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SOUTHERN COMPANY

March 16, 2015

Docket Nos.: 50-366 NL-15-0539

U. S. Nuclear Regulatory Commission
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Edwin I. Hatch Nuclear Plant - Unit 2
Feedwater Pipe to Inconel Extension Piece
Full Structural Weld Overlay
Nondestructive Examination Results - Spring 2015 Outage (2R23)

Ladies and Gentlemen:

Hatch Nuclear Plant (HNP) In-Service Inspection (ISI) Alternative HNP-ISI-ALT-08-02, Version 1.0 was developed to install weld overlays on selected dissimilar metal welds at both HNP units. The Nuclear Regulatory Commission (NRC) approved this generic alternative per NRC safety evaluation reports (SER) dated June 24, 2009 and May 26, 2011 (Accession Numbers: ML090340017 and ML11139A438, respectively). In the HNP Unit 2 - 2R23 Spring 2015 outage, Feedwater weld 2B21-1FW-12AA-8 was overlaid due to inspection issues associated with this weld (in the 2009 outage, only 30% Code coverage was obtained for this weld). This weld is an Alloy 182 weld that joins a ferritic transition piece to an Inconel safe-end extension. The overlay was required because an adequate ultrasonic examination was not possible for this weld due to the taper on the transition-piece between welds 12AA-7 and -8 and the weld overlay applied on weld 12AA-9 which encompasses part of the base material between welds 12AA-8 and -9.

The ISI Alternative states (in part) on Page 8 of 38, "SNC will provide the NRC, within 14 days after the completion of the ultrasonic examination of the weld overlay installations, (1) the examination results of the weld overlays, and (2) a discussion of any repairs to the overlay material and/or base metal and the reason for repair".

Southern Nuclear Operating Company (SNC) completed the following non-destructive examinations (NDE) on March 2, 2015 and the following is a summary of the examination results. No repairs of the overlay material or the base metal were necessary.

- Liquid penetrant (PT) examinations were performed on the original base material and subsequently on the final overlay configuration. No relevant indications were recorded.

- A visual (VT) examination was performed on the buffer layer which was applied along the entire area where the full structural weld overlay (FSWOL) was to be installed with no issues noted. Please see the detailed discussion of this examination later in this letter.
- Ultrasonic (UT) examinations were performed on the completed FSWOL using non-encoded manual phased array techniques. There were no recordable indications.

The ISI alternative provides for three specific liquid penetrant examinations to be performed prior to any welding, after applying the buffer layer and when the weld overlay has been completed. Thus, the approved ISI alternative requires a liquid penetrant examination of the non-credited buffer layer(s). Since the weld traveler required non-credited buffer layer(s), a liquid penetrant examination was to be performed as specified in the ISI alternative, but a visual examination was performed instead on the buffer layer. Note that the visual examination that was performed on the buffer layer did not meet the requirements of HNP-ISI-ALT-08-02, Version 1.0.

HNP Condition Report 10038060 was written on March 9, 2015 to document this situation. The missing liquid penetrant examination cannot be performed at this time due to additional weld overlay passes installed. SNC engaged Structural Integrity (SI) to conduct an evaluation based on their significant working history on Boiling Water Reactor (BWR) weld overlays. SI provided the results of that evaluation (Enclosure 1) which concluded that the omitted in-process surface examination is inconsequential to the integrity of the FSWOL and that no further action is required.

Corporate Engineering Programs and NDE Services have reviewed the NDE examination results. The two liquid penetrant examinations (pre- and post-overlay) showed no recordable indications. The Performance Demonstration Initiative qualified UT examination was performed on the finished weld overlay with no recordable indications. It is important to note that this examination was performed using a non-encoded manual phased-array UT technique. The UT examination consisted of two applications. The first, defined as the "weld acceptance", is a one-time examination looking for both laminar and planar indications in the applied weld material. Scanning was performed in four directions. The second application, defined as the pre-service inspection (PSI)/ISI examination, was performed to look at the outer 25% of base material under the overlay. At this time, no other NDE examinations are needed. The ISI ultrasonic examination will be repeated in either the 2R24 or 2R25 outage as required by ISI Alternative ALT-08-02. Therefore, the results of the aforementioned NDE examinations support the position that the weld overlay is acceptable for service.

This letter satisfies the 14-day examination reporting requirements from the SNC request for alternative dated June 11, 2008.

This letter contains no NRC commitments. If you have any questions, please contact Ken McElroy at (205) 992-7369.

Respectfully submitted,

C. R. Pierce

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Regulatory Affairs Director

CRP/OCV

Enclosure: 1. SI Technical Justification

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Edwin I. Hatch Nuclear Plant - Unit 2
Feedwater Pipe to Inconel Extension Piece
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Enclosure 1

SI Technical Justification

Structural Integrity Associates, Inc.®

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March 13, 2015
Report No. 1500364.401.R0
Quality Program: ☒ Nuclear ☐ Commercial

Mr. James Agold
Southern Nuclear Operating Company
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Subject: Evaluation of Edwin I. Hatch Nuclear Plant Unit 2 Feedwater System Weld 2B21-1FW-12AA-8 Full Structural Weld Overlay Surface Examination Requirements

Dear James:

This letter documents the results of SI's review of the significance of omitting an in-process surface examination during installation of a full structural weld overlay as required by Southern Nuclear ISI Alternative HNP-ISI-ALT-08-02, Version 1.0. Based on this review, we conclude that the omitted in-process surface exam is inconsequential to the integrity of the full structural weld overlay applied to feedwater system weld 2B21-1FW-12AA-8 and that no further action is required.

Should you have any questions, please do not hesitate to contact me by phone or email.

Best Regards,

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Cc: Daniel Sommerville, P.E. (SI)

Review Inputs

Review inputs provided by Southern Nuclear include:

- Southern Nuclear Condition Report 10038060, 2B21-1FW-12AA-8 Weld Overlay PT [1]
- Edwin I. Hatch Nuclear Plants 1 & 2 ISI proposed alternative for full-structural weld overlay and associated NRC Safety Evaluation [2], [3], [4], [5]
- Weld overlay dimensions [6]

Weld overlay design for weld 2B21-1FW-12AA-8 was performed by Structural Integrity (SI) in 2008 and 2009. Relevant SI documents include:

- Weld overlay structural sizing calculation [7]
- Weld overlay design report [8]
- Weld overlay drawing [9]

Background

During the Edwin I. Hatch Nuclear Plant Unit 2 (HNP2) spring 2015 2R23 refueling outage, Feedwater System weld 2B21-1FW-12AA-8 was mitigated by a full structural weld overlay (FSWOL). The weld overlay was applied preemptively as a result of a physical configuration that prevented Code-compliant volumetric examination of the weld.

The weld overlay design was completed by SI in 2008 and 2009 [7], [8]. Figure 1, excerpted from Reference [9], illustrates the weld overlay design. The FSWOL of 2B21-1FW-12AA-8 was completed using a high-chromium nickel-base weld filler material (Alloy 52M) and abuts a pre-existing nickel-base Alloy 82 weld overlay of adjacent weld 2B21-1FW-12AA-9. The overlaid components include the safe end extension (Alloy 600), a carbon steel transition piece (SA-508 Cl. 1), feedwater system piping (SA-106 Grade B carbon steel) and welds 2B21-1FW-12AA-8 (Alloy 182) and 2B21-1FW-12AA-7 (ferritic similar metal weld). [8]

Prior to application of the FSWOL of weld 2B21-1FW-12AA-8, an initial surface exam of the repair area was performed, with no unacceptable indications identified. Following completion of the FSWOL, an acceptance and preservice examination was performed using both surface and volumetric examination techniques. No unacceptable indications were identified. In the process of documenting the FSWOL, Southern Nuclear Operating Company (SNC) identified that the in-process surface examination typically performed on any buffer or sacrificial layers of weld metal applied had not been performed. A condition report was initiated to document the omission.

Discussion

An in-process liquid penetrant surface exam of any buffer or sacrificial weld layers applied is considered to be good practice for all weld overlays. Such examinations provide improved assurance that the final volumetric examination will not detect indications in this region.

However, there are a number of reasons why the omission of this surface examination does not result in a non-conformity.

First, Code Case N-740-1 [10] does not require an in-process liquid penetrant surface examination for all weld overlays. SNC alternative ISI-ALT-08-02 [2] takes guidance from ASME Code Case N-740-1. Specifically, Code Case N-740-1 requires surface examination only when a weld metal layer is applied to seal unacceptable indications identified in the area to be repaired. In this case, the initial liquid penetrant surface exam of the area to be repaired did not identify any unacceptable indications and thus, consistent with Code Case N-740-1, an in-process surface examination is not required. SI notes that Code Case N-504-4 [11] includes similar wording and does not require a surface examination of buffer or sacrificial weld layers when the initial surface examination of the area to be repaired does not identify unacceptable indications.

Second, the FSWOL in question is a somewhat different case than the generic cases addressed by the SNC alternative. In order to address multiple weld overlay configurations and scenarios, the SNC alternative was necessarily written in a generic fashion. As such, the text of the alternative is written generally and must include the potential for overlay of austenitic stainless steel base metal. When overlaying stainless steel base metal with nickel-base weld filler material, the application of a stainless steel buffer layer is necessary, as is application of bridge beads to tie the stainless steel buffer layer to any Inconel weld material. Industry experience with overlays involving stainless steels is that there is a significant potential for cracking to occur in these bridge beads and stainless steel buffer layers. Experiments performed by EPRI have demonstrated that impurities in austenitic stainless steel base materials promote hot cracking in high-chromium nickel-base welds. For the base materials and weld metals included in this study, the results show that there is high assurance that hot cracking will not occur when weld dilution is kept below threshold values [12]. Therefore, when overlaying an austenitic stainless steel component, an in-process liquid penetrant surface exam is highly recommended after application of the stainless steel buffer layer.

In contrast, a stainless steel buffer layer as described above was not necessary for the FSWOL of weld 2B21-1FW-12AA-8. The overlay region includes only carbon steel, Alloy 600, and Alloy 82/182 materials. All weld layers were applied using Alloy 52M. To ensure that minimum chromium requirements are met, it is sometimes necessary to instead include an Alloy 52M sacrificial layer. Although such a layer was not required for this case[1], review of the final weld overlay dimensional drawing prepared by Welding Services Inc. (WSI) [6] indicates that an Alloy 52M sacrificial layer was in fact included.

In SI's experience, there have been few welding issues associated with the use of Alloy 52M in applications not involving overlay of stainless steel base metals. Thus, the importance of a liquid penetrant surface exam of the Alloy 52M sacrificial layer was substantially reduced simply because there was less risk of unacceptable indications.

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[1] SI Report 0800742.402 [8] states: "*Extensive weld overlay repair welding in light water reactors and laboratory evaluations have determined that welding Alloy 52M filler over LAS nozzle material will produce sufficient chromium in the initial weld deposited layer to meet the minimum requirements for resistance to IGSCC (20% Cr per Code Case N-740 for BWRs). Consequently, all deposited weld layers will be considered as IGSCC resistant structural replacement material for the WOL.*"

Finally, regardless of any examinations performed prior to or during application of the FSWOL, successful completion of the acceptance and preservice examinations are credited to ensure the integrity of the FSWOL. The surface examination performed after application of buffer or sacrificial weld layers is performed only as a good practice to ensure that there are no surface-connected indications that would result in rejecting the FSWOL during the acceptance and preservice UT examinations. In the case of the FSWOL of 2B21-1FW-12AA-8, regardless of the omission of a liquid penetrant surface examination after application of the Alloy 52M sacrificial layer, the acceptance and preservice UT did not identify any unacceptable indications.

Conclusion

For the reasons summarized above, it is SI's opinion that the omission of the liquid penetrant surface examination typically performed after application of a buffer or sacrificial weld layer in no way adversely impacts the integrity of the FSWOL associated with weld 2B21-1FW-12AA-8. Further, based on the results of the acceptance and preservice examination results, there is no basis for concern regarding the integrity of the FSWOL.

Prepared by:

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Verified by:

Nick Mohr, P.E. Associate	3/13/2015 Date

Verified by:

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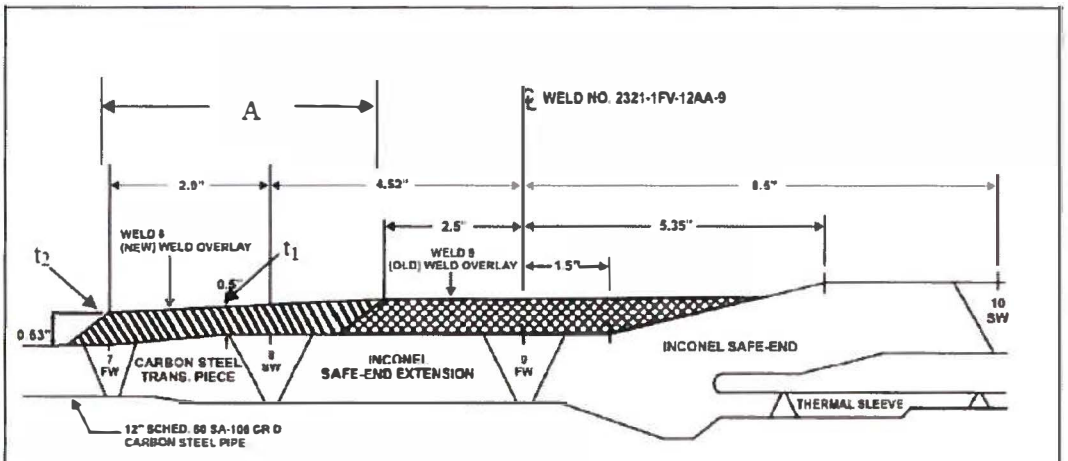
Wayne Lunceford, P.E.	3/13/2015 Date



WELD NUMBER	FLAW CHARACTERIZATION	DESIGN DIMENSIONS			COMMENTS
		t_1	t_2	A	
Feedwater Nozzle Weld #8	Assumed 360° Circ. 100% through wall flaw	12.7 mm (0.5") at weld #8/carbon steel interface	16.00 mm (0.63") at weld #7 centerline	Approximately 124.97 mm (4.92") See Note 6.	Tie new overlay into existing #9 overlay and full thickness to centerline of #7 overlay.

0	MLH 12/26/08	AJG 12/26/08	MLH 12/26/08	
Revision	Prepared by/Date	Checked By/Date	Approved by/Date	COMMENTS

Job No: 0800742.00	Plant/Unit:	STRUCTURAL INTEGRITY ASSOCIATES, INC.
File No: 0800742.501	Hatch Unit 2	
Drawing No: 0800742.501	Title: Standard Weld Overlay Design	Sheet 1 o 2

Figure 1: Weld Overlay Design Sketch for Weld #8 [9])[2]

[2] Note: A typographical error exists in this SI Drawing. The carbon steel feedwater system piping is identified as SA-106 Gr. D. The correct grade is Gr. B. A revision of this SI drawing will correct this error. This typographical error has no impact on the FSWOL analysis since the correct material grade was used in the analysis.

References

[1] Southern Nuclear Condition Report 10038060, 2B21-1FW-12AA-8 Weld Overlay PT. (SI File No. 1500364.201)

[2] SNC Letter to U.S. NRC NL-08-0877, Edwin I. Hatch Nuclear Plant Units 1 & 2 Proposed Alternative in Accordance with 10 CFR 50.55(a)(3)(i), Application of Dissimilar Metal Weld Full-Structural Weld Overlays, Alternative ISI ALT-08-02 Version 1. June 11, 2008. (ADAMS Accession No. ML090260295)

[3] U.S. NRC Safety Evaluation: Inservice Inspection Program Request for Alternative for Edwin I. Hatch Nuclear Plant, Unit Nos. 1 and 2, Southern Nuclear Operating Company, Inc., Docket Nos. 50-321, 50-366. June 24, 2009. (ADAMS Accession No. ML090340017)

[4] SNC Letter to U.S. NRC NL-11-0692, Edwin I. Hatch Nuclear Plant Units 1 & 2 Discrepancies Identified Between Alternative ISI-ALT-08-02 and the NRC Safety Evaluation. April 27, 2011. (ADAMS Accession No. ML111250064)

[5] U.S. NRC Letter, Edwin I. Hatch Nuclear Plant Unit Nos. 1 and 2, Correction to Safety Evaluation Inservice Inspection Program Alternative Issued June 24, 2009. (ADAMS Accession No. ML11139A438)

[6] AZZ / WSI Drawing 426317, Revision 0, Drawing Construction WOL Feedwater Nozzle, Hatch Unit 2, January 28, 2015. (SI File No. 1500364.202)

[7] SI Calculation: Weld Overlay Structural Sizing Calculation for Feedwater Nozzle Weld #8 – Hatch Unit 2, Revision 0, Dec. 26, 2008. (SI File No. 0800742.302)

[8] SI Report: Weld Overlay Design Report for the Hatch Nuclear Plant Unit 2 Feedwater Weld 2B21-1FW-12AA-8, Revision 0, March 24, 2009. (SI File No. 0800742.402)

[9] SI Drawing: Standard Weld Overlay Design – Hatch Unit 2 Feedwater Weld #8, Revision 0, Dec 26, 2008. (SI File No. 0800742.501)

[10] ASME Boiler and Pressure Vessel Code, Code Case N-740-1, "Dissimilar Metal Weld Overlay for Repair or Mitigation of Class 1, 2, and 3 Items, Section XI, Division 1", Approved January 4, 2008.

[11] ASME Section XI Code Case N-504-4, "Alternative Rules for Repair of Classes 1, 2, and 3 Austenitic Stainless Steel Piping, Section XI, Division 1", Approved July 14, 2006.

[12] Welding and Repair Technology Center: Measures to Minimize 52M Hot Cracking on Stainless Steel Base Materials, EPRI, Palo Alto, CA: 2014. 3002003140. (**EPRI Proprietary Information**)