Indian Point Uni 2 ECT Inspection Results Regulatory Conference

Pre-Meeting Agenda

(Rev. C, 9/20/2000)

(3)

Executive Conference Room
September 20, 2000
1:00 pm - 3:00 pm

1.	NRC Logistics:	Dave Lew
2.	Conduct of the Meeting - Proposed Agenda (See Attached)	Dave Lew
3.	Review Findings & Position of ConEd Regarding 1997 ECT Inspection & Rebuttals (See Attached)	Wayne Schmidt
4.	Altran Position Regarding Event and Failure Mechanism	Bill Raymond
5.	Risk Significance and Importance	Jim Trapp
6.	Conclusions and Summary - Action Items - Final Strategy Mtg	Dave Lew

Indian Point Uni 2 ECT Inspection Results Regulatory Conference

Nuclear Regulatory Commission, Region I, September 26, 2000

AGENDA

1. Overview of the Event, Findings and Risk	Brian Holian
• Event & Impact of 2 SG's With Leaks • NRC Response (AIT, AIT Follow-up, SG Insp., CMOA Response) • Special SG Inspection • Findings • Risk	
2. Introduction - Regulatory Conference Process and Relationship with the New Oversight Program	Dan Holody
3. Introductions of Attendees	Brian Holian
4. ConEd Perspective - Findings and Risk	Jack Perry, Doug Gaynor
5. NRC Caucus	Break
6. NRC Perspective on the Findings	Brian Holian
7. NRC Perspective on Risk	Jim Trapp
8. Concluding Statement	Hub Miller

ConEd Perspective on Findings and Risk

A. ConEd will reiterate its position regarding the 1997 ECT inspection program. ConEd does not believe the 1997 evaluations were inadequate relative to compliance with requirements. This will be a brief recap of information already provided, with not much detail and no new information.

B. ConEd will discuss its view of the safety significance of the SG tube leak event, which will essentially agree with the NRC assessment.

C. ConEd's major presentation will provide a different perspective on the performance issues cited as the bases for the citations and the SDP results (RED). ConEd will discuss the contributions to risk from the three causes of a SG tube rupture: spontaneous, main steam line break (ConEd continues to evaluate the MSLB case to make sure it remains bounded by the spontaneous case. For MSLB, ConEd agrees CDF equates to LERF.), and ATWS. This will be a technical presentation focusing on two points:

> (1) A challenge to NRC's risk analysis that equates CDF to LERF, which is acceptable for generic considerations in a SDP phase I or II evaluation, but is not appropriate for the phase III evaluation. ConEd will present arguments why a specific risk evaluation should be used and show why CDF should be decoupled from LERF estimates for the major contributor to risk - the spontaneous leak as it occurred on February 15.
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> (2) Altran, in consultation with MIT, provided analyses and a rationale to show the CDF contribution due to a spontaneous tube leak is a factor of 10 less than the NRC estimate. The stress analyses for row 2 tubes and the insitu test results will be used to show that only tube R2C5 would leak and none would rupture.

D. The presentations on Sept 26 will be made by ConEd personnel (Jack Parry and Doug Gaynor having lead roles), with Westinghouse, Altran and the MIT consultant in attendance. Doug Gaynor will be in contact with Jim Trapp to discuss the SDP prior to the conference.

NRC Assertions and ConEd's Responses

NRC ASSERTION NUMBER 1 - ConEd 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.

CON ED'S RESPONSE TO NRC'S ASSERTION 1 - 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.

A current review of the 1997 data was conducted and shows that the indication in R2C67 had a S/N ratio of about 3:1. This data was compared to the EPRI data for Technique 96511 and the response from the calibration standards. (Note: EPRI qualification data set consisted primarily of EDM notches placed in row 1 U-bend samples, which 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 calibration standard peak to peak and vertical maximum voltages indicate that, given the noise level in SG24, R2C67, flaws >40% would be detectable at 300 kHz.

The 1997 noise level in SG 24 Row 2 Column 5 was also evaluated and suggest that flaw depths of approximately 50% TW and less may not be detected (signal to noise < 1:1). 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."

Based on information reviewed and available in 1997, including EPRI samples, their noise levels, and the depth of the flaws in the u-bend, and without the benefit of the passage of time or 2000 inspection results, ConEd concludes 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.

NRC'S COUNTERPOINT TO CON ED'S RESPONSE TO ASSERTION 1 - A review of tube R2C67 showed that the defect measured about 80% deep from 1997 data. The voltage was about 67% of that of the standard 80% EDM notch, as measured by Westinghouse. The presence of a 80% deep defect at the end of a cycle indicates that the inspection is not sensitive enough and that action should be taken to improve the test. The other tubes, all of which were missed, did not have as good a signal-to-noise ratio, although some had a ratio better than 1:1, particularly in the region close to the defect. It also seems that a signal-to-noise ratio better than 1:1 is needed in order to detect defects, unless there has been a recent tube-rupture at the plant being inspected. The noise level can be reduced considerably by using filtering techniques, such as the circumferential average filter in the Eddynet software. The ANSER software has a comparable filter, but this was not and has not been used. The guidelines permit the use of a filter but do not encourage it.

A PWSCC (and a SCC defect in general) yields only 20 to 70 percent (and perhaps less) of the signal amplitude that a calibration standard yields. Measurements on typical stress corrosion cracks has shown that the eddy-current voltage response from these cracks is almost never as large as that from a calibration standard. In general, the voltage response is on the order of 20% to 70% of that of a calibration notch of the same depth. This is on the stress corrosion cracks that have been detected. There may be others with less than 20% of the voltage that have remained undetected. These are the voltage numbers that should have been applied to the noise levels the other tubes, not tube 2-69 which is relatively clean. The defect depth measured on 2-67, using the 1997 data was 80%, not the 50% that was reported.

The vertical max. for the noise level in other tubes is on the order of 1-volt, which would correspond to a typical 80% deep stress corrosion crack. The signal-to-noise (vertical max. for both) of tube R2C5 at 400 kHz, with the proper phase adjustment, was 1.45 to 1. Since this crack was missed, it suggests that a signal-to-noise ratio greater than this is needed. This is assuming that the analyst is not going to look at the Lissajous unless he sees something on the C-scan. The analyst should be trained to look at the Lissajous if anything remotely suspicious is seen on the C-scan.

The statement that there is no quantitative noise criteria present in 1997 is correct, and there is no quantitative noise criteria present today. However, industry has been aware of the NRR's concern and NRR's desire for such a criteria for a number of years, well in advance of 1997. In response to our requests, software was written by Zetec in their 1995 release of Eddynet 95 that will measure the noise in tubes, and there have been a number of attempts by industry committees to correct this problem. The signal-to-noise on the EPRI ETSS 96511 flaw matrix that was used to qualify the midrange probe is meaningless. All of these are flaws that are detectable in spite of the noise present. The performance of this probe in the field invalidates (missing 8 of the nine or more flaws that were present) the probability of detection (POD) premises that EPRI has developed.

The probe qualification done on the EPRI data set in 1997 shows how erroneous these qualifications are. There were at least 9 cracks present in 1997, only one of which was found. The inclusion of EDM notches and laboratory grown samples biases the probability of detection. Also, for actual pulled tube samples, only the easily detectable cracks are ever found and pulled. This also forms a bias toward the flaws being easier to detect than they actually are.

NRC'S ASSERTION NUMBER 2 - There was no specific corrective action in response to a new and significant defect at the apex of R2C67. 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.

CON ED'S RESPONSE TO NRC'S ASSERTION 2 - The corrective action taken in response to the detection of the R2C67 PWSCC indication was appropriate. We used such a qualified technique during the 1997 inspection – Revision 4 of the EPRI Guidelines, ETSS 96511. Moreover, the ECT response to R2C67 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 R2C67 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, which typically lead to a step increase in numbers of indications found. 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 EFPY 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. 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.

During the 1997 inspection, additional analyst training was provided whenever the inspection findings were unexpected. We considered the discovery of the R2C67 indication a "typical flaw responses" not requiring additional analyst training.

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.

NRC'S COUNTERPOINT TO CON ED'S RESPONSE TO ASSERTION 2 - The licensee has indicated in its response to this item that a qualified technique, ETSS 96511, was used during the 1997 inspection. However, the 1997 examinations used a calibration standard which did not contain the 40% through-wall (TW) ID axial and circumferential notches required by ETSS 96511 for setup. In addition, the instructions provided to the analysts for examination of low radius u-bends simply required phase rotation be adjusted so that probe motion was horizontal, with no phase rotation requirements established for either the 100% TW or the 20% TW EDM notches that were present in the1997 Westinghouse calibration standard. This approach is inconsistent with any plus point probe qualification.

The comment made by the licensee regarding the noise levels in R2C67 being bounded by the response of the samples used in the EPRI studies is believed irrelevant. The R2C67 flaw was indicated by the c-scan to be not associated with noise ridges. What is at issue is that significant noise was present in the eddy current data acquired from low radius u-bends, with the capability to mask flaws present in noise regions. Following the initial identification in 1997 of PWSCC in a low radius u-bend, coupled with the potential for flow slot hourglassing (and resulting increased stresses at the apex of the bends)indicated by the number of tubes found to be restricted at the top tube support plate, it is believed that the licensee should have implemented review actions to assure other PWSCC flaws were not present.

The licensee should have been additionally sensitized by the fact that Dominion Engineering had predicted prior to 1997 that PWSCC would not be expected for several cycles in low radius u-bends.

NRC'S ASSERTION 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.

CON ED'S RESPONSE TO NRC'S ASSERTION 3 - 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.

NRC'S COUNTERPOINT TO CON ED'S RESPONSE TO ASSERTION 3 - Probability of Detection is based on the ability to identify flaws in a sample set. The number of samples containing flaws and the number of samples that contain no flaws are statistically significant. The significance is based on the confidence and probability originally established as an acceptable level of performance. For steam generator eddy current detection, using a EPRI qualified technique, the level established as an acceptable level of performance is an 80% POD, at 90% confidence level for flaws ÿ60% thru wall. Please note that no technique is qualified for any flaws that are less than 60% through wall in accordance with the Appendix H of the EPRI Guideline.

Because the qualification is performed by EPRI for a generic population of steam generator flaws the sample set is chosen to represent the spectrum of tube conditions that are in the generic population.

Because tube noise is an essential parameter that can have an affect on Eddy Current detection there should be a few tubes that are above and below the noise levels in the Indian Point Steam Generators. As any one essential parameter begins to dominate, however, it has an affect on the POD and confidence. If you demand a confidence of 90% be maintained then as the number of noisy tubes encountered in a qualification sample set is increased the POD will correspondingly decrease. If the noise levels and numbers increase the POD will fall below the acceptable level of 80%.

It is for this reason Indian Point 2 should have qualified a technique separately for the noise levels and population encountered in their steam generators. Because we know they missed 8 flaws it is self evident that the POD for the techniques they used were below the acceptable limits of a qualified technique.

NRC'S ASSERTION NUMBER 4 - The correct calibration standards were not used.

CON ED'S RESPONSE TO NRC'S ASSERTION 4 - 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.

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.

NRC'S COUNTERPOINT TO CON ED'S RESPONSE TO ASSERTION 4 - The use by the licensee of a general statement from the EPRI PWR Steam Generator Examination Guidelines, Revision 4, regarding method of manufacture and types of artificial flaws required to be present in calibration standards is not relevant. Paragraph 7.1 in the EPRI Guidelines states, "Nondestructive examination of steam generator tubes shall be conducted using techniques capable of detecting and/or sizing the types of degradation known or reasonably expected to exist in accordance with industry experience. An inspection technique is qualified if sensors (coils, transducers, etc.) used have been proven capable by performance demonstration to meet the requirements of Appendices H and/or J.

Paragraph H.1 in Appendix H, "Performance Demonstration For Eddy Current Examination," of the EPRI Guidelines states, in part, "...Each organization that performs eddy current examinations shall use techniques and equipment qualified in accordance with this Appendix...." Paragraph H.2.1.1 in Appendix H identifies that calibration method is an essential variable to insure proper data acquisition. Paragraph H.2.1.2 in Appendix H further requires the Analysis Technique Specification Sheet to define the method of calibration used for signal characterization.

The licensee has also stated "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." This posture totally ignores the obligation discussed above to use a technique that is qualified in accordance with the requirements of Appendix H of the EPRI Guidelines.

The current qualified technique in the EPRI Performance Demonstration Data Base for detection of PWSCC in low radius u-bends is ETSS # 96511Pwscc_ubend.doc. This technique was entered in the EPRI data base approximately 1 year before the 1997 outage examinations and was thus available for

IP2 use in 1997. The calibration requirements contained in the qualified technique specified the use of a phase rotation setting of 10 for 40% TW axial and circumferential ID notches, thus necessitating the use of a calibration standard containing such flaws for compliance with the technique calibration requirements.

NRC'S ASSERTION NUMBER 5 - The probe setup was incorrect. Probe motion was set to horizontal.

CON ED'S RESPONSE TO NRC'S ASSERTION 5 - 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.

NRC'S COUNTERPOINT TO CON ED'S RESPONSE TO ASSERTION 5 - The licensee has claimed that the setup used in 1997 met the then applicable ETSS probe setup guidelines/requirements. It was additionally stated that the 1997 plus point technique set phase such that residual probe motion was horizontal with the 20% ID notch at 0 to 5 .

The insensitivity of the plus point probe to probe motion results in too small a signal to allow the adjustment to be made accurately, and is contrary to the guidance of ETSS # 96511Pwscc_ubend.doc. No information has been provided, to date, that would support a statement that a a phase rotation setting of 0 to 5 was used for the 20% TW ID notch. The only guidance provided to the analysts by Analysis Technique Specification (ANTS) Sheet # IP2-97-E, Revision 0, was to adjust phase rotation so that probe motion was horizontal, with no instructions provided with respect to phase rotation criteria to be used for axial or circumferential notches. The absence of such instructions results essentially in delegation to the analyst for determination of setup requirements.

ETSS # 96511Pwscc_ubend.doc, as previously stated in Item 4 above, specified the use of a phase rotation setting of 10 for 40%TW axial and circumferential ID notches. The actual probe setup used obviously did not satisfy that criteria, since the calibration standard used did not contain these notches.

Paragraph H.4.3 in Appendix H of the EPRI Guidelines does permit use of alternative calibration methods without requalification, if it can be demonstrated that the calibration method is equivalent to those described in the qualified acquisition technique or qualified analysis method. Eddy current acquisition and analysis was performed in 1997, however, without demonstrating that the sole requirement of setting probe motion horizontal was equivalent to the requirements of ETSS # 96511Pwscc_ubend.doc. The licensee statements should also be considered in the context of the qualification that was performed by Westinghouse to demonstrate that the magnetic bias plus point probe used at IP2 in 1997 was equivalent to the non-magnetic bias probe used for ETSS # 96511Pwscc_ubend.doc. This equivalency qualification used a phase rotation setting of 40 for a 100% TW EDM notch which corresponds to a phase rotation setting of ~15 for a 20% TW EDM notch and ~23 for a 40% TW EDM notch. The requirements of ANTS Sheet # IP2-97-E, Revision 0, obviously also did not comply with the requirements of the Westinghouse equivalency qualification.