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FRAMATOME ANP

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Title CALLAWAY 1RFO12 - EPRI APPENDIX H EDDY CURRENT TECHNIQUE QUALIFICATION

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Reviewer is Independent.

Remarks:

Complete revision for the October 2002, 1RFO12 Outage.

This document provides the results of the review of the Appendix H Eddy Current Techniques that will be used at the Callaway, 1RFO12, steam generator tube inspection and their applicability to the in-generator tubing and tube degradation.

This review is required as part of Section 6.2.4 of EPRI PWR Steam Generator Examination Guidelines, Rev 5.

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1.0 Introduction

Based upon the requirements specified in Reference 4.1 for site qualified techniques, a documented review of a qualified technique's essential variables must be made to ensure the application of any EPRI Appendix H technique during a steam generator inspection is applicable to the site-specific generator conditions. The purpose of this report is to provide the documentation that the ET techniques that will be used at Callaway during the 1RFO12 inspection are adequate for the detection and sizing (where applicable) for the damage mechanisms that are both active and potential for these steam generators.

2.0 Eddy Current (ET) Techniques

All of the EPRI Appendix H techniques used, as comparison, for the Callaway tubing were performed utilizing different frequencies than will be used for the Callaway examination. An equivalency had to first be established for the different frequencies. This was achieved by comparing relative current densities. Section H.4.1.2 in the PWR Steam Generator Examination Guidelines, Revision 5 require that the current densities should be within 10% of the qualified frequency to be considered equivalent. Table 1 illustrates the relative current densities for the frequencies and techniques used at Callaway and Table 2 illustrates the relative current densities for the EPRI Appendix H frequencies and techniques. Based on these tables, an equivalency, between the EPRI Appendix H frequencies and the Callaway frequencies was established.

The EPRI Appendix H ET techniques to be used during the 1RFO12 inspection of the Callaway steam generators were reviewed to determine their applicability to the site conditions. A review of the pulled tube samples and lab samples used to support the Appendix H technique qualifications was performed. An analysis of a sample of ET data from Callaway ensured that the characteristics of the in-generator tubing (i.e. denting, deposits, geometrical changes) is consistent with those used to develop the qualified techniques. The data was also reviewed by Framatome ANP (FANP) for similarity and applicability to Callaway tubing conditions, signal-to-noise, and essential ET variables to be used during the examination. The graphics provided on pages 14 and 15 depict typical areas of the Callaway steam generators. The graphics on pages 35 - 55 depict indications from the EPRI data sets and actual Callaway data of the same general areas. Based upon this review, the tubing conditions that are expected in the Callaway steam generators are equivalent to those of the qualification samples.

Table 3 lists the techniques that will be used for each of the active and potential degradation mechanisms at Callaway. The essential variables for tubing, equipment, technique, and analysis were taken from Reference 4.1, page 6-3, Figure 6-2, and page H-2, H.2.1.1.

Based upon the review of Reference 4.1, there are two classifications of eddy current techniques that are available for use during the Callaway inspection for detection and sizing of steam generator tube degradation. They are "site-qualified" and "qualified" techniques. A third classification, "qualified-by-extension" (QBE) will also be utilized for this examination. The "qualified by extension" techniques are those that are bounded by other EPRI qualified techniques.

Site qualified techniques:

"Site qualified techniques" have an EPRI ETSS for detection and/or sizing and have been reviewed by FANP for similarity and applicability to Callaway tubing conditions, signal-to-noise, and essential ET variables to be used during the examination. One key part of this comparison is that the degradation must have been previously detected at Callaway in order to compare the signals and classify the technique as "Site" qualified. These techniques are directly applicable to Callaway and are denoted as "Site" in the *Detection* or *Sizing* portion of the Technique Qualification Category column in Table 3. AVB wear, Circumferential and Axial ODSCC at expansion transitions, and Circumferential and Axial PWSCC at expansion transitions, are the only active tube damage mechanisms at Callaway. These techniques may also be utilized for sizing to assist in evaluations for Condition Monitoring and Operation Assessment. The technique used for this mechanism is "site-qualified" for detection and sizing. Listed below are the site qualified techniques utilized for this examination:

Bobbin:
96004.3

RPC:
20510.1 20511.1 21409.1 21410.1

Qualified techniques:

"Qualified techniques" have an EPRI ETSS for detection and/or sizing, but a direct comparison could not be made because the degradation mechanism has not been detected at Callaway. These are denoted as "qualified" in the *Detection* or *Sizing* portion of the Technique Qualification Category column in Table 3. Listed below are the qualified techniques utilized for this examination:

Bobbin:
96001.1 96005.2 96007.1 96008.1

RPC:
21998.1 22841.3 22842.3 96910.1 96911.1 96511.2
96511.3 99997.1 99997.2 MAGPPT MAGGPTTP

Qualified-by-extension:

"Qualified-by-extension"(QBE) techniques do not have a specific EPRI ETSS for detection and/or sizing, but Callaway has applied a technically justifiable technique for detecting and/or sizing a damage mechanism based on electro-magnetic theory, geometrical similarities, and/or similar flaw characteristics. These are denoted as "QBE" in the *Detection* or *Sizing* portion of the Technique Qualification Category column in Table 3. Listed below are the EPRI techniques that are qualified-by-extension for detection and/or sizing and the applicable damage mechanisms that are covered by these techniques.

Bobbin Coil

- **96004.3, 96005.2, 96007.1, and 96008.1** will be utilized for detection of freespan indications, i.e., Manufacturing Burnish Marks (MBM).
- **96004.3 and 96005.2** will be utilized for the detection and/or sizing of loose parts and loose part wear. There are no actual EPRI qualified techniques for the detection of loose-parts, but low frequency screening of the ET data (bobbin and rotating coils) can easily detect structures outside the tubes (i.e., TSPs and TTS). Therefore, the detection of loose-parts by these techniques is considered as "qualified-by-extension" at Callaway. Sizing of loose-part

wear will also be performed and considered qualified-by-extension provided that the actual wear from the loose part can be compared to samples in the above EPRI data sets and a reliable calibration curve can be established using wear indications similar in morphology to the actual wear.

RPC Coil

- **20510.1** will be utilized for the detection for circumferential PWSCC at dented locations based on similar ID geometry and the ability of the surface-riding probe to smoothly traverse the irregular geometry of this area.
- **20511.1** will be utilized for the detection for axial PWSCC at dented locations based on similar ID geometry and the ability of the surface-riding probe to smoothly traverse the irregular geometry of this area.
- **21409.1** will be utilized for detection of freespan indications, i.e., Manufacturing Burnish Marks (MBM).
- **22841.3** will be utilized for the detection of axial ODSCC associated with expansion transitions, support structures and freespan ding location based on similar ID geometry, bounding conditions, and the ability of the surface-riding RPC probe to smoothly traverse these areas.
- **22842.3** will also be utilized for the detection of circumferential ODSCC at support structures, freespan dings based on similar ID geometry, bounding conditions, and the ability of the surface-riding RPC probe to smoothly traverse these areas.
- **96910.1 and 96911.1** will be utilized for the detection and/or sizing loose parts and loose part wear. There are no actual EPRI qualified techniques for the detection of loose-parts, but low frequency screening of the ET data (bobbin and rotating coils) can easily detect structures outside the tubes (i.e., TSPs and TTS). Therefore, the detection of loose-parts by these techniques is considered as "qualified-by- extension" at Callaway. Sizing of loose-part wear will also be performed and considered qualified-by-extension provided that the actual wear from the loose part can be compared to samples in the above EPRI data sets and a reliable calibration curve can be established using wear indications similar in morphology to the actual wear.

In each case of techniques that are extended for sizing of degradation, the sizing uncertainties associated with these are considered for the purposes of condition monitoring assessment only. A plug on detection philosophy should be used to disposition these indications since the sizing is not explicitly included in the EPRI ETSS database.

3.0 Conclusions

The table and graphics provided in this report show that the review of the EPRI qualified techniques to be used at Callaway was completed. The techniques are categorized as either site-qualified, qualified, or qualified-by-extension as noted in Table 3. The use of all the techniques listed in Table 3 is justified during the inspection of the Callaway steam generators at 1RFO12, for each of the degradation mechanisms that are potential at Callaway. A qualitative Signal-to-Noise (S/N) comparison was performed on the EPRI data sets and the Callaway historical data. In all cases the Callaway S/N ratios were equivalent to the data that was used in the EPRI techniques.

4.0 References

- 4.1 EPRI Report TR-107569-V1R5, "PWR Steam Generator Examination Guidelines: Revision 5 Volume 1, September 1997".
- 4.2 FANP Procedure, 54-ISI-79, Revision 5, "Eddynet 98 System Checkout Procedure".
- 4.3 FANP document 51-5001224-00, Appendix H Equivalency Testing: MRPC Examinations.
- 4.4 FANP document 51-5001223-00, Appendix H Equivalency Testing: Cable Lengths.
- 4.5 Zetec MIZ-30 Eddy Current Tester Implementation Documents, May 31, 1994.
- 4.6 FANP document, 51-5001301-00, Appendix H Equivalency, PWSCC Sizing at Higher Examination Speeds.
- 4.7 Westinghouse document STD-DP-1997-7996, "Qualification of Magnetically Biased Plus Point Probe for Welded Sleeve Inspection per STD-QP-1996-7702, Rev. 0."
- 4.8 Westinghouse Document DDM-96-009 Rev.0, "Documentation of Appendix H Compliance and Equivalency".
- 4.9 FANP document 51-5010426-00, Salem 2R11 Small Radius U-bend Noise Study.
- 4.10 FANP document 51-5011653-00, Callaway Fill Factor Equivalency.
- 4.9 FANP document 51-5014354-00 "Eddy Current Probe Extension Cable Comparison".
- 4.10 AmerenUE document ETP-BB-01309 Rev.013, " STEAM GENERATOR EDDY CURRENT TESTING ACQUISITION AND ANALYSIS GUIDELINES".

Callaway Bobbin Technique Summary				
EPRI ETSS	EPRI Frequency	Damage Mechanism	Callaway Equiv. Frequency	Areas Qualified By Extension (QBE)
96001.1	400/100 D	Thinning @ TSP's and Top-of-Tubesheets <i>Detection / Sizing</i>	630/160 D	N/A
96004.3	200/100 A 300/150 A	Wear @ TSP's, FDB, and AVB's, <i>Detection / Sizing</i>	320/160 A	Freespan indications <i>Detection</i> Loose Part / Loose Part Wear <i>Detection / Sizing</i> Tube-to-Tube Wear <i>Detection / Sizing</i>
96005.2	400/100 D	Pitting in the presence of copper. <i>Detection / Sizing</i>	630/160 D	Pitting in Sludge Pile <i>Detection / Sizing</i> Freespan indications. <i>Detection</i> Loose Part / Loose Part Wear <i>Detection / Sizing</i>
96007.1	400/100 D 550/130 D	IGA/SCC @ non-dented drilled tube support locations	630/160 D	Freespan indications <i>Detection</i>
96008.1	400/100 D	Axial ODSCC at non-dented eggcrates and/or sludge pile region. <i>Detection / Sizing</i>	630/160 D	Axial ODSCC in freespan areas. <i>Detection / Sizing</i> Freespan indications <i>Detection</i>

Callaway RPC Technique Summary				
EPRI ETSS	EPRI Frequency	Damage Mechanism	Callaway Equiv. Frequency	Areas Qualified By Extension (QBE)
20510.1 +Point™	200 300	Circ PWSCC at expansion transitions. <i>Detection / Sizing</i>	300	Circ PWSCC at Dented locations. <i>Detection / Sizing</i>
20511.1 +Point™	200 300	Axial PWSCC at expansion transitions. <i>Detection / Sizing</i>	300	Axial PWSCC at Dented locations. <i>Detection / Sizing</i>
21409.1 +Point™	200 300	Axial ODSCC at support structures, freespan, & sludge pile. <i>Detection</i>	300	N/A
21410.1 +Point™	200 300	Circ ODSCC at expansion transitions. <i>Detection</i>	300	Circ ODSCC at support structures, freespan, & sludge pile. <i>Detection</i>
21998.1 +Point™	300	Volumetric indications within the freespan areas. <i>Detection / Sizing</i>	300	N/A

Callaway RPC Technique Summary				
EPRI ETSS	EPRI Frequency	Damage Mechanism	Callaway Equiv. Frequency	Areas Qualified By Extension (QBE)
22841.3 +Point™	300 w/BP Filter	Axial ODSCC @ dented support structures. <i>Detection / Length sizing</i>	410 w/BP Filter	Axial ODSCC @ expansion transitions, freespan dings, and support structures. <i>Detection</i>
22842.3 +Point™	300	Circ ODSCC @ dented support structures. <i>Detection / Length sizing</i>	410	Circ ODSCC @ expansion transitions, freespan dings, and support structures. <i>Detection</i>
96910.1 +Point™	300/100	Mechanically induced wear at Broached TSP's. <i>Detection / Sizing</i>	300/100	Loose Part , Tube-to-Tube and FDB wear. <i>Detection / Sizing</i> Volumetric freespan indications <i>Detection / Sizing</i>
96911.1 .115 Pancake	300/100	Mechanically induced wear at Broached TSP's. <i>Detection / Sizing</i>	300/100	Loose Part , Tube-to-Tube and FDB wear. <i>Detection / Sizing</i> Volumetric freespan indications <i>Detection / Sizing</i>
99997.1 +Point™	800	Axial / Circ PWSCC in Low-Row Ubends	800*	N/A
99997.2 +Point™	1000	Axial / Circ PWSCC in Low-Row Ubends	1000*	N/A

* The 800 and 1000 kHz are not equivalent frequencies for this wall-thickness tubing (0.040") based on the ratio of relative current density at the inside diameter (ID) to the relative current density at the outside diameter (OD). Relative current densities for a given frequency are relatively equal at the ID surface regardless of tubing wall thickness. EPRI techniques 99997.1 and 99997.2 are strictly for PWSCC in the Low-Row Ubend areas on the ID of the tube. Lower frequencies will be utilized during this exam to inspect for OD initiated degradation.

TABLE 1

Callaway ET Parameters versus Frequency
0.688" x 0.040" Inconel 600

Frequency (Hz)	Standard Depth of Penetration (Inches)	(Wall thickness) / (Standard Depth)	Relative OD Current Density (% of ID Density)	Approximate ID/OD Impedance Plane Phase (Degrees)
Bobbin Coil Frequencies- Callaway				
30,000	0.113	0.35	70	41
160,000	0.049	0.82	44	94
320,000	0.035	1.15	32	132
630,000	0.025	1.62	20	186
Rotating Coil Frequencies- Callaway				
20,000	0.137	0.29	75	33
100,000	0.062	0.65	52	74
200,000	0.044	0.91	40	105
300,000	0.036	1.12	33	128
400,000	0.031	1.29	28	148
410,000	0.31	1.31	27	150
600,000	0.025	1.58	21	181
800,000	0.022	1.83	16	209
1,000,000	0.020	2.04	13	234
Rotating Coil Frequencies – Laser Welded Sleeves (Total Wall 0.075")				
60,000	0.080	0.94	39	107
80,000	0.069	1.08	34	124
140,000	0.052	1.43	24	164
170,000	0.048	1.58	21	181
240,000	0.040	1.87	15	215
340,000	0.034	2.23	11	256

TABLE 2

EPRI Appendix H Parameters versus Frequency

EPRI ETSS #	Description	Frequency kHz	Tube Wall Inches	Standard Depth of Penetration	Relative OD Density (% ID Density)	Callaway ETSS #
Bobbin Techniques						
96001.1	Thinning @ TSP's and Top-of-Tubesheets	400/100 D	0.049	0.031/0.062	21/45	1
96004.3	Wear @ TS, AVB, Vert. & Diag. Straps	200/100 A 300/150 A	0.049 0.040	0.044/0.062 0.036/0.051	33/45 33/45	1
96005.2	Pitting in the Presence of Copper	400/100 D	0.050	0.031/0.062	20/45	1
96007.1	IGA/ODSCC @ non-dented drilled tube supports	400/100 D 550/130 D	0.049 0.043	0.031/0.062 0.026/0.054	21/45 20/45	1
96008.1	IGA/ODSCC detect and size @ non-dented tube supports & sludge pile	400/100 D 400/100 D	0.050 0.048	0.031/0.062 0.031/0.062	20/45 21/46	1
RPC Techniques						
20510.1	Circ PWSCC at expansion transitions - +Point™	200 300	0.048 0.043	0.044 0.036	33 30	2
20511.1	Axial PWSCC at expansion transitions - +Point™	200 300	0.049 0.043	0.044 0.036	33 30	2
21409.1	Axial ODSCC at support structures, freespan, crevice & sludge pile - +Point™	200 300	0.048 0.043	0.044 0.036	33 30	2, 6
21410.1	Circ ODSCC at expansion transitions - +Point™	200 300	0.048 0.043	0.044 0.036	33 30	2, 6
21998.1	Volumetric Indications in Freespan - +Point™	300	0.043	0.036	30	2,6
22841.3	Axial ODSCC detect & size at dented support structures - +Point™ Bandpass	300	0.050	0.036	25	2,3,6
22842.3	Circ ODSCC detect & length size at dented support structures - +Point™	300	0.050	0.036	25	2,3,6
96910.1	Mechanically induced Wear @ Broached TSPs. (Loose Part Wear / Pitting) - +Point™	300/100	0.037	0.036/0.062	36/55	2,36
96911.1	Mechanically induced Wear @ Broached TSPs. (Loose Part Wear / Pitting) - 0.115MR	300/100	0.037	0.036/0.062	36/55	2,5
99997.1	Axial & Circ PWSCC in Low-Row-Ubends	800	0.049	0.022	11	8
99997.2	Axial & Circ PWSCC in Low-Row-Ubends	1000	0.049	0.020	8	8
Westinghouse Laser Welded Sleeve Appendix H Parameters versus Frequency RPC Techniques						
WEST ETSS #	Description	Frequency KHz	PAR + LWS Tube Wall In.	Std. Depth Penetration	Relative OD Current Density (% ID Density)	Callaway ETSS
MAGPPT	Axial, Circumferential, and Volumetric degradation in Parent Tube and LWS	150/100 A 75/50 A	0.081	0.051/0.062 0.072/0.088	20/27 32/40	4
MAGGPPTP	Axial, Circumferential, and Volumetric degradation in Parent Tube and LWS. Process Flaws	300/120/100 A 75/50 A	0.081	0.036/0.057/0.062 0.072/0.088	10/24/27 32/40	4

FORMULAS USED FOR CURRENT DENSITY

Standard Depth of Penetration = $\delta = 1.98 \sqrt{\frac{\rho}{f}}$ where:

ρ = Resistivity in *micro* Ω cm = 98.00 for Inconel 600

f = frequency in cycles per second (hertz)

Relative Current Density = $100 \times e^{-\left(\frac{t}{\delta}\right)}$ where:

t = tube wall thickness in inches

δ = Standard Depth of Penetration

Approximate ID/OD Impedance Plane Phase = $\frac{2 \times t \times 57.3}{\delta}$ (Degrees)

**Table 3
CALLAWAY**

	Degradation Mechanism	Orientation	Location	Probe	EPRI ETSS Detection Technique (and page)	EPRI POD	EPRI ETSS Sizing Technique	EPRI Sizing RMSE	Non-Site Qualified Sizing Technique	Non-Site Qualified Sizing RMSE (note 2)	Technique Qualification Category	Application of EPRI Technique to site conditions (note 1)
1	Cold Leg Thinning (potential)	--	Cold Leg TSP	Bobbin	96001.1 (A-230)	.82 @ 50%TW @ .90CL	96001.1	14.4%TW	None	N/A	Detection: Qualified Sizing: Qualified	Pulled Tube No Site Data
2	Wear (active)	--	AVB FDB	Bobbin	96004.3 (A-256)	.912 @ 60%TW @ .90 CL	96004.3	3.85%TW for flaws up to 90%	None	N/A	Detection: Site Qualified Sizing: Site Qualified	Lab Sample Site Data
3	Pitting @ copper (potential)	--	Above TTS	Bobbin	96005.2 (A-266)	.825 @ 50%TW @ .90 CL	96005.2	20.97% TW	None	N/A	Detection: Qualified Sizing: Qualified	Pulled Tube No Site Data
4	IGA/ODSCC (potential)	--	Non-dented Drilled TSP	Bobbin	96007.1 (A-291)	.896 @ 60% TW @ .90 CL	96007.1	20.13% TW	None	N/A	Detection: Qualified Sizing: Qualified	Pulled Tube No Site Data
5	IGA/ODSCC (potential)	--	Non-dented Eggcrates & SLG region	Bobbin	96008.1 (A-296)	.811 @ 40%TW @ .90 CL	96008.1	21.34 %TW	None	N/A	Detection: Qualified Sizing: Qualified	Pulled Tube No Site Data
6	PWSCC (active) (potential)	Circ	Expansion Transition Dented Locations	+Point™	20510.1 (A-79)	.915 POD 40% TW @ .90 CL	20510.1	25.80% TW	None	N/A	Detection: Qualified / QBE Sizing: Qualified / QBE	Lab Sample Site Data No Site Data
7	PWSCC (active) (potential)	Axial	Expansion Transition Dented Locations	+Point™	20511.1 (A-88)	.896 POD 40% TW @ .90 CL	20511.1	17.22% TW	None	N/A	Detection: Qualified / QBE Sizing: Qualified / QBE	Lab Sample Site Data No Site Data
8	ODSCC (potential)	Axial	Support Structures Freespan SLG Pile	+Point™	21409.1 (A-114)	.819 POD 50% TW @ .90 CL	21409.1	42.33% TW	None	N/A	Detection: Qualified Sizing: Qualified	Lab Sample Site Data
9	ODSCC (active) (potential)	Circ	Exp. Trans. Structures Freespan SLG Pile	+Point™	21410.1 (A-123)	.905 POD 50% TW @ .90 CL	21410.1	35.90% TW	None	N/A	Detection: Qualified / QBE Sizing: Qualified / QBE	Lab Sample Site Data
10	Volumetric Indications (potential)	Volumetric	Freespan	+Point™	21998.1 (A-164)	.926 POD 40% TW @ .90 CL	21998.1	9.07%	None	N/A	Detection: Qualified Sizing: Qualified	Lab Samples Site Data
11	ODSCC (potential) (active) (potential)	Axial	Dented Supports Exp Trans, FS dings, Sup Loc.	+Point™	22841.3 (A-186)	.901 POD 40% TW @ .90 CL	None	N/A	None	N/A	Detection: Qualified / QBE Sizing: Qualified / QBE	Lab Sample No Site Data Site Data No Site Data

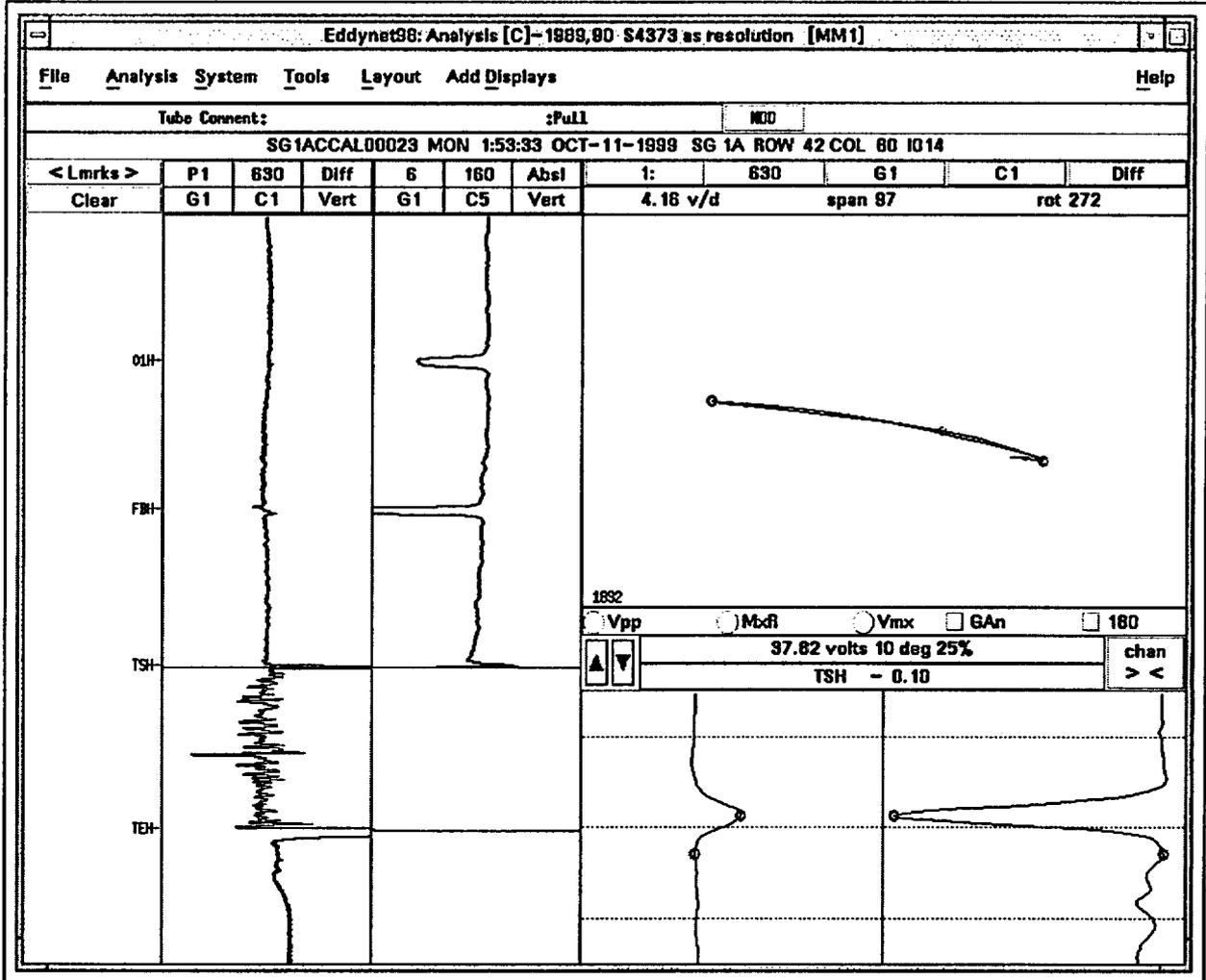
**Table 3
CALLAWAY**

	Degradation Mechanism	Orientation	Location	Probe	EPRI ETSS Detection Technique (and page)	EPRI POD	EPRI ETSS Sizing Technique	EPRI Sizing RMSE	Non-Site Qualified Sizing Technique	Non-Site Qualified Sizing RMSE (note 2)	Technique Qualification Category	Application of EPRI Technique to site conditions (note 1)
12	ODSCC (potential) (potential)	Circ	Dented Supports FS dings, Sup Loc.	+Point TM	22842.3 (A-202)	.891 POD 40% TW @ .90 CL	None	N/A	None	N/A	Detection: Qualified / QBE Sizing: Qualified / QBE	Lab Sample No Site Data No Site Data
13	Wear (active) (active) (potential)	--	TSP AVB FDB	+Point TM	96910.1 (A-400)	.924 POD >40% @90 CL	96910.1	7.74 % TW	None	N/A	Detection Qualified / QBE Sizing Qualified / QBE	Lab Sample Site Data No Site Data No Site Data
14	Wear (active) (active) (potential)	--	TSP AVB FDB	.115 Pan.	96911.1 (A-405)	.924 POD >40% @90 CL	96911.1	12.62% TW	None	N/A	Detection Qualified / QBE Sizing Qualified / QBE	Lab Sample Site Data No Site Data No Site Data
15	PWSCC (potential)	Axial Circ	Low Row U-bend Region	+Point TM	99997.1 (A-421)	.915 POD >/=27% TW @ 90 CL	99997.1	23.41% TW	None	N/A	Detection: Qualified Sizing: Qualified	Lab Sample No Site Data
16	PWSCC (potential)	Axial Circ	Low Row U-bend Region	+Point TM	99997.2 A-(425)	.915 POD >/=27% TW @ 90 CL	99997.1	23.41% TW	None	N/A	Detection: Qualified Sizing: Qualified	Lab Sample No Site Data
17	Loose Part (potential)	--	Anywhere	Bobbin	Extension Of 96004.3, 96005.2	None	None	None	None	N/A	Detection QBE Sizing: QBE	N/A Site Data
18	Wear (potential)	--	@ Loose Parts	+Point TM .115	Extension of 96910.1 96911.1	None	96910.1 96911.1	7.74% 12.62%	None	N/A	Detection QBE Sizing: QBE	N/A Site Data
19	Free Span Indications	NQH VOL (MBM)	Anywhere	Bobbin	Extension Of 96004.3, 96005.2, 96007.1, 96008.1	None	None	None	None	N/A	Detection: QBE Sizing: N/A	N/A Site Data
20	Parent Tube OD and ID Cracking	Axial Circ Vol	Laser Welded Sleeves	Mag- Bias +Point TM	<u>W ETSS</u> MAGPPT	<u>W POD</u> SEE ETSS	None	None	None	N/A	Detection: Qualified West. Qual STD-DP-1997- 7996 Sizing: N/A	Lab / Pulled Samples No Site Data
21	Weld Process Ind's.	Axial Circ Vol	Laser Welded Sleeves	Mag- Bias +Point TM	<u>W ETSS</u> MAGGPTTP	<u>W POD</u> SEE ETSS	None	None	None	N/A	Detection: Qualified West. Qual STD-DP-1997- 7996 Sizing: N/A	Lab / Pulled Samples No Site Data

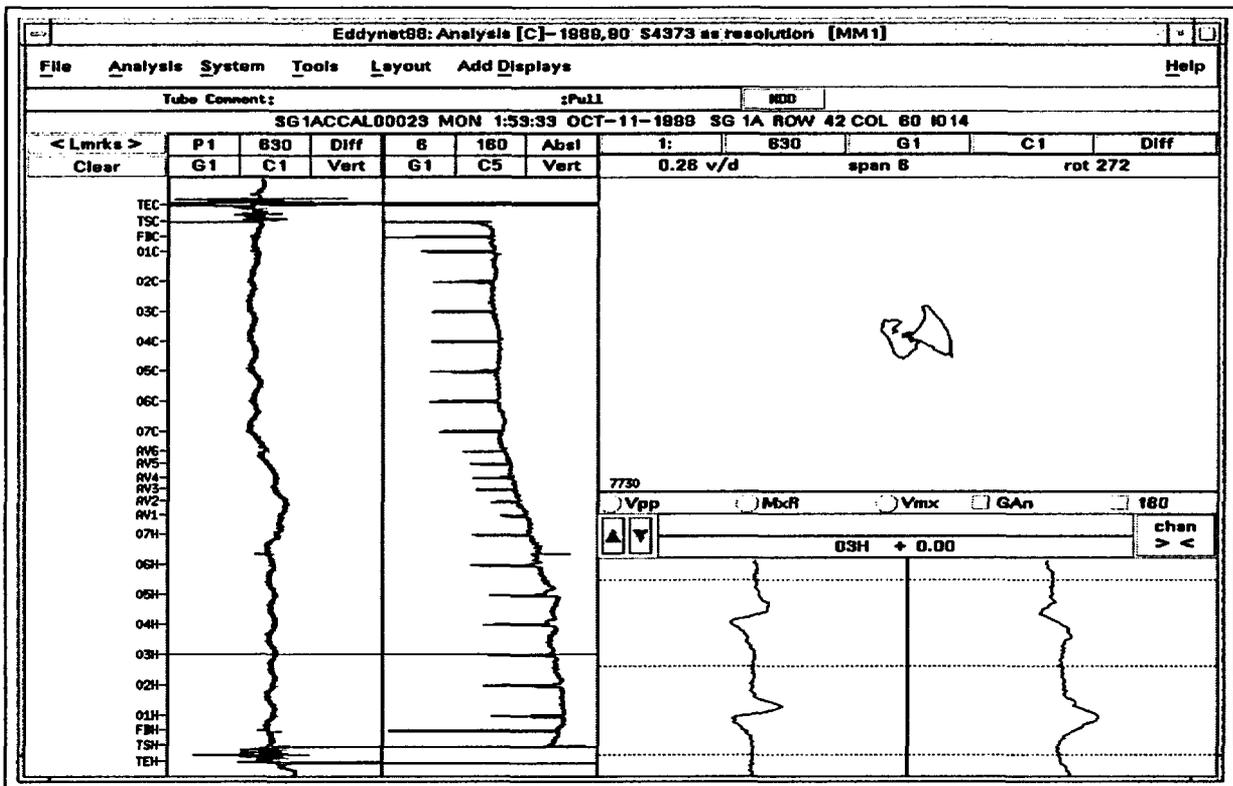
Note 1: Applicability of EPRI Appendix H qualified techniques to Site Specific Conditions have been reviewed. The criteria used for review included tubing essential variables such as denting, deposits, tube geometry changes, as well as signal voltage and signal-to-noise ratio.

Note 2: TBD indicates that, for active and/or potential tube damage mechanisms that are being sized by a non-qualified sizing technique, a suitable RMSE needs to be established to support condition monitoring and operational assessment.

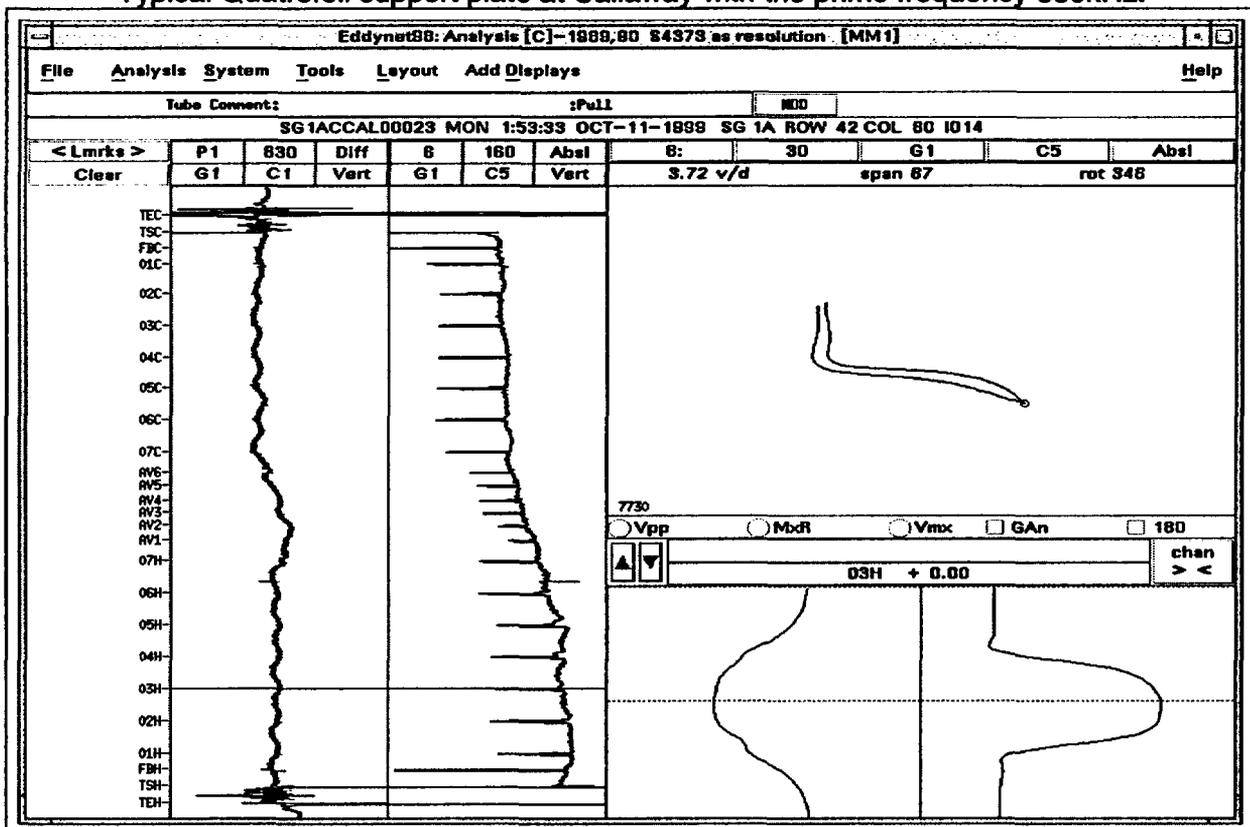
The following graphics shows typical areas of the Callaway steam generators:



Typical top-of-tubesheet at Callaway with the prime frequency of 630 kHz.



Typical Quatrefoil support plate at Callaway with the prime frequency 630kHz.



Typical Quatrefoil support plate at Callaway with a low frequency 30kHz

Technique 1
Detection and Sizing of Thinning at non-dented tube supports and tubesheets;
Bobbin Exam

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1
page 6-3, Figure 6-2

Essential Variables	EPRI Appendix H ETSS #96001.1	CALLAWAY ETSS #1	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 0.875 OD X 0.050 Wall	Inconel 600 0.688 OD X 0.040 Wall	Equivalent based on current density
Instrument	Zetec Miz-18	Zetec Miz-30	Zetec MIZ-30 Eddy Current Tester Implementation Documents 31 May 1994
Probe size & type	Fill factor 86% or greater 83 ft probe cable	.560 Diameter (85% fill factor) 110 ft probe cable	FANP Document 51-5011653-00 Fill Factor Equivalency FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Analog cable type & length	Zetec RG-174 100 ft	Zetec 75 ft 36 pin High Performance Extension Cable	FANP Document 51-5014354- 00: EC Probe Ext. Cable Comparisons
Frequencies	400 kHz, 300 kHz, 200 kHz & 100 kHz Differential & Absolute	630 kHz, 320 kHz, 160 kHz & 30 kHz	EPRI PWR Steam Generator Examination Guidelines: Revision 5 volume 1, page H-4, H.4.1.2
Drive Voltage & Gain	None stated (Miz-18 is equal to 11 volts, X1 Gain)	12 Volts, X2 Gain	Zetec MIZ-30 Eddy Current Tester Implementation Documents 31 May 1994
Coil excitation modes	Differential & Absolute	Differential & Absolute	Equivalent
Calibration method (Acquisition)	None Stated	100% TWH 40 degrees	Equivalent
Minimum data to be recorded	8 channels	8 channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	33 samples per inch	33 samples per inch	EPRI PWR Steam Generator Examination Guidelines: Revision 5 volume 1, page H-5, H.4.4
Scan pattern	None stated	Pulled	Equivalent
Method of calibration (Analysis)	Channel 1/7 (400/100 diff mix) 100% TWH @ 50% FSH. Probe motion horz. Flaw down first. Phase curve 100, 60 & 20% TWHs Default volts	Channel P1 (630/160 diff mix) 100% TW @ 6 - 8 divisions. Probe motion horz. Flaw down first. Phase curve 100, 60 & 20% TWHs. 4.0 volts in channel 1 on 20% TWHs	Equivalent based on current density
Data review requirements (Analysis)	None Stated	Review support plate with channel P1	Equivalent
Reporting requirements (Analysis)	None Stated	Use the Vp-p Measurement method Report on P1 % TW	Equivalent
Instrument (Analysis)	Hewlett Packard model 300 Zetec Eddynet Version 8	Hewlett Packard model 9000/700 Zetec Eddynet 98	Framatome Technologies 54-ISI -79 rev 03 Eddynet System Checkout Procedure

Technique 2
Detection and Sizing of AVB, TSP, and FDB Wear;

Bobbin Exam

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1
page 6-3, Figure 6-2

Essential Variables	EPRI Appendix H ETSS #96004.3	CALLAWAY ETSS #1	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 0.875 OD X 0.049 Wall	Inconel 600 0.688OD X 0.040 Wall	Equivalent based on current density (Deg. Ass.)
Instrument	Zetec Miz-30	Zetec Miz-30	Zetec MIZ-30 Eddy Current Tester Implementation Documents 31 May 1994
Probe size & type	Fill factor 86% or greater 83 ft probe cable	.560 Diameter (85% fill factor) 110 ft probe cable	FANP Document 51-5011653-00 Fill Factor Equivalency FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Analog cable type & length	None Stated	Zetec 75ft 36 pin High Performance Extension Cable	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Frequencies	300 kHz, 200 kHz, 150 kHz & 100kHz	630 kHz, 320kHz, 160 kHz & 30 kHz	EPRI PWR Steam Generator Examination Guidelines: Revision 5 volume 1, page H-4, H.4.1.2
Drive Voltage & Gain	12 Volts, X2 Gain	12 Volts, X2 Gain	Zetec MIZ-30 Eddy Current Tester Implementation Documents 31 May 1994
Coil excitation modes	Differential & Absolute	Differential & Absolute	Equivalent
Calibration method (Acquisition)	None Stated	100% TWH 40 degrees	Equivalent
Minimum data to be recorded	8 channels	8 channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	33 samples per inch	>= 33 samples per inch	Equivalent
Scan pattern	None stated	Pulled	Equivalent
Method of calibration (Analysis)	Channel 6/8 (200/100 abs & 300/150 abs.mix), 40% TW @ 50% FSH Probe motion horz. Flaws up first Amplitude curve 40%, 20% & 0% Default volts	Ch. P2 & (320/160 abs mix) 40% AVB Wear @ 5 divisions. Probe motion horz. Flaws up first Amp curve (P2)60%, 40%, 20% & 0% 5.0 volts VertMax on 60% FB Wear flaw	Equivalent
Data review requirements (Analysis)	None Stated	Detect wear in Process channel P1. Size using P2.	Equivalent
Reporting requirements (Analysis)	Use the vert max voltage measurement method report % TW	Use the vert max voltage measurement method Report on P2 % TW	Equivalent
Instrument (Analysis)	Hewlett Packard model 300 Zetec Version 18.6 rev 5.2	Hewlett Packard model 9000/700 Zetec Eddynet 98	Framatome Technologies 54-ISI -79 rev 03 Eddynet System Checkout Procedure

Technique 3
Detection and Sizing of Pitting;
Bobbin Exam

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1
page 6-3, Figure 6-2

Essential Variables	EPRI Appendix H ETSS #96005.2	CALLAWAY ETSS #1	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 0.875 OD X 0.050 Wall	Inconel 600 0.688OD X 0.040 Wall	Equivalent based on current density
Instrument	Zetec Miz-18	Zetec Miz-30	Zetec MIZ-30 Implementation Documents 31 May 1994
Probe size & type	Fill factor 86% or greater 83 ft probe cable	.560 Diameter (85% fill factor) 110 ft probe cable	FANP Document 51-5011653-00 Fill Factor Equivalency FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Analog cable type & length	Zetec RG-174 10ft	Zetec 75ft 36 pin High Performance Extension Cable	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Frequencies	400 kHz & 100 kHz Differential	630 kHz, 320kHz, 160 kHz & 30 kHz	EPRI PWR Steam Generator Examination Guidelines: Revision 5 volume 1, page H-4, H.4.1.2
Drive Voltage & Gain	11 Volts, X1 Gain	12 Volts, X2 Gain	Zetec MIZ-30 Eddy Current Tester Implementation Documents 31 May 1994
Coil excitation modes	Differential	Differential & Absolute	Equivalent
Calibration method (Acquisition)	None Stated	100% TWH 40 degrees	Equivalent
Minimum data to be recorded	8 channels	8 channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	33 samples per inch	>= 33 samples per inch	Equivalent
Scan pattern	None stated	pulled	Equivalent
Method of calibration (Analysis)	Channel 3/7 (400/100 diff mix), 100% TWH @ 50% FSH, probe motion horz. Flaw down first Phase curve 100, 60 & 20% TWHs. Default volts	Channel P1 (630/160 diff mix) 100% TW @ 6- 8 divisions. Probe motion horz. (35°) Flaw down first. Phase curve 100, 60 & 20% TWHs, 4 volts, channel 1 on 4x20% TWHs	Increased sensitivity Equivalent
Data review requirements (Analysis)	None Stated	Review strip charts and Lissajous	Equivalent
Reporting requirements (Analysis)	None Stated	Use the Vp-p Measurement method report P1 as NQI	Equivalent
Instrument (Analysis)	Hewlett Packard model 300 Zetec Version 18.6	Hewlett Packard model 9000/700 Zetec Eddynet 98	Framatome Technologies 54-ISI -79 rev 03 Eddynet System Checkout Procedure

Technique 4

**Detection of IGA/SCC at non-dented Drilled Tube-support plates;
Bobbin Exam**

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1
page 6-3, Figure 6-2

Essential Variables	EPRI Appendix H ETSS #96007.1	CALLAWAY ETSS #1	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 0.875 OD X 0.050 Wall 0.750 OD X 0.043 Wall	Inconel 600 0.688OD X 0.040 Wall	Equivalent based on current density
Instrument	Zetec Miz-18	Zetec Miz-30	Zetec MIZ-30 Implementation Documents 31 May 1994
Probe size & type	Fill factor 86% or greater 100 ft probe cable	.560 Diameter (85% fill factor) 110 ft probe cable	FANP Document 51-5011653-00 Fill Factor Equivalency FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Analog cable type & length	Zetec RG-174 50 ft	Zetec 75ft 36 pin High Performance Extension Cable	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Frequencies	400 kHz, & 100 kHz 500 kHz, & 130 kHz	630 kHz, 300kHz, 160 kHz & 30 kHz	EPRI PWR Steam Generator Examination Guidelines: Revision 5 volume 1, Page H-4, H.4.1.2
Drive Voltage & Gain	11 Volts, X1 Gain	12 Volts, X2 Gain	Zetec MIZ-30 Eddy Current Tester Implementation Documents 31 May 1994
Coil excitation modes	Differential	Differential & Absolute	Equivalent
Calibration method (Acquisition)	None Stated	100% TWH 40 degrees	Equivalent
Minimum data to be recorded	2 channels	8 channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	33 samples per inch	>= 33 samples per inch	Equivalent
Scan pattern	None stated	pulled	Equivalent
Method of calibration (Analysis)	Ch 1/5 (400/100 & 550/130 diff mix). 100% TWH @ 50% FSH. Probe motion horz. Flaw down first. Phase curve 100, 60 & 20% TWHs 6.00 volts on 4X20 FBH ASME standard	Channel P1 (630/160 diff mix) 100% TW @ 6 – 8 divisions. Probe motion horz. (35°)Flaw down first. Phase curve 100, 60 & 20% TWHs,4 volts, channel 1 on 4x20% TWHs	Increased sensitivity Equivalent
Data review requirements (Analysis)	Set mix channel and 100 kHz in strip charts with 100 kHz mix in the lissajous	630/160 mix (P1) & 160 kHz vertical in strip charts & P1 in lissajous. Review TSP and freespan with P1 & 160kHz in lissajous	Equivalent based on current density- Degradation Assessment
Reporting requirements (Analysis)	Report using mix channel	Use the Vp-p Measurement method Report P1 as DSI at TSP and/or NQL in freespan	Equivalent
Instrument (Analysis)	Hewlett Packard model 300 Zetec Eddynet Version 18.6, Rev. 5	Hewlett Packard model 9000/700 Zetec Eddynet 98	Framatome Technologies 54-ISI -79 rev 03 Eddynet System Checkout Procedure

Technique 5

Detection of IGA/ODSCC at non-dented quatrefoil support plates and in Sludge Pile Region;

Bobbin Exam

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1
page 6-3, Figure 6-2

Essential Variables	EPRI Appendix H ETSS #96008.1	CALLAWAY ETSS #1	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 0.875 OD X 0.050 Wall	Inconel 600 0.688OD X 0.040 Wall	Equivalent based on current density
Instrument	Zetec Miz-18	Zetec Miz-30	Zetec MIZ-30 Implementation Documents 31 May 1994
Probe size & type	Fill factor 86% or greater 100 ft probe cable	.560 Diameter (85% fill factor) 110 ft probe cable	FANP Document 51-5011653-00 Fill Factor Equivalency FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Analog cable type & length	Zetec RG-174 60 ft	Zetec 75ft 36 pin High Performance Extension Cable	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Frequencies	400 kHz, & 100 kHz Differential	630 kHz, 320kHz, 160 kHz & 30 kHz	EPRI PWR Steam Generator Examination Guidelines: Revision 5 volume 1, page H-4, H.4.1.2
Drive Voltage & Gain	11 Volts, X1 Gain	12 Volts, X2 Gain	Zetec MIZ-30 Eddy Current Tester Implementation Documents 31 May 1994
Coil excitation modes	Differential	Differential & Absolute	Equivalent
Calibration method (Acquisition)	None Stated	100% TWH 40 degrees	Equivalent
Minimum data to be recorded	2 channels	8 channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	30 samples per inch	>= 33 samples per inch	Equivalent
Scan pattern	None stated	pulled	Equivalent
Method of calibration (Analysis)	Ch 1/5 (400/100 diff mix) 100% TWH @ 50% FSH Probe motion horz. Flaw down first. Phase curve 100, 60 & 20% TWHs 2.75 volts on 4X20 FBH ASME standard	Channel P1 (630/160 diff mix) 100% TW @ 6 - 8 divisions. Probe motion horz. (35°)Flaw down first. Phase curve 100, 60 & 20% TWHs, 4 volts, channel 1 on 4x20% TWHs	Increased sensitivity Equivalent
Data review requirements (Analysis)	Set mix channel and 100 kHz in strip charts with 400/100 kHz mix in the lissajous	630/160 mix (P1) & 160 kHz vertical in strip charts & P1 in lissajous. Review TSP and freespan with P1 & 160kHz in lissajous	Equivalent based on current density- Degradation Assessment
Reporting requirements (Analysis)	Report using mix channel	Use the Vp-p Measurement method Report P1 as DSI at TSP and/or NQI in freespan	Equivalent
Instrument (Analysis)	Hewlett Packard model 300 Zetec EddyNet Version 18.6, Rev. 5	Hewlett Packard model 9000/700 Zetec EddyNet 98	Framatome Technologies 54-ISI -79 rev 03 EddyNet System Checkout Procedure

Technique 6

**Detection of Circumferential PWSCC @ expansion transitions;
+Point™ Exam**

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1
page 6-3, Figure 6-2

Essential Variables	EPRI Appendix H ETSS #20510.1	CALLAWAY UNIT 3 ETSS #3	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 0.875 OD X 0.048, 0.050 Wall 0.750 OD X 0.043 Wall	Inconel 600 0.688 X 0.040 Wall	Equivalent based on current density
Instrument	Zetec Miz-30	Zetec Miz-30	Equivalent
Probe size & type	+Point(TM)™ 50 ft motor unit	+Point(TM)™ 83 ft motor unit	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Analog cable type & length	Zetec 50 ft low loss	Zetec 75ft 36 pin High Performance Extension Cable	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Frequencies	300 kHz, 200 kHz	300 kHz, 200 kHz, 100 kHz, 20 kHz	EPRI PWR Steam Generator Examination Guidelines: Revision 5 volume 1, page H-4, H.4.1.2
Drive Voltage & Gain	12 Volts, X2 Gain	12 Volts, X2 Gain	Equivalent
Coil excitation modes	Absolute	Absolute	Equivalent
Calibration method (Acquisition)	None Stated	40% ID Axial notch 15 degrees	Equivalent
Minimum data to be recorded	2 channels	11channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	30 samples per inch circumferentially 25 per inch axially	30 samples per inch circumferentially 30 per inch axially	EPRI PWR Steam Generator Examination Guidelines: Revision 5 volume 1, page H-5, H.4.4
Withdraw Speed/RPM	0.2" /sec @ 300 rpm	0.4" /sec @ 800 rpm	Framatome Appendix H Equivalency Document No. 51-5001301-00
Scan pattern	Data should be collected on the push for transition regions	Tube sheet shall be scanned on the push, other locations may be scanned on the pull or push	Equivalent
Method of calibration (Analysis)	40% Circ notch 5 div. 40% ID Circ notch @ 15°. 20 volts on 100% Circ notch.	40% ID Circ notch 5 div. 40% ID Circ notch 15 degrees 20 volts on 100% Circ notch	Equivalent
Data review requirements (Analysis)	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels in area of interest	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels over the entire data, terrain plot	Equivalent
Reporting requirements (Analysis)	None stated	Use the Vp-p measurement method. Report as SAI,SCI,etc. on Ch. 3 or P1.	Equivalent
Instrument (Analysis)	Hewlett Packard model 9000/700 Zetec Eddyner 95 version 27 or equivalent	Hewlett Packard model 9000/700 Zetec Eddyner 98	Framatome ANP 54-ISI -79 rev 05 Eddyner System Checkout Procedure

Techniques 7

**Detection of Axial PWSCC expansion transitions i.e., TTS;
+Point™ Exam**

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1
page 6-3, Figure 6-2

Essential Variables	EPRI Appendix H ETSS 20511.1	CALLAWAY UNIT 3 ETSS #3	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 0.750 OD X 0.049 Wall 0.875 OD X 0.043 Wall	Inconel 600 0.688 X 0.040 Wall	Equivalent based on current density
Instrument	Zetec Miz-30	Zetec Miz-30	Equivalent
Probe size & type	+Point(TM)™ 50 ft motor unit	+Point(TM)™ 83 ft motor unit	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Analog cable type & length	Zetec 50 ft low loss	Zetec 75ft 36 pin High Performance Extension Cable	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Frequencies	200 kHz 300kHz	300 kHz, 200 kHz, 100 kHz, 20 kHz	EPRI PWR Steam Generator Examination Guidelines: Revision 5 volume 1, page H-4, H.4.1.2
Drive Voltage & Gain	12 volts, X2 Gain	12 Volts, X2 Gain	FANP Document 51-5001224-00 Appendix H Equivalency Testing: MRPC Examinations
Coil excitation modes	Absolute	Absolute	Equivalent
Calibration method (Acquisition)	None Stated	40% ID Axial notch 15 degrees	Equivalent
Minimum data to be recorded	1channels	11channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	30 samples per inch circumferentially 25 per inch axially	30 samples per inch circumferentially 30 per inch axially	Equivalent
Withdraw Speed/RPM	0.2" /sec @ 300 rpm	0.4" /sec @ 800 rpm	Framatome Appendix H Equivalency Document No.: 5001301-00
Scan pattern	None stated for support plates	Tube sheet shall be scanned on the push, other locations may be scanned on the pull or push	Equivalent
Method of calibration (Analysis)	40% Axial 5 div. 40% ID Axial notch @ 15° 20 volts on 100% Axial notch	40% ID Axial notch 5 div. 40% ID Axial notch 15 degrees 20 volts on 100% Axial notch	Equivalent
Data review requirements (Analysis)	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels in area of interest	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels over the entire data, terrain plot	Equivalent
Reporting requirements (Analysis)	None stated	Use the Vp-p measurement method. Report as SAI,SCI,etc. on Ch. 3 or P1.	Equivalent
Instrument (Analysis)	Hewlett Packard model 9000/700 Zetec Eddyner 95 ver 1 or equivalent	Hewlett Packard model 9000/700 Zetec Eddyner 98	Framatome ANP 54-ISI -79 rev 05 Eddyner System Checkout Procedure

Technique 8

**Detection of Axial ODSCC @ support structures and freespan regions;
+Point™ Exam**

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1
Page 6-3, Figure 6-2

Essential Variables	EPRI Appendix H ETSS #21409.1	CALLAWAY UNIT 3 ETSS #3	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 0.875 OD X 0.050 Wall 0.750 OD X 0.043 Wall	Inconel 600 0.688 X 0.040 Wall	Equivalent based on current density
Instrument	Zetec Miz-30	Zetec Miz-30	Equivalent
Probe size & type	+Point(TM)™ 50 ft motor unit	+Point(TM)™ 83 ft motor unit	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Analog cable type & length	Zetec 50 ft low loss	Zetec 75ft 36 pin High Performance Extension Cable	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Frequencies	300 kHz, 200 kHz	300 kHz, 200 kHz, 100 kHz, 20 kHz	EPRI PWR Steam Generator Examination Guidelines: Revision 5 volume 1, page H-4, H.4.1.2
Drive Voltage & Gain	12 Volts, X2 Gain	12 Volts, X2 Gain	Equivalent
Coil excitation modes	Absolute	Absolute	Equivalent
Calibration method (Acquisition)	None Stated	40% ID Axial notch 15 degrees	Equivalent
Minimum data to be recorded	2 channels	11channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	30 samples per inch circumferentially 25 per inch axially	30 samples per inch circumferentially 30 per inch axially	EPRI PWR Steam Generator Examination Guidelines: Revision 5 volume 1, page H-5, H.4.4
Withdraw Speed/RPM	0.2" /sec @ 300 rpm	0.4" /sec @ 800 rpm	Framatome Appendix H Equivalency Document No. 51-5001301-00
Scan pattern	Data should be collected on the push for transition regions	Tube sheet shall be scanned on the push, other locations may be scanned on the pull or push	Equivalent
Method of calibration (Analysis)	40% ID Axial notch 5 div. 40% ID Axial notch 15 degrees 20 volts on 100% Axial notch	40% ID Axial notch 5 div. 40% ID Axial notch 15 degrees 20 volts on 100% Axial notch	Equivalent
Data review requirements (Analysis)	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels in area of interest	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels over the entire data, terrain plot	Equivalent
Reporting requirements (Analysis)	None stated	Use the Vp-p measurement method. Report as SAI,SCI,etc. on Ch. 3 or P1.	Equivalent
Instrument (Analysis)	Hewlett Packard model 9000/700 Zetec Eddynt 95 version 27 or equivalent	Hewlett Packard model 9000/700 Zetec Eddynt 98	Framatome ANP 54-ISI -79 rev 05 Eddynt System Checkout Procedure

Technique 9

**Detection of Circumferential ODSCC @ expansion transitions i.e., TTS;
+Point™ Exam**

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1
page 6-3, Figure 6-2

Essential Variables	EPRI Appendix H ETSS #21410.1	CALLAWAY UNIT 3 ETSS #3	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 0.875 OD X 0.050 Wall 0.750 OD X 0.043 Wall	Inconel 600 0.688 X 0.040 Wall	Equivalent based on current density
Instrument	Zetec Miz-30	Zetec Miz-30	Equivalent
Probe size & type	+Point(TM)™ 50 ft motor unit	+Point(TM)™ 83 ft motor unit	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Analog cable type & length	Zetec 50 ft low loss	Zetec 75 ft 36 pin High Performance Extension Cable	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Frequencies	300 kHz, 200 kHz	300 kHz, 200 kHz, 100 kHz, 20 kHz	EPRI PWR Steam Generator Examination Guidelines: Revision 5 volume 1, page H-4, H.4.1.2
Drive Voltage & Gain	12 Volts, X2 Gain	12 Volts, X2 Gain	Equivalent
Coil excitation modes	Absolute	Absolute	Equivalent
Calibration method (Acquisition)	None Stated	40% ID Axial notch 15 degrees	Equivalent
Minimum data to be recorded	2 channels	11channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	30 samples per inch circumferentially 25 per inch axially	30 samples per inch circumferentially 30 per inch axially	EPRI PWR Steam Generator Examination Guidelines: Revision 5 volume 1, page H-5, H.4.4
Withdraw Speed/RPM	0.2" /sec @ 300 rpm	0.4" /sec @ 800 rpm	Framatome Appendix H Equivalency Document No. 51-5001301-00
Scan pattern	Data should be collected on the push for transition regions	Tube sheet shall be scanned on the push, other locations may be scanned on the pull or push	Equivalent
Method of calibration (Analysis)	40% ID Circ notch 5 div. 40% ID circumferential notch 15 degrees 20 volts on 100% Circ notch	40% ID Circ notch 5 div. 40% ID circumferential notch 15 degrees 20 volts on 100% Circ notch	Equivalent
Data review requirements (Analysis)	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels in area of interest	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels over the entire data, terrain plot	Equivalent
Reporting requirements (Analysis)	None stated	Use the Vp-p measurement method. Report as SAI,SCI,etc. on Ch. 3 or P1.	Equivalent
Instrument (Analysis)	Hewlett Packard model 9000/700 Zetec Eddyner 95 version 27 or equivalent	Hewlett Packard model 9000/700 Zetec Eddyner 98	Framatome ANP 54-ISI -79 rev 05 Eddyner System Checkout Procedure

Technique 10

**Detection and depth sizing of Volumetric Indications in the Freespan areas;
+Point™ Exam**

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1
page 6-3, Figure 6-2

Essential Variables	EPRI Appendix H ETSS 21998.1	CALLAWAY UNIT 3 ETSS #3	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 0.750OD X 0.043 Wall	Inconel 600 0.688 X 0.040 Wall	Equivalent based on current density
Instrument	Zetec Miz-30	Zetec Miz-30	Equivalent
Probe size & type	+Point(TM)™ 50 ft motor unit	+Point(TM)™ 83 ft motor unit	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Analog cable type & length	Zetec 50 ft low loss	Zetec 75 ft 36 pin High Performance Extension Cable	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Frequencies	300 kHz	300 kHz, 200 kHz, 100 kHz, 20 kHz	EPRI PWR Steam Generator Examination Guidelines: Revision 5 volume 1, page H-4, H.4.1.2
Drive Voltage & Gain	12 Volts, X2 Gain	12 Volts, X2 Gain	Equivalent
Coil excitation modes	Absolute	Absolute	Equivalent
Calibration method (Acquisition)	None Stated	40% ID Axial notch 15 degrees	Equivalent
Minimum data to be recorded	1 channels	11channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	30 samples per inch circumferentially 25 per inch axially	30 samples per inch circumferentially 30 per inch axially	Equivalent
Withdraw Speed/RPM	0.2" /sec @ 300 rpm	0.4" /sec @ 800 rpm	Equivalent
Scan pattern	None stated	Tube sheet shall be scanned on the push, other locations may be scanned on the pull or push	Equivalent
Method of calibration (Analysis)	40% ID Axial notch visible. 40% ID Axial notch 15 degrees 20 volts on 100% TWH	40% ID Axial notch 5 div. 40% ID Axial notch 15 degrees 20 volts on 100% Axial notch	Equivalent
Data review requirements (Analysis)	Monitor the strip chart and scroll the region of interest. Terrain plot the raw channel in area of interest.	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels over the entire data, terrain plot	Equivalent
Reporting requirements (Analysis)	Indications indicative of degradation Report using 300kHz.	Use the Vp-p measurement method. Report as SAI,SCI,etc. on Ch. 3 or P1.	Equivalent
Instrument (Analysis)	Hewlett Packard model 9000/700 Zetec Eddynet 98 version 1	Hewlett Packard model 9000/700 Zetec Eddynet 98	Framatome ANP 54-ISI -79 rev 05 Eddynet System Checkout Procedure

Technique 11

**Detection of Axial ODSCC @ dented support structures. Extended to detection of ODSCC at expansion transitions;
+Point™ Exam**

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1
page 6-3, Figure 6-2

Essential Variables	EPRI Appendix H ETSS 22841.3	CALLAWAY UNIT 3 ETSS #3	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 0.875 OD X 0.050 Wall	Inconel 600 0.688 X 0.040 Wall	Equivalent based on current density
Instrument	Zetec Miz-30	Zetec Miz-30	Equivalent
Probe size & type	+Point(TM)™ 50 ft motor unit	+Point(TM)™ 83 ft motor unit	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Analog cable type & length	Zetec 50 ft low loss	Zetec 75ft 36 pin High Performance Extension Cable	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Frequencies	300 kHz w/BP Filter	410 kHz w/BP Filter	EPRI PWR Steam Generator Examination Guidelines: Revision 5 volume 1, page H-4, H.4.1.2
Drive Voltage & Gain	12 Volts, X2 Gain	12 Volts, X2 Gain	Equivalent
Coil excitation modes	Absolute	Absolute	Equivalent
Calibration method (Acquisition)	None Stated	40% ID Axial notch 15 degrees	Equivalent
Minimum data to be recorded	2 channels	11channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	30 samples per inch circumferentially 30 per inch axially	30 samples per inch circumferentially 30 per inch axially	Equivalent
Withdraw Speed/RPM	0.4" /sec @ 800 rpm	0.4" /sec @ 800 rpm	Equivalent
Scan pattern	None stated	Tube sheet shall be scanned on the push, other locations may be scanned on the pull or push	Equivalent
Method of calibration (Analysis)	40% ID Axial notch 5 div. 40% ID Axial notch 15 degrees 20 volts on 100% Axial notch 300kHzBP 23/70/280	40% ID Axial notch 5 div. 40% ID Axial notch 15 degrees 20 volts on 100% Axial notch 300kHzBP 23/70/280	Equivalent
Data review requirements (Analysis)	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels in area of interest	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels over the entire data, terrain plot	Equivalent
Reporting requirements (Analysis)	Indications indicative of degradation Length size using 300kHzBP	Use the Vp-p measurement method. Report as SAI,SCI,etc. on Ch. 3 or P1.	Equivalent
Instrument (Analysis)	Hewlett Packard model 9000/700 Zetec Eddynet 98 version 1	Hewlett Packard model 9000/700 Zetec Eddynet 98	Framatome ANP 54-ISI -79 rev 05 Eddynet System Checkout Procedure

Technique 12

Detection of Circumferential ODSCC @ dented support structures. Extended to detection of ODSCC at dented and non-dented freespan locations;

+Point™ Exam

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1

Page 6-3, Figure 6-2

Essential Variables	EPRI Appendix H ETSS #22842.3	CALLAWAY UNIT 3 ETSS #3	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 0.875 OD X 0.050 Wall	Inconel 600 0.688 X 0.040 Wall	Equivalent based on current density
Instrument	Zetec Miz-30	Zetec Miz-30	Equivalent
Probe size & type	+Point(TM)™ 50 ft motor unit	+Point(TM)™ 83 ft motor unit	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Analog cable type & length	Zetec 50 ft low loss	Zetec 75 ft 36 pin High Performance Extension Cable	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Frequencies	300 kHz	410 kHz	EPRI PWR Steam Generator Examination Guidelines: Revision 5 volume 1, page H-4, H.4.1.2
Drive Voltage & Gain	12 Volts, X2 Gain	12 Volts, X2 Gain	Equivalent
Coil excitation modes	Absolute	Absolute	Equivalent
Calibration method (Acquisition)	None Stated	40% ID Axial notch 15 degrees	Equivalent
Minimum data to be recorded	2 channels	11channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	30 samples per inch circumferentially 30 per inch axially	30 samples per inch circumferentially 30 per inch axially	Equivalent
Withdraw Speed/RPM	0.4" /sec @ 800 rpm	0.4" /sec @ 800 rpm	Equivalent
Scan pattern	None stated	Tube sheet shall be scanned on the push, other locations may be scanned on the pull or push	Equivalent
Method of calibration (Analysis)	40% ID Circ notch 5 div. 40% ID Circ notch 15 degrees 20 volts on 100% Circ notch	40% ID Circ notch 5 div. 40% ID Circ notch 15 degrees 20 volts on 100% Circ notch	Equivalent
Data review requirements (Analysis)	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels in area of interest	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels over the entire data, terrain plot	Equivalent
Reporting requirements (Analysis)	Indications indicative of degradation	Use the Vp-p measurement method. Report as SAI,SCI,etc. on Ch. 3 or P1.	Equivalent
Instrument (Analysis)	Hewlett Packard model 9000/700 Zetec Eddyner 95/98 version 1	Hewlett Packard model 9000/700 Zetec Eddyner 98	Framatome ANP 54-ISI -79 rev 05 Eddyner System Checkout Procedure

Technique 13

**Detection and Sizing of mechanically induced wear at broached tube support plates;
+Point™ Coil**

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1
page 6-3, Figure 6-2

Essential Variables	EPRI Appendix H ETSS 96910.1	CALLAWAY UNIT 3 ETSS #3	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 0.625 OD X 0.037 Wall	Inconel 600 0.688 X 0.040 Wall	Equivalent based on current density
Instrument	Zetec Miz-30	Zetec Miz-30	Equivalent
Probe size & type	+Point(TM)™ 50 ft motor unit	+Point(TM)™ 83 ft motor unit	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Analog cable type & length	Zetec 50 ft low loss	Zetec 75 ft 36 pin High Performance Extension Cable	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Frequencies	300 /100 kHz Mix	300 kHz, 200 kHz, 100 kHz, 20 kHz	Equivalent based on current density
Drive Voltage & Gain	12 Volts, X1 Gain	12 Volts, X2 Gain	FANP Document 51-5001224-00 Appendix H Equivalency Testing: MRPC Examinations
Coil excitation modes	Absolute	Absolute	Equivalent
Calibration method (Acquisition)	None stated	40% ID Axial notch 15 degrees	Equivalent
Minimum data to be recorded	2 channels	11channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	30 samples per inch circumferentially 25 per inch axially	30 samples per inch circumferentially 30 per inch axially	Equivalent
Withdraw Speed/RPM	None stated	0.4" /sec @ 800 rpm	Framatome Appendix H Equivalency Document No.: 51-5004290-00
Scan pattern	None stated	Tube sheet shall be scanned on the push, other locations may be scanned on the pull or push	Equivalent
Method of calibration (Analysis)	20% ID Axial notch @ 1.5 divisions 20% ID Axial notch @ 8 degrees 20 volts on 100% Axial notch	40% ID ax & circ notch 5 div. 40% ID Axial & circumferential notch 15 degrees 20 volts on 100% Axial notch	Equivalent
Data review requirements (Analysis)	None stated	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels over the entire data, terrain plot	Equivalent
Reporting requirements (Analysis)	None stated	Use the Vert-Max measurement method. Report as % TW on 300/100 mix channel.	Equivalent
Instrument (Analysis)	Hewlett Packard model 300 Zetec Eddyner 95 Version 2	Hewlett Packard model 9000/700 Zetec Eddyner 98	Framatome ANP 54-ISI -79 rev 05 Eddyner System Checkout Procedure

Technique 14

**Detection and Sizing of mechanically induced wear at broached tube support plates;
.115 Pancake Coil**

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1
page 6-3, Figure 6-2

Essential Variables	EPRI Appendix H ETSS 96911.1	CALLAWAY UNIT 3 ETSS #3	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 0.625 OD X 0.037 Wall	Inconel 600 0.688 X 0.040 Wall	Equivalent based on current density
Instrument	Zetec Miz-30	Zetec Miz-30	Equivalent
Probe size & type	.115" Pancake 50 ft motor unit	.115" Pancake 83 ft motor unit	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Analog cable type & length	Zetec 50 ft low loss	Zetec 75 ft 36 pin High Performance Extension Cable	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Frequencies	300 /100 kHz Mix	300 kHz, 200 kHz, 100 kHz, 20 kHz	Equivalent based on current density
Drive Voltage & Gain	12 Volts, X1 Gain	12 Volts, X2 Gain	FANP Document 51-5001224-00 Appendix H Equivalency Testing: MRPC Examinations
Coil excitation modes	Absolute	Absolute	Equivalent
Calibration method (Acquisition)	None stated	40% ID Axial notch 15 degrees	Equivalent
Minimum data to be recorded	2 channels	11channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	30 samples per inch circumferentially 25 per inch axially	30 samples per inch circumferentially 30 per inch axially	Equivalent
Withdraw Speed/RPM	None stated	0.4" /sec @ 800 rpm	Framatome Appendix H Equivalency Document No.: 51-5004290-00
Scan pattern	None stated	Tube sheet shall be scanned on the push, other locations may be scanned on the pull or push	Equivalent
Method of calibration (Analysis)	20% ID Axial notch @ 1.5 divisions 20% ID Axial notch @ 8 degrees 20 volts on 100% Axial notch	40% ID ax & circ notch 5 div. 40% ID Axial & circumferential notch 15 degrees 20 volts on 100% Axial notch	Equivalent
Data review requirements (Analysis)	None stated	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels over the entire data, terrain plot	Equivalent
Reporting requirements (Analysis)	None stated	Use the Vert-Max measurement method. Report as % TW on 300/100 mix channel.	Equivalent
Instrument (Analysis)	Hewlett Packard model 300 Zetec Eddyner 95 Version 2	Hewlett Packard model 9000/700 Zetec Eddyner 98	Framatome ANP 54-ISI -79 rev 05 Eddyner System Checkout Procedure

Technique 15

Detection of Axial and Circumferential PWSCC in Short Radius U-bends;

+Point™ Exam

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1
page 6-3, Figure 6-2

Essential Variables	<i>EPRI Appendix H ETSS 99997.1</i>	CALLAWAY ETSS # 8	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 0.875 OD X 0.049 Wall	Inconel 600 0.688 OD X 0.040 Wall	Equivalent based on current density at ID.
Instrument	Zetec Miz-30	Zetec Miz-30	Zetec MIZ-30 Eddy Current Tester Implementation Documents 31 May 1994
Probe size & type	+Point(TM) 83 ft motor unit	+Point(TM) 83 ft motor unit	Equivalent
Analog cable type & length	Zetec 50 ft low loss	Zetec 50 ft 36 pin High Performance Extension Cable	FANP Document 51-5014354- 00: EC Probe Ext. Cable Comparisons
Frequencies	800 kHz	800 kHz	Equivalent
Drive Voltage & Gain	11 Volts , X1 Gain	11 Volts , X1 Gain	Equivalent
Coil excitation modes	Absolute	Absolute	Equivalent
Calibration method (Acquisition)	None Stated	40% ID Axial notch 15 degrees	Equivalent
Minimum data to be recorded	1 channels	5 channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	30 samples per inch circumferentially 30 per inch axially	30 samples per inch circumferentially 30 per inch axially	Equivalent
Withdraw Speed/RPM	0.1" /sec @ 300 rpm	0.1" /sec @ 200 rpm	Framatome Appendix H Equivalency Document No.: 51-5004290-00
Scan pattern	None stated	Data can pushed or pulled	Equivalent
Method of calibration (Analysis)	40% ID axial notch 2 divisions 40% ID axial notch 15° 20 volts on 100% Axial notch	40% ID Axial & Circ notch 5 div. 40% ID Axial & Circ notch 15° 20 volts on 100% Axial & Circ notch	Increased sensitivity Equivalent
Data review requirements (Analysis)	Monitor raw and process chs. on the strip chart and scroll the region of interest. Terrain plot the raw and process channels in area of interest	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels over the entire data.	Equivalent
Reporting requirements (Analysis)	None stated	Use the Vp-p measurement method. Report as SAI, SCI, etc. on Ch. 2or P2.	Equivalent
Instrument (Analysis)	Hewlett Packard model 300 Zetec Eddynet 95 Version 1	Hewlett Packard model 9000/700 Zetec Eddynet 98	Framatome Technologies 54-ISI -79 rev 03 Eddynet System Checkout Procedure

Technique 16

Detection of Axial and Circumferential PWSCC in Short Radius U-bends;

+Point™ Exam

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1
page 6-3, Figure 6-2

Essential Variables	EPRI Appendix H ETSS 99997.2	CALLAWAY ETSS # 8	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 0.875 OD X 0.049 Wall	Inconel 600 0.688 OD X 0.040 Wall	Equivalent based on current density at ID.
Instrument	Zetec Miz-30	Zetec Miz-30	Zetec MIZ-30 Eddy Current Tester Implementation Documents 31 May 1994
Probe size & type	+Point(TM) 83 ft motor unit	+Point(TM) 83 ft motor unit	Equivalent
Analog cable type & length	Zetec 50 ft low loss	Zetec 50 ft 36 pin High Performance Extension Cable	FANP Document 51-5014354- 00: EC Probe Ext. Cable Comparisons
Frequencies	1000 kHz	1000 kHz	Equivalent
Drive Voltage & Gain	11 Volts , X1 Gain	11 Volts , X1 Gain	Equivalent
Coil excitation modes	Absolute	Absolute	Equivalent
Calibration method (Acquisition)	None Stated	40% ID Axial notch 15 degrees	Equivalent
Minimum data to be recorded	1 channels	5 channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	30 samples per inch circumferentially 30 per inch axially	30 samples per inch circumferentially 30 per inch axially	Equivalent
Withdraw Speed/RPM	0.1" /sec @ 300 rpm	0.1" /sec @ 200 rpm	Framatome Appendix H Equivalency Document No.: 51-5004290-00
Scan pattern	None stated	Data can pushed or pulled	Equivalent
Method of calibration (Analysis)	40% ID axial notch 2 divisions 40% ID axial notch 15° 20 volts on 100% Axial notch	40% ID Axial & Circ notch 5 div. 40% ID Axial & Circ notch 15° 20 volts on 100% Axial & Circ notch	Increased sensitivity Equivalent
Data review requirements (Analysis)	Monitor raw and process chs. on the strip chart and scroll the region of interest. Terrain plot the raw and process channels in area of interest	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels over the entire data.	Equivalent
Reporting requirements (Analysis)	None stated	Use the Vp-p measurement method. Report as SAI, SCI, etc. on Ch. 2or P2.	Equivalent
Instrument (Analysis)	Hewlett Packard model 300 Zetec EddyNet 95 Version 1	Hewlett Packard model 9000/700 Zetec EddyNet 98	Framatome Technologies 54-ISI -79 rev 03 EddyNet System Checkout Procedure

Technique 17

**Detection of loose-parts;
Bobbin Exam**

This technique is an extension of bobbin techniques 1 (96004.3), and 2 (96005.2).

Technique 18

**Detection of wear associated with loose-parts;
+Point™ Coil / .115 Pancake Coil**

This technique is an extension of RPC technique 13 (96910.1) and technique 14 (96911.1).

Technique 19

Detection of freespan indications, i.e., ADS and DFS (bobbin)

This technique is an extension of bobbin techniques 1 (96004.3), 2 (96005.2), 3 (96007.1), and 4 (96008.1).

Technique 20

Detection of Axial, Circumferential and Volumetric Indications in the parent tube of Laser Welded Sleeves.

Mag-Biased +Point™ Exam

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1
page 6-3, Figure 6-2

Essential Variables	Westinghouse Appendix H ETSS #MAGPPT	CALLAWAY ETSS # 4	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 / Inconel 690 0.750 X 0.043 / 0.740 X 0.040 (0.083)	Inconel 600 / Inconel 690 0.688 X 0.040 / 0.579 X 0.035 (0.075)	Equivalent based on current density
Instrument	Tecrad TC6700 ECAU	Zetec Miz-30	Zetec MIZ-30 Eddy Current Tester Implementation Documents 31 May 1994
Probe size & type	+Point(TM) 50 ft motor unit	+Point(TM) 83 ft motor unit	FANP Document 51-5014354- 00: EC Probe Ext. Cable Comparisons
Analog cable type & length	Westinghouse < 100 ft low loss	Zetec 75 ft 36 pin High Performance Extension Cable	Westinghouse Document DDM-96-009 R0
Frequencies	300, 200, 150, 75 and 50 kHz	300 kHz, 200 kHz, 100 kHz, 20 kHz	Equivalent
Drive Voltage & Gain	Gain 38 or less	X2 Gain @ 12 Volts	Equivalent based on EPRI and Zetec quals.
Coil excitation modes	Absolute	Absolute	Equivalent
Calibration method (Acquisition)	Exp. Trans. Horizontal & all flaws visible.	100% TWH @ 30 deg. 50% POD ax notch 2-3 div.	Equivalent
Minimum data to be recorded	6 channels	6 channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	30 samples per inch circumferentially 30 per inch axially	30 samples per inch circumferentially 30 per inch axially	Equivalent
Withdraw Speed/RPM	0.2" /sec @ 300 rpm	0.1" /sec @ 200 rpm	Framatome Appendix H Equivalency Document No.: 51-5004290-00
Scan pattern	None stated	Data can be pushed or pulled	Equivalent
Method of calibration (Analysis)	40% ID Circ notch 2 divisions 40% ID Circ notch 10 to 15 degrees 10.0 volts on 100% TWH	100% TWH @ 30/210 deg. 50% POD Ax notch 2-3 divisions 50% POD Circ notch 2-3 divisions 100% ax/circ notch @ 20.00 v.	FTI Document 51-5001224-00 Appendix H Equivalency Testing: MRPC Examinations
Data review requirements (Analysis)	Review strip chart and C-scan displays for vertical displacements for all freq.	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels over the entire data.	Equivalent
Reporting requirements (Analysis)	None stated	Use the Vp-p measurement method. Report as SAI,SCI,etc. on Ch. 3 or P3.	Equivalent
Instrument (Analysis)	Hewlett Packard model HP433 or equiv. ANSER 8.0 R4 or equiv.	Hewlett Packard model 9000/700 Zetec EddyNet 98	Framatome Technologies 54-ISI -79 rev 03 EddyNet System Checkout Procedure

Technique 21

Sleeve Inspection and Weld Inspection for Process Flaws.

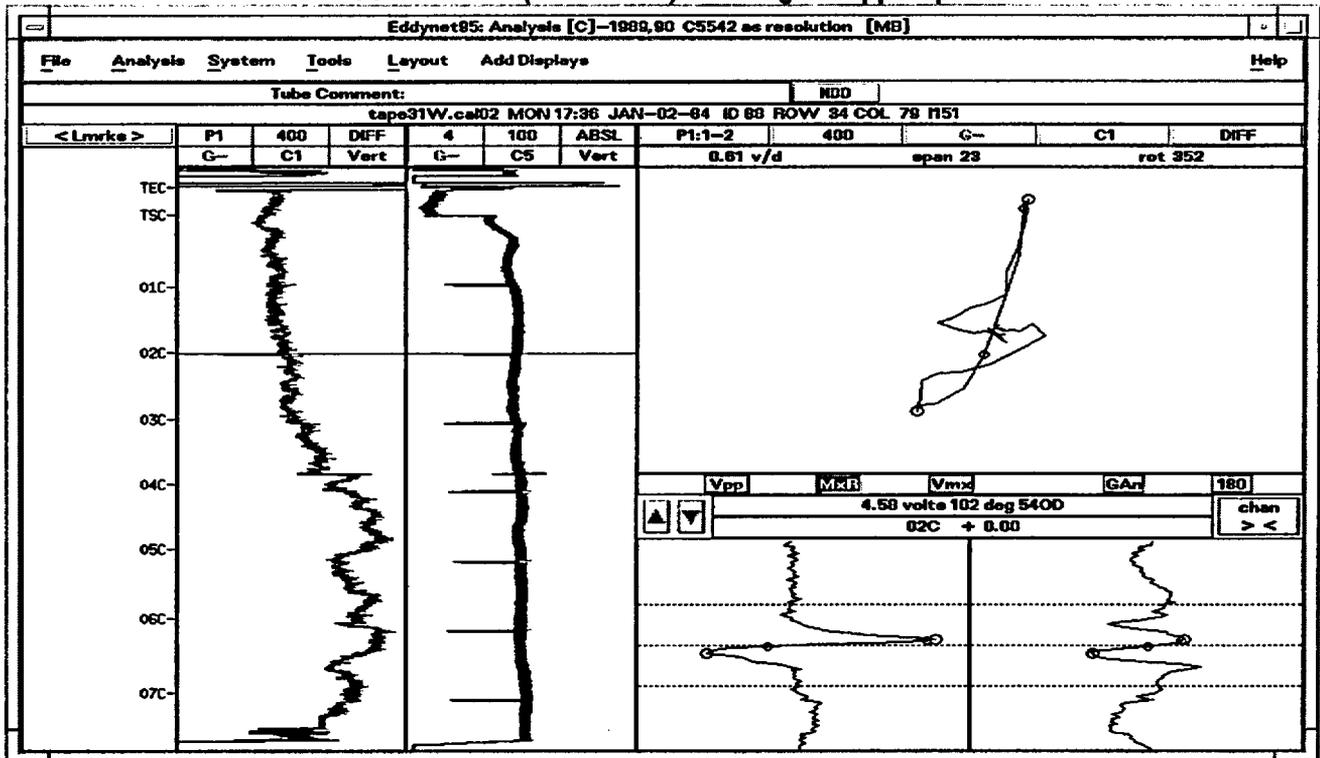
Mag-Biased +Point™ Exam

Reference: EPRI PWR Steam Generator Examination Guidelines, Revision 5, Volume 1

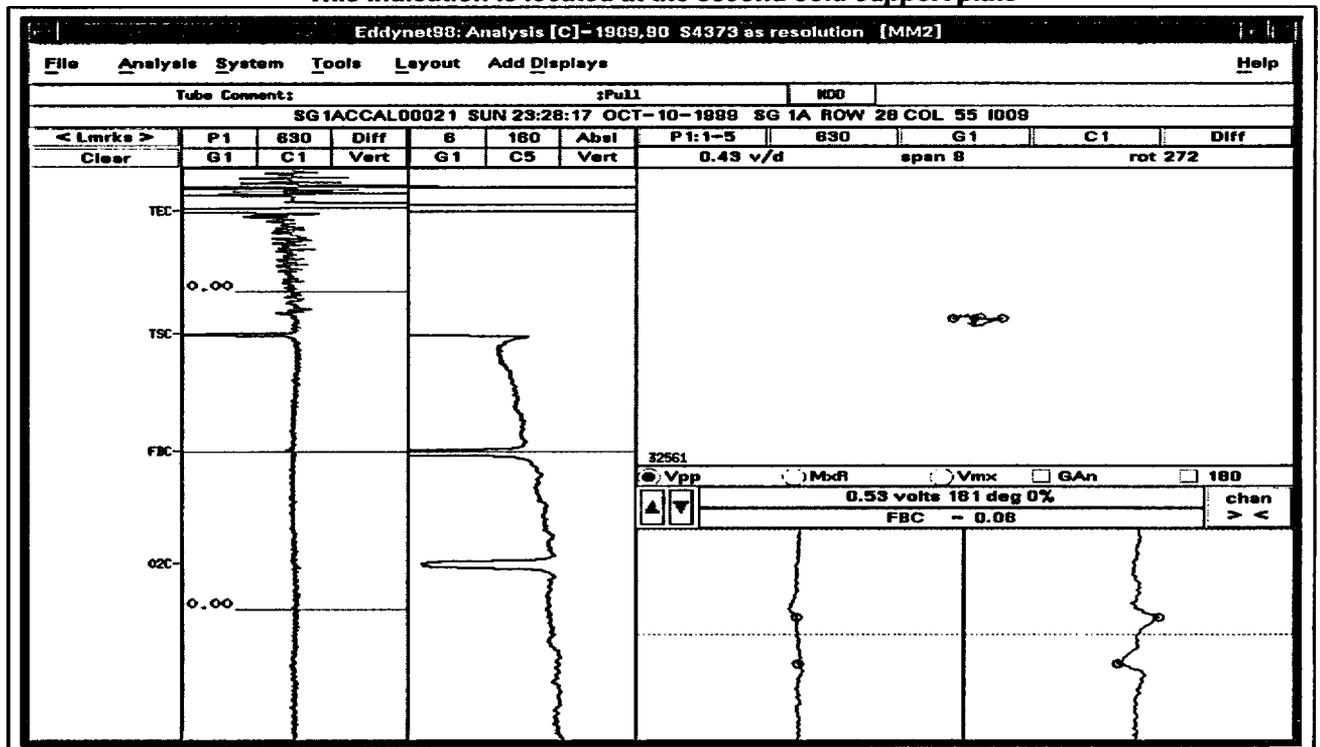
page 6-3, Figure 6-2

Essential Variables	Westinghouse Appendix H ETSS #MAGGPPTP	CALLAWAY ETSS # 4	Equivalency Basis Used for Appendix H
Tubing Diameter	Inconel 600 / Inconel 690 0.750 X 0.043 / 0.740 X 0.040 (0.083)	Inconel 600 / Inconel 690 0.688 X 0.040 / 0.579 X 0.035 (0.075)	Equivalent based on current density
Instrument	Tecrad TC6700 ECAU	Zetec Miz-30	Zetec MIZ-30 Eddy Current Tester Implementation Documents 31 May 1994
Probe size & type	+Point(TM) 50 ft motor unit	+Point(TM) 83 ft motor unit	FANP Document 51-5014354-00: EC Probe Ext. Cable Comparisons
Analog cable type & length	Westinghouse < 100 ft low loss	Zetec 75 ft 36 pin High Performance Extension Cable	Westinghouse Document DDM-96-009 R0
Frequencies	300, 120, 100, 75 and 50 kHz	300 kHz, 200 kHz, 100 kHz, 20 kHz	Equivalent
Drive Voltage & Gain	Gain 44 or less	X2 Gain @ 12 Volts	Equivalent based on EPRI and Zetec quals.
Coil excitation modes	Absolute	Absolute	Equivalent
Calibration method (Acquisition)	100% FBH @ 195 deg or 50% ID Circ notch in slv @ 15 deg.	100% TWH @ 30 deg. 500% POD ax notch 2-3 div.	Equivalent
Minimum data to be recorded	6 channels	6 channels	Equivalent
Method of data recording	Digital	Digital	Equivalent
Digitizing rate	30 samples per inch circumferentially 30 per inch axially	30 samples per inch circumferentially 30 per inch axially	Equivalent
Withdraw Speed/RPM	0.2" /sec @ 300 rpm	0.1" /sec @ 200 rpm	Framatome Appendix H Equivalency Document No.: 51-5004290-00
Scan pattern	None stated	Data can be pushed or pulled	Equivalent
Method of calibration (Analysis)	100% FBH @ 195 deg or 50% ID Circ notch in slv @ 15 deg. 10.0 volts on 100% TWH	100% TWH @ 30/210 deg. 50% POD Ax notch 2-3 divisions 50% POD Circ notch 2-3 divisions 100% ax/circ notch @ 20.00 v.	FTI Document 51-5001224-00 Appendix H Equivalency Testing: MRPC Examinations
Data review requirements (Analysis)	Review strip chart and C-scan displays for vertical displacements for all freq.	Monitor the strip chart and scroll the region of interest. Terrain plot the raw and process channels over the entire data.	Equivalent
Reporting requirements (Analysis)	None stated	Use the Vp-p measurement method. Report as SAI,SCI,etc. on Ch. 3 or P3.	Equivalent
Instrument (Analysis)	Hewlett Packard model HP433 or equiv. ANSER 8.0 R4 or equiv.	Hewlett Packard model 9000/700 Zetec EddyNet 98	Framatome Technologies 54-ISI -79 rev 03 EddyNet System Checkout Procedure

**Degradation Mechanism 1 – Cold Leg Thinning:
ETSS # 96001.1 (Bobbin coil) Thinning at support plates**

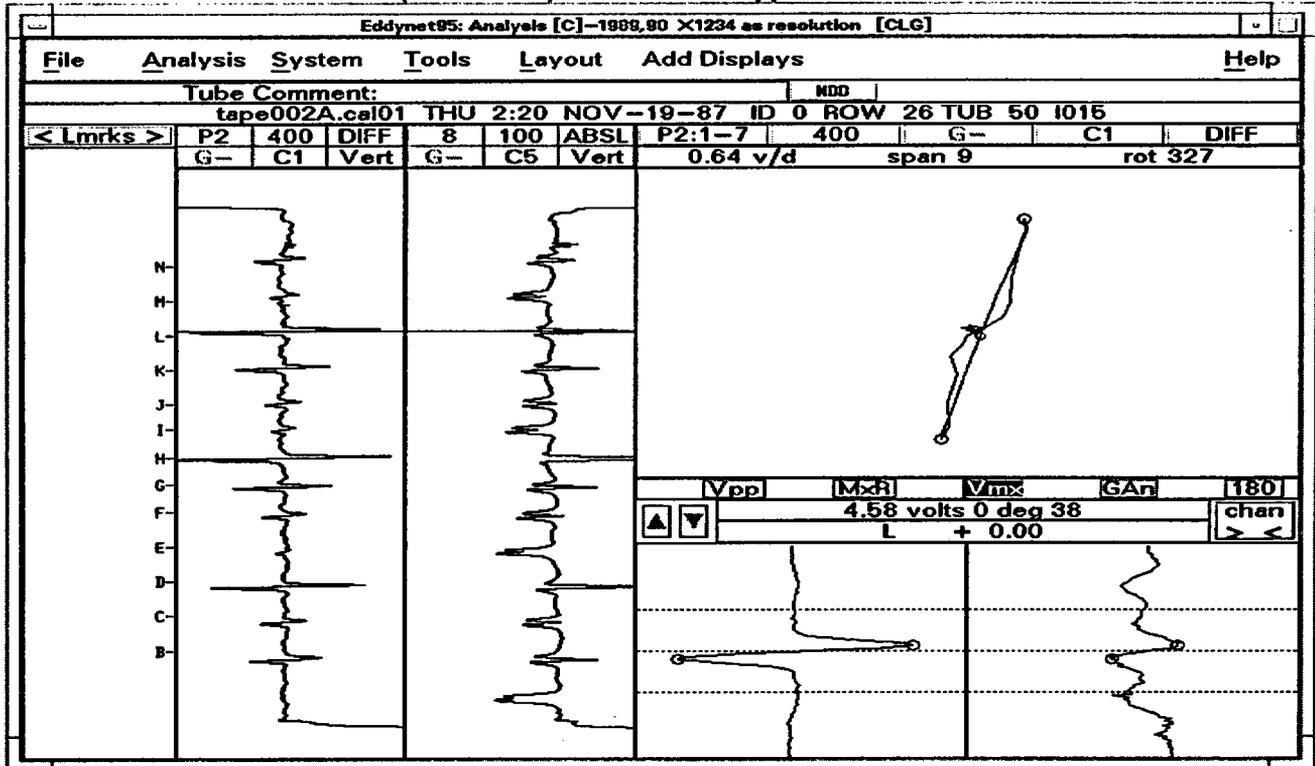


*Pulled tube from Point Beach
This indication is located at the second cold support plate*

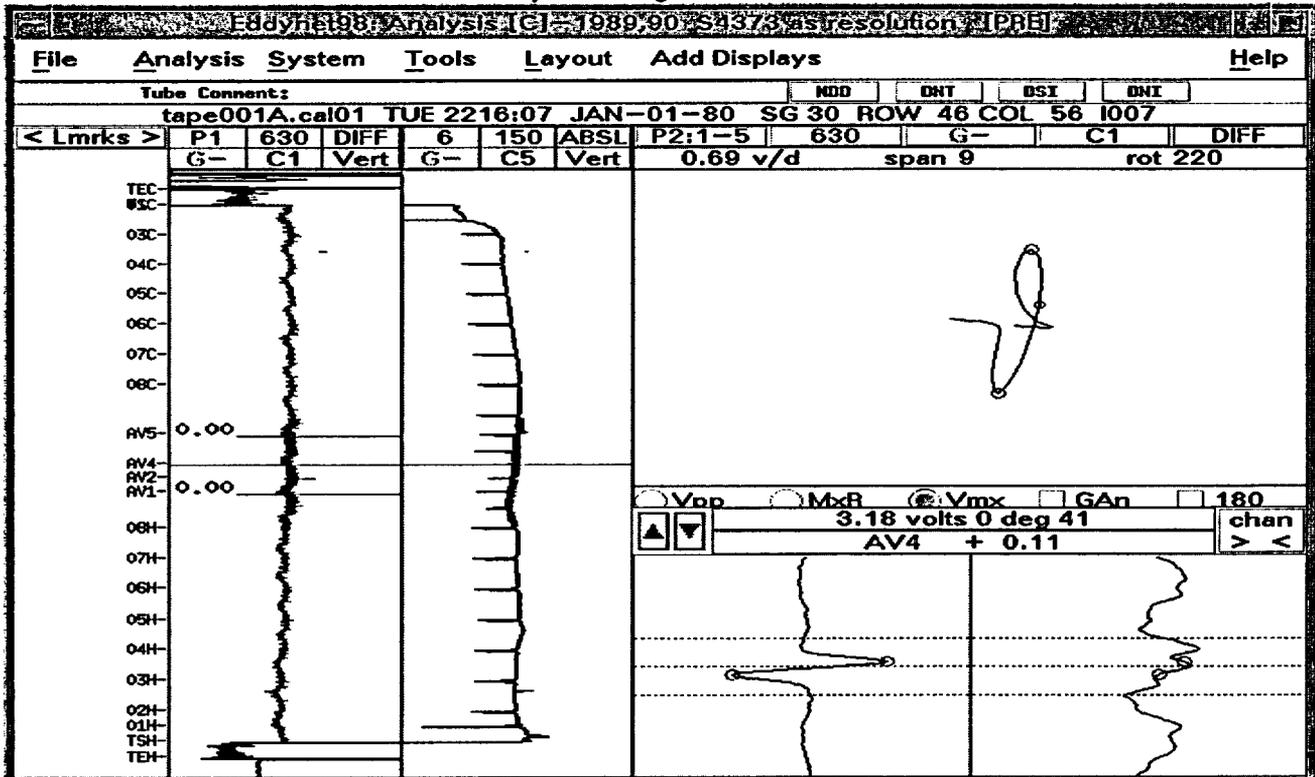


*Typical cold leg (FBC) at Callaway.
COLD LEG THINNING HAS NOT BEEN REPORTED AT CALLAWAY NUCLEAR STATION*

Degradation Mechanism 2 – AVB Wear:
ETSS # 96004.3 (Bobbin coil) Wear at tube supports and anti-vibration bars.

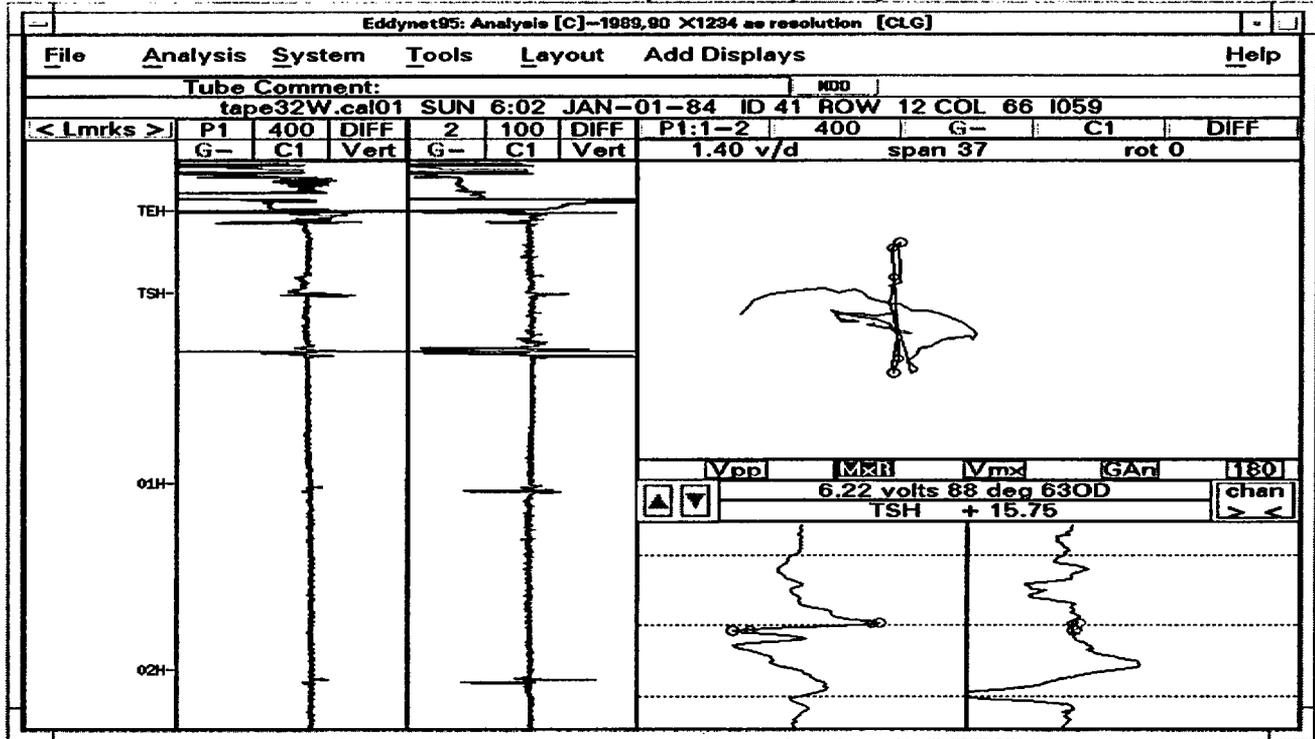


Lab Sample for single-sided AVB wear

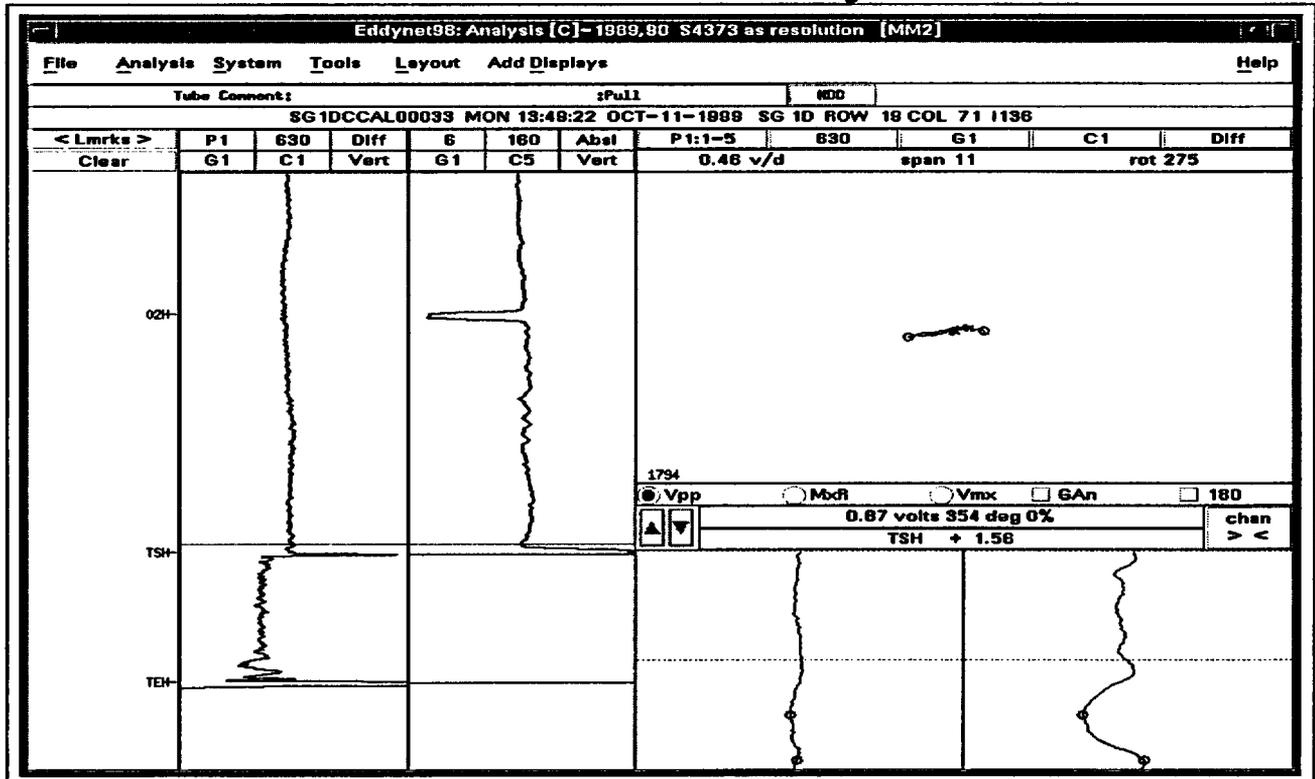


*Tube from Callaway Nuclear Station
This Indication is located at AVB 4.*

**Degradation Mechanism 3 – Pitting above TTS:
ETSS # 96005.2 (Bobbin coil) Pitting**

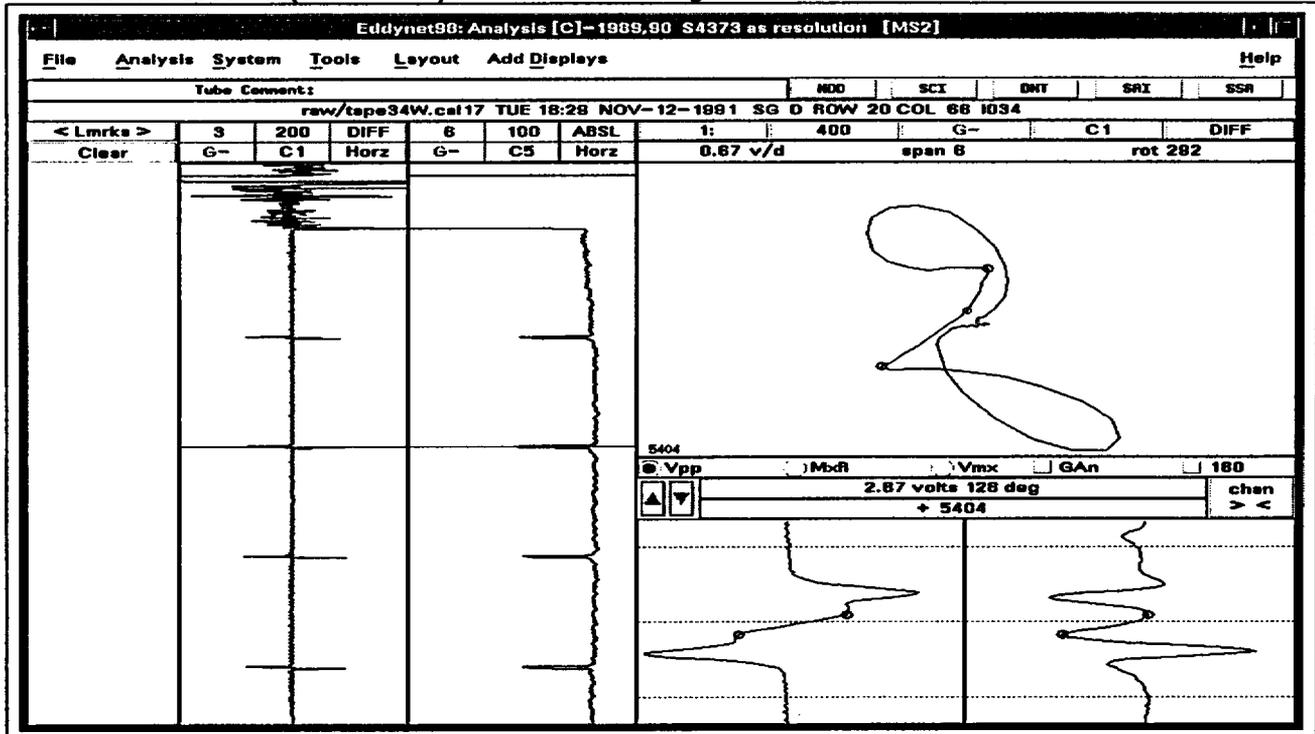


*Pulled tube from Indian Point 3
This indication is located above the hot leg tubesheet*

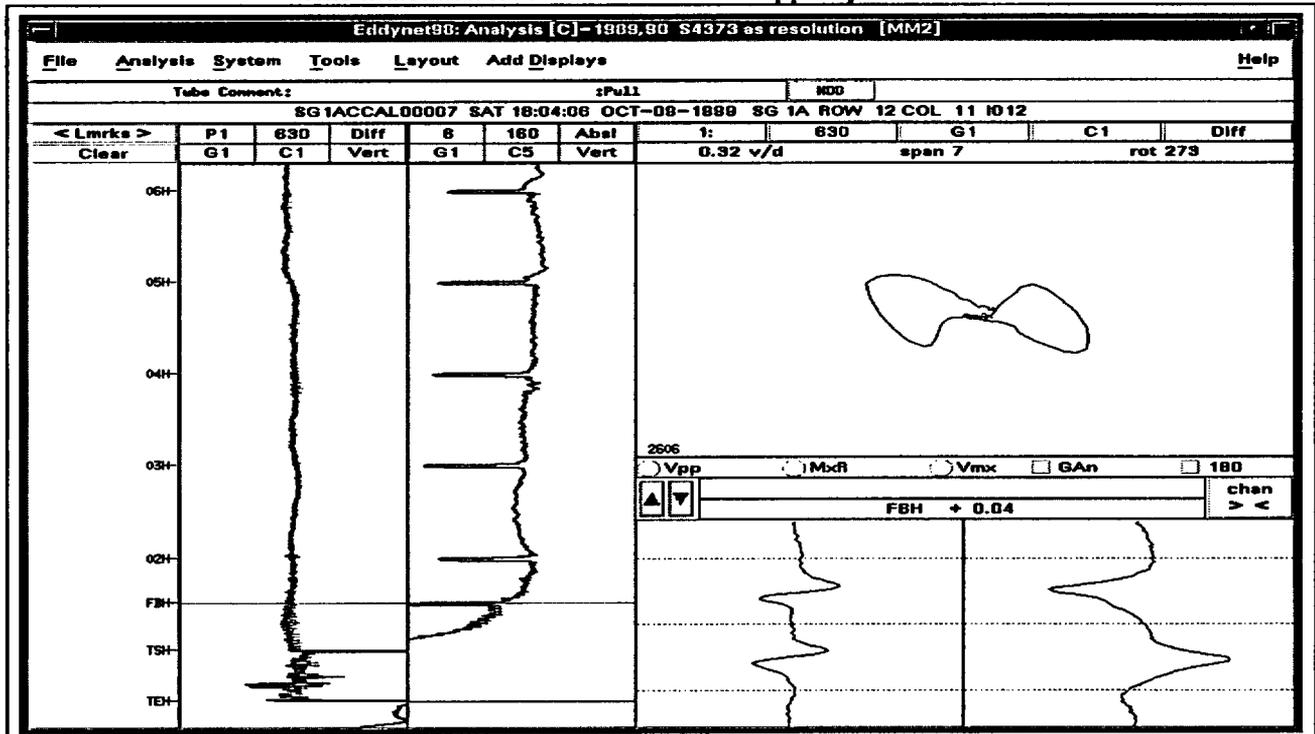


*Typical area above the hot leg TTS with sludge at Callaway.
PITTING HAS NOT BEEN REPORTED AT CALLAWAY NUCLEAR STATION.*

**Degradation Mechanism 4 – IGA/ODSCC Non-Dented Drilled Tube Supports:
ETSS # 96007.1 (Bobbin coil) Detection and sizing of IGA/ODSCC at non-dented drilled TSP's.**

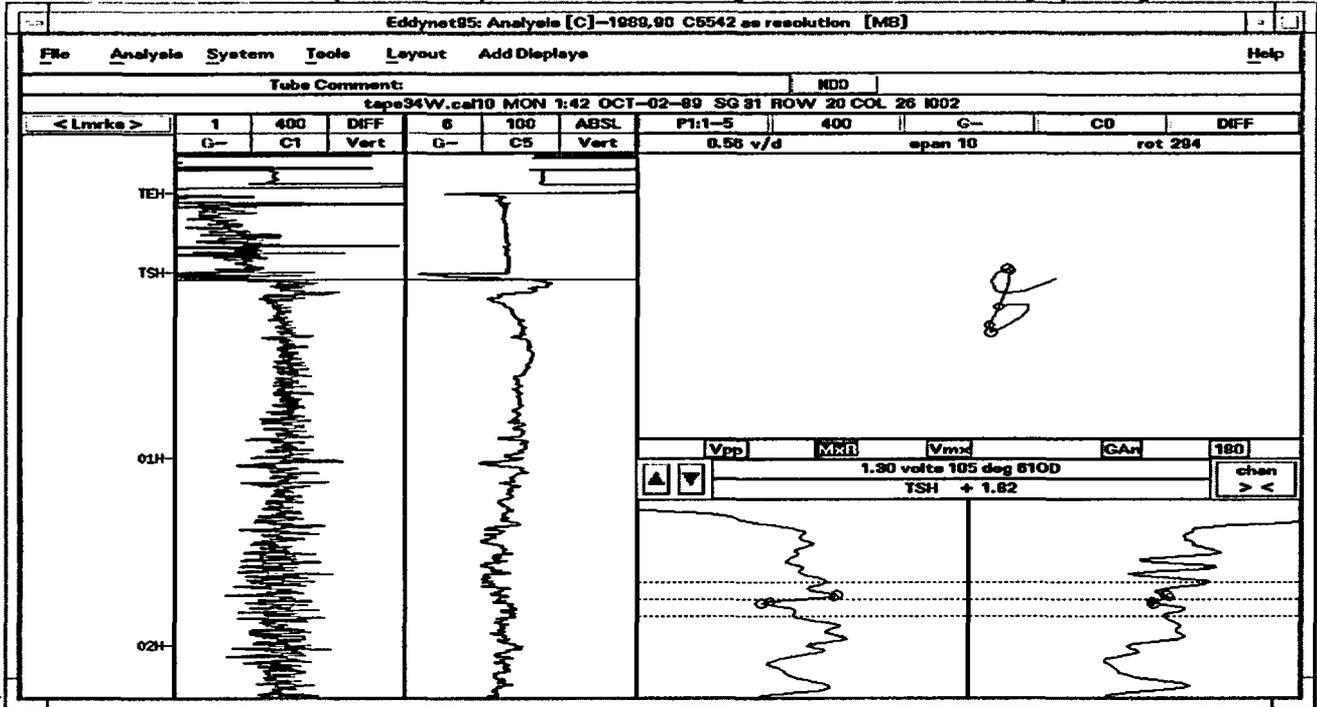


*Pulled tube from Farley.
This indication is located at the 02H support plate location.*

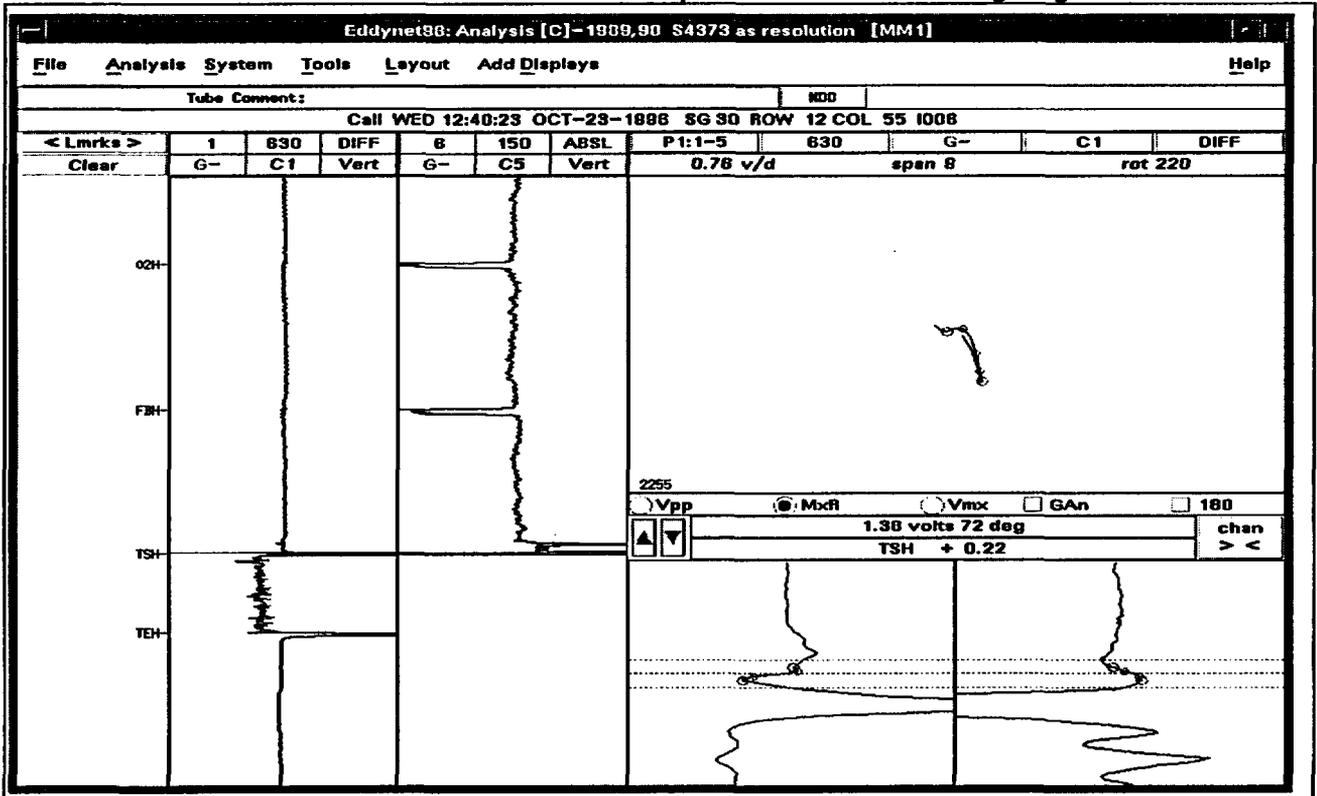


*Typical area at the H/L flow distribution baffle at Callaway.
IGA/ODSCC AT THE FLOW DISTRIBUTION BAFFLE HAS NOT BEEN REPORTED AT CALLAWAY
NUCLEAR STATION.*

**Degradation Mechanism 5 – IGA/ODSCC at Eggcrates and In Sludge Pile region:
ETSS # 96008.1 (Bobbin coil) Detection and sizing of IGA/ODSCC in sludge pile region.**

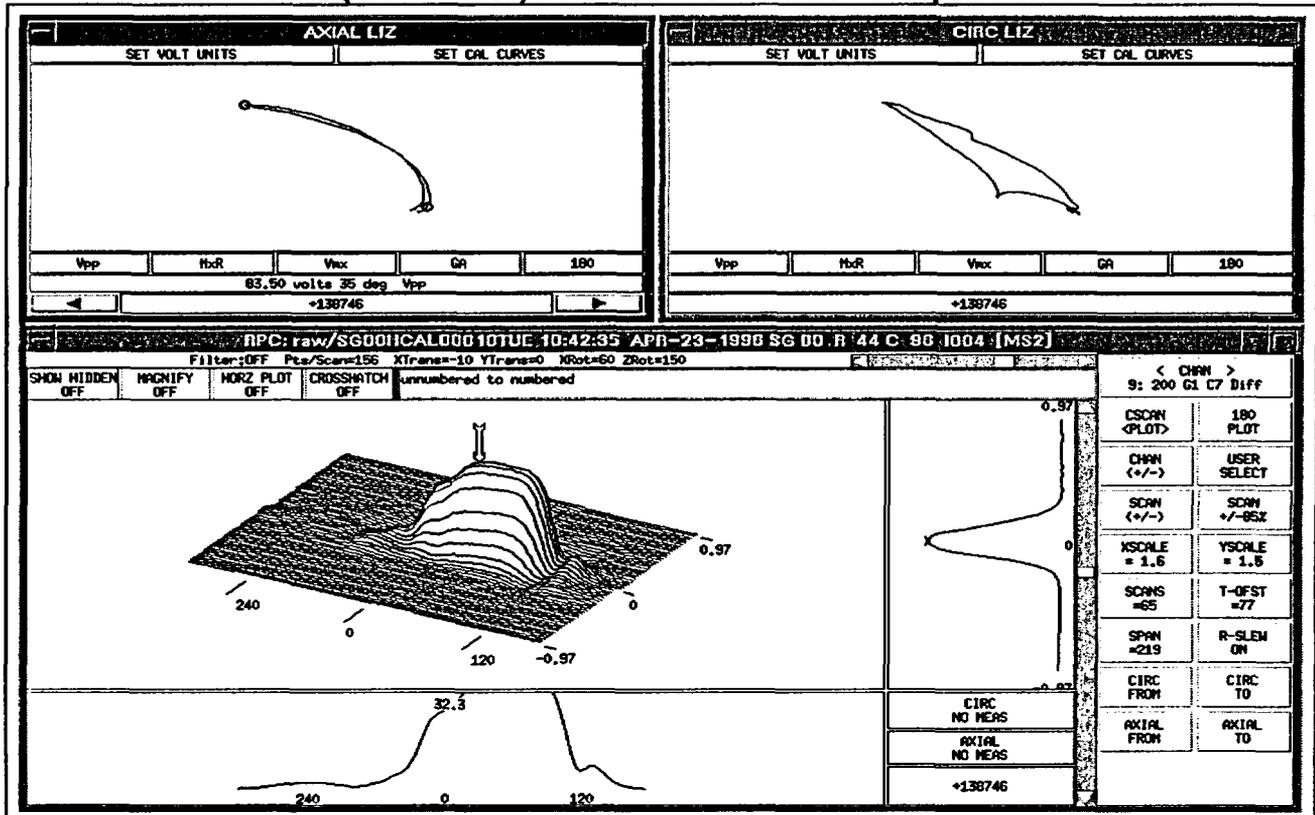


***Pulled tube from Farley
This Indication is located above the top of tubesheet in the sludge region***

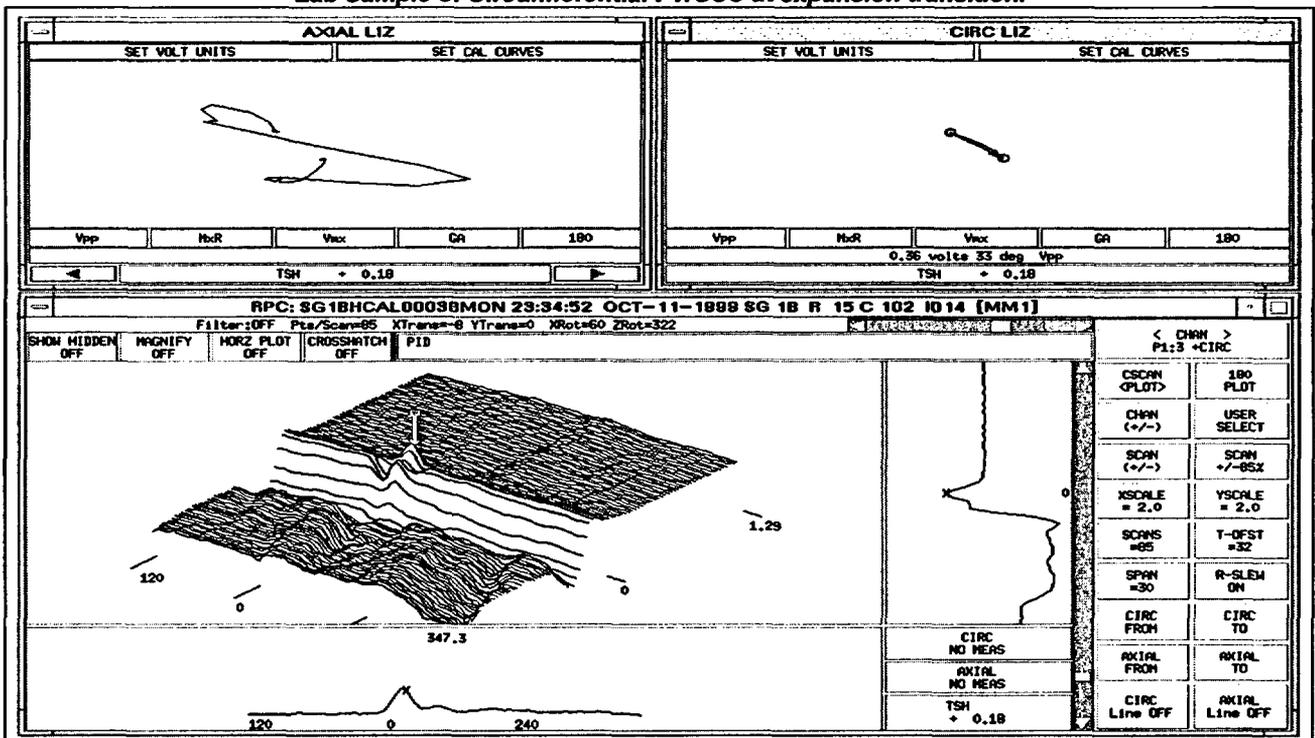


Confirmed ODSCC (MAI) In Sludge Pile above the HL top-of-tubesheet area at Callaway.

**Degradation Mechanism 6 Circumferential PWSCC at expansion transitions:
ETSS # 20510.1 (+Point™ Coll) Detection of Circ PWSCC at expansion transitions.**

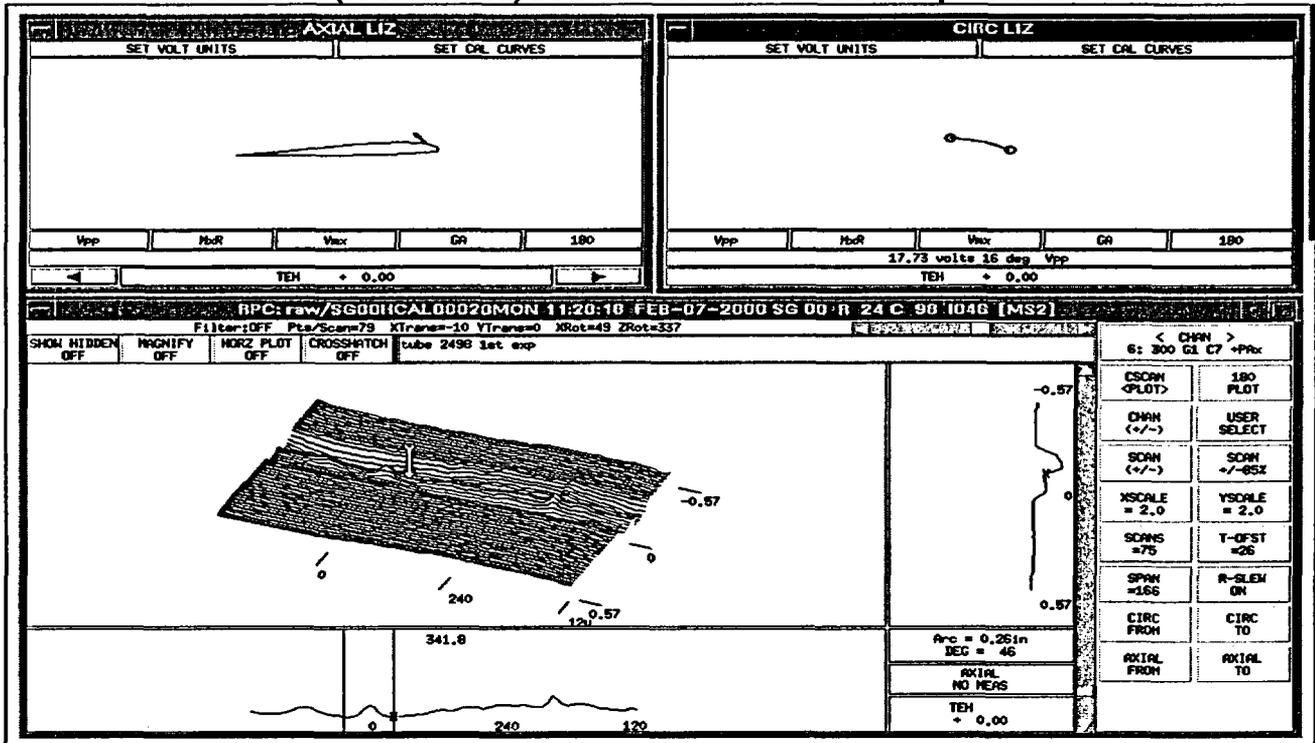


Lab Sample of Circumferential PWSCC at expansion transition.

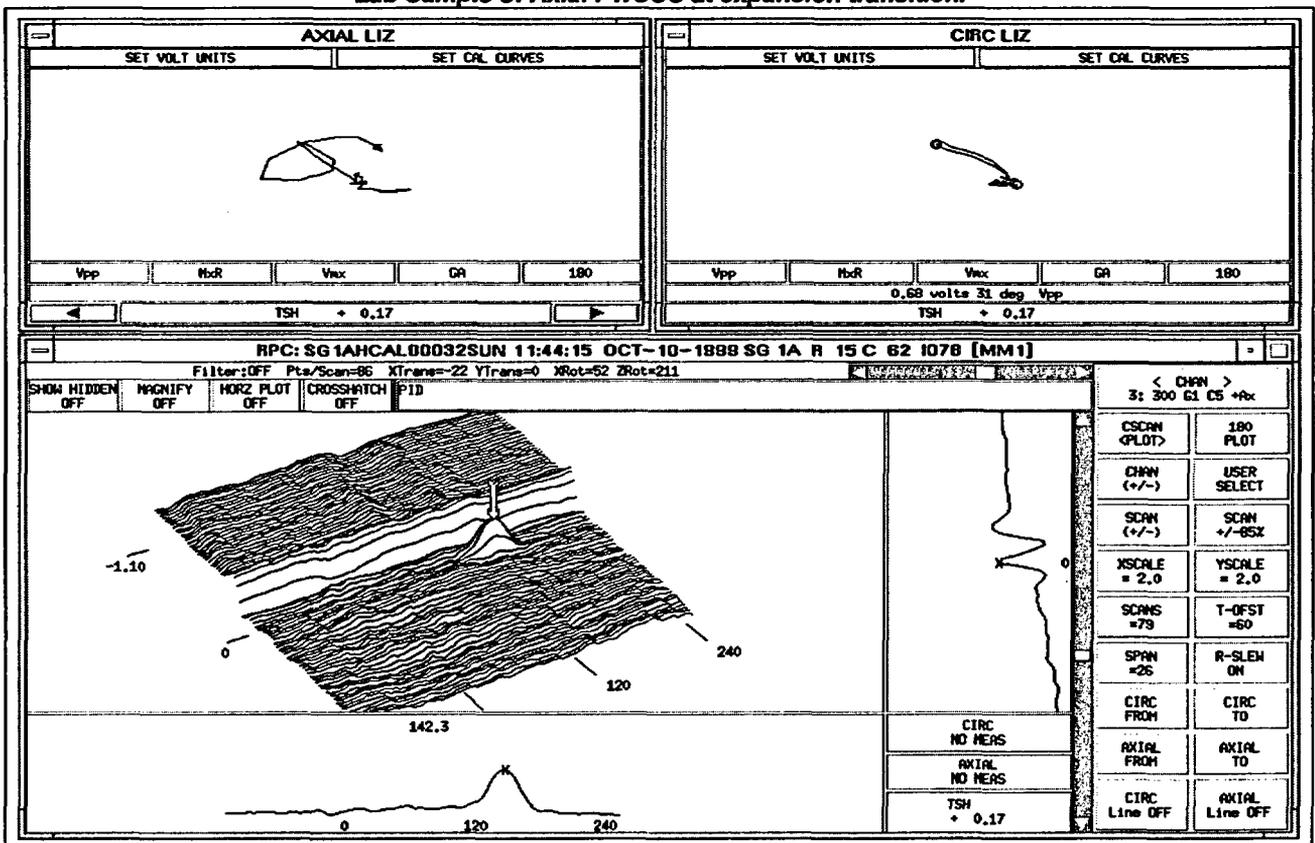


Tube from Callaway. This circumferential indication is located at the hot-leg expansion transition.

Degradation Mechanism 7 - Axial PWSCC:
ETSS # 20511.1 (+Point™ Coll) Detection of Axial PWSCC in expansion transitions.

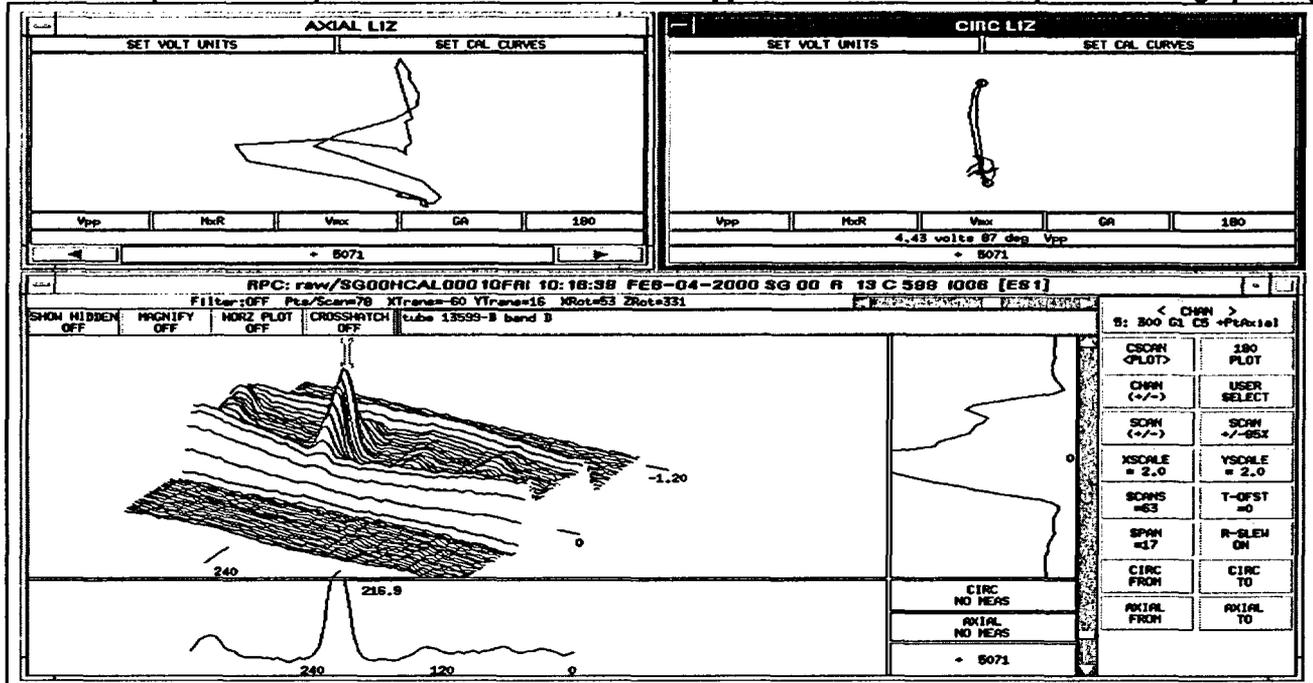


Lab Sample of Axial PWSCC at expansion transition.

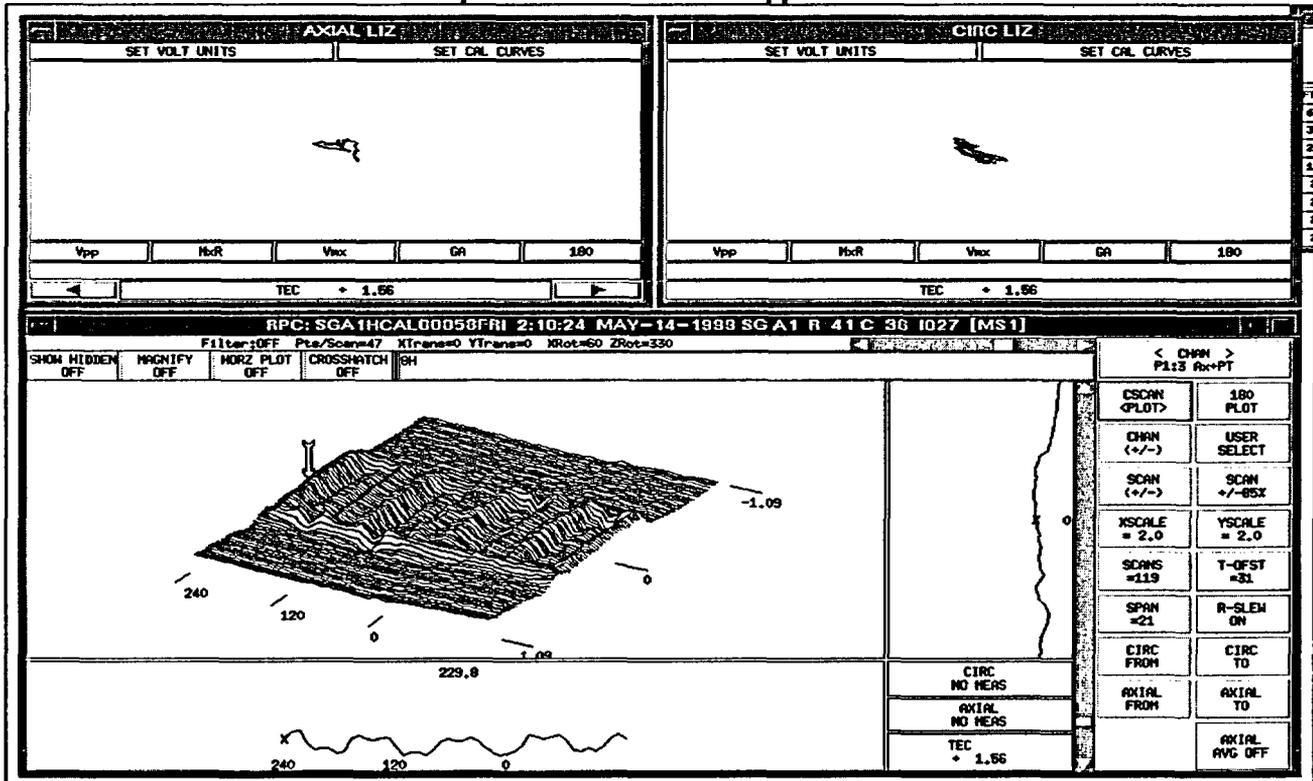


Tube from Callaway. This axial indication is located just above the hot-leg expansion transition.

**Degradation Mechanism 8 Axial ODSCC Support Structures, Freespan, and Sludge Pile Regions:
ETSS # 20409.1 (+Point™ coil) Detection of axial ODSCC at support structures and freespan and sludge pile regions.**



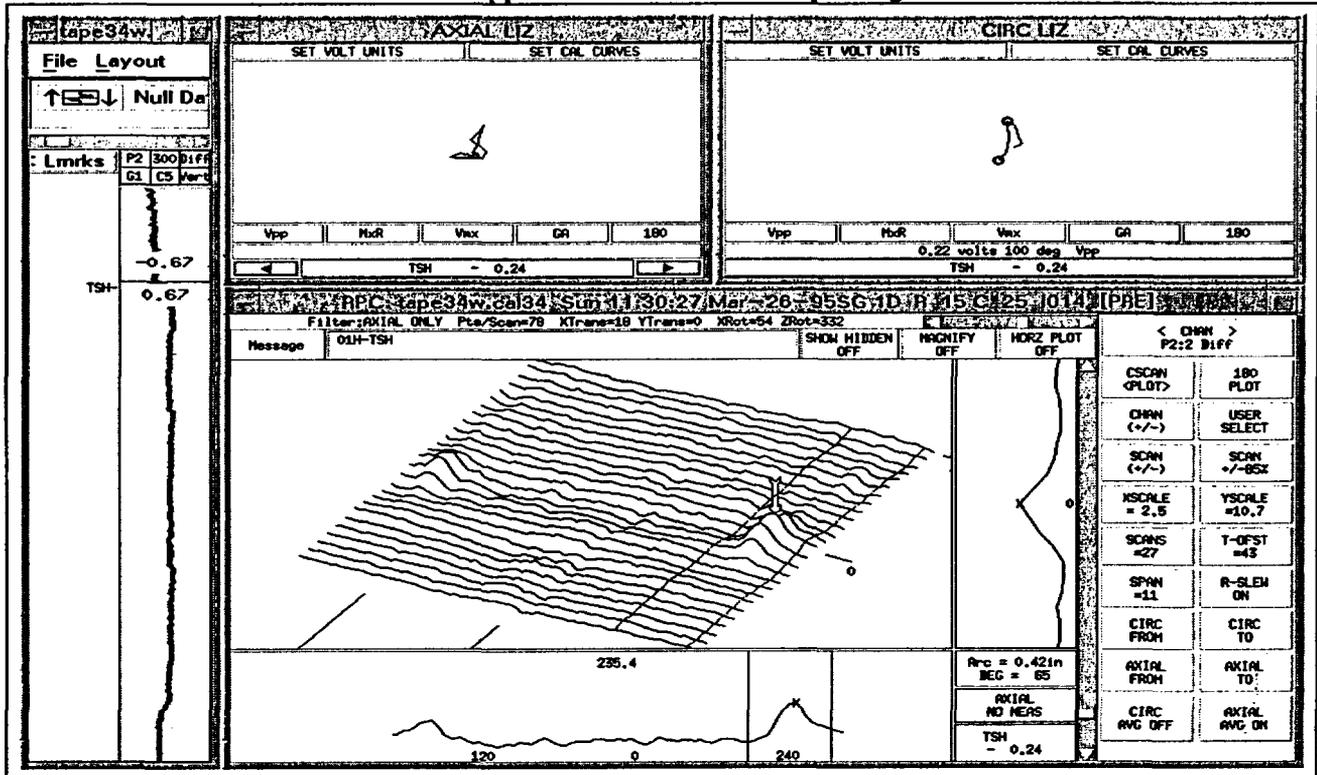
Lab sample of Axial ODSCC at support structures



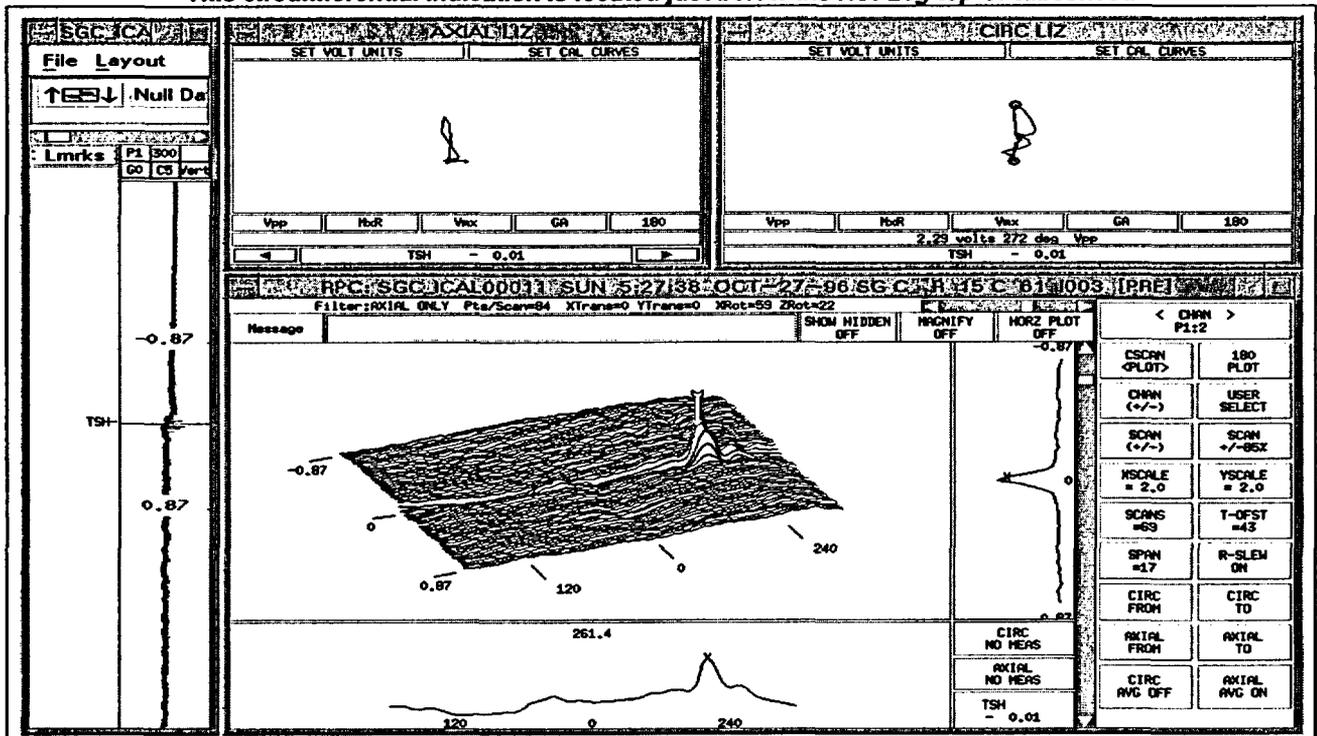
Typical quatrafoil tube support response for "F" Model S/G's.

AXIAL ODSCC AT TSP'S HAS NOT BEEN REPORTED AT CALLAWAY NUCLEAR STATION.

Degradation Mechanism 9 – Circumferential ODSCC at TTS:
ETSS # 20409.1 (+Point™ coil) Detection of circumferential ODSCC at expansion transitions. QBE for Circ detection at support structures and freespan regions.

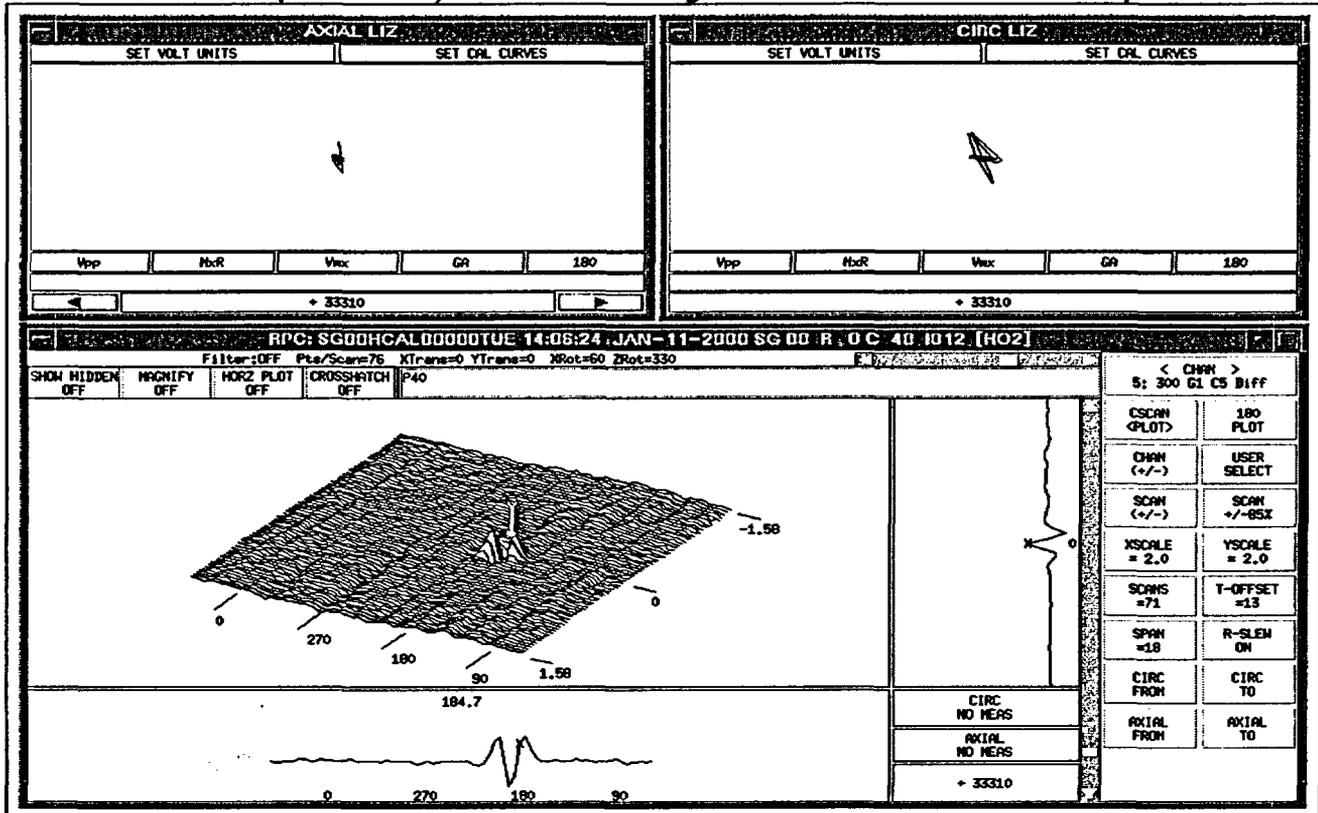


***Pulled Tube from STP.
This circumferential indication is located just below the Hot-Leg top-of-tubesheet.***

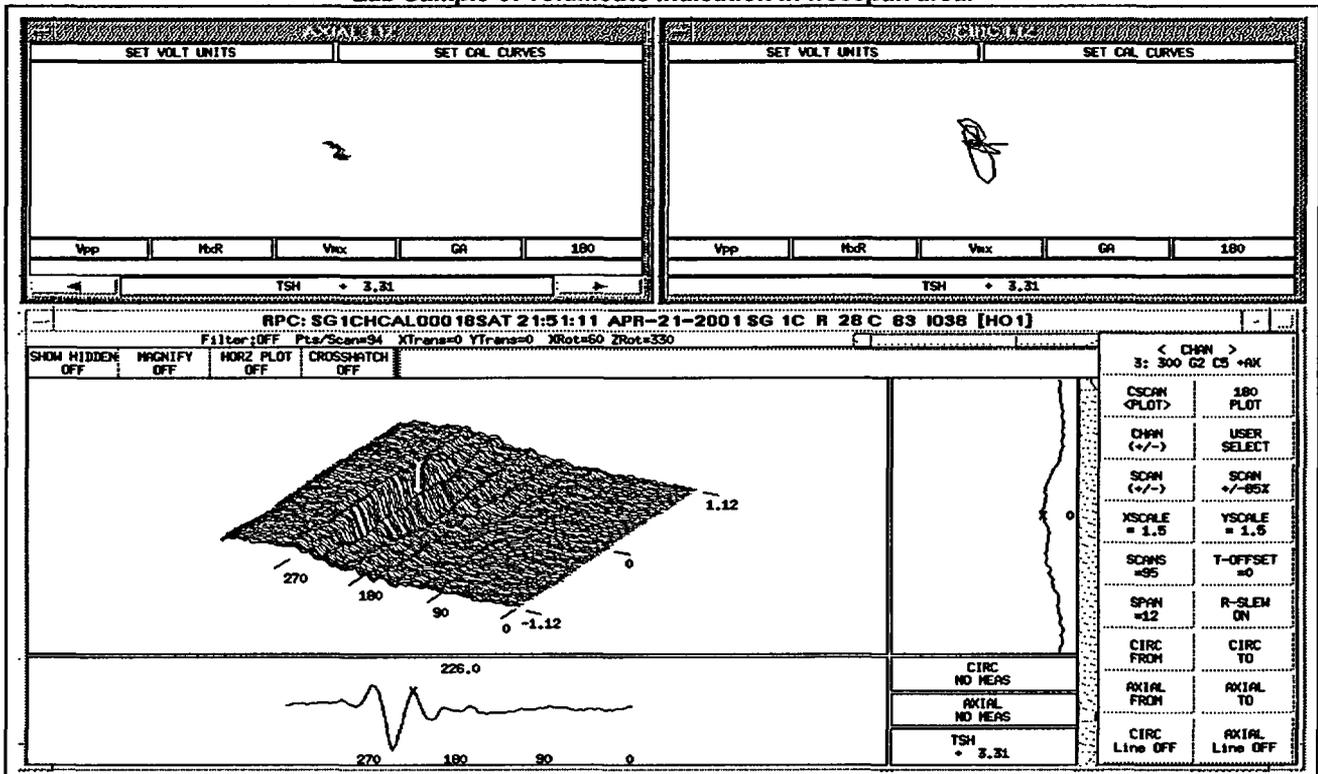


***Tube from Callaway.
This circumferential indication is located just below the Hot-Leg top-of-tubesheet***

Degradation Mechanism 10- Volumetric Indications in Freespan:
ETSS # 21998.1 (+Point™ coll) Detection and sizing of Volumetric Indications in Freespan areas.

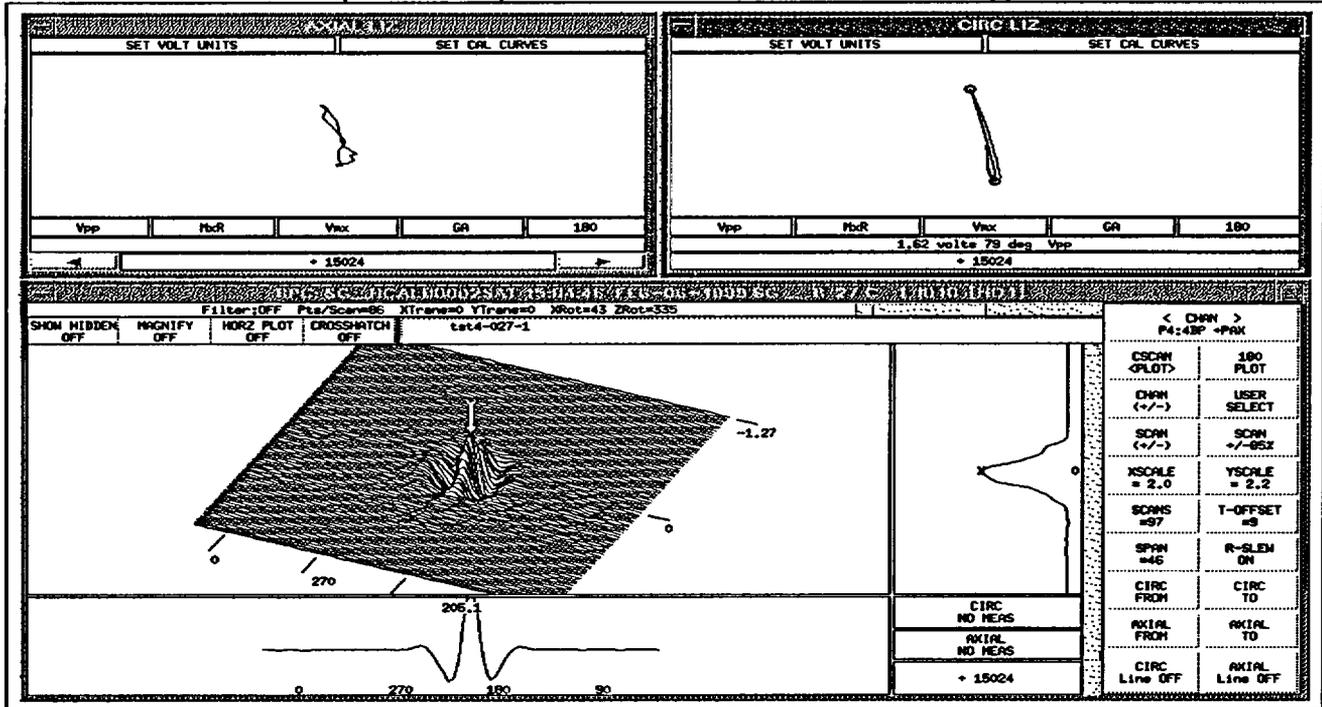


Lab Sample of volumetric Indication in freespan area.

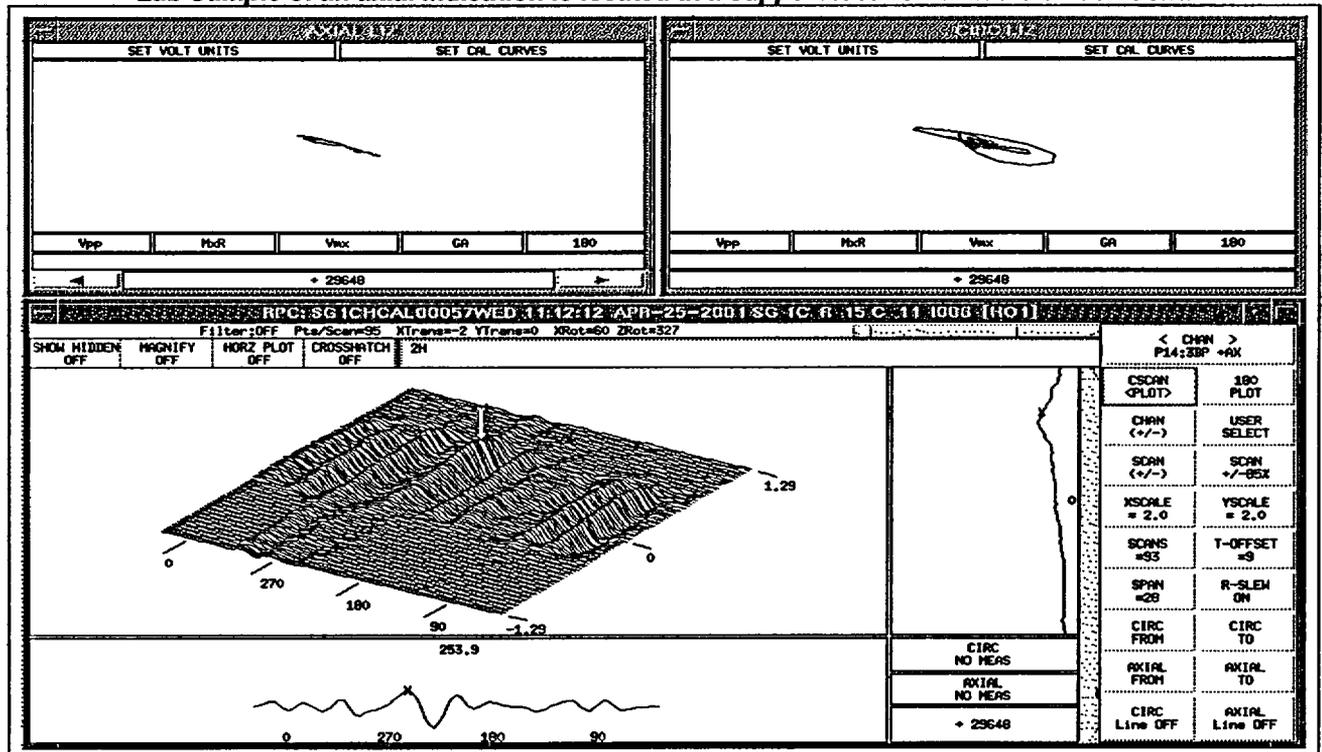


Volumetric Indication in freespan area at Callaway.

**Degradation Mechanism 11 – Axial ODSCC at Dented Support Locations - Extended to TTS , Support Structures and Freespan Dings:
ETSS # 22841.3 (+Point™ coll) Detection of axial ODSCC at dented support structures.**



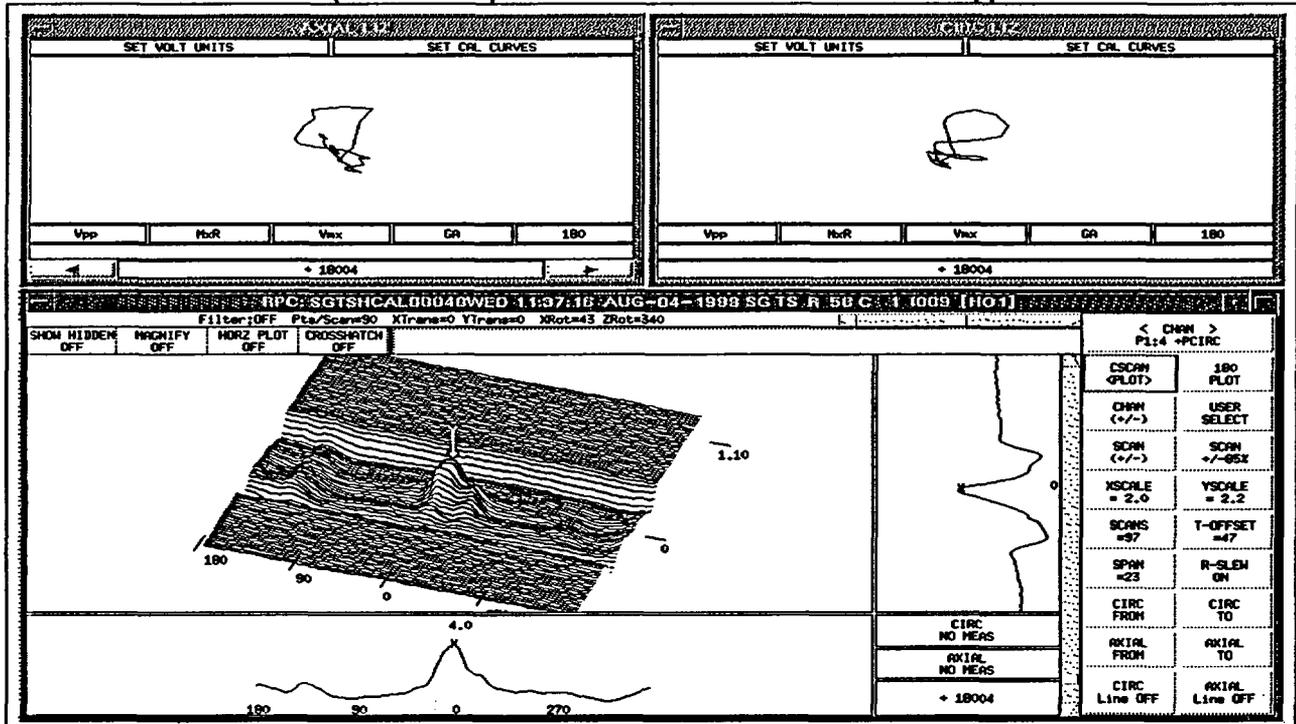
Lab Sample of an axial indication is located at a support location with a 5.97 volt dent.



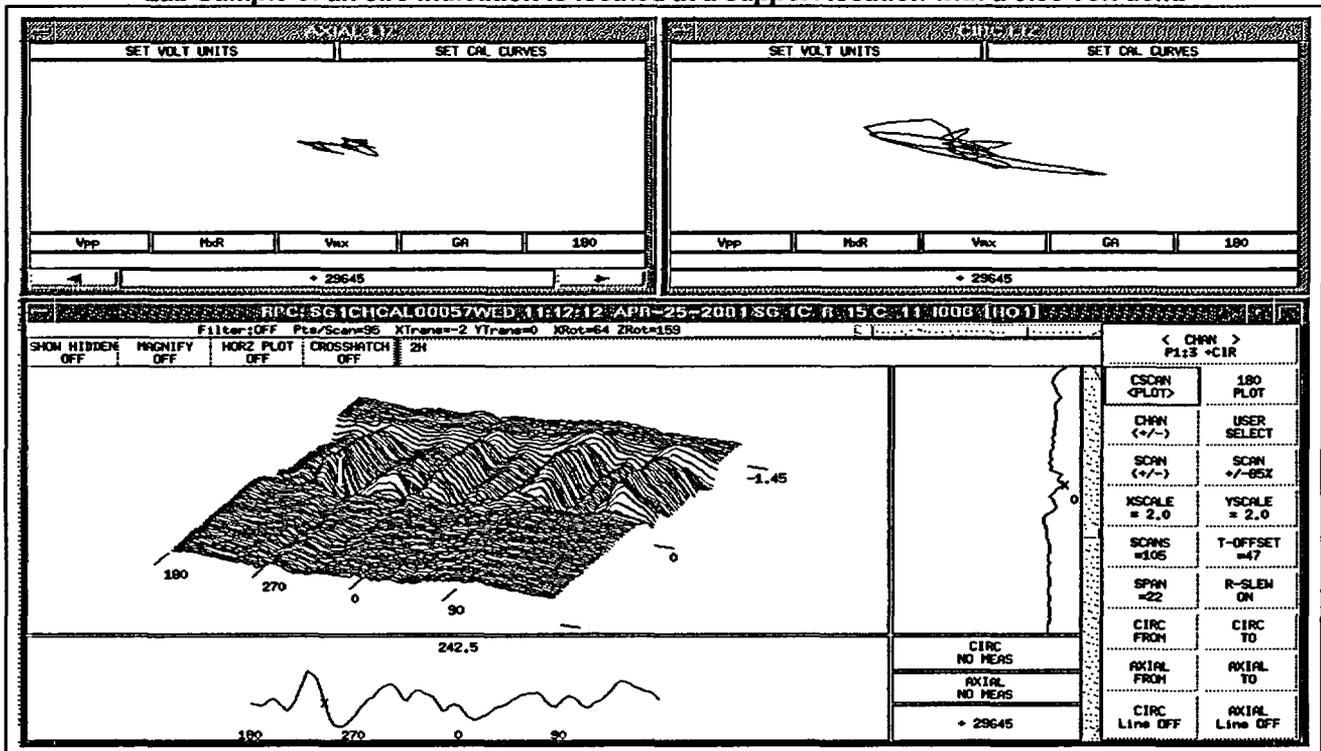
5.46 Volt at Dented TSP at Callaway.

AXIAL ODSCC AT DENTED SUPPORT STRUCTURES HAS NOT BEEN REPORTED AT CALLAWAY.

**Degradation Mechanism 12 – Circumferential ODSCC at Dented Support Locations - Extended to TTS, Support Structures and Freespan Dings:
ETSS # 22842.3 (+Point™ coll) Detection of Circ ODSCC at dented support structures.**



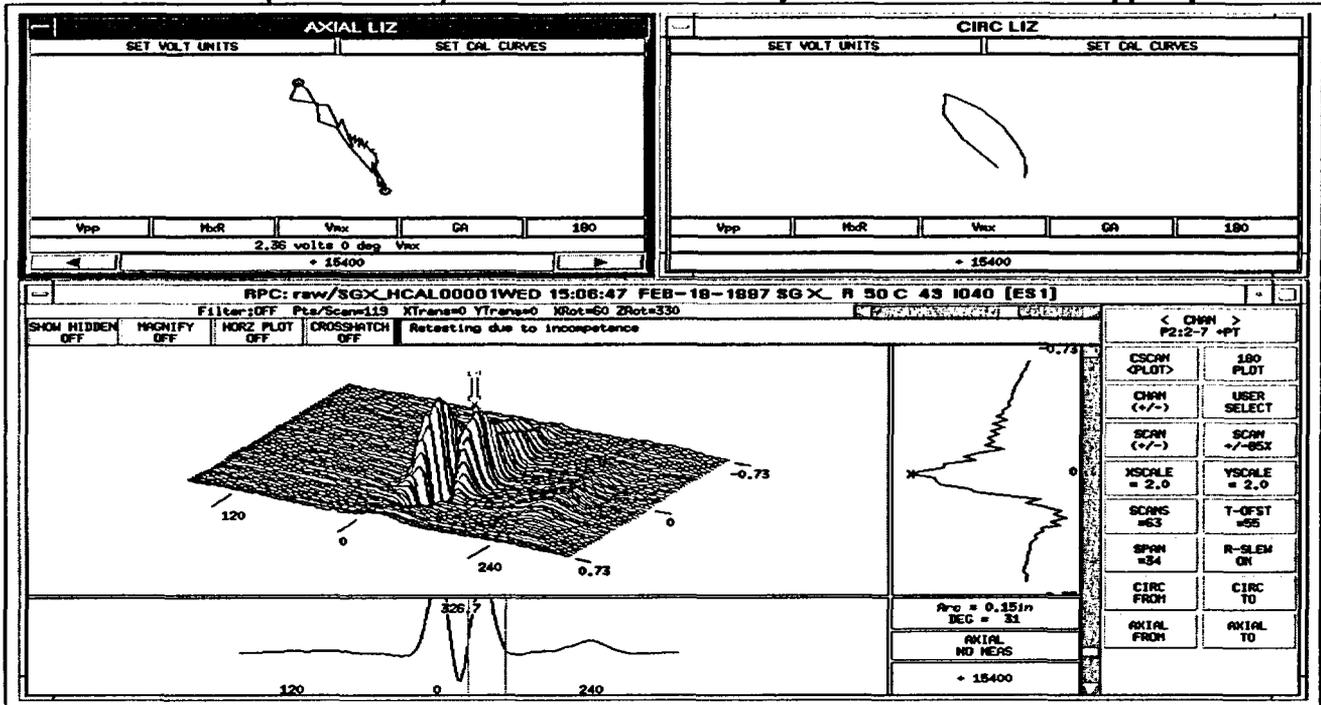
Lab Sample of an circ Indication is located at a support location with a 5.50 volt dent.



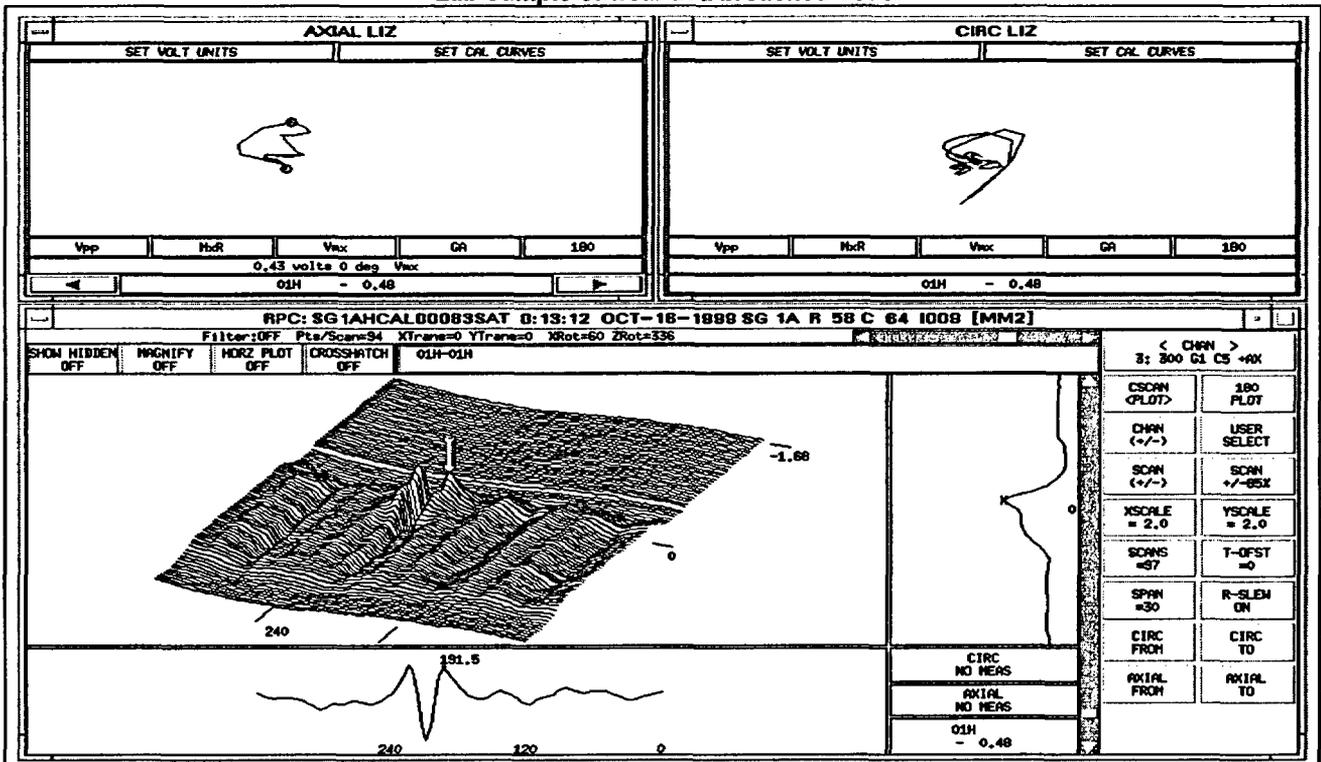
5.46 Volt Dent at TSP from Callaway

AXIAL ODSCC AT DENTED SUPPORT STRUCTURES HAS NOT BEEN REPORTED AT CALLAWAY.

**Degradation Mechanism 13 –Wear at TSP's, and FDB's:
ETSS # 96910.1 (+Point™ Coil) Detection of mechanically induced wear at tube support plates.**



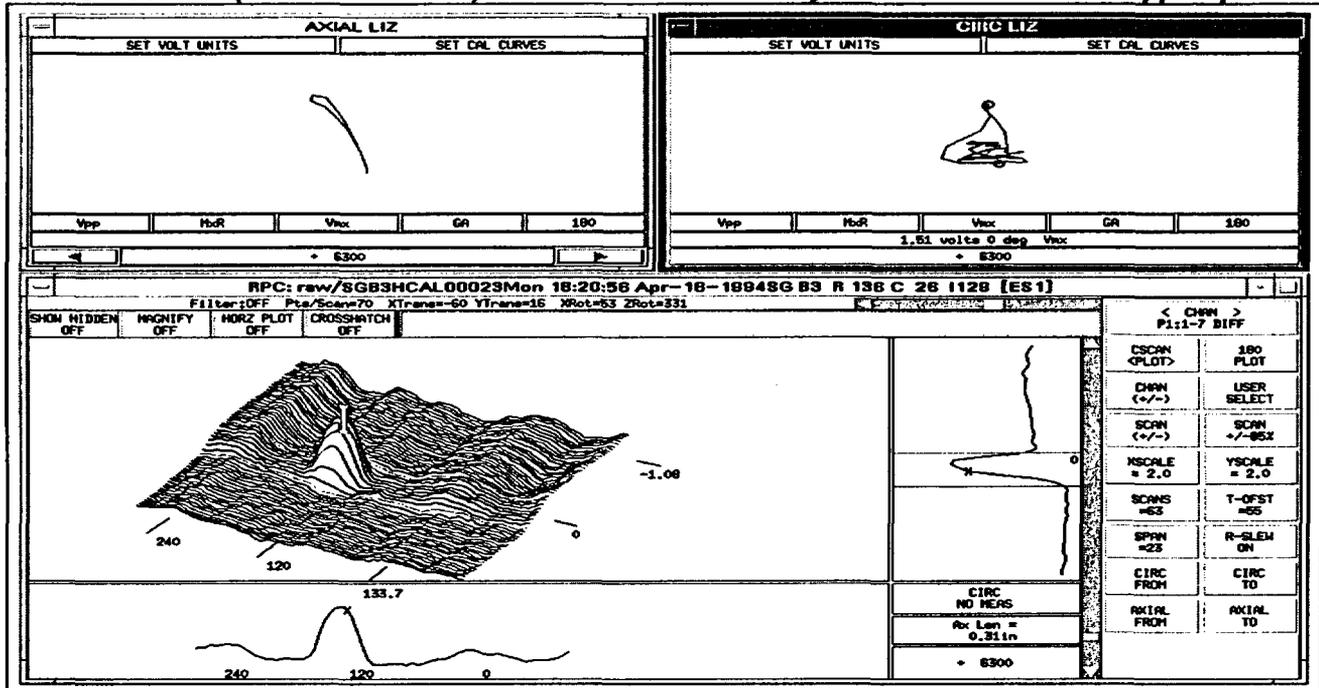
Lab Sample of wear at a braached TSP.



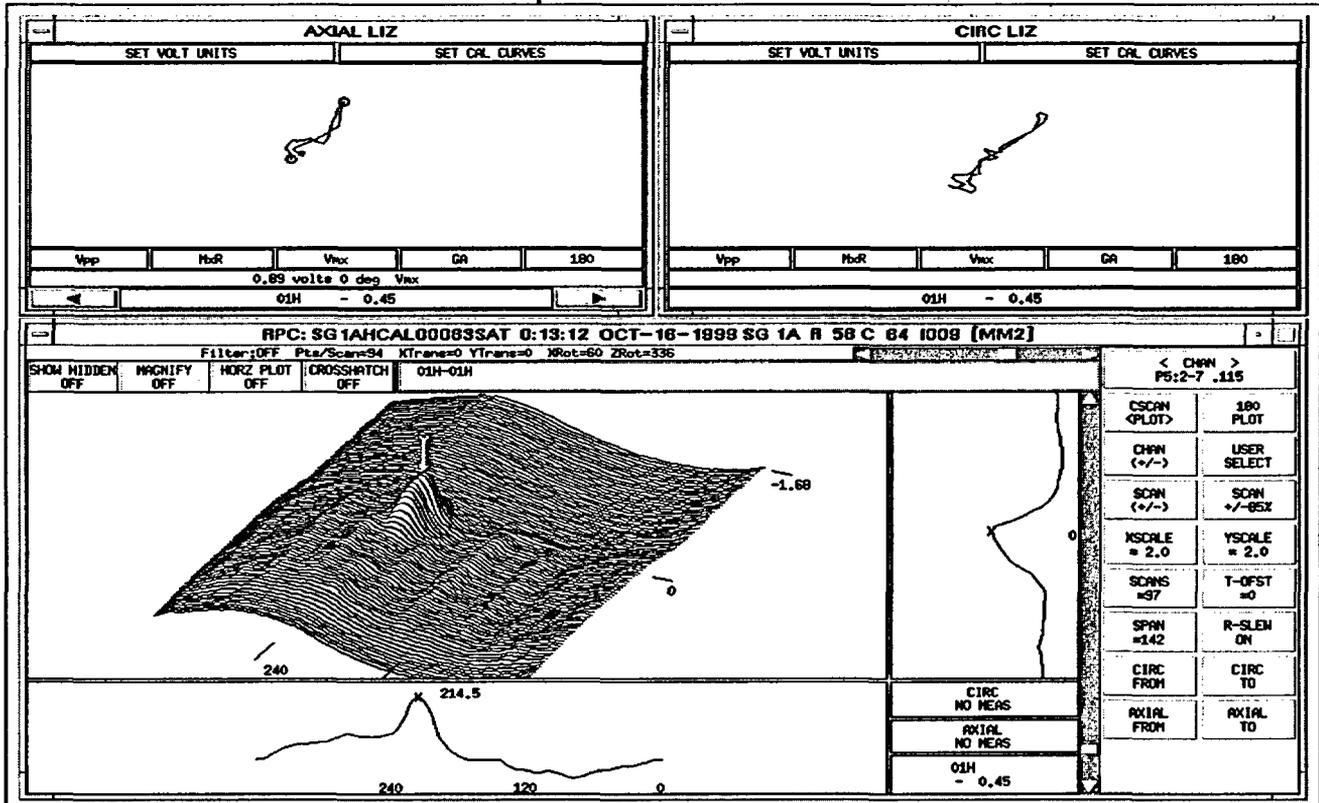
Callaway wear indication located at 01H quatrafoll support location.

**FLOW DISTRIBUTION WEAR HAS NOT BEEN REPORTED AT
CALLAWAY NUCLEAR STATION.**

**Degradation Mechanism 14 –Wear at TSP's and FDB's:
ETSS # 96911.1 (.115 Pancake Coil) Detection of mechanically induced wear at tube support plates.**



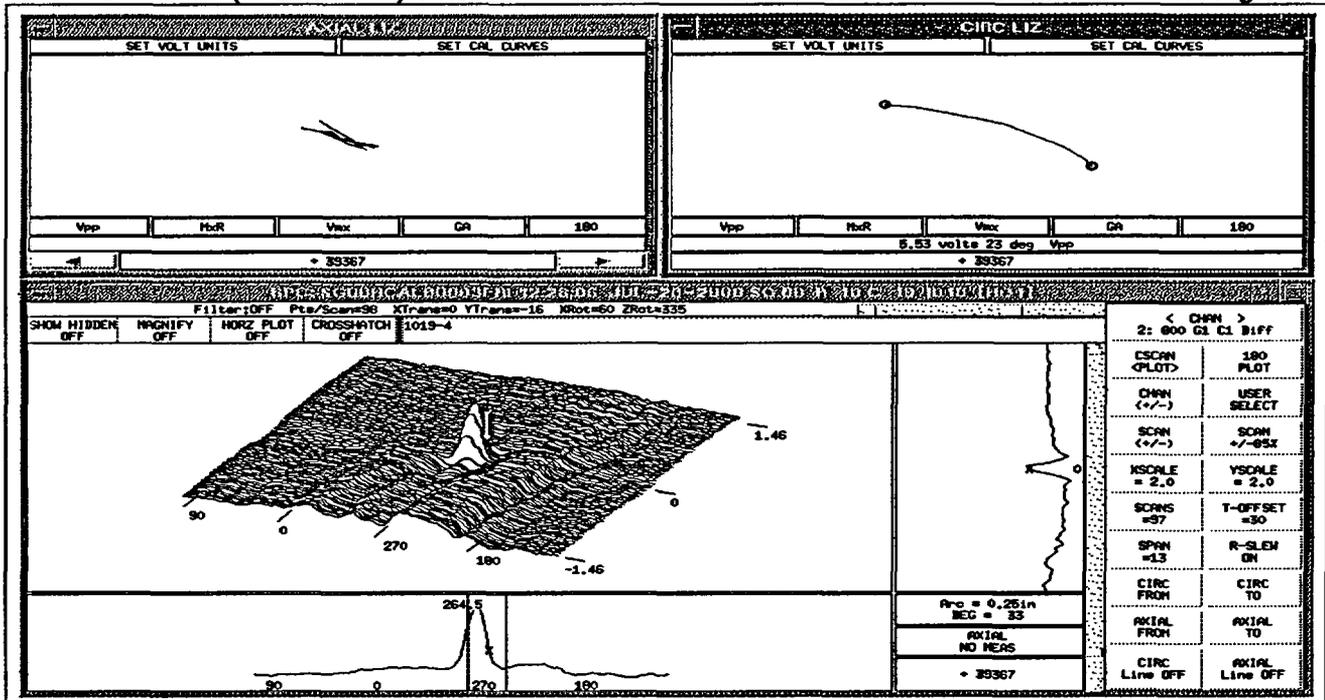
Lab Sample of wear at a broached TSP.



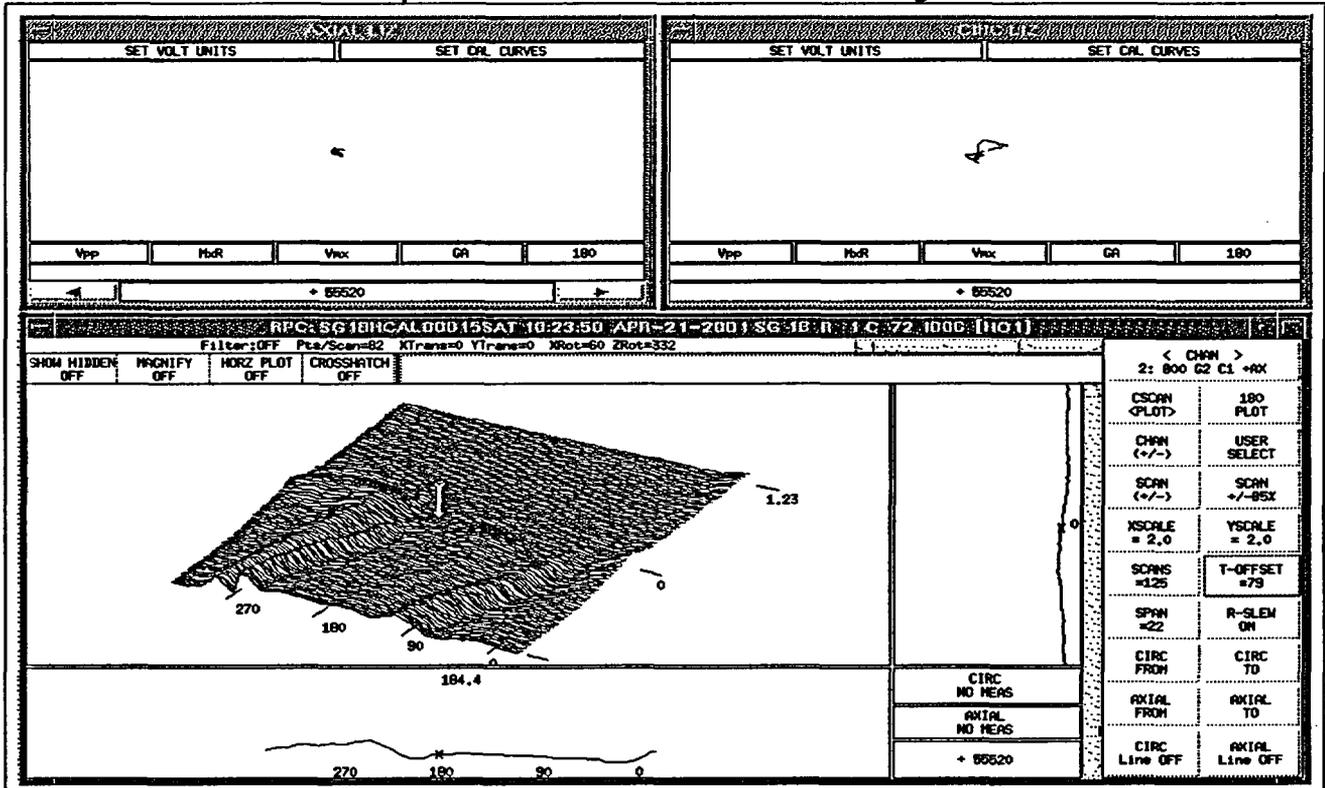
Callaway. wear indication is located at 01H quatrafoll support location.

**FLOW DISTRIBUTION WEAR HAS NOT BEEN REPORTED AT
CALLAWAY NUCLEAR STATION.**

**Degradation Mechanism 15 – Axial and Circumferential PWSCC in Short Radius U-bends:
ETSS # 99997.1 (+Point™ coll) Detection of circumferential and axial PWSCC in low row U-bend regions**



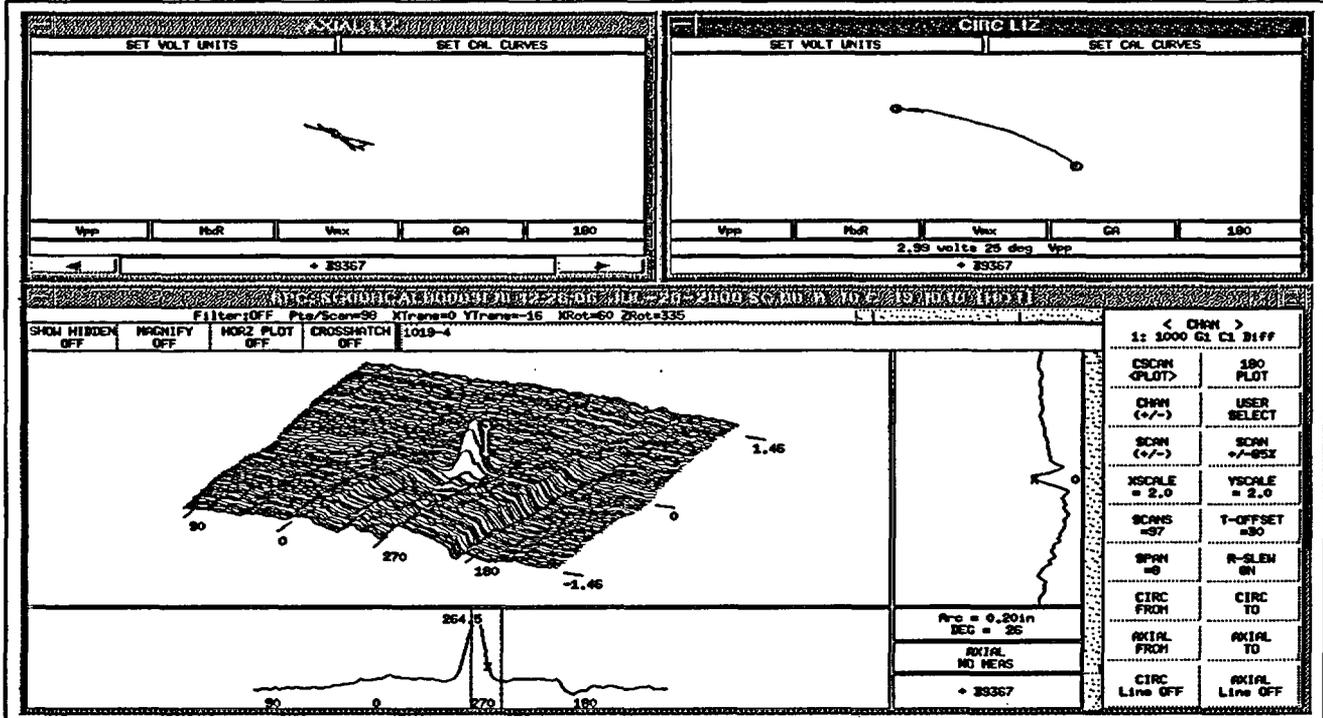
Lab Sample of axial PWSCC in low row U-bend tangent area.



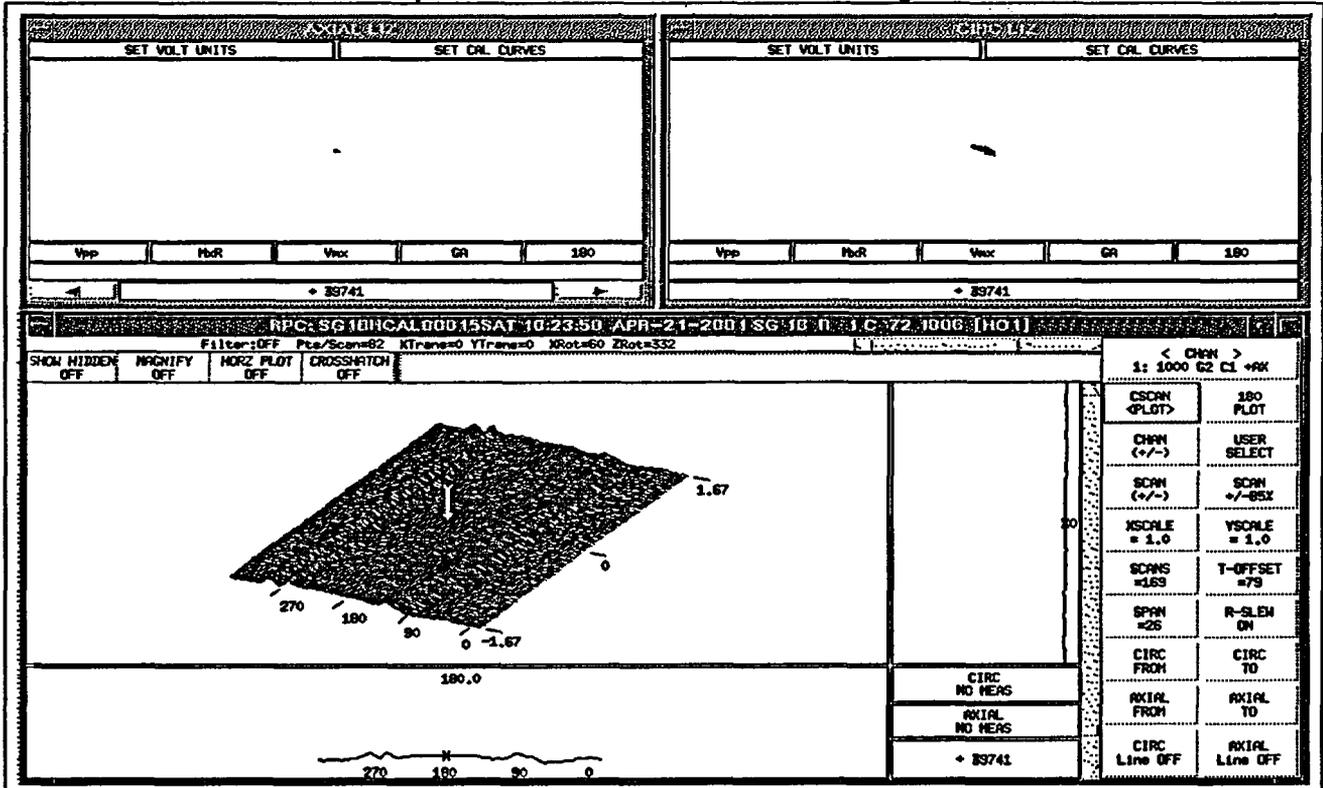
Typical Row 1 U-Bend tangent area at Callaway.

AXIAL OR CIRC PWSCC IN SHORT RADIUS U-BENDS HAS NOT BEEN REPORTED AT CALLAWAY NUCLEAR STATION.

**Degradation Mechanism 16 – Axial and Circumferential PWSCC In Short Radius U-bends:
ETSS # 99997.2 (+Point™ coil) Detection of circumferential and axial PWSCC in low row U-bend regions**



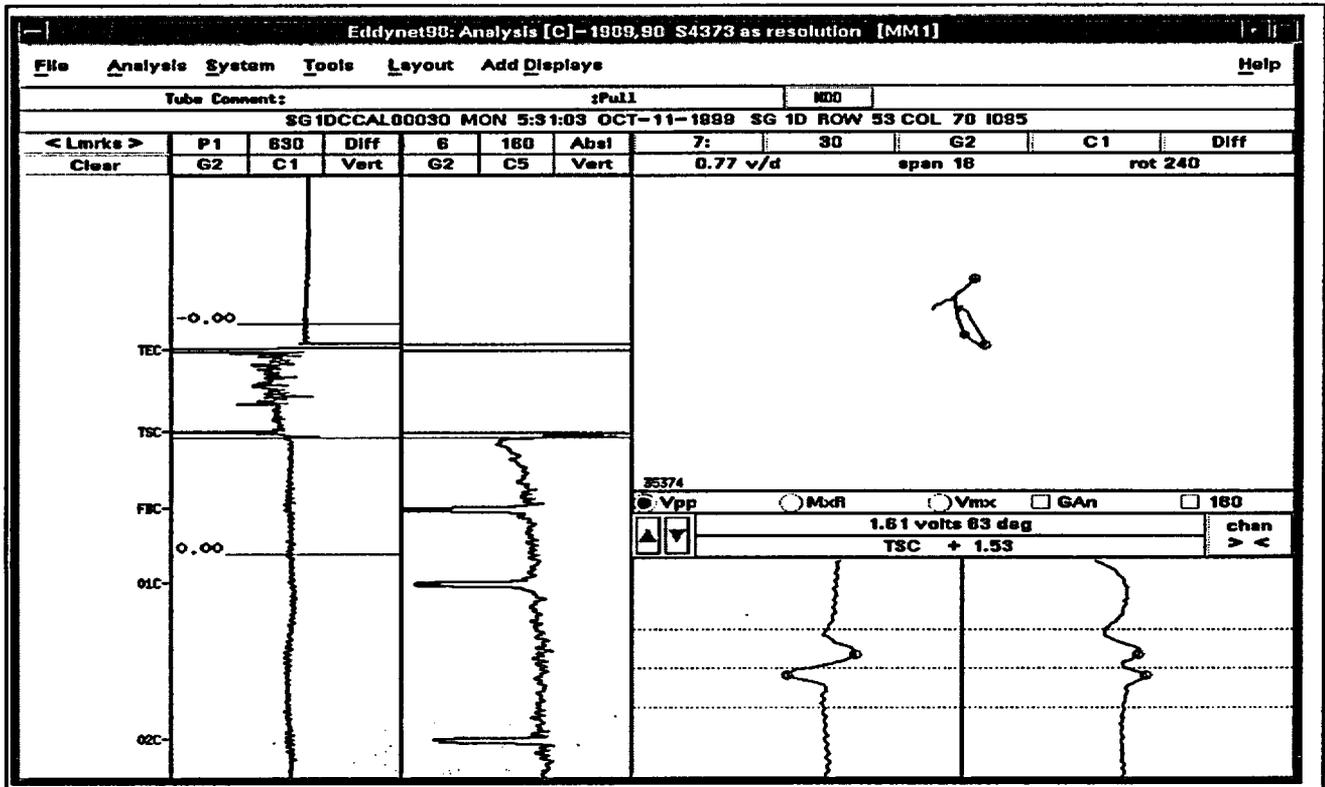
Lab Sample of axial PWSCC in low row U-bend tangent area.



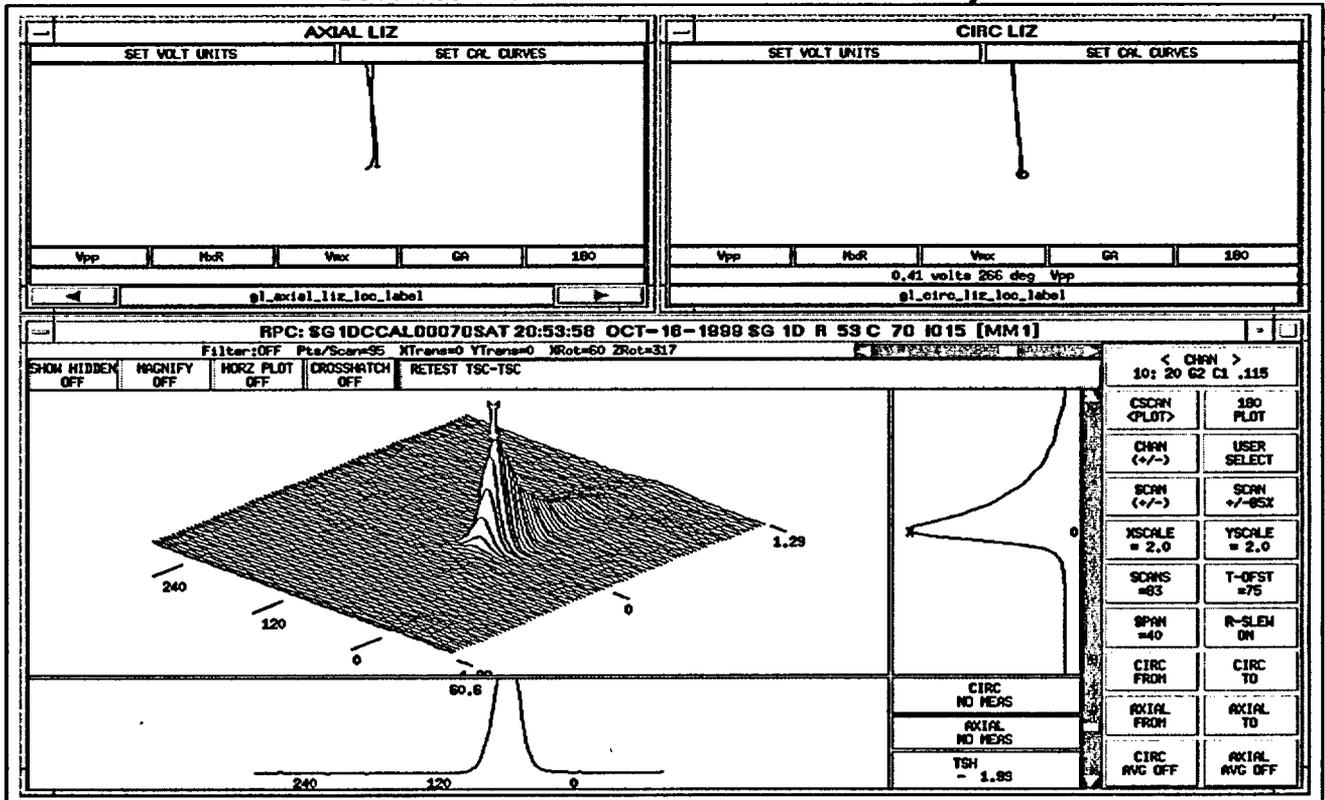
Typical Row 1 U-Bend at the apex area at Callaway.

AXIAL or CIRC PWSCC IN SHORT RADIUS UBENDS HAS NOT BEEN REPORTED AT CALLAWAY NUCLEAR STATION.

Degradation Mechanism 17 - Loose Part:

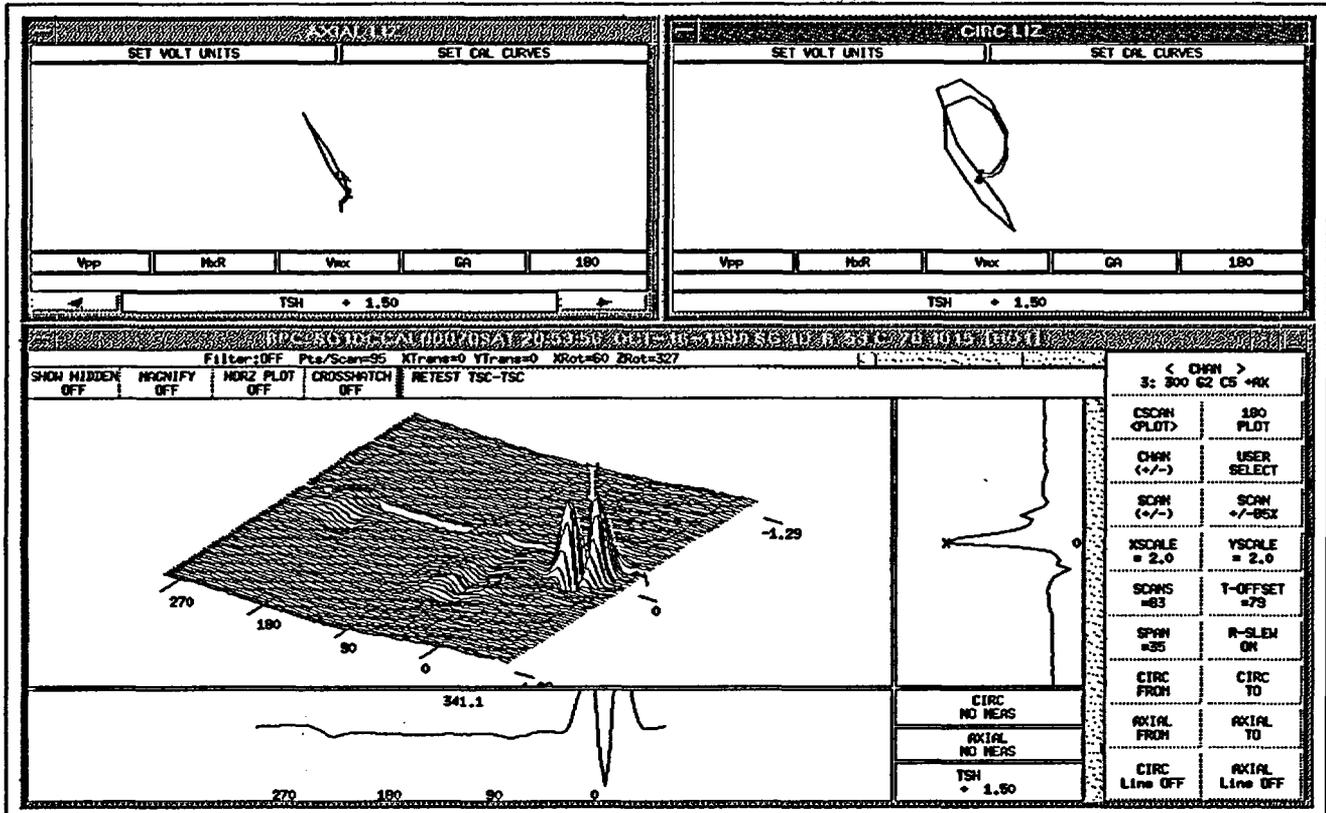


Bobbin coil Indication of a Loose Part from Callaway.

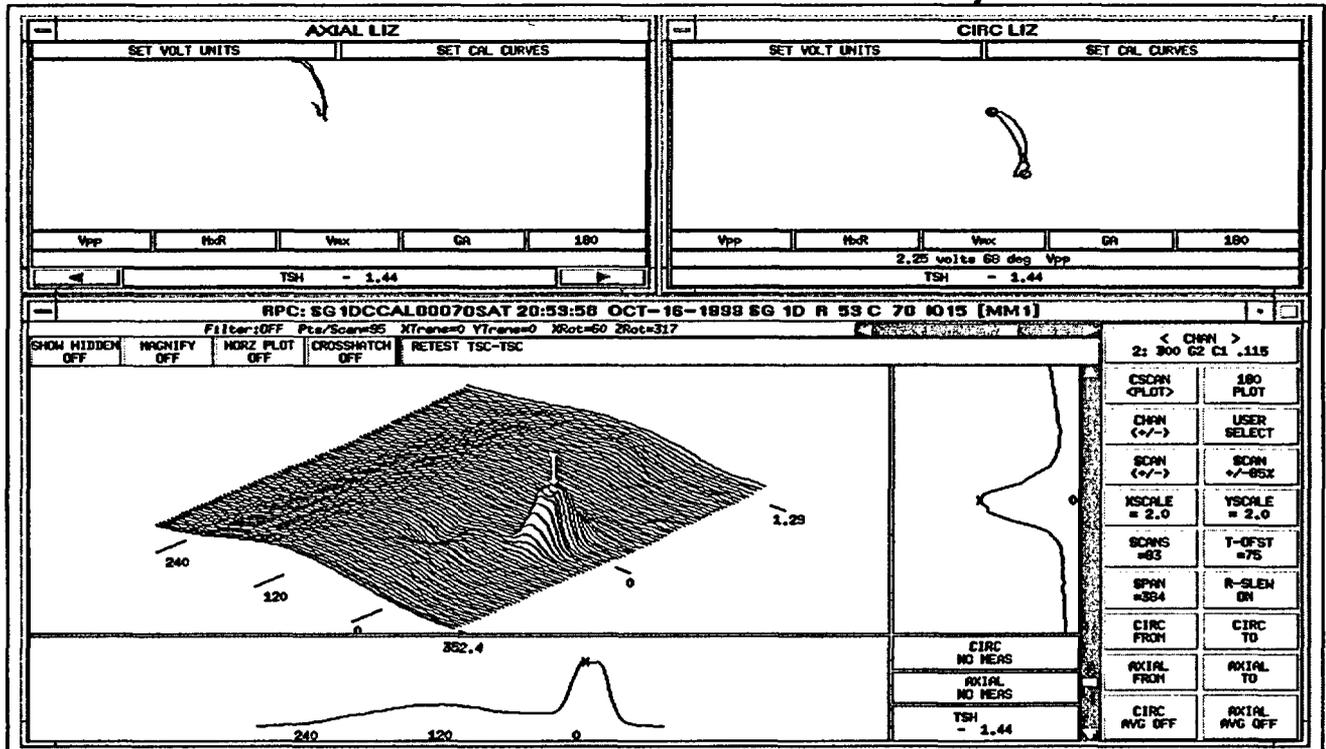


.115 Pancake coil Indication of Loose Part from Callaway.

Degradation Mechanism 18 – Loose Part Wear:

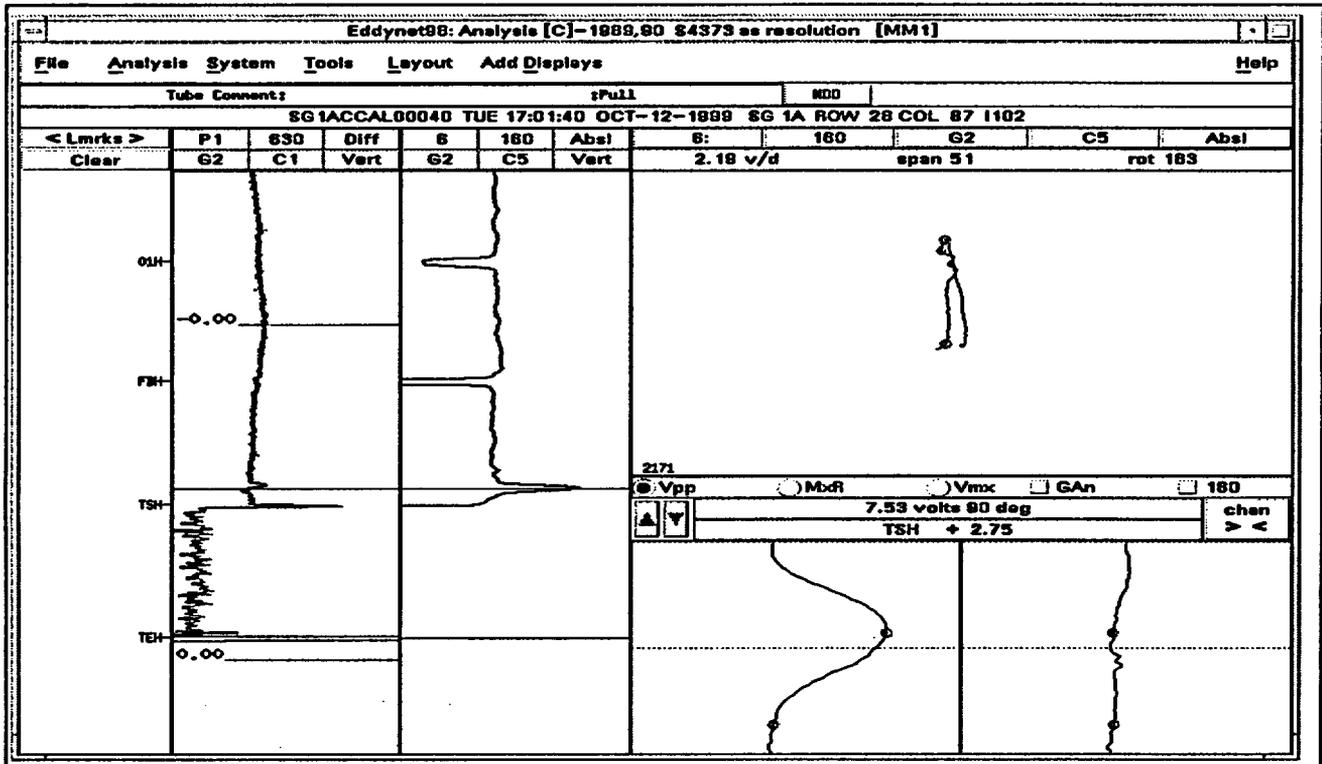


Loose Part Wear with the +Point™ coil at Callaway.

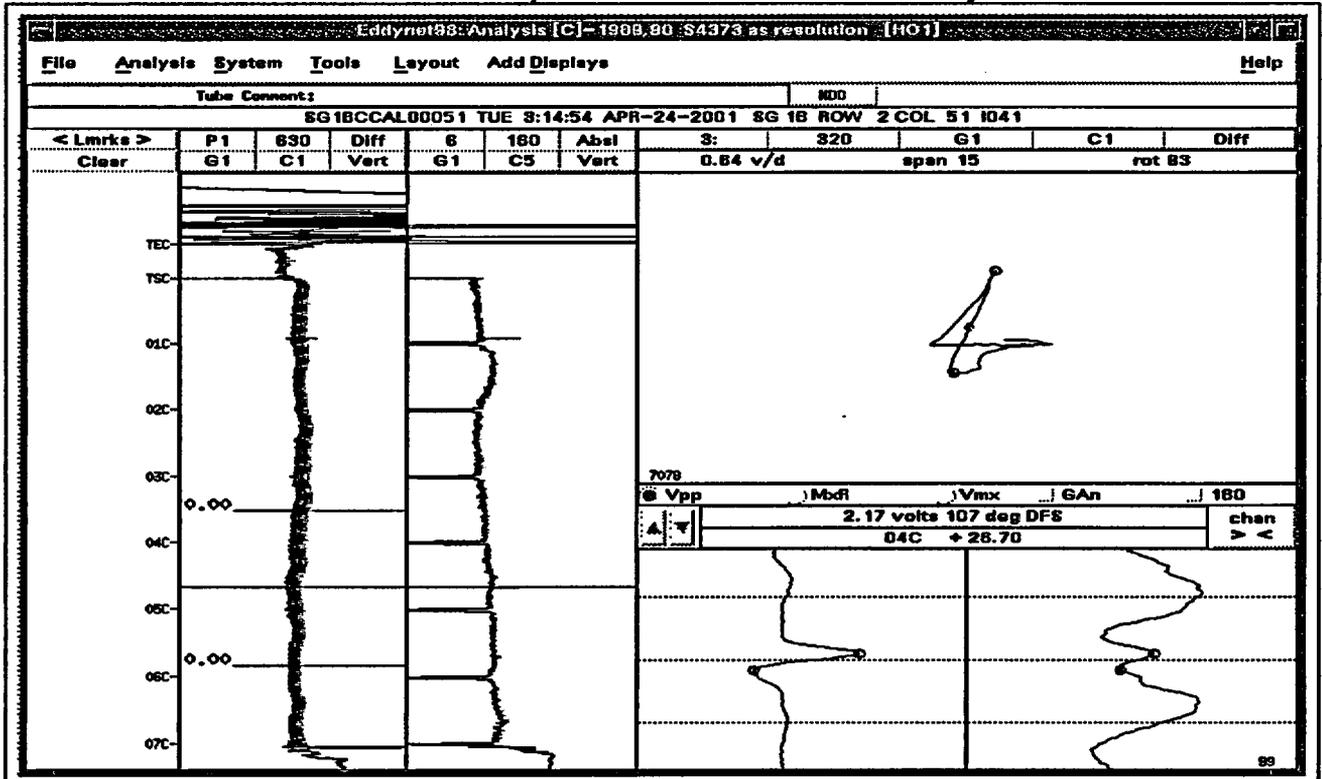


Loose Part Wear with the 0.115 Pancake coil from Callaway.

Degradation Mechanism 19- FreeSpan - ADS / DFS (MBM):

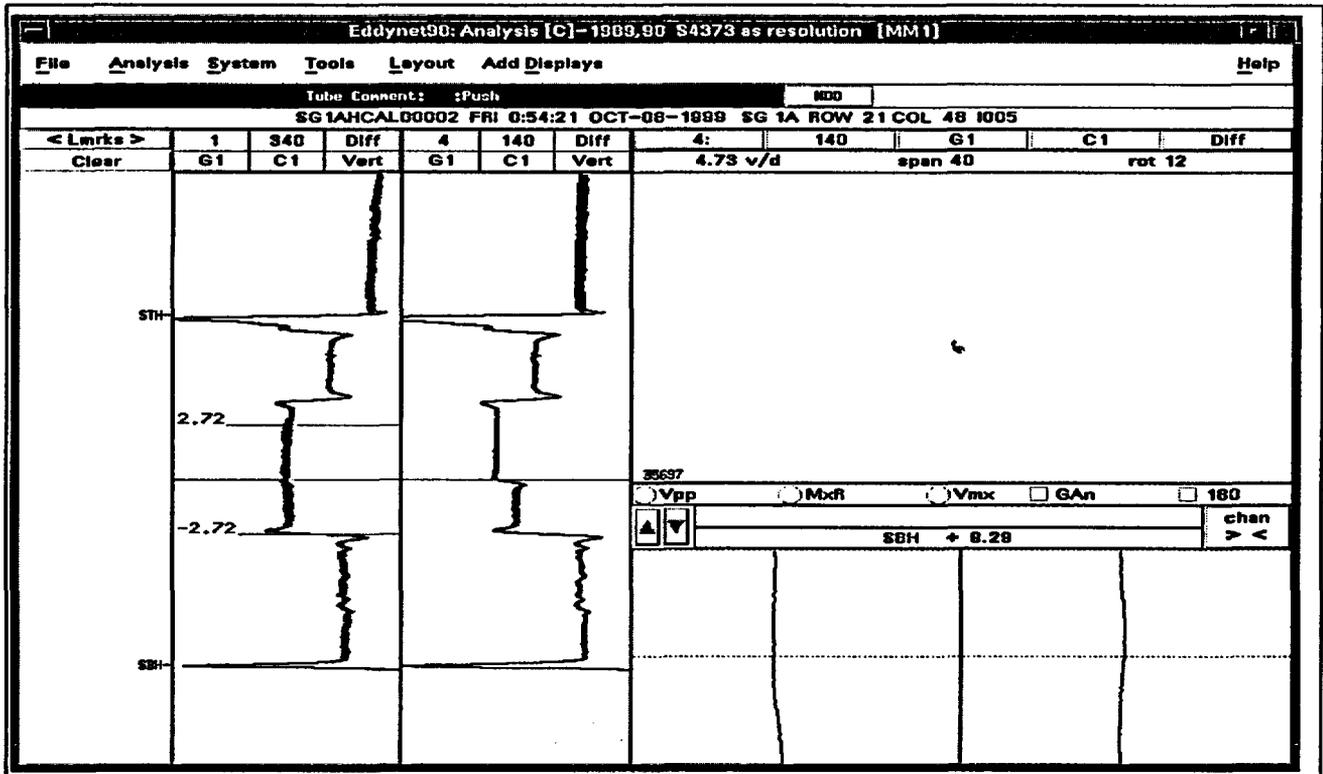


Absolute Freespan bobbin Indication from Callaway

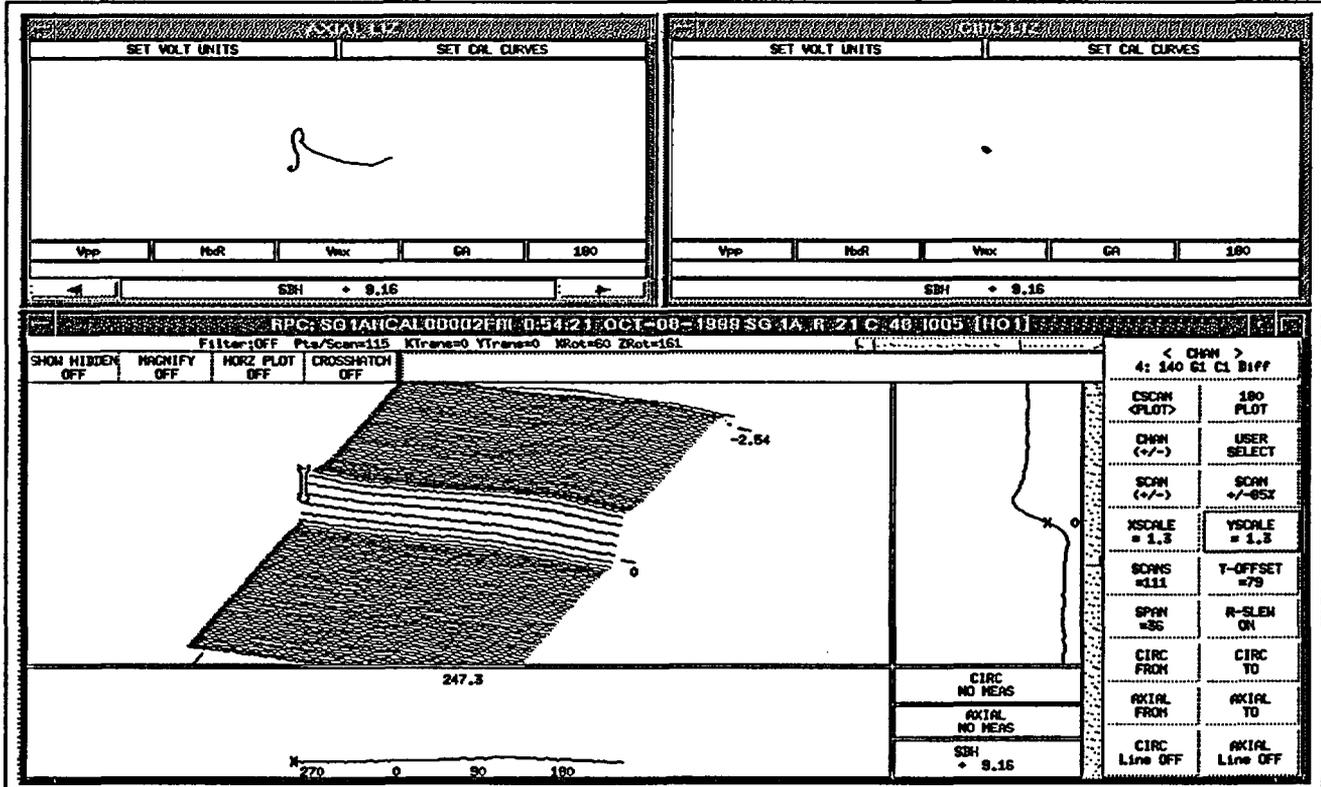


Differential Freespan Indication from Callaway.

Degradation Mechanism 18 – Parent Tube OD and ID Cracking / Laser Welded Sleeves:

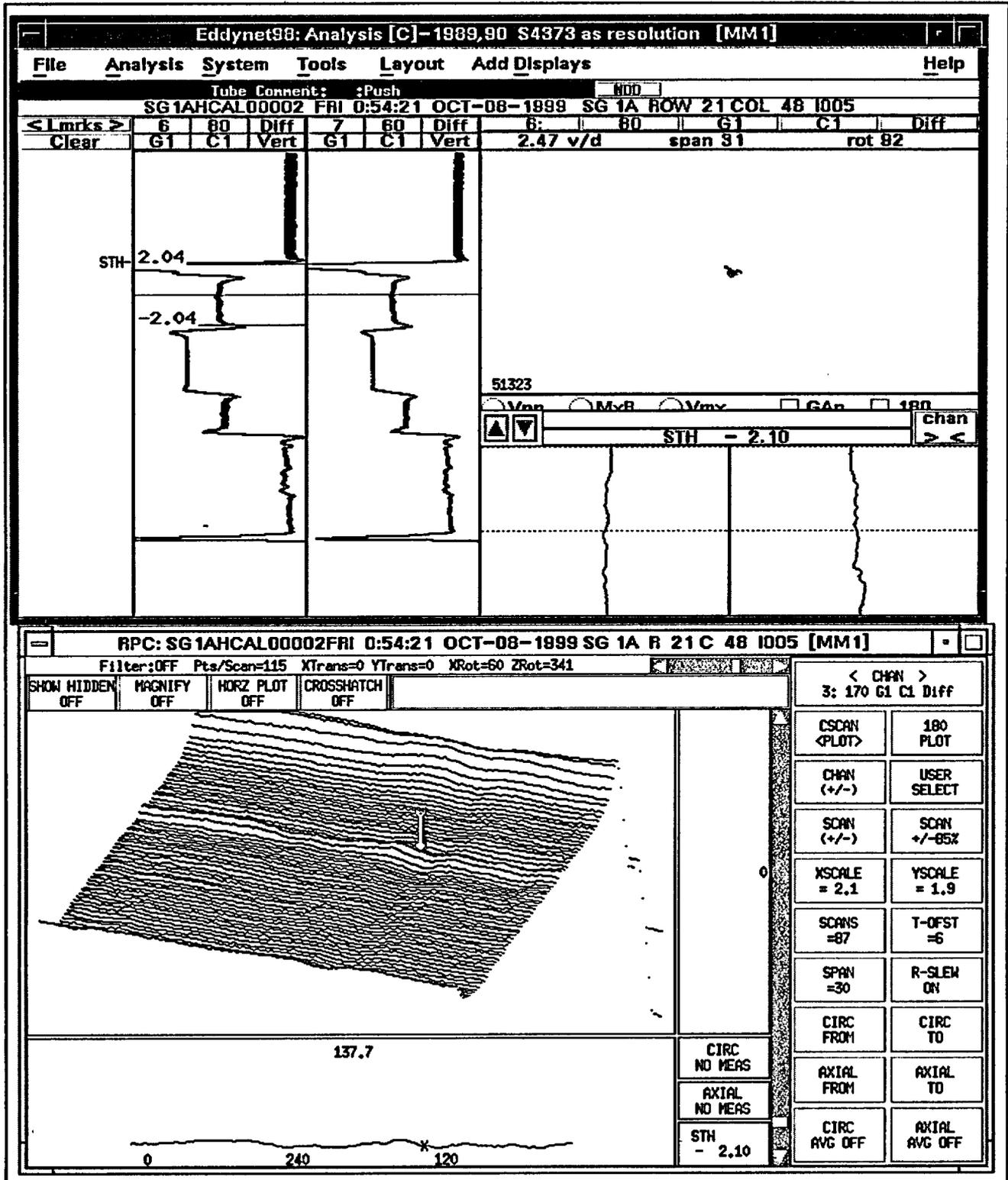


Typical Laser Welded Sleeve from Callaway.



Typical Laser Welded Sleeve from Callaway

Degradation Mechanism 21- Weld Process Indications / Laser Welded Sleeves:



Typical Laser Weld area of Installed LWS at Callaway.

S/G	Row	Col	Outage	Location relative to top TSH (In)	Indication	Max Depth (% TW)	Total PDA (%)	Flaw PDA (%)	axial length (In)	circ extent (degrees)	Method	H* zone
A	21	47	RF7	-1.05	SCI	100				108°	MRPC	C
A	19	80	RF7	-2.62	SCI	100				116°	MRPC	C
A	21	43	RF8	-1.3	MCI					239°	MRPC	C
A	21	43	RF8	-2.54	MCI					149°	MRPC	C
A	56	47	RF8	-1.52	SVI				0.35		MRPC	A
A	21	48	RF8	-2	SCI					59°	MRPC	C
A	46	53	RF8	-0.33	SCI					40°	MRPC	B
A	21	54	RF8	-0.35	SCI					40°	MRPC	C
A	17	57	RF8	-0.66	SCI					45°	MRPC	C
A	19	63	RF8	-2.5	MCI					50°	MRPC	C
A	19	70	RF8	-2.96	SVI				0.9		MRPC	C
A	15	72	RF8	-2.12	SCI					45°	MRPC	C
A	19	72	RF8	-2.68	MCI					71°	MRPC	C
A	22	82	RF8	-3.75	SCI					48°	MRPC	B
A	38	87	RF8	-1.86	MCI					113°	MRPC	B
A	31	93	RF8	-2.46	MCI					56°	MRPC	B
B	21	38	RF8	-3.42	MCI					65°	MRPC	B
C	14	71	RF8	-3.52	SCI					48°	MRPC	C
C	35	77	RF8	-3.96	MCI					48°	MRPC	B
C	30	91	RF8	-3.78	MCI					93°	MRPC	B
D	22	55	RF8	-3.1	SVI				0.22		MRPC	C
D	32	94	RF8	-2.81	SCI					37°	MRPC	B
D	24	116	RF8	-0.33	SCI					39°	MRPC	A
A	21	37	RF9	-4.92	SCI		6.4			25°	MRPC	B
A	27	38	RF9	-1.11	SCI		6.6			28.8°	MRPC	B
A	21	42	RF9	-0.42	SCI		3.4			19.4°	MRPC	C
C	16	76	RF9	-2.51	SCI		6.4			27°	MRPC	C
D	28	45	RF9	-4.76	SCI		5			27°	MRPC	B
D	24	59	RF9	-3.64	SCI		17.6			64.7°	MRPC	C
D	13	102	RF9	-4.2	SCI		4.6			31.9°	MRPC	B
A	17	32	RF10	-1.11	SCI	94	2.76	29.66		33°	MRPC	B
A	47	61	RF10	-0.81	SAI	59		40.44	0.25		MRPC	B
A	33	64	RF10	-0.34	SCI	54	2.22	31.91		25°	MRPC	B
A	31	97	RF10	-4.33	SCI						MRPC	B
A	31	97	RF10	-4.62	SCI	68	11.37	37.92		108°	MRPC	B
C	34	45	RF10	-4.55	MCI	98	20.93	73.13		102°	MRPC	B
C	34	45	RF10	-5.74	SCI	96	5.84	57.8		36°	MRPC	B
D	36	62	RF10	-0.45	MCI	90	8.29	53.56		54°	MRPC	B
A	26	47	RF11	-3.32	SCI	98	17.01	50.58		121°	MRPC	B
A	39	86	RF11	-3.21	SCI	97	10.58	67.07		56°	MRPC	B

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A	18	42	RF12	-6.02	MCI	100	15.7			77.1°	MRPC	C
A	18	44	RF12	-0.96	SCI	70	3.2			25.7°	MRPC	C
A	19	69	RF12	-5.45	SCI	99	8.1			36°	MRPC	C
A	21	45	RF12	-2.3	SCI	91	3.6			21.5°	MRPC	C
A	23	43	RF12	-0.33	SCI	92	5.2			30°	MRPC	C
A	23	78	RF12	-7.88	SCI	100	6.5			32°	MRPC	C
A	23	97	RF12	-8.4	SCI	99	9.1			42.4°	MRPC	B
A	24	88	RF12	-5.6	SCI	99	15.9			63.5°	MRPC	B
A	25	71	RF12	-7.72	MCI	100	29.3			132.2°	MRPC	C
A	26	53	RF12	-2.59	SCI	98	5.2			25.7°	MRPC	C
A	32	65	RF12	-3.18	SCI	62	2.98			25.4°	MRPC	B
A	34	73	RF12	-3.53	SCI	73	3.5			25.1°	MRPC	B
A	34	80	RF12	-4.76	SCI	100	11.7			55.8°	MRPC	B
A	39	88	RF12	-1.98	SCI	99	6.5			29.7°	MRPC	B
A	42	62	RF12	-0.62	SCI	62	3.2			25.7°	MRPC	B
A	44	62	RF12	-0.67	SCI	38	1.3			21.4°	MRPC	B
A	46	61	RF12	-0.75	MAI	98			0.2		MRPC	B
A	46	61	RF12	-0.74	SCI	100	8.5			38.2°	MRPC	B
A	48	61	RF12	-0.98	SCI	67	1.3			25.8°	MRPC	B
B	29	90	RF12	-1.93	SCI	94	5			39.1°	MRPC	B
B	33	77	RF12	-5.41	SCI	100	12.1			61.8°	MRPC	B
C	11	68	RF12	-5.22	SCI	99	7.6			32.7°	MRPC	C
C	13	68	RF12	-5.36	SCI	98	18.8			74.8°	MRPC	C
C	14	72	RF12	-7.33	SCI	78	3			22.8°	MRPC	C
C	15	28	RF12	-6.45	MCI	99	4.6			22.7°	MRPC	B
C	17	77	RF12	-3.51	SCI	85	10.5			52.3°	MRPC	C
C	17	77	RF12	-2.69	SCI	99	6.6			33.8°	MRPC	C
C	18	77	RF12	-9.86	SCI	98	96.4			360°	MRPC	C
C	18	77	RF12	-7.09	SCI	96	29.8			124.4°	MRPC	C
C	18	77	RF12	-6.51	MCI	100	37.5			155.6°	MRPC	C
C	21	65	RF12	-10.58	SCI	100	26.5			107.5°	MRPC	C
C	21	101	RF12	-4.25	MCI	100	31			122.9°	MRPC	B
C	22	101	RF12	-7.04	MCI	100	34.9			145.6°	MRPC	B
C	29	69	RF12	-5.68	SCI	98	36.6			143.1°	MRPC	B
C	30	93	RF12	-6.91	SCI	99	5.2			27.1°	MRPC	B
C	30	93	RF12	-4.07	SCI	96	7.8			34.9°	MRPC	B
C	36	46	RF12	-5.1	MCI	99	10.6			45.4°	MRPC	B
D	29	82	RF12	-7.23	SCI	100	7.84			36.9°	MRPC	B
D	42	57	RF12	-5.63	MCI	98	55.3			223.6°	MRPC	B

No data was available in blank spaces

Attachment 9
ULNRC-04861
Callaway Plant

Low Flowmeter Calibration Data

Verification Date: 12/02/02

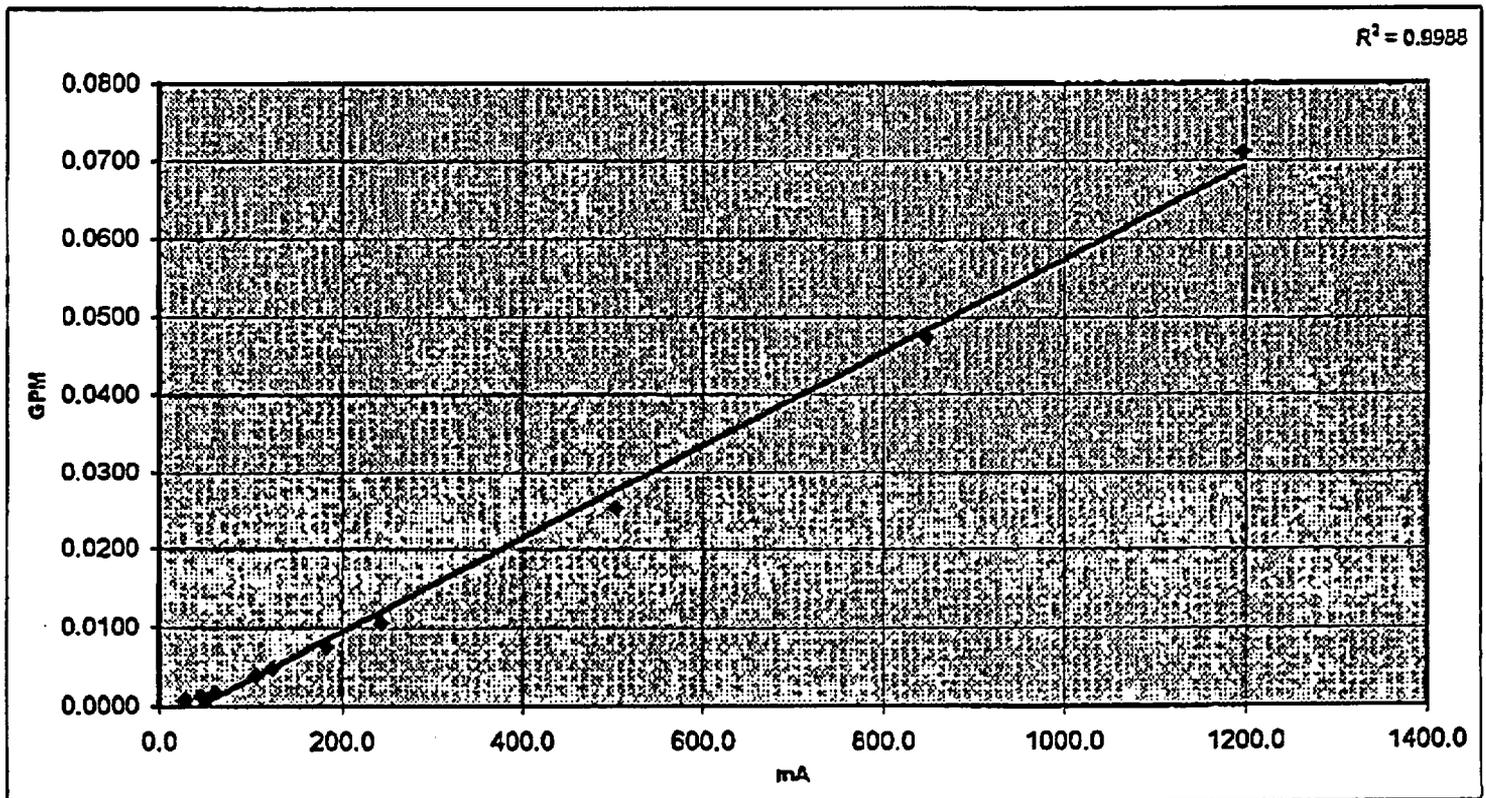
Verified By: B. C. Mahne *[Signature]*

DAS VH No: 7645

Yes As Found Readings
Yes As Left Readings

Beaker	Target Hz	Time (sec)	ml	Hz	GPM	cc/min
10	30 +/-5	60.56	2.0	28.5	0.0007	2.774
10	45 +/-5	60.26	4.5	46.0	0.0012	4.481
10	60 +/-5	60.01	6.5	61.5	0.0017	6.467
50	105 +/-5	59.91	14.6	106.0	0.0038	14.522
50	120 +/-5	59.56	18.0	124.0	0.0048	18.133
100	180 +/-10	59.40	28.0	184.0	0.0075	28.283
100	240 +/-10	60.03	40.0	242.5	0.0106	39.980
250	500 +/-10	60.18	95.0	503.0	0.0253	95.745
250	850 +/-10	60.31	180.0	848.0	0.0473	179.075
1000	1200 +/-10	60.22	270.0	1196.0	0.0711	269.014

Point	Hz	GPM
1	0.0	0.0000
2	28.5	0.0007
3	46.0	0.0012
4	61.5	0.0017
5	106.0	0.0038
6	124.0	0.0048
7	184.0	0.0075
8	242.5	0.0106
9	503.0	0.0253
10	848.0	0.0473
11	1196.0	0.0711



Beaker	Target GPM	ml	Time (sec)	Output Flowrate (GPM)	Calculated Flowrate (GPM)	Difference +/-10%
10	0.002 +/-0.001	7.0	60.53	0.0019	0.0018	-3.65%
250	0.035 +/-0.001	140.0	60.30	0.0352	0.0356	+1.35%
1000	0.07 +/-0.01	275.0	59.87	0.0715	0.0728	+1.79%