SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REGARDING PROPOSED ASME CODE ALTERNATIVE VEGP 3&4-PSI/ISI-ALT-15R1

ALTERNATIVE REQUIREMENTS FOR ASME SECTION XI EXAMINATION COVERAGE

OF WELDOLET BRANCH CONNECTION WELDS

SOUTHERN NUCLEAR OPERATING COMPANY

GEORGIA POWER COMPANY

OGLETHORPE POWER CORPORATION

MEAG POWER SPVM, LLC

MEAG POWER SPVJ, LLC

MEAG POWER SPVP, LLC

CITY OF DALTON

VOGTLE ELECTRIC GENERATING PLANT UNITS 3 AND 4

DOCKET NUMBERS 52-025 AND 52-026

1.0 INTRODUCTION

By letter dated December 23, 2020 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML20358A178) (Reference 6), as revised and replaced in its entirety by letter dated February 9, 2021, (ADAMS Accession Nos. ML21040A164) (Reference 7), Southern Nuclear Operating Company, Inc. (the licensee or SNC) requested U.S. Nuclear Regulatory Commission (NRC) approval of an alternative, designated VEGP 3&4-PSI/ISI-ALT-15R1, pursuant to § 50.55a(z)(2) of Title 10 of the *Code of Federal Regulations* (10 CFR), to the requirements of American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI for applicable preservice inspection (PSI) of four ASME Code Class 1 weldolet-to-pipe branch connection welds. The proposed alternative would allow the licensee to perform single-sided ultrasonic testing (UT) examinations of the weldolet-to-pipe branch connection welds with a reduced examination coverage and perform a supplemental "best effort" examination to the maximum extent possible during the preservice inspection (PSI) at Vogtle Electric Generating Plant (VEGP), Units 3 and 4.

Specifically, pursuant to 10 CFR 50.55a(z)(2), the licensee requested to use the proposed alternative on the basis that compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

2.0 REGULATORY EVALUATION

Sections 10 CFR 50.55a(c)(1), 50.55a(d)(1), and 50.55a(e)(1) require systems and components to meet the requirements for Class 1, 2 and 3, respectively, in Section III of the ASME Code.

Section 50.55a(g)(2)(ii) of 10 CFR requires that systems and components that are classified as ASME Code Class 1, 2 and 3 must be designed and be provided with the access necessary to perform the required PSI and inservice inspection (ISI) examinations set forth in the Editions and Addenda of Section III or Section XI of the ASME Code incorporated by reference in paragraph (a)(1) of 10 CFR 50.55a.

Per 10 CFR 50.55a(z), alternatives to the requirements of paragraphs (b) through (h) of 10 CFR 50.55a or portions thereof may be used when authorized by the Director, Office of Nuclear Reactor Regulation. In proposing alternatives, the licensee must demonstrate that: (1) the proposed alternative would provide an acceptable level of quality and safety; or (2) compliance would result in hardship or unusual difficulty without a compensating increase in quality and safety.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request and the Commission to authorize the alternative requested by the licensee.

3.0 TECHNICAL EVALUATION

3.1 The Licensee's Relief Request

ASME Code Components Affected

Proposed Alternative VEGP 3&4-PSI/ISI-ALT-15R1 addresses four stainless steel 4-inch diameter weldolet-to-14-inch-diameter-pipe branch connection welds. The welds are located on the Reactor Coolant System (RCS) Automatic Depressurization System lines. The welds in VEGP, Unit 3, are designated as SV3-RCS-PLW-013-SW3 and SV3-RCS-PLW-01C-SW3. The welds in VEGP, Unit 4, are designated as SV4-RCS-PLW-013-SW3 and SV4-RCS-PLW-01C-SW3.

ASME Codes of Record

ASME Code, Section III, 1998 Edition, including the 2000 Addenda.

ASME Code, Section XI, 2007 Edition, through the 2008 Addenda.

ASME Code Requirement

ASME Code, Section XI, Subarticle IWA-2200, "Examination Methods," states, in part, that all nondestructive examinations of the required examination surface or volume shall be conducted to the maximum extent practical. "Essentially 100 percent" of the required surface or volume shall be examined. Essentially 100 percent coverage is achieved when the applicable examination coverage is greater than 90 percent.

The welds in this proposed alternative are ASME Code, Section XI, Class 1, Examination Category B-J, "Pressure Retaining Welds in Piping," Item B9.31, with the required examination

volume defined in Figure IWB-2500-10. The personnel, equipment, and procedures used in the UT examinations must be qualified through performance demonstration as described in ASME Code, Section XI, Appendix VIII.

Reason for Request

The examination volume required by ASME Code, Section XI, Subarticle IWA-2200 for weldolet-to-pipe branch connections identified in this alternative is not achievable due to the configurations of these weldolet-to-pipe branch connections that does not allow access to the welds from both sides for examination. To date, no UT examination procedure has been able to pass ASME Code, Section XI, Appendix VIII performance demonstration testing of stainless steel welds without access to both sides of the weld.

Proposed Alternative

As an alternative to the ASME Code, Section XI, Subarticle IWA-2200 requirement for "essentially 100 percent" of the required volumetric examination, the licensee proposes to perform qualified volumetric examinations to the maximum extent practical. Supplemental "best effort" UT techniques that do not meet the requirements of ASME Code, Section XI, Appendix VIII will be applied to the maximum extent practical for the examination volume listed above and extending through the full thickness of the material.

Basis for Use

This proposed alternative is based on the qualified and supplemental "best effort" coverage obtained for the four welds and on precedent of prior approval for other operating facilities obtaining similar examination coverage, including the use of supplemental "best effort" volumetric examinations, such as approved for Brunswick Steam Generating Plant, Unit 2 (Reference 1). The welds received an average axial examination coverage of approximately 63 percent and an average circumferential examination coverage of approximately 55 percent using qualified UT examinations.

Additionally, a flaw tolerance evaluation was conducted to justify the reduced examination coverage for the weldolet-to-pipe branch connection locations by demonstrating that a large postulated inside surface axial or circumferential flaw at the weldolet-to-pipe weld regions encompassing the missed examination regions will not grow to the maximum allowable evaluation flaw size for the 60-year design life of the plant. The flaw tolerance evaluation was based on the flaw evaluation supporting the ASME Code alternative request VEGP 3&4-PSI/ISI-ALT-06 (References 2, 3 and 4) which was approved by the NRC (Reference 5). The weldolet branch connection welds were evaluated based on the guidelines in ASME Code, Section XI, IWB-3640 and Appendix C.

Duration of Proposed Alternative

The licensee is proposing to use this alternative during the PSI program and the ISI program for each unit.

3.2 NRC Staff Evaluation

Section 50.55a of 10 CFR requires that components of nuclear power plants meet the requirements of the ASME Code, except where alternatives have been authorized by the Director, Office of Nuclear Reactor Regulation, pursuant to 10 CFR 50.55a(z). Section 50.55a(g)(2)(ii) of 10 CFR requires that systems and components that are classified as ASME Code Class 1, 2, and 3 must be designed and be provided with the access necessary to perform the required PSI and ISI examinations set forth in the Editions and Addenda of Section III or Section XI of the ASME Code incorporated by reference in paragraph (a)(1) of 10 CFR 50.55a.

The ASME Code of Record for the construction of VEGP, Units 3 and 4, is the 1998 Edition, including the 2000 Addenda, of ASME Code, Section III. ASME Code, Section III, NCA-3220 requires that, "the design and arrangement of components to permit accessibility in accordance with Section XI." The ASME Code of Record for the PSI/ISI of VEGP, Units 3 and 4 is the 2007 Edition, including the 2008 Addenda, of ASME Code, Section XI. The examination requirements for ASME Code Class 1 components are provided in ASME Code, Section XI, Subsection IWB. ASME Code, Section XI, Figure IWB-2500-10, requires the inner 1/3 of the piping wall thickness for Category B-J piping welds be examined for a distance of 1 inch or 1/2 the pipe wall thickness, whichever is less, into the base material on each side of the weld.

Pursuant to 10 CFR 50.55a(z)(2), the licensee requested approval to use the coverage obtained in lieu of the essentially 100 percent examination volume requirement for the subject stainless steel welds for the PSI and ISI programs at VEGP, Units 3 and 4.

Based on the configuration of the four welds, the UT examinations of the four weldolet-to-pipe welds are restricted to single-sided examinations. To date no UT examination procedure has been qualified for single-sided examinations of stainless steel welds to the requirements of ASME Code, Section XI, Appendix VIII. Obtaining increased examination coverage of the four welds would require redesigning and modifying the current ASME Code, Section III-designed weldolet-to-pipe welds to allow for examinations from both sides of the welds. Redesigning and modifying the welds would constitute a hardship to the licensee.

The proposed alternative is to perform qualified ASME Code, Section XI, Appendix VIII, volumetric examinations to the maximum extent practical and supplemental "best effort" UT examinations to the maximum extent practical for the examination volume and extending through the full thickness of the material. The proposed alternative is based on the combination of the ASME Code, Section XI, Appendix VIII-qualified examination coverage and the supplemental "best effort" coverage using unqualified examination procedures. The qualified examination coverage of the welds includes an average of approximately 63 percent of the inner 1/3 of the piping wall thickness for axial scans to detect circumferential flaws and an average of approximately 55 percent of the inner 1/3 of the piping wall thickness for circumferential scans to detect axial flaws. The supplemental "best effort" examinations cover the entire inner 1/3 of the piping wall thickness required weld volume and up to 75 percent of the entire weld volume. The qualified examinations are able to detect small flaws, and the supplemental "best effort" examinations provide reasonable assurance of finding large flaws. The axial scans for circumferential flaws cover the wetted surface of the welds and provide reasonable assurance that a large circumferential flaw on the far side of the weld would be detected by the examinations. The supplemental "best effort" examinations provide additional assurance that any large flaws in the remaining volume would be detected. Additionally, as the geometry of the welds will not change and coverage for future ISI examinations will likely remain the same as

the PSI examinations, the PSI examinations will provide a reasonable benchmark for future ISI examinations. The NRC staff also agrees that the UT examination coverage for these weldolet branch connection welds is similar to prior approvals of reduced examination coverage, such as in Reference 1.

The NRC staff reviewed the flaw tolerance analysis conducted by the licensee and documented in Enclosures 7 and 8 of the SNC letter dated February 9, 2021 (Reference 7), which provided information that a large postulated flaw (missed flaw in the inner 1/3 of the piping wall thickness) at the weldolet branch connection weld region will not grow to the maximum allowable end-of-evaluation flaw size for the design life of the plant (60 years). The NRC staff agrees that fatigue is the primary degradation mechanism in the flaw tolerance analysis since primary water stress corrosion cracking is related to nickel-based alloys and therefore is not of a concern for the stainless steel weldolet branch connection. In addition, other forms of stress corrosion cracking are bounded by fatigue crack growth since the base metal (austenitic stainless steel) has a very low susceptibility to stress corrosion cracking due to the low oxygen content in the AP1000 reactor coolant system.

The fatigue crack growth for the weldolet branch connection weld was evaluated by determining whether the fatigue crack growth performed for the valve-to-pipe welds in References 2, 3, and 4 was bounding. The NRC found the methodology used in References 2, 3, and 4, to be acceptable in Reference 5. Based on the NRC staff's review, both the weldolet branch connection weld and the valve-to-pipe weld locations are stainless steel weld material, with potentially reduced examination coverage that may contain missed flaws exposed to the reactor coolant. The transient events and cycles, loadings combinations, and welding residual stresses are considered to be the same between the weldolet and the pipe weld locations since both locations have similar geometrical properties and are in the same piping lines which have consistent loading events. Although there are some differences in the two weld types as discussed in Enclosures 7 and 8 of the SNC letter dated February 9, 2021 (Reference 7), the NRC staff concluded that the previous fatigue crack growth in References 3 and 4 was bounding due to the similarities and lower stresses and cumulative usage factors in the weldolet branch connection welds compared to the valve-to-pipe welds. The flaw tolerance analysis demonstrated that it would require a greater than 71 percent of the wall thickness initial axial flaw and a greater than 75 percent of the wall thickness circumferential flaw to reach the maximum end-of-evaluation flaw size in 60 years. Therefore, the results from Table 1 of Enclosure 6 of the SNC letter dated February 9, 2021 (Reference 7), demonstrated the structural integrity of the weldolet branch connection weld location will be maintained because any flaw in the required inner 1/3 wall thickness examination region would not grow to the maximum allowable end-of-evaluation flaw size per ASME Code, Section XI, during the design life of 60 years.

Based on the information provided in the submittal, the NRC staff finds that (1) the coverage obtained using qualified and supplemental "best effort" examinations to the maximum extent practical provides reasonable assurance that large flaws would be found by the UT examinations, (2) the provided flaw analysis demonstrate that any flaws missed by the UT examinations would not threaten the structural integrity of the four welds, (3) the examination coverage is similar to prior NRC approval of reduced examination coverage of weldolet branch connection welds, and (4) the licensee's hardship justification is acceptable.

4.0 CONCLUSION

As set forth above, the NRC staff finds that complying with the specified ASME Code, Section III and Section XI, requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2). Additionally, the proposed alternative described in VEGP 3&4-PSI/ISI-ALT-15R1 (Reference 7) provides reasonable assurance of structural integrity of the subject welds. Therefore, the NRC authorizes the use of the VEGP 3&4-PSI/ISI-ALT-15R1 during the PSI program and the ISI program at VEGP, Units 3 and 4.

All other ASME Code, Section III and Section XI, requirements for which the alternative was not specifically requested and approved in this proposed alternative remain applicable including third-party review by the Authorized Nuclear Inservice Inspector.

5.0 REFERENCES

1. NRC Safety Evaluation for Brunswick Steam Generating Plant, Unit 2, "Relief Requests RR-47, RR-48, RR-49, and RR-50 for the Third 10-YEAR Interval Inservice Inspection," dated July 22, 2011 (ADAMS Accession No. ML11175A173).

2. VEGP 3&4 PSI/ISI-ALT-6, "Request for Alternative: Preservice and Inservice Inspection Requirements for Specific Valve-to-Pipe Welds," dated October 19, 2018 (ADAMS Accession No. ML18292A789).

3. VEGP 3&4 PSI/ISI-ALT-6, "Supplement to Request for Alternative: Preservice and Inservice Inspection Requirements for Specific Valve-to-Pipe Welds," dated January 28, 2019 (ADAMS Accession No. ML19028A449).

4. VEGP 3&4 PSI/ISI-ALT-6, "Supplement to Request for Alternative: Preservice and Inservice Inspection Requirements for Specific Valve-to-Pipe Welds," dated April 5, 2019 (ADAMS Accession No. ML19095B589).

5. NRC Safety Evaluation for VEGP 3&4 PSI/ISI-ALT-6, "Preservice and Inservice Inspection Requirements for Specific Valve-to-Pipe Welds," dated April 25, 2019 (ADAMS Accession No. ML19087A172).

6. VEGP 3&4 PSI/ISI-ALT-15, "Request for Alternative: Alternative Requirements for ASME Section XI Examination Coverage of Weldolet Branch Connection Welds," dated December 23, 2020 (ADAMS Accession No. ML20358A178).

7. VEGP 3&4 PSI/ISI-ALT-15R1, "Revision to Request for Alternative: Alternative Requirements for ASME Section XI Examination Coverage of Weldolet Branch Connection Welds," dated February 9, 2021 (ADAMS Accession No. ML21040A164).

8. NRC "Summary of Public Meeting with Southern Nuclear Operating Company on October 15, 2020," dated October 15, 2020 (ADAMS Accession No. ML20296A243).

9. NRC "Summary of Public Meeting with Southern Nuclear Operating Company on December 10, 2020, dated December 18, 2020 (ADAMS Accession No. ML20351A282).

10. NRC Proprietary Letter for Enclosure 2 to Reference 6, dated December 30, 2020 (ADAMS Accession No. ML20364A193).

11. NRC Proprietary Letter for Enclosure 8 to Reference 7, dated February 16, 2021 (ADAMS Accession No. ML21042A628).