item #12 - #4

Subj: U-bend tubes with cracks
Date: 6/1/2000
To: smc1@nrc.gov S. Coffin, NRC

Stephanie & Emmett:
The U-bend tubes with cracks in 1997 were:

SG21 Row 2 Col 87
SG23 Row 2 Col 85
SG24 Row 2 Col 4, Row 2 Col 5, Row 2 Col 67, Row 2 Col 69, Row 2 Col 71, Row 2 Col 72, Row 2 Col 74.
Only Row 2 Col 67 was detected in 1997. I have located all of them in the 1997 data with the possible exception of Row 2 Col 4.

I would like to have the meeting in the afternoon so I could get a morning flight to Washington or Pittsburg.
Caius

Subj: Another Cal
Date: 6/8/2000
To: pieringp@westinghouse.com
CC: (smc1@nrc.gov)

Gary:
There was some discussion about the two representations of tube 2/71 of steam generator 24, and it was determined that there were two high-frequency scans of this tube and two plots. The cal groups were stated to be 220 and 240. I have already profiles the 2/71 from cal 240. Would you also send me cal 220 of steam generator 24 so I can take a look at this cal also.

Also, do you have the qualification cals for the ceramic probe that was used at the last of the inspection for the sludge pile/crevice region scans. I requested this from Andy, but you were off that day and I do not believe that they were ever sent.

Thanks, Caius

Subj: Probe Qualification
Date: 6/8/2000
To: henry@eddy2.epri.com

Gary:
Indian Point used a probe with an increased lift-off for some of their sludge pile inspection. The probe had a lift-off of 0.017-inches compared to 0.010-inches for the standard plus-point. I believe that these probes have also been used at Palo Verde and maybe some other plants. Do you know if they have received an EPRI qualification, and what they are called?

J 1/70

Thanks, Caius

Subj: Ceramic wear probes
Date: 6/9/2000
To: ghenry@epri.com

Gary:
Indian Point used a plus-point probe with a ceramic wear-face that increased lift-off for some of their sludge pile inspection. The probe had a lift-off of 0.017-inches compared to 0.010-inches for the standard plus-point. I believe that these probes have also been used at Palo Verde and maybe some other plants. Do you know if they have received an EPRI qualification, and what they are called?
Thanks, Caius

Subj: Ceramic faced probe
Date: 6/13/2000
To: elm@nrc.gov, smc1@nrc.gov

File: C:\WP\FI\INDIAN11.NRR (276903 bytes)
DL Time (32000 bps): < 2 minutes

Emmett and Stephanie:
I have completed a brief study of the ceramic faced plus-point probe that Indian Point used to help with their problem of wearing out too many probes. The bottom line is it seems to be about the same as the standard plus-point probe, so I see no problem.

I received the disk from Westinghouse yesterday and will continue to work on it until I get the ANO data.
Caius

Subj: Indian Point 2
Date: 6/15/2000
To: tees@airmail.net (Ian Barnes)

Ian:
I will be teaching in bible school every day this week until about 1:00PM. I should be home from about 2:00 to 4:00 tomorrow (Friday) afternoon. I have written quite a bit about Indian Point that I will be glad to E-mail you.

The bobbin data for the low radius u-bends does not give a sensitive inspection. The best inspection is obtained using a small high-frequency plus-point probe. All of the OD noise seemed to be due to deposits. There is a smaller amount of id noise that may be due to geometry. The inspection was considerably improved, but there are probably some short, relatively deep defects that are being missed. I do not feel that they are

missing anything nearly as large as 2/5 was, nor do I feel that they are missing anything that may be dangerous.

Caius

Subj: Indian point reports
Date: 6/19/2000
To: tees@airmail.net (Ian Barnes)

File: C:\ZIP\FI\INDIAN.EXE (1102617 bytes)
DL Time (32000 bps): < 10 minutes

Ian:
I am sending you all of my DRAFT reports from indian point in a self-extracting file. Excute it and it will become 10 WordPerfect files.

Caius

Subj: Tube r2c69
Date: 6/24/2000
To: tees@airmail.net (Ian Barnes)
CC: smc1@nrc.gov

File: C:\WP\FI\R2C69S~1.NRR (0 bytes)
DL Time (32000 bps): < 1 minute

Ian:
Here are the scans in 1997 and 2000 of tube R2C69 of steam generator 24, made at 400 kHz with the mid-range probe. You already have the scans made with the high frequency probe, before and after pressure testing, along with the profiles. Sorry to take so long but I had to move some ANO stuff before I could pull these up.

Caius

Subj: Defective tube list:
Date: 6/27/2000
To: tees@airmail.net (Ian Barnes)
CC: smc1@nrc.gov

Ian:
Here is a list of the defective tubes and when they were detected:
2-67 of Steam Generator 24 was detected in 1997 outage.
2-5 of Steam Generator 24 burst to initiate 2000 outage.
2-87 of S G 21 was detected with the midrange probe.
2-69 and 2-72 of SG 24 were detected with the midrange probe.
High frequency inspection was added.
2-85 of SG23 was detected with the high frequency probe.
2-4, 2-71 and 2-74 of SG24 were detected with the high frequency probe.

Of these 9 defects, 7 were visible (with hindsight) in the 1997 inspection. Tubes 2-4 and tubes 2-74 were questionable.
I will go over my notes and put my objections to the guidelines in writing for you.
Caius

Subj: IG review for IP2
Date: 6/27/2000
To: smc1@nrc.gov, cdb@nrc.gov
CC: ejs@nrc.gov

Stephanie:
One of the Lisa's that I talked to in Pittsburgh called and wants me to look at some IP2 documents and comment on them. She will be getting them to me soon. However, I may be able to put her off until I can get the profiles for Emmett.
Caius

Subj: High frequency, calibration standards
Date: 6/28/2000
To: tees@airmail.net (Ian Barnes)

File: C:\AMERIC~1.0A\MISC\TEMP\MAINYANK.ZIP (8208 bytes)
DL Time (32000 bps): < 1 minute

Ian:
here are two Maine Yankee reports.* One deals with the problem with the standard, the other with the high-frequency, small probe.
Caius

*SEE ATTACHED

Subj: Guidelines
Date: 6/28/2000
To: tees@airmail.net (Ian Barnes)

Ian:
The specific things that I did not like about the guidelines:

1. The history of the plant and defect types was brief.
2. Loose parts should be emphasized.
3. Figures should be in the text.
4. Figure and table captions should contain needed information.
5. Acts sheets do not match the figures in the guidelines.
6. A written procedure is needed to call bad data.
7. Guidelines need specific instructions to detect probe skipping and hanging.

Training:
Written documentation is needed to insure quality and consistency.
Caius

Subj: Files
Date: 6/29/2000
To: LAP1@nrc.gov

Lisa:
I got the file about the INPO visit. It appeared to be in a Word format rather than WordPerfect. However, I was able to read it with no trouble. I can discuss it with you over the phone when you like. I am usually gone between 12:00 pm and 3:00 pm in the afternoons. I plan to be here all next week.

I did not receive the second .tif file. Try to resend it if you want me to look at it. Have a good day.

Caius Dodd

Related to email dated 6/28/00

Maine Yankee Comments

Concentrate inspection on weld id rather than parent tube od

The inspection has been designed to primarily concentrate on the outer surface of the parent tube. However, the weld is on the inner surface of the sleeve, and this region is as important. The present plus-point probe does a good job of inspecting the parent tube. A second plus-point probe should be designed to inspect the sleeve. The probe should be smaller and operate at higher frequencies. Its greatest sensitivity should be to defects on the surface of the weld, with lesser sensitivity as the depth increases. Both probes will be sensitive to defects at the sleeve-parent tube interface.

These recommendations are essentially the same as I gave for the weld inspection at Kewaunee. Maine Yankee has apparently not followed these recommendations. It is unfortunate that they are this far into their outage with a poor inspection plan. This problem seems to be generic for the inspection of welded sleeves, and the recommendations for the probes and the standards that follow should apply to sleeve inspections at other plants.

Kewaunee used a high-frequency 0.080 pancake coil in the sleeve inspection, but the primary use was to make sure that the sleeve did not have defects in the free-span. The defect signal from the parent tube was so large with the plus-point that any sleeve defects in the region would be missed. At 800 KHz with the 0.080-inch coil these large indications vanished and only the sleeve was inspected. There will be more lift-off due to the surface roughness in this region, and a small high-frequency plus-point may be required.

The present setup uses a 0.052-inch diameter through-wall hole. At the 0.040-inch pitch of the scan, the signal from this hole varies greatly with axial distance. There is only one hit for the "maximum" signal and it may not be the correct one. It is completely different from the hits on either side. Due to the random nature of the scan, this is a poor artifact to calibrate this type of probe.

Use notch and id standards for Plus-Point rather than Cecco standards

The standards do not have any id notches, and the method of setting up this test does not allow an accurate phase adjustment for id inspection. One of the two standards used was designed for the Cecco probe and is not adequate for the plus-point. This will make it hard to identify anything on the inner surface of the weld, and separate weld defects from surface roughness.

I discussed this problem with Bob Vollmer of Zetec and he agreed with these recommendations. He said that Zetec could make a high frequency, smaller plus-point that would give a much better definition of the cracks in the welds. I asked if the ferrite core could be left out of the probe to reduce the inductance and extend the frequency range and he said that he would check on it. He has passed this on as an action item to his probe shop and will get an estimate of when they will have a probe.

Notes from Maine Yankee:

The depth vs phase for different notches for this application is not normal

The standards were reviewed and measurements were made at different frequencies on the 77% and the 40% circ. notches. The phases rotate correctly with frequency for both notches, but are reversed between the 40% and 77% notches. The amplitudes appear to be correct. This reversal may be due to variations in the electromagnetic properties such as conductivity, permeability or wall thickness of the weld. It also may be due to the notch length (0.25-inches) being short compared to the probe length.

Table I Readings at different frequencies for Circumferential notches

Freq.	39% Notch		78% Notch	
Khz	Phase	Volts	Phase	Volts
300	110	0.33	127	0.82
150	88	0.74	99	2.60
100	80	0.72	85	2.55
75	76	0.58	78	2.11
50	70	0.76	68	2.78

The placement of a small notch on the od of the sleeve would have a similar effect in that the phase would be reversed and the voltage would still be small, but the drawings show the notch on the parent tube od. Also, I am not sure that the changes would be this great. Since conclusions about the location of the indications within the sleeve and parent tube are drawn from the amplitude and phase of the signal, these discrepancies should be resolved. I discussed this problem with Bob Vollmer and Jeff Raschiatore of Zetec and they did not know the cause either. Bob said that indications should not be thrown out due to improper phase rotation until we understood the causes of this anomaly. The use of frequency appears to be a better method of determining the location of the defect within the sleeve and parent tube than using the phase shift.

It is not apparent to me how the weld is located using readings made on the standard.

It does not appear that there was a lot of planning for this test. There is a written procedure for what the production analysts call, and it is quite conservative. There needs to be a written procedure for how the calls are being resolved, so that we will have documentation as a reference at future outages.

The plugs that are added at this outage should be put in so that they can be removed and the sleeves retested at future outages when better inspection methods are available.

Related to email dated
6/28/00

Mr. Kenneth J. Karwoski
Office of Nuclear Reactor Regulation
Materials and Chemical Engineering Branch
U.S. Nuclear Regulatory Commission
MS OWFN 7D4
Washington, DC 20555

Trip to Maine Yankee **March 13, 1995**

On March 7 I traveled to Portland Maine to review the eddy-current inspection of the steam generators of the Maine Yankee Nuclear Power Plant. I was joined by Ken Karwoski of the NEC. Before the trip I reviewed the reports of the leaker outage in the Fall of 1994 and the subsequent inspection. Four tubes were leaking and the cause of the leaks was PWSCC at the top of the roll transition. Ken Karwoski and I reviewed the data analysts guidelines and inspection in general. There were very minor suggestions that I made for the analysts guidelines, including better graphics and quantitative measurements of the acceptable noise level of the data. In general, the guidelines were good.

Calibration Standard

The calibration standard used for the pancake coils was a subset of the ASME Section XI tubing standard that consists of drilled holes and was developed for the bobbin probe. While drilled holes have been used for past inspections, EDM notches are better for crack standards since their geometry better matches that of a crack. The use of a drilled hole for the standard also gives a phase shift that is too close to the tube id readings, according to Sagar. The defect depths are being measured off of the wrong calibration curve and there are no points between 0% and 100% on the id calibration curve. As a general rule, a notch standard should be required for pancake coil calibrations, and also for bobbin coil calibrations where crack depths are being measured.

Operating Frequency

In addition, at the frequencies used, the phase spread is not adequate for measuring the depth of id defects. Most of the defects observed fell on the od curve and the depth reported was called from this curve. There may be a variation in the phase produced by random factors in the test that are beyond our control at the present. If the phase shift produced by the defects happened to vary in the opposite direction, the defects would be missed. Some changes may need to be made in the length of the extension cable and the number of turns on the coil, but coils operating at higher frequencies are needed in order to get the proper resolution for id defects. The phase spread will increase and the sensitivity to od artifacts such as deposits will decrease. Unfortunately, the lift-off signal will also increase. I am including the results of some computations that I have run for 400KHz and 800KHz for a pancake coil (P60) that we designed at ORNL and tested at Prairie Island. It takes about three hours to run each of the defect curves and I suspect that the computed amplitude for the deeper defects is low. However, they show the increased phase shift (measured with respect to the lift-off curve) for the id defects. The defects that I used were 0.250-inches long and 0.005-inches wide. I am not sure that the smaller coils will work properly. If you can get the dimensions for me, I will run them when I return.

Voltage ratio

A Zetec three-coil rotating probe was used. This probe consists of a regular pancake coil, a coil sensitive to axial cracks and a coil sensitive to circumferential cracks. Ideally, the axial coil will get no signal from a circumferential crack and the circumferential coil will get no signal from an axial crack. For EDM notches, due partially to the width of the notches, the ratio is about 3 to 1, and for laboratory produced cracks, the ratio is 6 to 1. For pulled tubes with circumferential cracks, the minimum ratio of the circumferential voltage to the axial voltage was 2.08 to 1. A ratio of two to one has been established as the criteria for determining if a defect is volumetric or circumferential. While the exact value of this ratio can be debated, and deposits and lift-off can interfere with the ratio, this is much better test for determining if circumferential cracks are present than using a pancake coil. It would be interesting some time to make measurements on models of Zetec coils that have been scaled up so that the width of EDM notches can be taken into account.

Plus Point Probe

The Zetec plus point probe has the potential to cancel out the first order effects of lift-off. As you can see from the computations, only 0.002 inch of lift-off can produce signals that are as large as the defects in question. These probes also tend to cancel out first order effects from all volumetric indications, including od deposits and the ASME Section XI holes. Since there is no reliable standard is being presently used to set up these probes, the present results are in question. However, a standard with a set axial and circumferential id notches, ranging from 20% to through wall should correct this problem.

I will be gone all of next week and plan to be back by Sunday, March 26. The best phone number for me will be (813) 642-1006 if you need me for anything.

Caius Dodd