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

September 21, 2022

ST. LUCIE NUCLEAR PLANT UNIT NO. 2, AUTHORIZATION AND SAFETY EVALUATION FOR ALTERNATIVE RELIEF REQUEST NO. 10 - HARDSHIP OR UNUSUAL DIFFICULTY WITHOUT COMPENSATING INCREASE IN LEVEL OF QUALITY OR SAFETY (EPID L-2021-LLR-0089)

LICENSEE INFORMATION

Recipient's Name and Address: Mr. Bob Coffey
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Licensee: Florida Power and Light

Plant Name(s) and Unit(s): St. Lucie Nuclear Plant, Unit 2

Docket No(s).: 50-389

APPLICATION INFORMATION

Submittal Date: December 17, 2021

Submittal Agencywide Documents Access and Management System (ADAMS) Accession No.: ML21351A134

Alternative Provision: The licensee requested an alternative under Title 10 of the *Code of Federal Regulations* (10 CFR), paragraph 50.55a(z)(2).

ISI Requirement: American Society of Mechanical Engineer (ASME) Boiler & Pressure Vessels Code (Code), Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," Subsection IWB-2500, Examination Category B-O, Pressure Retaining Welds in Control Rod Drive Housings, Item B14.20.

Applicable Code Edition and Addenda: The applicable Code of Record for the fourth 10-year ISI Interval at St. Lucie 2 is ASME Code, Section XI, 2007 Edition through 2008 Addenda.

Brief Description of the Proposed Alternative: In lieu of ASME required volumetric, or surface (inside surface) ISI examinations of welds 1 through 4, on 10 percent of peripheral control element drive mechanism (CEDM) housings at St. Lucie Plant Unit 2, the subjects welds will continue to receive VT-2 examination as required by Examination Category B-P with the Reactor Coolant Pressure Boundary (RCPB) system leakage test conducted prior to startup from each refueling outage. Florida Power & Light (FPL) will perform nondestructive examinations, in accordance with ASME Code Section XI requirements, on 12 CEDM weld number 5 locations accessible via the 10 inspection ports. The examination of the accessible welds (weld # 5) on 12 periphery CEDMs combined with the periodic system leakage tests provides an acceptable method for identification of degradation.

Reactor pressure vessel closure head (RPVCH) support structure disassembly would be required to obtain access to the subject welds. In addition, the CEDM Coil Stack Assembly (drive motor coils) would require disassembly which is a high-risk activity that involves disassembly of sensitive electrical components that position control rods which function to control reactivity and safe shutdown. There is risk of damage to components during disassembly and restoration as well as alignment and post maintenance testing that could severely impact the plant with an extended off-line condition to properly obtain long lead replacement parts, if required. The estimated dose for the disassembly, examination, and re-assembly of a single CEDM to facilitate the examination of welds 1 through 4 is 3.36 rem.

The proposed alternative has been requested in accordance with the provisions of 10 CFR 50.55a(z)(2), hardship without a compensation increase in quality and safety.

For additional details on the licensee’s request, please refer to the documents located at the ADAMS Accession No(s) identified above.

STAFF EVALUATION

On April 24, 2015 (ML15026A405), the NRC approved a similar alternative, Relief Request Number 14, for the third 10-year ISI interval for St. Lucie Plant Unit 2. The St. Lucie Plant Unit 2 RPVCH, including CEDMs, was replaced in 2008. There are 96 CEDM housings with 32 CEDM housings located on the peripheral. Each CEDM housing contains five welds. ASME Code requires that all 5 CEDM housing welds in 10 percent of the peripheral CEDMs receive ISI examinations. To satisfy this requirement at St. Lucie Plant Unit 2, welds in a minimum of 4 peripheral housings would need to be inspected. As stated above, the proposed alternative is applicable to welds number 1 through 4. Weld number 5 will be inspected as required by ASME Code Section XI. Weld number 5 in twelve CEDM housings will receive an ultrasonic examination.

To perform the code required examination on welds number 1 through 4, FPL would need to disassemble the CEDM housing, such as removing the seismic shroud, cooling shroud, coil stack assembly, electrical cables, and other components. The removal and reinstallation of these assemblies would expose plant personnel to an estimated radiological dose of 3.36 rem per housing inspected. In addition, the assembly and disassembly of the CEDM housing may introduce human errors that may cause adverse effects on the operation of the CEDM. Therefore, the NRC staff has determined that it is a hardship and unusually difficult for FPL to perform either surface or volumetric examinations of CEDM weld Nos. 1 through 4 in accordance with the ASME Code, Section XI. Given this hardship, the NRC staff reviewed the licensee’s proposed alternative to determine if it provides a reasonable assurance of structural integrity of the subject components.

CEDM housing weld number 1 joins the upper pressure housing (UPH) upper end fitting to the UPH tube which are fabricated from 316 SS. The weld material used for weld number 1 is type 316L SS consumable inserts and bare wire filler material. These base and weld materials are generally considered resistant to stress corrosion cracking (SCC) in a pressurized water reactor (PWR) RCS environment with a typical dissolved oxygen content of < 20 parts per billion (ppb) and a limiting value of 100 ppb. The RCS chemistry at St. Lucie Plant Unit 2 is controlled to reduce oxygen by the chemistry control program with a steady state limit of ≤100 ppb and a normal value of < 5 ppb during normal operation. If trapped air and limited mixing of RCS fluid at the top of the CEDM UPH were to exist, resulting in a higher dissolved oxygen content, the relatively low operating temperature at weld number 1 creates an environment where SCC is unlikely to occur.

Weld number 2 joins the UPH tube to the lower end UPH end fitting, which are fabricated from 316 SS. The weld material used for weld number 2 is type 316L SS consumable inserts and bare wire filler material. As discussed above, these materials are generally considered resistant to SCC in a PWR RCS environment with a typical dissolved oxygen content of < 20 ppb with a limiting value of 100 ppb which is within the bounds of St. Plant Lucie Unit 2 RCS chemistry controls. Therefore, SCC is unlikely to occur in weld number 2.

The motor housing is fabricated from F403 modified martensitic SS using ASME Code Case N-2. Code Case N-2 requires that heat treatment for F403 is performed by either annealing or normalizing and tempering at 1250 F°. Either heat treatment produces a microstructure that has a low susceptibility to SCC. The top and bottom of the motor housing have a weld buildup (butter) using ERNiCrFe-7A (alloy 52M) weld filler metal followed by an ASME Code compliant post-weld heat treatment (PWHT) at 1250 to 1400°F. PWHT of the butter reduces residual stress and tempers the weld heat effected zone (HAZ) in the F403 material, which becomes hardened during the welding process. Reducing residual stress and tempering of the HAZ greatly reduces the potential for SCC. Alloy 52M is generally considered resistant to SCC in a PWR RCS environment, with no known cracking identified by operating experience in the US PWR fleet.

After PWHT, weld number 3 (alloy 52M) joins the F348 SS motor housing upper end fitting to the weld buildup (butter) on the F403 modified martensitic SS motor housing (top end). F348 is a columbium/tantalum stabilized stainless steel and is generally resistant to SCC in the PWR RCS environment. Therefore, it is unlikely that SCC would occur. Weld number 4 joins the alloy 52M butter on the lower end of the motor housing to the RPVCH alloy 690 penetration tube using ERNiCrFe-2 (alloy 52) filler metal or ENiCrFe-7 (alloy 152) shielded manual arc welding electrodes. Alloys 690, 52, and 152 are generally considered resistant to SCC in a PWR RCS environment, with no known cracking identified by operating experience in the US PWR fleet.

For the current St. Lucie Plant Unit 2 RPVCH, the CEDM sub-components and weld materials are similar to the previous CEDM’s except that alloy 600 material and weld material (alloys 82/182) in the original RPVCH CEDMs has been replaced with alloy 690 and its compatible alloy 52/52M/152 weld materials, which are significantly more resistant to SCC. The previous RVCH was inservice for 25-years. No degradation was reported during the 25-year service history of the old CEDMs. Given the degradation free service history of similar materials in the previous and current CEDMs at St. Lucie Plant Unit 2, the change to alloys 690/52M/52/152 in lieu of alloys 600/82/182, as well as the service history of similar CDEMs in the nuclear fleet, degradation of these welds is unlikely.

A VT-2 examination is performed of all CEDMs from the 62 ft containment elevation looking down from the platform above the CEDM housings during the reactor coolant system leakage test conducted prior to startup from each refueling outage. A mandatory RPVCH bare metal visual examination, in accordance with ASME Code Case N-729-6, as modified by 10 CFR 50.55a(g)(6)(ii)(D), is performed on the St. Lucie Plant Unit 2 RPVCH every 5 years. These examinations, coupled with the RCS inventory balance every 24 hours during operation, reactor cavity sump inlet flow monitoring system, containment atmosphere radiation gas monitoring system, and the containment atmosphere radiation particulate monitoring system, provides reasonable assurance that any significant leakage in the CEDM housings would be detected before leakage became a safety concern.

Based on the above, the NRC staff finds that the licensee's proposed alternative provides reasonable assurance of structural integrity of subject welds and is, therefore, acceptable.

CONCLUSION

The NRC staff has determined that complying with the specified requirements described in the licensee's request referenced above would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The proposed alternative provides reasonable assurance of structural integrity of the subject components. The NRC staff concludes that the licensee has adequately addressed the regulatory requirements set forth in 10 CFR 50.55a(z)(2).

The NRC staff authorizes the use of proposed alternative, Relief Request 10, at St. Lucie Plant Unit 2 for the remainder of the fourth 10-year Inservice Inspection Interval which is scheduled to end on August 7, 2023.

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

Principal Contributor: Davis, Robert

Date: September 21, 2022

David J. Wrona

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SUBJECT: ST. LUCIE NUCLEAR PLANT, UNIT NO. 2, AUTHORIZATION AND SAFETY EVALUATION FOR ALTERNATIVE RELIEF REQUEST NO. 10 - HARDSHIP OR UNUSUAL DIFFICULTY WITHOUT COMPENSATING INCREASE IN LEVEL OF QUALITY OR SAFETY (EPID L-2021-LLR-0089) DATED SEPTEMBER 21, 2022

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