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Subject: Arkansas Nuclear One - Unit 2
Docket No. 50-368
License No. NPF-6
Steam Generator Inspection Eddy Current Program Improvements
from the 2P99 Inspection (TAC NO. MA4814)

Gentlemen:

On March 9, 2000 (2CAN030003), Entergy Operations submitted a proposed license change to allow risk-informed operation for the remainder of the 14th operational cycle for Arkansas Nuclear One, Unit 2 (ANO-2). The following information is provided to support Entergy Operations' position that there was an improvement in the inspection program in 2P99 which led to the identification of an increased number of flaws. As discussed in our correspondence of June 20, 2000 (2CAN060015), Entergy attributed part of this improvement to the use of a new calibration standard in 2P99.

In conversation with the NRC staff on improvements in probability of detection (POD) due to a change in the calibration standard used in 2P99, the NRC staff consultant indicated that, in his opinion, the calibration standard change had not improved POD. This was based upon a comparison of the signal-to-noise (S/N) ratio for 2P99 as compared to the previous outage (2R13). The consultant did acknowledge that the signal amplitude was larger in the 2P99 inspection due to the change in calibration standard. Entergy Operations agrees that the S/N ratio may not have improved significantly; however, we do not agree that the application of the new calibration standard did not result in an improved POD. We believe that, regardless of the S/N ratio, an analyst is more likely to call a larger amplitude signal. By setting up on the new calibration standard, the flaw indications in 2P99 were magnified by approximately 37% over how the indication would have appeared in 2R13 utilizing the old calibration standard. We believe, based upon discussions with analysts that actually participated in the 2P99 and 2R13 campaigns, that this increase in the signal presentation makes the flaws more readily apparent.

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The application of the new calibration standard also results in a higher voltage signal for a given flaw (i.e., a flaw with a 0.2 volt indication in 2R13 would have measured approximately 0.3 volt in 2P99). This is significant given the site specific training conducted just prior to the outage emphasized the detection of low amplitude indications at the lower hot leg eggcrate supports. It was specifically noted in this training that during 2R13 a low voltage flaw was detected which was subsequently determined to be structurally significant (i.e., failed an in-situ pressure test at 3958 psi).

Also contributing to improved detection of eggcrate axial flaws was the focused inspection during 2P99 which was concentrated on the lower hot leg eggcrate supports.

It is Entergy Operations' belief that the magnified eddy current signal, in conjunction with the increased voltage reading for the flaw and site specific training conducted to specifically sensitize the analysts to low voltage flaws, clearly resulted in improved detection capability and can be directly attributable to the increased number of flaws detected during 2P99. A detailed discussion of the effect of the setup change is attached.

As discussed in our correspondence dated June 20, 2000, the increased number of flaws detected during 2P99 can only be attributed to one or a combination of three things: increased growth rate, increased initiation rate, or increased POD. That correspondence provided clear evidence that the increased number of indications was not due to the increased growth or initiation rates and provided evidence to support improved POD. Entergy Operations firmly believes the increased number of flaws detected during 2P99 can be directly attributed to improved POD.

Should you have any questions concerning the information provided, please contact me.

Very truly yours,

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Observations From a Review of 2P99 and 2R13 Data

This attachment addresses the issue of changes seen to signals based on the differences when using two different calibration standards during successive outages. The two standards are the ASME bobbin standard used in outages prior to 2P99 (referred to as the 2R13 standard) and the most recent calibration standard (referred to as the 2P99 standard). Because of differences in the two calibration standards (wall thickness being the primary contributor) the amplitudes from the 2P99 calibration standard are lower resulting in the need to increase EDDYNET parameters to bring them within required tolerances. This adjustment to the 2P99 standard setup results in a larger signal size, a phase angle rotated more vertical (resulting in a larger separation angle between signal and noise), and an increased voltage.

The setup for both 2R13 and 2P99 was the same based on the examination technique specification sheet (ETSS). The amplitude was set on the four 20% through-wall (TW) holes at 4.00 volts on Channel 1 and the signal for the 100 % TW hole was set to 75% of the full screen height (FSH).

Figure 1 shows the 2R13 calibration standard with the 2R13 setup requirements for SPAN on channel P1 (multi-frequency channel used to suppress the eggcrate signal). SPAN represents the GAIN or signal size that the analyst would use to visually observe the data. Channel P1 is used to perform initial screening of the eggcrates for indications of degradation.

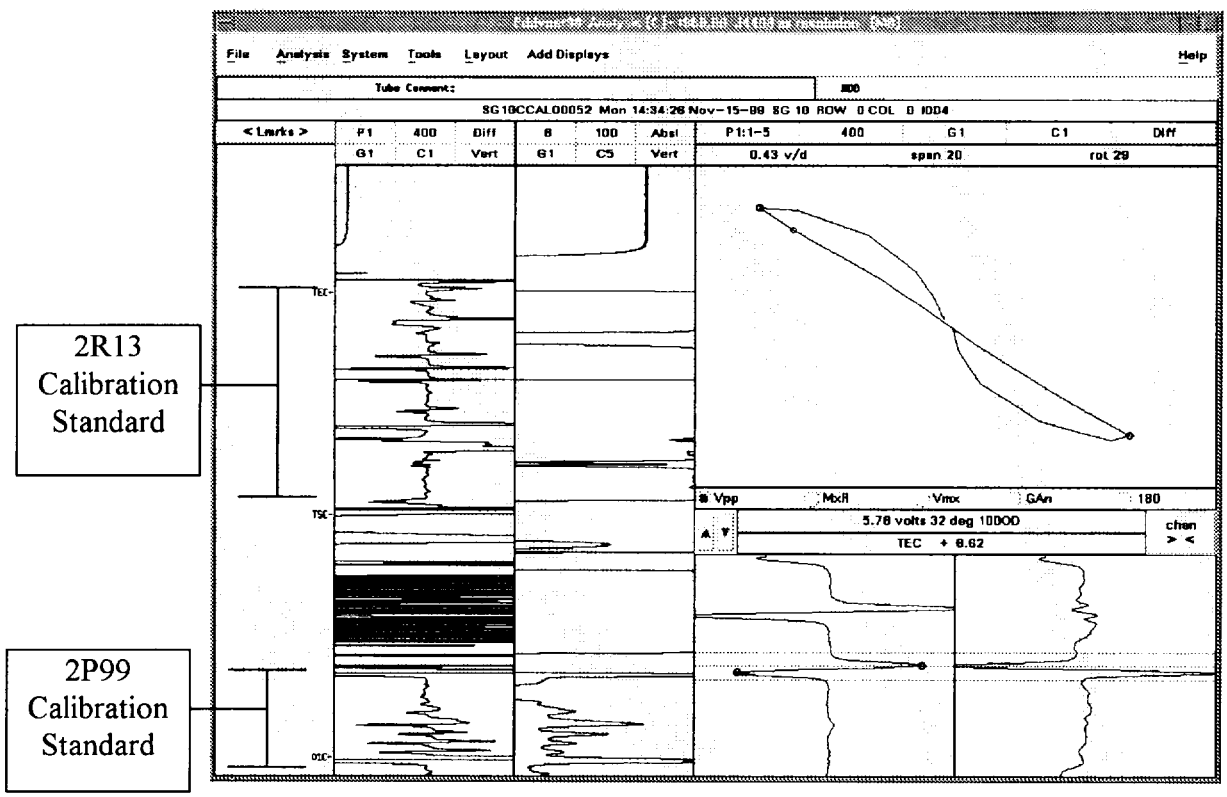

Figure 1
100% TW Hole 2R13 Standard and Setup

Figure 2 shows the 2P99 calibration standard using the setup performed with the 2R13 calibration standard. Note that the depth no longer reads 100% TW (96%) and the signal size is approximately 55% of the FSH. This comparison indicates that for a given signal identified in 2P99 using the 2R13 calibration setup, the signal would have been smaller and shallower than what it would have been using the 2P99 calibration standard. As such, an adjustment to the signal would be required to meet the ETSS requirements in accordance with the EPRI NDE Guidelines Appendix H qualification parameters.

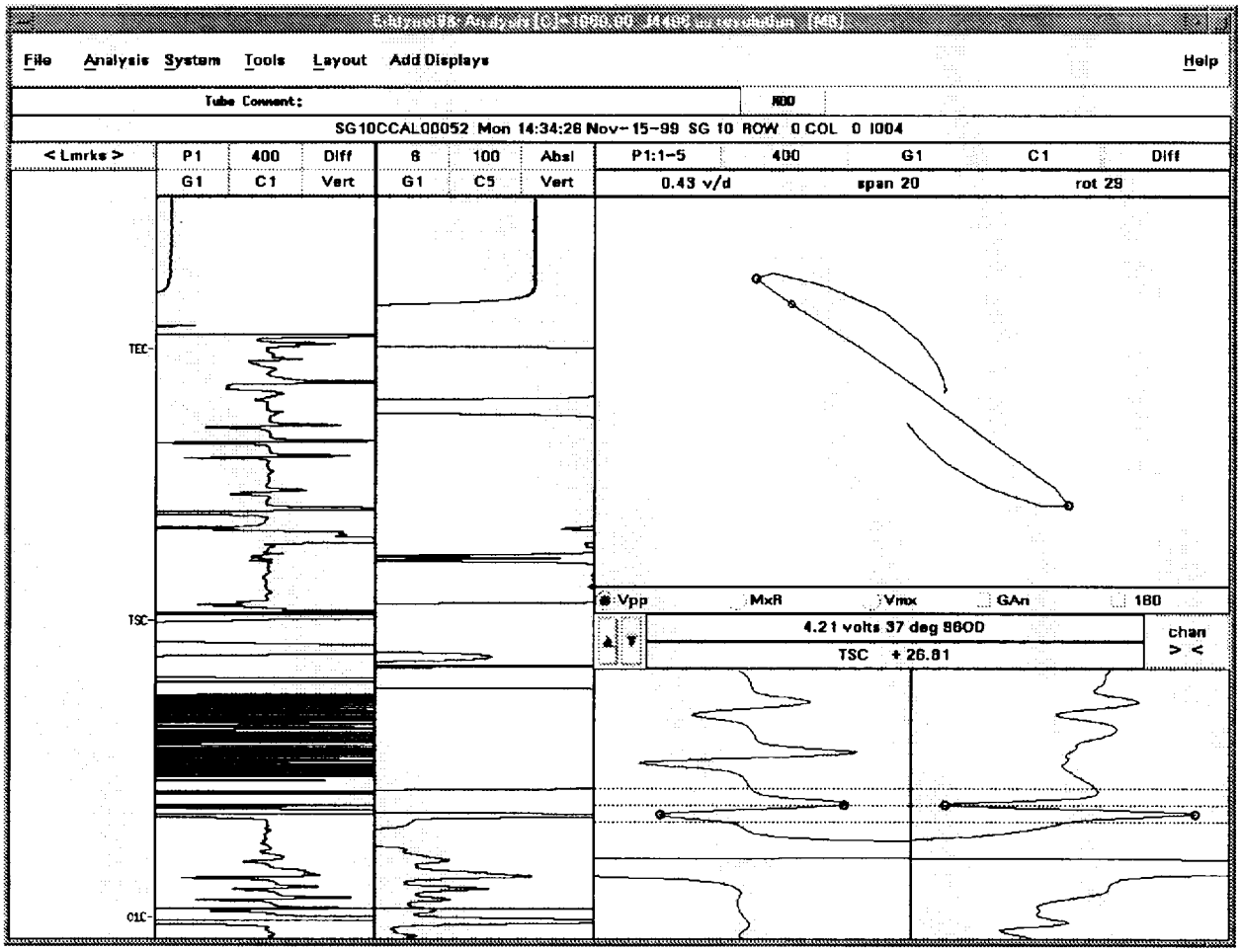

Figure 2
100% TW Hole on the 2P99 Calibration Standard With the 2R13 Setup

Figure 3 represents the 2P99 calibration standard 100% TW hole adjusted to meet the ETSS requirements. The signal was increased to 75% of the FSH and the voltage was set on the four 20% TW holes to 4.00 volts. This results in an increase in voltage from 4.21 volts to 5.79 volts. The phase angle also changed from 37 degrees to 32 degrees, which results in an increase in reported depth from 96% to 100% TW. The overall result is a smaller SPAN setting, and thus a larger screen presentation (higher magnification), for the 2P99 calibration standards.

The above information shows how the 2P99 calibration standard affected the eddy current setup. The following information demonstrates the effect of the setup change on the actual field eddy current data.

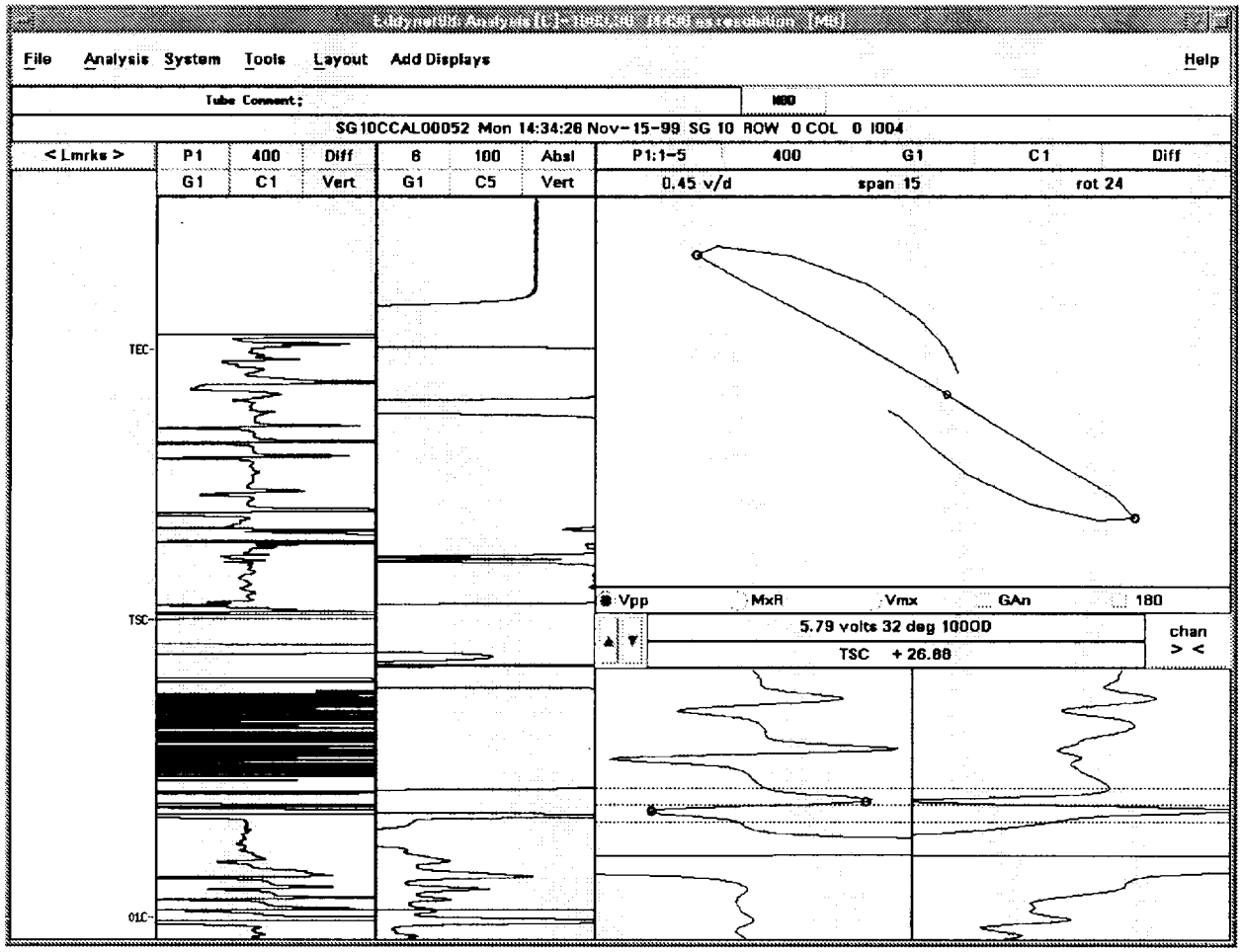

Figure 3
100% TW Hole on the 2P99 Calibration Standard Set to the ETSS Requirements

Several indications from 2P99 were analyzed using the two different calibration standards and their corresponding setups. This is presented in Figures 4 through 9. Each figure shows the indication with the 2P99 setup on top and the 2R13 setup on the bottom. The primary focus is on three different aspects of the diagrams. The first is to look at the signal amplitude relative to the horizontal noise. In each case, the ability to detect a flaw is improved. The second area is in the expanded strip chart. The signal is not only larger, but also exhibits more flaw-like characteristics. The third area is that the signal phase is generally rotated more vertical above the horizontal noise providing an improvement in the S/N ratio.

Conclusions:

Due to the differences between the 2P99 and 2R13 calibration standards, the data presented to the analyst is better when using the 2P99 standards. This is because of increased signal amplitude, higher GAIN settings used for the display of the data, and the larger separation angle between the signal of interest and background noise for the P1 channel. These parameters are of primary importance for visual recognition (detection) of flaw-like indications and therefore, directly influence the probability of detection for manual human analysis systems.