08/03/00 #4

PWSCC in u-bends at Indian Point

I believe that the present u-bend inspection for PWSCC at Indian Point is adequate for the remaining 4 months of operation because:

1) All the tubes that leaked in the pressure test (and one other) were already on the plugging list from the 2000 inspection using the midrange probe. Tube 2-71 was on the plugging list because the midrange probe would not go through the tube (although a scan had been attempted several times). The tube was not listed as having a defect because it could not be scanned, but it was on the plugging list.

2) The high frequency probe defected three additional defects that were pressure tested. All of these tubes passed the pressure test. This provides an additional layer of assurance that there are no PWSCC tubes that will rupture left in the generator. (I still should look at the noise level in the remaining 5 tubes that had a high level with the high-frequency probe.)

3) The eddy-current pressure test on the tubes did not turn up any additional tube leaks. However, two new indications did appear on one tube that leaked under pressure testing, and only three additional tubes were pressure tested. This was not enough tubes to be statistically significant, and the utility hurt themselves by being so stingy.

4) The plant is only scheduled to operate for 4 additional months. Tube 2-5 would did not rupture until almost the end of the cycle. Therefore, with this much improved inspection I believe that the tubes that passed the high frequency plus-point inspection will last for at least 4 months.

I believe that the POD studies in general are flawed. Tubes with EDM notches and lab-produced flaws have a larger signal and lower noise than tubes from the generator. Tubes from the generator have a signal with a favorable signal-to-noise ratio, or the noise is located where it does not significantly interfere with the signal, or we would never know it was there. The inspection back in 1997 was qualified with an 80% probability of detection with a 90% confidence level. Yet, only one of nine defects was found in the inspection.

Review of Westinghouse POD Claims

I have made a quick review of the Westinghouse claims about the noise levels. The noise levels appear to be approximately as they have indicated on the egg-crate tubes. If they have based their POD on lab samples (which all of the scans that I had were) then the POD is biased since Lab samples produce a higher voltage than steam generator samples do. However, their study is based on the use of the midrange plus-point, where the Indian Point u-bend test is based on the high-frequency plus-point. I do not have exact figures at this time, but the high frequency probe produces about twice the voltage on the calibration standard as the midrange probe does for id notches. I believe that at least some of this will carry over to the actual defects found in the generator. I am going to request their profiles of these cracks using the midrange probe from the 2000 data and compare this to the high-frequency voltages.

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The noise in the u-bends is at least in line with what they have quoted, for the 4 tubes that they have furnished (and for others that I have looked at). The measurement of the vertical noise in the u-bends is not as straight forward as that at the egg-crate support-plates. Some rules and procedures should be developed for this.

They used a more strict noise criteria for calling bad data (still not written) for the high-frequency probe than they did for the midrange probe. The tube that they said had too much noise to inspect would have been called clean by the standards that they were observing for the midrange probe in early March.

Scott Redner (Prairie Island)has done a noise study on the midrange probe and the high-frequency probe, and concluded that the midrange probe is not qualified at Indian Point but the high-frequency probe is.

I believe that the u-bend tubes that passed this inspection will not rupture during the next 4 month operating cycle due to PWSCC.

Profile of Tube 2-67 of steam generator 24

The profile of tube 2-67 is shown in Figure 1. The estimated length is about 0.35-inches. The

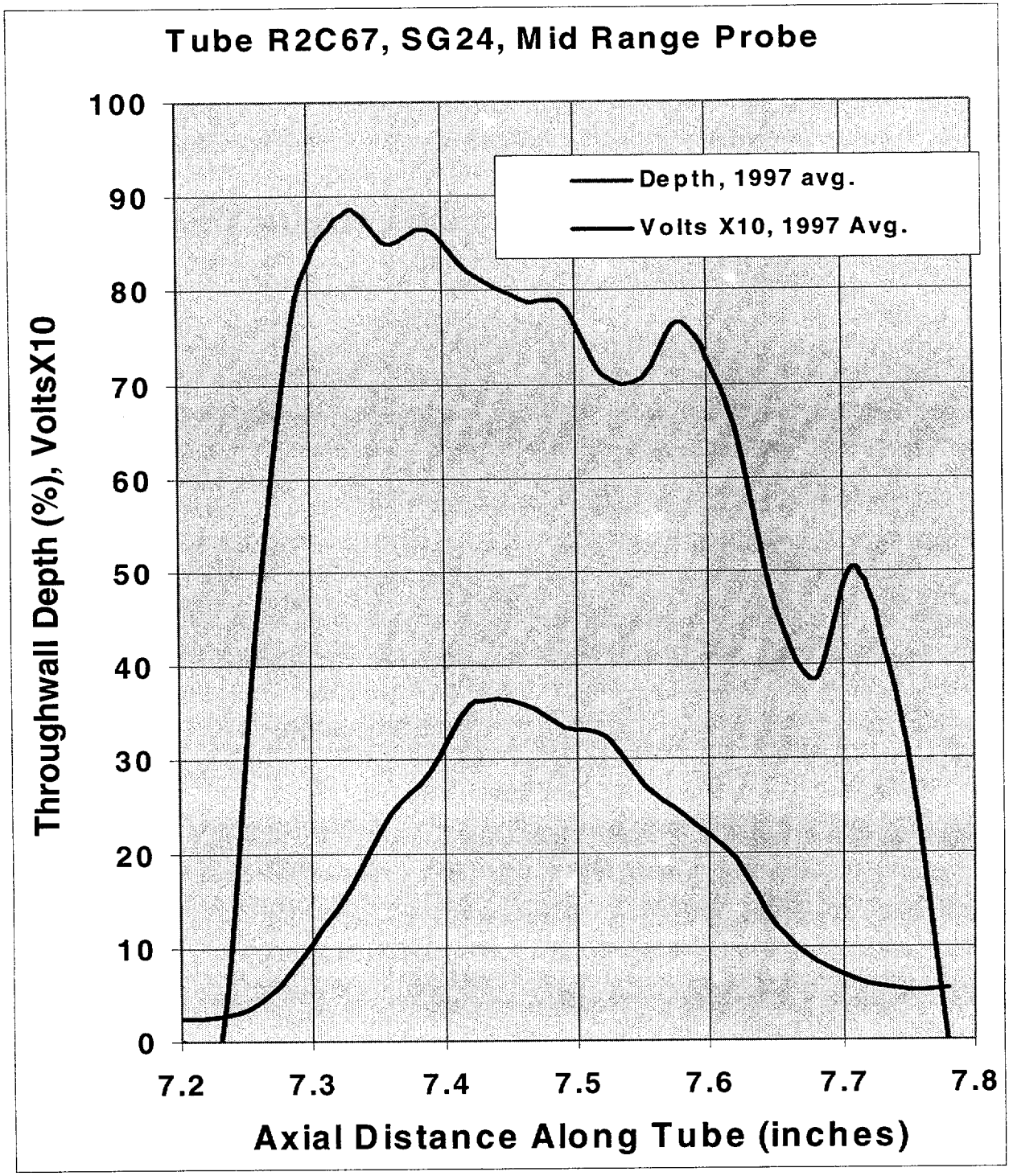

Figure 1 Depth and voltage profile of the crack in tube 2-67 of steam generator 24 located in 1997.

depth is the average of the 300 kHz and the 400 kHz readings. The crack measures about 80% deep at the maximum voltage reading, typically where the depth is measured in field evaluations. The voltage amplitude of this signal is about 3.5 volts, which is about 65% of that of an 80% EDM notch.

The c-scan of this tube is shown in Figure 2. The crack sits beside a ridge, in a valley, and is in an easily detectable portion of the tube. The large amplitude of the voltage signal, in relation to

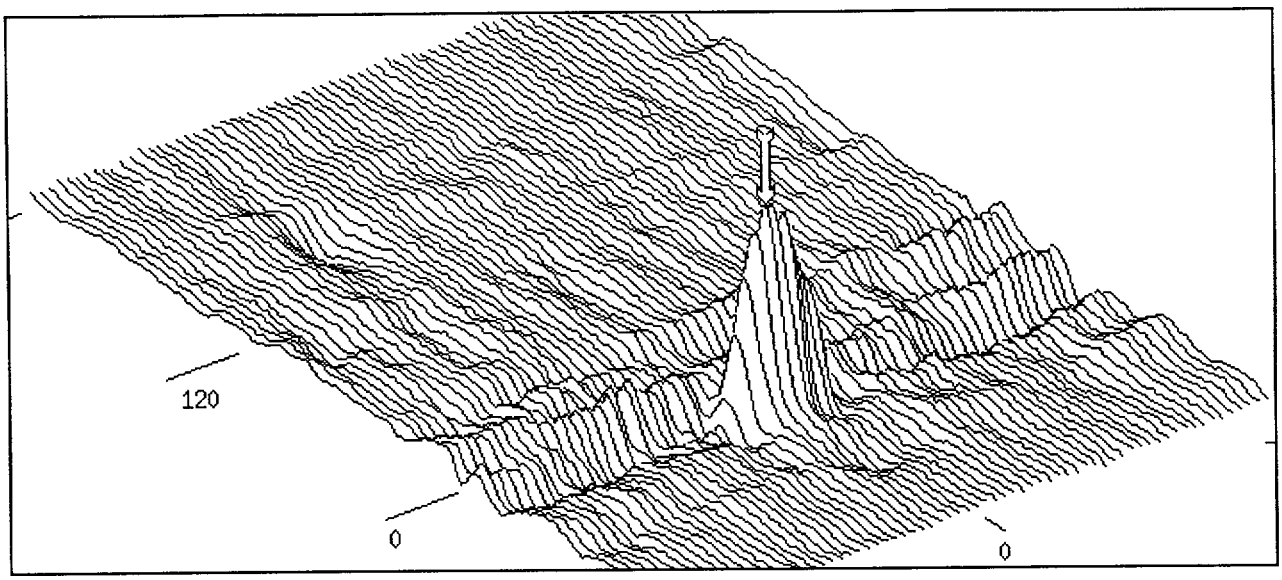

Figure 2 Crack in tube 2-67 of steam generator 24, found in 1997.

the standard calibration notch would indicate that this is a "mature" crack. The growth pattern of the other cracks at this plant shows that the voltage amplitude grows more than the crack depth. Many of the cracks profiled from data at this outage had a poor signal-to-noise ratio, which introduced a large uncertainty in the measurement of the crack depth. However, that is not the case with this crack. There has not been any "adjustment" on the profile of this crack, such as Westinghouse does in their profiling. This is not normally done in the field evaluation of crack depth.