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AUTH.NAME AUTHOR AFFILIATION
STALL,J.A. Florida Power & Light Co.
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SUBJECT: Forwards response to request for addl info re review of SG tube insp & repair criteria for Unit 1.

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CATEGORY 1 DOCUMENT

Florida Power & Light Company, P.O. Box 128, Fort Pierce, FL 34954-0128

June 25, 1996

L-96-166
10 CFR 50.4

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

RE: St. Lucie Unit 1
Docket No. 50-335
Steam Generator Tube Inspection
Request for Additional Information (RAI) Response

As a result of a meeting with Florida and Light Company (FPL) on April 22, 1996, the NRC has been reviewing the steam generator inspection and repair criteria for St. Lucie Unit 1. In order to complete their review, the NRC identified the need for additional information. The specific information needed was identified in the enclosure to your letter dated May 24, 1996.

In a conference call on June 5, 1996, the NRC staff extended the response date for the RAI to June 25, 1996. The extension of the response date was based on the expanded scope of inspection of the St. Lucie Unit 1 steam generators being performed by FPL.

The responses to questions and the supporting information are enclosed. Please contact us if there are additional questions.

Very truly yours,

J. Scarola for

J. A. Stall
Vice President
St. Lucie Plant

JAS/GRM

cc: Stewart D. Ebneter, Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, St. Lucie Plant

A001.1/1

Request for Additional Information Responses

NRC Request 1

The repair criteria to be used to disposition eddy current indications (e.g., indications at the expansion transitions, drilled hole tube support plate intersections, and in the free span)

FPL Response

Eddy current indications of tube degradation at tube expansion transitions and drilled support plate intersections will be removed from service based on detection by motorized rotating pancake coil (MRPC) inspections. Circumferentially oriented degradation will be stabilized.

Eddy current indications of tube degradation in free span regions which are crack-like will be removed from service based on detection by MRPC inspection. Free span indications which are not crack-like by MRPC inspection may remain in service provided the indication was present on pre-service baseline inspection data and the through-wall bobbin coil depth is less than 40%.

NRC Request 2

The qualification data supporting the sizing capability of indications in the sludge pile and the eggcrate supports (e.g., eddy current determined depth and length, destructive examination length, destructive examination average and maximum depth).

FPL Response

Qualification data supporting the sizing capability of indications in the sludge pile and eggcrate supports is provided as Enclosure 2 of this letter. The qualification effort includes all available destructive examination results for tubes pulled from sludge pile and eggcrate regions in Combustion Engineering (CE) design steam generators. The results for this qualification exceed the Electric Power

Research Institute (EPRI) requirements, *PWR Steam Generator Examination Guidelines, Appendix H,* for threshold and probability of detection and sizing accuracy. Applicable correspondence, eddy current determined depth and length, destructive examination length, and destructive examination average depth and maximum depth are included. Eddy current bobbin coil graphics for tube flaws used for the qualification are also included in Enclosure 2.

NRC Request 3

The 95/95 confidence level values for growth, NDE uncertainty, material properties, and limiting flaw sizes. For the limiting flaw sizes, the following should be submitted: (1) the limiting depth given an infinitely long indication, (2) the limiting length given a through-wall indication, and (3) the correlation relating depth and/or length to the structural integrity of the tube.

FPL Response

Burst pressure calculations are based on the Framatome equation using average crack depth. Attachment A Figure 1, *Predicted Burst Pressure Versus Normalized Observed Burst Pressure - PVNGS Unit 2 Pulled Tube Data,* shows pulled tube data from Palo Verde Nuclear Generating Station (PVNGS) Unit 2 supporting the use of the Framatome equation. Attachment A Figure 2, *RPC Crack Length Versus Structurally significant Crack Length - PVNGS Unit 2 Pulled Tube Data,* shows that crack length based on pancake coil eddy current data is a conservative estimate of the structurally significant crack length and Attachment A Figure 3, *Maximum Crack depth Versus Average Crack Depth - PVNGS Unit 2 Pulled tube Data,* illustrates that the structurally significant portion of the crack profile has a characteristic ratio of maximum depth to average depth. Attachment A Figure 2 and Attachment A Figure 3 are also based on pulled tube data from PVNGS Unit 2 where the operative degradation mechanism is upper bundle, axial outside diameter stress corrosion cracking/intergranular attack (ODSCC/IGA).

Until plant specific data is obtained, the lower 95 percent tolerance limit for the sum of the yield plus ultimate strength at temperature is taken as 124.4 ksi. Attachment A

Figure 4, *Distribution of Sum of Yield and Ultimate Strengths of alloy 600 Tubing at Operating Temperature - ANO Unit 2,* is a histogram of these sums for Arkansas Nuclear One (ANO) Unit 2 which provides a good correspondence to St. Lucie Unit 1. Attachment A Figure 5, *Tube Flow Strength Distribution for Unit 2 Analysis,* and Attachment A Figure 6, *Palo Verde Unit 3 Tube Strength Distribution Function,* illustrate that other Combustion Engineering (CE) designed units have very similar lower tolerance limit mechanical properties. In fact the chosen lower tolerance limit value would be a reasonable choice for all Westinghouse, CE, and Babcock and Wilcox (B&W) steam generators.

Attachment A Figure 7, *Preliminary Deterministic Analysis for St. Lucie Unit 1 - Axial Corrosion Degradation,* is a plot of maximum crack depth versus runtime. Regulatory Guide 1.121 structural limits on maximum crack depth for St. Lucie are shown for different crack lengths using lower tolerance limits mechanical properties. Projected depth versus time is illustrated for both an average and a 95 percent upper bound growth rate, as determined from St. Lucie Unit 1 bobbin probe eddy current data. Finally, the through wall crack lengths meeting 3 times differential pressure and steam line break differential pressures are listed in a note on Attachment A Figure 7.

The figures referred to in this response are included as Attachment A of this enclosure.

NRC Request 4

The plans for ensuring adequate operational leakage integrity (e.g., adopting industry guidance with respect to program implementation and leakage limits).

FPL Response

St. Lucie Plant off-normal operating procedure (ONOP) 1-0830030, *Steam Generator Tube Leak,* has been revised to incorporate the criteria for shutdown based on primary to secondary leak rates as established in EPRI TR-104788, *PWR Primary to Secondary Leak Guidelines,* dated May 1995.

NRC Request 5

The method for ensuring adequate leakage integrity under postulated accident conditions.

FPL Response

The method to be used to establish end of cycle (EOC) leak rate will be a probabilistic method using a Monte Carlo numerical simulation of deterministic models for crack opening area and through-wall leak rate. Statistical distributions for material strengths and through-wall crack lengths are included in the simulation. The analysis will follow a mechanistic approach whereby the beginning of cycle (BOC) flaw distributions of undetected flaws will be projected (grown in size) over the cycle to give EOC probability distribution for through-wall cracks (leakers) should a main steam line break (MSLB) occur. The deterministic leakage model for MSLB conditions is based on a two-phase fluids model that represents the flow through a crack. Non-equilibrium flashing, mass transfer between liquid and vapor phases, fluid friction due to surface roughness, and convergent/divergent flow paths are modeled. Fracture mechanics methods and industry leakage data are used to establish the crack opening area as a function of MSLB pressure and crack length. The NRC Generic Letter 95-05 will be used as guidance in establishing the EOC leakage acceptance criteria.

NRC Request 6

The distribution of indications detected (length and depth, as appropriate), the distribution of growth rates (length and depth, as appropriate), the distribution of NDE uncertainty (length and depth, as appropriate).

FPL Response

The distribution of defects for St. Lucie Unit 1 is given in Attachment B Figure 1, *PSL-1 Distribution of Indication Maximum Depths*. The data is from bobbin coil inspection during the current refueling outage (SL1-14) and consists of more than 17000 data points from both steam generators. The upper 95 percent probability/confidence value for this data is less than 40 percent through wall.

The distribution of defect growth rates for the St. Lucie Unit 1 bobbin data is given in Attachment B Figure 2, *PSL-1 Distribution of Indication Growth Rates*. The upper 95 percent probability/confidence value for this data is less than 32 percent through wall/EFPY.

The defect length distribution for the more limited size rotating pancake coil (RPC) data set is given in Attachment B Figure 3, *Comparison of PSL1 Crack Lengths with Palo Verde Unit 2 Crack Lengths*, and compared with the length distribution (RPC) obtained for PVNGS Unit 2. The distributions for the two plants are comparable.

The figures referenced in this response are provided in Attachment B of this enclosure.

NRC Request 7

A commitment to perform a mid-cycle inspection within six months of startup from the current refueling outage, pending staff review of your mid-cycle inspection criteria and your probabilistic tube integrity assessment.

FPL Response

While FPL maintains the highest level of confidence in our steam generator inspection program to predict steam generator tube integrity, we are clearly focused on the performance of the St. Lucie Unit 1 steam generators through their last cycle of operation. We believe we have historically implemented a conservative maintenance program of the steam generator tubes and will continue this conservative approach through our last cycle of service with these steam generators.

To determine if a mid-cycle inspection is necessary, FPL will complete a runtime analysis to demonstrate compliance with NRC GL 95-05, *Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking*. The methodology used to compute probability of burst for St. Lucie Unit 1 will incorporate guidance contained in NRC GL 95-05. This will be particularly true for estimation of defect growth rates. Since St. Lucie Unit 1 does not apply a voltage-based repair criteria, the difference

between the NRC GL 95-05 model and that proposed for use in the Unit 1 evaluation are:

a. The principal variables will be defect dimensional attributes rather than NDE voltage.

b. The burst pressure will be treated deterministically with the exception of randomized material properties.

c. The probability of detection (POD) will be a function of defect depth.

d. The defect population followed in the analysis will be inferred from probabilistic initiation, growth, and function of depth.

The proposed analyses will be consistent in structure and implementation with those used for the PVNGS Units 2 and 3 evaluations.

A critical element of our decision-making process on the need for a St. Lucie Unit 1 mid-cycle steam generator inspection is the probabilistic analysis of the potential for, and risk of, steam generator tube failures. Since the probabilistic analyses to address potential for steam generator tube failures are not yet complete, FPL does not currently have the information necessary to determine the appropriateness of a mid-cycle inspection.

In light of the above, FPL is unable to commit to a mid-cycle inspection of the St. Lucie Unit 1 steam generators. FPL is scheduled to meet with the NRC on July 3, 1996, to discuss the planned development and technical analysis of the criteria discussed above.

As discussed above, FPL will have the results of the analysis and will present the results to the NRC within 90 days following the St. Lucie Unit 1 startup from the current refueling outage (SL1-14). By this meeting, FPL will have all the required information to inform the NRC staff of mid-cycle steam generator inspection plans for St. Lucie Unit 1.

Attachment A

Figures Referenced in the Response to Question 3

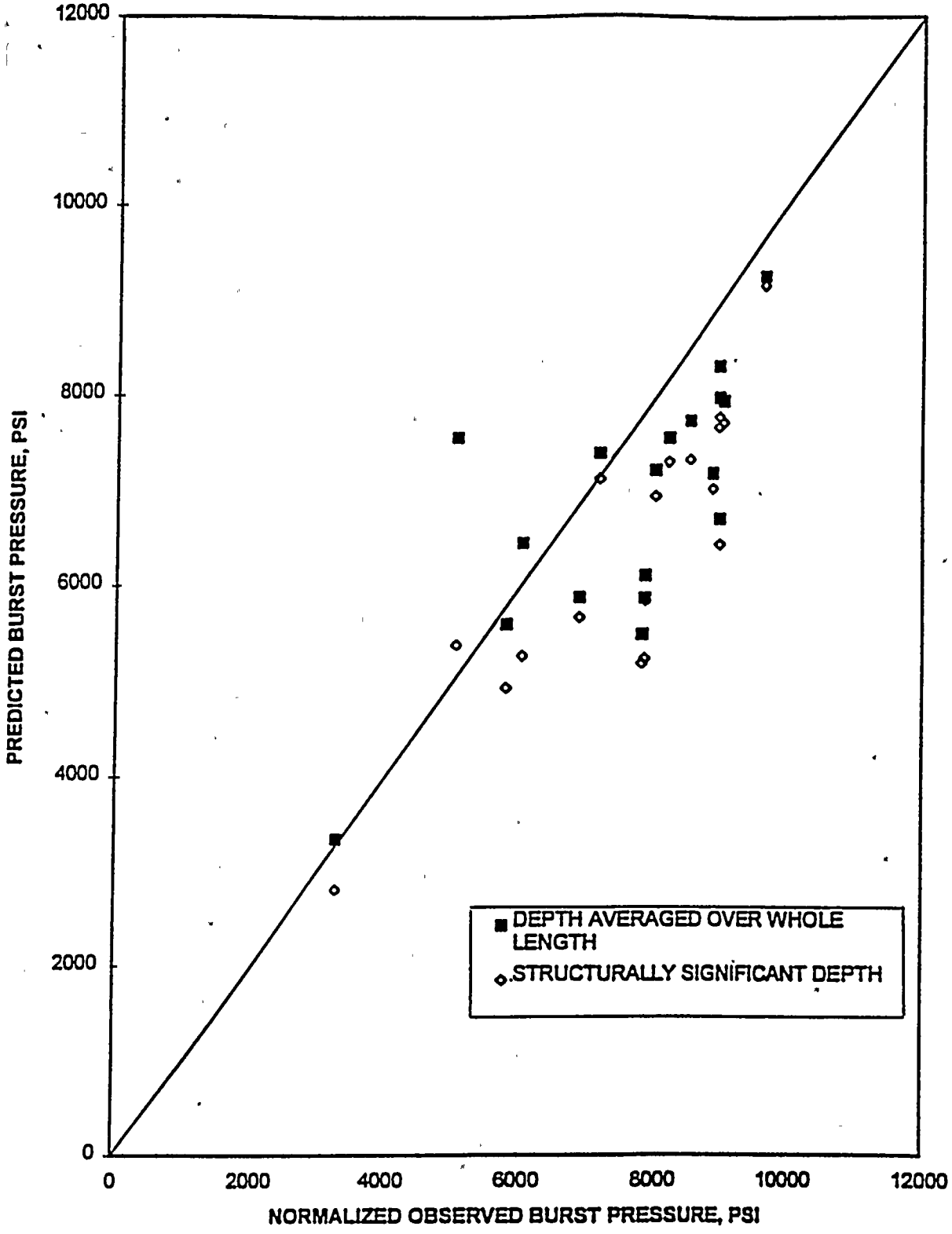


Figure 1. Predicted Burst Pressure Versus Normalized Observed Burst Pressure, PVNGS Unit 2 Pulled Tube Data.

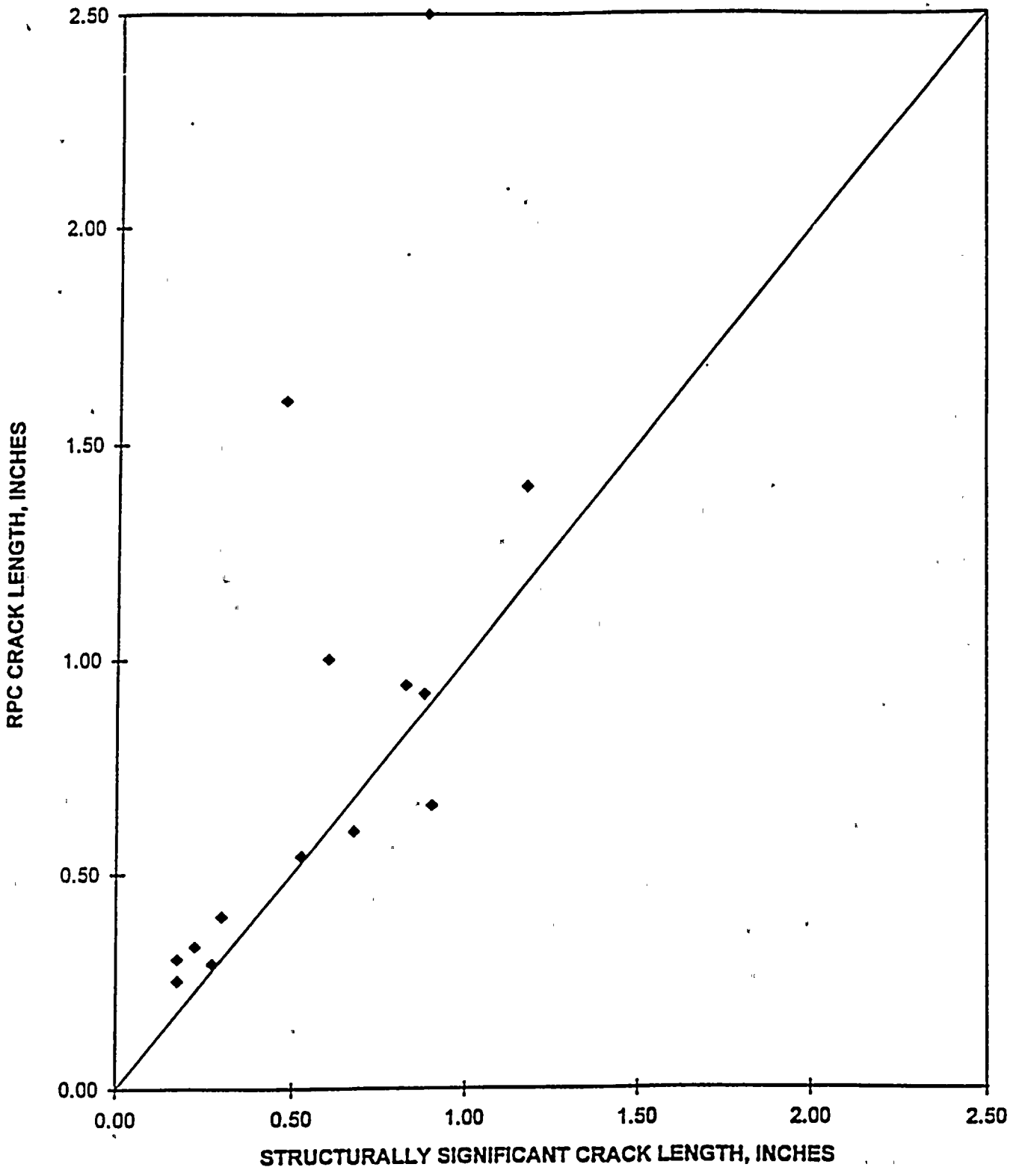


Figure 2. RPC Crack Length Versus Structurally Significant Crack Length, PVNGS Unit 2 Pulled Tube Data.

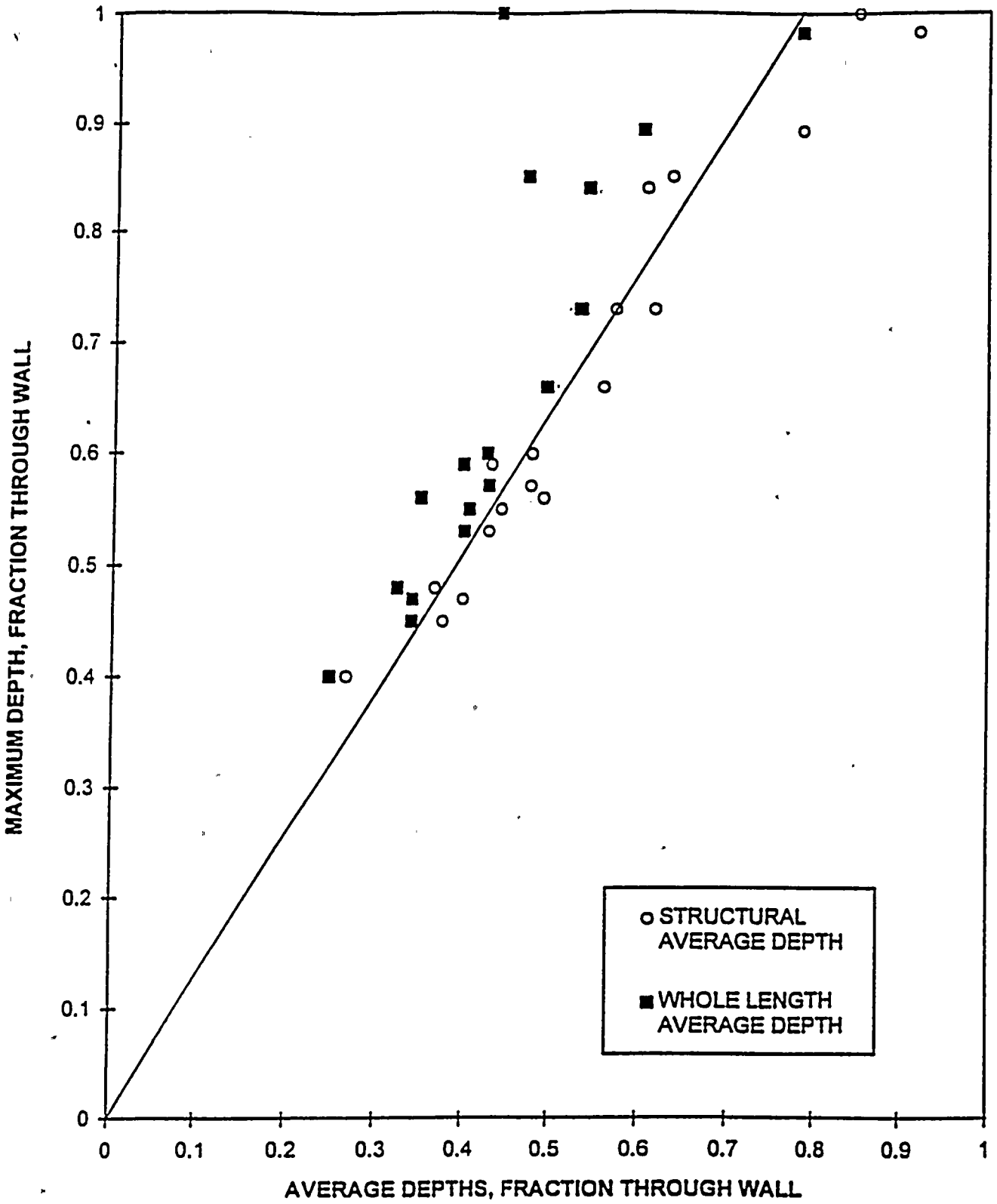


Figure 3. Maximum Crack Depth Versus
Average Crack depth, PVNGS Unit 2 Pulled Tube Data.

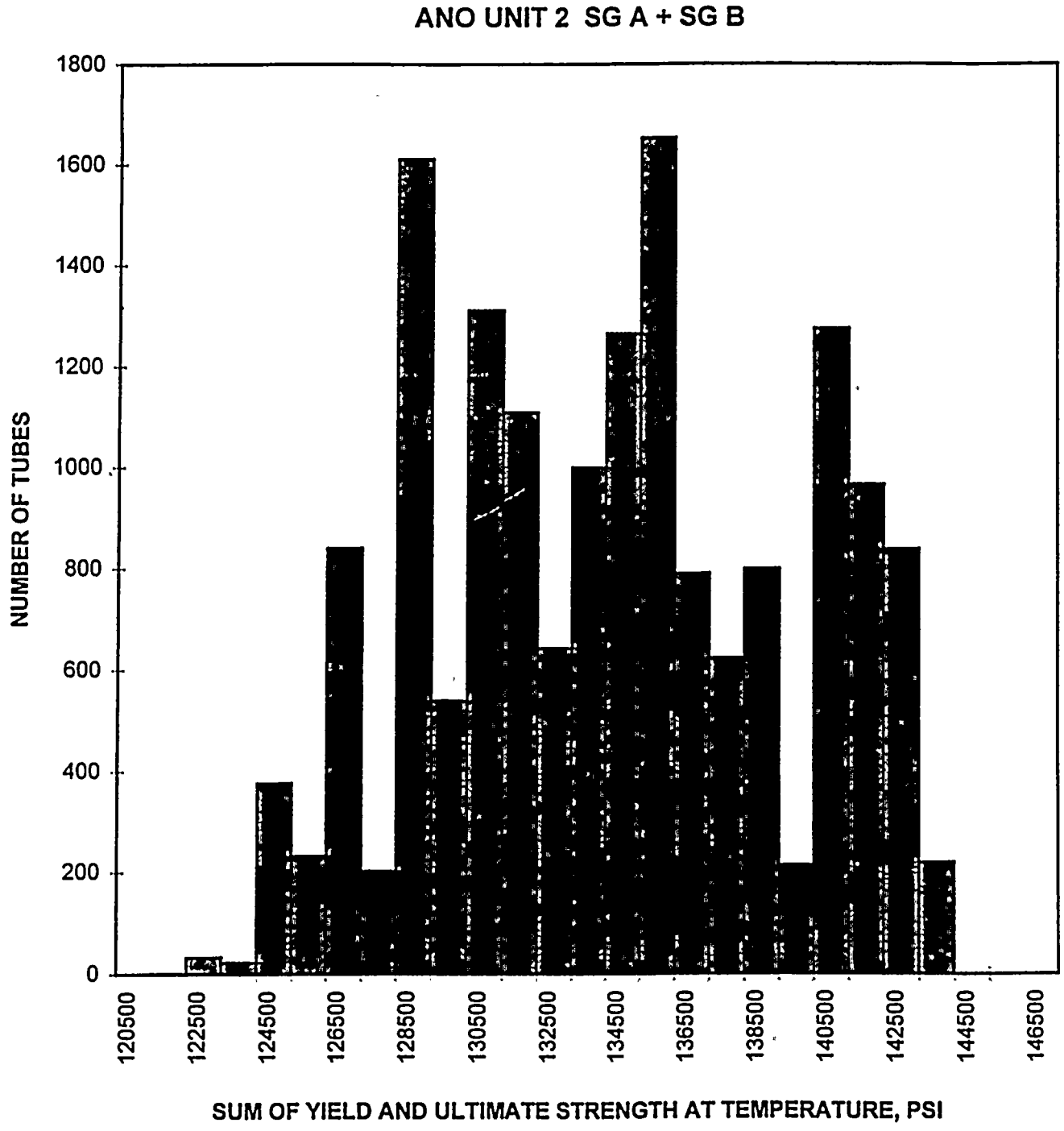


Figure 4. Distribution of sum of Yield and Ultimate Strengths of Alloy 600 tubing at Operating Temperature, ANO Unit 2.

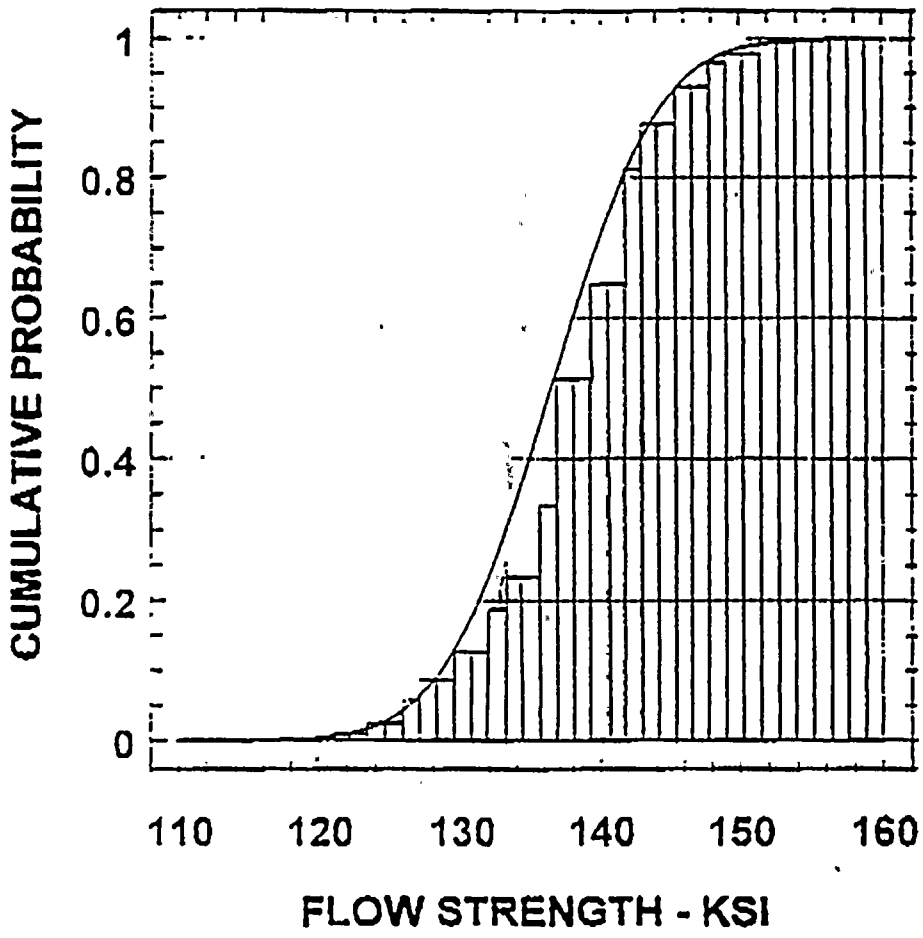


Figure 5. Tube Flow Strength Distribution for Unit 2 Analysis.

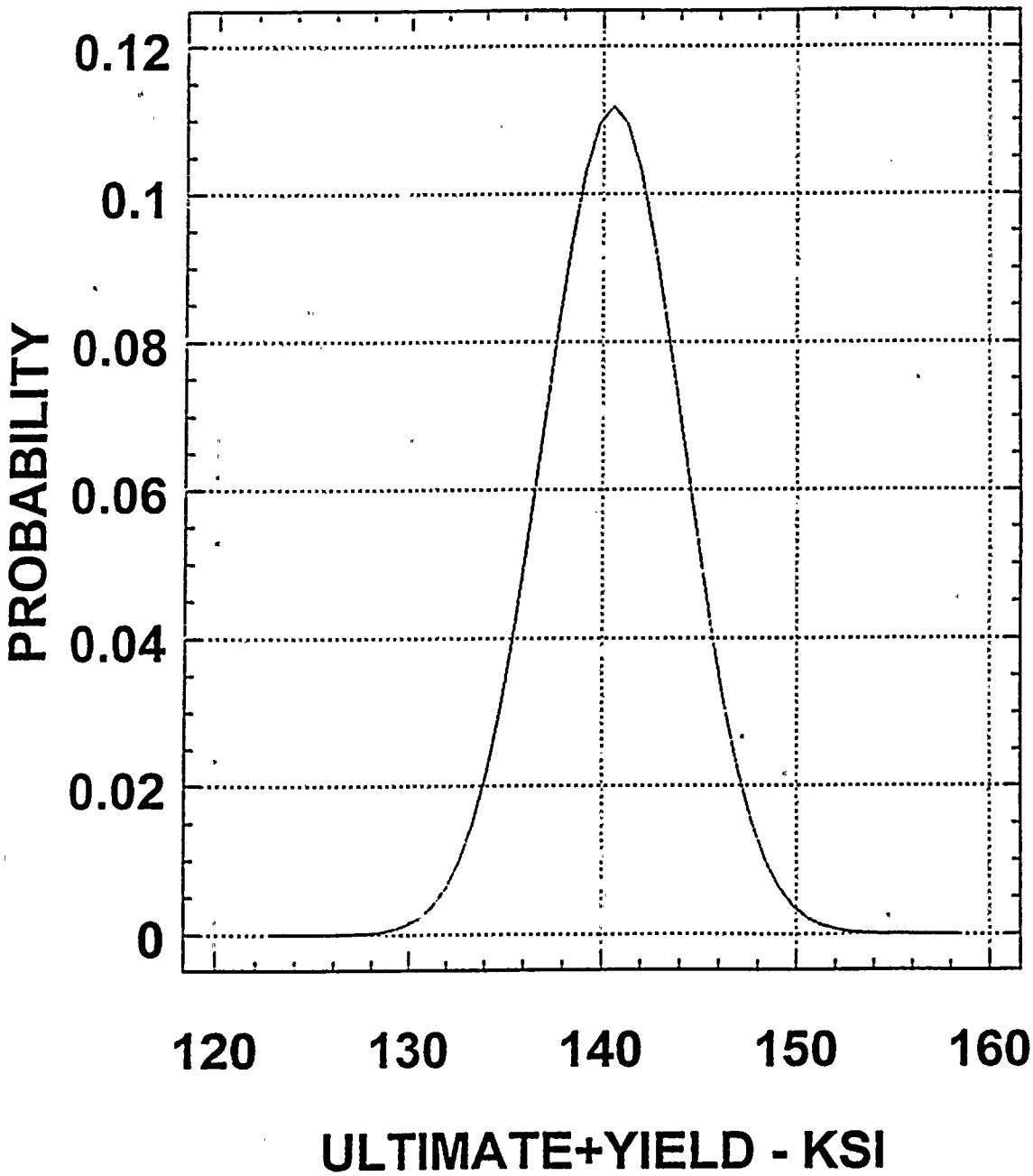


Figure 6. Palo Verde Unit 3 Tube Strength Distribution Function

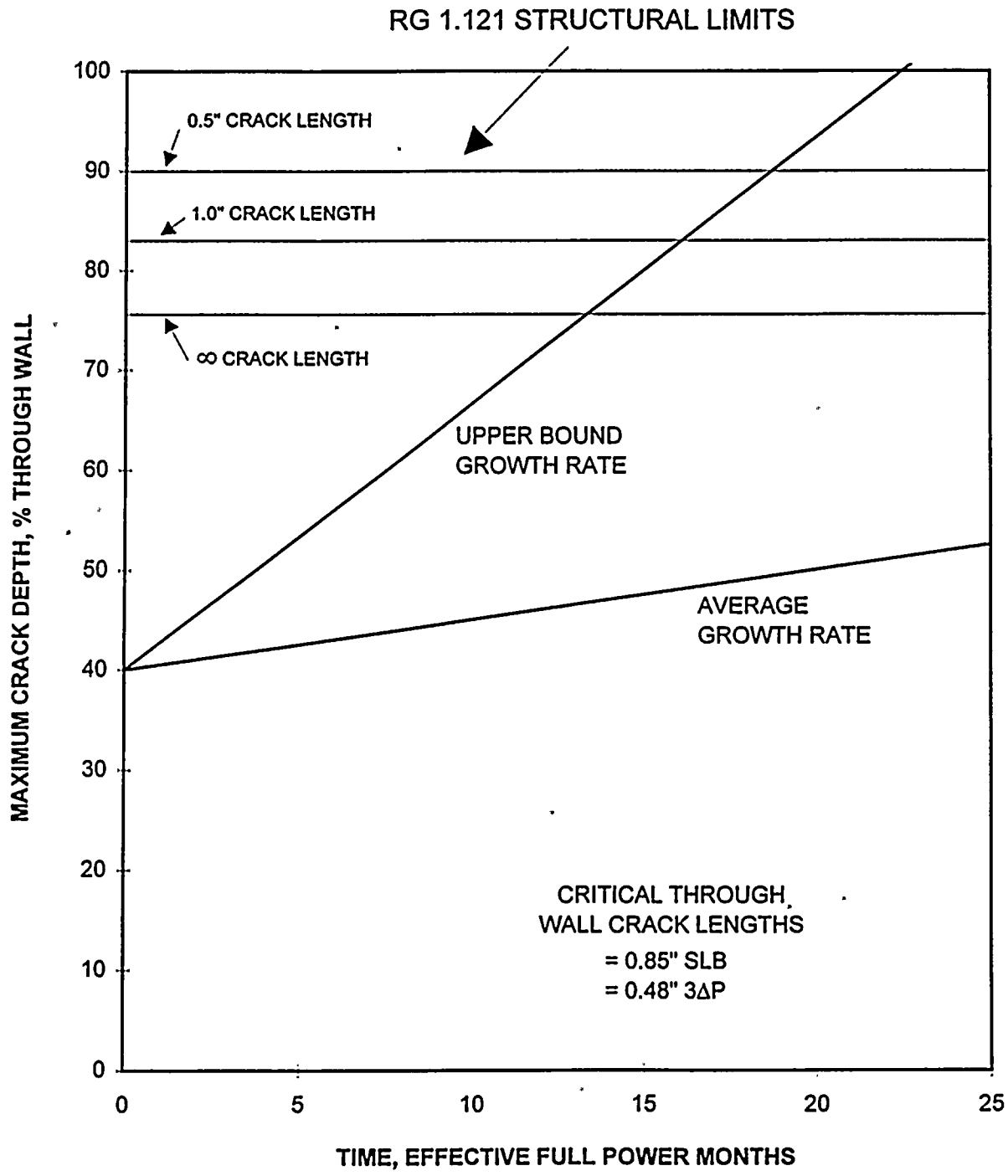


Figure 7. Preliminary Deterministic Analysis for St. Lucie Unit 1, Axial Corrosion Degradation.

Attachment B

Figures Referenced in the Response to Question 6

PSL-1 DISTRIBUTION OF INDICATION MAXIMUM-DEPTHS

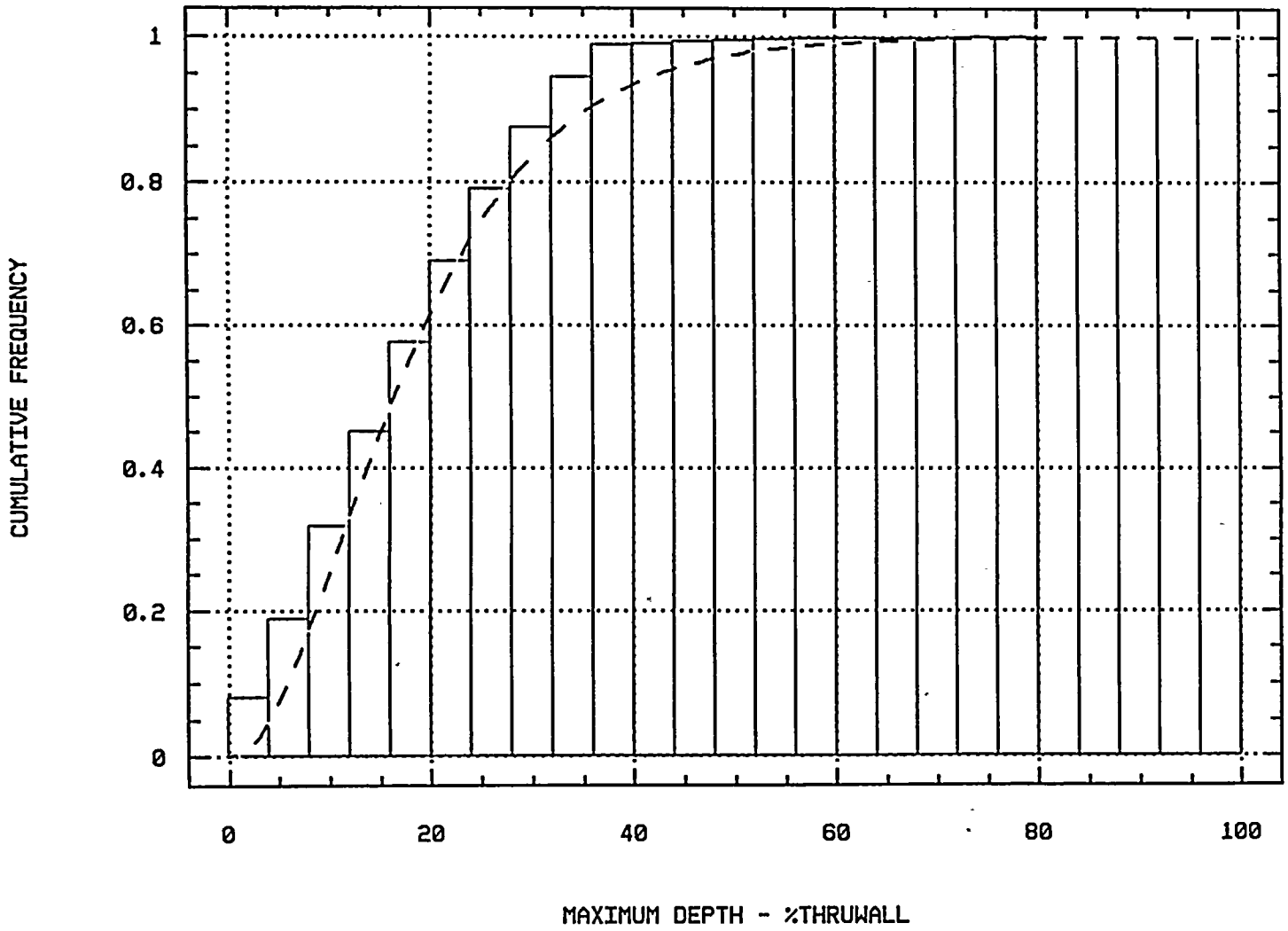


Figure 1.

BOBBIN DATA

PSL-1 DISTRIBUTION OF INDICATION
GROWTH RATES

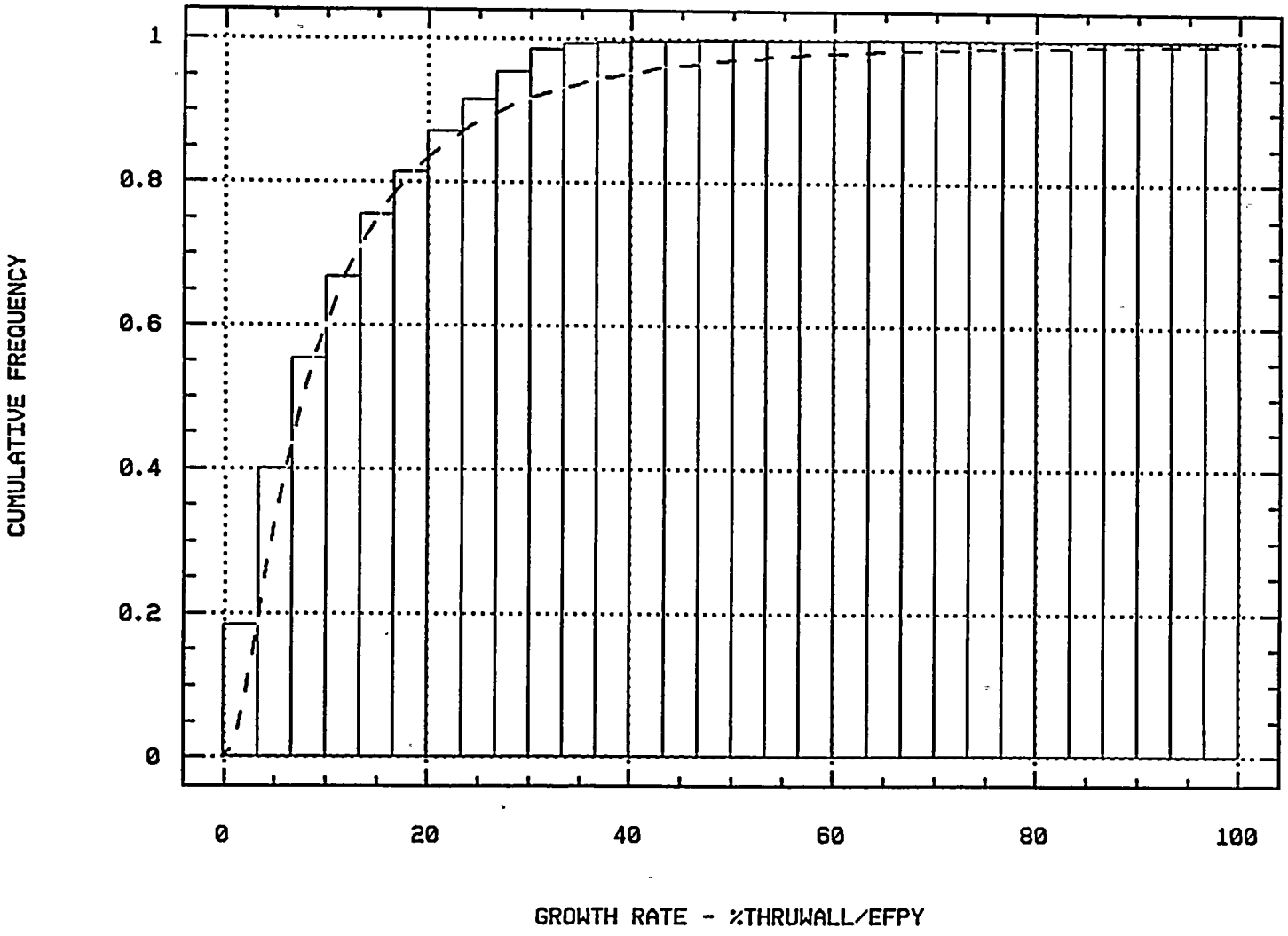


Figure 2.

BOBBIN DATA

Comparison of PSL1 Crack Lengths with

Palo Verde Unit 2 Crack Lengths

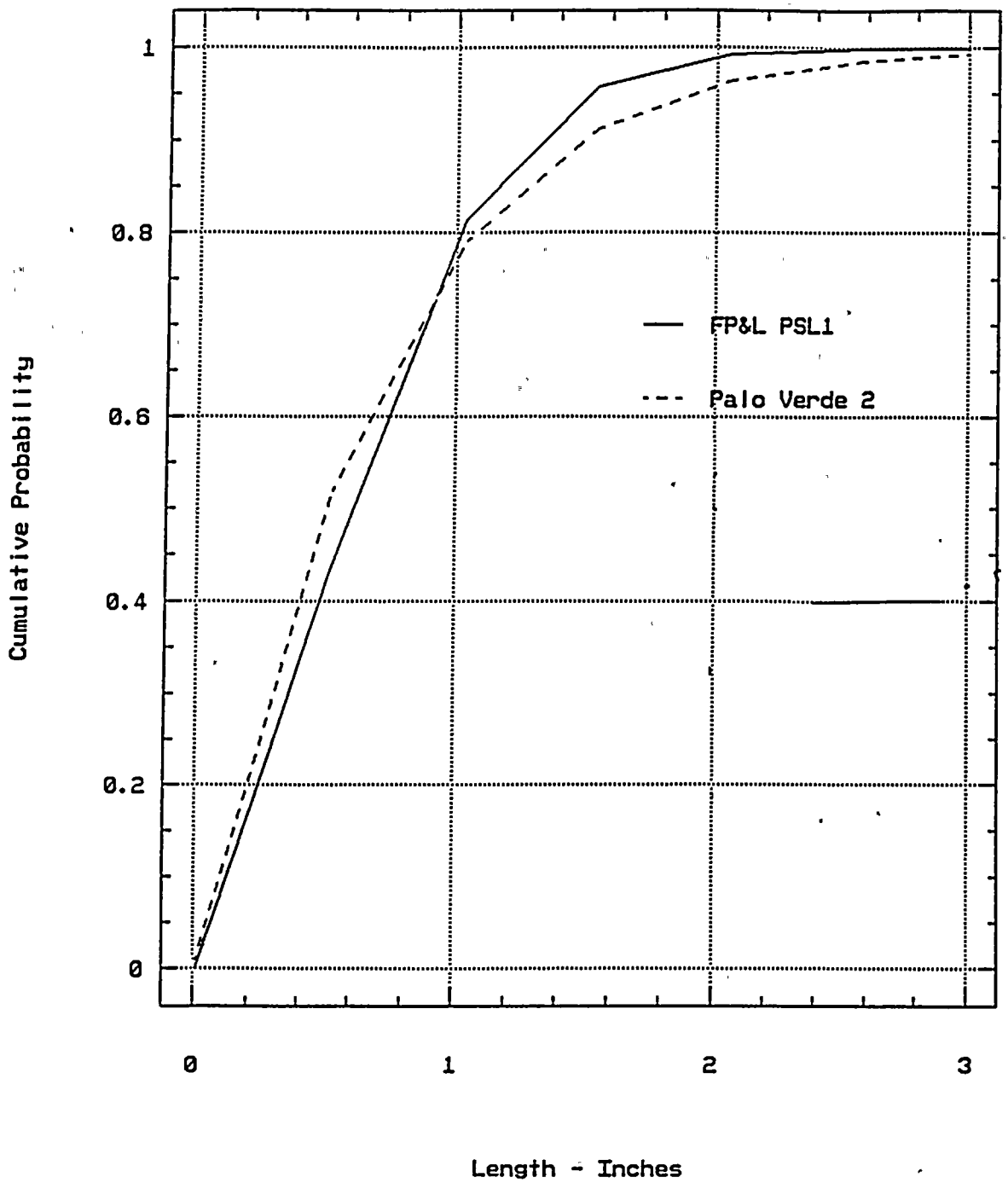


Figure 3.

ENCLOSURE 2

FPL QUALIFICATION DATA

SUPPORTING SIZING CAPABILITY

OF INDICATIONS IN THE SLUDGE PILE

AND THE EGGCRATE SUPPORTS

1. FPL letter dated March 13, 1996, Request for Peer Evaluation of Appendix H Bobbin Coil Qualification.

2. EPRI letter dated March 28, 1996, Results of Peer Review Group at EPRI NDE Center.

3. Eddy Current Bobbin Coil Graphics for Tube Flaws used for the EPRI Qualification Package.

4. Eddy Current Metallography Correlations for Tubes Pulled at St. Lucie Unit 1, Arkansas Nuclear One Unit 2, and Arizona Public Service.

St. Lucie Unit 1
Docket No. 50-335
L-95-166 Enclosure 2
Item 1

Page 1-1

Florida Power & Light Company, P.O. Box 14000, Juno Beach, FL 33408-0420

March 13, 1996

Mr. Mohamad Behravesh
Electric Power Research Institute
3412 Hillview Ave.
P. O. Box 10412
Palo Alto, CA 94303

Subject: Peer Review of Appendix H Bobbin Coil Qualification

Dear Mohamad:

Confirming our recent discussions, FPL requests an Industry Peer Review of our efforts to qualify a bobbin coil technique for detection & sizing of OD IGA/SCC indications. The attached spread sheet provides summarized results for the data set used in this qualification effort. The Qualification Data Set contains pulled tube flaws from St. Lucie Unit 1, Arkansas Unit 2 and Palo Verde Unit 2. IGA/SCC samples were also provided by the EPRI NDE Center and are included in the Qualification Data Set.

The Qualification Data Set, along with a Training and Testing Data Set, will be provided with supporting materials to Mr. Gary Henry prior to the Peer Review Meeting at the EPRI NDE Center on March 27, 1996. Due to limited time availability and the volume of work scheduled for the Peer Review meeting, we suggest that priority be given to completing peer review of the Qualification Data Set to accommodate Spring outage inspection needs. Review of the Training & Testing Data Sets for inclusion into the QDA Program could, if necessary, be deferred to a later peer review meeting.

We look forward to working with your staff on this matter. If we can provide further information, please contact me at (407) 694-4909.

Sincerely,

Gary L Boyers

Gary L. Boyers, FPL S/G Program Coordinator

Attachments: Spreadsheet and chart

cc:				
	G. P. Alexander	W. K. Heise	D. Harrison	Entergy Operations
	J. W. Connor	A. Montalbano	G. Henry	EPRI NDE Center
	K. R. Craig	JPN-CSI-96-032	R. S. Maurer	ABB/CE
	D. J. Denver		C. Smith	BG & E
	A. J. Flowers		J. Smith	RG & E
	R. F. Gross		K. Sweeney	APS

EPRI PWR STEAM GENERATOR EXAMINATION GUIDELINES, APPENDIX "H"
QUALIFICATION DATA SET - BOBBIN COIL DETECTION & SIZING OF ODSCC
IN EGGCRATE SUPPORT PLATE & FREESPAN REGIONS

(This data set emphasizes influence from an eggcrate structure at the flaw location)

SAMP ID ROW/LINE	TAPE # CAL	CRACK LENGTH	CRACK DESCRIP.	PROBE EXTENSION	FILL FACTOR	STRUC NONE/EC	VOLTS 400 Khz	MAX MET.%	400 Khz ECT %	ECT/MET DELTA	DELTA SQUARED
EPRI - J23	004a.100	0.258	Lab - 340d	Bob/w100'	0.86	None	0.52	16	24	8	64
EPRI - J23	003a.100	0.258	Lab - 340d	Bob/w100'	0.86	EC	n/a	16	0	-16	256
EPRI - J15	003a.100	0.2	Lab - 170d	Bob/w100'	0.86	EC	2.13	63	68	5	25
EPRI - J7	003a.100	0.377	Lab - 10d	Bob/w100'	0.86	EC	1.78	59	76	17	289
EPRI - J5	003a.100	0.326	Lab - 110d	Bob/w100'	0.86	EC	10.75	96	85	-11	121
EPRI - J2	003a.100	0.89	Lab - 40d	Bob/w100'	0.86	EC	20.74	100	93	-7	49
EPRI - J13	003a.100	0.376	Lab - 43d	Bob/w100'	0.86	EC	0.63	35	29	-6	36
PSL1-120/12	050A.103	0.6	IGA/TG/SCC	Bob/w100'	0.73	3H-EC	3.64	72	70	-2	4
PSL1-120/12	050A.103	0.4	IGA/TG/SCC	Bob/w100'	0.73	TSH+2.2"	1.79	30	26	-4	16
PSL1-59/95	050A.103	0.7	IGA Patch	Bob/w100'	0.73	01-EC	0.64	52	46	-6	36
PSL1-59/95	050A.103	0.4	IGA Patch	Bob/w100'	0.73	02-EC	1.09	13	3	-10	100
PSL1-79/91	050A.103	0.5	IGA Patch	Bob/w100'	0.73	TSH+1.2	0.7	16	0	-16	256
PSL1-79/91	050A.103	0.8	IGA Patch	Bob/w100'	0.73	TSH+3.9"	0.91	42	44	2	4
ANO2-19/55	34C.104	0.7	IGA/IGSCC	Bob/w100'	0.79	1H EC	0.33	52	96	44	1936
ANO2-19/55	34C.104	0.5	IGA/IGSCC	Bob/w100'	0.79	2H EC	0.59	49	28	-21	441
ANO2-96/116	34C.104	0.5	IGA/IGSCC	Bob/w100'	0.79	2H EC	0.73	59	44	-15	225
APS2-127/140	SG22H.014	0.58	IGA/IGSCC	Bob/w100'	0.84	7H EC	1.59	100	67	-33	1089
APS2-127/140	SG22H.014	1.05	IGA/IGSCC	Bob/w100'	0.84	8H EC	1.05	89	60	-29	841

Correlation Coifficient = 0.8330948

%TW	DETECTED	Frac / POD @ 90% CL	
< 35%	3 of 5	0.6	<.80
>=35%	13 of 13	1	0.8

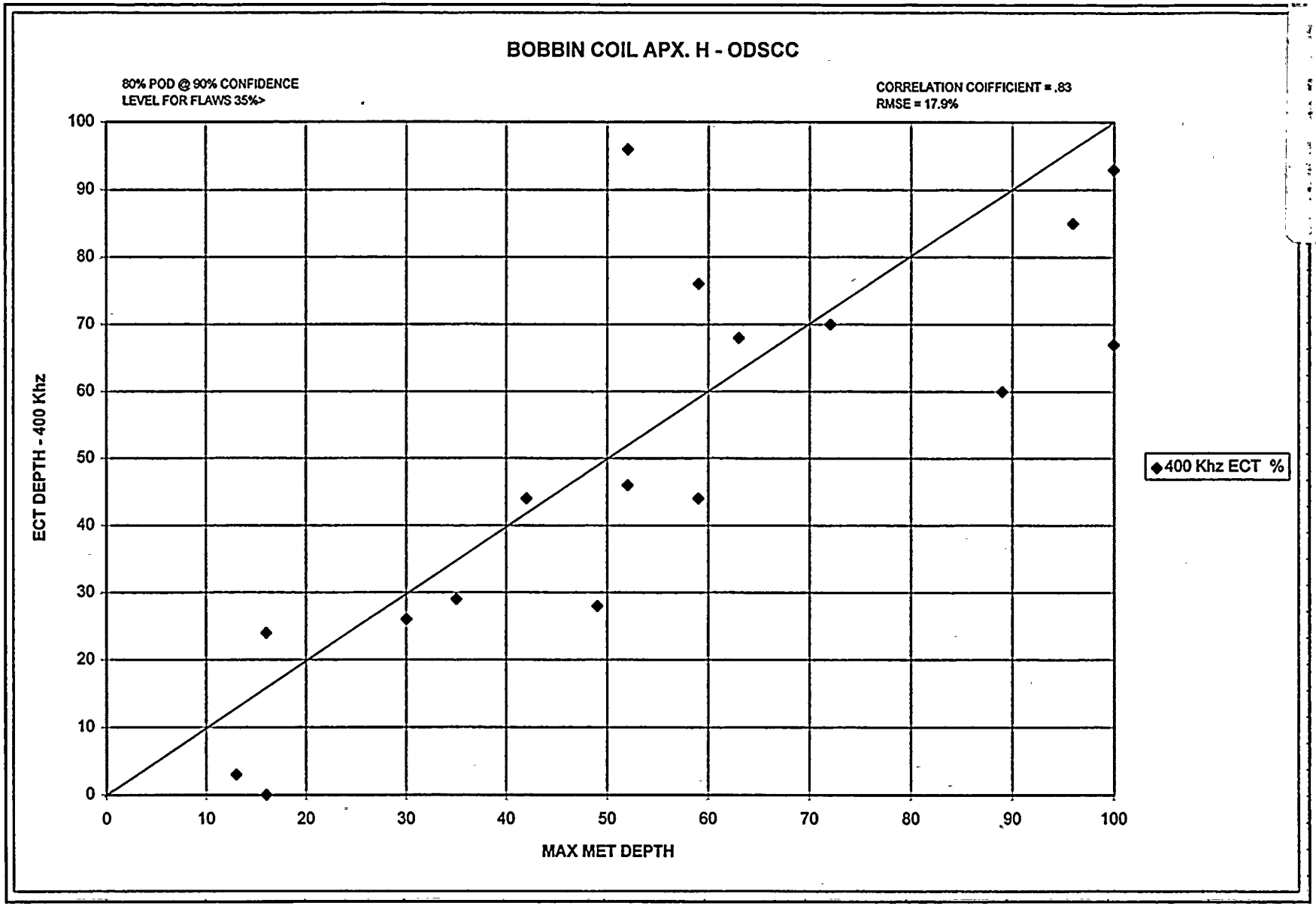
Mean =	-5.55
Std Dev =	17.54

Sum/Sq =	5788
RMSE =	17.93197
18 Data Points	

Note: 1. This qualification data set contains EPRI "J" Samples (Lab IGA/SCC) and pulled tube flaws from ST. Lucie 1, ANO 2 and Palo Verde 2 with emphasis on eggcrate interferrence.

Note: 2. Eggcrate supports produce a much smaller signal than drilled supports and, therefore, interfere less with flaw signal detection & sizing. Other non-drilled support designs may have ECT signal characteristics which are similar to eggcrate designs.

FLORIDA POWER LIGHT
ST. LUCIE STEAM GENERATOR PROGRAM



PSL1QUAL.XLS

EPRI
Electric Power
Research Institute

Powering Progress through Innovative Solutions

March 28, 1996

Mr. Gary L. Boyers
FPL S/G Coordinator
Florida Power and Light Company
P.O. Box 14000
Juno Beach, FL 33408-0420

Subject: Peer Review of Appendix H Bobbin Coil Qualification

Dear Gary:

Per your request of March 13, 1996 your qualification package for bobbin coil depth sizing was presented to an industry Peer Review Group at the EPRI NDE Center on March 27, 1996. In the opinion of the Peer Review Group the qualification data that you had submitted meets the requirement of Appendix H. Please see the attached approval sheet for details of applicability and names of the Peer Review Group members.

Sincerely,

MMBehravesh

Mohamad M. Behravesh
Manager, Steam Generator NDE and
Chair, ISI Guidelines Committee

Attachdment

CC: Ken Craig / FP&L
David Goetcheus / TVA
John Smith / RG&E
Chuck Welty / EPRI
Gary Henry / NDE Center
David Black /Duke Power
Scott Redner / NSP
Richard Marlow / Rockridge
Gary Pierini / Westinghouse
Bob Vollmer / Zetec

Headquarters: 3412 Hillview Avenue, Post Office Box 10412, Palo Alto, CA 94303, USA • (415) 855-2000
Washington Office: 2000 L Street, NW, Suite 805, Washington, DC 20036, USA • (202) 872-9222 • Fax: (202) 293-2697

Technique Qualification

SYSTEM M12-18 Eddy Nef

FREQUENCIES 400 560 ___ ___ ___ ___ ___ ___

MECHANISM ODSCC at Egg Crates ~~in Freespan~~ HH Sludge Pile

GRAPHICS _____

ACT & ANTS COMPLETED ✓

POD & C/L .8@90%

POD GRAPHICS _____

RMSE & COEF. 17.9 %

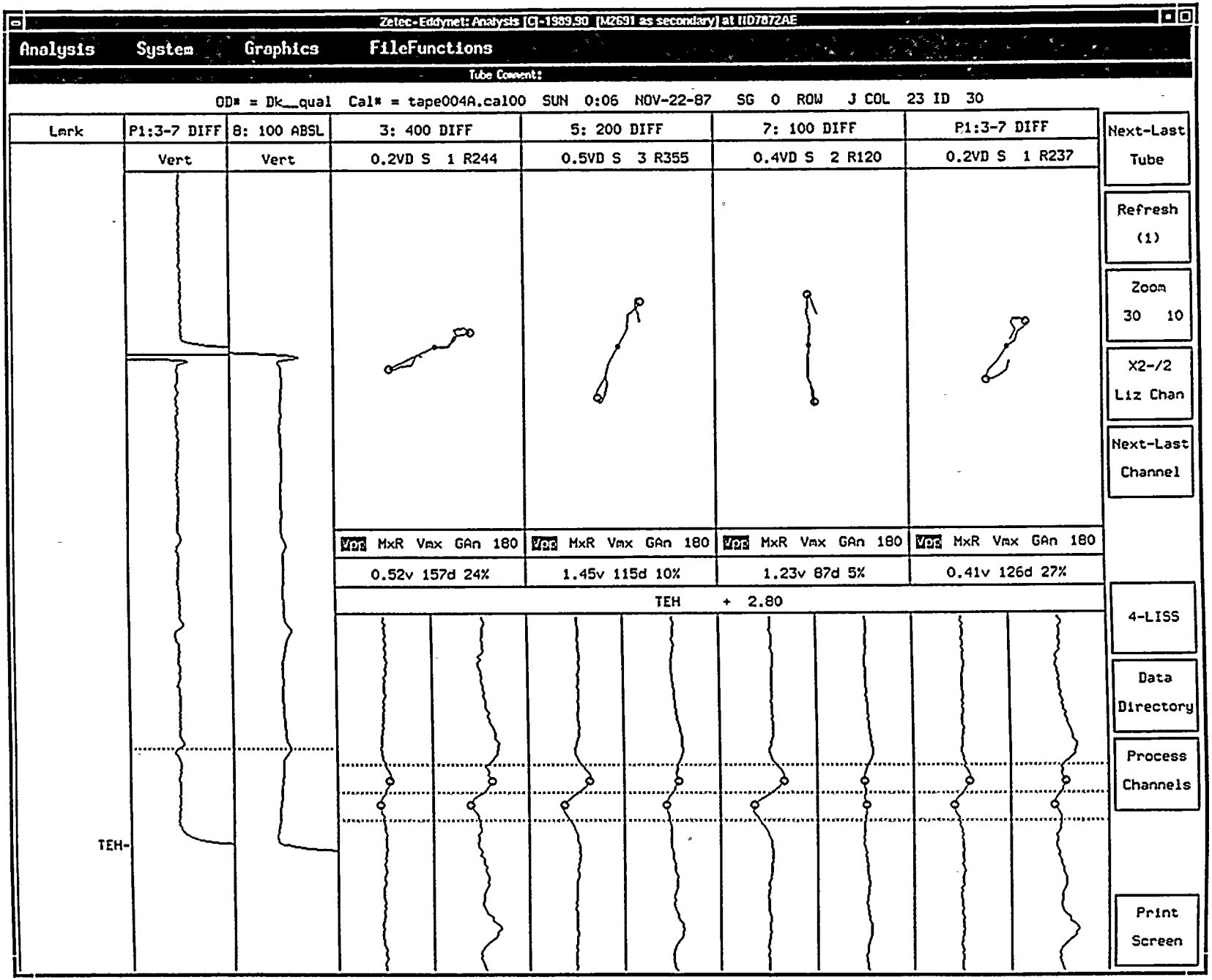
TRAINING DATA ✓

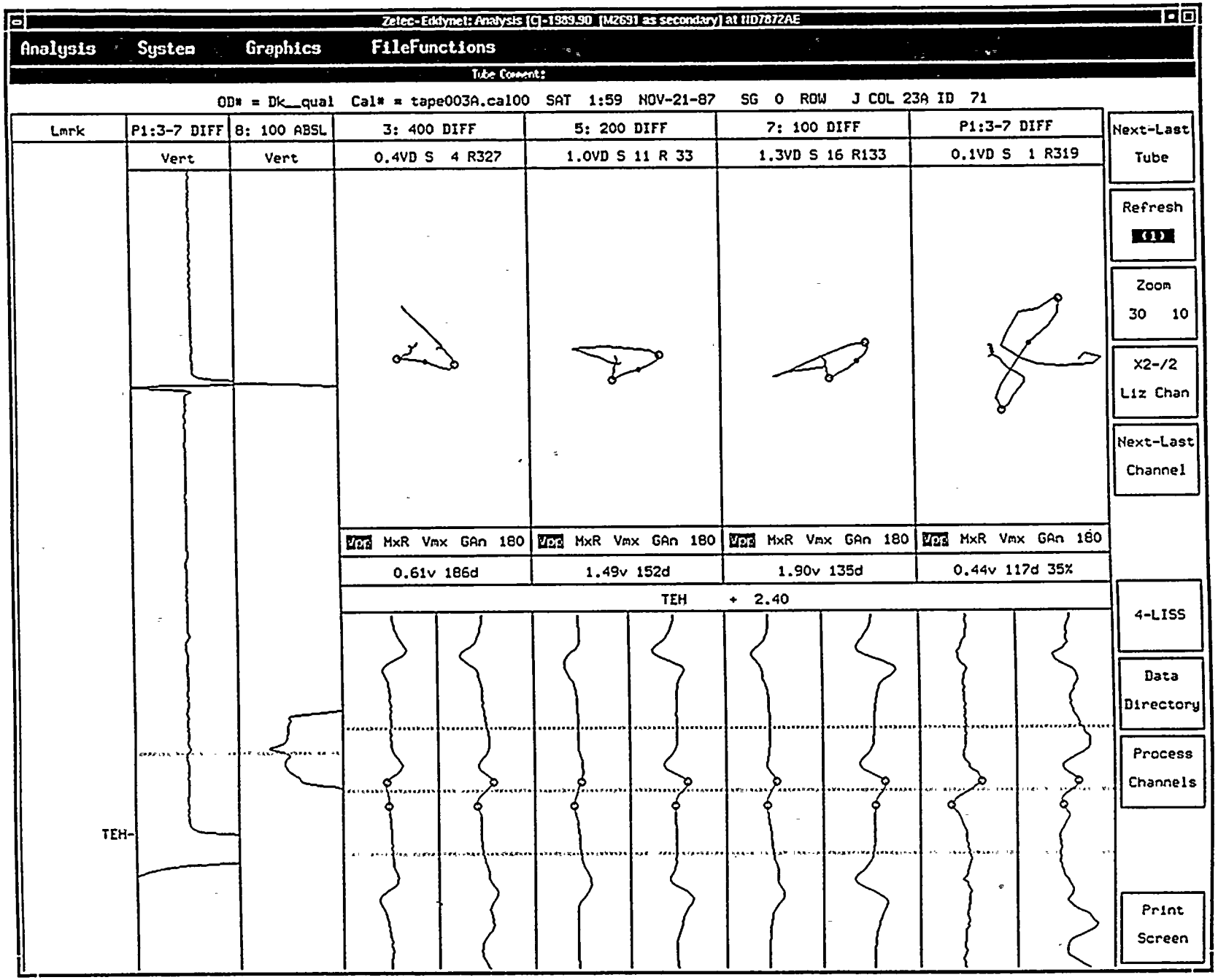
TEST DATA ✓

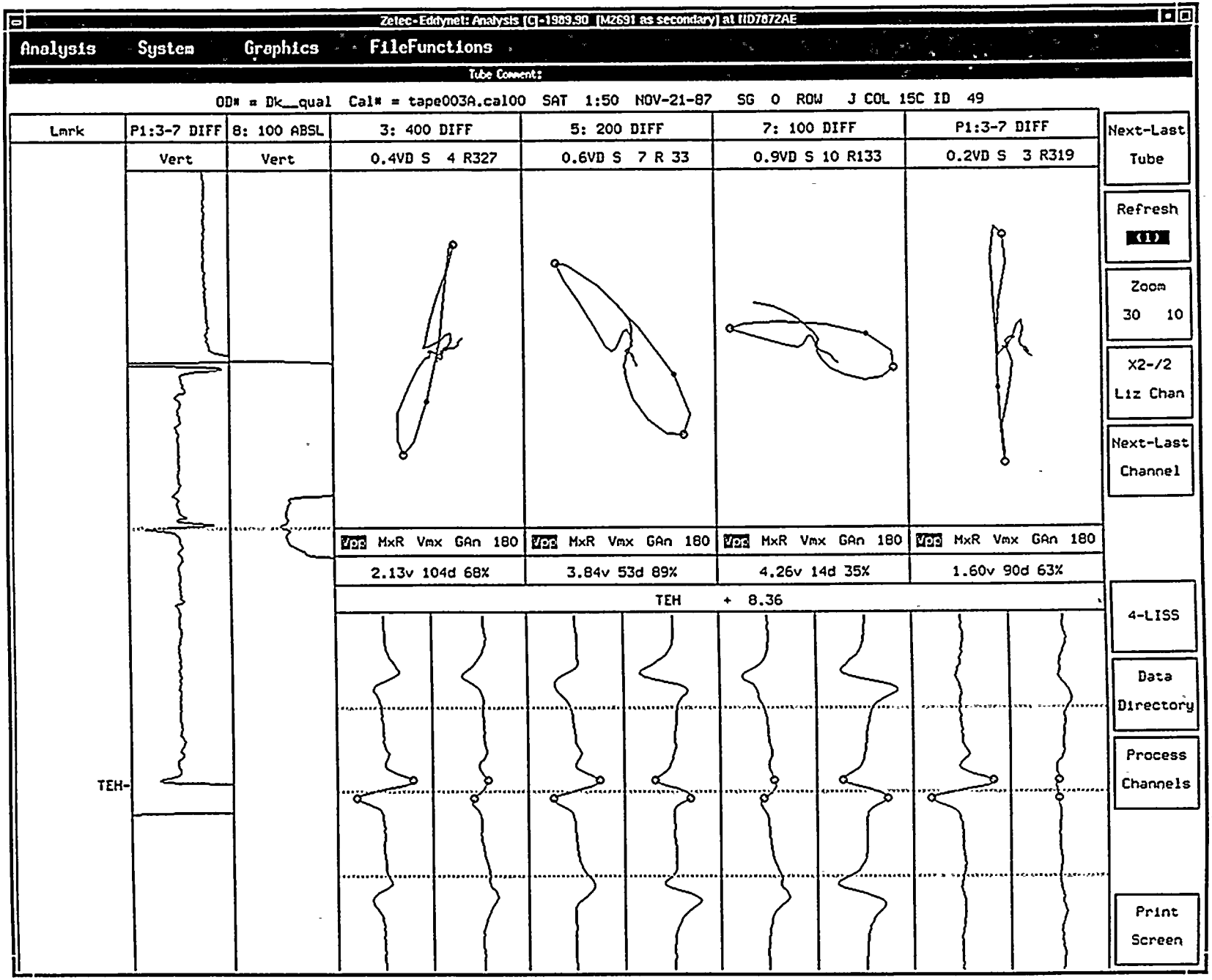
PEER REVIEWED BY:

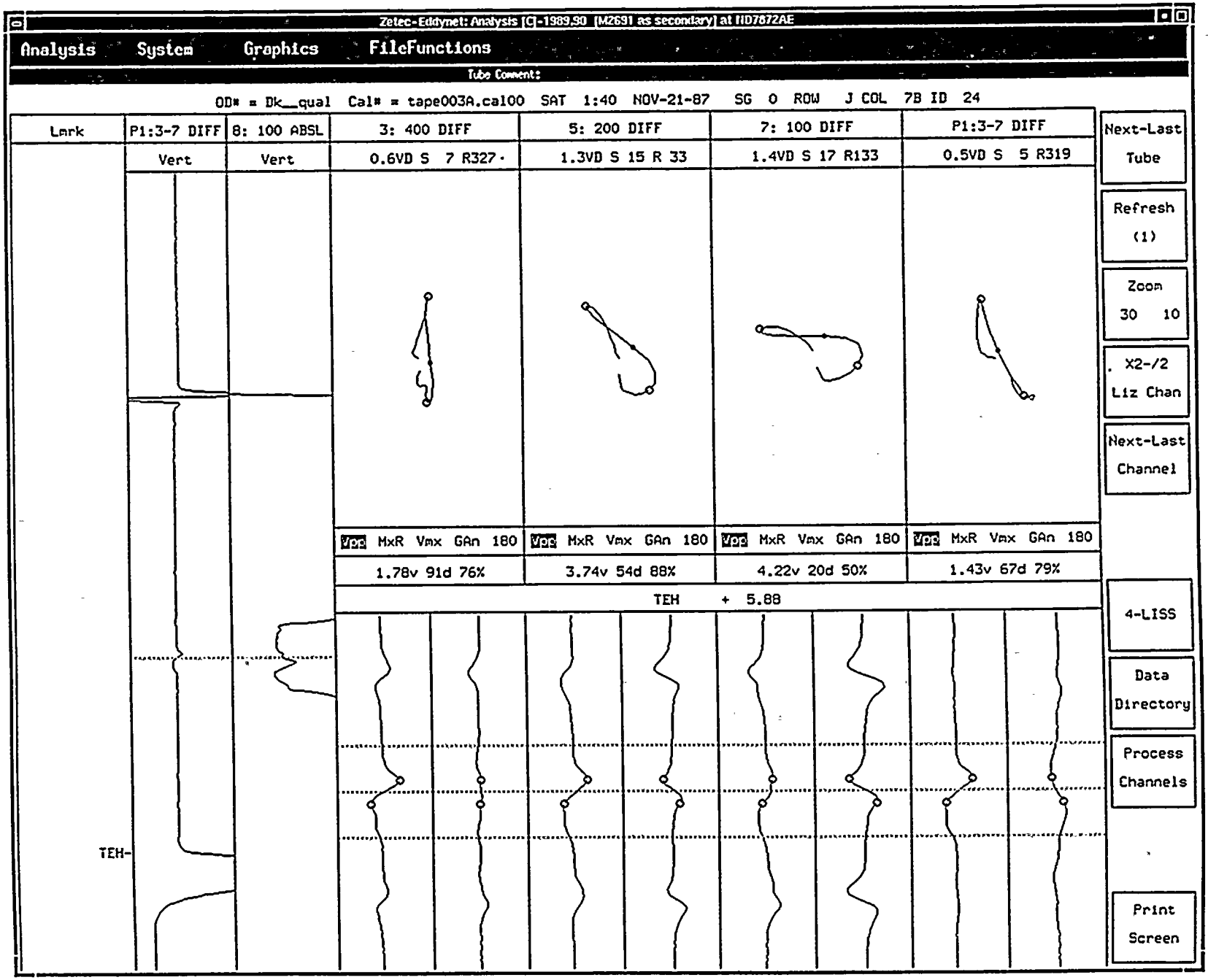
Print Name	Signature	Technique *		Training		Testing		Date
		Acceptable	Unacceptable	Acceptable	Unacceptable	Acceptable	Unacceptable	
G. PIERINI	[signature]	✓		N/A		N/A		3/27/96
S. REDNER	[signature]	✓		N/A		N/A		3/27/96
L Mowlou	[signature]	✓		N/A		N/A		3/27/96
R.A. Tolmer	[signature]	✓		N/A		N/A		3-27-96
DM Black	[signature]	✓		N/A		N/A		3-27-96

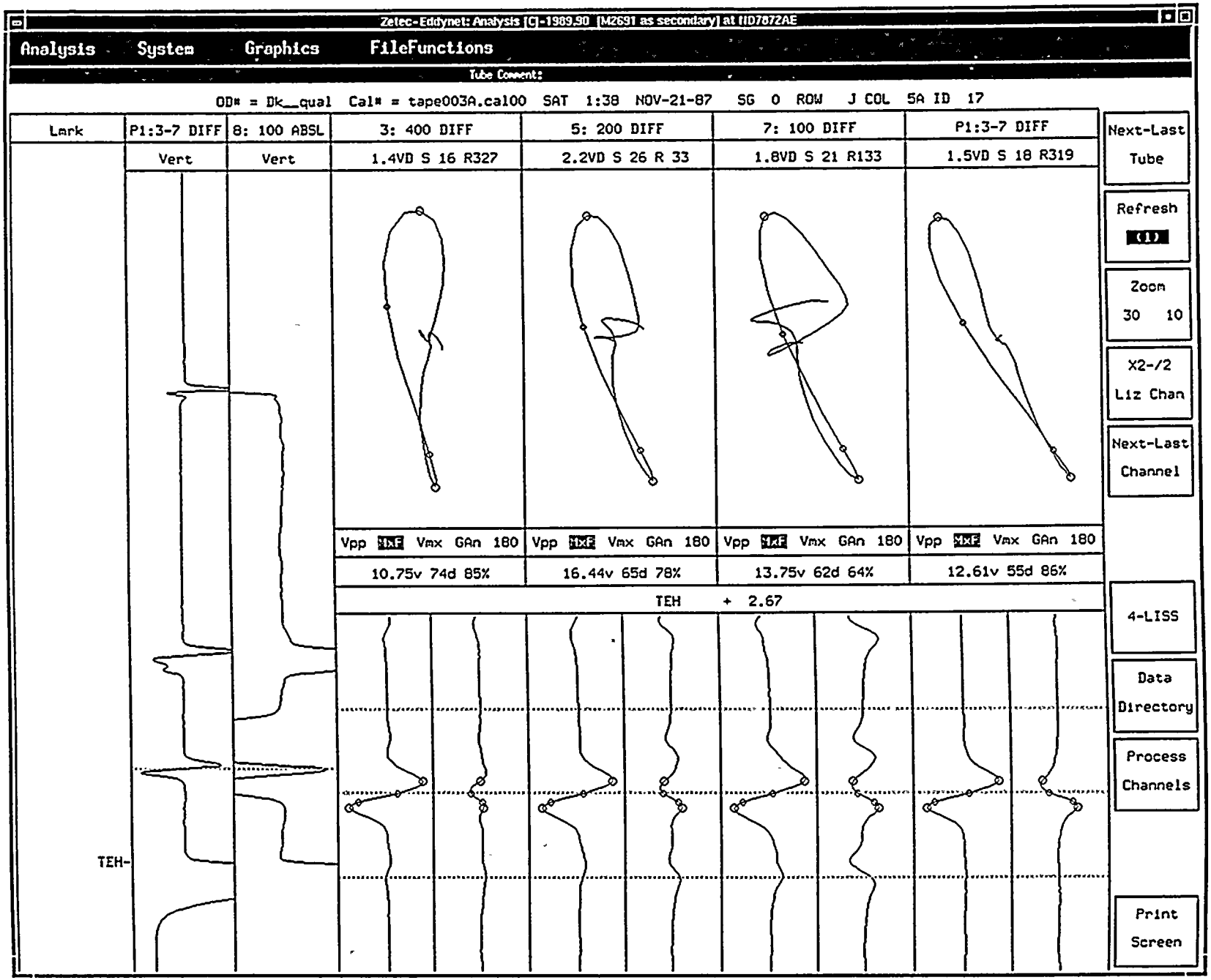
* NOT APPROVED FOR GENERAL INDUSTRY USE.

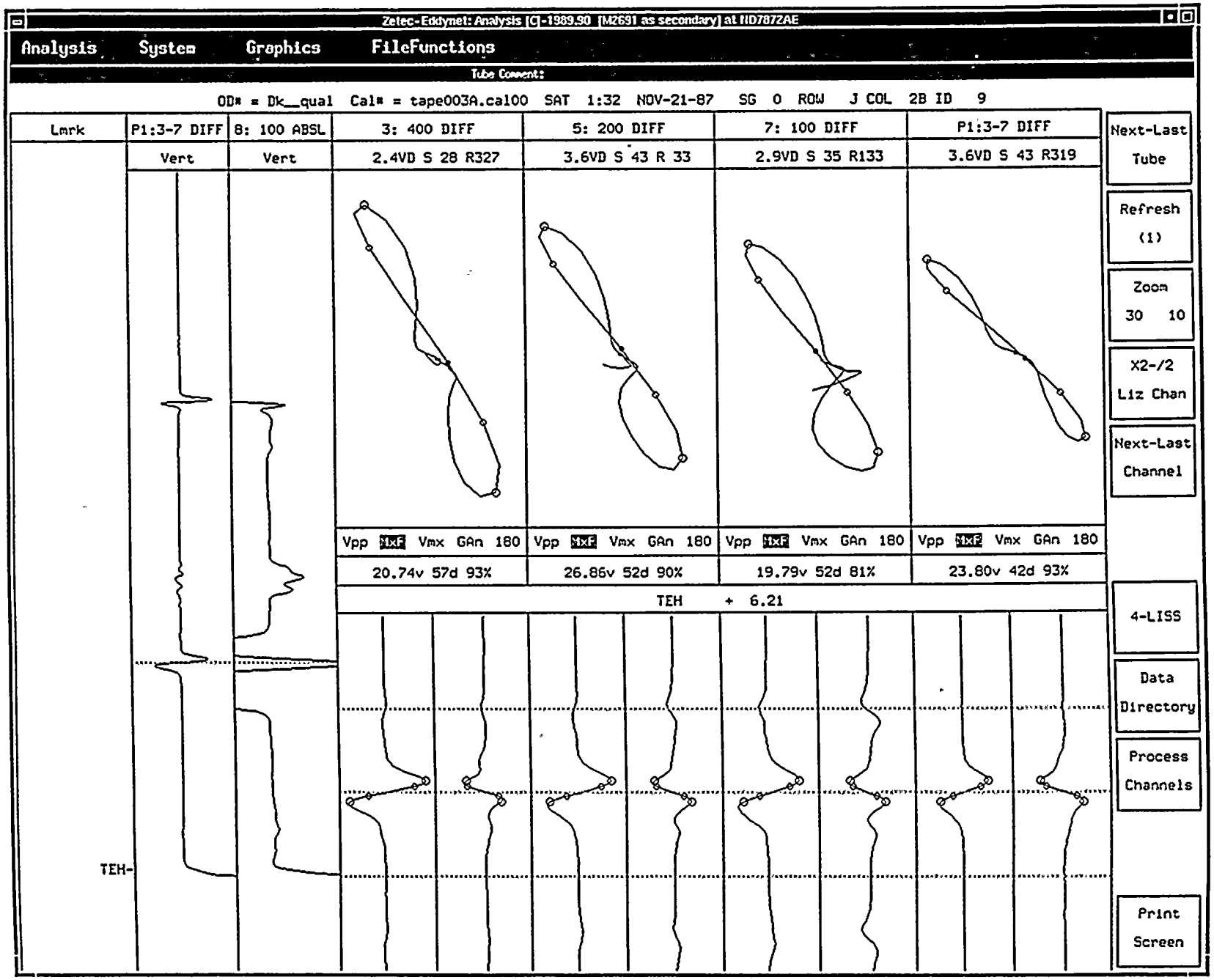

Zetec-Eddynet: Analysis [C-1989,90 [M2691 as secondary] at IID7872AE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD* = Dk__qual Cal* = tape004A.cal00 SUN 0:06 NOV-22-87 SG 0 ROW J COL 23 ID 30
Lark
P1:3-7 DIFF
8: 100 ABSL
3: 400 DIFF
5: 200 DIFF
7: 100 DIFF
P1:3-7 DIFF
Vert
Vert
0.2VD S 1 R244
0.5VD S 3 R355
0.4VD S 2 R120
0.2VD S 1 R237
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
0.52v 157d 24%
1.45v 115d 10%
1.23v 87d 5%
0.41v 126d 27%
TEH + 2.80
TEH-
Next-Last Tube
Refresh (1)
Zoom 30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen

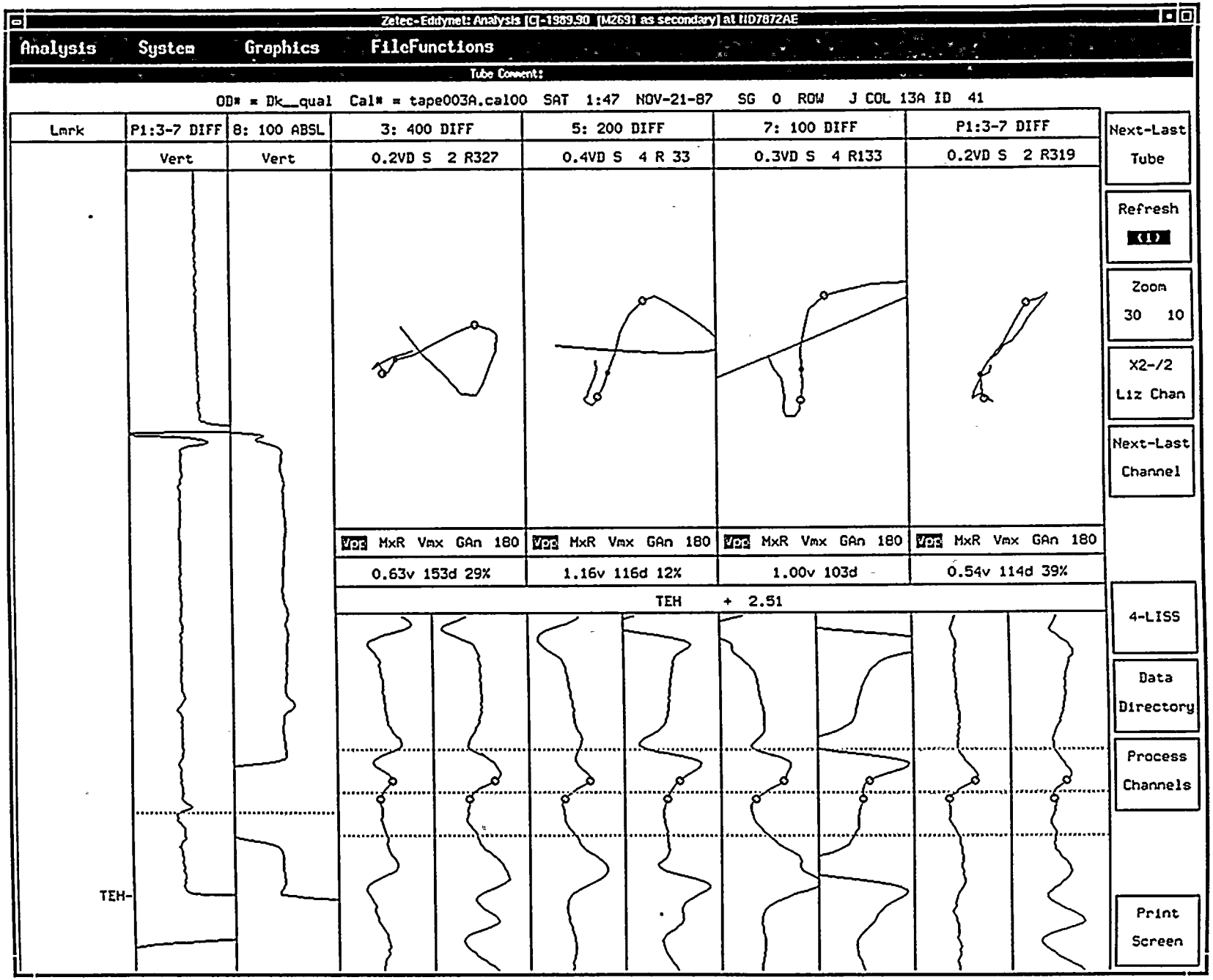

Zetec-Eddynet: Analysis [G]-1989.90 [MZ691 as secondary] at HD7872AE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD* = Dk_qual Cal* = tape003A.cal00 SAT 1:59 NOV-21-87 SG 0 ROW J COL 23A ID 71
Lmrk
P1:3-7 DIFF
8: 100 ABSL
3: 400 DIFF
5: 200 DIFF
7: 100 DIFF
P1:3-7 DIFF
Vert
Vert
0.4VD S 4 R327
1.0VD S 11 R 33
1.3VD S 16 R133
0.1VD S 1 R319
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
0.61v 186d
1.49v 152d
1.90v 135d
0.44v 117d 35%
TEH + 2.40
TEH-
Next-Last Tube
Refresh
Zoom 30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen

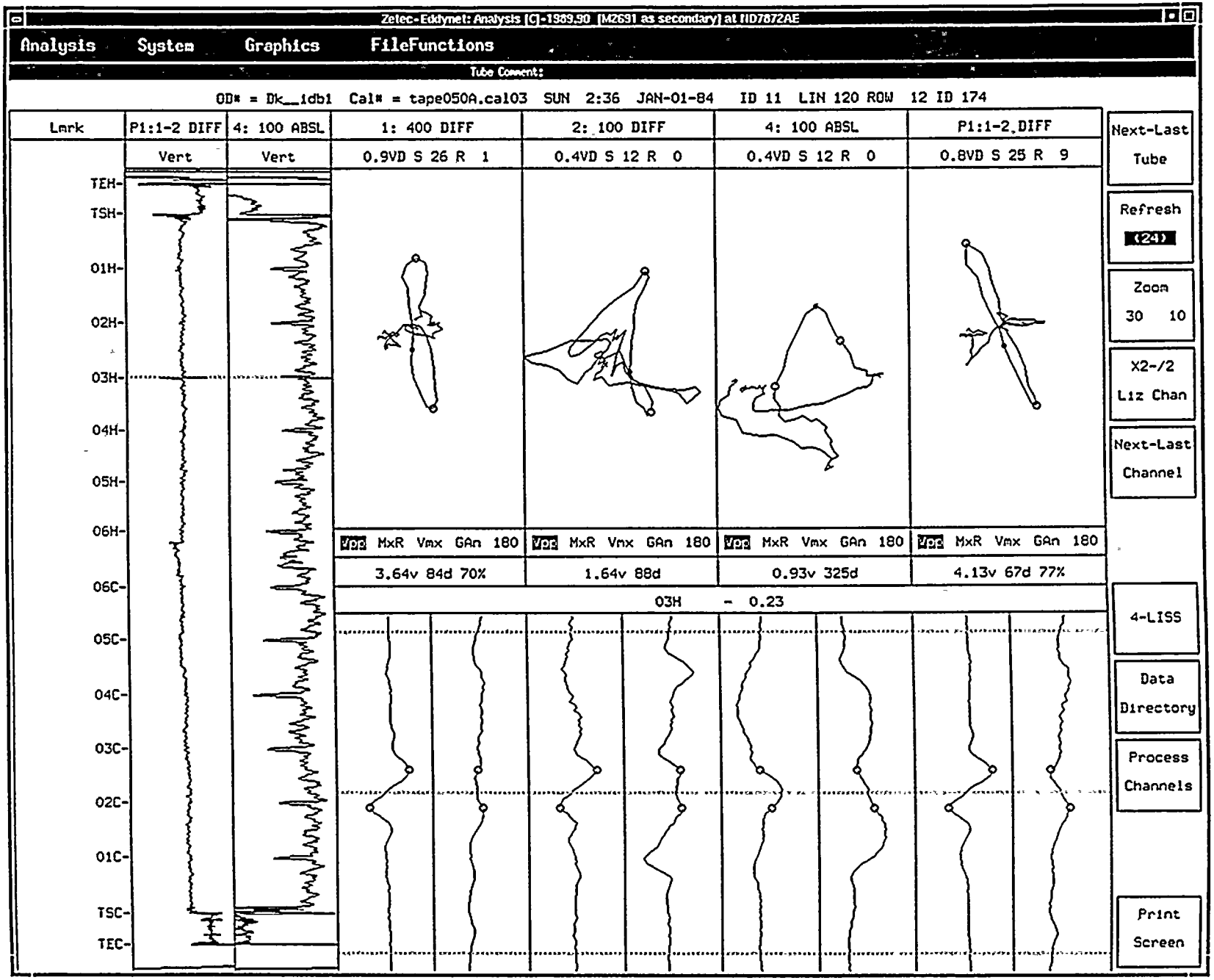

Zetec-Eddynet: Analysis (C)-1989,90 [M2691 as secondary] at HD7672AE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD= = Dk__qual Cal= = tape003A.cal00 SAT 1:50 NOV-21-87 SG 0 ROW J COL 15C ID 49
Lmrk
P1:3-7 DIFF
8: 100 ABSL
3: 400 DIFF
5: 200 DIFF
7: 100 DIFF
P1:3-7 DIFF
Vert
Vert
0.4VD S 4 R327
0.6VD S 7 R 33
0.9VD S 10 R133
0.2VD S 3 R319
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
2.13v 104d 68%
3.84v 53d 89%
4.26v 14d 35%
1.60v 90d 63%
TEH + 8.36
TEH-
Next-Last Tube
Refresh
Zoom 30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen

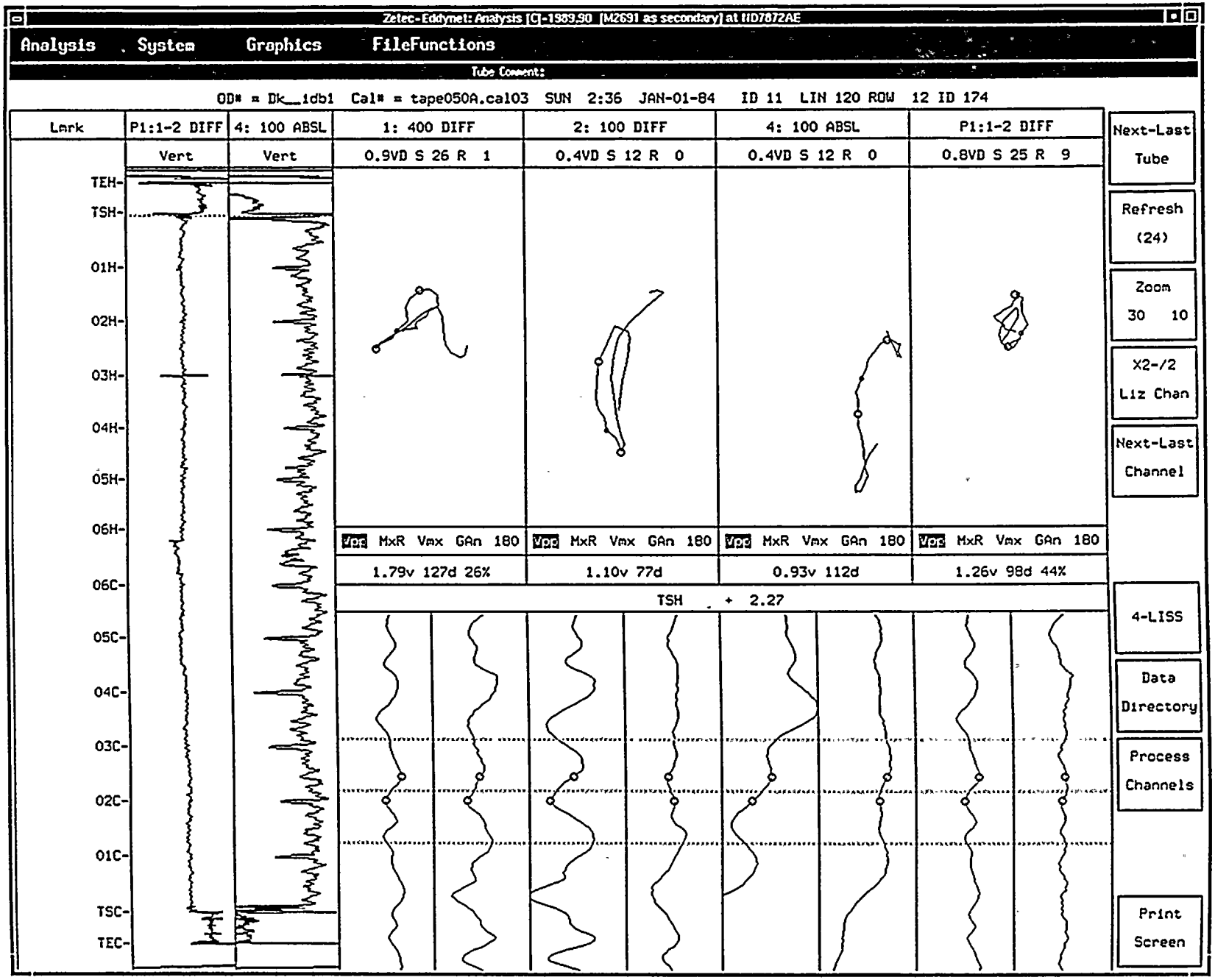

Zetec-Eddynet: Analysis [C]-1989.90 [MZ691 as secondary] at ND7872AE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD* = Dk__qual Cal* = tape003A.cal00 SAT 1:40 NOV-21-87 SG 0 ROW J COL 7B ID 24
Lark
P1:3-7 DIFF
8: 100 ABSL
3: 400 DIFF
5: 200 DIFF
7: 100 DIFF
P1:3-7 DIFF
Vert
Vert
0.6VD S 7 R327
1.3VD S 15 R 33
1.4VD S 17 R133
0.5VD S 5 R319
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
1.78v 91d 76%
3.74v 54d 88%
4.22v 20d 50%
1.43v 67d 79%
TEH + 5.88
TEH-
Next-Last Tube
Refresh (1)
Zoom 30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen

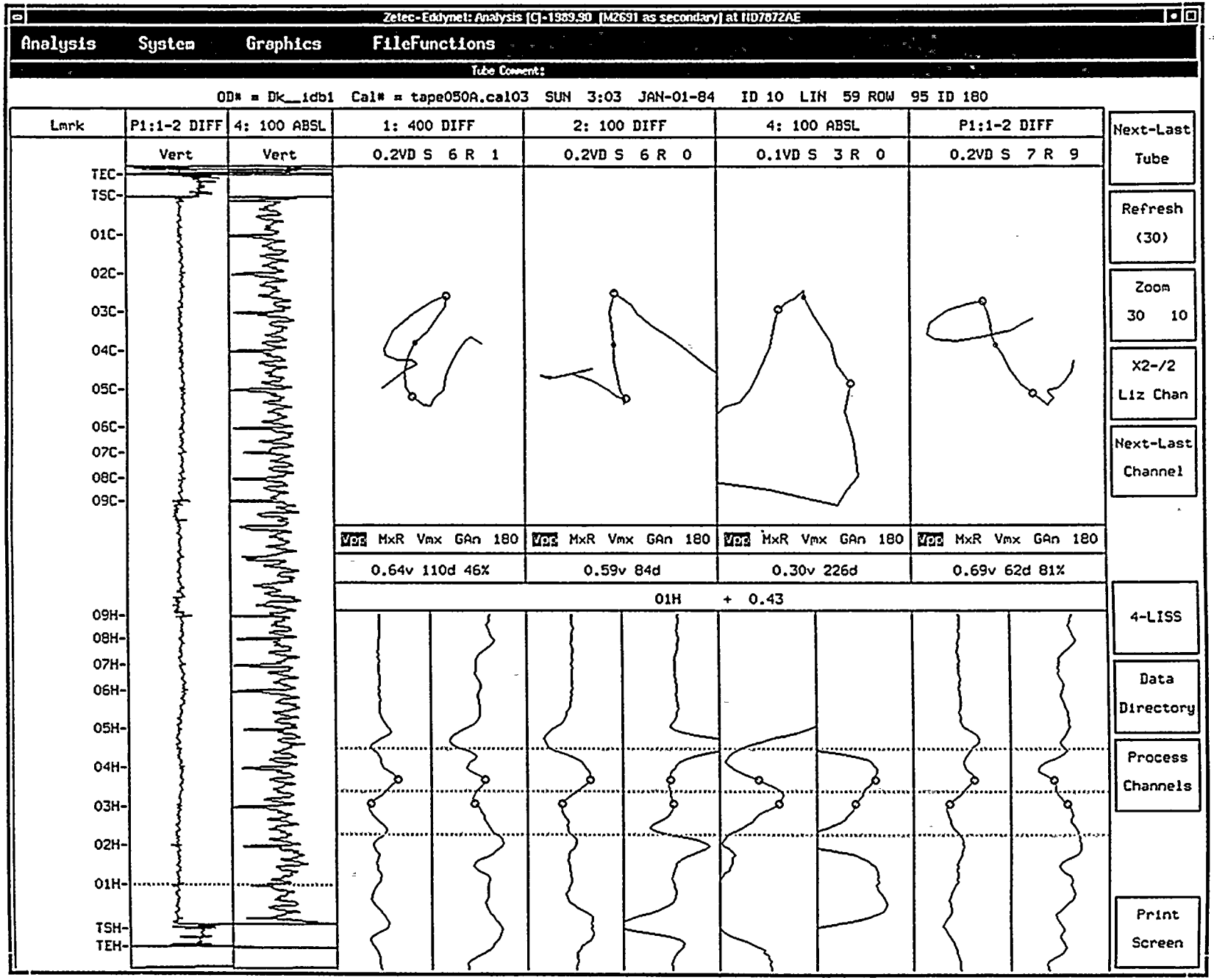

Zetec-Eddynet: Analysis (C)-1989,90 [M2691 as secondary] at ID7672AE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD* = Dk__qual Cal* = tape003A.cal00 SAT 1:38 NOV-21-87 SG 0 ROW J COL 5A ID 17
Lmrk
P1:3-7 DIFF
8: 100 ABSL
3: 400 DIFF
5: 200 DIFF
7: 100 DIFF
P1:3-7 DIFF
Vert
Vert
1.4VD S 16 R327
2.2VD S 26 R 33
1.8VD S 21 R133
1.5VD S 18 R319
Vpp MXF Vmx GAn 180
Vpp MXF Vmx GAn 180
Vpp MXF Vmx GAn 180
Vpp MXF Vmx GAn 180
10.75v 74d 85%
16.44v 65d 78%
13.75v 62d 64%
12.61v 55d 86%
TEH + 2.67
TEH-
Next-Last Tube
Refresh
Zoom 30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen

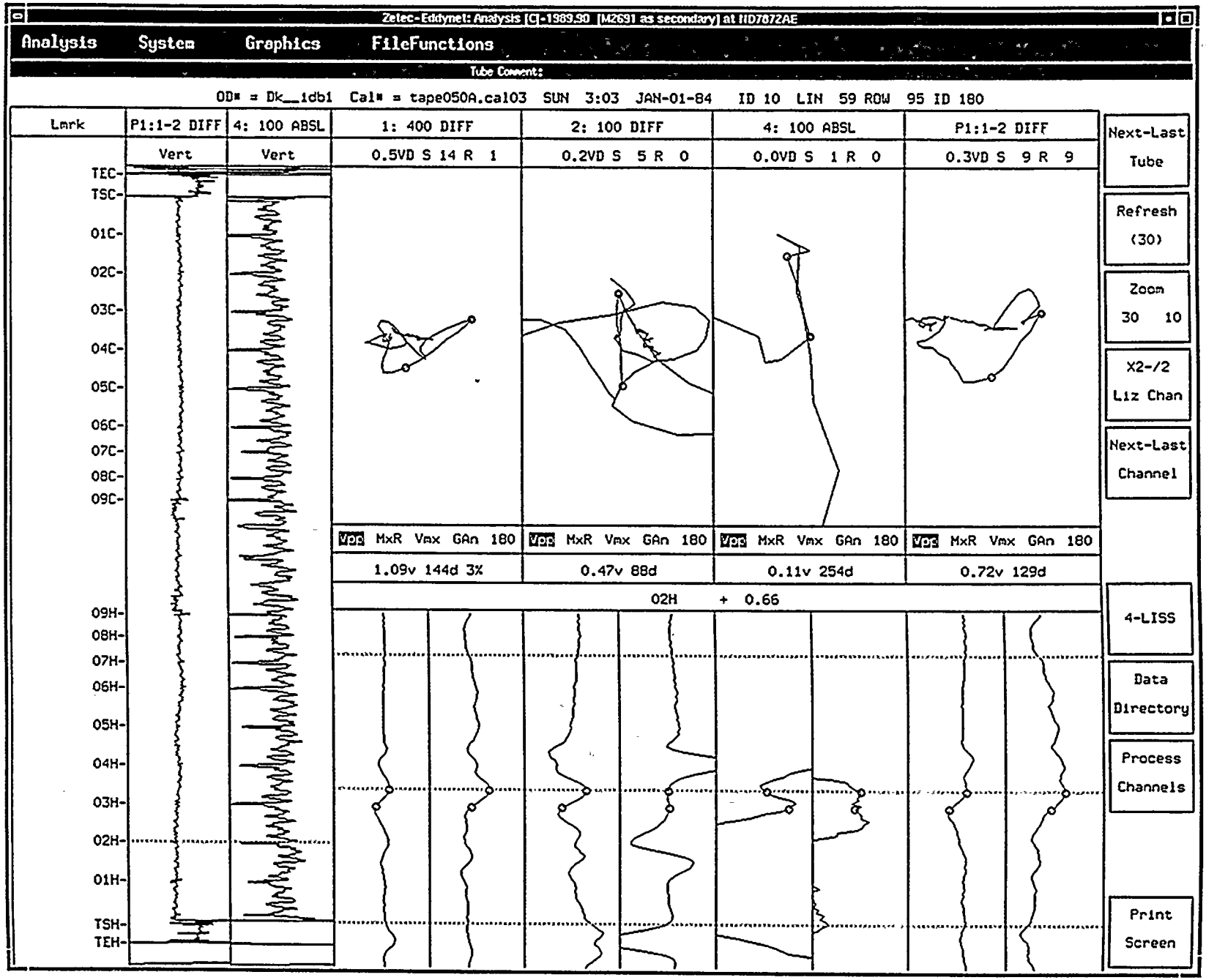

Zetec-Eddynet: Analysis [C-1989.90 [MZ691 as secondary] at HD787ZAE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD* = Dk__qual Cal* = tape003A.cal00 SAT 1:32 NOV-21-87 SG 0 ROW J COL 2B ID 9
Lmrk
P1:3-7 DIFF
8: 100 ABSL
3: 400 DIFF
5: 200 DIFF
7: 100 DIFF
P1:3-7 DIFF
Vert
Vert
2.4VD S 28 R327
3.6VD S 43 R 33
2.9VD S 35 R133
3.6VD S 43 R319
Vpp MxF Vmx GAn 180
Vpp MxF Vmx GAn 180
Vpp MxF Vmx GAn 180
Vpp MxF Vmx GAn 180
20.74v 57d 93%
26.86v 52d 90%
19.79v 52d 81%
23.80v 42d 93%
TEH + 6.21
TEH-
Next-Last Tube
Refresh (1)
Zoom 30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen

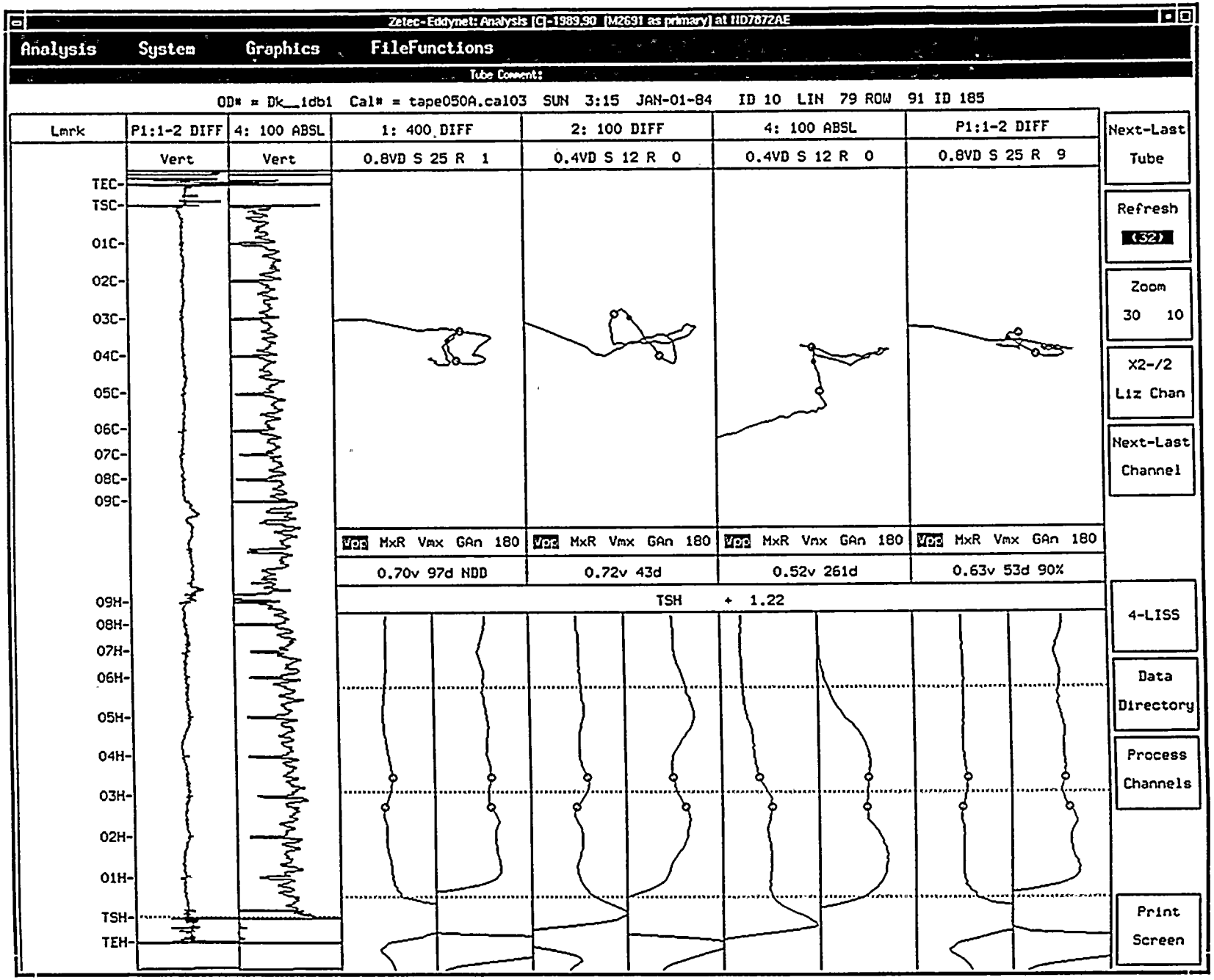

Zetec-Eddynet: Analysis [C]-1989.90 [M2691 as secondary] at HD7872AE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD* = Dk__qual Cal* = tape003A.cal00 SAT 1:47 NOV-21-87 SG 0 ROW J COL 13A ID 41
Lmrk
P1:3-7 DIFF
8: 100 ABSL
3: 400 DIFF
5: 200 DIFF
7: 100 DIFF
P1:3-7 DIFF
Vert
Vert
0.2VD S 2 R327
0.4VD S 4 R 33
0.3VD S 4 R133
0.2VD S 2 R319
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
0.63v 153d 29%
1.16v 116d 12%
1.00v 103d
0.54v 114d 39%
TEH + 2.51
TEH-
Next-Last Tube
Refresh
Zoom 30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen

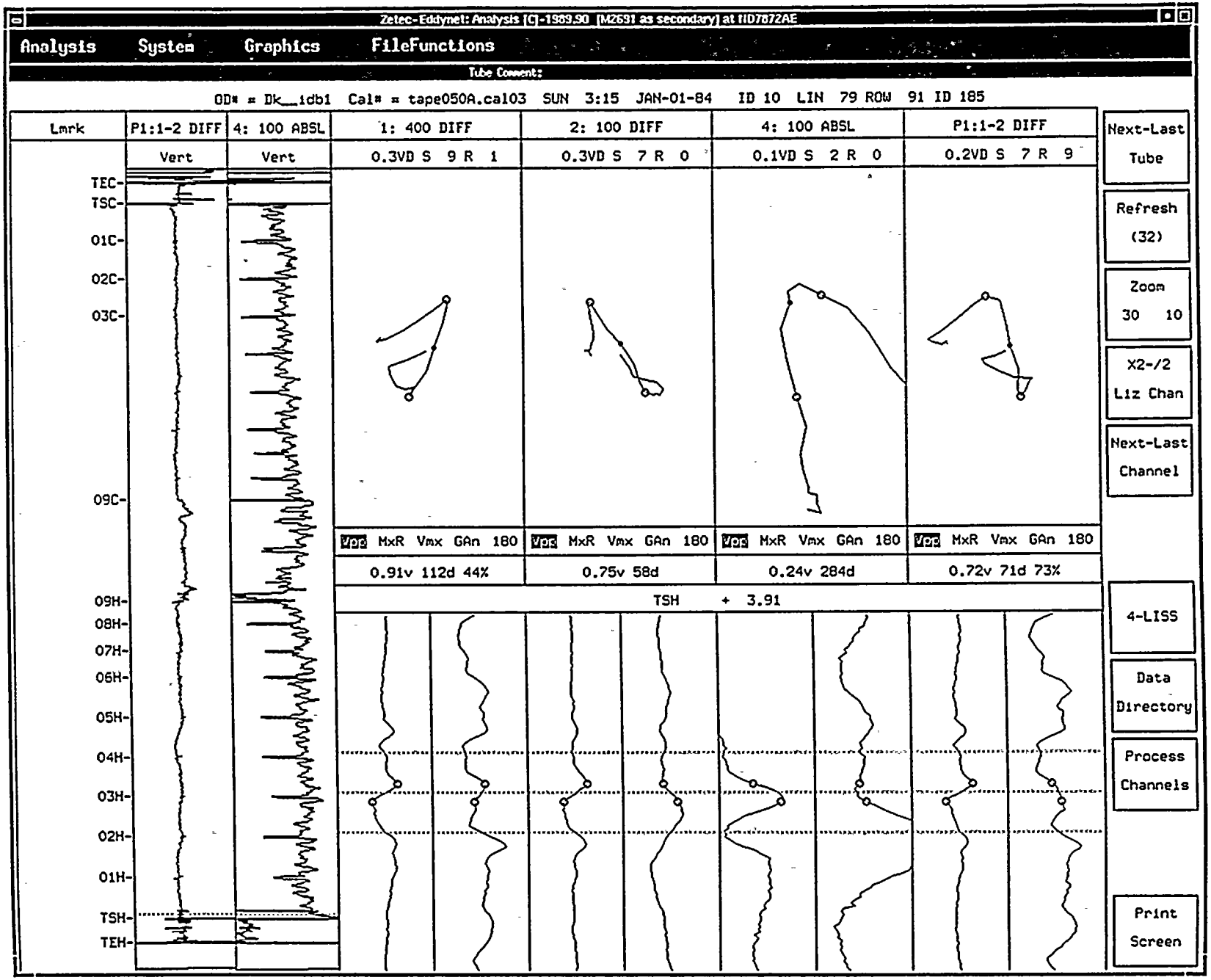

Zetec-Eddynet: Analysis (C)-1989,90 [M269] as secondary] at IID7872AE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD* = Dk__idb1 Cal* = tape050A.cal03 SUN 2:36 JAN-01-84 ID 11 LIN 120 ROW 12 ID 174
Lmrk
P1:1-2 DIFF
4: 100 ABSL
1: 400 DIFF
2: 100 DIFF
4: 100 ABSL
P1:1-2 DIFF
Vert
Vert
0.9VD S 26 R 1
0.4VD S 12 R 0
0.4VD S 12 R 0
0.8VD S 25 R 9
TEH-
TSH-
01H-
02H-
03H-
04H-
05H-
06H-
06C-
05C-
04C-
03C-
02C-
01C-
TSC-
TEC-
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
3.64v 84d 70%
1.64v 88d
0.93v 325d
4.13v 67d 77%
03H - 0.23
Next-Last Tube
Refresh
(24)
Zoom
30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen

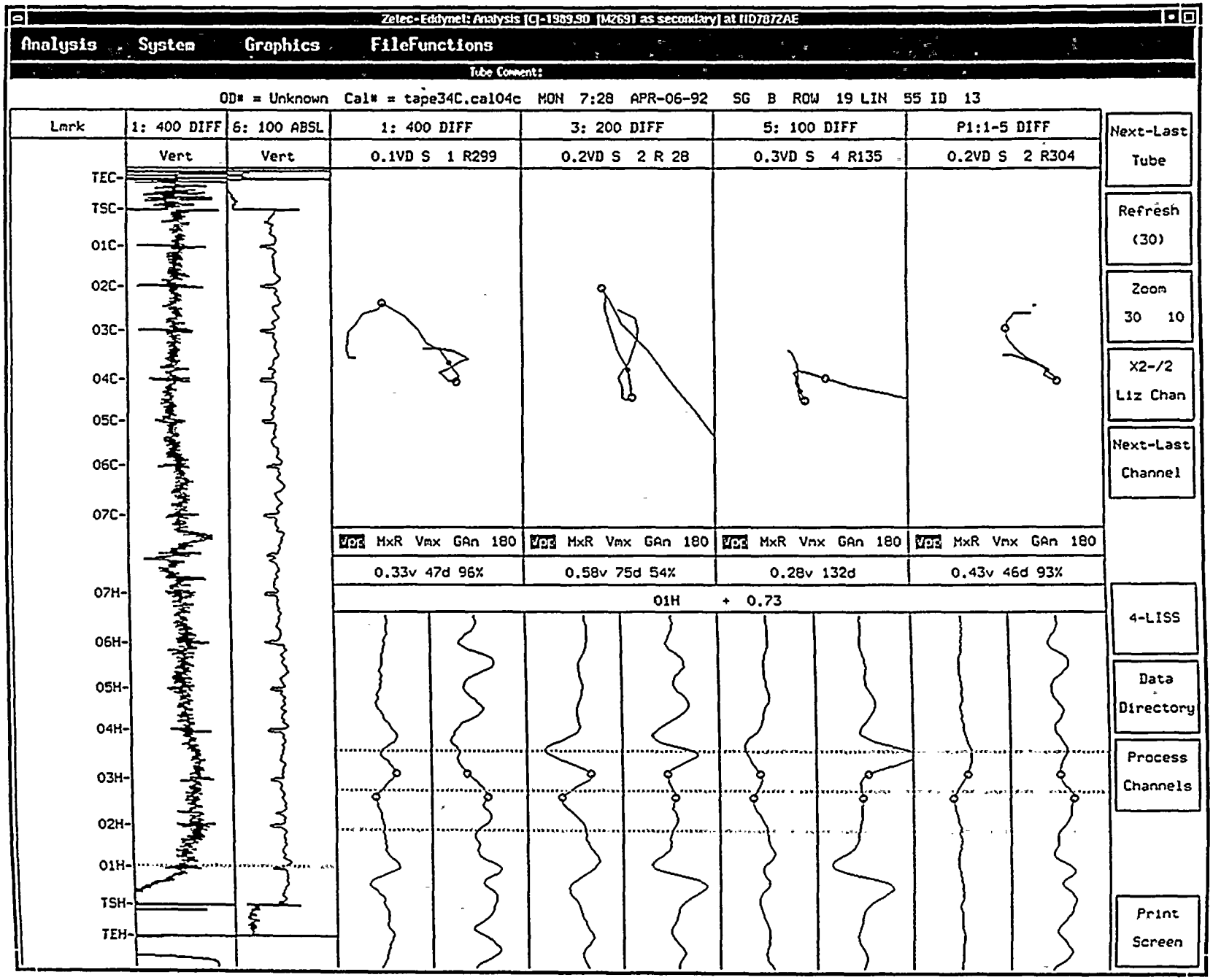

Zetec-Eddynet: Analysis [C]-1989.90 [M2691 as secondary] at IID7872AE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD# = Dk__idb1 Cal# = tape050A.cal03 SUN 2:36 JAN-01-84 ID 11 LIN 120 ROW 12 ID 174
Lark
P1:1-2 DIFF
4: 100 ABSL
1: 400 DIFF
2: 100 DIFF
4: 100 ABSL
P1:1-2 DIFF
Vert
Vert
0.9VD S 26 R 1
0.4VD S 12 R 0
0.4VD S 12 R 0
0.8VD S 25 R 9
TEH-
TSH-
01H-
02H-
03H-
04H-
05H-
06H-
06C-
05C-
04C-
03C-
02C-
01C-
TSC-
TEC-
Vpp MxR Vmx GAn 180
1.79v 127d 26%
Vpp MxR Vmx GAn 180
1.10v 77d
Vpp MxR Vmx GAn 180
0.93v 112d
Vpp MxR Vmx GAn 180
1.26v 98d 44%
TSH + 2.27
Next-Last Tube
Refresh (24)
Zoom 30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen

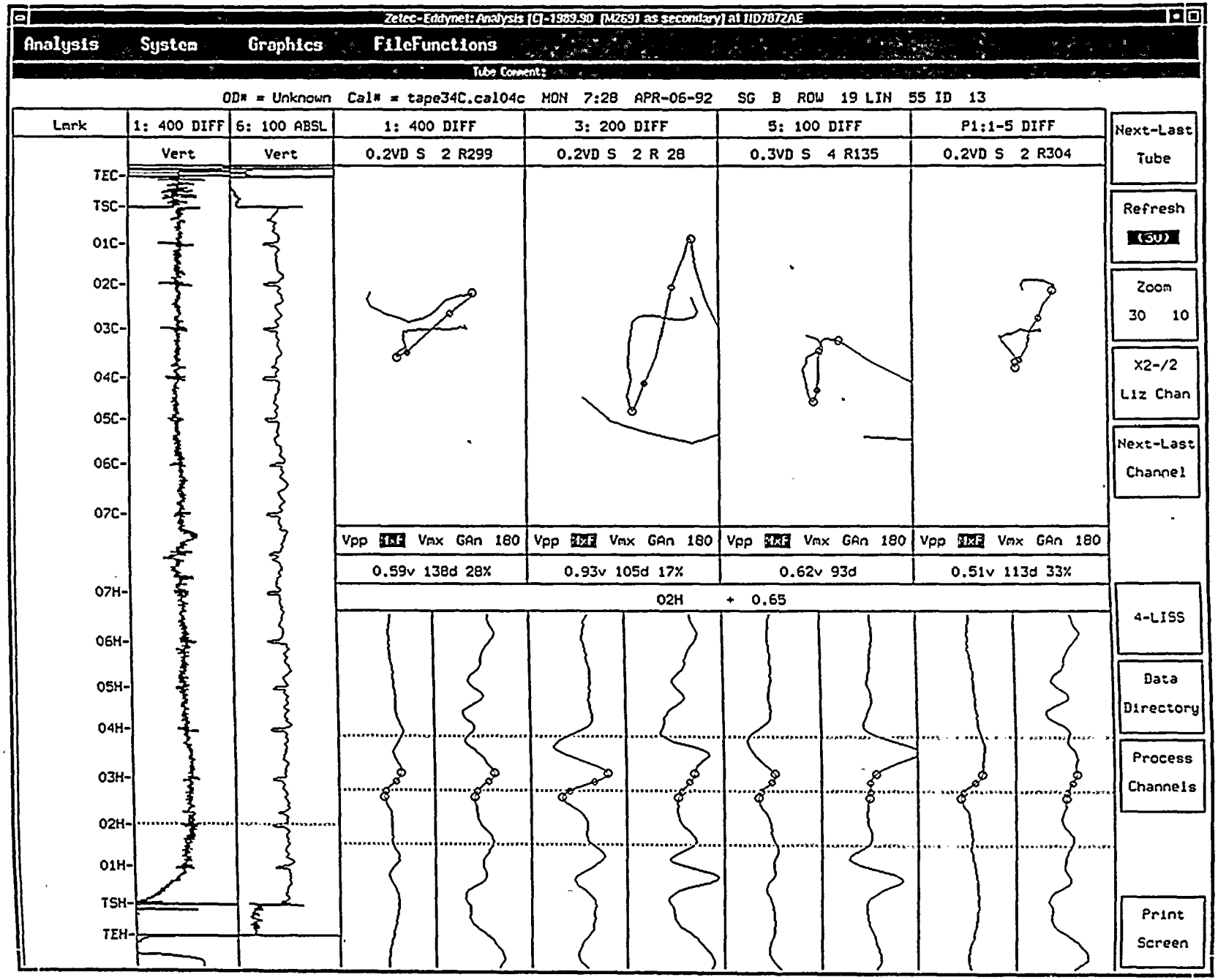

Zetec-Eddynet: Analysis [G]-1989.90 [M2691 as secondary] at IID7672AE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD* = Dk__idb1 Cal* = tape050A.cal03 SUN 3:03 JAN-01-84 ID 10 LIN 59 ROW 95 ID 180
Lmrk
P1:1-2 DIFF
4: 100 ABSL
1: 400 DIFF
2: 100 DIFF
4: 100 ABSL
P1:1-2 DIFF
Vert
Vert
0.2VD S 6 R 1
0.2VD S 6 R 0
0.1VD S 3 R 0
0.2VD S 7 R 9
TEC-
TSC-
01C-
02C-
03C-
04C-
05C-
06C-
07C-
08C-
09C-
Vpp MxR Vmx GAn 180
0.64v 110d 46%
0.59v 84d
0.30v 226d
0.69v 62d 81%
01H + 0.43
09H-
08H-
07H-
06H-
05H-
04H-
03H-
02H-
01H-
TSH-
TEH-
Next-Last Tube
Refresh (30)
Zoom 30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen

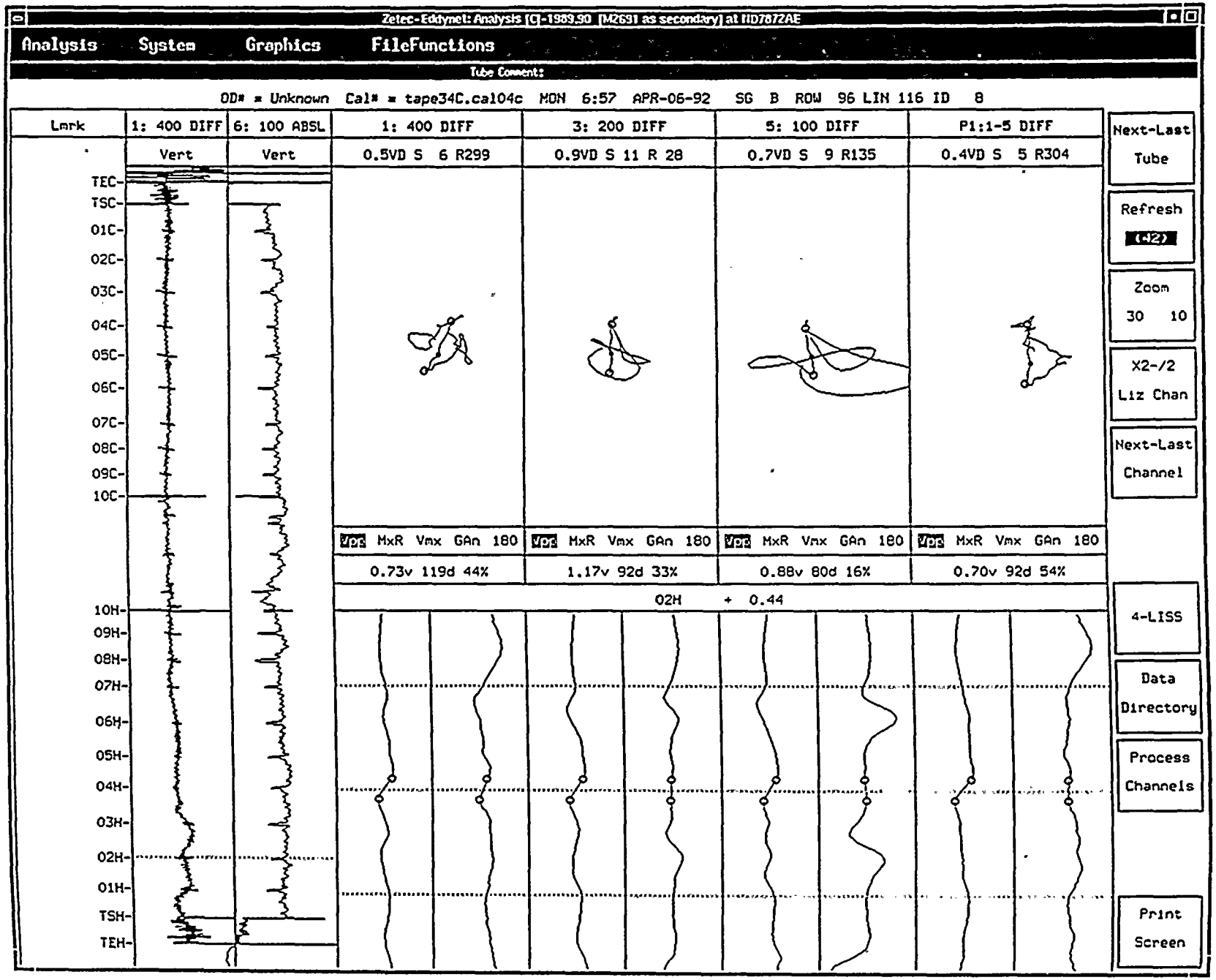

Zetec-Eddynet: Analysis [CJ-1989.90 [M2691 as secondary] at IID7872AE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD# = Dk__idb1 Cal# = tape050A.cal03 SUN 3:03 JAN-01-84 ID 10 LIN 59 ROW 95 ID 180
Lmrk
P1:1-2 DIFF
4: 100 ABSL
1: 400 DIFF
2: 100 DIFF
4: 100 ABSL
P1:1-2 DIFF
Vert
Vert
0.5VD S 14 R 1
0.2VD S 5 R 0
0.0VD S 1 R 0
0.3VD S 9 R 9
TEC-
TSC-
01C-
02C-
03C-
04C-
05C-
06C-
07C-
08C-
09C-
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
1.09v 144d 3%
0.47v 88d
0.11v 254d
0.72v 129d
02H + 0.66
09H-
08H-
07H-
06H-
05H-
04H-
03H-
02H-
01H-
TSH-
TEH-
Next-Last Tube
Refresh (30)
Zoom 30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen

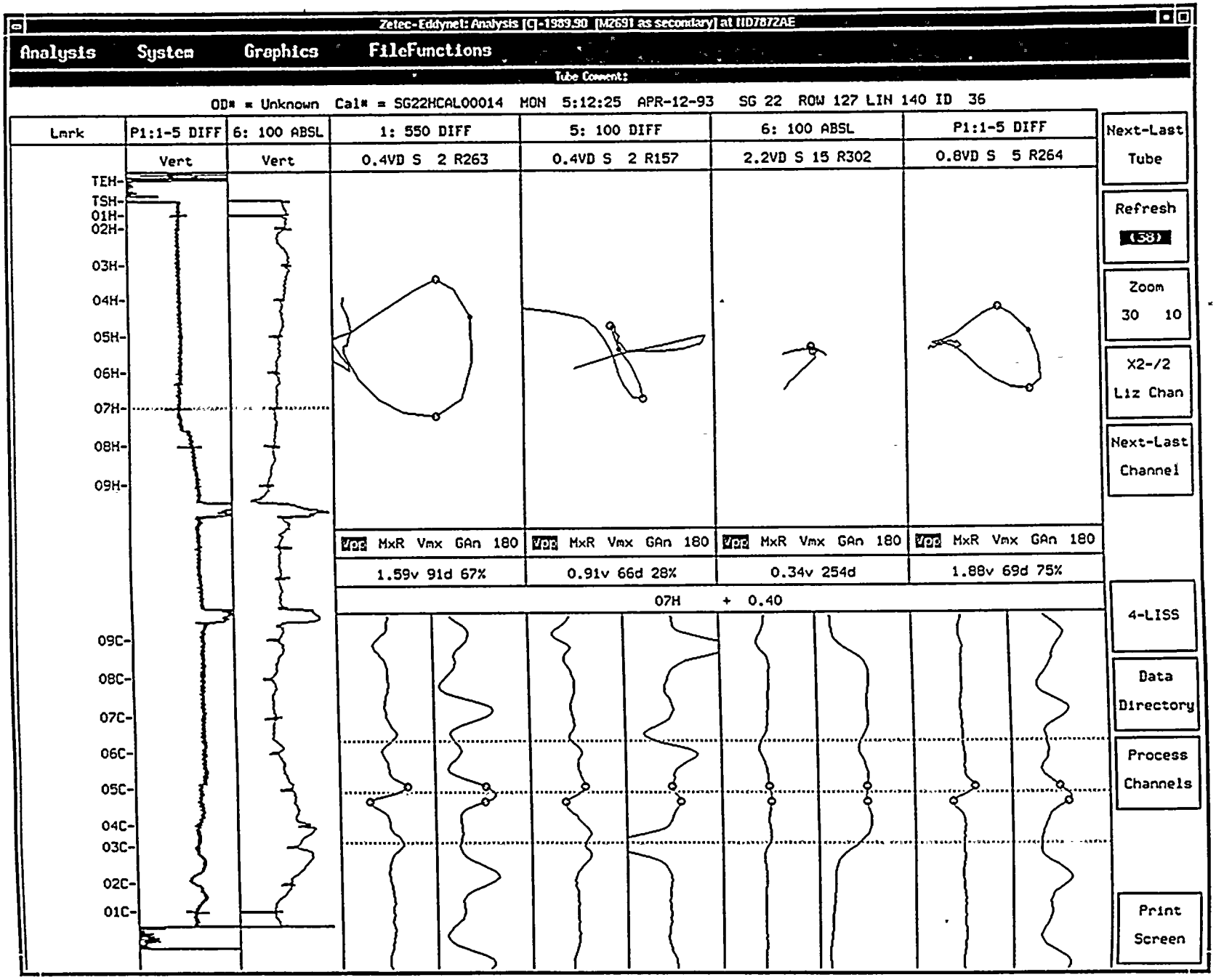

Zetec-Eddynet: Analysis (C)-1989,90 [M2691 as primary] at HD7672AE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD* = Dk__idb1 Cal* = tape050A.cal03 SUN 3:15 JAN-01-84 ID 10 LIN 79 ROW 91 ID 185
Lmrk
P1:1-2 DIFF
4: 100 ABSL
1: 400 DIFF
2: 100 DIFF
4: 100 ABSL
P1:1-2 DIFF
Vert
Vert
0.8VD S 25 R 1
0.4VD S 12 R 0
0.4VD S 12 R 0
0.8VD S 25 R 9
TEC-
TSC-
01C-
02C-
03C-
04C-
05C-
06C-
07C-
08C-
09C-
09H-
08H-
07H-
06H-
05H-
04H-
03H-
02H-
01H-
TSH-
TEH-
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
0.70v 97d NDD
0.72v 43d
0.52v 261d
0.63v 53d 90%
TSH + 1.22
Next-Last Tube
Refresh
(52)
Zoom
30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen

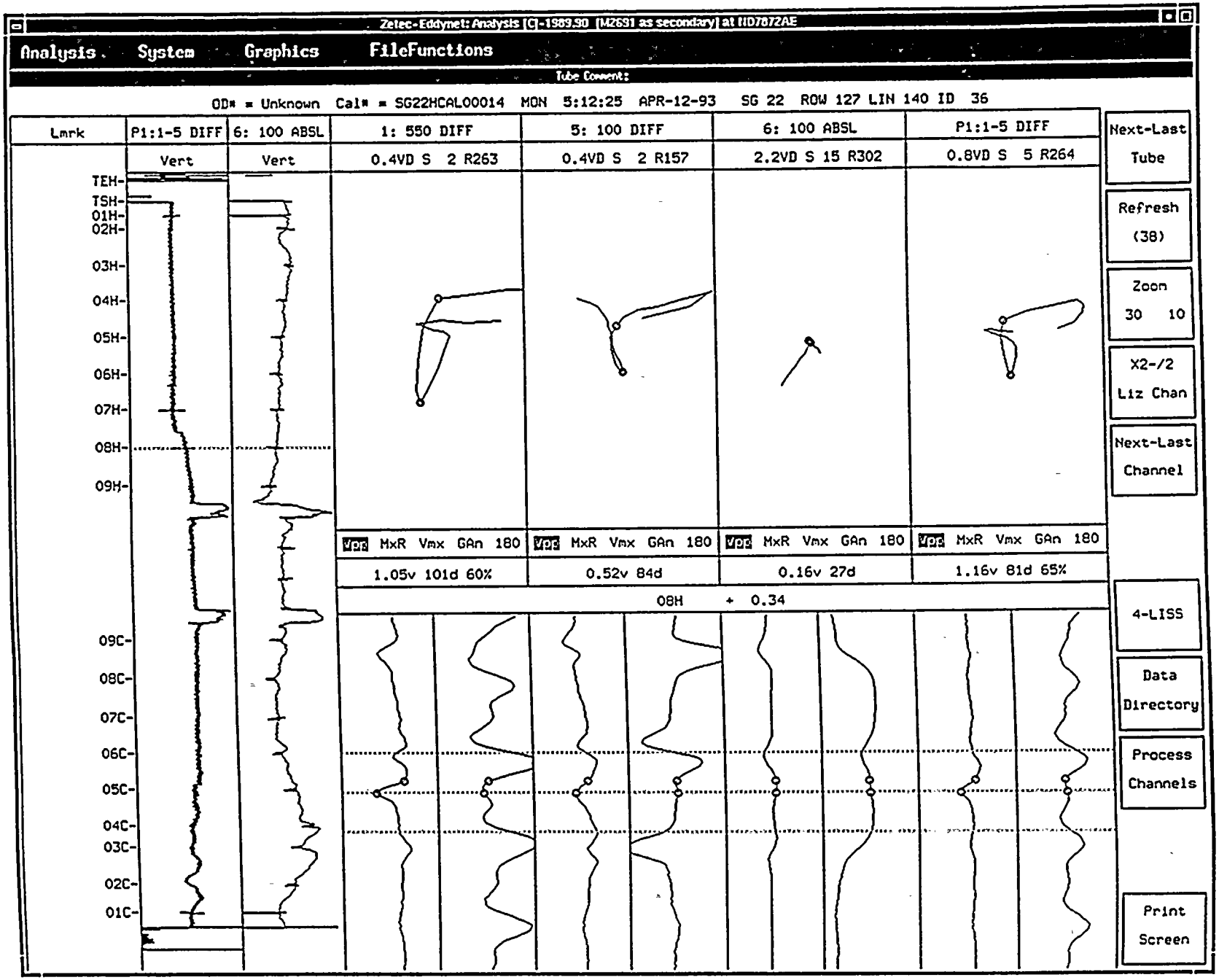

Zetec-Eddynet: Analysis [C]-1989.30 [MZ691 as secondary] at !ID7872AE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD# = Dk__idb1 Cal# = tape050A.cal03 SUN 3:15 JAN-01-84 ID 10 LIN 79 ROW 91 ID 185
Lmrk
P1:1-2 DIFF
4: 100 ABSL
1: 400 DIFF
2: 100 DIFF
4: 100 ABSL
P1:1-2 DIFF
Vert
Vert
0.3VD S 9 R 1
0.3VD S 7 R 0
0.1VD S 2 R 0
0.2VD S 7 R 9
TEC-
TSC-
01C-
02C-
03C-
09C-
09H-
08H-
07H-
06H-
05H-
04H-
03H-
02H-
01H-
TSH-
TEH-
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
Vpp MxR Vmx GAn 180
0.91v 112d 44%
0.75v 58d
0.24v 284d
0.72v 71d 73%
TSH + 3.91
Next-Last Tube
Refresh (32)
Zoom 30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen


Zetec-Eddynet: Analysis [C]-1989.90 [M2691] as secondary] at IID707AE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD* = Unknown Cal* = tape34C.cal04c MON 7:28 APR-06-92 SG B ROW 19 LIN 55 ID 13
Lmrk
1: 400 DIFF
6: 100 ABSL
1: 400 DIFF
3: 200 DIFF
5: 100 DIFF
P1:1-5 DIFF
Vert
Vert
0.1VD S 1 R299
0.2VD S 2 R 28
0.3VD S 4 R135
0.2VD S 2 R304
TEC-
TSC-
01C-
02C-
03C-
04C-
05C-
06C-
07C-
Vpt MxR Vmx GAn 180
Vpt MxR Vmx GAn 180
Vpt MxR Vmx GAn 180
Vpt MxR Vmx GAn 180
0.33v 47d 96%
0.58v 75d 54%
0.28v 132d
0.43v 46d 93%
07H-
06H-
05H-
04H-
03H-
02H-
01H-
TSH-
TEH-
01H + 0.73
Next-Last Tube
Refresh (30)
Zoom 30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen


Zetec-Eddynet: Analysis [C]-1989.90 [MZ691 as secondary] at IID7872AE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD# = Unknown Cal# = tape34C.cal04c MON 7:28 APR-06-92 SG B ROW 19 LIN 55 ID 13
Lmrk
1: 400 DIFF
6: 100 ABSL
1: 400 DIFF
3: 200 DIFF
5: 100 DIFF
P1:1-5 DIFF
Vert
Vert
0.2VD S 2 R299
0.2VD S 2 R 28
0.3VD S 4 R135
0.2VD S 2 R304
TEC-
TSC-
01C-
02C-
03C-
04C-
05C-
06C-
07C-
07H-
06H-
05H-
04H-
03H-
02H-
01H-
TSH-
TEH-
Vpp 1xF Vmx GAn 180
Vpp 4xF Vmx GAn 180
Vpp 4xF Vmx GAn 180
Vpp 4xF Vmx GAn 180
0.59v 138d 28%
0.93v 105d 17%
0.62v 93d
0.51v 113d 33%
02H + 0.65
Next-Last Tube
Refresh (3D)
Zoom 30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen


Zetec-Eddynet: Analysis [G-1989.90 [MZ691 as secondary] at IID787ZAE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD# = Unknown Cal# = tape34C.cal04c MON 6:57 APR-06-92 SG B ROW 96 LIN 116 ID 8
Lmrk
1: 400 DIFF
6: 100 ABSL
1: 400 DIFF
3: 200 DIFF
5: 100 DIFF
P1:1-5 DIFF
Vert
Vert
0.5VD S 6 R299
0.9VD S 11 R 28
0.7VD S 9 R135
0.4VD S 5 R304
TEC
TSC
01C
02C
03C
04C
05C
06C
07C
08C
09C
10C
10H
09H
08H
07H
06H
05H
04H
03H
02H
01H
TSH
TEH
Vpt MxR Vmx GAn 180
0.73v 119d 44%
Vpt MxR Vmx GAn 180
1.17v 92d 33%
Vpt MxR Vmx GAn 180
0.88v 80d 16%
Vpt MxR Vmx GAn 180
0.70v 92d 54%
02H + 0.44
Next-Last Tube
Refresh (42)
Zoom 30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen


Zetec-Eddynet: Analysis [G-1989.90 [MZ691 as secondary] at HD7872AE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD* = Unknown Cal* = SG22HCAL00014 MON 5:12:25 APR-12-93 SG 22 ROW 127 LIN 140 ID 36
Lmrk
P1:1-5 DIFF
6: 100 ABSL
1: 550 DIFF
5: 100 DIFF
6: 100 ABSL
P1:1-5 DIFF
Vert
Vert
0.4VD S 2 R263
0.4VD S 2 R157
2.2VD S 15 R302
0.8VD S 5 R264
TEH-
TSH-
01H-
02H-
03H-
04H-
05H-
06H-
07H-
08H-
09H-
09C-
08C-
07C-
06C-
05C-
04C-
03C-
02C-
01C-
Vpp MxR Vmx GAn 180
1.59v 91d 67%
Vpp MxR Vmx GAn 180
0.91v 66d 28%
Vpp MxR Vmx GAn 180
0.34v 254d
Vpp MxR Vmx GAn 180
1.88v 69d 75%
07H + 0.40
Next-Last Tube
Refresh (58)
Zoom 30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen


Zetec-Eddynet: Analysis [G-1989.50 (M2691 as secondary] at ID7872AE
Analysis
System
Graphics
FileFunctions
Tube Comment:
OD* = Unknown Cal* = SG22HCAL00014 MON 5:12:25 APR-12-93 SG 22 ROW 127 LIN 140 ID 36
Lmrk
P1:1-5 DIFF
6: 100 ABSL
1: 550 DIFF
5: 100 DIFF
6: 100 ABSL
P1:1-5 DIFF
Vert
Vert
0.4VD S 2 R263
0.4VD S 2 R157
2.2VD S 15 R302
0.8VD S 5 R264
TEH-
TSH-
01H-
02H-
03H-
04H-
05H-
06H-
07H-
08H-
09H-
09C-
08C-
07C-
06C-
05C-
04C-
03C-
02C-
01C-
Vpp MxR Vmx GAn 180
1.05v 101d 60%
0.52v 84d
0.16v 27d
1.16v 81d 65%
08H + 0.34
Next-Last Tube
Refresh (38)
Zoom 30 10
X2-/2 Liz Chan
Next-Last Channel
4-LISS
Data Directory
Process Channels
Print Screen

ISITION TECHNIQUE SPECIFICATION SHEET
3BIN IGA ODSCC "QUALIFICATION DATA SET")

ACTS# Bobbin_iga_odscc_qual.3/96	PAGE: 1 of 1
EXAMINATION SCOPE	
Material: Inconnel 600	
Outer Diameter: .750", .875"	Wall Thickness: .043", .049"
Applicability: Detection of OD IGA/SCC at and non-dented eggcrate (or similar design) support plates and sludge pile regions.	
Instrument: Miz 12, Miz 18	Probe: Bobbin
Manufacturer: Zetec	Type: A-xxx-SF, A-xxx-M/ULC
Model: Miz 12, Miz 18a	Manufacturer: Zetec
Software/Mfg./Rev.: Zetec System Disk 200/300 Series, Eddynet, Various revs.	Size: Fill Factor = 73% to 86%
CABLES	
Probe Cable: Yes	Extension Cable: Yes
Type: Shielded	Type: Shielded
Length: 83'	Length: 100'
FREQUENCIES	
Mode: Differential	Absolute
Channels/Frequencies/Voltage/Gain: PSL ANO APS 1- 400 400 560 3- 100 200 990 5- 600 100 100 7- 10 10 10	Channels/Frequencies/Voltage/Gain: PSL ANO APS 2- 400 400 560 4- 100 200 990 6- 600 100 100 8- 10 10 10
CALIBRATION METHOD	**SAMPLING RATE**
Standard: Various ASME	Samples/Sec.: =>30 Samp./in.
DATA RECORDING	
Equipment Manufacturer: Teac / HP	Model: 2300S / HCD-75z / 3968a
Media: Tape	Format: Analog / Digital
Scan Pattern: Axial	Probe Speed: Variable (see Samp/Sec)
Direction: Withdrawal	Maximum: 24"/sec.
Pitch: n/a	

ANALYSIS TECHNIQUE SPECIFICATION SHEET
(BOBBIN IGA ODSCC "QUALIFICATION DATA SET")

ANTS# Bobbin_iga_odscc_qual.3/96	Page: 1 of 1
Instrument: HP	Reference ACTS#
Manufacturer: HP	Bobbin_iga_odscc_qual.3/96
Model: 700 Series	
Software/Mfg./Rev: Zetec/Eddynet/Version 27	

DIFFERENTIAL CHANNELS

	Channel 1	Channel 3	Channel 5	Channel 7
Span:	100% @ 50% fsh	100% @ 50% fsh	100% @ 50% fsh	100% @ 50% fsh
Phase:	Probe Motion Horiz Flaws down first	Probe Motion Horiz Flaws down first	Probe Motion Horiz Flaws down first	Probe Motion Horiz Flaws down first
Cal Std:	ASME	ASME	ASME	ASME
Curve:	Phase 20,60,100%	Phase 20,60,100%	Phase 20,60,100%	Phase 20,60,100%
Volts:	Normalize 5 Volts on 4-20% FBHs	Normalize 5 Volts on 4-20% FBHs	Normalize 5 Volts on 4-20% FBHs	Normalize 5 Volts on 4-20% FBHs

ABSOLUTE CHANNELS

	Channel 2	Channel 4	Channel 6	Channel 8
Span:	ASME flaws visible & below screen sat.	ASME flaws visible & below screen sat.	ASME flaws visible & below screen sat.	ASME flaws visible & below screen sat.
Phase:	Probe Motion Horiz Flaws up first	Probe Motion Horiz Flaws up first	Probe Motion Horiz Flaws up first	Probe Motion Horiz Flaws up first
Cal Std:	ASME	ASME	ASME	ASME
Curve:	n/a	n/a	n/a	n/a
Volts:	Normalize 5 Volts on 4-20% FBHs	Normalize 5 Volts on 4-20% FBHs	Normalize 5 Volts on 4-20% FBHs	Normalize 5 Volts on 4-20% FBHs

Screen Setup (Minimum): Lt. Strip - Prime/Qtr Diff. Mix, Rt Strip - 100 Abs. (span of about 10).

Analysis Protocol: Mix on ASME Std. support ring. This technique is applied for detection & sizing of indications associated with OD IGA/SCC at non-dented eggcrate (or similar design) tube supports or sludge pile regions. A size threshold does not apply. Refer to the enclosed analysis rules and logic diagrams for analysis of indications. Free span indications above the 1st support plate, & indications which are distorted due to deposits, support plate edge effects or other interferring conditions should be considered for further evaluation and disposition or repair.

bob_qual.iga

ST. LUCIE UNIT 1

EDDY CURRENT - METALLOGRAPHY CORRELATION

LINE/ROW/SEC LOCATION	(BOBBIN) FPL FIELD	B&W LAB	B&W 8x1	ACTUAL DEPTH	DEFECT APPEARANCE
SLUDGE PILE (120/12-2)	41%	40%	-(1)	30%	IG/TG SCC PARALLEL AXIAL CRACKS. 0.4" LONGEST OVER 1" AXIAL LENGTH ACROSS 360° OF TUBE CIRC. MOST OVER 90°.
SLUDGE PILE (79/91-2) 1.4" ATS	UDS/69%(2)	≤20%	50%	16%	IGA PATCH "AXIAL" CIRC. 1/2" x 1/2"
4.4" ATS	57%	50%	60%	42%	IGA PATCH "AXIAL" CIRC. .8" x 1/2"
#1 EGG CRATE (59/95)	DSS/72%(2)	NOT SEEN	50%	52%	IGA PATCH (0.7 AXIAL x 0.3 CIRC.)
#2 EGG CRATE (59/95-5)	29%	25%	30%	13%	IGA PATCH (0.4 AXIAL x 0.3 CIRC.)
#3 EGG CRATE (120/12-7)	82%	80%	90%	72%	IGA/TG SCC PARALLEL AXIAL CRACKS IN LAND AREA 0.6" LONGEST OVER 2 INCHES AXIAL ACROSS 0.1" OF TUBE CIRC.

(1)NO DATA TAKEN
(2)POST MET LAB EVALUATION
UDS-UNDEFINED SIGNAL
DSS-DISTORTED SUPPORT SIGNAL

APPENDIX I

PULLED TUBE SAMPLE NDE

ANO-2 SG TUBE PULL SAMPLE NDE

SG	Row	Line	Location	Pre-Pull Bobbin	Pre-Pull MRPC	Pre-Pull UT	Metallography
A	13	147	TSH + 0.17"	DTI	SCI @ 80 Volts 89% Thru-Wall 360 Degrees	Multiple Circ 100% Max 61% Avg 347 Degrees	360 Degree 100% Max 94% Avg
A	55	63	TSH + 0.16"	DTI	SCI @ 40 Volts 88% Thru-Wall 360 Degrees	Multiple Circ 100% Max 49% Avg 289 Degrees	360 Degree 100% Max 88% Avg
B	19	55	TSH + 0.41"	DTI	NDD	5-20% Max Depth Circ Cracks	NDD
			TSH + 1.55"	31% Thru-Wall 0.56 Volts	NDD	NDD	NDD
			01H + 0.66"	DSI 0.26 Volts	SAI @ 0.77 Volts 46% Thru-Wall 0.72" Long	NDD	Max 52% Avg 36%
			02H + 0.70"	26% Thru-Wall 0.68 Volts	SAI @ 0.64 Volts 26% Thru-Wall 0.57" Long	NDD	Max 49% Avg not available
B	96	116	02H + 0.42"	41% Thru-Wall 0.99 Volts	SAI @ 2.05 Volts 39% Thru-Wall 0.51" Long	NDD	Max 59% Avg 41%
B	36	130	TSH + 0.06"	DTI	SCI @ 7 Volts 80% Thru-Wall 360 Degrees	Wrong location tested	360 Degree 100% Max 88% Avg

surfaces and there appears to be numerous unopened surface cracks. The axial preference of the opened cracks is due to the tube being squeezed. Further away from the apex of the bend created by the tube being squeezed, the cracking has not opened up as much. There also is less surface cracking because the area away from the apex is also away from the ridge deposit.

Figure 10-17 shows the descaled tube surface of Tube R117L144 at the very bottom of the ridge deposit. In the figure the axial direction is horizontal. As mentioned above, while particulates and polishing marks are evident, no scratches were found. Short axially oriented cracks can be seen on the surface, but they have not opened up significantly and there is no grain dropout.

Tube R127L140 Section 13

Significant corrosion also occurred at several points where tubes contacted eggcrate support straps. Three such areas were burst tested and subsequently examined by SEM. The worst corrosion of an eggcrate contact point occurred at the 07H support intersection with Tube R127L140 (Section 13). This tube section leaked from a crack at a low pressure and required a bladder to complete the laboratory burst test, however vacuum grease was not used.

Figure 10-18 shows a portion of the burst face of Tube R127L140 Section 13. The figure shows the cracking extending to the outer surface of the tube. Cracking is intergranular and was branched. No transgranular cracking was evident. In this particular location there was no evidence of elongated grains near the outer surface.

Figure 10-19 presents two areas near the inner wall of the tube section in the vicinity of where the tube leaked during the burst test. Some erosion of the grains near the ID has occurred. Cracking was 100% throughwall at this location.

Date 3/7/96

Number of pages including cover sheet

TO: GARY BUTLER

Phone

Fax Phone (407) 494 - 5090

FROM:

Arizona Public Service

5801 S Wintersburg Road
Mail Station 7696
Tonopah, AZ 85354-7529

Phone (602) 393-5049

Fax Phone (602) 393-5366

CC: Rich Schaller

REMARKS: ☐ Urgent ☐ For your review ☐ Reply ASAP ☐ Please Comment

POST TUBE PULL GRAPHICS

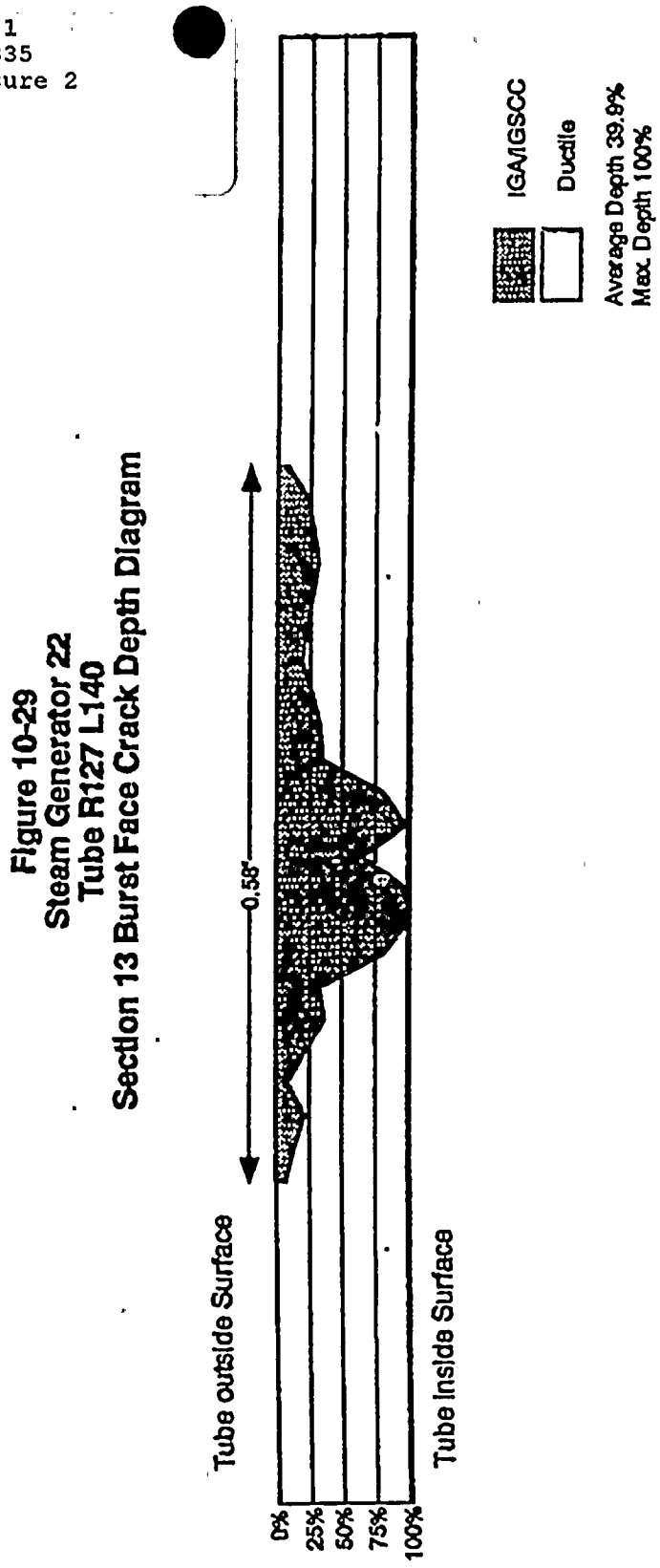


Figure 10-29
Steam Generator 22
Tube R127 L140
Section 13 Burst Face Crack Depth Diagram

(THEC)

Figure 10-29. Steam Generator 22 Tube R127L140 Section 13 Burst Face Crack Depth Diagram.

Because of relative movement between the tube and the support, a significant amount of surface wear occurred on the OD of the tube. Evidence of this is seen in Figure 10-20. Severe elongation of grains is shown in the figure, especially near the OD surface, that is 4-5 grains deep (roughly 4 mils). Beyond this depth the grains are similar in appearance to those shown in Figure 10-18. Also shown in Figure 10-20 is a ligament. Ligaments were present over the whole burst surface. Figure 10-21 shows the outer surface of Tube R127L140 where it contacted a 07H support strap. The figure shows a tube wear mark next to the burst fracture. The burst fracture is intergranular in this area where the grains at the surface have been smeared and elongated by mechanical means. There is evidence of other surface cracks in the wear area.

Tube R127L140 Section 15

The portion of Tube R127L140 that contacted the 08H support (Section 15) also experienced intergranular corrosion. This section was burst tested, sectioned and then examined by SEM. The corrosion in this section was similar, but not as deep as that of the 07H support. The maximum penetration (%TW) was 89.3 and the average penetration (%TW) was 58.0. Also smeared grains were not seen on this sample. Cracking was similar to the cases presented earlier; cracking was OD initiated, intergranular, with no signs of transgranular cracking, branching can be seen from the main crack and there were numerous ligaments on the burst crack.

Tube R117L144 Section 13

The 07H eggcrate support contact region of Tube R117L144 (Section 13) also experienced OD initiated intergranular corrosion. This section was pressurized to 7938 psi when it developed a leak. It was descaled in an EDTA solution and dye penetrant tested. Unlike the other areas of corrosion mentioned this area consisted of 4-5 short axially oriented cracks. The area

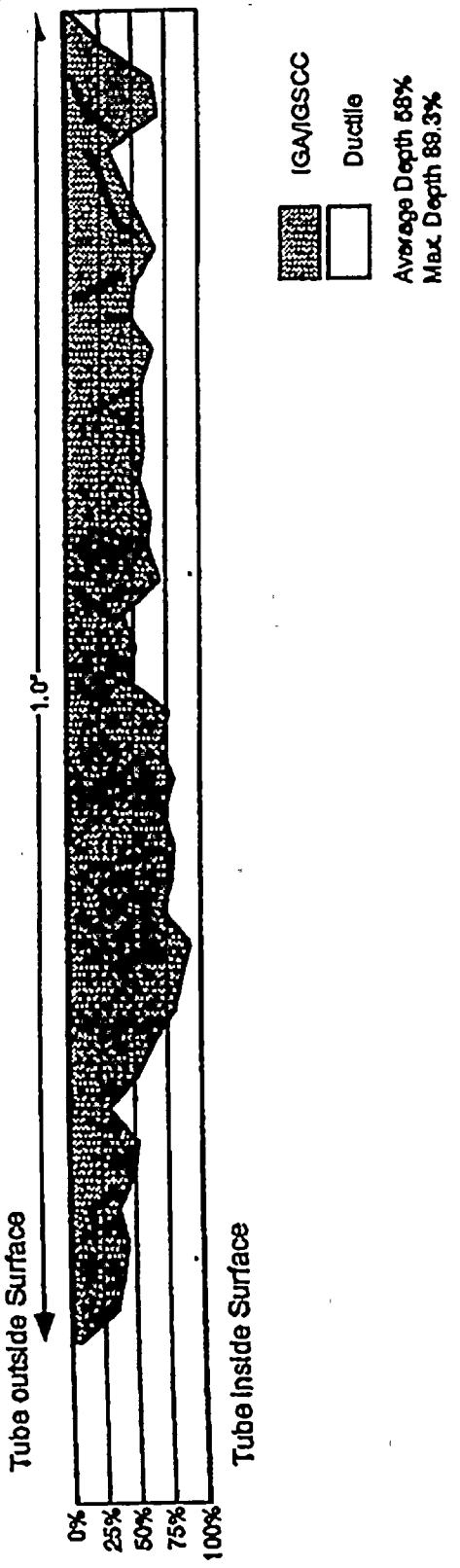


Figure 10-30
Steam Generator 22
Tube R127 L140
Section 15 Burst Face Crack Depth Diagram

8HEC

Figure 10-30. Steam Generator 22 Tube R127L140 Section 15 Burst Face Crack Depth Diagram.