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

June 27, 2017

Mr. James J. Hutto
Regulatory Affairs Director
Southern Nuclear Operating Company, Inc.
P.O. Box 1295 / Bin 038
Birmingham, AL 35201-1295

SUBJECT: VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2 – INSERVICE INSPECTION ALTERNATIVE REGARDING CATEGORY B-N-2 AND B-N-3 WELDS (VEGP-ISI-ALT-13) (CAC NOS. MF9136 AND MF9137)

Dear Mr. Hutto:

By letter dated January 26, 2017, as supplemented by letter dated April 20, 2017, Southern Nuclear Operating Company, Inc., (SNC, the licensee) submitted a relief request (VEGP-ISI-ALT-13) for the Vogtle Electric Generating Plant (VEGP), Units 1 and 2. SNC proposed to extend the interval from 10 years to 20 years for the performance of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code, Section XI, required Category B-N-2 and B-N-3 examinations of the reactor pressure vessel (RPV) interior attachments and core support structure.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the licensee proposed to use an alternative on the basis that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the proposed alternative and concludes, as set forth in the enclosed safety evaluation, that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2). Therefore, the NRC staff authorizes the use of alternative request VEGP-ISI-ALT-13, for VEGP, Units 1 and 2, for the third 10-year ISI interval, which ended on May 30, 2017.

All other ASME BPV Code, Section XI, requirements for which relief was not specifically requested and authorized herein by the staff remain applicable, including the third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact the Project Manager, Michael Orenak, at 301-415-3229 or by e-mail at Michael.Orenak@nrc.gov.

Sincerely,

Michael T. Markley, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-424, 50-425

Enclosure:
Safety Evaluation

cc: Listserv

UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PROPOSED ALTERNATIVE VEGP-ISI-ALT-13

REGARDING CATEGORY B-N-2 AND B-N-3 WELDS

SOUTHERN NUCLEAR OPERATING COMPANY, INC.

VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2

DOCKET NUMBERS 50-424 AND 50-425

1.0 INTRODUCTION

By letter dated January 26, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17026A438), as supplemented by letter dated April 20, 2017 (ADAMS Accession No. ML17110A135), Southern Nuclear Operating Company, Inc. (SNC, the licensee) submitted a proposed alternative, VEGP-ISI-ALT-13, for the Vogtle Electric Generating Plant (VEGP), Units 1 and 2. SNC proposed to extend the interval from 10 years to 20 years for the performance of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code, Section XI, required visual (i.e., VT-3) examinations for the Category B-N-2 and B-N-3 components (Category B-N-2 and B-N-3 examinations) that are parts of the reactor pressure vessel (RPV) interior attachments and core support structure.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the licensee proposed to use the alternative on the basis that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

2.0 REGULATORY EVALUATION

In accordance with 10 CFR 50.55a(g)(4), "*Inservice inspection standards requirement for operating plants*," the licensee is required to perform inservice inspection (ISI) of ASME Code Class 1, 2, and 3 components and system pressure tests during the first 10-year interval and subsequent 10-year intervals that comply with the requirements in the latest edition and addenda of Section XI of the ASME BPV Code incorporated by reference in 10 CFR 50.55a(a), subject to the limitations and modifications listed in 10 CFR 50.55a(b).

Pursuant to 10 CFR 50.55a(z), *"Alternatives to codes and standards requirements,"* alternatives to the requirements of paragraphs (b) through (h) of this section [50.55a] or portions thereof may be used when authorized by the Director, Office of Nuclear Reactor Regulation. A proposed alternative must be submitted and authorized prior to implementation. The applicant or licensee must demonstrate that: (1) *"Acceptable Level of Quality and Safety,"* the proposed alternative would provide an acceptable level of quality and safety; or (2) *"Hardship without a Compensating Increase in Quality and Safety,"* compliance with the specified requirements of this section [50.55a] would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that the licensee may propose an alternative to the ASME BPV Code, Section XI, and the NRC staff has the regulatory authority to authorize the licensee's proposed alternative.

3.0 TECHNICAL EVALUATION

3.1 Proposed Alternative VEGP-ISI-ALT-13

3.1.1 Description of Proposed Alternative

In VEGP-ISI-ALT-13, the licensee proposed extending the duration of the third 10-year ISI interval for Categories B-N-2 and B-N-3, Item Numbers B13.60 and B13.70, VT-3 examinations, to May 30, 2027. This extension would allow the VT-3 examinations to be performed, at the latest, in 2027, when the B-A and B-D examinations are scheduled.

3.1.2 Components for Which Alternative is Requested

The affected components are the interior attachments and core support structures of the VEGP RPVs. The following examination categories and item numbers from IWB-2500 and Table IWB-2500-1 of the ASME BPV Code, Section XI, are addressed in this request:

Exam Category	Item Number	Description
B-N-2	B13.60	Interior Attachments Beyond Beltline Region
B-N-3	B13.70	Removable Core Support Structures

VEGP, Unit 1, Components:

Component ID	Description
11201-V6-001-W41	Core Support Lug at 0 degrees
11201-V6-001-W42	Core Support Lug at 60 degrees
11201-V6-001-W43	Core Support Lug at 120 degrees
11201-V6-001-W44	Core Support Lug at 180 degrees
11201-V6-001-W45	Core Support Lug at 240 degrees
11201-V6-001-W46	Core Support Lug at 300 degrees
11201-V6-001-CSS-01	Core Support Structure

VEGP, Unit 2, Components:

Component ID	Description
21201-V6-001-W41	Core Support Lug at 0 degrees
21201-V6-001-W42	Core Support Lug at 60 degrees
21201-V6-001-W43	Core Support Lug at 120 degrees
21201-V6-001-W44	Core Support Lug at 180 degrees
21201-V6-001-W45	Core Support Lug at 240 degrees
21201-V6-001-W46	Core Support Lug at 300 degrees
21201-V6-001-CSS-01	Core Support Structure

3.1.3 Code Edition and Addenda of Record

The code of record for the third 10-year ISI interval at VEGP, Units 1 and 2, for the inspection of ASME BPV Code Class 1, 2, and 3 components is the 2001 Edition through the 2003 Addenda of the ASME BPV Code, Section XI.

3.1.4 Applicable Code Requirements

IWB-2412, Inspection Program B, requires VT-3 examination of the reactor vessel interior attachments and core support structure identified in Table IWB-2500-1, Examination Categories B-N-2 and B-N-3, to be performed once each inspection interval.

IWA-2430(d)(1) allows the inspection interval to be reduced or extended by as much as one year, therefore the existing code allows the inspection interval to be extended to May 30, 2018. For VEGP, Unit 1, the NRC staff granted a five-month deferral of the required examinations on November 23, 2016 (ADAMS Accession No. ML16313A042), such that these examinations are now scheduled to be performed during refueling outage 21 in the fall of 2018.

3.1.5 Reason for Proposed Alternative

The Category B-N-2 and B-N-3 examinations are typically performed at the end of an interval in conjunction with the ultrasonic testing (UT) of the RPV welds. Normally, the only time that the licensee can access the core support structure is when the all fuel and the core barrel are removed from the RPV for the UT of the RPV welds during a refueling outage. SNC received authorization to extend the examination of the reactor vessel Category B-A and B-D welds from 10 years to 20 years on March 20, 2014 (ADAMS Accession No. ML14030A570). As a result, VEGP has no other requirements or activities that require removing the core barrel prior to next Category B-A and B-D weld examinations, except for the Category B-N-2 and B-N-3 examinations.

The licensee stated that performing these Category B-N-2 and B-N-3 examinations and the Category B-A and B-D examinations during the same refueling outage results in significant savings in outage duration, savings in radiation exposure, and the one-time avoidance of a lift of a heavy close-fit component that has some potential for inflicting damage to itself, reactor vessel surfaces, and refueling floor structures/liners, SNC requested to extend the third ISI interval from 10 years to 20 years for the B-N-2 and B-N-3 components.

3.1.6 Proposed Alternative and Basis for Use

SNC proposes to extend the third ISI interval for the Category B-N-2 interior attachment welds beyond the reactor vessel beltline region and the Category B-N-3 reactor vessel core support structure surfaces to coincide with the end of the fourth ISI interval that is scheduled to be on May 30, 2027.

To justify that following the ASME BPV Code requirements would result in hardship or unusual difficulty, the licensee states that the Category B-N-2 and B-N-3 examinations require removal of the core barrel from the RPV to gain access to the RPV interior attachments and the core support structure. To remove and reinstall the core barrel requires implementation of detailed planning and precision lifts to ensure that the core barrel and/or RPV are not damaged. In addition, the core barrel is extremely radioactive.

To justify that following the ASME BPV Code requirements would result in no compensating increase in the level of quality and safety, the licensee provided past plant-specific inspection results for the Category B-N-2 and B-N-3 components for the two previous inspections per unit. The only noted indications were in the second inspection interval of VEGP, Unit 1, Refueling Outage 1R13 in 2006 and were (1) a thin foreign object of approximately 0.375 inch length adhered to the bottom surface (on the right-hand side) of the upper core plate clevis insert at the 90-degree location, and (2) a similar indication on the corresponding area (on the left-hand side) of the same clevis insert. The indications were assessed by the licensee and determined to be not service related and not affect the structural integrity of the reactor internals.

The licensee also provided assessment of the fleet inspection results for the Category B-N-2 and B-N-3 components, stating that WCAP-17435-NP, Revision 1, "Results of the Reactor Internals Operating Experience Survey Conducted under PWROG [pressurized water reactor owners group] Project Authorization PA-MSC-0568," dated March 15, 2013, indicated no inspection indications for the Category B-N-2 and B-N-3 components for the domestic fleet of RPVs.

For lower support clevis cap screw degradation discovered at one domestic Westinghouse plant, the licensee stated that the industry sponsored evaluations and assessments show that the ability of the lower radial support system to perform its intended safety function is unrelated to the integrity of the cap screws used to hold the clevis insert in place.

Regarding potential primary water stress corrosion cracking (PWSCC) for Alloy 600 base material and Alloy 82/182 weld material, the licensee stated:

> The VEGP Unit 1 and Unit 2 reactors contain six core support lugs fabricated from Alloy 600 base material which are attached to the RPV wall with alloy 82/132/182 welds. The inlay pad is Alloy 82 material, the attachment weld is 132/82, and a lug tie-in weld is alloy 182. The finished lugs and attachment welds received post-weld heat treatment with the entire reactor vessel at the fabricator (Combustion Engineering), which relieves the stresses from the welding operation. SNC is unaware of any industry [operating experience (OE)] related to [PWSCC] for similar vessel attachment welds.

The licensee plans to perform the ASME BPV Code, Section XI, required VT-3 examinations on the core support structure and interior reactor vessel attachments prior to the next scheduled Category B-A and B-D weld examinations due to a removal of the core barrel. This statement was provided to supplement the qualitative arguments, solely based on plant-specific and fleet OE, that support the conclusion that no indications are likely to be found and no compensating increase in the level of quality and safety is likely to be obtained.

3.1.7 Duration of Proposed Alternative

The third 10-year ISI interval ended on May 30, 2017. The proposed alternative would extend the duration of the third 10-year ISI interval for Examination Categories B-N-2 and B-N-3, Item Numbers B13.60 and B13.70, VT-3 examinations to May 30, 2027.

3.2 NRC Staff Evaluation

Historically, RPV welds and the VT-3 inspections of the interior attachments and core support structures were performed at the same time. The licensee's request to extend the RPV weld inspection for VEGP, Units 1 and 2, from 10 to 20 years was approved on March 20, 2014. This approval was based on the licensee's successful demonstration of the plant-specific applicability of the NRC-approved topical report WCAP-16168-NP-A, Revision 2, "Risk-Informed Extension of the Reactor Vessel In-Service Inspection Interval," (ADAMS Accession No. ML082820046) to VEGP, Units 1 and 2. WCAP-16168-NP-A, Revision 2, supports a risk-informed assessment of extension of the ISI interval for a pressurized water reactor (PWR) RPV from 10 years to 20 years for Categories B-A and B-D components.

3.2.1 Hardship or Unusual Difficulty

Due to the March 20, 2014, the RPV Category B-A and B-D welds examination interval extension, a full core off-load and core barrel removal would be necessary in the third ISI interval solely for the purpose of Category B-N-2 and B-N-3 component examinations. The Category B-N-2 and B-N-3 examinations require removal of the core barrel which is restrained at the bottom by the clevis inserts/support lugs with a close tolerance fit to the corresponding core barrel radial keys. As a result, precision lifts are required to ensure that the core barrel and/or reactor vessel are not damaged. Further, a highly radioactive core barrel adds complexity to the core barrel lifting. Thus, every time the core barrel and fuel are removed from the unit, there is a risk for damaging the RPV and RPV internals and an associated radiation exposure to workers. The licensee's proposed alternative will reduce risk of component damage and maintain radiation exposure to the workers as low as is reasonably achievable (ALARA). Considering the difficulty associated with the core barrel removal for a much reduced scope of inspection (i.e., only Category B-N-2 and B-N-3 examinations in lieu of Category B-A, B-D, B-N-2, and B-N-3 component examinations), the NRC staff concludes that performing only Category B-N-2 and B-N-3 examinations present an unusual difficulty or hardship.

3.2.2 No Compensating Increase in the Level of Quality and Safety

All plant-specific and fleet inspection results for the Category B-N-2 and B-N-3 components showed no service-related indications. The discovery of a thin foreign object at the vicinity of the upper core plate clevis insert was determined to be not service-related and does not affect the structural integrity of the reactor internals.

For PWR reactor internals, the licensee identified two related issues: (1) the lower support clevis cap screw degradation discovered at one domestic Westinghouse plant and (2) the VEGP support lug materials susceptible to PWSCC. Since the lower support clevis cap screws are not considered B-N-2 components, they are outside the scope of this alternative request.

Regarding the VEGP support lug materials susceptible to PWSCC, the licensee states that core support lugs were fabricated from Alloy 600 base material and are attached to the RPV with Alloy 82/132/182 welds. The licensee also states that SNC is unaware of any industry OE related to PWSCC for similar vessel attachment welds. In the supplement dated April 20, 2017, the licensee states that based on the reactor vessel design basis reports, the maximum membrane plus bending stress on the interface between the lug and weld under normal operating conditions, considering interference, is approximately 8.5 thousand pounds per square inch. This stress is relatively low compared to the stresses (near yield stress) required for PWSCC initiation. Second, the low neutron fluence and relatively low operating temperature

(T_{cold}) for the core support lugs makes PWSCC unlikely to affect the lugs and their attachment welds during the extended ISI interval. Regarding the benefit of post-weld heat treatment (PWHT), Enclosure 2 of the supplement states that the reason for the strong favorable effect on surface residual stresses, and consequently on PWSCC initiation resistance, is that the PWHT causes recrystallization of the surface cold-worked layer produced by grinding. Enclosure 2 also references test data to support reduced crack growth rate (a factor of two) for PWHT welds if PWSCC was initiated, and presents OE showing extremely few cases of PWSCC for certain components of domestic and foreign units when the Alloy 82/182 or Alloy 600 material received PWHT. The NRC staff reviewed the above stress value, neutron fluence, operating temperature, and PWHT effect on residual stresses and finds that they provide reasonable assurance that PWSCC, if it exists, will not impact the structural integrity of the Category B-N-2 component during the alternative ISI interval.

Therefore, based on plant-specific and fleet OE, the NRC staff finds that, if the ASME BPV Code inspection requirements are followed for the Category B-N-2 and B-N-3 components in the extended third ISI interval, reasonable assurance exists that the inspection results will show favorable inspection results. Therefore, the NRC staff concludes that following the ASME BPV Code requirements would result in no compensating increase in the level of quality and safety.

3.2.3 Proposed Inspections if the Core Barrel is Removed

The hardship of the Category B-N-2 and B-N-3 examinations is eliminated if the core barrel is removed from the RPV for reasons other than to solely perform the examinations. The licensee proposed that if there is an opportunity to perform examinations due to a removal of the core barrel prior to the next scheduled Category B-A and B-D weld examinations, the ASME BPV Code required VT-3 examinations will be performed on the core support structure and interior reactor vessel attachments (i.e., the Category B-N-2 and B-N-3 components).

This element of the proposed alternative could decrease the inspection interval of the Category B-N-2 and B-N-3 components to much less than 20 years. The NRC staff considers this element important because unlike the RPV Category B-A and B-D examination every 20 years that is based on the quantitative risk-informed analysis of WCAP-16168-NP-A, Revision 2, the proposed Category B-N-2 and B-N-3 examination interval of 20 years is based on a qualitative analysis considering unusual difficulty, OE, and RPV attachment susceptibility to PWSCC.

4.0 CONCLUSION

Based on (1) the risk to plant structures and ALARA concerns during core barrel removal solely for the Category B-N-2 and B-N-3 examinations, (2) plant-specific and fleet OE, (3) the assessment of impact of PWSCC on support lugs, and (4) that the licensee proposes to perform an inspection whenever core barrel is removed, requiring the licensee to follow the ASME BPV Code requirements would represent a hardship without a compensating increase in the level of quality and safety. Therefore, proposed alternative VEGP-ISI-ALT-13 is authorized for the Category B-N-2 and B-N-3 components pursuant to 10 CFR 50.55a(z)(2) until the end of the extended third interval, which is May 30, 2027 for VEGP, Units 1 and 2.

All other requirements of the ASME Code, Section XI, not specifically included in the request for the proposed alternatives remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: Simon C. F. Sheng, NRR/DE/EVIB

SUBJECT: VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2 – INSERVICE INSPECTION ALTERNATIVE REGARDING CATEGORY B-N-2 AND B-N-3 WELDS (VEGP-ISI-ALT-13) (CAC NOS. MF9136 AND MF9137) DATED JUNE 27, 2017

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