EX6

From: "Ian Barnes" [redacted]

To: KP_DO.kp1_po(WLS) Schmidt, W

Date: Thu, Jun 29, 2000 8:42 PM

Subject: RAI REVIEW

Wayne,

Attached is my review of assigned RAI issues.

Ian

6 | 6

REVIEW OF RAI RESPONSES

Ian Barnes

1. NRC RAI Letter dated March 24, 2000

1.1 **Issue 4: Provide the documentation of the site qualification review of the eddy current techniques applied during the 1997 and 2000 inspections.**

The licensee responded to Issue 4 in a June 19, 2000 letter. Westinghouse identified the techniques used and qualification references in Document MRS-TRC-1088. The licensee also correctly indicated that documentation of "site qualification" for the applicability of the techniques was not specifically indicated as required (by Revision 4 of the EPRI PWR Steam Generator Examination Guidelines) for the 1997 IP2 outage. It should be noted, however, that paragraph H2.2.1(d) in Supplement H2 to Revision 4 of the PWR Steam Generator Examination Guidelines does state with respect to qualification data set requirements, "Where applicable, the influence of extraneous test variables associated with each of the damage mechanisms (e.g., denting, deposits, tube geometry changes) shall be assessed. No information was provided during the onsite inspection which would indicate that consideration was given relative to the effects of deposits on the qualification status of the low radius U-bends. Meaningful review of the licensee response would require obtaining all of the referenced Westinghouse qualification documents and would be extremely time consuming to complete. I do not think performing this review would add significantly to the conclusions of the inspection.

1.2 **Issue 9: Provide a completed Appendix K of the EPRI Steam Generator Examination Guidelines checklist for a forced outage.**

The licensee responded to Issue 9 in a May 15, 2000, letter. No specific new concerns were identified during review of the completed Appendix K checklist.

2. NRC RAI Letter dated April 28, 2000 (Root Cause Evaluation)

2.1 **Issue 1: Section 2 second paragraph, states that excessive noise prevented detection of R2C5 precursor signal in 1997. Weren't there other more fundamental contributing factors? For example, could not a correct calibration setup during the 1997 inspection have permitted the precursor signal in R2C5 to have been detected at that time? Could not a site specific performance demonstration program in accordance with Electric Power Research Institute (EPRI) guidelines have alerted the licensee to the significant limitations of the generically qualified mid-range plus point for detecting primary water stress corrosion cracking (PWSCC) in Indian Point 2 (IP2) small radius u-bends, due to large amount of noise associated with surface deposits. Could not absence of adequate noise and data quality criteria in the data analysis procedures have also been an important contributing factor?**

The licensee responded to Issue 1 in a June 16, 2000, letter. In its response, the licensee included the following statements: (a) "Con Edison has reviewed the 1997 calibration setup and compared it with alternative calibration setups, including that used in 2000. This evaluation, which included review by industry analysts, indicates that a precursor signal in tube R2C5 would most likely not have been detected in 1997, even with the setup used in

2000 for the mid-range +Point probe. The various settings do not materially improve detectability; and (b) "During the 1997 inspections, the eddy current calibration setup utilized was appropriate and in accordance with industry requirements. Industry calibration setup requirements are specified in the EPRI Eddy Current Technique Specification Sheets (ETSS). The EPRI technique for U-bend +Point inspections, ETSS-96511, specifies that the phase angle of the 40% ID flaw be set to 10 degrees; however, the EPRI PWR SG Examination Guidelines, Revision 4 standard in effect in 1997, did not have a 40% ID flaw. For this reason the 1997 IP2 technique sheet, Analyst Technique Sheet (ANTS) IP2-97-E, specified the probe motion and through-wall signals as setup references...."

The inspectors were informed by licensee personnel that the licensee technical requirements for the 1997 steam generator tube examinations (Refueling Outage 2R13) 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 noted that the applicable Westinghouse drawing, 1B79882, Revision 0, for the ACGT-006-97 EDM notch calibration standard that was used for the1997 plus point probe examinations of low radius U-bends, was approved on March 14, 1997, shortly before the May 1997 2R13 outage. The reasons for Westinghouse not including the 40% through-wall ID axial and circumferential EDM notches (required by ETSS # 96511Pwscc_ubend.doc) in this standard were not ascertained during the onsite inspection.

Inclusion in ANTS IP2-97-E, Revision 0, of a requirement for the analyst to adjust phase rotation so that probe motion was horizontal was viewed by the inspectors as technically inappropriate for the plus point probe, due to its insensitivity to probe motion resulting in too small a signal to allow this adjustment to be accurately accomplished. It was additionally noted that improper phase rotation setting can negatively impact the ability to detect small ID flaw indications. The examination in 1997 of low radius u-bends, using a different calibration standard and phase rotation settings to that required by ETSS # 96511Pwscc_ubend.doc, is viewed as a violation of paragraph 4.3 in Specification No. NPE-72217, Revision 10. The licensee statement that an appropriate eddy current calibration setup was utilized which was in accordance with industry requirements is considered erroneous.

NRC review of the 1997 eddy current data for tube R2C5, Steam Generator 24, included: (a) the data obtained using the incorrect 2R13 outage calibration setup, and (b) the data obtained using the calibration standard flaws and phase rotation settings required by ETSS # 96511Pwscc_ubend.doc. C-scans of the tube R2C5 flaw location area showed that the flaw signal was associated with a noise ridge that ran along the tube. The presence of a noise ridge at this location made the flaw indication much less visible to an eddy current analyst. Use of a technique which conformed to ETSS # 96511Pwscc_ubend.doc was noted to somewhat improve the visibility of the flaw indication in the c-scan plot. Review of the Lissajous screen at this location, for both calibration setups, clearly indicated, however, from the shape of the indication that a crack-like flaw was present. The NRC staff concluded that careful review of the Lissajous screen during scrolling of the strip chart should have identified the presence of the ID flaw.

2.2 **Issue 6: Section 5 states that an apex indication was found in SG 24, R2C67, in 1997**

with a length of 0.4 inches. You elected not to perform an insitu pressure test of this location on the grounds that the Westinghouse screening criteria were met. These screening criteria are intended to account for eddy current measurement error. What was the basis for the assumed measurement error? Was this assumption applicable to the very low signal to noise ratio existing in the subject tube? Describe the supporting qualification data for samples simulating the IP2 specific noise conditions. Apart from plugging the tube, you apparently took no further action at that time to assess the potential for significant flaws developing in the U-bend during the next operating cycle. Given the evidence of hourglassing of the uppermost support plates, the apex location of the R2C67 indication, and the quality of the eddy current inspection data for the inner row u-bends, and the experience from the Surry 2 tube rupture, why wasn't imminent failure of the inner row tubes anticipated?

The licensee responded to Issue 6 in a June 15, 2000, letter. The response was considered satisfactory relative to why an insitu pressure test of tube R2C67was not performed. A reference was made in the response to the use of Dominion Engineering for updating projections of PWSCC in low radius u-bends, following the identification in 1997 of PWSCC in R2C67. This should probablywhich should be further evaluated, probably by Research, since it does suggest that the licensee took some actions in response to the identified degradation. The updated projection of one tube exhibiting PWSCC in 2000 is shown by events to be incorrect and suggests that the Weibull analysis was negatively impacted, as a minimum, by the failure of the eddy current examination technique to detect existing flaws. I consider the licensee discussion relative to likelihood of imminent failure to be unsatisfactory, primarily because: (a) it does not address the progression of denting indicated by the increase in probe restrictions at TSP 6 in the 1997 inspections, and (b) fails to address what are the potential ramifications with respect to the presence and growth of additional PWSCC following the initial identification.

2.3 **Issue 7: Why wasn't a site-specific qualification performed as called for in the EPRI Guidelines?**

The licensee responded to Issue 7 in a June 19, 2000, letter. See 1.1 above regarding discussion of Revision 4 of the EPRI PWR Examination Guidelines and its lack of explicit requirements for a documented review of site specific qualification.

2.4 **Issue 8: Section 5 states that the 1997 precursor signal for R2C5 in SG24 was not permitted to be seen because of the noise levels which were present. Why was this noise considered acceptable? Why weren't steps taken to reduce noise?**

The licensee responded to Issue 8 in a June 16, 2000, letter. The response presented a position that: (a) the noise level in tube R2C5 was not considered by analysts to be excessive compared to noise level in steam generator tubing at other plants; and (b) specific noise level requirements were not included in Revision 4 of the EPRI PWR Steam Generator Examination Guidelines or other documents, resulting in disposition of tube R2C5 noise level being left to the discretion of the data analysts. The licensee further indicated that the 1997 detection of a PWSCC flaw in tube R2C67, Steam Generator 24, indicated that the flaw detection capability was adequate, and that in the absence of a high frequency probe there were no feasible alternatives available at that time to improve signal quality or reduce u-bend noise levels.

Licensee comments regarding the absence of specific noise level requirements in industry standards are correct. The indicated comparability of noise levels in tube R2C5 versus tubing at other plants was considered by NRC staff to be speculative and not verifiable. A licensee position that the detection of a PWSCC flaw in tube R2C67, Steam Generator 24, was considered indicative of the adequacy of the flaw detection capability was viewed by NRC staff as questionable. The initial detection of a PWSCC flaw in low radius u-bends, in the presence of complicating noise, was considered by NRC staff review to be indicative of a need for the licensee to implement additional data review actions for low radius u-bends to assure that the presence of less obvious flaws was identified. This action was not performed.

The licensee additionally stated that, in the absence of the high frequency probe, there were no feasible alternatives available in 1997 to either improve signal quality or reduce u-bend noise levels. Development of a high frequency plus point probe, to minimize the effects of tube surface deposits on ID flaw signals, was considered by NRC staff to have been as achievable in 1997 as the subsequent development in 2000. Similarly, the application by NRC eddy current consultant, Dr. C.V.Dodd, of a circumferential line filter to tube R2C5 eddy current data demonstrated a significant improvement in the defect visibility in the c-scan plot.

2.5 **Issue 9: Section 5 states that as a result of the tube failure investigation, a number of changes were incorporated into the analysis process. It is further stated that more stringent criteria were established for data quality. This implies that data quality criteria were employed during previous inspections. Please describe in detail the data quality criteria used previously. Were these documented? Were they for example, in the data analysis procedures? Were they addressed in the analyst training process? Please describe in detail the current data quality requirements and where they are documented. It is also stated in Section 5 that the analysis setup process was changed to achieve better resolution of the 20% ID calibration notch. Was the 1997 setup a correct setup in accordance with standard industry practice?**

The licensee responded to Issue 9 in a June 16, 2000, letter. The response clearly identifies that data quality requirements were not formalized in 1997, with reliance placed on the experience and judgement of the analyst. Some attempts were made in 2000 to identify data quality requirements for u-bends to analysts. The training material presented to the analysts was noted to be qualitative in nature, making it difficult to assess its effectiveness. In that noise criteria are still not included in the EPRI PWR Steam Generator Examination Guidelines, it is believed that the IP2 status relative to data quality is probably not atypical.

Resolution of the 20% ID calibration notch relates to the discussion in 2.1 above, where depending on the phase rotation setting used by the analyst determines whether a 20% ID notch is detected. The licensee reiterated its position that the 1997 analysis technique setup was within acceptable industry practice. As discussed in 2.1 above, NRC review determined that the 1997 practice constituted a violation of a requirement to use procedures which were qualified to the requirements of Appendix H to the EPRI PWR Steam Generator Examination Guidelines.

2.6 **Issue 17: Section 9.1 states that prior to the IP2 event, there have been no significant industry leakage events at the row 2 apex location. Have there been reported row 2 apex cracks? What were the circumstances? What about row 3? Apart from axial apex cracks and tangent point cracks, have there been other kinds of axial or circ. ID**

or OD cracks affecting row 2 or 3 u-bends? (NUREG/CR-5117 reported ODSCC at the apex of row 2 u-bends at Surry 2).

The licensee responded to Issue 17 in a June 19, 2000, letter. No specific questions were noted relative to the licensee response, with the data suggesting PWSCC in low radius u-bends has not been a significant historical problem. Final conclusions can not be drawn, however, without knowledge of the details and effectiveness of the eddy current examination techniques that were employed.