Con Ed - Handout - FOR Exit

(16)

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During the course of the NRC Special Inspection Team assessment of the Indian Point Unit 2 1997 steam generator inspection, the team raised a number of questions relating to the program. Additional clarification on five of the items is provided below.

Item Number 1

Con Ed did not recognize nor evaluate potential noise in the eddy current test (ECT) data. This is important as the noise could mask a 70% to 100% through-wall indication.

Discussion

(1) sizing

In 1997 a single U-bend indication was detected in SG 24 Row 2 Column 67. At the time, a depth of 50% through-wall was estimated using a +Point probe and the tube was repaired by plugging. The indication had a signal to noise ratio of approximately 3 to 1 and the noise levels did not appear to differ appreciably from row 1 and 2 U-bend data from other plants. The inspection method used was the most advanced technique available in the industry and it appeared to us that the technique was performing as expected. Based on the information available in 1997, there was no indication that flaws between 70% and 100% through-wall would be missed due to noise. Also, there was no data available which would establish a correlation between signal amplitude and depth. It also should be noted that in 1997 there were no industry criteria to evaluate noise in a quantitative manner.

(1) eddy current technology

In response to the NRC's question, a current review of the 1997 data was conducted. The review of this data shows that the indication in R2 C67 had an amplitude of 3.11 volts while the background noise level was 1.04 volts peak to peak and 0.44 volts vertical maximum. This data was compared to the EPRI data for technique 96511 and the response from the calibration standards. It should be noted that the EPRI qualification data set consisted primarily of EDM notches placed in row 1 U-bend samples. It is recognized that EDM notches yield larger signal amplitudes for a given depth than PWSCC. In the absence of data from partial through-wall PWSCC specimens, the response of the calibration notches was benchmarked along with the noise levels present in the EPRI samples. The peak to peak and vertical maximum voltages are listed in the table below. All measurements were made from the 300 kHz component.

(3)

CALIBRATION STANDARD USED IN ETSS 96511

AXIAL EDM SLOTS	VOLTS PEAK to PEAK	VOLTS VERTICAL MAX
100 %	20.00	9.39
80 ID	5.40	1.96
60 ID	3.84	1.11
40 ID	2.17	0.44
20 ID	0.66	0.12

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This data suggests that, given the noise levels in R 2 C 67, flaws ≥ 40% would be detectable (i.e. signal to noise for a ≥ 40% flaw is ≥ 1 to 1).

The 1997 noise level in SG 24 Row 2 Column 5 was also evaluated. This data shows a peak to peak amplitude of 1.63 volts and a vertical maximum amplitude of 0.98 volts. The result from this assessment suggests that flaw depths of approximately 50% TW and less may not be detected (signal to noise < 1 to 1). This observation is consistent with NRC IN 97-26, "Degradation in Small Radius U-Bend Regions of Steam Generator Tubes" issued May 19, 1997 which states:

> *"There continues to be an absence of pulled tube information to confirm that the detection threshold for these cracks is better than 40 or 50-percent through wall. In addition, available inspection techniques are not capable of reliably sizing crack depths and, for this reason, it has been industry's practice to "plug on detection" U-bend indications that are found."*

The table below lists the EPRI samples, their noise levels, and the depth of the flaws in the u-bend.

ETSS 96511 FLAW MATRIX

SAMPLE	NOISE VPP	NOISE VM	DEPTH	DEPTH	DEPTH
Z5324	0.72	0.21	41	27	32
TVA-1	0.78	0.27	45	44	44
TVA-13	0.75	0.20	55	55	55
TVA-23	0.70	0.16	55	58	54
1019-I	1.26	0.29	40		
1019-III	1.39	0.61	50		
1019-IV	1.60	0.56	60		
1019-UB-I	1.22	0.41	60		
Z-5300	1.71	0.52	44	100	
TSL-126	1.19	0.19	>40		
TSL-15	1.33	0.16	>40		
TSL-2	1.03	0.20	100		
TSL-10	0.66	0.17	>40		
TSL-113	1.04	0.15	42	42	
TSL-115	1.27	0.16	62	62	
AVERAGE	1.11	0.28	N/A	N/A	N/A

The data shows that some samples had a noise level greater than that observed in R 2 C 67, while other samples were less. Specifically, 9 of 15 samples were ≥ 1.04 volts peak to peak and 3 of 15 Samples were ≥ 0.44 volts vertical maximum.

We would conclude that, based on the information available in 1997 reviewed at the time of the 1997 inspection without the benefit of the passage of time or 2000 inspection

results, there was no indication that flaws between 70% and 100% through-wall would be missed due to noise.

Data quality criteria were not in place in 1997 across the industry, and guidance was only developed following the current evaluation of R2C5. There were no criteria and no database to form a postulate that the noise effects could mask a flaw such as that present in R2C5 in 1997. It is very doubtful that any review in 1997 of the finding of a single apex flaw in row 2 at Indian Point-2 would have rationally led to consideration of a potential imminent flaw. Hindsight is very enlightening, but any review of 1997 evaluations must be put into the knowledge basis of 1997 rather than after the knowledge gained from the R2C5 evaluation.

Item Number 2

There was no specific corrective action in response to a new and significant defect at the apex of R 2 C 67. The flaw had been sized at 50% through-wall. ConEd should have recognized that corrective action was required in accordance with 10CFR Part 50 Appendix B.

Discussion

The corrective action taken in response to the detection of the R2C67 PWSCC indication was appropriate.

In 1997 Revision 4 of the EPRI Guidelines required the use of a qualified technique. We used such a qualified technique during the 1997 inspection – ETSS 96511. Moreover, the ECT response to R2 C67 was typical of those in the training materials, indicating to us that this technique was performing as was expected. A review of the EPRI ETSS shows that the noise levels in R2 C67 were bounded by the response of the samples used in the EPRI study.

The indication found in 1997 was based on the first +Point inspection of the IP2 low row U-bends following prior inspections with the bobbin coil. The first +Point inspections typically lead to an inspection transient (step increase in numbers of indications). The finding of a single U-bend indication in the +Point inspection after prior bobbin coil inspections was not considered an unusual event after about 16 EPFY of operation. In contrast, the Surry-2 tube rupture occurred in a row 1 tube after about 2 EFPY of operation when denting progression was very active with hourglassing progressing to flow slot closure, which exceeds that at the top TSP at Indian Point-2.

Based on the information available to us in 1997, reviewed at the time of the 1997 inspection without the benefit of the passage of time or 2000 inspection results, no additional corrective actions would have been required in response to the indication identified in R2 C67.

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From a programmatic point of view, during the 1997 inspection, additional analyst training was provided whenever the inspection findings were unexpected. Discovery of ODSCC/IGA in the tubesheet crevice region during the course of the Indian Point 2 1997 inspection resulted in additional analyst training and re-evaluation of data in the tubesheet crevice region. This was done as these indications were not considered "typical flaw responses" and differed, somewhat, from the materials the analysts had been trained on. This was not the case, however, with the discovery of the R2 C67 indication.

All elements of the licensee and vendor quality assurance programs were complied with in 1997, and hence the requirements of 10CFR Part 50, Appendix B were satisfied.

Item Number 3

Given that some of the samples used in the EPRI study had noise levels *above*, while others had noise levels *below* those observed in R2 C67, we should not have used the POD listed in the technique.

Response

As discussed previously, the noise level in R2 C67 was bounded by the EPRI study. In addition, the analyst experience was that similar noise levels existed at other plants that were using the same ECT technique. In 1997 there was no Industry guidance which would have directed us, or suggested that we use a POD other than that listed in the ETSS. Moreover, there are no NRC regulations, requirements or technical advisories that contain such direction or guidance.

Item Number 4

The correct calibration standards were not used.

Discussion

The calibration standards which were used in 1997 met industry standards and followed the then current EPRI guidance – EPRI PWR Steam Generator Examination Guidelines, Rev. 4.

EPRI PWR Steam Generator Examination Guideline – Revision 4 requirements for rotating probes were as follows:

Electro-discharge machining (EDM) and laser-machined notch standards are typically used to establish setup conditions for rotating probe technology. The notches should be of:

- *both axial and circumferential orientation, and*
- *standard lengths and depths on the OD and ID.*

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There is no further guidance provided for specific depths of the notches. Although the 1997 IP-2 calibration standards did not include a 40% ID notch, they met the requirements at that time.

Item Number 5

The probe setup was incorrect. Probe motion was set to horizontal.

Discussion

The setup used in 1997 met the then applicable ETSS probe setup guidelines/requirements.

ETSS 96511 establishes phase (10 Degrees) on the 40% ID notch. The plus point technique, as applied at IP-2 in 1997, set phase such that residual probe motion was horizontal with the 20% ID notch at 0 to 5 degrees. The calibration standard used in the EPRI ETSS 96511 qualification did include a 40% ID notch. A review of this data shows that when the 40% ID notch is set at 10 degrees the resultant phase for the 20% notch is approximately 1 degree with residual from probe motion horizontal.

The EPRI Revision 5 standard used at Indian Point 2 during the 2000 inspections does have a 40% ID flaw, and this signal was used to calibrate the analysis software as specified in ETSS-96511. The site specific technique sheet, ANTS IP2-00-E, specifies 15 degrees for the 40% notch, which is more conservative than the 10 degree EPRI ETSS requirement. Review of the 1997 data for R2C5 using the mid-range probe and the 2000 setup with the phase rotation set at 15 degrees, also did not show a flaw.