFSAR, while updating the acceptance criteria for verifying the design features necessary to ensure the IRWST injection, drain, containment recirculation, and fourth-stage ADS valves perform the design functions required to meet the existing safety margins in the safety analyses. Therefore, the proposed changes satisfy the same design functions in accordance with the same codes and standards as stated in the UFSAR. These changes do not adversely affect any design code, function, design analysis, safety analysis input or result, or design/safety margin.

No safety analysis or design basis acceptance limit/criterion is challenged or exceeded by the proposed changes, and no margin of safety is reduced.

Therefore, the requested amendment does not involve a significant reduction in a margin of safety.

Based on the above, it is concluded that the proposed amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of “no significant hazards consideration” is justified.

4.4 Conclusions

Based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission’s regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public. Therefore, it is concluded that the requested amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of “no significant hazards consideration” is justified.

5. ENVIRONMENTAL CONSIDERATIONS

The details of the proposed changes are provided in Sections 2 and 3 of this license amendment request.

The proposed changes would revise the Combined Licenses (COLs) in regard to the calculated flow resistance of the In-containment Refueling Water Storage Tank (IRWST) injection and drain lines, the containment recirculation lines, and the fourth-stage automatic depressurization system (ADS) valves and associated piping.

The proposed changes require changes to Updated Final Safety Analysis Report (UFSAR) information, which involve a change to the plant-specific Tier 1 and corresponding changes to COL Appendix C.

This review has determined the proposed change requires an amendment to the COL. However, facility construction and operation following implementation of the requested amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or a significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the requested amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9), in that:

(i) There is no significant hazards consideration.

As documented in Section 4.3, Significant Hazards Consideration Determination, of this license amendment request, an evaluation was completed to determine whether or not a significant hazards consideration is involved by focusing on the three standards set forth in 10 CFR 50.92, “Issuance of amendment.” The Significant Hazards Consideration determined that (1) the requested amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated; (2) the requested amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated; and (3) the requested amendment does not involve a significant reduction in a margin of safety. Therefore, it is concluded that the requested amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and accordingly, a finding of “no significant hazards consideration” is justified.

(ii) There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite.

The proposed changes revise the allowable calculated flow resistance for the IRWST injection and drain lines, the containment recirculation lines, and the fourth-stage ADS valves and associated piping. The proposed changes are unrelated to any aspect of plant construction or operation that would introduce any change to effluent types (e.g., effluents containing chemicals or biocides, sanitary system effluents, and other effluents), or affect any plant radiological or non-radiological effluent release quantities. Furthermore, the proposed changes do not affect any effluent release path or diminish the functionality of any design or operational features that are credited with controlling the release of effluents during plant operation. Therefore, it is concluded that the requested amendment does not involve a significant change in the types or a significant increase in the amounts of any effluents that may be released offsite.

(iii) There is no significant increase in individual or cumulative occupational radiation exposure.

The proposed changes revise the allowable calculated flow resistance for the IRWST injection and drain lines, the containment recirculation lines, and the fourth-stage ADS valves and associated piping. The proposed changes do not adversely affect walls, floors, or other structures that provide shielding. Plant radiation zones (addressed in UFSAR Section 12.3) are not affected, and controls under 10 CFR 20 preclude a significant increase in occupational radiation exposure. Therefore, the requested amendment does not involve a significant increase in individual or cumulative occupational radiation exposure.

Based on the above review of the requested amendment, it has been determined that anticipated construction and operational effects of the requested amendment do not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the requested amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), an environmental impact statement or environmental assessment of the proposed amendment is not required.

6. REFERENCES

1. Westinghouse Electric Company, 10 CFR 50.46 Annual Report for the AP1000 Standard Plant Design. DCP_NRC_003287. March 15, 2016. [ADAMS Accession Number ML16077A009]

2. Southern Nuclear Operating Company, Inc. (ND-16-0984) Vogtle Electric Generating Plants Units 3 and 4 Request for License Amendment and Exemption: Automatic Depressurization System (ADS) Stage 2, 3 & 4 Valve Flow Area Changes and Clarifications (LAR-16-012), July 25, 2016. [ADAMS Accession Number ML16207A340]

Southern Nuclear Operating Company

ND-17-0443

Enclosure 2

Vogtle Electric Generating Plant (VEGP) Units 3 and 4

Exemption Request:

PXS/ADS Line Resistance Changes

(LAR-17-009)

(Enclosure 2 consists of 12 pages, including this cover page.)

1.0 PURPOSE

Southern Nuclear Operating Company (the Licensee) requests a permanent exemption from the provisions of 10 CFR 52, Appendix D, Section III.B, Design Certification Rule for the AP1000 Design, Scope and Contents, to allow a departure from elements of the certification information in Tier 1 of the generic AP1000 Design Control Document (DCD). The regulation, 10 CFR 52, Appendix D, Section III.B, requires an applicant or licensee referencing Appendix D to 10 CFR Part 52 to incorporate by reference and comply with the requirements of Appendix D, including certified information in DCD Tier 1. Tier 1 includes Inspections, Tests, Analyses and Acceptance Criteria (ITAAC) that must be satisfactorily performed prior to fuel load. The design details to be verified by these ITAAC are specified in the tables that are referenced in each individual ITAAC. Enclosure 1, Section 2 of this submittal contains the detailed description of the changes proposed by this exemption request.

This request for exemption will apply the requirements of 10 CFR 52, Appendix D, Section VIII.A.4 to allow the following changes to Tier 1 information:

Plant-specific Tier 1 ITAAC Changes

Text, Table, or Figure	Description of the Proposed Change
Tier 1 Table 2.1.2-4	Revise Item 8.d) ii) by identifying that the inspections and analyses are conducted on sub-loops and replacing the current maximum flow resistance for fourth-stage automatic depressurization system (ADS) Loops 1 and 2 with the proposed maximum flow resistance sub-loop values provided in Table 1-2.
Tier 1 Table 2.2.3-4	Revise Item 8.c) i) by replacing the calculated flow resistance range for in-containment refueling water storage tank (IRWST) Injection Lines A and B with the corresponding IRWST injection line flow resistance range values provided in Table 1-1, and indicating that the check valves are not required to open fully during this low-pressure injection test.
Tier 1 Table 2.2.3-4	Revise Item 8.c) i) by replacing the maximum calculated flow resistance values for Containment Recirculation Lines A and B with the corresponding containment recirculation line flow resistance values provided in Table 1-1, and indicating that the check valves are not required to open fully during this low-pressure injection test.
Tier 1 Table 2.2.3-4	Revise Item 9.a) i) by replacing the maximum calculated flow resistance value for IRWST drain line with the proposed maximum flow resistance value provided for this line in Table 1-1.

Table 1-1 – Current and Proposed Flow Resistance

Plant-specific Tier 1 ITAAC Table and Item Number	Line	Current ITAAC Max. Flow Resistance (ft/gpm^2)	Proposed ITAAC Max. Flow Resistance (ft/gpm^2)	Current ITAAC Min. Flow Resistance (ft/gpm^2)	Proposed ITAAC Min. Flow Resistance (ft/gpm^2)
Table 2.2.3-4 Item 8.c) i)[1]	IRWST Injection Line A	$\leq 9.20 \times 10^{-6}$	$\leq 9.09 \times 10^{-6}$	$\geq 5.53 \times 10^{-6}$	$\geq 5.35 \times 10^{-6}$
Table 2.2.3-4 Item 8.c) i)[1]	IRWST Injection Line B	$\leq 1.03 \times 10^{-5}$	$\leq 1.05 \times 10^{-5}$	$\geq 6.21 \text{ X } 10^{-6}$	$\geq 6.15 \text{ X } 10^{-6}$
Table 2.2.3-4 Item 8.c) i)[1]	Containment Recirc Line A	$\leq 1.11 \times 10^{-5}$	$\leq 1.33 \times 10^{-5}$	NA	NA
Table 2.2.3-4 Item 8.c) i)[1]	Containment Recirc Line B	$\leq 1.04 \times 10^{-5}$	$\leq 1.21 \times 10^{-5}$	NA	NA
Table 2.2.3-4 Item 9.a) i)	IRWST Drain	$\leq 4.07 \times 10^{-6}$	$\leq 4.44 \times 10^{-6}$	NA	NA

[1]The change also clarifies during the test, sufficient flow will be provided to open check valves, not "fully" open check valves.

Table 1-2 – Current and Proposed Fourth-Stage ADS Flow Resistance

Fourth-stage ADS Sub-Loop Valves and Piping			
Plant-specific Tier 1 ITAAC Table and Item Number	**ADS Loop**	**Current ITAAC Max. Flow Resistance (ft/gpm^2)**	**Proposed ITAAC Max. Flow Resistance (ft/gpm^2)**
Table 2.1.2-4 Item 8.d) ii)[1]	Fourth-stage ADS Loop 1	$\leq 1.70 \times 10^{-7}$	Sub-loop A: $\leq 5.91 \times 10^{-7}$ Sub-loop C: $\leq 6.21 \times 10^{-7}$
Table 2.1.2-4 Item 8.d) ii)[1]	Fourth-stage ADS Loop 2	$\leq 1.57 \times 10^{-7}$	Sub-loop B: $\leq 4.65 \times 10^{-7}$ Sub-loop D: $\leq 6.20 \times 10^{-7}$

[1]The proposed change also aligns the Inspections, Tests, and Analyses column with sub-loop acceptance criteria.

This request applies the requirements for granting exemptions from design certification information, as specified in 10 CFR Part 52, Appendix D, Section VIII.A.4, 10 CFR 52.63, §52.7, and §50.12.

2.0 BACKGROUND

The Licensee is the holder of Combined License Nos. NPF-91 and NPF-92, which authorize construction and operation of two Westinghouse Electric Company AP1000 nuclear plants, named Vogtle Electric Generating Plant (VEGP) Units 3 and 4, respectively.

The proposed changes affect the Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for the fourth-stage ADS valves and associated piping; the IRWST injection and drain lines; and containment recirculation lines. The proposed change for flow resistances of the fourth-stage ADS sub-loop valves and associated piping; IRWST injection lines; containment recirculation lines; and IRWST to containment drain lines involve revisions to plant-specific DCD Tier 1 Table 2.1.2-4, Item 8.d) ii) (fourth-stage ADS sub-loop valves and piping flow resistance); Tier 1 Table 2.2.3-4, Item Item 8.c) i) (IRWST injection and containment recirculation flow resistances); and Tier 1 Table 2.2.3-4, Item 9.a) i) (IRWST to containment drain line flow resistance) information. The acceptance criteria for these ITAAC items are proposed to be changed to use revised calculated flow resistance values due to the changes in the methods for calculating the flow resistances and the check valves in the IRWST injection lines and containment recirculation lines not fully opening.

These activities require an exemption from generic DCD Tier 1 information. This enclosure requests an exemption from elements of the AP1000 Tier 1 certified design information to allow a departure from the tables providing information supporting the associated ITAAC concerning passive core cooling system (PXS) and ADS line resistances. No SSC or function is changed within this activity.

3.0 TECHNICAL JUSTIFICATION OF ACCEPTABILITY

During controlled depressurization via the ADS, the accumulators and core makeup tanks (CMTs) maintain reactor coolant system (RCS) inventory. Once the RCS depressurizes, injection from the IRWST maintains long-term core cooling. For continued injection from the IRWST, the RCS must remain depressurized. Design maximum resistance values for the IRWST delivery lines are used to model this condition conservatively.

As described in UFSAR Subsection 15.6.5.4B.3.1, the small-break loss-of-coolant accident (LOCA) safety design approach is to provide for a controlled depressurization of the primary system if the break cannot be terminated, or if the nonsafety-related charging system is postulated to be lost or cannot maintain acceptable plant conditions. The CMT level activates primary system depressurization. The CMT provides makeup to help compensate for the postulated break in the RCS. As the CMT level drops, the first through fourth stages of the ADS valves are ramped open in sequence. The ADS valve descriptions are presented in UFSAR Table 15.6.5-10. The RCS depressurizes due to the break and opening of the ADS valves, while subcooled water from the CMTs and accumulators enters the reactor vessel downcomer to maintain system inventory and keep the core covered. Design basis maximum values of PXS resistances are applied to obtain a conservative prediction of system behavior during the small-break LOCA events.

As described in UFSAR Subsection 15.6.5.4C.1 the purpose of the long-term cooling analysis is to demonstrate that the passive systems provide adequate emergency core cooling system performance during the IRWST injection/containment recirculation time scale. The long-term cooling analysis is performed using the WCOBRA/TRAC computer code to verify that the passive injection system is providing sufficient flow to the reactor vessel to cool the core and to preclude boron precipitation.

3.1 IRWST Injection and Containment Recirculation Check Valves

The injection lines from the IRWST and the containment sump are each essential flow paths needed for long-term core cooling. The containment recirculation (PXS-PL-V119A/B) and IRWST injection (PXS-PL-V122A/B and PXS-PL-V124A/B) check valves isolate the containment sump and IRWST, respectively, and open due to a differential pressure across the valve disk. The check valves in the IRWST lines are fully opened by flow at the start of injection. The containment recirculation valves will be partially open during events in which containment recirculation is initiated. At lower flows, the disc sags to a partially open position, increasing the resistance of the valve, resulting in a higher loss factor. The current ITAAC states that the test will be performed and that sufficient flow will be provided to fully open the check valves. The acceptance criteria of the test is a range of line resistances listed in the ITAAC which are not bounding due to the discovery of the disc sag issue.

Results show that the new ITAAC maximum resistance for Train A is lower than the current ITAAC acceptance criteria. This drop in resistance is due to revised tee methodology that is used in the calculation. Since the safety analysis uses the variable resistance curve (based on the check valves), lowering the ITAAC maximum line resistance value aligns the ITAAC flow resistance acceptance criteria with the variable resistance curve.

The proposed minimum resistances for the IRWST injection lines were calculated using the full-open resistances for the check valves. The full-open check valve resistances provide a conservative minimum resistance for the line as a whole. The proposed resistance values for both IRWST Injection lines are shown in Table 1-1.

For the containment recirculation lines, a similar process was performed using the minimum containment recirculation flood-up level (107'-10"), which was selected to align with the flood-up level used in the safety analysis. The proposed minimum resistances for the containment recirculation lines were also calculated using the full-open resistances for the check valves. The proposed resistance values for the containment recirculation lines are shown in Table 1-1.

3.2 IRWST Drain and Fourth-Stage ADS lines

The changed methodology for calculating the piping tee loss factor resulted in an increase in the calculated maximum line resistance values for the fourth-stage ADS valves and associated piping, and IRWST drain lines. This methodology accounts for the specific geometry and flow split of each tee. Because the resistance values increased (more resistance equals less flow), the values listed in the ITAAC for the fourth-stage ADS and IRWST drain lines are no longer conservative. The proposed resistance values for IRWST drain lines are shown in Table 1-1 and fourth-stage ADS lines are shown in Table 1-2.

3.3 Fourth-Stage ADS Test Methodology

On-site preparation for the performance of the localized fourth-stage ADS line flow resistance test revealed that the test methodology presented several challenges to successful completion. As currently written, this test is performed by replacing the fourth-stage ADS valves (RCS-PL-V004 A/B/C/D) with flow venturis instrumented with differential pressure detectors, and using the normal residual heat removal system (RNS) pumps to provide flow through each fourth-stage ADS flow path separately. However, the capacity of the RNS pumps is too low to obtain a readable pressure drop and maintain the line resistance of each ADS loop (with both valves open). The fourth-stage ADS line flow resistance test was changed from requiring testing of all flow path combinations with all valves open, to testing each valve flow path individually. RNS pumps continue to be used to provide flow for the test.

The new test methodology is acceptable as it does not impact the safety analysis and for the following reasons:

- The RNS pumps do not provide adequate flow to test with two valves open per loop. In this configuration, the test is unable to obtain meaningful and measurable pressure drops across the lines.
- The single valve test method is in keeping with accident assumptions of single failure where one valve in the loop fails to open. The method verifies the assumptions used for a single valve failure by more accurately determining the flow resistance through each valve instead of two valves in parallel. This is the limiting single failure for the AP1000 and, as such, testing each individual valve would confirm the resistances used in safety analyses for the single failure case.
- The information obtained from testing each valve separately will confirm that the calculation method is accurate.
- The single flow path configuration provides a more comprehensive test that enhances the ability to detect piping configuration deviations from the assumed design.
- The single flow path configuration provides an order of magnitude greater pressure drop that can be easily measured by the test instrumentation to get accurate data to compare against the applicable analyses.

3.4 Summary

The proposed changes revise UFSAR information, which involve changes to COL Appendix C Table 2.1.2-4 Item 8.d) ii) for calculated flow resistance for fourth-stage ADS valves and associated piping; Table 2.2.3-4 Item 8.c) i) for calculated flow resistance for IRWST injection lines and containment recirculation lines; and Table 2.2.3-4 Item 9.a) i) for calculated flow resistance for IRWST drain line, with corresponding changes to the associated plant-specific DCD Tier 1 information. The proposed changes also affect Updated Final Safety Analysis Report (UFSAR) Table 3.9-17 revising the allowable calculated flow resistance for the IRWST injection lines in Note 5, and clarifying that the check valves are not fully opened and the test is of the injection line and not of just the check valves. The proposed changes also revise

UFSAR Subsection 14.2.9.1.3 revising the allowable calculated flow resistance for IRWST injection lines and IRWST drain and containment recirculation lines. The proposed changes to UFSAR Subsection 14.2.9.1.3 also revise the acceptance criteria for flow resistance from that for two fourth-stage ADS loops, (Loop 1 and Loop 2) to acceptance criteria for four fourth-stage ADS sub-loops, and designates the sub-loops. The proposed changes revise the necessary information to verify the IRWST injection and drain lines, the containment recirculation lines, and the fourth-stage ADS lines are constructed in accordance with the design certification as provided in COL Appendix C and plant-specific DCD Tier 1 ITAAC.

The proposed changes maintain the required design function of the fourth-stage ADS valves of allowing the RCS to depressurize, and allowing IRWST injection, following a design basis accident. Therefore, the previously evaluated and approved RCS and PXS safety-related and nonsafety-related design functions described in the UFSAR, and the results and consequences of the small-break LOCA safety analysis, large-break LOCA and long-term core cooling safety analyses, containment safety analysis, non-LOCA safety analyses, and loss of RNS during shutdown safety analysis described in the UFSAR, are not adversely affected by these proposed changes to COL Appendix C Subsection 2.1.2 and 2.2.3.

The proposed changes do not adversely affect any safety-related equipment or function, design function, radioactive material barrier or safety analysis.

Specific details of the technical evaluation supporting this request for exemption are discussed in Section 3 of the associated License Amendment Request provided in Enclosure 1 of this letter.

4.0 JUSTIFICATION OF EXEMPTION

10 CFR Part 52, Appendix D, Section VIII.A.4 and 10 CFR 52.63(b)(1) govern the issuance of exemptions from elements of the certified design information for AP1000 nuclear power plants. Because the Licensee has identified changes to information regarding the PXS low pressure injection and fourth-stage ADS flow resistances in plant-specific Tier 1 ITAAC text in Tables 2.1.2-4 and 2.2.3-4, an exemption from the certified design information in generic AP1000 Tier 1 is needed.

10 CFR Part 52, Appendix D, and 10 CFR 50.12, §52.7, and §52.63 state that the NRC may grant exemptions from the requirements of the regulations provided six conditions are met: 1) the exemption is authorized by law [§50.12(a)(1)]; 2) the exemption will not present an undue risk to the health and safety of the public [§50.12(a)(1)]; 3) the exemption is consistent with the common defense and security [§50.12(a)(1)]; 4) special circumstances are present [§50.12(a)(2)(ii)]; 5) the special circumstances outweigh any decrease in safety that may result from the reduction in standardization caused by the exemption [§52.63(b)(1)]; and 6) the design change will not result in a significant decrease in the level of safety [Part 52, App. D, VIII.A.1].

The requested exemption to change information regarding the fourth-stage ADS valves and associated piping; the in-containment refueling water storage tank (IRWST) injection and drain lines; and containment recirculation lines in Tier 1 ITAAC Tables 2.1.2-4 and 2.2.3-4 satisfies the criteria for granting specific exemptions as described below.

1. **This exemption is authorized by law**

   The NRC has authority under 10 CFR 52.63, §52.7, and §50.12 to grant exemptions from the requirements of NRC regulations. Specifically, 10 CFR 50.12 and §52.7 state that the NRC may grant exemptions from the requirements of 10 CFR Part 52 upon a proper showing. No law exists that would preclude the changes covered by this exemption request. Additionally, granting of the proposed exemption does not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commission's regulations.

   Accordingly, this requested exemption is "authorized by law," as required by 10 CFR 50.12(a)(1).

2. **This exemption will not present an undue risk to the health and safety of the public**

   The proposed exemption from the requirements of 10 CFR 52, Appendix D, Section III.B would allow changes to elements of the plant-specific Tier 1 DCD to depart from the AP1000 certified (Tier 1) design information. The plant-specific DCD Tier 1 will continue to reflect the approved licensing basis for VEGP Units 3 and 4, and will maintain a consistent level of detail with that which is currently provided elsewhere in Tier 1 of the DCD. Therefore, the affected plant-specific DCD Tier 1 ITAAC will continue to serve their required purpose.

   The proposed changes do not introduce any new industrial, chemical, or radiological hazards that would represent a public health or safety risk, nor do they modify or remove any design or operational controls or safeguards intended to mitigate any existing on-site hazards. Furthermore, the proposed changes would not allow for a new fission product release path, result in a new fission product barrier failure mode, or create a new sequence of events that would result in fuel cladding failures. The proposed changes maintain existing safety margins. The proposed changes verify and maintain the capabilities of the IRWST injection, drain, containment recirculation, and fourth-stage ADS valves to perform their design functions. The proposed changes maintain existing safety margin through continued application of the existing requirements of the UFSAR, while updating the acceptance criteria for verifying the design features necessary to ensure the IRWST injection, drain, containment recirculation, and fourth-stage ADS valves perform the design functions required to meet the existing safety margins in the safety analyses. Therefore, the proposed changes satisfy the same design functions in accordance with the same codes and standards as stated in the UFSAR. These changes do not adversely affect any design code, function, design analysis, safety analysis input or result, or design/safety margin. Accordingly, these changes do not present an undue risk from any existing or proposed equipment or systems.

   Therefore, the requested exemption from 10 CFR 52, Appendix D, Section III.B would not present an undue risk to the health and safety of the public.

3. The exemption is consistent with the common defense and security

The exemption from the requirements of 10 CFR 52, Appendix D, Section III.B would revise flow resistance values in plant-specific Tier 1 Table 2.1.2-4, Item 8.d) ii) (fourth-stage ADS sub-loop valves and piping flow resistance); Table 2.2.3-4, Item 8.c) i) (IRWST injection and containment recirculation flow resistances); and Table 2.2.3-4 Item 9.a) i) (IRWST to containment drain line flow resistance). The acceptance criteria for these ITAAC items are proposed to be changed to use revised calculated flow resistance values due to the changes in the methods for calculating the flow resistances and the check valves in the IRWST injection lines and containment recirculation lines not fully opening. The exemption does not adversely impact the design, function, or operation of any plant SSCs associated with the facility's physical or cyber security, and therefore does not adversely affect any plant equipment that is necessary to maintain a safe and secure plant status. The proposed exemption has no adverse impact on plant security or safeguards.

Therefore, the requested exemption is consistent with the common defense and security.

4. Special circumstances are present

10 CFR 50.12(a)(2) lists six "special circumstances" for which an exemption may be granted. Pursuant to the regulation, it is necessary for one of these special circumstances to be present in order for the NRC to consider granting an exemption request. The requested exemption meets the special circumstances of 10 CFR 50.12(a)(2)(ii). That subsection defines special circumstances as when "Application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule."

The rule under consideration in this request for exemption is 10 CFR 52, Appendix D, Section III.B, which requires that a licensee referencing the AP1000 Design Certification Rule (10 CFR Part 52, Appendix D) shall incorporate by reference and comply with the requirements of Appendix D, including Tier 1 information. The VEGP Units 3 and 4 COLs reference the AP1000 Design Certification Rule and incorporate by reference the requirements of 10 CFR Part 52, Appendix D, including Tier 1 information. The underlying purpose of Appendix D, Section III.B is to describe and define the scope and contents of the AP1000 design certification, and to require compliance with the design certification information in Appendix D.

The proposed exemption would allow changes to revise ITAAC in Tier 1 Tables 2.1.2-4 and 2.2.3-4. The proposed changes maintain the intent of the associated ITAAC to verify the line resistances are consistent with the calculated line resistances used for design analyses. The proposed changes do not impact the ability of any SSC to perform its functions or negatively impact safety. Furthermore, the proposed changes to the ITAAC in Tier 1 Tables 2.1.2-4 and 2.2.3-4 are consistent with format and content of other similar information currently provided in these Tier 1 tables. Accordingly, this change to the certified information will enable the licensee to safely verify the construction of the AP1000 facility consistent with the design certified by the NRC in 10 CFR Part 52, Appendix D.

Therefore, special circumstances are present, because application of the current generic certified design information in Tier 1 as required by 10 CFR Part 52, Appendix D, Section III.B, in the particular circumstances discussed in this request is not necessary to achieve the underlying purpose of the rule.

5. **The special circumstances outweigh any decrease in safety that may result from the reduction in standardization caused by the exemption**

   The exemption from the requirements of 10 CFR 52, Appendix D, Section III.B would change elements of the plant-specific Tier 1 by departing from standard AP1000 certified (Tier 1) design information. This exemption would allow changes to ITAAC in Tier 1 Tables 2.1.2-4 and 2.2.3-4. Based on the nature of the proposed departures from generic Tier 1 information and the understanding that these changes were identified during the design finalization process for the AP1000, it is expected that this exemption will be requested by other AP1000 licensees and applicants. However, even if other AP1000 licensees and applicants do not request this same departure, the special circumstances will continue to outweigh any decrease in safety from the reduction in standardization. No SSC design function is affected by the proposed changes and the intent of the ITAAC associated with this request, to verify the as-built line resistances are consistent with the calculated line resistances used for design analyses, will continue to be maintained. Furthermore, the justification provided in the license amendment request and this exemption request and the associated mark-ups demonstrate that there is a limited change from the standard information provided in the generic AP1000 DCD, which is offset by the special circumstances identified above.

   Therefore, the special circumstances associated with the requested exemption outweigh any decrease in safety that may result from the reduction in standardization caused by the exemption.

6. **The design change will not result in a significant decrease in the level of safety.**

   The proposed exemption would allow departure from AP1000 generic Tier 1 DCD information by revising ITAAC in Tier 1 Tables 2.1.2-4 and 2.2.3-4 as described above. The proposed changes do not have an adverse effect on the ability of any safety-related SSCs to perform their design basis functions.

   As a result of the limited scope and nature of the proposed changes associated with this exemption request, no systems or equipment will be adversely impacted such that there are new failure modes introduced by these changes.

   Since no SSC design function will be affected by the proposed changes and the intent of the ITAAC associated with this request will continue to be maintained, it is concluded that the proposed changes associated with the exemption will not result in a significant decrease in the level of safety.

5.0 RISK ASSESSMENT

A risk assessment was not determined to be applicable to address the acceptability of this proposal.

6.0 PRECEDENT EXEMPTIONS

None identified.

7.0 ENVIRONMENTAL CONSIDERATION

The Licensee requests a departure from elements of the certified information in Tier 1 of the generic AP1000 DCD. The Licensee has determined that the proposed departure would require a permanent exemption from the requirements of 10 CFR 52, Appendix D, *Design Certification Rule for the AP1000 Design,* Section III.B, with respect to revising text within Tier 1 regarding the PXS low pressure injection and fourth-stage ADS flow resistances in Tier 1 ITAAC text in Tables 2.1.2-4 and 2.2.3-4; however, the Licensee evaluation of the proposed exemption has determined that the proposed exemption meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9).

Based on the above review of the proposed exemption, the Licensee has determined that the proposed activity does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed exemption meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), an environmental impact statement or environmental assessment of the proposed exemption is not required.

Specific details of the environmental considerations supporting this request for exemption are discussed in Section 5 of the associated License Amendment Request provided in Enclosure 1 of this letter.

8.0 CONCLUSION

The Licensee requests a permanent exemption from elements of AP1000 design certification information reflected in Tier 1. The proposed exemption would allow departures from AP1000 generic Tier 1 information by revising ITAAC in Tier 1 Tables 2.1.2-4 and 2.2.3-4 to provide acceptance criteria that reflect the change in the calculated line resistances. These changes are necessary to provide clarity and consistency within the text, and to minimize ambiguity in Tier 1 material. The exemption request meets the requirements of 10 CFR 52.63, *Finality of design certifications*, 10 CFR 52.7, *Specific exemptions*, 10 CFR 50.12, *Specific exemptions*, and 10 CFR 52 Appendix D, *Design Certification Rule for the AP1000 Design*. Specifically, the exemption request meets the criteria of 10 CFR 50.12(a)(1) in that the request is authorized by law, presents no undue risk to public health and safety, and is consistent with the common defense and security. Furthermore, approval of this request does not result in a significant decrease in the level of safety, presents special circumstances by satisfying the underlying purpose of the AP1000 Design Certification Rule, does not present a significant decrease in safety as a result of a reduction in standardization, and meets the eligibility requirements for categorical exclusion.

9.0 REFERENCES

None.

Southern Nuclear Operating Company

ND-17-0443

Enclosure 3

Vogtle Electric Generating Plant (VEGP) Units 3 and 4

Proposed Changes to the Licensing Basis Documents

(LAR-17-009)

Note:
Added text is shown as bold **Blue Underline**
Deleted text is shown as bold ~~**Red Strikethrough**~~

(Enclosure 3 consists of 5 pages, including this cover page.)

ITAAC for plant-specific Tier 1 Table 2.1.2-4 item 8.d), and COL Appendix C ITAAC No. 2.1.02.08d.ii, revise text as shown below:

Design Commitment	Inspections, Tests, Analyses	Acceptance Critieria
8.d) The RCS provides automatic depressurization during design basis events.	i) A low pressure flow test and associated analysis will be conducted to determine the total piping flow resistance of each ADS valve group connected to the pressurizer (i.e., ADS Stages 1-3) from the pressurizer through the outlet of the downstream ADS control valves. The reactor coolant system will be at cold conditions with the pressurizer full of water. The normal residual heat removal pumps will be used to provide injection flow into the RCS discharging through the ADS valves. Inspections and associated analysis of the piping flow paths from the discharge of the ADS valve groups connected to the pressurizer (i.e., ADS Stages 1-3) to the spargers will be conducted to verify the line routings are consistent with the line routings used for design flow resistance calculations.	i) The calculated ADS piping flow resistance from the pressurizer through the sparger with all valves of each ADS group open is ≤ 2.91E-6 ft/gpm^2.
	ii) Inspections and associated analysis of each fourth-stage ADS ~~valve group~~ sub-loop (four valves and associated piping connected to each hot leg) will be conducted to verify the line routing is consistent with the line routing used for design flow resistance calculations	ii) The calculated flow resistance for each ~~group of~~ fourth-stage ADS sub-loop valves and piping ~~with all valvesopen~~ is: ~~Loop 1: ≤ 1.70x10^{-7} ft/gpm^2~~ ~~Loop 2: ≤ 1.57x10^{-7} ft/gpm^2~~ Loop 1: Sub-loop A: ≤ 5.91 x 10^{-7} ft/gpm^2 Sub-loop C: ≤ 6.21 x 10^{-7} ft/gpm^2 Loop 2: Sub-loop B: ≤ 4.65 x 10^{-7} ft/gpm^2 Sub-loop D: ≤ 6.20 x 10^{-7} ft/gpm^2

ITAAC for plant-specific Tier 1 Table 2.2.3-4 items 8.c) and 9.a), and COL Appendix C ITAAC Nos. 2.2.03.08c.i.03, 2.2.03.08c.i.04, and 2.2.03.09a.i, revise text as shown below:

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8.c) The PXS provides RCS makeup, boration, and safety injection during design basis events.	i) A low-pressure injection test and analysis for each CMT, each accumulator, each IRWST injection line, and each containment recirculation line will be conducted. Each test is initiated by opening isolation valve(s) in the line being tested. Test fixtures may be used to simulate squib valves. IRWST Injection: The IRWST will be partially filled with water. All valves in these lines will be open during the test. Sufficient flow will be provided to ~~fully~~ open the check valves. Containment Recirculation: A temporary water supply will be connected to the recirculation lines. All valves in these lines will be open during the test. Sufficient flow will be provided to ~~fully~~ open the check valves.	i) The injection line flow resistance from each source is as follows: IRWST Injection: The calculated flow resistance for each IRWST injection line between the IRWST and the reactor vessel is: Line A: ≥ ~~5.53~~5.35 x 10^{-6} ft/gpm^2 and ≤ ~~9.20~~9.09 x 10^{-6} ft/gpm^2 Line B: ≥ ~~6.21~~6.15 x 10^{-6} ft/gpm^2 and ≤ ~~1.03~~1.05 x 10^{-5} ft/gpm^2. Containment Recirculation: The calculated flow resistance for each containment recirculation line between the containment and the reactor vessel is: Line A: ≤ ~~1.11~~1.33 x 10^{-5} ft/gpm^2 Line B: ≤ ~~1.04~~1.21 x 10^{-5} ft/gpm^2.
9.a) The PXS provides a function to cool the outside of the reactor vessel during a severe accident.	i) A flow test and analysis for each IRWST drain line to the containment will be conducted. The test is initiated by opening isolation valves in each line. Test fixtures may be used to simulate squib valves.	i) The calculated flow resistance for each IRWST drain line between the IRWST and the containment is ≤ ~~4.07~~4.44 x 10^{-6} ft/gpm^2.

UFSAR Table 3.9-17, System Level Operability Test Requirements, revise Note 5 as shown below:

5. The flow capability of each IRWST injection line is demonstrated by conducting flow tests and inspections. A flow test is conducted to demonstrate the flow capability of the injection line from the IRWST through the IRWST injection check valves. Water flow from the IRWST through the IRWST injection check valve demonstrates the flow capability of this portion of the line. Sufficient flow is provided to ~~fully~~ open the check valves. The test is terminated when the flow measurement is obtained. The allowable calculated flow resistance from the IRWST ~~to each injection line check is:~~through each direct vessel injection flow path to the reactor vessel is: Line A: ≥ ~~5.53~~5.35 x 10^{-6} ft/gpm^2 and ≤ ~~9.20~~9.09 x 10^{-6} ft/gpm^2 and Line B: ≥ ~~6.21~~6.15 x 10^{-6} ft/gpm^2 and ≤ ~~1.03~~1.05 x 10^{-5} ft/gpm^2.
   The flow capability of the portion of the line from the IRWST check valves to the DVI line is demonstrated by conducting an inspection of the inside of the line. The inspection shows that the lines are not obstructed. It is not necessary to operate the IRWST injection squib valves for this inspection.

UFSAR Subsection 6.3.2.2.8.6, Low Differential Pressure Opening Check Valves, delete the sixth paragraph as shown below:

~~In current plants, there are many applications of simple swing-check valves that have similar operating conditions to those in the passive core cooling system. The extensive operational history and experience derived from similar check valves used in the safety injection systems of currentpressurized water reactors indicate that the design is reliable. Check valve failure to open and common mode failures have not been significant problems.~~

UFSAR Subsection 14.2.9.1.3, Passive Core Cooling System Testing, revise paragraphs n), o), and q) as shown below:

n) The proper flow resistance of each of the in-containment refueling water storage tank injection lines is verified by gravity draining water from the tank through the direct vessel injection flow path, while measuring the water level (driving head) and discharge flow rate using temporary instrumentation. A test fixture with prototypical resistance may be used tosimulate the squib valves in the flow paths tested. The acceptance criteria for the resistance of these lines are ≤ ~~9.20~~9.09 x 10^{-6} ft/gpm^2 and ≥ ~~5.53~~5.35 x 10^{-6} ft/gpm^2 for line A and ≤ ~~1.03~~1.05 x 10^{-5} ft/gpm^2 and ≥ ~~6.21~~6.15 x 10^{-6} ft/gpm^2 for line B with all valves open.

o) The flow resistance of each of the flow paths from the in-containment refueling water storage tank to each containment sump, and from each containment sump to the reactor is verified by a series of tests. These tests gravity drain water from the in-containment refueling water storage tank to the containment sump, and from the sump through the direct vessel injection flow path, while measuring the storage tank water level (driving head) and injection flow rate using temporary instrumentation. This testing is performed using temporary piping to prevent flooding of the containment. A test fixture with prototypical resistance may be used to simulate the squib valves in the flow paths tested. The acceptance criteria for the resistance of the lines between each containment sump and the reactor are ≤ ~~1.11~~1.33 x 10^{-5} ft/gpm^2 for line A and ≤ ~~1.03~~1.21 x 10^{-5} ft/gpm^2 for line B with all valves open. The acceptance criterion for the resistance of the lines between the IRWST and each containment sump is ≤ ~~4.07~~4.44 x 10^{-6} ft/gpm^2.

q) The resistance of each automatic depressurization stage 4 flow path ~~and their flow path combinations~~ is verified by pumping cold water from the in-containment refueling water storage tank into the cold, depressurized, water-filled reactor coolant system using the normal residual heat removal pump(s). The resistances are determined by measuring the residual heat removal pump flow rate and the pressure drop across the flow paths tested using temporary instrumentation. A test fixture with prototypical resistance may be used to simulate the squib valves in the flow paths tested. The acceptance criteria for the resistance of these lines ~~are ≤ 1.70 x 10^{-7} ft/gpm^2 for ADS stage 4 on loop 1 and ≤ 1.57 x 10^{-7} ft/gpm^2 for ADS stage 4 on loop 2 with all valves open.~~are:

- Loop 1, sub-loop A: ≤ 5.91 x 10^{-7} ft/gpm^2
- Loop 1, sub-loop C: ≤ 6.21 x 10^{-7} ft/gpm^2
- Loop 2, sub-loop B: ≤ 4.65 x 10^{-7} ft/gpm^2
- Loop 2, sub-loop D: ≤ 6.20 x 10^{-7} ft/gpm^2