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

SAFETY EVALUATION BY THE OFFICE OF NEW REACTORS

REQUEST FOR ALTERNATIVE NO. 6

SAFETY EVALUATION OF ALTERNATIVE REQUEST VEGP 3&4-PSI/ISI-ALT-06

REGARDING PRESERVICE AND INSERVICE INSPECTION REQUIREMENTS FOR

SPECIFIC VALVE-TO-PIPE WELDS

TO THE COMBINED LICENSE NOS. NPF-91 AND NPF-92

SOUTHERN NUCLEAR OPERATING COMPANY, INC.

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 NOS. 52-025 AND 52-026

1.0 INTRODUCTION

By letter dated October 19, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18292A789), as supplemented by letters dated January 28, 2019, and April 5, 2019 (ADAMS Accession Nos. ML19028A449 and ML19095B590), Southern Nuclear Operating Company, Inc. (SNC) requested U.S. Nuclear Regulatory Commission (NRC) approval of an alternative, pursuant to § 50.55a(z)(1) 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 and inservice inspection (PSI/ISI) of a specific subset of ASME Code Class 1 and 2 valve-to-pipe welds in ASME Code, Section XI Table IWB-2500-1 examination Category B-J and Table IWC-2500-1 examination Category C-F-1, and ASME Code Class 3 valve-to-pipe welds treated as Class 2. The proposed alternative would allow SNC to eliminate the volumetric examination requirement for the austenitic stainless steel valve material and allow performance of the

Enclosure

inspection for the pipe base material and entire weld from the pipe side, during the PSI/ISI at Vogtle Electric Generating Plant (VEGP), Units 3 and 4.

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 preservice and inservice 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 New Reactors. 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.

3.0 TECHNICAL EVALUATION

3.1 SNC's Alternative

SNC's alternative request is to eliminate the volumetric examination requirement for the austenitic stainless steel valve material but perform an inspection for the pipe base material and entire weld, including the fusion lines, from the pipe side, during the PSI and first and second intervals of the ISI at VEGP, Units 3 and 4.

The components affected by this request are a specific subset of ASME Code Class 1 and 2 valve-to-pipe welds in Table IWB-2500-1 examination Category B-J of Section XI, Table IWC-2500-1 examination Category C-F-1 of Section XI, and ASME Code Class 3 valve-to-pipe welds treated as ASME Code Class 2 (examination Category C-F-1). These specific valve-to-pipe welds are listed in Table 1 (Category 1 – cast austenitic stainless steel (CASS) valve welded to wrought austenitic stainless steel pipe welds) and Table 2 (Category 2 wrought austenitic stainless steel valve welded to wrought austenitic stainless steel pipe) of letter dated October 19, 2018, as supplemented by letter dated April 5, 2019. The valve design geometry for both Category 1 and 2 welds do not allow for essentially 100 percent of the required examination volume coverage as defined in ASME Code, Section XI, IWA-2200(c). In addition, the CASS material of the valve body for Category 1 welds limits the inspection coverage and effectiveness.

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 inspection requirements for ASME Code Class 1, and 2 components are provided in ASME Code, Section XI, Subsection IWB and Subsection IWC, respectively. Section XI, Figure IWB-2500-8 and IWC-2500-8 require the inner 1/3 of the piping wall thickness for Category B-J and Category C-F-1 piping welds, respectively, be examined for a distance of 1/4-inch into the base material on each side of the weld.

In accordance with ASME Code, Section XI, IWA-2200(c), all nondestructive examinations of the required examination surface or volume shall be conducted to the maximum extent practical. When performing visual (VT-1), surface, radiographic, or ultrasonic examination on a component with defined surface or volume, 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; however, in no case shall the examination be terminated when greater than 90 percent coverage is achieved, if additional coverage of the required examination surface or volume is practical.

Design Features and Weld Conditioning

SNC stated that ultrasonic examination technology has been limited in its capability to qualify equipment, procedures, and personnel for single-sided exams of austenitic stainless steel pipe-to-valve welds to the requirements in 10 CFR 50.55a(b)(2)(xvi)(B). Currently qualified ultrasonic examination coverage per the latest revision of ultrasonic examination procedure PDI-UT-2 is approximately 50 percent of the required ASME Code, Section XI examination volume. The examination volume not qualified for coverage is that associated with the austenitic valve material and one-half of the weld material adjacent to the valve. Ultrasonic test techniques applied from the CASS valve body and consistent with Section XI, Appendix III are not practical given the restricted outer surface geometry of the valve and the limitations caused by the microstructure of the CASS valve bodies.

SNC stated that the AP1000 design features implemented on the VEGP, Units 3 and 4 valve-to-pipe welds were intended to improve inspectability and provide better access to the valve-side examination volume as illustrated in Figure 2 of the SNC letter dated October 19, 2018. These design features include a flush weld (weld conditioning by grinding and/or machining) on the outer surface with a 1/32-inch per inch flatness with a smooth transition from the weld to pipe. Additionally, Figure 2 of SNC letter dated October 19, 2018 shows a reduced maximum outside diameter (OD) taper of 18° on the valve for a distance of 1.5 times the minimum pipe wall thickness from the valve-to-pipe weld in comparison to the 30° maximum OD taper as specified in ASME Code, Section III, Subsection NB, Figure NB-4250-1 and Subsection NC, Figure NC-4250-1. These AP1000 design features have made it possible to qualify a new ultrasonic examination procedure, specifically for VEGP, Units 3 and 4.

Performance Demonstration of Ultrasonic Examination of Pipe Base Material and Entire Weld

Section XI, Appendix VIII, “Performance Demonstration for Ultrasonic Examination Systems,” as condition by 10 CFR 50.55a(b)(2)(xv)(A)(1), requires examination of austenitic welds from both sides. If examination from both sides is not possible, procedures and personnel qualified for single-side examination in accordance with Appendix VIII, Supplement 2, and Supplement 10, respectively, with all flaws on the opposite side of the weld, shall be used to examine the required volume. 10 CFR 50.55a(b)(2)(xvi)(B) requires examinations performed from one side of a ferritic or stainless steel pipe weld must be conducted with equipment, procedures, and personnel that have demonstrated proficiency with single-side examinations. To demonstrate equivalency to two sided examinations, the demonstration must be performed to the requirements of Appendix VIII, as conditioned by 10 CFR 50.55a(b)(2)(xvi)(B) and 10 CFR 50.55a(b)(2)(xv)(A).

SNC’s proposed alternative ultrasonic examination procedure has been developed based on the requirements of the latest revision of ultrasonic examination procedure PDI-UT-2. In accordance with Appendix VIII, Subsubarticle 3130(a) of Section XI of the ASME Code, any two procedures with the same essential variables are considered equivalent. This new procedure has been demonstrated by SNC to extend the qualified ultrasonic examination coverage beyond the current 50 percent to include the far side of the weld material, up to the fusion line, resulting in a larger qualified valve-to-pipe examination volume, illustrated in Figure 2 of SNC letter dated October 19, 2018. All of the flaws contained in the mock-ups were detected in the sample set during the procedure qualification. The pipe sizes and thicknesses utilized in the mockups bound the VEGP, Units 3 and 4 configurations. In addition, these mockups have been used in conjunction with existing mock-ups to develop the VEGP, Units 3 and 4 specific ultrasonic examination procedure. SNC stated that individuals qualified to the VEGP, Units 3 and 4-specific procedure shall be qualified to PDI-UT-2.

SNC stated that the examination techniques used in the VEGP, Units 3 and 4-specific examination procedure would result in essentially 100 percent coverage in the piping base metal and the weld (excluding the valve base material) for axial and circumferential flaws. The VEGP, Units 3 and 4-specific examination procedure requires a prerequisite to have the weld crown removed to allow scanning on top of weld and a flatness of 1/32-inch over the size of the transducer. A table was added to the VEGP, Units 3 and 4-specific ultrasonic examination procedure to add specific transducers for circumferential scanning of axial flaws on top of the weld. No changes were necessary to the VEGP, Units 3 and 4-specific examination procedure for the identification of circumferential flaws from the pipe side of the weld.

SNC stated that while the proposed alternative is to eliminate the requirement for a volumetric examination of the austenitic valve material in the valve-to-pipe welds, the VEGP, Units 3 and 4-specific ultrasonic examination procedure would be used to inspect the weld and fusion line using ultrasonic test scanning techniques from the pipe side of the weld, and on the conditioned weld surface. For circumferential flaws, longitudinal wave ultrasonic techniques currently defined in PDI-UT-2 would be used for the detection of circumferentially-oriented flaws from the pipe side of the weld to detect flaws over the entire weld volume, including the fusion line. These longitudinal wave probes would be contoured to the outer diameter surface in accordance with the procedure requirements and would be used for axial beam scanning from the pipe side of the weld toward the valve for the detection and length sizing of circumferential flaws. A best effort examination would be performed on the ASME Code, Section XI volume for the valve base material for circumferential flaws.

For axial flaws, SNC stated that longitudinal wave ultrasonic techniques are not currently defined in PDI-UT-2 for the detection of axially-oriented flaws from the conditioned weld surface and where practical from the valve surface. However, VEGP, Units 3 and 4-specific ultrasonic examination procedure is qualified to detect flaws over the entire weld volume, including the fusion line using longitudinal wave probes to detect axial flaws. These longitudinal wave probes would also include a skew or beam correction angle to compensate for the valve taper angle and provide for more direct impingement on axial planar flaws. The probes would be contoured to the outer diameter surface in accordance with the site-specific procedure requirements and would be used for circumferential beam scanning from the conditioned weld surface and where practical from the valve surface for the detection and length sizing of axial flaws. Circumferential scans of the weld would be performed primarily from the top of the weld. A best effort examination would be performed on the ASME Code, Section XI volume for the valve base material for axial flaws.

These ultrasonic test techniques scanned from the OD surface would be applied for the preservice examination to obtain a baseline volumetric examination of the ASME Code, Section XI defined examination volume. SNC also noted that volumetric examination of the weld using the radiographic examination method will have already been performed in accordance with ASME Code, Section III.

Additionally, per the examination requirements of ASME Code, Section III, paragraphs NB-2541 and NB-2571, a liquid penetrant examination of all external and accessible interior portions of the valve bodies and machined surfaces (including the weld prep) has been completed prior to N-stamping the valves. For CASS valves, visual examinations would be performed in accordance with design specifications. Application of other volumetric methods such as inside diameter applied ultrasonic techniques is not practical due to access and the as-welded surface conditions of the weld.

Operating Experience

SNC states volumetric examinations of cast stainless steel were first addressed in ASME Code, Section XI Code Case N-481, "Alternative Examination Requirements for Section XI, Division 1, Examination of Pump Casings." This code case replaced the requirement of a volumetric examination of pump casings with a visual examination. The technical basis for this code case was that cast stainless steel is highly resistant to corrosion, has low stress due to the cast design, and has not had any issues with degradation during service. Flaw tolerance evaluations were also performed to cover the range of different CASS pump casing designs. Code Case N-481 was incorporated into the ASME Code in the 1980s. In 2008, valve bodies were treated in the same manner because they were of similar design and had trouble-free operating experience. Similar examination requirements for valve bodies were inserted in Table IWB-2500 of ASME Code, Section XI. In 2011, the NRC endorsed the 2008 Addenda to the 2007 Edition of the ASME Code in 10 CFR 50.55a.

In its letter dated January 28, 2019, SNC stated that a review was performed to include the operating experience in the NRC-issued Grimes letter dated May 19, 2000 (ADAMS Accession No. ML003717179), for valve body cracking operating experience. The review included the Sequence Coding and Search System (SCSS), the Nuclear Plant Reliability Data System (NPRDS) database, and foreign event files for thermal fatigue. The SCSS search covered the years from 1979 to 1999, and the NPRDS search covered 1987 to 1996. Ten valve body indications were identified over this time period. Of that ten, five failures were associated with stainless steel valve bodies. The five events were attributed to wall thinning, transgranular stress corrosion cracking, thermal stratification, indeterminate, and preferential corrosion at a weld repair. It should be noted that none of the events resulted in catastrophic failure of the valve, rather through-wall leaks were identified per leak detecting sensors. This review provides assurance that the operating experience associated with stainless steel valve bodies was exemplary for the time period from 1979 to 1999.

In addition, SNC conducted a search of operating experience records covering the period from January 1, 2000, to January 7, 2019, to identify operating experience for indications in valve-to-pipe welds. A search was performed by SNC of the licensee event reports (LERs) that contain the following sets of keywords: 1) "valve," "weld," "body," and "indication;" and 2) "valve," "weld," "body," and "crack." SNC performed additional industry searches using the following keywords: "weld," "crack," "leak," and "valve body" which resulted in 70 instances of operating experience, with 23 deemed to be relevant to valve-to-pipe welds. In summary, two failures were a result of a valve body defect but neither were associated with a valve-to-pipe weld interface, one failure was deemed attributable to valve thinning, one failure was due to outer diameter stress corrosion cracking due to chloride contamination at a valve-to-pipe weld, and all others were located in small bore locations that are not required to be ultrasonically examined by ASME Code, Section XI. One instance of operating experience was identified for valve-to-piping welds that are in the scope of ASME Code, Section XI to be ultrasonically examined, but this failure originated from the outer diameter, while ASME Code, Section XI ultrasonic examinations are performed to inspect the inner diameter.

No operating experience were identified for valve-to-piping welds that are in the scope of ASME Code, Section XI to be ultrasonically examined. The reviews documented encompass operating experience of valve body failures at valve-to-pipe weld interfaces for 2400 reactor-years of operating U.S. pressurized-water reactor (PWRs) and 1300 reactor-years for operating U.S. boiling-water reactor (BWRs). Per the SNC review, there has been only one identified valve-to-piping weld failure subject to volumetric examination per ASME Code, Section XI and this was due to a failure mode that was initiated from the outer diameter of the material which is not the location for which ASME Code, Section XI volumetric exams are conducted for valve-to-pipe welds. This review provides high assurance that there are no adverse trends related to valve-to-piping weld failures on the valve body side that would suggest that volumetric examination of the valve body volume currently required to be inspected per ASME Code, Section XI is warranted. The SNC review also provides high assurance that the operational experience for large bore valve-to-piping welds (i.e., valve-to-piping welds that require volumetric examination in accordance with ASME Code, Section XI) is excellent.

Flaw Tolerance Analysis

Since there is no ultrasonic qualification in place for exams from the cast valve body side of the weld, no credit can be given to the examination volume, which consists of the austenitic stainless steel valve material. Therefore, to support the alternative request for the examination of these particular locations, a sample flaw tolerance evaluation was provided in the SNC letter dated October 19, 2018, to demonstrate that the valve base material is flaw tolerant (i.e., a postulated flaw in the required examination region does not grow to the maximum allowable end-of-evaluation period flaw size within the life of the plant).

The valve-to-pipe weld locations were evaluated by SNC and were based on the guidelines in paragraph IWB-3640 and Appendix C of the 2007 Edition with 2008 Addenda ASME Code, Section XI code. The maximum allowable end-of-evaluation period flaw size is calculated at the representative valve location discussed above for a postulated inside surface axial and circumferential flaw with an aspect ratio (flaw length: flaw depth) equal to 6:1. This particular aspect ratio would conservatively bound any flaws discovered during pre-service and in-service inspections; furthermore, the postulated flaw shape is typical of ASME Code, Section XI flaw evaluations. The evaluations of inside surface flaws are considered by SNC, because the required examination for this valve-to-weld location is of the inner one-third thickness of the wall. Furthermore, the evaluation of postulated inside surface flaws conservatively covers evaluations for embedded flaws and outside surface flaws as the stress intensity factors and crack growth rates for inside surface flaws are more limiting than embedded and outside surface flaws.

SNC stated that the primary crack growth mechanism for postulated flaws in the stainless steel valve-to-pipe weld location is fatigue crack growth (FCG). Crack growth due to primary water stress corrosion cracking (PWSCC) growth does not need to be investigated since the base metal (CASS and wrought austenitic stainless steel valve) and stainless steel weld material have a very low susceptibility to stress corrosion cracking due to the lack of oxygen in a PWR environment. The maximum allowable postulated flaw size is determined by subtracting the 60-year (design life) FCG from the maximum allowable end-of-evaluation flaw sizes. The purpose of this evaluation is to demonstrate that the maximum allowable postulated flaw size for 60 years which would be acceptable is large compared to the area which requires examination.

A representative flaw tolerance evaluation was completed by SNC for a typical CASS valve-to-pipe weld location since the weld cannot be fully volumetrically examined because of the ultrasonic examination requirements of Section XI for the CASS material. The intent of the SNC analysis was to demonstrate that a large postulated flaw at the CASS valve-to-pipe weld region in the examination region will not grow to the maximum end-of-evaluation flaw size for the design life of the plant (60 years).

The CASS valve-to-pipe weld location were evaluated by SNC per the guidelines in paragraph IWB-3640 of ASME Code, Section XI and Appendix C. Postulated inside surface axial and circumferential flaws with aspect ratio of 6:1 were evaluated at the CASS valve-to-pipe weld locations. AP1000-specific geometry, loadings, and material properties were considered in the maximum end-of-evaluation period flaws and the FCG analysis. The flaw tolerance evaluation incorporated the limiting ASME Code material properties based on the base metals. The welding process is required to be GTAW (gas tungsten arc welding) for the welds included in this alternative, and thus the maximum end-of-evaluation flaw sizes are based on limit load with Z=1.

Table A4-5 of the SNC letter dated October 19, 2018, shows that the maximum end-of-evaluation flaw size (a_f/t) is 0.53 for an axial flaw and 0.42 for a circumferential flaw with aspect ratio of 6:1. The FCG analysis demonstrates that it would require a very large initial axial flaw (greater than 52 percent of the wall thickness) or circumferential flaw (greater than 41 percent of the wall thickness) to reach the maximum end-of-evaluation flaw size in 60 years. Thus, SNC states that the results from Table A3-5 of the SNC letter dated October 19, 2018, can be used to demonstrate the structural integrity of the valve-to-pipe location, i.e., any flaw in the required inner one-third wall thickness examination region would not grow to the maximum end-of-evaluation flaw size per ASME Code, Section XI in 60 years (design life).

SNC stated that the proposed alternative provides an acceptable level of quality and safety in accordance with 10 CFR 50.55a(z)(1) based on operating experience research, prior approval and implementation of ASME Code, Section XI Code Case N-481, and the results of the representative flaw tolerance evaluation as detailed in the SNC letter dated October 19, 2018. The duration of the proposed alternative is the PSI and for the first and second ISI intervals of Section XI of the ASME Code.

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 New Reactors, 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 preservice and inservice 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 inspection requirements for ASME Code Class 1 and 2 components are provided in ASME Code, Section XI, Subsection IWB and Subsection IWC, respectively. Section XI, Figure IWB-2500-8 and IWC-2500-8 require the inner 1/3 of the piping wall thickness for Category B-J and Category C-F-1 piping welds, respectively, be examined for a distance of 1/4-inch into the base material on each side of the weld.

Pursuant to 10 CFR 50.55a(z)(1), SNC requested approval to eliminate the volumetric examination requirement for the austenitic stainless steel valve material but perform an inspection for the pipe base material and entire weld, including fusion lines, from the pipe side, during the PSI and first and second intervals of the ISI at VEGP, Units 3 and 4.

The proposed alternative is based on the ability to perform the inspection of the pipe base material and the entire weld, including fusion lines, by performing the ultrasonic scanning on the pipe side and weld, during the PSI and ISI at VEGP, Units 3 and 4. Also, the welds for VEGP, Units 3 and 4 are required by the VEGP, Units 3 and 4-specific ultrasonic examination procedure to be conditioned to allow for scanning on the welds, unlike the current operating fleet. In addition, the proposed alternative is based on the satisfactory operating experience of the CASS and wrought austenitic stainless steel valve body base materials, along with a flaw tolerance analysis of the valve body materials are discussed below.

Design Features and Weld Conditioning

The AP1000 design features implemented on the VEGP, Units 3 and 4 valve-to-pipe welds were intended to improve inspectability and provide better access to the examination volume as illustrated in Figure 2 of SNC letter dated October 19, 2018. These design features include a flush weld (conditioned weld by grinding/buffing and/or machining) on the outer surface with a 1/32-inch per inch flatness with a smooth transition from the weld to pipe. The staff finds that these design features aid in the ability to scan on the weld, which in turn increases the examination coverage to detect and size axial flaws from half of the weld to the entire weld, including the fusion lines. The SNC proposed alternative includes the performance of the inspection for the pipe base material and the entire weld, including the fusion lines, by performing the ultrasonic scanning on the pipe side and on the weld, during the PSI/ISI at VEGP, Units 3 and 4. Conditioning of the weld is also included in the VEGP, Units 3 and 4-specific ultrasonic examination procedure. Currently, the ultrasonic inspection is limited to the pipe base material and half of the weld on the pipe side. The staff concludes that these AP1000 design features have made it possible to qualify a new ultrasonic examination procedure specifically for VEGP, Units 3 and 4 to detect and size flaws in the pipe base material and the entire weld, including the fusion lines. Based on the satisfactory operating experience of the valve base material, these areas (weld, fusion line, and pipe) could potentially exhibit material degradation. Therefore, the staff agrees that the weld, fusion lines and pipe should be examined for essentially 100 percent coverage to the requirements of Section XI of the ASME Code to detect material degradation.

Performance Demonstration of Ultrasonic Examination of Pipe Base Material and Entire Weld

As part of the proposed alternative to eliminate the examination of the valve base material, SNC would perform ultrasonic examinations of the weld and fusion line examination volume using ultrasonic test techniques from the pipe side of the weld and on the conditioned weld surface during the PSI/ISI at VEGP, Units 3 and 4.

Specifically:

- The proposed alternative would perform ultrasonic inspection of the weld and pipe base material (a distance of 1/4-inch into the pipe base material from the weld) for the inner 1/3 of the piping wall thickness per Figures IWB-2500-8 and IWC-2500-8 in ASME Code, Section XI using a qualified ultrasonic examination procedure and personnel. The ultrasonic examination procedure is qualified to detect and size circumferential oriented flaws in the pipe base material and entire weld, including the fusion lines. The examination procedure is also qualified for detecting axial flaws in the pipe base material and entire weld including the fusion lines by performing the scanning on the conditioned weld and pipe base material.

- The ultrasonic inspection of the valve base material would be performed as a best effort examination and would not meet the required coverage in IWA-2200(c), Section XI of the ASME Code. This best effort ultrasonic examination could be performed using ultrasonic test techniques from the pipe side of the weld, on the conditioned weld surface, and where practical, from the valve side of the weld.

Currently, the ultrasonic inspection coverage is limited to the pipe base material and half of the weld, on the pipe side. ASME Code, Section XI, Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," as conditioned by 10 CFR 50.55a(b)(2)(xv)(A)(1), requires examination of austenitic welds from both sides, unless the examinations from one side of the stainless steel pipe weld are conducted with equipment, procedures, and personnel that have demonstrated proficiency with single-side examinations per the requirements of 10 CFR 50.55a(b)(2)(xvi)(B). SNC has demonstrated a VEGP, Units 3 and 4-specific ultrasonic examination procedure based on ultrasonic examination procedure PDI-UT-2 in accordance with the performance demonstration requirements in Appendix VIII of Section XI of the ASME Code. Twenty-five mockups were developed based on the VEGP, Units 3 and 4 weld joint configurations and bound the pipe sizes and wall thickness for VEGP, Units 3 and 4.

The staff finds that using the VEGP, Units 3 and 4-specific ultrasonic examination procedure that has been demonstrated to Appendix VIII of Section XI of the ASME Code, as conditioned by 10 CFR 50.55a(b)(2)(xvi)(B) and 10 CFR 50.55a(b)(2)(xv)(A), will ensure circumferential and axial-oriented flaws in the pipe base material and entire weld, including the fusion lines, would be detected and sized to maintain the integrity of the valve-to-pipe welds. In addition, the staff finds the use of qualified personnel for the PDI-UT-2 examination procedure and the VEGP, Units 3 and 4-specific examination procedure to the requirements of Appendix VIII of Section XI of the ASME Code acceptable since it demonstrates the proficiency of the personnel to detect and size flaws.

Operating Experience

The staff understands that ultrasonic test techniques currently are not qualified to detect and size flaws in CASS valve bodies in accordance with ASME Code, Section XI, Appendix III due to the restricted outer surface geometry of the valve and the limitations caused by the microstructure of the CASS valve bodies. The staff also agrees that the CASS and wrought austenitic stainless steel valve body material is resilient and flaw tolerant based on the flaw evaluations performed by SNC (discussed below) in accordance with paragraph IWB-3640 and Appendix C of the 2007 Edition with 2008 Addenda to ASME Code, Section XI and its satisfactory operating experience. The staff confirmed the industry operating experience demonstrates that CASS and wrought austenitic stainless steel material has shown little degradation that typically can be detected using ultrasonic inspection techniques. The few instances of degradation observed in CASS and wrought austenitic stainless steel material can be found using a surface or visual inspection techniques. As discussed in SNC letter dated January 28, 2019, SNC will continue to perform visual examinations required by Table IWB-2500-1, Category B-M-2 in Section XI of the ASME Code. In addition, as part of this alternative, a best effort ultrasonic examination would be performed of the valve base material. Therefore, the staff finds the elimination of the ASME Code required volumetric examination of the valve material for the pipe-to-valve welds listed in Table 1 and Table 2 of letter dated October 19, 2018, as supplemented by letter dated April 5, 2019, to be acceptable because of the satisfactory operating experience, the visual examination specified in Section XI of the ASME Code, and the best effort ultrasonic examination performed for the valve base material. In addition, staff finds that the completed examinations required by ASME Code, Section III for the valves, which consists of a radiographic (volumetric examination), and a liquid penetrant examination of all external and accessible interior portions of the valve bodies and machined surfaces (including the weld prep) ensures that unacceptable flaws are not present that can be initiation sites for material degradation.

Flaw Tolerance Analysis

The flaw tolerance analysis conducted by SNC and documented in Enclosure 1 of SNC letter dated October 19, 2018, demonstrated that a large postulated flaw at the CASS valve-to-pipe weld region in the examination region will not grow to the maximum end-of-evaluation flaw size for the design life of the plant (60 years). The flaw tolerance analysis calculated that it would require a greater than 52 percent of the wall thickness initial axial flaw or a greater than 41 percent of the wall thickness initial circumferential flaw to reach the maximum end-of-evaluation flaw size in 60 years. The results from Table A3-5 of enclosure 1 of SNC letter dated October 19, 2018, demonstrated the structural integrity of the valve-to-pipe location is maintained because any flaw in the required inner one-third wall thickness ultrasonic examination region would not grow to the maximum end-of-evaluation flaw size per ASME Code, Section XI during the design life of 60 years. The staff also finds that PWSCC crack growth is related to nickel-based alloys and therefore is not of a concern for the CASS and wrought austenitic stainless steel material. In addition, other forms of stress corrosion cracking are bounded by the fatigue crack growth analysis since the base metal (CASS and wrought austenitic stainless steel valve) has a very low susceptibility to stress corrosion cracking due to the low oxygen content in used in the AP1000. The staff finds the flaw tolerance analysis used to calculate the fatigue crack growth rate acceptable because it used an NRC-approved fatigue analysis tool that meets the ASME Code and bounds the valves specified in Table 1 and Table 2 of letter dated October 19, 2018, as supplemented by letter dated April 5, 2019.

In summary, the staff reviewed the information provided and finds that SNC has demonstrated, as described above, that the proposed alternative provides an acceptable level of quality and safety because the alternative to eliminate the volumetric examination requirement for the austenitic stainless steel valve material, but perform an inspection for the pipe base material and entire weld, including fusion lines, from the pipe side and weld, during the PSI/ISI at VEGP, Units 3 and 4 would:

1. Ensure the integrity of the pipe material and entire weld by examining essentially 100 percent of the pipe material and entire weld, including fusion line. The examination would be able to detect and size both circumferential and axial flaws.

2. Ensure valve material would continue to perform its function based on satisfactory operating experience and having large flaw tolerance.

4.0 CONCLUSION

As set forth above, the staff determines that the proposed alternative to the requirements of the 2007 Edition, including the 2008 Addenda, of ASME Code, Section XI, Subparagraph IWA-2200(c) and Figures IWB-2500-8 and IWC-2500-8, and the requirements of the 1998 Edition, including the 2000 Addenda, of ASME Code, Section III, Subparagraph NCA-3220 provides an acceptable level of quality and safety. Accordingly, the staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1), and otherwise is in compliance with the ASME Code requirements. Therefore, the staff authorizes PSI/ISI-ALT-6 for the PSI, and the first and second ISI intervals at VEGP, Units 3 and 4. All other requirements of ASME Code, Sections III and XI, and 10 CFR 50.55a, for which an alternative has not been specifically requested and authorized, remain applicable.

5.0 REFERENCES

1. Vogtle Electric Generating Plant Units 3 and 4, “Request for Alternative: Preservice and Inservice Inspection Requirements for Specific Valve-to-Pipe Welds (VEGP 3&4 PSI/ISI-ALT-6),” dated October 19, 2018 (ADAMS Accession No. ML18292A789).

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

3. Vogtle Electric Generating Plant Units 3 and 4, “Supplement to Request for Alternative: Preservice and Inservice Inspection Requirements for Specific Valve-to-Pipe Welds (VEGP 3&4 PSI/ISI-ALT-6),” dated April 5, 2019 (ADAMS Accession No. ML19095B590)