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Signal-to-noise measurements made in the sludge pile region:

Signal-to-noise measurements were made on selected tubes with defects in the sludge pile region by Andy Neff. These measurements were made for the bobbin, Cecco and plus-point probes. The bobbin and Cecco had measurements made in 1997 and 2000. The plus-point probe had only scans made in 2000. The measurements are only approximate, and the Cecco signal measurements can only be compared to the noise measurements. The noise measurements made for the bobbin and Cecco probes were only in the vicinity of the axial defects. The noise measurements made for the plus-point included the entire sludge pile span. The measurements were less noisy near the top of the tube sheet than they were on up near the top of the sludge pile. The sludge pile noise was also present on the cold leg, although to a lesser extent. These first three tubes had clear plus-point hits that were definitely cracks above the top of the tube sheet.

Tube	Probe	Year	Signal Voltage	Noise Voltage
35/51 SG22	Cecco	1997	13.66 volts	28.17 Volts P-P
	Bobbin	1997	0.71 volts	1.59 Vert Max
	Cecco	2000	10 volts	32 Volts P-P
	Bobbin	2000	1.22 volts	1.82 Vert Max
	Plus-point	2000	0.70-volts	0.3 Vert Max

Tube	Probe	Year	Signal Voltage	Noise Voltage
34/51 SG22	Cecco	1997	7.38 volts	8.37 volts
	Bobbin	1997	2.51 volts	3.02 Vert Max
	Cecco	2000	15.81 volts	26.49 volts
	Bobbin	2000	2.71 volts	3.75 Vert Max
	Plus-point	2000	0.87-volts	0.3 Vert Max

Tube	Probe	Year	Signal Voltage	Noise Voltage
29/46 SG23	Cecco	1997	1.69 volts	1.7 Vert Max
	Bobbin	1997	3.6 volts	3.6 volts
	Cecco	2000	11.75 volts	11.75 volts
	Bobbin	2000	3.06 volts	3.0 Vert Max
	Plus-point	2000	0.37-volts	0.3 Vert Max

A sample of about 10 additional tubes were looked at in the sludge pile region, to gage the noise of the plus-point probe, some being from the hot leg and some being from the cold leg. The noise level in this region increased as high as 0.5 volts Vert Max. No doubt that the noise level is higher on some tubes that I did not examine.

The tubes in the table were only called by the secondary analyst, although they had a good signal-to-noise ratio. The reason that these tubes were missed should be followed up by the utility since they represent a breakdown in the inspection process.

There were also tubes on the pressure-testing list that were not defective tubes. Tube 42/43 of steam generator 24 showed two low-amplitude, shallow crack-like indications, one having an amplitude of 0.12-volts and the other having an amplitude of 0.31 volts. Niether the amplitude or the phase of these indications changed during the pressure testing. Therefore, if these were actual defects, I would conclude that they do not degrade the tubing. Most likely they were od artifacts in the coating on the tube. The utility is probably plugging a number of tubes similar to these.

Several pit calls in tubes 45/51 and 17/63 of SG24 were also reviewed. These were, in my opinion, harder to call than the axial cracking. The signal-to-noise is somewhat poorer for the pits, and they are only picked out of the noise by their shape. The pit test is marginal, but these indications probably do not constitute a danger to the tube integrity. While there is a clear difference between pitting and larger volumetric indications with clean, low-noise measurements, it is not always apparent for the field tests. However, this also does not make much difference in the tube integrity. Volumetric indications will produce larger voltage signals than the pits, and therefore be easier to detect.

The EPRI pit sizing for the bobbin probe used 64 calibration points, 55 of which were machined defects. The machined pits are easier to detect, more uniform, and have less noise signals than the pulled tube pits. I fell that this may have biased the qualification test and question its validity. I also believe that pit sizing with the rotating probes will be more accurate. The operating frequency should be expanded to higher frequencies to eliminate the influence of od deposits. This will provide a screening for the deeper pits, which we need to insure that are not missed.

Some advanced mixing methods may be able to improve the signal-to-noise in this region, but this is not available at this time. The utility has improved the inspection considerably in the u-bend region, where it is probably adequate at this time. The test will probably not detect all defects smaller than 60% at this time. However, the missed defects are probably quite short and the tube would not rupture under accident conditions. At my suggestion, a few tubes were inspected using the high frequency probe in the sludge region. The data from these scans were of poor quality and no conclusions could be drawn from this test.