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SOUTHERN COMPANY

MAY 14 2014

Docket Nos.: 50-321
50-366

NL-14-0672

U. S. Nuclear Regulatory Commission
ATTN: Mr. Richard Croteau
Director Reactor Projects
Office of the Regional Administrator, Region II
245 Peachtree Center Avenue, NE
Suite 1200
Atlanta, Georgia 30303-1257

Edwin I. Hatch Nuclear Plant
Unit 1 Updated Status/Analysis of Core Shroud

Ladies and Gentlemen:

This letter is being provided at the request of Nuclear Regulatory Commission (NRC) management to support a more complete understanding of the results from recent inspections of the Hatch Unit 1 core shroud as well as resulting actions (taken/planned) and evaluations performed that were associated with that activity.

By letters dated December 3, 2004 (ML043430471) Southern Nuclear Operating Company (SNC) provided to the Nuclear Regulatory Commission (NRC), an updated analysis of the findings for the Edwin I. Hatch Nuclear Plant Unit 1 flawed Core Shroud Vertical welds based upon examination results obtained during the Spring 2004 Refueling Outage. The results of that examination and evaluation indicated that the end of interval (EOI) for re-examination should be 10 years for the two flawed core shroud vertical welds designated V5 and V6. This analysis was reviewed by the NRC staff and responses to requests for additional information were provided in a letter dated April 15, 2005 (ML051100309). The staff concluded in a letter dated November 10, 2005 (ML053110060) that the flaw evaluation met the intent of the American Society of Engineers Code Section XI (ASME XI) and demonstrated that the unit could be operated without repair of flawed vertical welds V5 and V6 for the analyzed interval of 10 years. Accordingly, SNC performed a re-examination of the two flawed vertical welds during the twenty-sixth refueling outage in the spring of 2014.

During the Spring 2014 Refueling Outage, SNC also performed activities intended to provide a broader structural and aging management assessment of the Hatch 1 core shroud. This effort was partly based on indications previously identified via visual examination techniques that while not structurally significant

were atypical and possibly indicative of irradiation effects. Included in this inspection campaign was volumetric examination of additional vertical welds, volumetric examination of the atypical visual indications of the shroud and obtaining a boat sample from a highly irradiated shroud location.

A summary of the inspection results is provided in Enclosure 1. Also enclosed is the Core Shroud Weld Identification sketch (Enclosure 2). As of this date the boat sample obtained during the Spring 2014 outage is awaiting submittal and subsequent NRC approval of the vendor-supplied shipping container.

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

Enclosures:

1. Plant Hatch Unit 1 Spring 2014 Core Shroud Inspection and Evaluation Summary
2. Drawing, Core Shroud Weld Identification Roll Out (Inside View)

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Edwin I. Hatch Nuclear Plant
Response to Request for Additional Information

Enclosure 1

Plant Hatch Unit 1 Spring 2014 Core Shroud
Inspection and Evaluation Summary

Background/History

The Hatch Unit 1 Core shroud is fabricated with type 304 stainless steel plate rolled and welded vertically and horizontally as depicted in Enclosure 2. All of the similar metal welds were performed at the fabricator's facility and shipped in the "as-welded" condition. The Boiling Water Reactor (BWR) fleet began experiencing Intergranular Stress Corrosion Cracking (IGSCC) in core shroud welds as early 1992. Southern Nuclear Operating Company (SNC) preemptively installed a tie rod modification in 1994 to structurally replace shroud horizontal welds H1-H8. The tie rod modification depends upon vertical weld integrity thus requiring a regimen of vertical weld inspection.

Visual examinations were performed on the shroud vertical welds beginning in H1R16 (1996) and detected cracking at V5 and V6 which was evaluated as acceptable. An ultrasonic volumetric examination (UT) was performed on welds V3 through V8 during H1R17 (1997) and repeated during H1R21 (2004) for welds V5 and V6. At the time of initial UT, the technique was not fully demonstrated for sizing. Therefore, the examinations were considered for "information only" but did not yield results that necessitated a revised flaw evaluation. Indications of varying length were recorded on V5, V6, V4 and V8 during H1R18 (1999) visual examinations. The indications on V4 and V8 were sufficiently small to meet Boiling Water Reactor Vessel Inspection Program, BWRVIP-76, guidance for a 10-year re-inspection interval. The indications on V5 and V6 were somewhat longer and prompted a plant specific analyses which determined a re-inspection in 2004. The 2004 evaluation of V5 and V6 was based on the UT examination during H1R21 (2004). This analysis was submitted to and reviewed by the Nuclear Regulatory Commission (NRC) staff in 2005 [ML053110060] and established a ten year re-inspection interval. As part of the recovery effort from tie rod upper support cracking detected in H1R22 (2006), shroud horizontal weld UT examinations were conducted which established acceptable structural integrity of the horizontal welds to demonstrate redundancy to the degraded tie rod assemblies. During H1R23 (2008) the planned replacement of all four tie rod upper supports could not be completed. The existing upper supports in two locations were left in place. As part of the effort to justify structural integrity for another fuel cycle, shroud horizontal weld UT examination was again conducted during H1R23 (2008). In H1R24 (2010), the final two upgraded upper supports were installed and the shroud repair returned to full long term functionality.

During the H1R23 (2008) outage two-sided visual examinations of shroud vertical welds V3, V4, V7, and V8, and single-sided visual examinations of shroud vertical welds V1, V2, V9, V10 and V11 were completed. Some new indications were recorded at the inner surface of V4, V7, and V8. The indications on V7 and V8 appeared to be vertical branching components of horizontal weld H5 flaws and were small enough to meet BWRVIP-76-A screening criteria. The indications on V4 required evaluation and appeared to traverse through the horizontal weld H4 which is atypical of IGSCC. All the indications on V4 have aspects suggesting

Irriadiation Assisted Stress Corrosion Cracking (IASCC). An INPO operating experience report, OE 080614-004, was issued to alert the industry and re-examinations were performed during H1R24 (2010) to better interrogate the inner diameter (ID) high fluence intersections. Prior to H1R24 (2010), the flaws were evaluated based on the H1R23 (2008) flaw lengths. During H1R24 (2010), these locations were visually reexamined in order to obtain improved flaw characterization. No new flaws were detected and the evaluation prepared prior to H1R24 (2010) was determined to be conservative and still applicable. This operating experience was shared with the industry.

H1R26 Shroud inspection scope

Based on flaws characterized during H1R21 and evaluated per BWRVIP guidance, a re-examination was due in 2014 (1R26). In conjunction with the BWRVIP-required examination an extensive inspection campaign was planned to facilitate an assessment of the overall Unit 1 shroud material condition. The plan included UT examination of additional shroud vertical welds, off-axis UT scanning to better characterize indications visually detected outside the heat affected zone (HAZ) of high fluence vertical-horizontal weld intersections and a boat sample to determine material properties and accumulated fluence. This campaign was supported by the BWRVIP and intended to provide sufficient information to develop a long term strategy for the Unit 1 shroud and for the BWRVIP to assess current shroud inspection and evaluation strategies.

Below is a summary of shroud examinations completed during H1R26:

- Volumetric UT of 8 out of 11 vertical welds (BWRVIP-76-A)
- V5 and V6 repeated UT examinations from 2004 (BWRVIP-76-A)
- Volumetric UT of horizontal/vertical weld intersections H4/V4, H5/V8 & H5/V7 (augmented examinations to further characterize atypical indications visually detected during 2008)
- Visual examination from the outer diameter (OD) of 3 vertical welds, inaccessible via UT or ID visual (BWRVIP-76-A)
- Visual examination of ≈36% of shroud ID surfaces (ASME Code Section XI, surfaces made accessible by scheduled removal of fuel)
- Visual examination of ≈50% of shroud OD surfaces (ASME Code Section XI)

As part of the augmented examinations SNC's inspection vendor, in a joint effort with SNC, the BWRVIP and the EPRI-NDE center, successfully demonstrated a UT procedure and transducer package capable of detecting and sizing atypical indications similar to those seen at Hatch. The intent was to use the UT information of these atypical indications to choose an optimum location from which to obtain the planned boat sample.

Boat Sample decision process

The boat sample location was to be based on UT examination results at the H4/V4, H5/V8 or H5/V7 intersections as these were the locations of the atypical indications. Locations were pre-selected for planning/execution purposes as candidate boat sample locations at both H4/V4 and H5/V8 intersections, with a decision tree providing options to choose elsewhere if UT criteria were not met. One of the pre-selected visual indications at H5/V7 met the UT criteria for the boat sample. The remaining 2 locations at H5/V7 were not detected via UT. However, the H5/V7 intersection is at a lower fluence in comparison to the H4/V4 intersection and thus less desirable for material testing if a higher fluence location otherwise met the criteria. All three pre-determined axial flaws at H4/V4 failed the UT criteria for taking a boat sample because leaving a through-wall remnant flaw had not been included in the analysis for an as-left configuration. The decision criteria were compared against other newly identified part-through-wall (UT) flaws in the vicinity of the H4/V4 intersection. A flaw located at ~9.5 inches counter clockwise from V4, and ~1.5 inches above H4, approximately 0.8 inches deep, was chosen based on the pre-outage decision criteria and a boat sample was obtained. The sample currently resides in the Plant Hatch Unit 1 Fuel Pool awaiting submittal and subsequent NRC approval of the Class B shipping container so that it can be sent to the hot-cell equipped laboratory contracted by the BWRVIP.

H1R26 Shroud Exam Results

As described earlier the intent of the shroud examinations was to comply with BWRVIP requirements which had established a re-examination interval of ten years for the long, limiting flaw in the HAZ of vertical weld V6. This weld and the flawed V5 weld were UT examined from the ID in essentially the same manner as the previous examination in 2004. The limiting flaw in the HAZ of V6 did not change in length (20.3") since 2004 but depth progressed from 78% through-wall (TW) maximum to 100% TW for 13" of the flaw length, well within predicted crack growth rates (CGR) from BWRVIP guidance. The longest flaw along V5 had little change in length and depth progressed from 61% TW to 80% TW. A summary of vertical welds examined with UT is depicted in the table below:

Weld Identification	Weld length	% of Examined Weld length	% of Examined length flawed
V3 @140°	36"	82.0%	0%
V4 @320°	36"	91.0%	10.2%
V5 @50°	98"	97.1%	21.7%
V6 @ 230°	98"	96.9%	32.2%
V7 @140°	36"	84.8%	12.7%

V8 @320°	36"	86.4%	1.9%
V9 @50°	52"	63.2%	0%
V10 @170°	52"	90.0%	0%

Visual VT-3 examinations were performed of the shroud inner diameter per ASME Code Section XI Table IWB-2500-1 B-N-2 Item B13.40 "accessible surfaces". In addition to detecting indications associated with welds/HAZ, 4 indications at 3 azimuths were detected in the base metal plates at locations unassociated with a weld. Three of these indications were ≈ 3" long (one was 5/16"), and all were in higher fluence areas with clear visual evidence of surface grinding. One of the 3" long flaws was examined with UT with a maximum depth of 0.52" and with length in agreement with the visual measurement.

UT examination conducted at the intersections of H4/V4, H5/V7 and H5/V8 provided some expected and some unanticipated results. The 2 flaws detected at the intersection of H5/V7 were associated with horizontal weld HAZ IGSCC, initiated from the ID and were parallel to H5 in the HAZ below H5. Indications of this type at H5/V7 thus did not yield unanticipated or atypical results. Seventeen flaws were detected at the intersection of H5/V8 with surface-connection to both the ID (9 flaws) and OD (8 flaws). The scan lengths were 28" on the top side of H5 and 30" on the bottom side of H5. The flaws were all relatively shallow with no depth recorded to be greater than 23% through-wall (0.34") and all but one flaw were in the HAZ above H5. This intersection also did not exhibit atypical or unanticipated indications.

Unanticipated flaws were detected by the UT of the H4/V4 intersection. Similar to the other intersection scans, approximately 15" clockwise and counterclockwise from the vertical weld intersection (30" total scan length), above and below H4 was scanned with transducers oriented left/right and up/down. Four axially oriented through-wall flaws were detected near the intersection of H4/V4. Three of these flaws were the pre-selected candidates for a boat sample and the fourth was newly identified during H1R26. The lengths varied from ≈5.3" – 8" long. The through-wall nature of these flaws was unexpected. Two additional ID connected axial flaws >50% through-wall were detected and one of these flaws was selected for the boat sample. The H4/V4 intersection UT scan also detected ≈40 axially oriented, part-through-wall flaws that were OD surface connected (3.3" maximum length, 0.3" maximum depth).

SNC Actions in Response to Shroud Exam Results

SNC prepared structural evaluations prior to the outage. The evaluations assumed that all existing flaws were through-wall for the assessment of structural integrity and were grown in length in accordance with BWRVIP-99-A

requirements. The limiting flaw at V6 continued to pass structurally for a 10-year reexamination interval when extrapolated.

The structural evaluation was updated during H1R26 to include all additional flaws and updated flaw inspection results. This updated structural evaluation demonstrated structural flaw tolerance for an additional 10 years. Per BWRVIP-76-A guidance, the through-wall observations prompted a leakage assessment for comparison against LOCA analysis assumptions. The results of this assessment showed adequate margin in assumed ECCS flows to bound conservatively assumed shroud leakage rates and the existing LOCA analysis is acceptable for continued operation. This assessment was initially made for flaw growth projected over one cycle of operation and shortly thereafter updated to include two cycles of crack growth and accompanying leakage. This assessment results in more frequent inspections.

ASME Code Section XI and BWRVIP scope expansion requirements were reviewed and determined to be satisfied, as documented in corrective action program technical evaluations. The ASME Code examinations will be repeated under successive examination criteria no later than H1R28.

The flaws at the vertical welds and shroud weld intersections were structurally evaluated to be acceptable for a 10 year inspection interval, and are assessed for leakage with cracks extending for two cycles. SNC plans to re-examine the through-wall flaws no later than H1R28 (2018) unless a re-evaluation is successful in demonstrating adequate leakage margin exists to allow continued growth of the through-wall flaws for additional fuel cycles. It should be noted that SNC is transitioning to GNF-2 fuel beginning in 2016 on Hatch Unit 1 and as part of this transition an updated LOCA analysis will be prepared which will take into account the most recent shroud examination results.

SNC response – Communications to industry/NRC to-date

SNC notified the BWRVIP of unexpected through-wall cracking at H4/V4 and base metal indications.

Industry calls were held with the BWRVIP Integration, and Materials Executive committees to communicate these unexpected conditions, as well as the evaluation status of the shroud via PowerPoint presentation.

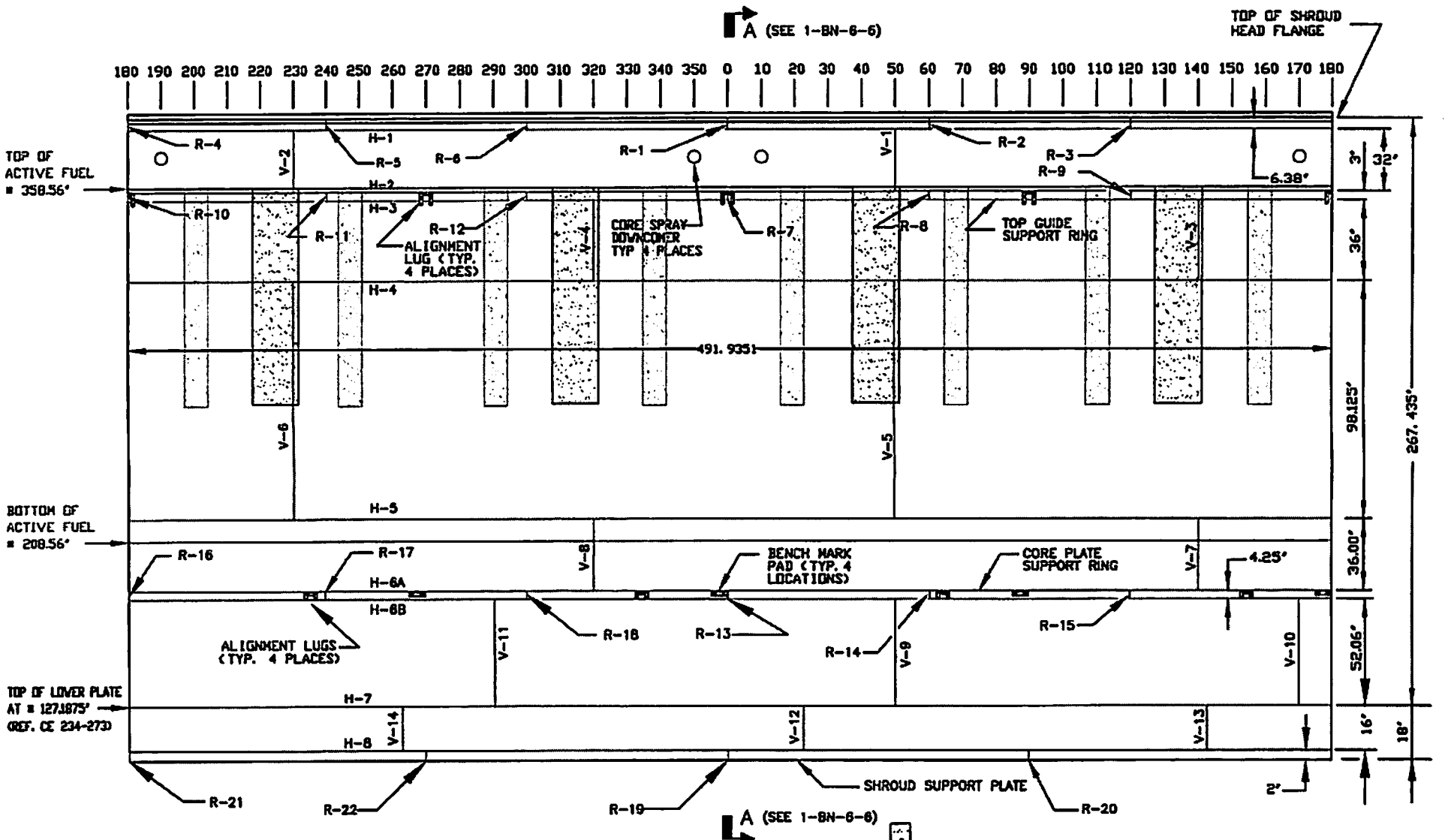
The Institute of Nuclear Power Operations was notified prior to the BWRVIP Integration committee teleconference, and was also represented during the teleconference. The Hatch NRC senior resident was briefed during the outage. Program engineers responded to informal questions from the Region II NRC-ISI inspector via email. As required by ASME Code Section XI, SNC will include shroud evaluations in the H1R26 OAR Form within 90 days after completion of the refueling outage. As required by participation in the BWRVIP, SNC will document a summary of the H1R26 BWRVIP inspection results to the BWRVIP within 120 days of the outage per BWRVIP-94 guidance.

BWRVIP Actions

The BWRVIP is funding and facilitating the boat sample destructive examination and analysis. An industry team is overseeing the sample analysis. The Nuclear Reactor Regulation (NRR) branch chief was briefed by the Integration Chair during the Hatch outage. The BWRVIP has formed a focus group to assess the recent shroud Operating Experience which conducted its first teleconference on 4/18/14. The results of the material testing of the boat sample planned for 2015 could factor into future inspection and repair contingency planning whether plant specific to Hatch or with potentially new or revised BWRVIP guidance.

Edwin I. Hatch Nuclear Plant
Response to Request for Additional Information

Enclosure 2
Drawing, Core Shroud Weld Identification Roll Out (Inside View)



= ZERO REFERENCE IS BOTTOM HEAD TORUS INVERT.

TYPICAL VERTICAL WELD (WELDS V-1 THRU V-11)

AREAS OF HIGH FLUENCE (> 1 MEV) CLOSEST TO THE SHROUD.

AREAS OF HIGH FLUENCE (> 1 MEV) CLOSE TO THE SHROUD.

DATE	12-19-00	9-4-94	02-10-89
REV	3	1	2

SOUTHERN NUCLEAR COMPANY

REFERENCE DRAWINGS
S-15122 (COMBUSTION ENGINEERING)
S-17857 (SUN SHIPBUILDING & DRYDOCK CO.)
S-18749 THRU S-18754 (SUN SHIPBUILDING & DRYDOCK CO.)
S-19622 (GENERAL ELECTRIC)

PROJECT	TITLE				
E I HATCH UNIT 1	CORE SHROUD WELD IDENTIFICATION ROLL OUT (INSIDE VIEW)				
	ITS REVIEW	ITS APPL.	DRAWN BY	SKETCH NUMBER	
	DRG	DMS	KFW	1-BN-6-5	