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REVIEW OF IP2 1997 STEAM GENERATOR EDDY CURRENT PROGRAM

Ian Barnes, July 25, 2000

The contents of Westinghouse Procedure DAT-IP2-001, "Data Analysis Technique Procedure," Revision 0, were compared against the requirements of the Electric Power Research Institute (EPRI) "PWR Steam Generator Examination Guidelines," Revision 4. Subsequent reference to the latter document will be as "EPRI Guidelines, Revision 4." Westinghouse Procedure DAT-IP2-001, Revision 0, provided the analysis guidelines that were in effect for the steam generator (SG) tubing eddy current examinations conducted during the 1997 Indian Point 2 Cycle 13 refueling outage. The areas of primary focus during this review were: (a) the training and testing of eddy current analysts, (b) conformance of Procedure DAT-IP-001, Revision 0, to the EPRI Guidelines, Revision 4, and (c) the adequacy and qualification status of the technique used for plus point probe examination of low radius u-bends.

1 TRAINING AND TESTING OF ANALYSTS

Section 6.2 (Site-Specific Performance Demonstration) of the EPRI Guidelines, Revision 4, states, in part, "...The actual preparation and administration of the analyst demonstration program should be approved by the utility with assistance from the ISI vendor, another vendor not involved in the steam generator examination, or other qualified individuals. It is important that strict rules be established during the initial preparation and future maintenance and updating of the performance demonstration so that the overall integrity of the program is maintained...."

A number of requests were made prior to and during the June 19-23, 2000, onsite inspection for the furnishing of lesson plans and practical test data that were utilized for the training and testing of the1997 refueling outage eddy current analysts. On July 14, 2000, Westinghouse personnel faxed additional information to supplement test scores that had been previously provided. The received information consisted of: (a) a copy of a handwritten log for May 4-10, 1997, describing onsite activities; (b) a one page training introduction outline, (c) setup instructions for the combined Cecco-5 and bobbin probe, and (d) information regarding the contents of the practice data sets. No information was received regarding the contents of the written and practical tests. The practice data sets for the plus point probe (Reels 12 and 20) were noted to contain inside diameter (ID) flaws at free span locations. Due to the lack of identification at IP2 of primary water stress corrosion cracking (PWSCC) in low radius u-bends prior to 1997, data from other SGs was used for the plus point practice data sets.

The inspectors considered the incomplete status of the eddy current analyst training and testing information to be an indicator that the site-specific performance demonstration requirements of the EPRI Guidelines, Revision 4, had not been appropriately implemented for the 1997 refueling outage. Specifically, the submitted information, and the elapsed time in obtaining it, were not indicative of the establishment of strict rules

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relative to preparation, maintenance, and updating of the site-specific performance demonstration. Due to the delay in obtaining records, the degree of involvement of the licensee in the process for training and testing of eddy current analysts was not established.

2 DATA ANALYSIS GUIDELINES

Review of Westinghouse Procedure DAT-IP2-001, Revision 0, showed that the guidance for plus point probe examinations was provided in the context of the use of combination rotating probes containing a standard pancake coil (115 mils diameter), a plus point coil, and a high frequency shielded pancake coil (80 mils diameter). These probes were indicated by the Eddy Current Probe Authorization List, Revision 1, dated May 14, 1997, to have Appendix H (of the EPRI Guidelines) qualifications and to be authorized for use in characterization of indications in dented intersections and restricted tubes. Separate guidance was not included with respect to the use of the medium frequency plus point probe for examination of low radius u-bends. Table 7 of this procedure, entitled "Set-Up For +Point," was noted to inappropriately require the analyst to adjust phase rotation so that probe motion was horizontal. The inspectors considered this guidance to be technically deficient, due to the insensitivity of the plus point probe to probe motion resulting in too small a signal to allow the adjustment to be accurately accomplished. It was further noted that the analyst was also instructed by Table 7 to establish a phase rotation setting of 30-35°for a 100% through-wall (TW) EDM notch. Use of a 30° phase rotation setting for the 100% TW notch was estimated by NRC staff to result in the rotation setting for a 20% TW EDM notch being ~2° (at 300 kHz), which would suggest that the ability to detect small PWSCC indications would be negatively impacted.

Other subject areas noted where strengthening of the procedure appeared warranted were:

- Inclusion of specific guidance relative to screening low frequency bobbin coil data for the presence of loose parts. The only current reference to loose parts noted during the review was in paragraph 9.2.1 which instructed the analyst to consider loose parts found in the SG when evaluating bobbin coil data.

- Development of more explicit guidance relative to data quality expectations, including measures to detect probe skipping and hanging.

3 LOW RADIUS U-BEND EXAMINATION TECHNIQUE USED IN 1997

The inspectors were informed by licensee personnel that the licensee technical requirements for the 1997 SG tube examinations (Cycle 13 refueling outage) were contained in Specification No. NPE-72217, "Eddy Current Examination of Nuclear Steam Generator Tubes, Indian Point 2," Revision 10. Paragraph 4.3 of this specification states, in part, "...The examination technique shall be performed using qualified methods that are capable of detecting axial, skew, and circumferential cracking. The techniques used shall be qualified to the EPRI Steam Generator Examination Guidelines, Appendix H,"

The inspectors ascertained from review of the EPRI Performance Demonstration Data Base that the current qualified EPRI technique (ETSS # 96511Pwscc_ubend.doc), for detection of circumferential and axial PWSCC in low radius u-bends, was included in the EPRI data base in May 1996. This technique utilized a calibration standard containing 100% TW axial, and 40% TW axial and circumferential inside diameter EDM notches. A phase rotation setting of 10° was specified in the section of the ETSS entitled, "Data Analysis," for the 40% TW circumferential and axial notches. The "Analysis Guidelines" portion of ETSS 96511Pwscc-ubend.doc indicated, however, the use of a 10-15°phase rotation setting for the 40% TW EDM notches. The NRC staff estimated that use of a 10° setting for the 40% ID EDM notch would result in a rotation setting for a 20% TW EDM notch of ~2°, which could potentially negatively impact the ability to detect small PWSCC flaws.

It was ascertained from review of Westinghouse Drawing 1B79882, Revision 0, which pertained to the ACGT-006-97 EDM notch calibration standard that was used for the 1997 plus point probe examinations of low radius U-bends, that the calibration standard did not include the 40% TW inside diameter axial and circumferential EDM notches required by ETSS # 96511Pwscc_ubend.doc. This drawing was approved on March 14, 1997, shortly before the May 1997 refueling outage. The reasons were not established why Westinghouse did not: (a) manufacture a calibration standard for the 1997 examinations which contained 40% TW axial and circumferential ID EDM notches, and (b) conform to the requirements of ETSS # 96511Pwscc_bend.doc which had been in existence for approximately 1 year.

The 1997 analysis of SG low radius u-bends at IP2 was performed in accordance with the requirements of Analysis Technique Specification (ANTS) Sheet # IP2-97-E, Revision 0. This ANTS sheet instructed the analyst to adjust phase rotation so that probe motion was horizontal, which was both not in accordance with ETSS # 96511Pwscc_ubend.doc and, as discussed in **2.** above, was considered technically deficient by the inspectors. The ANTS sheet additionally provided no instructions to the analyst with respect to the phase rotation criteria to be used for axial or circumferential notches. This omission resulted in the 1997 analytical technique requirements not being consistent with the requirements of either ETSS # 96511Pwscc_ubend.doc or the Westinghouse equivalency qualification discussed in **4.2** below. The effect of essentially delegating calibration setup requirements to individual analysts was illustrated by review in 2000 of the 1997 examination set-up that was used for Calibration Group 58 (i.e., the calibration group containing the failed SG 24 tube, R2C5). This review determined from the stored setup that a phase rotation setting of 28° for the 100% TW notch had been used for Calibration Group 58, with accompanying negative impact on ability to detect small PWSCC flaws.

The use of an unqualified technique in 1997 for examination of low radius u-bends is viewed as a violation of Criterion IX of 10CFR50, Appendix B, and paragraph 4.3 in Specification No. NPE-72217, Revision 10.

4 WESTINGHOUSE PLUS POINT PROBE TECHNIQUE QUALIFICATION

4.1 Roll Expansions and Dented/Non-Dented Intersections

Included in the documents furnished by Westinghouse for NRC review was an extract from Calculation Note DDM-96-009, "Documentation of Appendix H Compliance and Equivalency." Appendix 1 of this document pertained to the plus point coil. During review of Appendix 1, the inspectors noted than an examination technique specification sheet, File: pls-pt18.doc, dated April 26, 1996, also contained questionable phase rotation settings. The stated examination scope for File: pls-pt18.doc was PWSCC and outside diameter stress corrosion cracking in expansions and dented and non-dented intersections. The phase rotation settings for a 100% TW EDM notch was indicated to be ~20°, and probe motion horizontal. Establishing a phase rotation of 20° for a 100% TW EDM notch was estimated by the NRC staff to result in the rotation setting for a 20% TW EDM notch being less than zero and the rotation setting for a 40%TW EDM notch being of the order of 3-5°. These rotation settings were viewed as potentially having a significant negative affect on the ability to detect PWSCC flaws.

4.2 Low Radius U-Bends

The qualification document furnished by Westinghouse for plus point probe examination of low radius u-bends was entitled, "Eddy Current Low Row U-Bend Examination, MIZ-18A and TC6700, Non-Mag. Bias and Mag. Bias Equivalency Qualification." The document was undated and did not contain an alpha-numeric identifier. The purpose of this equivalency qualification was to demonstrate that the magnetic bias plus point probe (which was used for examination of the IP2 low radius u-bends) had comparable detection capability to the non-magnetic bias plus point probe. The EPRI raw data and standards for ETSS # 96511Pwscc_ubend.doc were utilized in the equivalency qualification process.

Review of the qualification document showed that a phase rotation setting of 40° for a 100%TW hole was utilized in the qualification process. This setting was estimated by NRC staff to result in the rotation setting for a 20% TW EDM notch being ~15% and the rotation setting for a 40% TW EDM notch being of the order of 23%. These values suggested that the Westinghouse equivalent qualification technique, in the absence of complicating factors such as noise, would demonstrate the ability to detect small PWSCC flaws. ANTS Sheet # IP2-97-E, Revision 0, was not prepared, however, to comply with the phase rotation requirements of the equivalent qualification, resulting in performance of 1997 production analyses with calibration group setting requirements for EDM notches apparently left to the discretion of individual analysts. As noted in **3.** above, this resulted in an actual phase rotation setting of 28° for a 100% TW EDM notch in Calibration Group 58, the SG 24 calibration group containing tube 2RC5.