

1985 LICENSE CONDITION 3.E STEAM GENERATOR INSPECTION

SAN ONOFRE UNIT 1

DOCKET NO. 50-206

February 1986

Southern California Edison Company

Rosemead, California

8603120076 860310
PDR ADDCK 05000206
Q PDR

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
Table of Contents	i
I. Introduction and Summary	1
II. Scope of Inspection	2
A. Inspection Scope Planned	2
B. Inspection Scope Performed	3
III. Inspection and Analytical Methodology	4
A. ECT Data Gathering	4
B. ECT Data Analysis	5
IV. Inspection Results	6
V. Steam Generator Operating History	7
VI. Conclusions	7
VII. References	9
Appendix A - Tubesheet Map	
Appendix B - Comparison of 1980 and 1985 ECT Data	

I. INTRODUCTION AND SUMMARY

A. Introduction

The purpose of this report is to provide to the Nuclear Regulatory Commission the information necessary to facilitate the NRC review of the results of the San Onofre Unit 1 (SONGS 1) steam generator inspection. This inspection was performed to meet the requirements of License Condition 3.E, Steam Generator Inspections, of Provisional Operating License No. DPR-13. Specifically, 3.E states:

During the refueling outage scheduled to begin no later than November 30, 1985, Southern California Edison shall perform an inspection of the steam generators. The inspection program shall be submitted to the Commission at least 45 days prior to the scheduled shutdown. Commission approval shall be obtained before resuming power operation following this inspection.

Accordingly, by letter dated July 5, 1985, Southern California Edison submitted a program for the steam generator inspection to be performed in compliance with License Condition 3.E. The inspection program, discussed in Section II of this report, indicated that SCE would perform the 3.E inspection in steam generator "B" since the results of previous inspections have shown that, in the region to be inspected, all three steam generators are behaving in a like manner. The program also described the eddy current inspection, analytical techniques and the method of repair.

B. Summary

This report provides a description of the results of the steam generator inspection performed to comply with License Condition 3.E and should allow the NRC staff reviewers to conclude that it is appropriate to approve resumption of power operation at SONGS 1 as it relates to the inspection of steam generators. Section II of this report provides a point-by-point description of the actions performed to complete the inspection program provided in our July 5, 1985 letter. Section III provides a description of the eddy current testing (ECT) and analytical methodology used in the inspection program. Section III also discusses the advancement in ECT technology and how the application of this technology at SONGS 1 allows a more accurate determination of the inservice condition of the non-sleeved steam generator tubes. This ECT advancement and consequent additional confidence in the ECT results form the basis for a revision of our current commitments regarding the plugging criteria for the non-sleeved tubes and inspection periodicity.

Section IV describes the results of the steam generator inspection and discusses the appropriateness of performing eddy current inspections of the non-sleeved steam generator tubes at refueling outage intervals. Section V discusses the steam generator operating history of SONGS 1 over the period since 1980. Section VI presents a summary of the conclusions reached throughout the report. Section VI also presents SCE's determination that: (1) it is appropriate that San Onofre Unit 1 be approved for resumption of power operation as it relates to the inspection of steam generators, (2) it is appropriate to inspect non-sleeved tubes at refueling outage intervals, and (3) the plugging limit for the non-sleeved tubes should be that which is described in Technical Specification 4.16.E.1.C. Finally, Section VII provides a listing of the references used in the report.

II. SCOPE OF INSPECTION

It is the purpose of this section to provide a description of the steam generator inspection scope planned to comply with License Condition 3.E, Steam Generator Inspections. The discussion also provides a point-by-point description of the scope planned and the scope completed.

A. Inspection Scope Planned

The general plan submitted in our letter of July 5, 1985 consisted of three basic areas:

1. Cold Secondary Side Leakage Test (If Necessary)

The cold secondary side leakage test consists of an 800 psid secondary-to-primary differential pressure test. The cold secondary side leakage test is intended to locate the source of primary-to-secondary leakage.

2. ECT of Non-Sleeved Steam Generator Tubes

Inspect approximately 30% of the non-sleeved tubes in steam generator "B" from the hot leg side to just below the first tube support plate. Only "B" steam generator is to be inspected since the results of previous inspections have indicated that all steam generators are performing in a like manner.

The inspection program consists of all non-sleeved tubes within two tubes of the sleeving repair boundary and a four-by-four pattern throughout the remainder of the periphery. This program is conducted utilizing the latest eddy current equipment available to the industry and San Onofre Unit 1. Data is collected using a MIZ-18 digital data collection system and analyzed with the DDA-4 digital analysis system. As stated in the July 5, 1985 submittal, the ECT inspection program uses two different probes, the standard bobbin coil probe and the 8 x 1 probe. Information gathered from the bobbin coil probe allows correlation to previous inspection data to further assess the IGA progression rate in the non-sleeved region.

If any tube inspected has an IGA indication greater than or equal to 50%, then additional tubes would be inspected until one tube without detectable IGA is found. In addition, the other two steam generators would be inspected in accordance with the above inspection plan.

3. Steam Generator Inspection Data Evaluation and Repair

All data generated in this inspection is evaluated using the DDA-4 digital data analysis system. The use of the DDA-4 improves the consistency and repeatability of interpretation.

The plugging criteria are consistent with that used to establish the original repair boundary. Specifically, all tubes with detectable IGA indications at the top of the tubesheet will be plugged. In addition, any non-sleeved tube immediately adjacent to a tube with an IGA indication greater than or equal to 50% will be plugged.

B. Inspection Scope Performed

1. Cold Secondary Side Leakage Test

The cold secondary side leakage test discussed above was to be conducted due to an indication of primary-to-secondary leakage that had been occurring at various leakage rates since the SONGS 1 return to service on November 27, 1984. The leakage started during March, 1985, and had an average leak rate of approximately 1 gallon per day (gpd) with a onetime peak of 5 gpd. The leak rate was 1 gpd when the Unit shut down on November 21, 1985.

The leak behavior was similar to the leakage experienced before SONGS 1 shut down for an interim eddy current inspection on February 27, 1982. During this February 27 outage, a leak test was conducted on all three steam generators and in steam generator "C" three tubes with leak limiting sleeves were found to be leaking at about 1-2 drops per minute. The results of that inspection were reported to the NRC as part of a report enclosed with our letter dated September 21, 1982. Based on the observed leak rate it was determined that the recently observed leakage is consistent with the allowable leakage design margin for leak limiting sleeves and the limits as stated in the Technical Specifications. Therefore, considering its similarity to the previous leakage and its technical specification acceptability, the test was not performed.

2. Eddy Current Testing

Multiple frequency ECT of 417 tubes (approximately 30% of the non-sleeved tubes in the "B" steam generator) was conducted with the standard bobbin coil probe and the 8 x 1 surface riding probe. The appropriateness of these probes is further discussed in Section III of this report. This ECT program was designed to assess the extent to which Intergranular Attack (IGA) is occurring at the top of the hot leg tubesheet. As shown in Figure 1 (Appendix A), the inspection pattern consisted of all non-sleeved tubes which lie within either two rows or columns of the sleeving repair boundary plus every fourth row and column (one sixteenth of the tubes) of the remainder of the non-sleeved tubes.

3. Steam Generator Inspection Data Evaluation and Repair

When the results of this inspection were evaluated, no tubes with IGA indications at the top of the tube sheet were detected in the 417 tubes inspected (see Section IV of this report) and no tubes required repair.

Based on the absence of indications of IGA in the tubes inspected, it is concluded that the current inservice condition of the non-sleeved steam generator tubes is adequate for the resumption of power operation.

III. INSPECTION AND ANALYTICAL METHODOLOGY

The purpose of this section is to provide a discussion of our application of ECT and analytical methodologies and the appropriateness of their use at SONGS 1.

A. ECT Data Gathering

Each tube was tested on the hot leg side of the steam generator from the entrance of the tube to just below the first tube support plate with two different probes, the standard bobbin coil and the 8 x 1 probe. The bobbin coil inspection was conducted utilizing the following frequencies; 400 KHz, 340 KHz, 100 KHz and 10 KHz. Each frequency was generated in both the differential and absolute modes. Based on industry research and as stated in the March 19, 1985 submittal, using the above frequencies the bobbin coil can detect the type of IGA found at SONGS 1 which exceeds 20% through-wall. The basis for the use of the 100 KHz absolute is further discussed in the report entitled "1985 Re-evaluation of Steam Generator Inspection Interval," submitted by our letter of March 19, 1982. The acceptability of the use of this frequency is discussed in the Safety Evaluation Report (SER) attached to Amendment No. 84 to Provisional Operating License No. DPR-13 dated June 5, 1985. The bobbin coil information also allows correlation to previous eddy current inspection data to further assess the IGA progression rate in the non-sleeved peripheral region of the steam generator.

The 4 x 4 probe used in past inspections was replaced by the industry standard 8 x 1 probe for the following reasons: 1) an 8 x 1 probe has eight individually monitored pancake probes which provide an indication of the circumferential extent of a defect and more sensitivity than does the series connection of each set of four pancake coils in the 4 x 4 probe, and 2) utilizing the increased capacity of the MIZ-18, each of the eight coils can be operated at two separate frequencies (300 KHz and 100 KHz) providing the capability to "mix out" the tubesheet entry signal and eliminating the need to compromise sensitivity using the 4 x 4 probe. SONGS 1 and industry experience has shown that pancake probes are better than the bobbin coil in detecting circumferential IGA. In past eddy current inspections, the pancake probe was used at SONGS 1 as the final test to identify if IGA was present and to aid in the determination that the tube should be removed from service. By combining the quantification capabilities of the bobbin coil and the detection capabilities of the 8 x 1 probe, the steam generator inspection program provided the best possible assessment of the condition of the non-sleeved tubes at the top of the hot leg tubesheet.

B. ECT Data Analysis

ECT data was collected utilizing the state-of-the-art MIZ-18 digital data collection system and analyzed with the DDA-4 digital analysis system. The evaluation of the ECT data using this hardware assures the consistency and repeatability of interpretation.

The data, once acquired, was analyzed utilizing the techniques defined in the SONGS 1 Eddy Current Data Interpretation Guidelines. These specific interpretation guidelines were developed by SCE to aid the eddy current analyst's evaluation of the SONGS 1 ECT data. The guidelines specify the type, extent and location of steam generator tube degradation found in the SONGS 1 steam generator tubing. The guidelines were developed based upon an extensive historical review of the ECT data from previous steam generator inspections, giving the eddy current analyst the ability to quickly refer to the previous history of specific tubes or areas in the steam generator. The guidelines also discuss the ECT techniques used to inspect the SONGS 1 steam generators and discuss the various strengths and limitations of each technique. The discussion of previous steam generator history also allows the eddy current analyst to be aware of inservice conditions such as thinning, denting or sludge that may affect the interpretation of a flaw.

Each of the 417 tubes was analyzed using the hardware and guidelines discussed above and the results are discussed in Section IV. The use of the SONGS 1 specific interpretation guidelines, coincident with the state-of-the-art hardware such as the DDA-4 and MIZ-18 provides confidence in the quality and accuracy of the inspection results.

Based upon the information provided above, it is concluded that the ECT and analytical methodologies as applied during the SONGS 1 License Condition 3.E Steam Generator Inspection are appropriate for assessment of the inservice condition of the non-sleeved steam generator tubes at the top of the hot leg tubesheet. It is also concluded that the application of these methodologies makes it appropriate to revise our current commitment regarding the plugging criteria for non-sleeved tubes established as part of our last license condition steam generator inspection.

IV. INSPECTION RESULTS

It is the purpose of this section to summarize the results of the ECT performed as part of the License Condition 3.E steam generator inspection.

The ECT results did not identify any tubes with IGA. However, when the results of the 417 tubes were compared to corresponding historical data, 47 tubes that had apparent new degradation above the top of the tubesheet were identified. To investigate if the degradation was new or due to improved detection capabilities, the 1985 ECT results were compared to the 1980 results for 52 indications in the 47 tubes. This comparison was done utilizing the DDA-4 to provide consistent results. The comparisons are provided in Appendix B along with the associated ECT data.

The result of the comparisons was that the steam generator tubes underwent a calculated mean growth of -1.1% over an operating time of 13.6 Equivalent Full Power Months (EFPM). This comparison identified 12 tubes with new > 20% indications and 0 cases of existing > 20% indications that had actual > 10% growth. This showed that the degradation was apparent and was, in fact, due to improved detection capabilities. Out of the 12 tubes with new > 20% indications only two tubes had no previous detectable defect.

A summary of the results of the non-sleeved tube inspection is as follows:

Tubes tested	417
Tubes compared between 1980 and 1985 (13.6 EFPM)	47
Tubes with new > 20% indications	12
Tubes with actual > 10% growth	0
Tubes plugged (IGA)	0
Mean Change	0(-1.1%)
Standard Deviation	10.8
Calculated Mean Growth (%/EFPM)	0(-0.08%)

The overall inspection yielded no tubes that had IGA indications. Therefore, it is concluded that the postulated IGA growth rate determined in SCE's March 19, 1985 report is adequately conservative and should not exceed 10% per refueling outage operating cycle (15 EFPM). Accordingly, it is concluded that it is appropriate that the non-sleeved steam generator tubes be inspected as part of the overall steam generator inspections performed in compliance with Technical Specification 4.16, Inservice Inspection of Steam Generator Tubing.

V. STEAM GENERATOR OPERATING HISTORY

The purpose of this section is to provide a discussion of the steam generator water chemistry, both prior to and during the most recent operating cycle and to provide a discussion of the unit operating history during the most recent operating cycle as they relate to the inservice condition of the non-sleeved tubes in the SONGS 1 steam generators.

Since SONGS 1 return to service on November 27, 1984, there have been three scheduled and five forced outages. It is noted that none of these outages were due to condenser leaks or extraordinary steam generator water chemistry conditions.

An overview of the steam generator water chemistry from 1980 to return to service on November 27, 1984 was previously provided to you in the March 19, 1985 submittal. As also stated in the submittal, since return to service on November 27, 1984, the steam generator water chemistry has been controlled and condenser problems corrected using a program that is consistent, to the extent practical, with the EPRI guidelines. Consistent with these guidelines, when condenser leaks were discovered in December 1984, February 1985 and October 1985, they were promptly corrected. Consequently the steam generator water chemistry has been consistently stable over the period of operation since return to service.

Based upon the information discussed above, it is concluded that the SONGS 1 operating history and steam generator water chemistry are consistent with the ECT results found in Section IV.

VI. CONCLUSIONS

The following conclusions have been made based upon a review of the ECT data and our steam generator operating history since return to service.

1. The results of the 1985 License Condition 3.E Steam Generator Inspection provide substantiation of the conclusions of the March 1985 Report, which conservatively concluded that the maximum IGA progression rate for the non-sleeved steam generator tubes is $\leq 10\%$ wall degradation per 15 EFPM refueling cycle operating interval. Therefore, it is deemed appropriate to provide for the reinspection of the non-sleeved steam generator tubes as part of the overall inspection required by Technical Specification 4.16, Inservice Inspection of Steam Generator Tubing. Specification 4.16.A.1, requires that the tubes selected for inspection include those where experience at San Onofre Unit 1 or experience in similar plants indicates critical areas to be inspected. Since the tubes surrounding the sleeving boundary constitute a "critical area," they would be included in any refueling outage inspection plan until such time as historical results show them to not be a "critical area" of concern.

2. The information presented in Section III of this report provides information that concludes that the eddy current technology currently being used to inspect the non-sleeved tubes is adequate to detect and quantify IGA at the top of the hot leg tubesheet as found in the SONGS 1 steam generators. Accordingly, it is concluded that the detectability/quantification issue raised as part of the sleeving repair project is now resolved and the plugging criterion in Technical Specification Section 4.16.E.1.C which states that any tube with an imperfection depth of $\geq 50\%$ of the nominal tube wall thickness shall be plugged is now appropriate for the non-sleeved steam generator tubes. Based upon these conclusions, it is determined that the implementation of the Technical Specification criteria for the plugging limit for the non-sleeved tubes is adequate to assure the continued integrity of the tubes in anticipated normal and transient operating conditions.
3. The information presented in all the sections of this report also provide adequate basis for the approval of resumption of power operation at San Onofre Unit 1 as it relates to the License Condition 3.E Steam Generator Inspection.

VII. REFERENCES

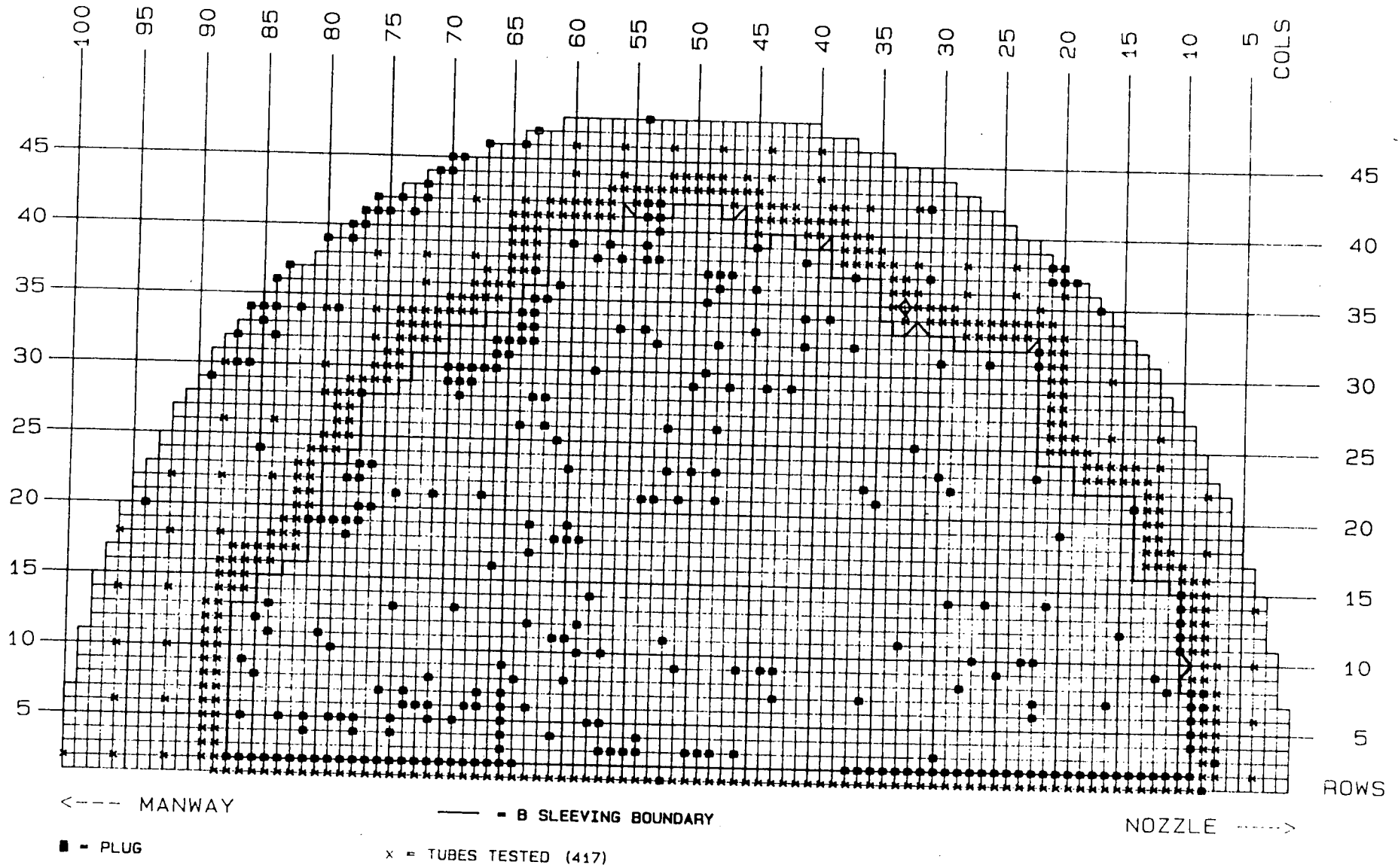
1. Letter, M. O. Medford, SCE, to J. A. Zwolinski, NRC, Steam Generator Tube Inspections, July 5, 1985
2. Letter, M. O. Medford, SCE, to J. A. Zwolinski, NRC, Steam Generator Inspections, March 19, 1985 with Enclosure "1985 Re-evaluation of Steam Generator Interval, March 1985"
3. Letter, K. P. Baskin, SCE, to D. M. Crutchfield, NRC, Steam Generator Inspection Report, September 21, 1982
4. NRC Amendment No. 84 to Provisional Operating License No. DPR-13 dated June 5, 1985

TL:6168F:7952u

APPENDIX A

FIGURE 1

STEAM GENERATOR TUBESHEET MAP



APPENDIX B

COMPARISON OF 1980 AND 1985
ECT DATA

TABLE 1

STEAM GENERATOR "B" ECT DATA COMPARISONS

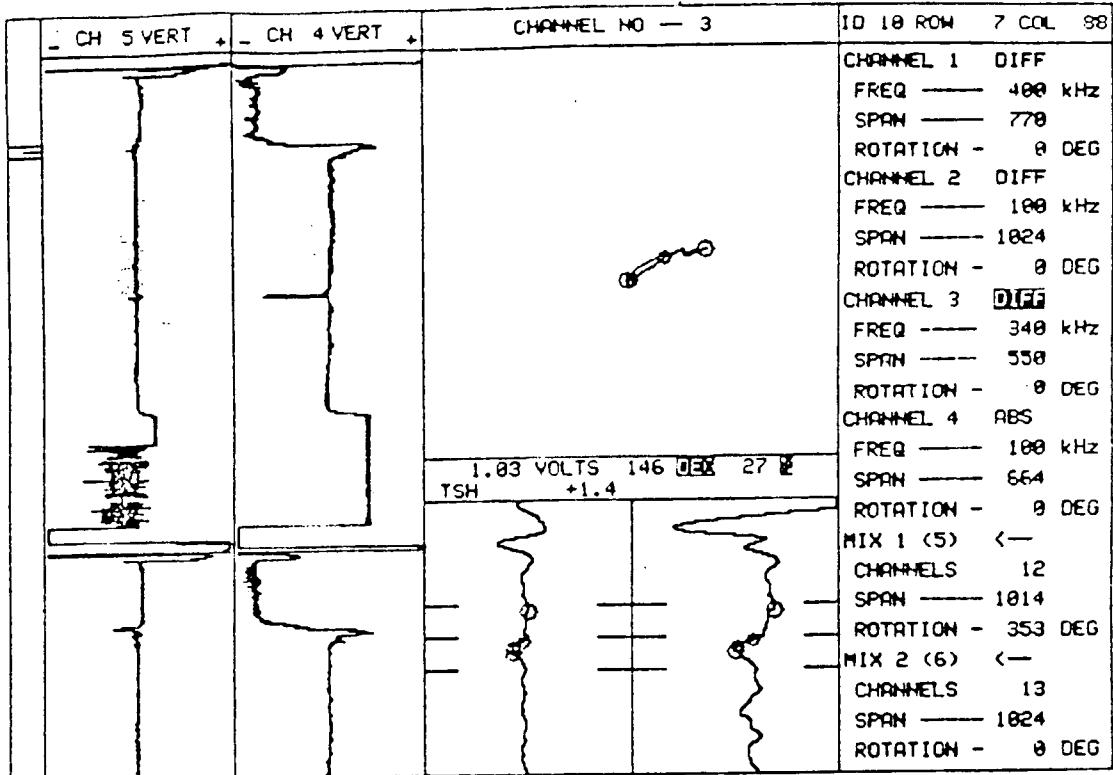
<u>Row</u>	<u>Tube</u>		<u>1980 Percent</u>	<u>1985 Percent</u>	<u>Percent Change</u>
	<u>Col</u>				
7	88		27	22	-5
9	88		19	24#	+5
10	88		36	25	-11
11	88		27	30	+3
11	88		24	28	+4
13	88		35	36	+1
14	87		26	22	-4
15	87		23	25	+2
15	88		26	25	-1
16	84		21	21	0
16	85		25	21	-4
16	86		28	28	0
17	82		25	23	-2
17	84		25	23	-2
19	82		22	27	+5
19	83		29	25	-4
20	81		17	21#	+4
25	19		17	24#	+7
25	19		27	22	-5
25	78		28	30	+2
26	19		28	38	+10
26	20		10	22#	+12
27	20		29	22	-7

<u>Row</u>	<u>Tube Col</u>	<u>1980 Percent</u>	<u>1985 Percent</u>	<u>Percent Change</u>
28	21	31	29	-2
29	78	0	22#	+22
30	74	18	27#	+9
30	76	0	25#	+25
31	74	34	21	-13
32	74	27	22	-5
32	75	20	28#	+8
33	73	29	28	-1
33	73	29	30	+1
34	26	24	24	0
34	33	19	22#	+3
35	31	25	22	-3
35	68	26	21	-5
36	65	34	22	-12
37	34	21	23	+2
38	34	22	24	+2
38	36	35	25	-10
38	36	34	26	-8
39	64	15	30#	+15
40	38	25	22	-3
41	41	34	26	-8
41	44	10	25#	+15
41	58	57	24	-33
41	59	54	21	-34
42	45	22	21	-1

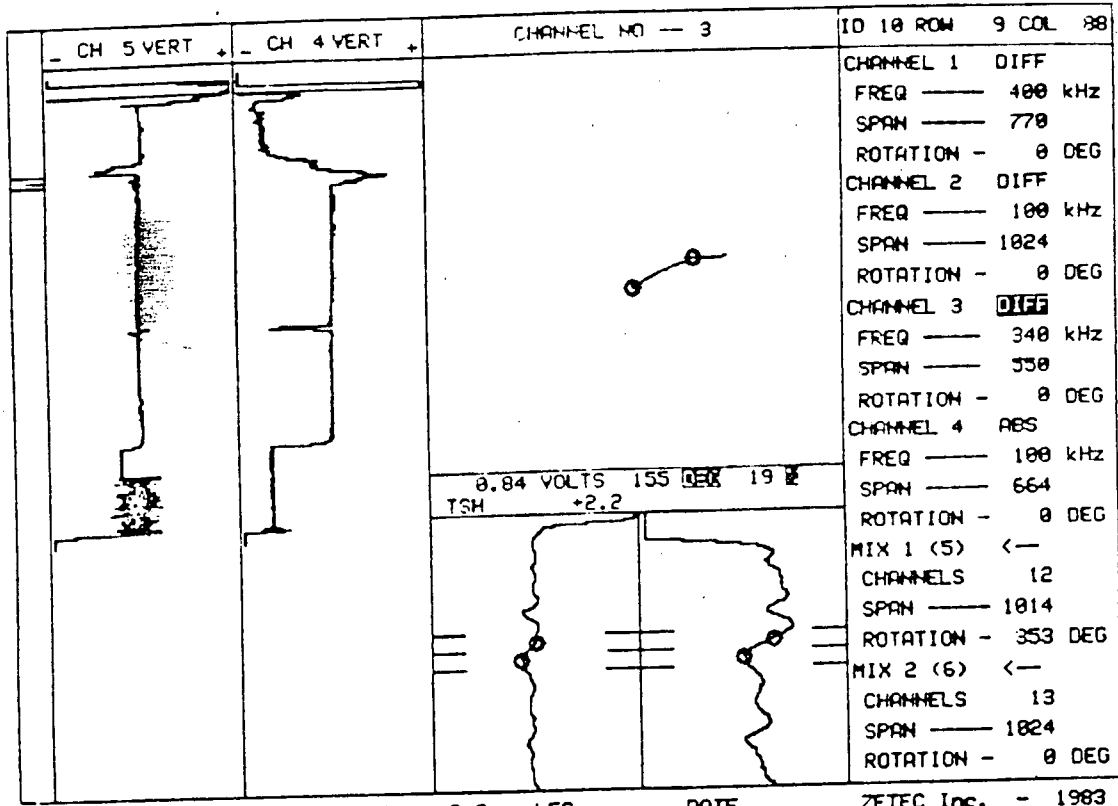
<u>Row</u>	<u>Tube Col</u>	<u>1980 Percent</u>	<u>1985 Percent</u>	<u>Percent Change</u>
42	55	23	22	-1
42	55	19	22#	+3
42	58	54	24	-30
43	48	33	32	-1

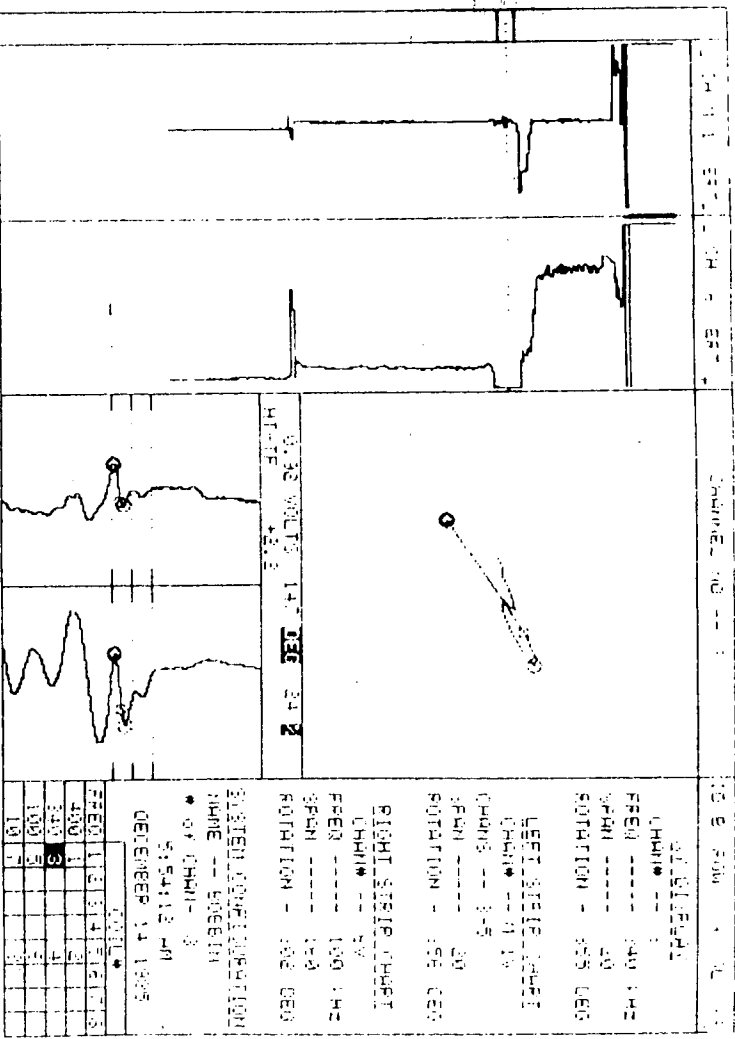
#New 20% Indications	12
Total number of tubes compared	47
Total number of indications compared	52

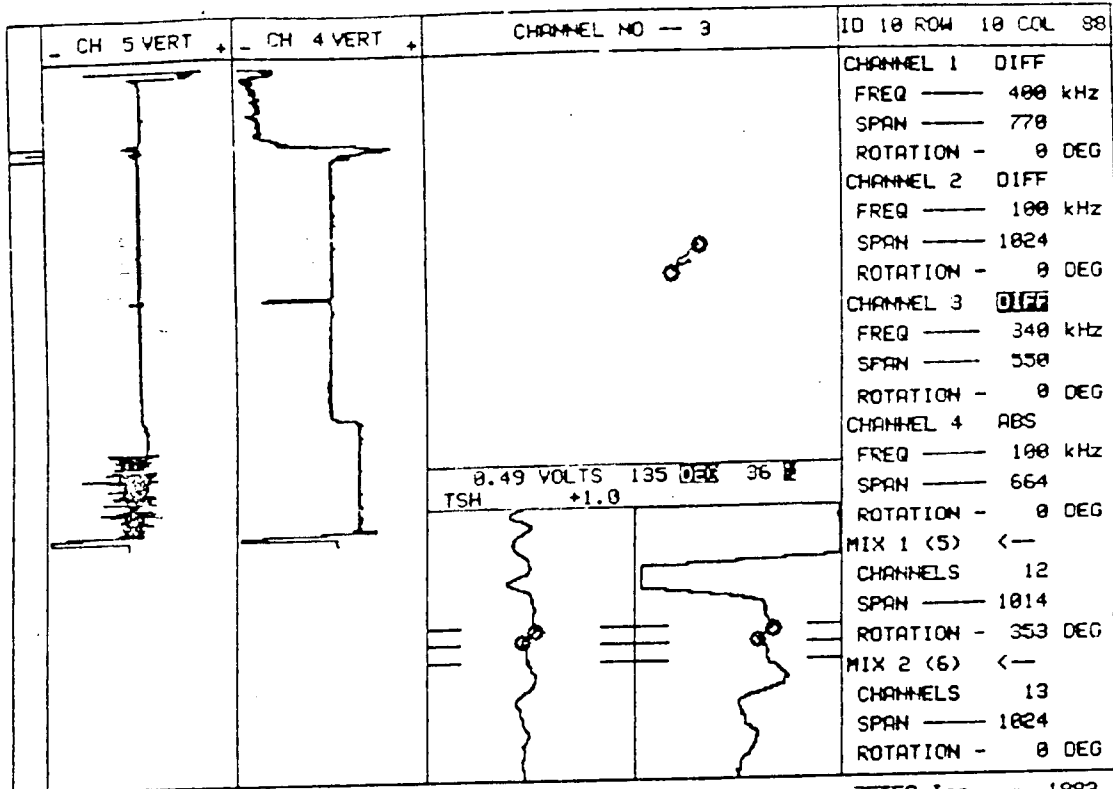
TL::6168F:7952u



20 PLANT SCE SONGS UNIT# I S/G B LEG INLET DATE 1980 ZETEC Inc. - 1983 Edition 12.0 Rev 1



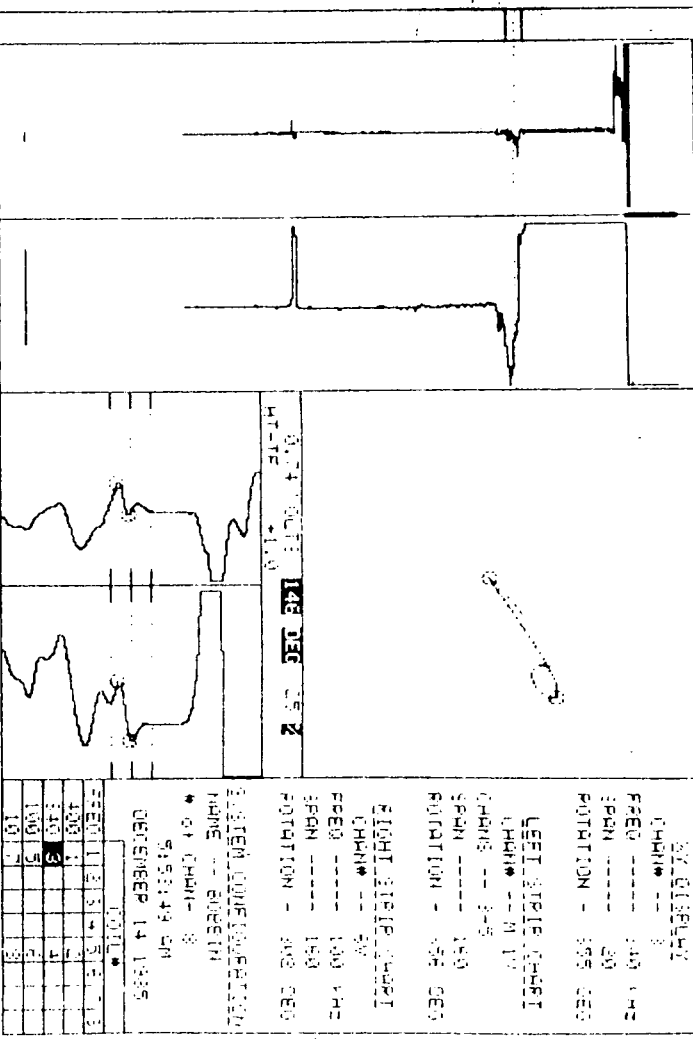




0.49 VOLTS 135 DEG 36
TSH +1.0

20	PLANT	UNIT#	S/G	LEG	DATE	ZETEC Inc. - 1983
	SCE SONGS	I	B	INLET	1980	Edition 12.0 Rev 1

CH 01 1 SEPT 1985 CH 02 2 SEPT 1985 CHANNEL NO. 1



15 PLANT 3000S DISK MAG 1 UNIT# 8 CED HOT DATE 12-13-85

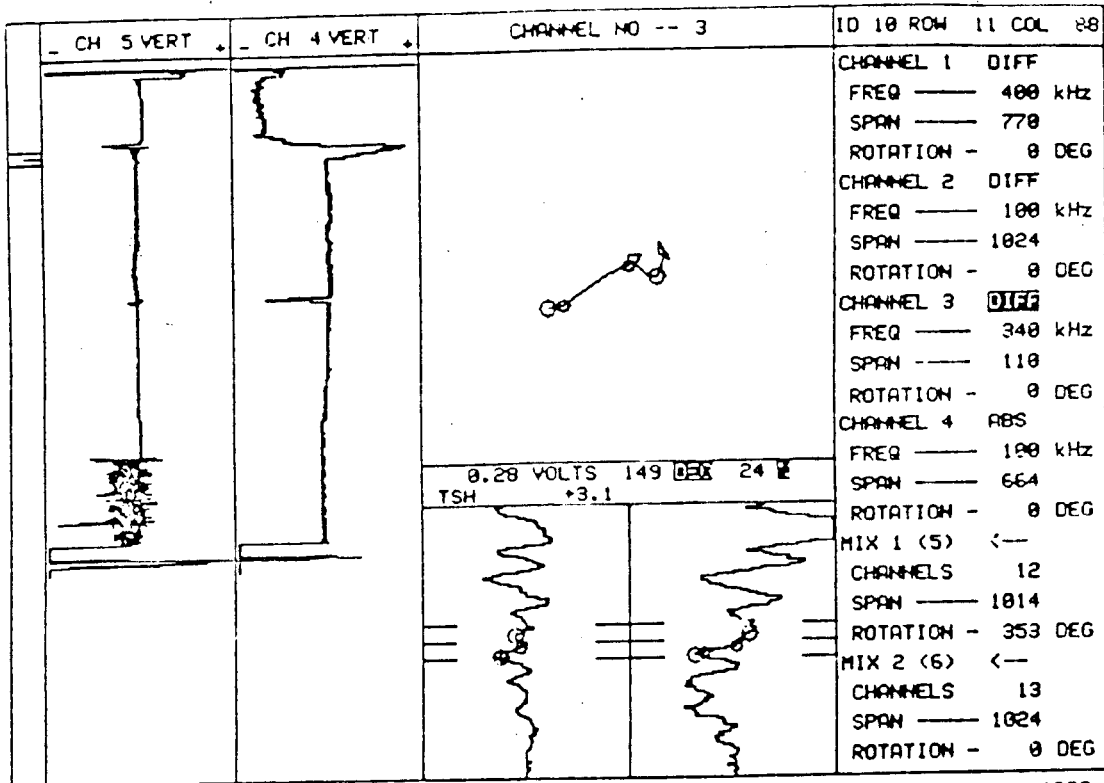
SYSTEM
 CHANNEL# 1
 FEED 100 VHS
 SPAN 20
 ROTATION - 575 CED

LEFT STRIP
 CHANNEL# 1
 CHANS 3-5
 SPAN 150
 ROTATION - 575 CED

RIGHT STRIP
 CHANNEL# 2
 FEED 100 VHS
 SPAN 150
 ROTATION - 575 CED

SYSTEM CONFIGURATION
 NAME BOBWIN
 * of Chan - 8
 5:55:49 AM
 DECEMBER 14 1985

DATE	TIME	CH	SP	ROT	FEED
12-13-85	10:00	1	1	1	1
12-13-85	10:05	1	1	1	1
12-13-85	10:10	1	1	1	1
12-13-85	10:15	1	1	1	1
12-13-85	10:20	1	1	1	1
12-13-85	10:25	1	1	1	1
12-13-85	10:30	1	1	1	1
12-13-85	10:35	1	1	1	1
12-13-85	10:40	1	1	1	1
12-13-85	10:45	1	1	1	1
12-13-85	10:50	1	1	1	1
12-13-85	10:55	1	1	1	1
12-13-85	11:00	1	1	1	1



0.28 VOLTS 149 DEG 24 V
TSH +3.1

CHANNEL NO -- 3 ID 10 ROW 11 COL 28

CHANNEL 1 DIFF
FREQ --- 400 kHz
SPAN --- 770
ROTATION - 0 DEG

CHANNEL 2 DIFF
FREQ --- 100 kHz
SPAN --- 1024
ROTATION - 0 DEG

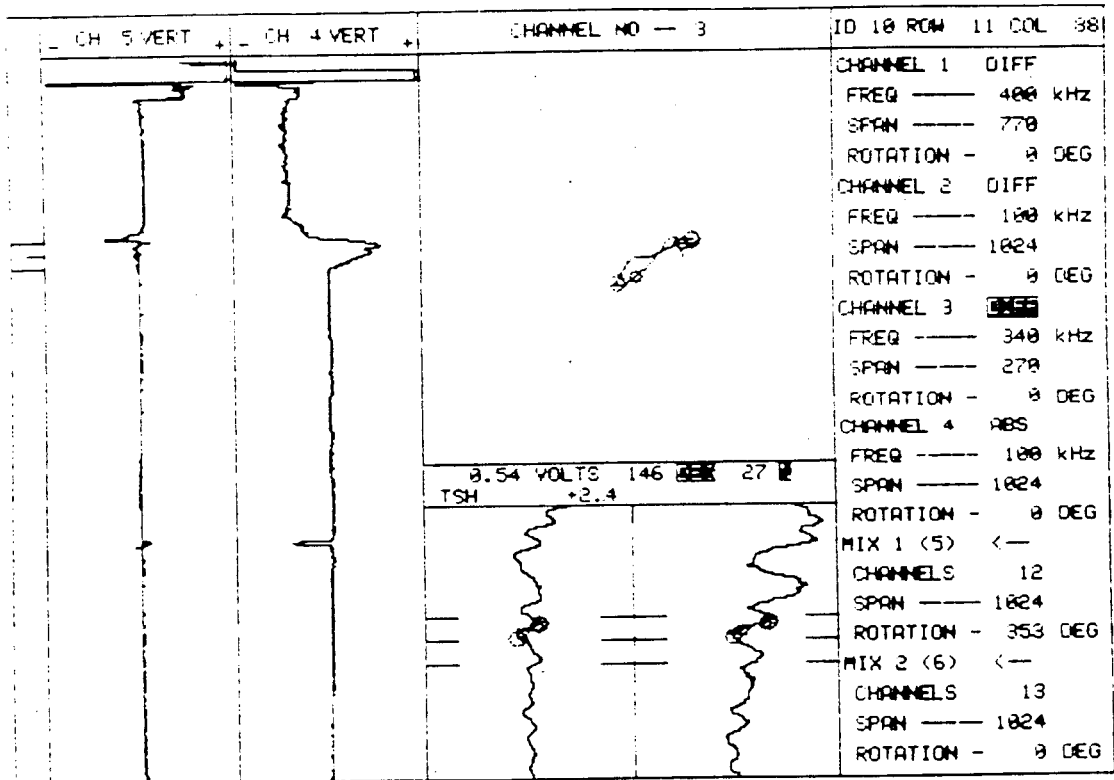
CHANNEL 3 **DIFF**
FREQ --- 340 kHz
SPAN --- 110
ROTATION - 0 DEG

CHANNEL 4 ABS
FREQ --- 100 kHz
SPAN --- 664
ROTATION - 0 DEG

MIX 1 (5) <---
CHANNELS 12
SPAN --- 1014
ROTATION - 353 DEG

MIX 2 (6) <---
CHANNELS 13
SPAN --- 1024
ROTATION - 0 DEG

20 PLANT SCE SONGS UNIT# I S/G B LEG INLET DATE 1980 ZETEC Inc. - 1983 Edition 12.0 Rev 1



0.54 VOLTS 146 DEG 27 V
TSH +2.4

CHANNEL NO -- 3 ID 10 ROW 11 COL 28

CHANNEL 1 DIFF
FREQ --- 400 kHz
SPAN --- 770
ROTATION - 0 DEG

CHANNEL 2 DIFF
FREQ --- 100 kHz
SPAN --- 1024
ROTATION - 0 DEG

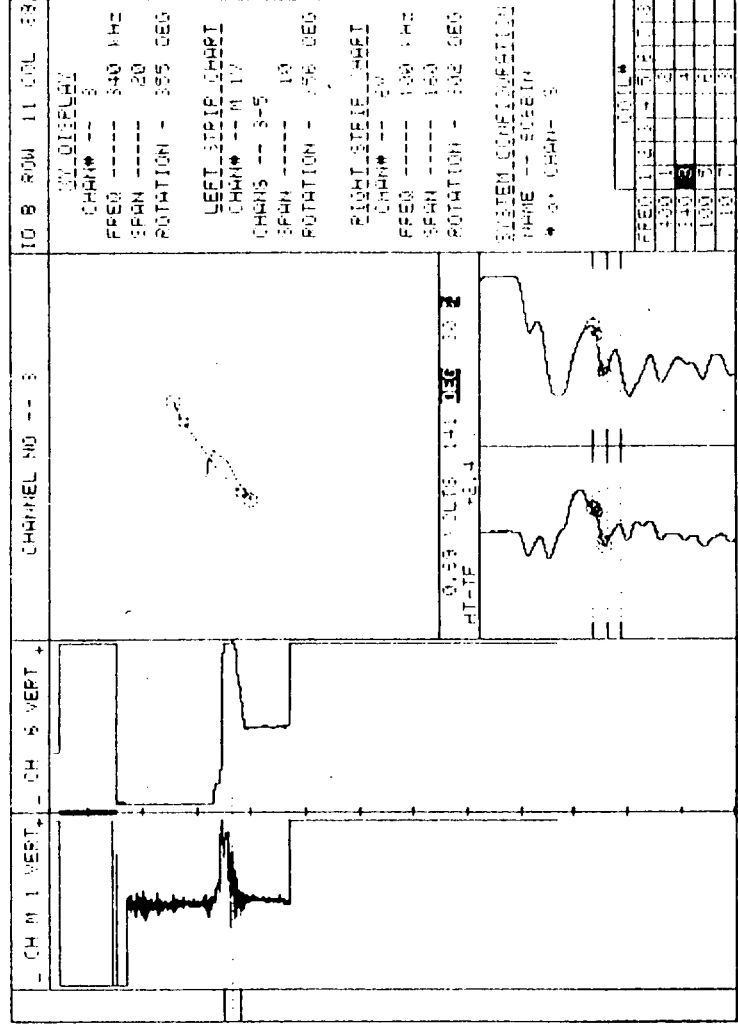
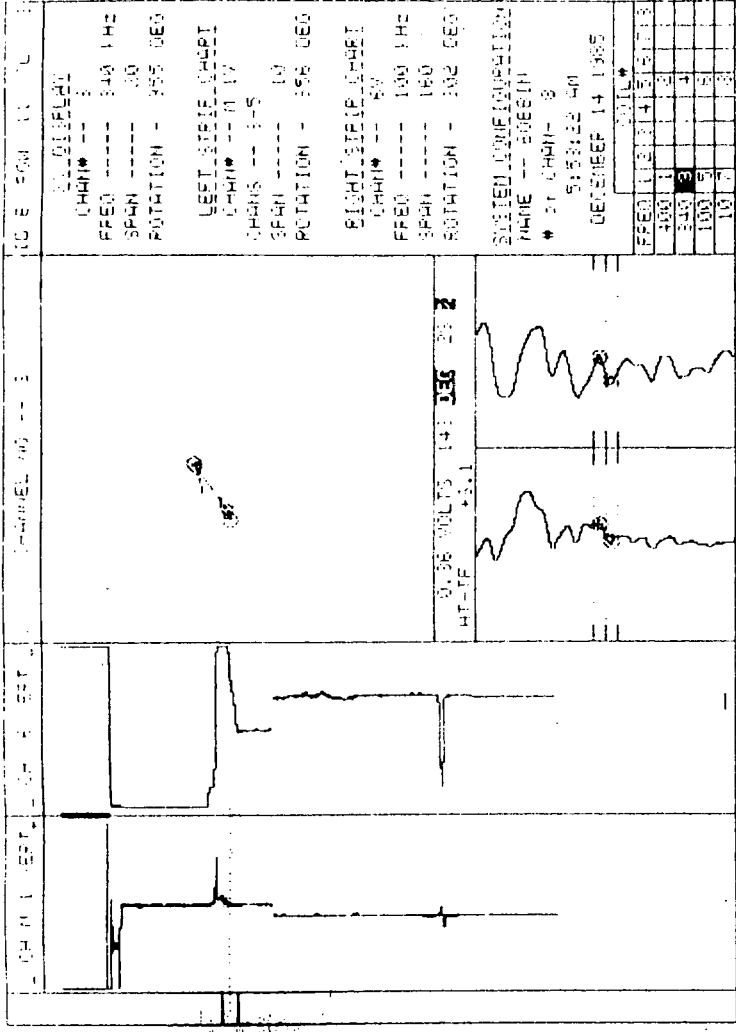
CHANNEL 3 **DIFF**
FREQ --- 340 kHz
SPAN --- 270
ROTATION - 0 DEG

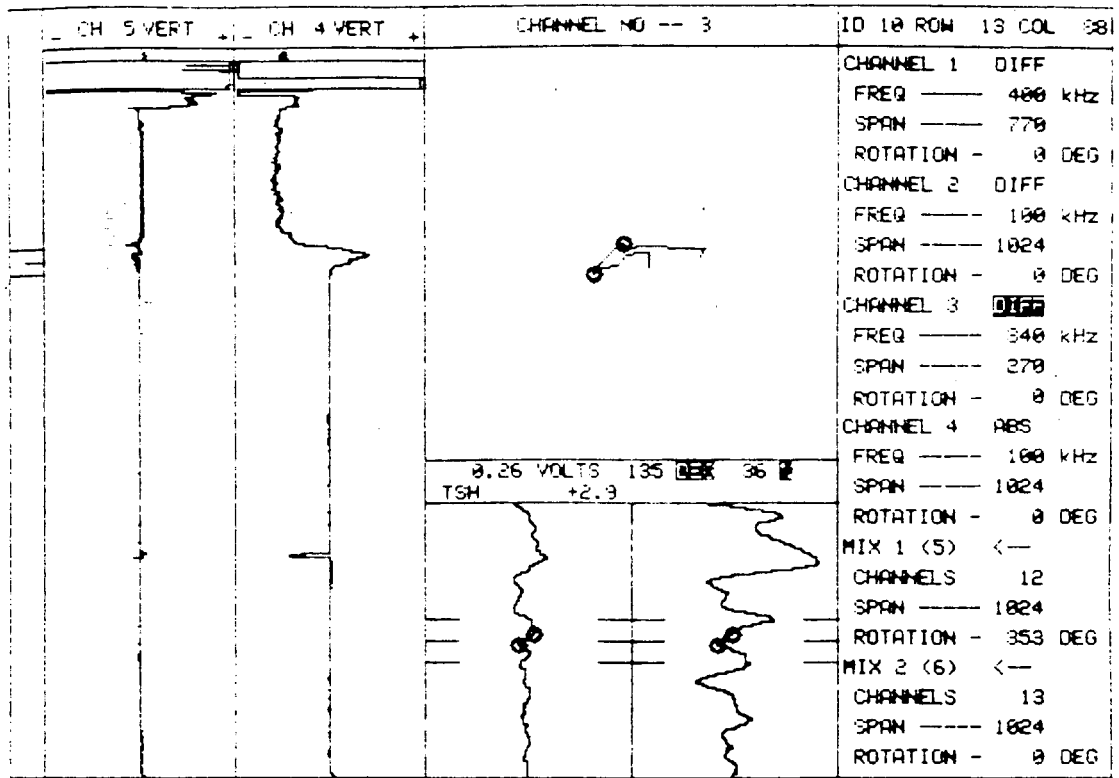
CHANNEL 4 ABS
FREQ --- 100 kHz
SPAN --- 1024
ROTATION - 0 DEG

MIX 1 (5) <---
CHANNELS 12
SPAN --- 1024
ROTATION - 353 DEG

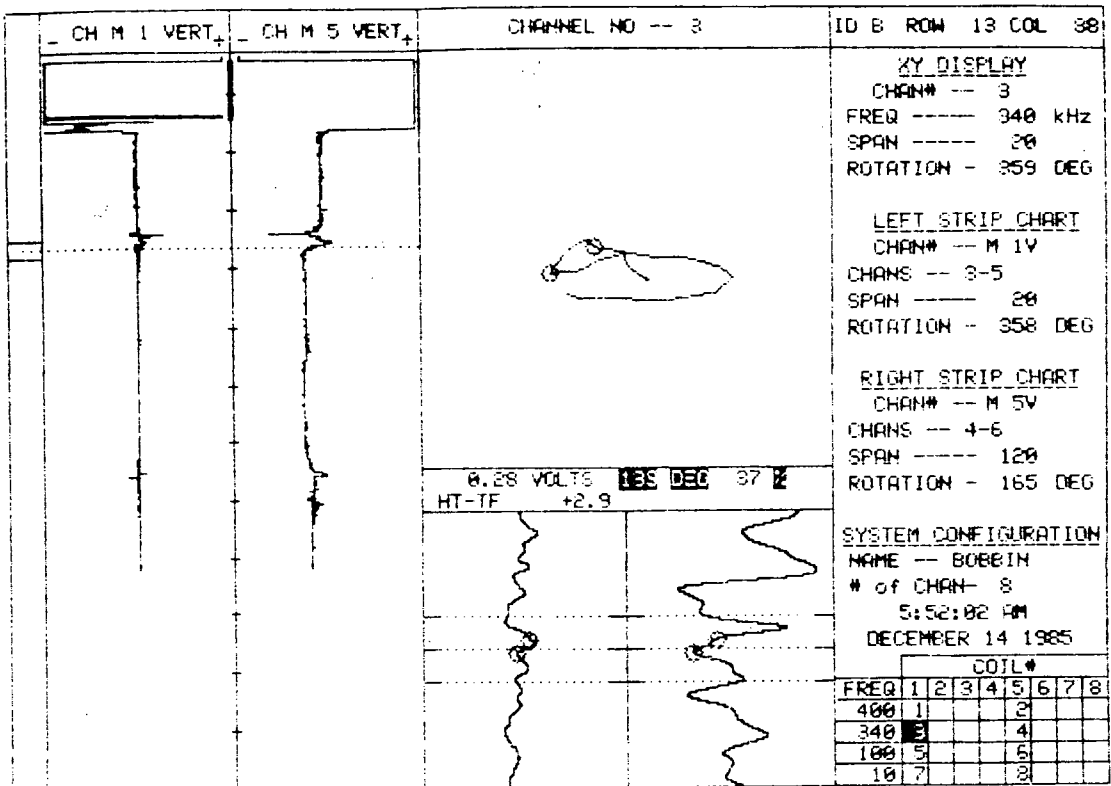
MIX 2 (6) <---
CHANNELS 13
SPAN --- 1024
ROTATION - 0 DEG

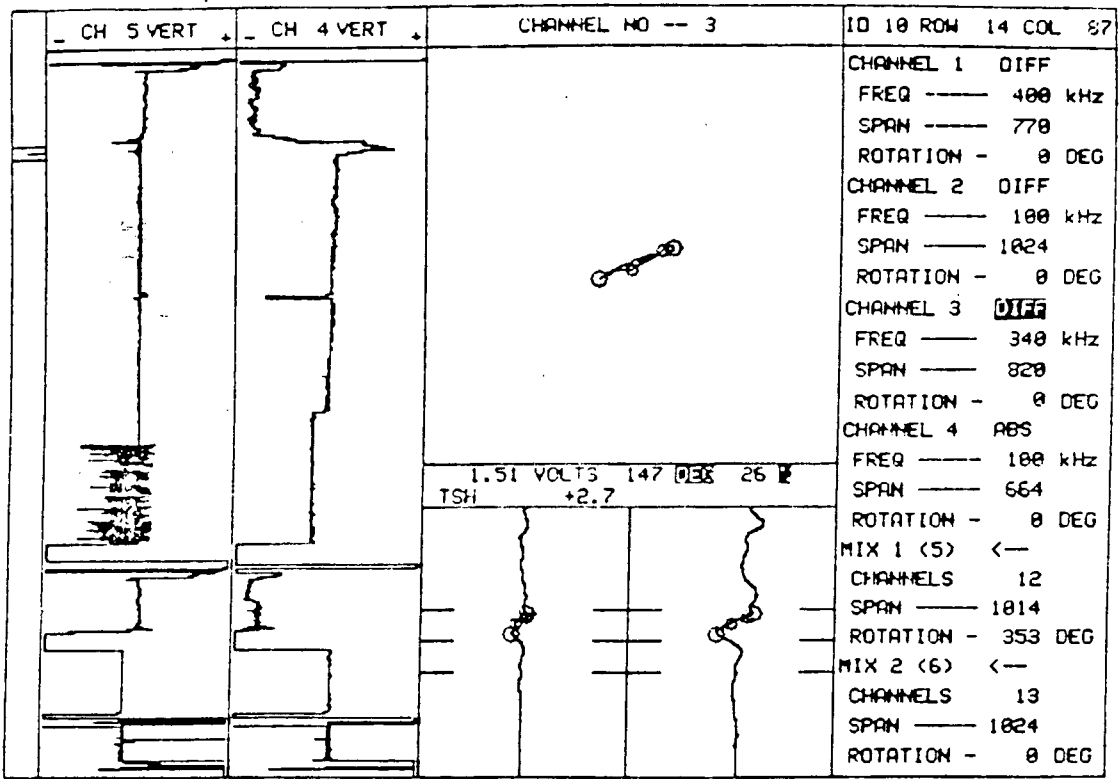
10 PLANT SCE SONGS UNIT# I S/G B LEG INLET DATE 1980 ZETEC Inc. - 1983 Edition 12.0 Rev 1



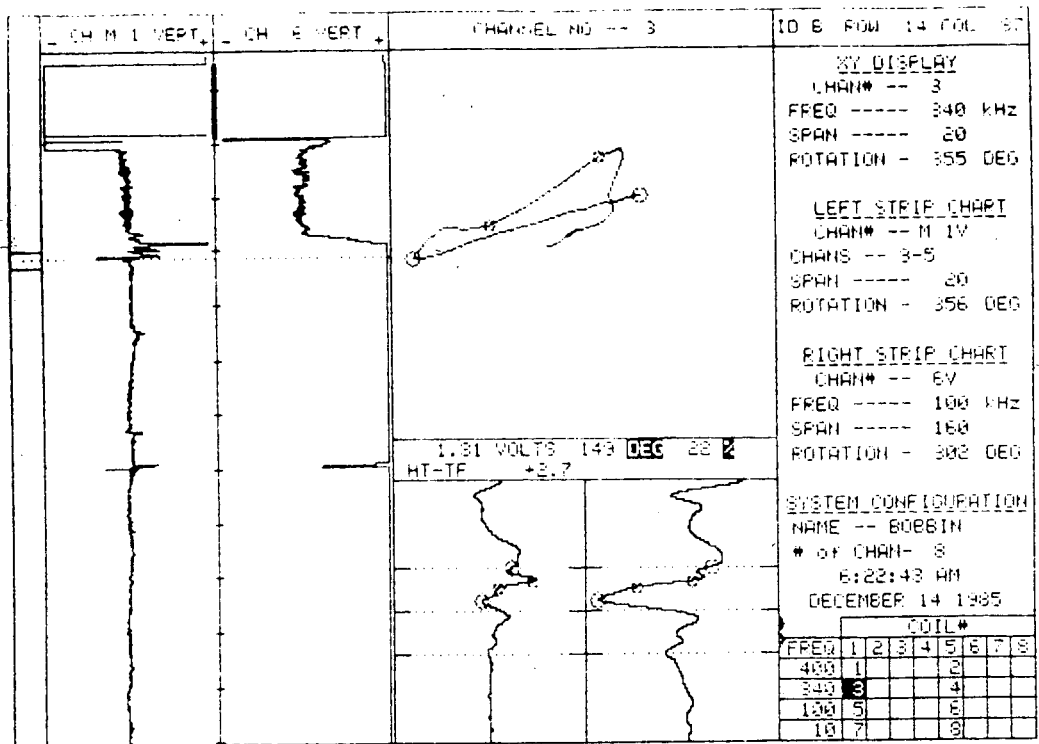


10	PLANT	UNIT#	S/G	LEG	DATE	ZETEC Inc. - 1983
	SCE SONGS	I	B	INLET	1980	Edition 12.0 Rev 1

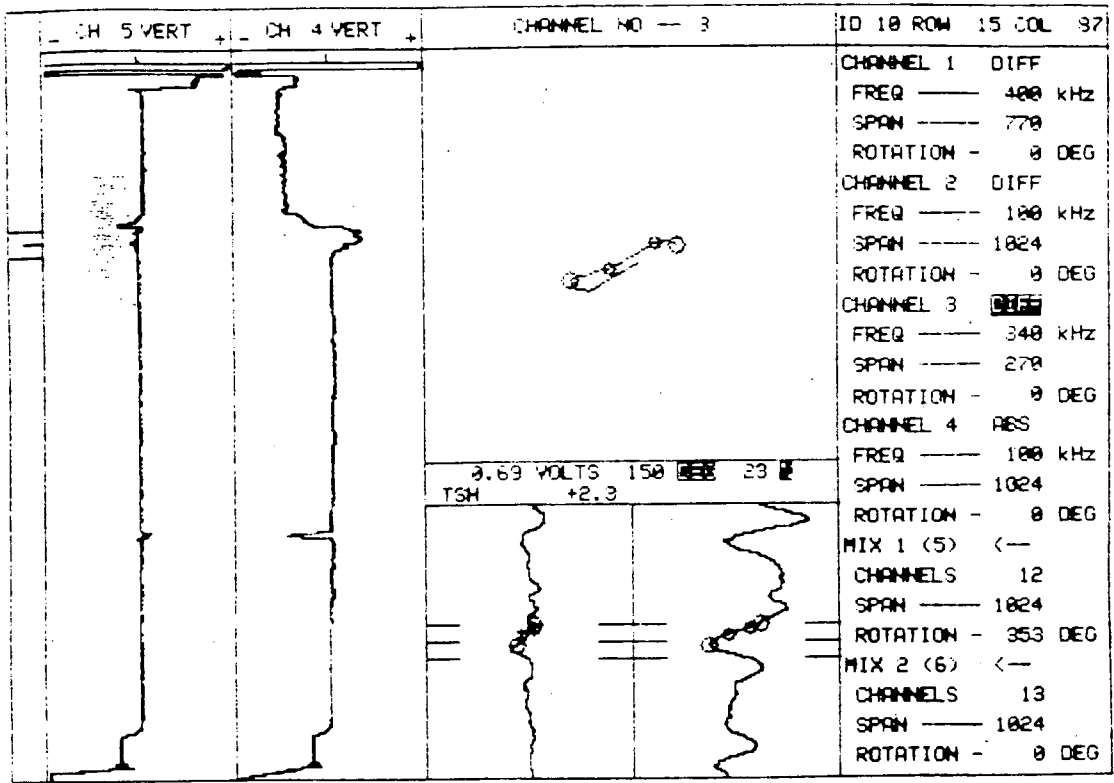




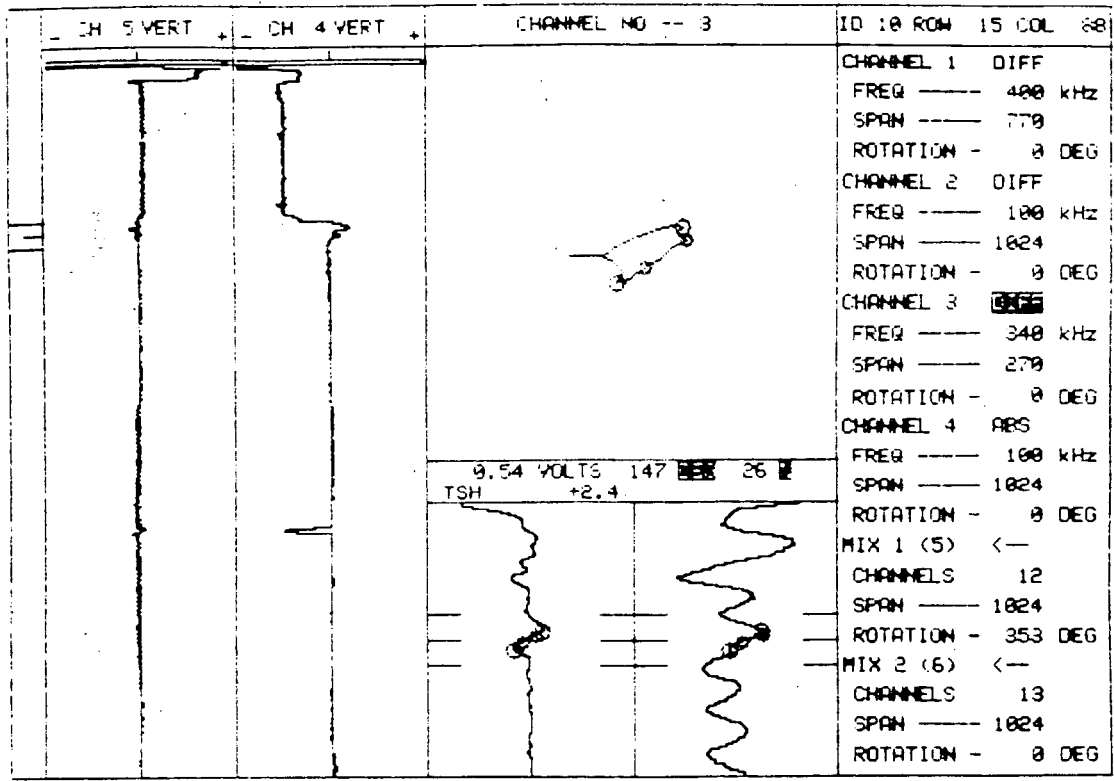
20 PLANT SCE SONGS UNIT# I S/G B LEG INLET DATE 1980 ZETEC Inc. - 1983 Edition 12.0 Rev 1



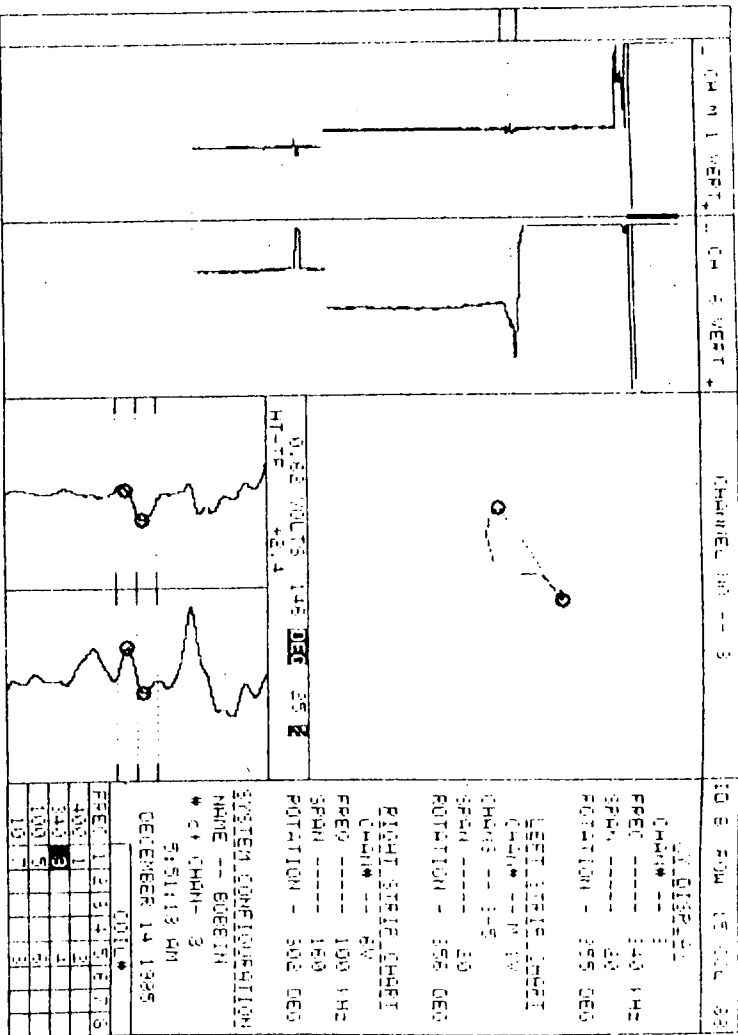
15 PLANT SONGS DISK 403 UNIT# 1 S/G 8 LEG HOT DATE 12-13-85

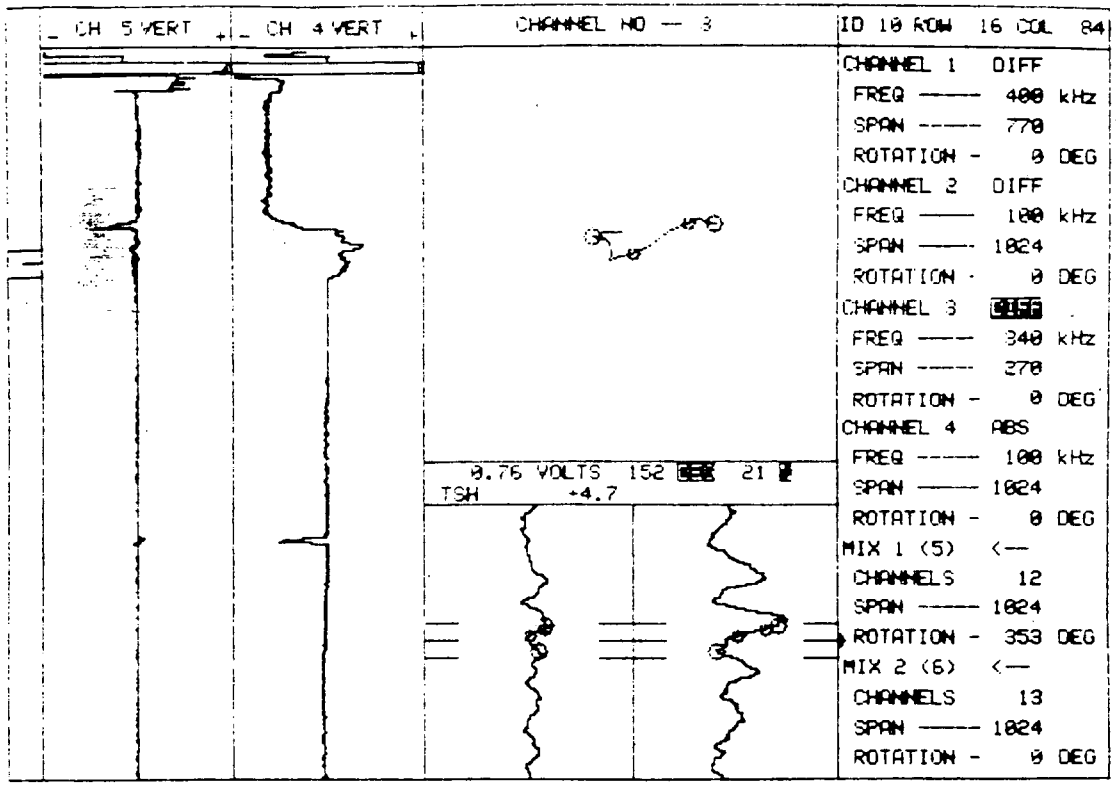


10 PLANT UNIT# S-13 LEG DATE ZETEC Inc. - 1983
 SCE SONGS I B INLET 1980 Edition 12.0 Rev 1



10	PLANT	UNIT#	S/G	LEG	DATE	ZETEC Inc. - 1983
	SCE SONGS	I	B	INLET	1980	Edition 12.0 Rev 1





ID 10 ROW 16 COL 84

CHANNEL 1 DIFF
 FREQ — 400 kHz
 SPAN — 770
 ROTATION - 0 DEG

CHANNEL 2 DIFF
 FREQ — 100 kHz
 SPAN — 1024
 ROTATION - 0 DEG

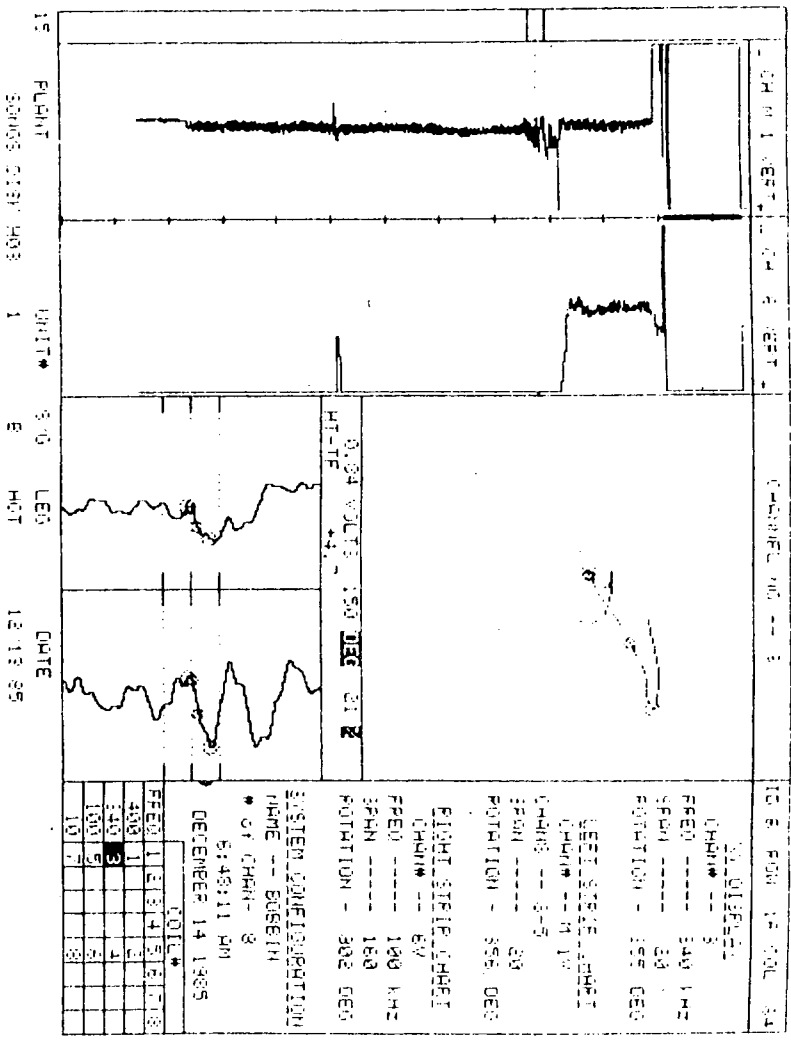
CHANNEL 3 **DIFF**
 FREQ — 340 kHz
 SPAN — 270
 ROTATION - 0 DEG

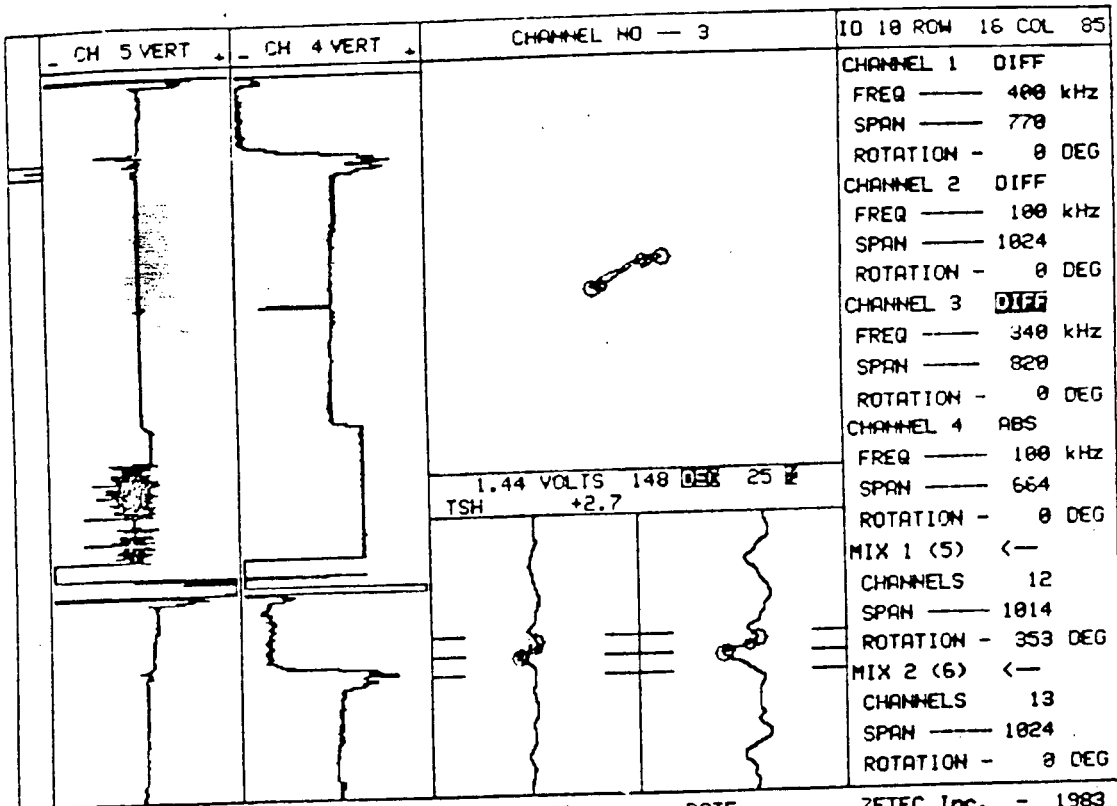
CHANNEL 4 ABS
 FREQ — 100 kHz
 SPAN — 1024
 ROTATION - 0 DEG

MIX 1 (5) <—
 CHANNELS 12
 SPAN — 1024
 ROTATION - 353 DEG

MIX 2 (6) <—
 CHANNELS 13
 SPAN — 1024
 ROTATION - 0 DEG

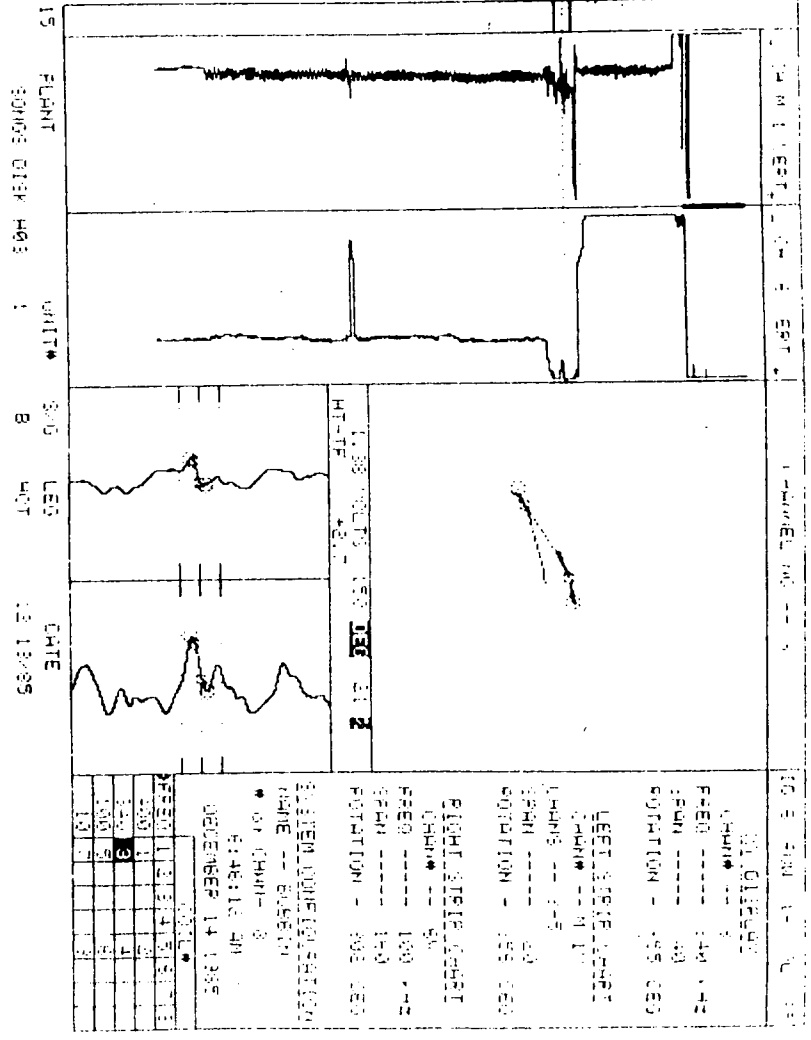
10	PLANT	UNIT#	S/G	LEG	DATE	ZETEC Inc. - 1983
	SCE SONGS	I	B	INLET	1980	Edition 12.0 Rev 1





1.44 VOLTS 148 DEG 25 Hz
TSH +2.7

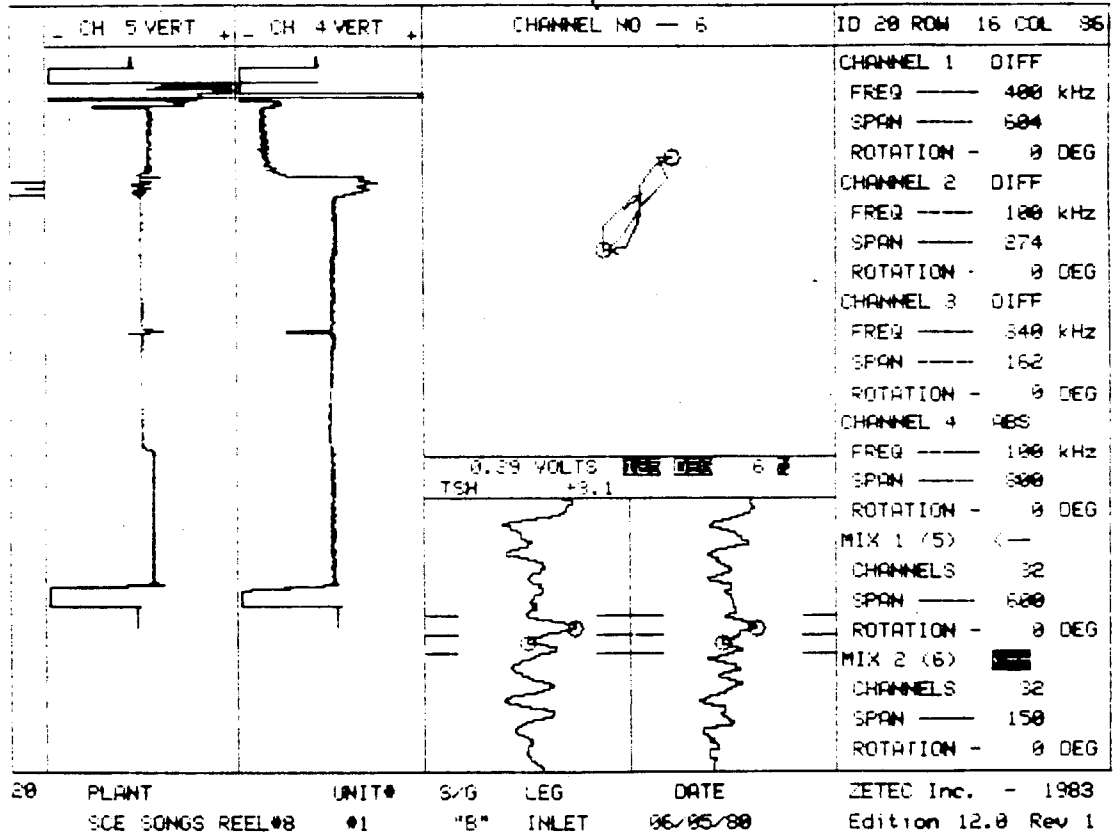
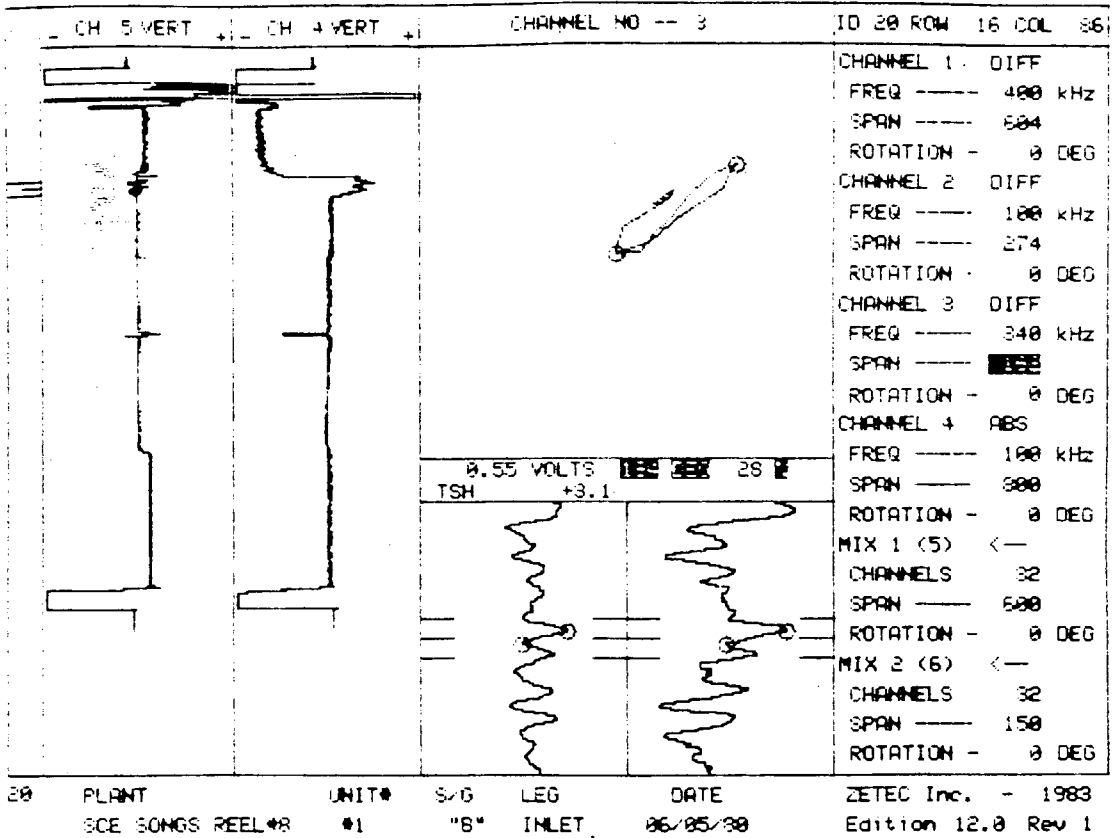
20 PLANT SCE SONGS UNIT# I S/G B LEG INLET DATE 1980 ZETEC Inc. - 1983 Edition 12.0 Rev 1

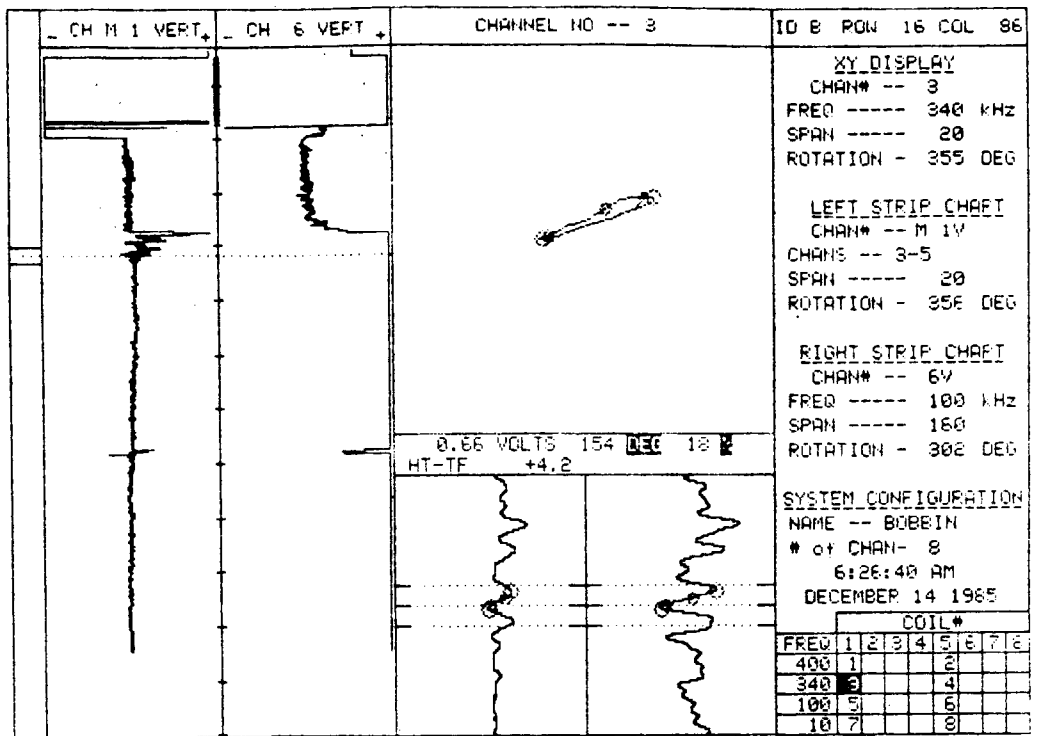


CHANNEL NO. 1
 CHANNEL NO. 2
 CHANNEL NO. 3
 CHANNEL NO. 4
 CHANNEL NO. 5
 CHANNEL NO. 6
 CHANNEL NO. 7
 CHANNEL NO. 8
 CHANNEL NO. 9
 CHANNEL NO. 10
 CHANNEL NO. 11
 CHANNEL NO. 12
 CHANNEL NO. 13
 CHANNEL NO. 14
 CHANNEL NO. 15
 CHANNEL NO. 16
 CHANNEL NO. 17
 CHANNEL NO. 18
 CHANNEL NO. 19
 CHANNEL NO. 20
 CHANNEL NO. 21
 CHANNEL NO. 22
 CHANNEL NO. 23
 CHANNEL NO. 24
 CHANNEL NO. 25
 CHANNEL NO. 26
 CHANNEL NO. 27
 CHANNEL NO. 28
 CHANNEL NO. 29
 CHANNEL NO. 30
 CHANNEL NO. 31
 CHANNEL NO. 32
 CHANNEL NO. 33
 CHANNEL NO. 34
 CHANNEL NO. 35
 CHANNEL NO. 36
 CHANNEL NO. 37
 CHANNEL NO. 38
 CHANNEL NO. 39
 CHANNEL NO. 40
 CHANNEL NO. 41
 CHANNEL NO. 42
 CHANNEL NO. 43
 CHANNEL NO. 44
 CHANNEL NO. 45
 CHANNEL NO. 46
 CHANNEL NO. 47
 CHANNEL NO. 48
 CHANNEL NO. 49
 CHANNEL NO. 50
 CHANNEL NO. 51
 CHANNEL NO. 52
 CHANNEL NO. 53
 CHANNEL NO. 54
 CHANNEL NO. 55
 CHANNEL NO. 56
 CHANNEL NO. 57
 CHANNEL NO. 58
 CHANNEL NO. 59
 CHANNEL NO. 60
 CHANNEL NO. 61
 CHANNEL NO. 62
 CHANNEL NO. 63
 CHANNEL NO. 64
 CHANNEL NO. 65
 CHANNEL NO. 66
 CHANNEL NO. 67
 CHANNEL NO. 68
 CHANNEL NO. 69
 CHANNEL NO. 70
 CHANNEL NO. 71
 CHANNEL NO. 72
 CHANNEL NO. 73
 CHANNEL NO. 74
 CHANNEL NO. 75
 CHANNEL NO. 76
 CHANNEL NO. 77
 CHANNEL NO. 78
 CHANNEL NO. 79
 CHANNEL NO. 80
 CHANNEL NO. 81
 CHANNEL NO. 82
 CHANNEL NO. 83
 CHANNEL NO. 84
 CHANNEL NO. 85
 CHANNEL NO. 86
 CHANNEL NO. 87
 CHANNEL NO. 88
 CHANNEL NO. 89
 CHANNEL NO. 90
 CHANNEL NO. 91
 CHANNEL NO. 92
 CHANNEL NO. 93
 CHANNEL NO. 94
 CHANNEL NO. 95
 CHANNEL NO. 96
 CHANNEL NO. 97
 CHANNEL NO. 98
 CHANNEL NO. 99
 CHANNEL NO. 100

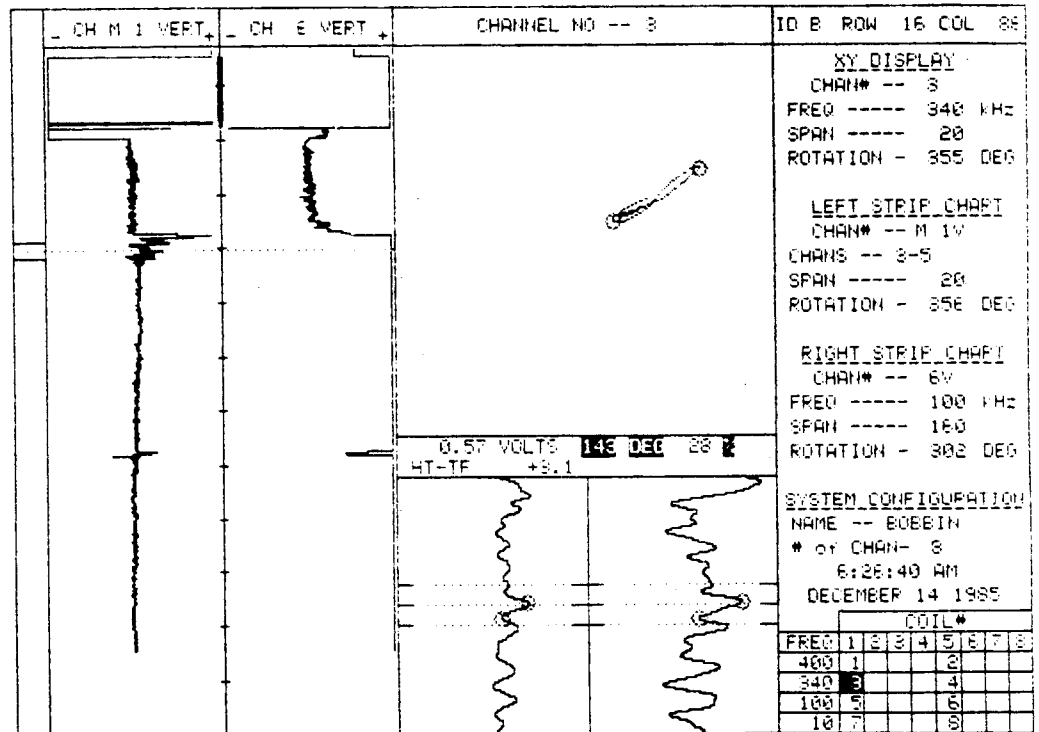
SYSTEM IDENTIFICATION
 NAME -- BUREAU
 * OF CHART -- 8
 DATE -- 14 1985
 TIME -- 11 30 AM

CHART	NO.	DATE	TIME
1	1	11	30
2	1	11	30
3	1	11	30
4	1	11	30
5	1	11	30
6	1	11	30
7	1	11	30
8	1	11	30
9	1	11	30
10	1	11	30

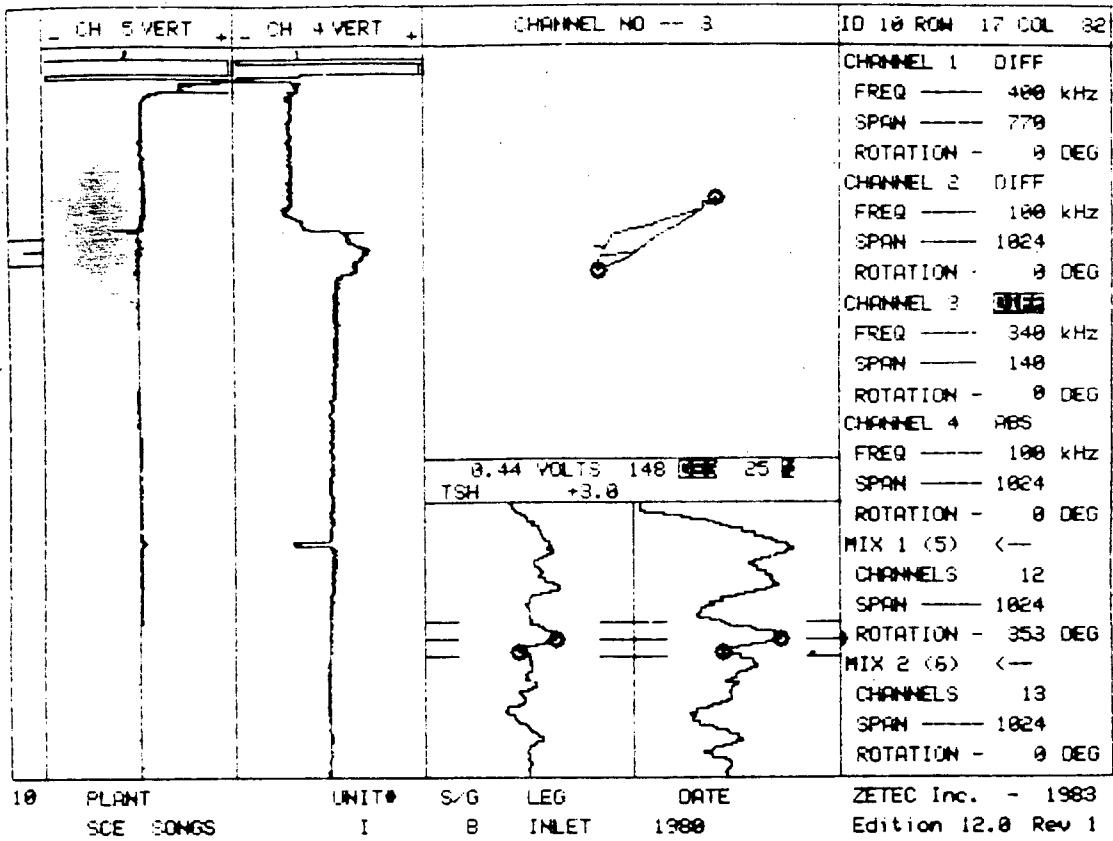


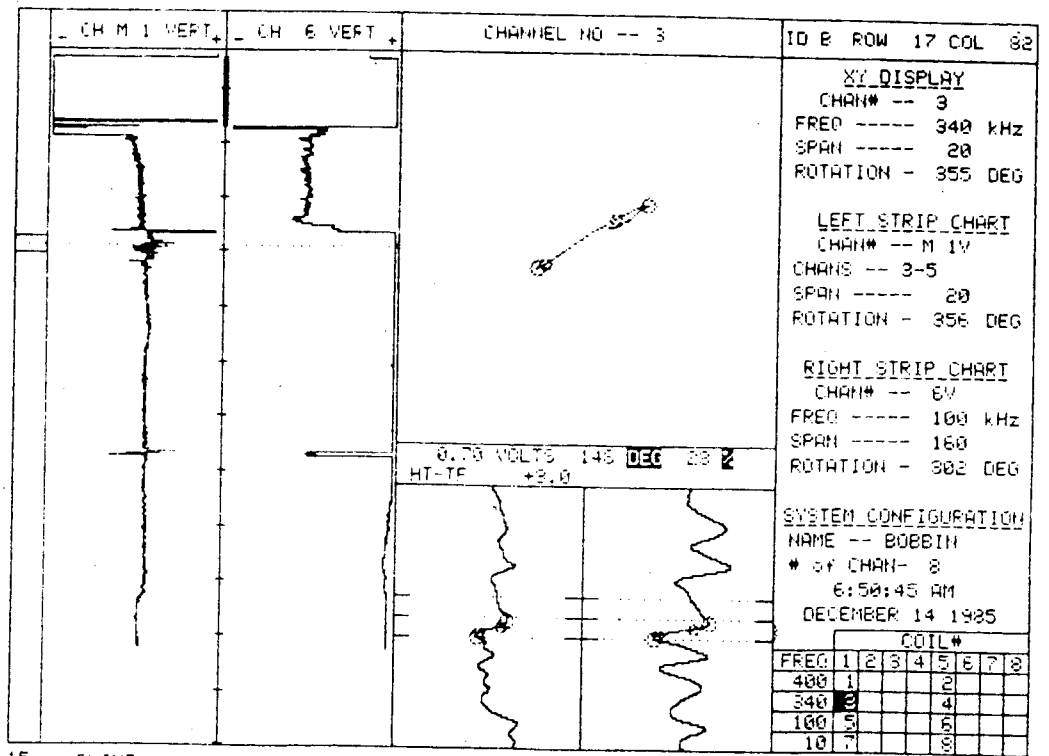


15 PLANT UNIT# S/G LEG DATE
 SONGS DISK H03 1 B HOT 12/13/85

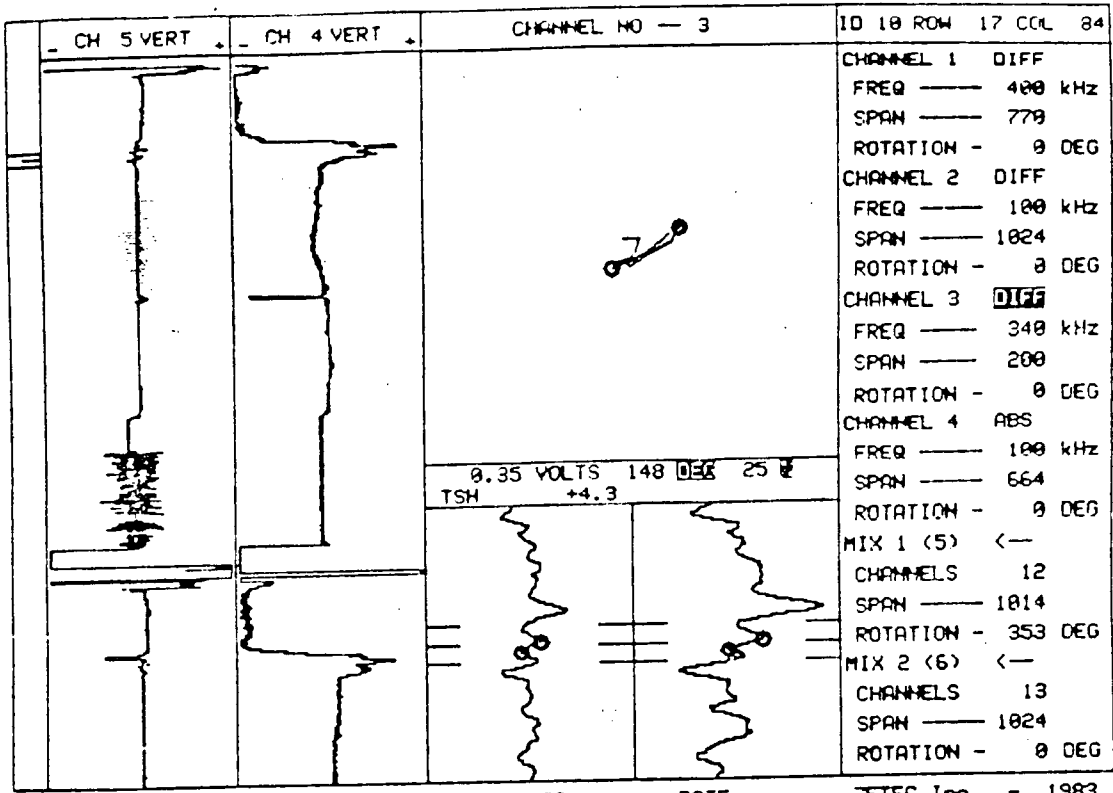


15 PLANT UNIT# S/G LEG DATE
 SONGS DISK H03 1 B HOT 12/13/85

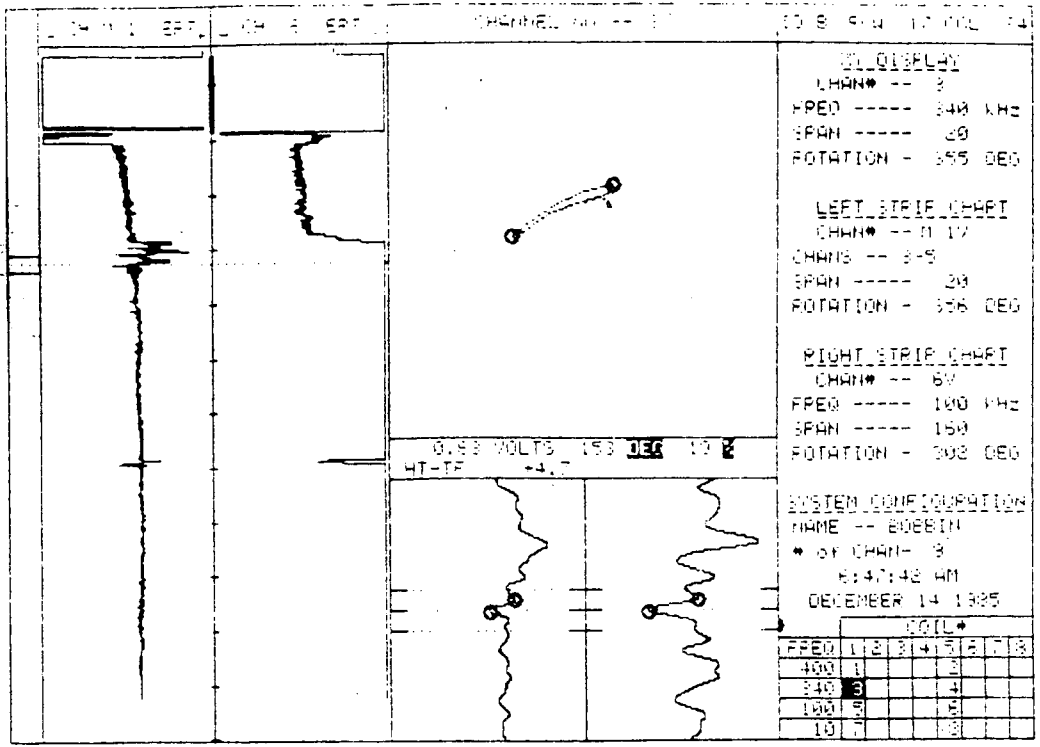




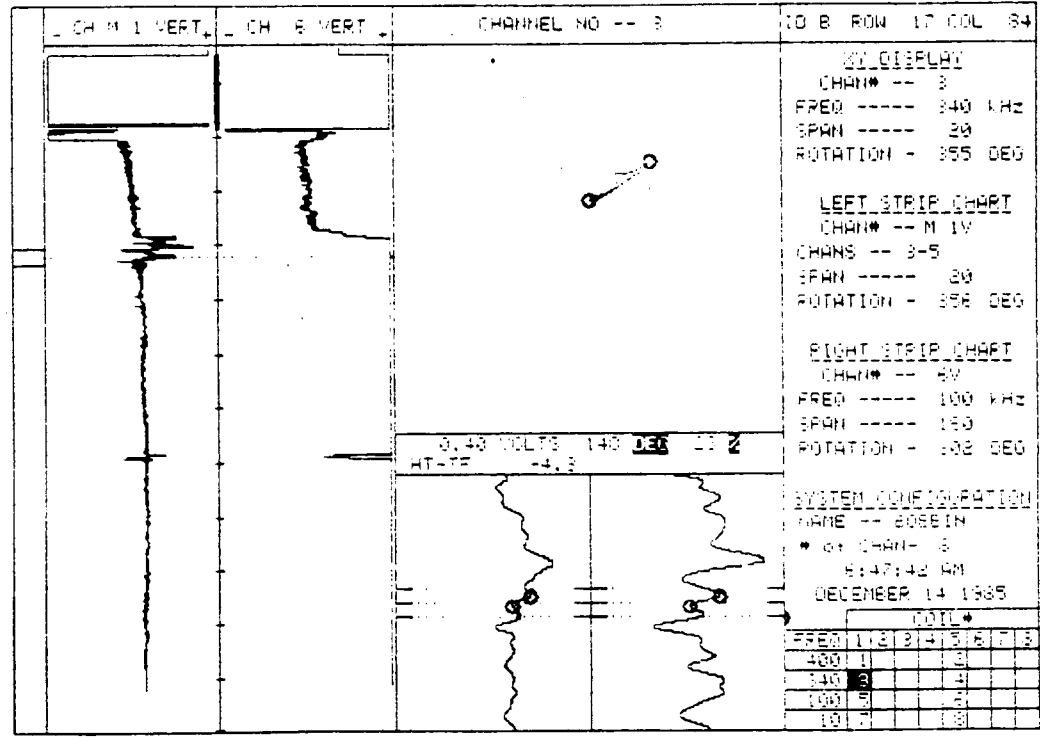
15 PLANT SONGS DISK HQ2 UNIT# 1 S/G B LEO HOT DATE 12/13/85



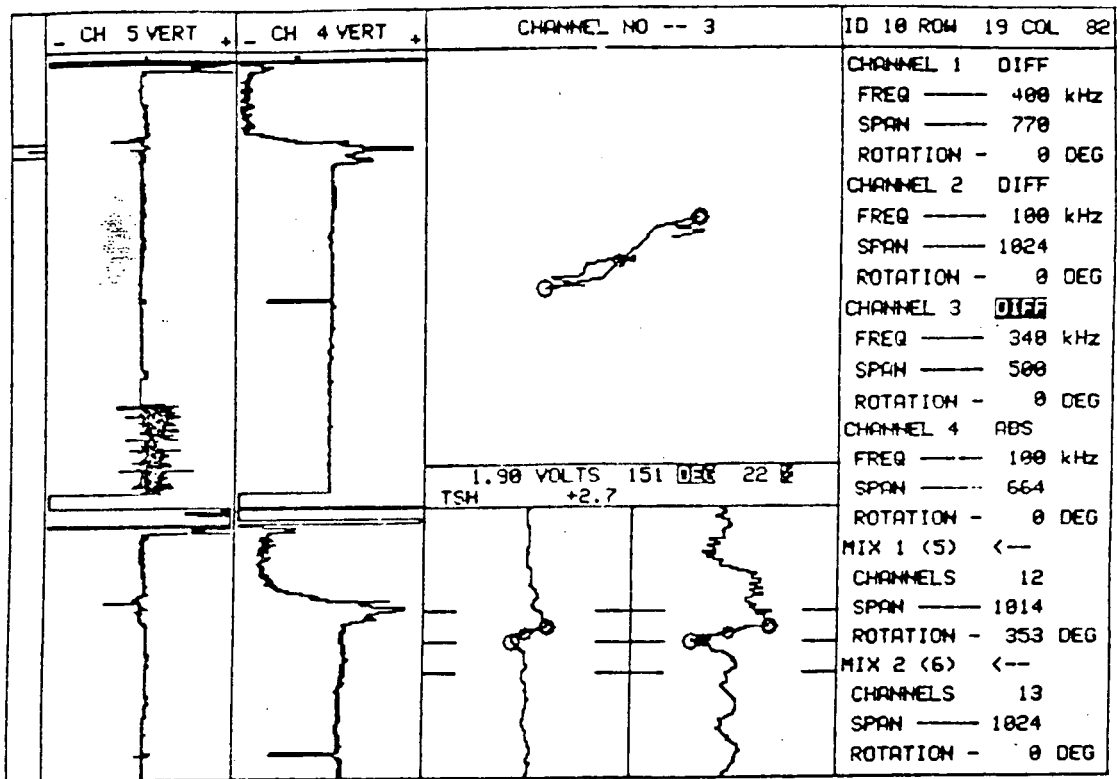
20 PLANT SCE SONGS UNIT# I S/G B LEG INLET DATE 1980 ZETEC Inc. - 1983 Edition 12.0 Rev 1



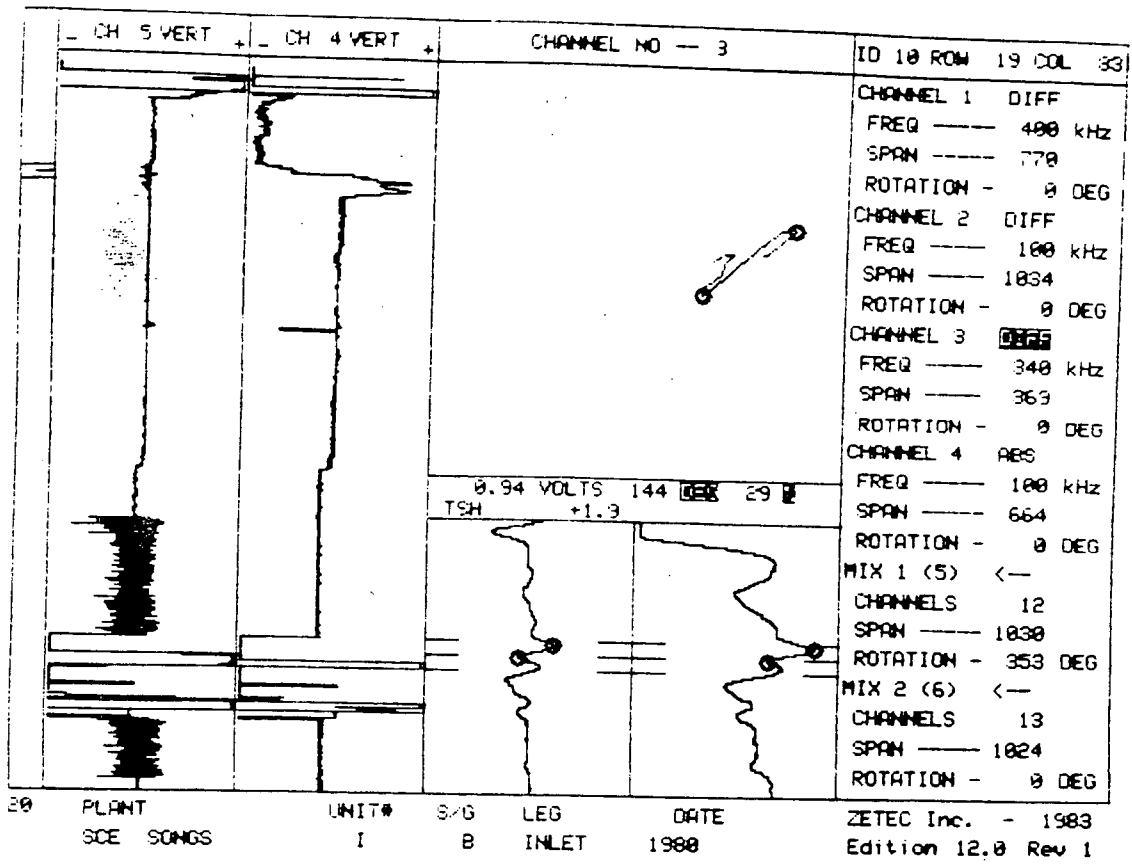
15 PLANT UNIT# S/G LEO DATE
 SONGS DISK HQ3 1 B HOT 12 13 85

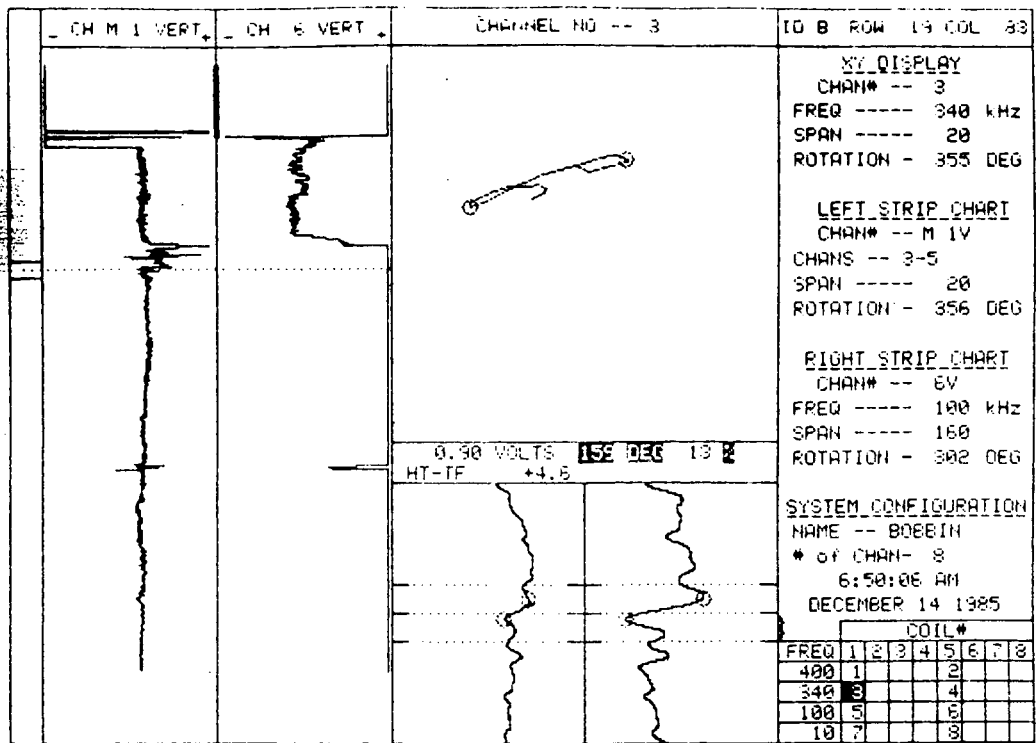


15 PLANT UNIT# S/G LEO DATE
 SONGS DISK HQ3 1 B HOT 12 13 85

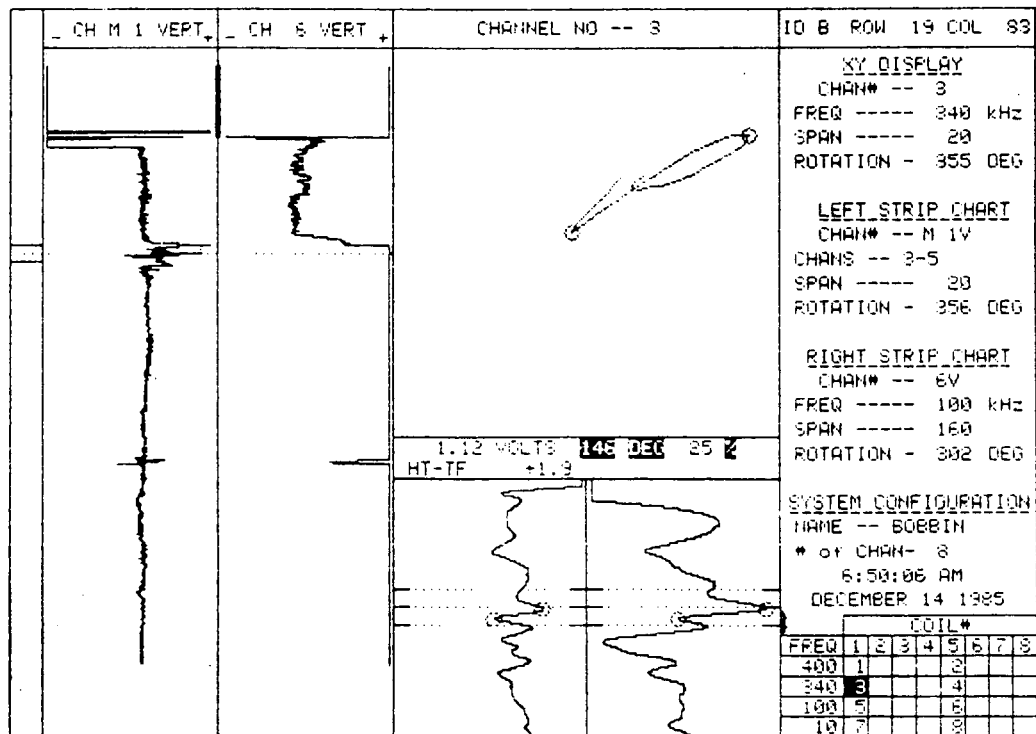


20	PLANT	UNIT*	S/G	LEG	DATE	ZETEC Inc. - 1983
	SCE SONGS	I	B	INLET	1980	Edition 12.0 Rev 1



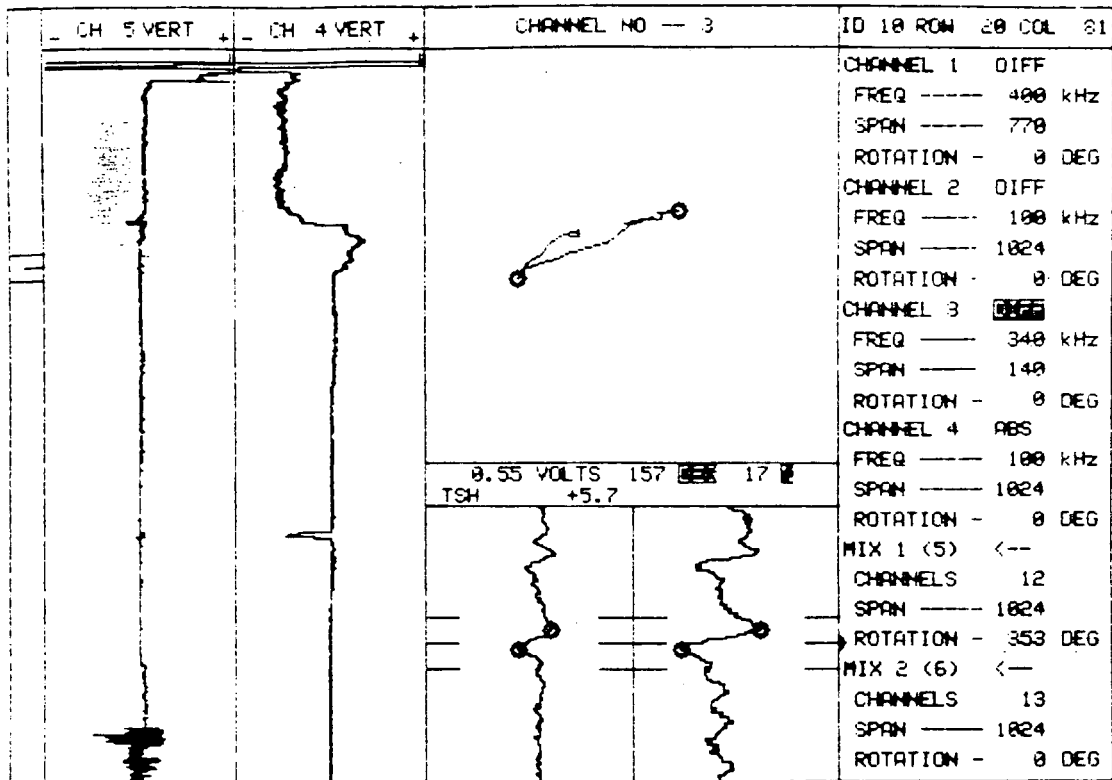


15 PLANT SONGS DISK H03 UNIT# 1 S/G B LEG HOT DATE 12/13/85

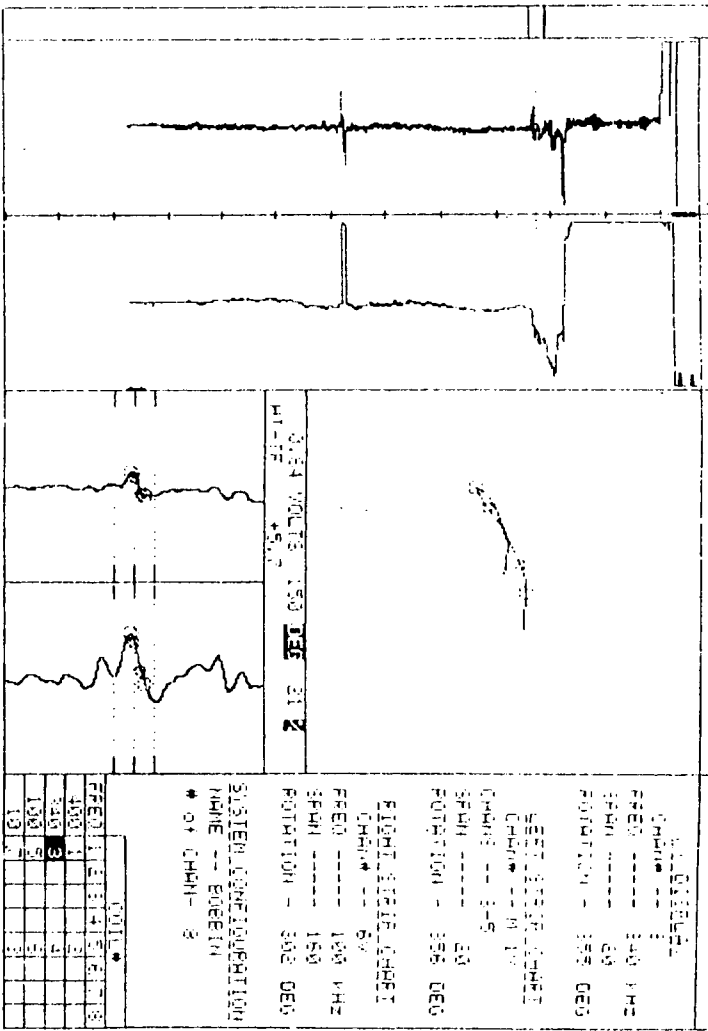


15 PLANT SONGS DISK H03 UNIT# 1 S/G B LEG HOT DATE 12/13/85

N

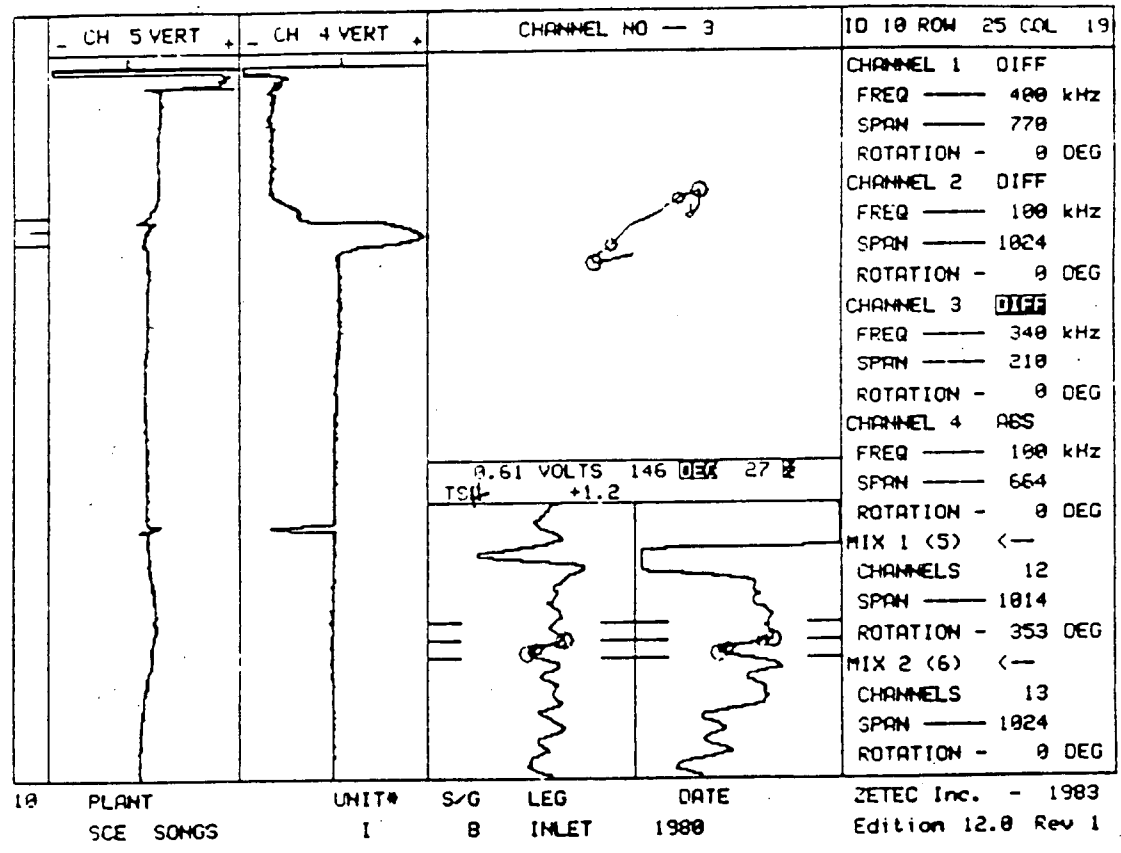
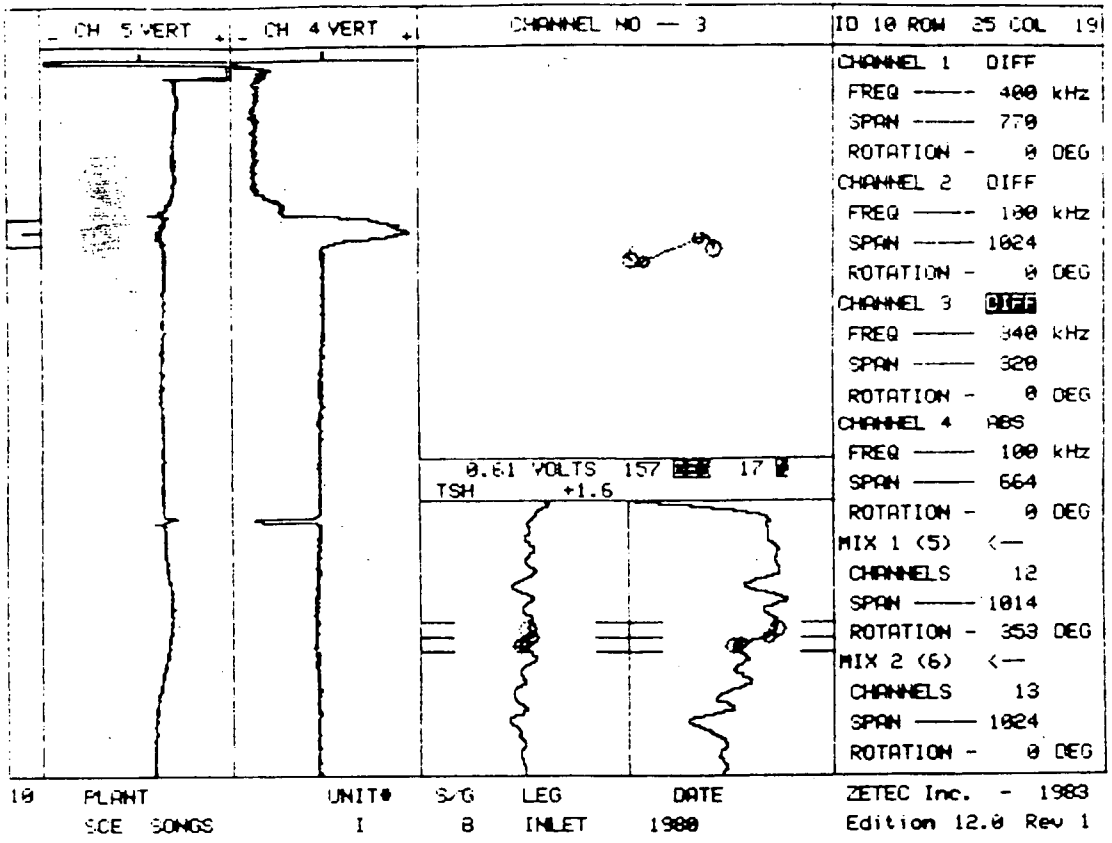


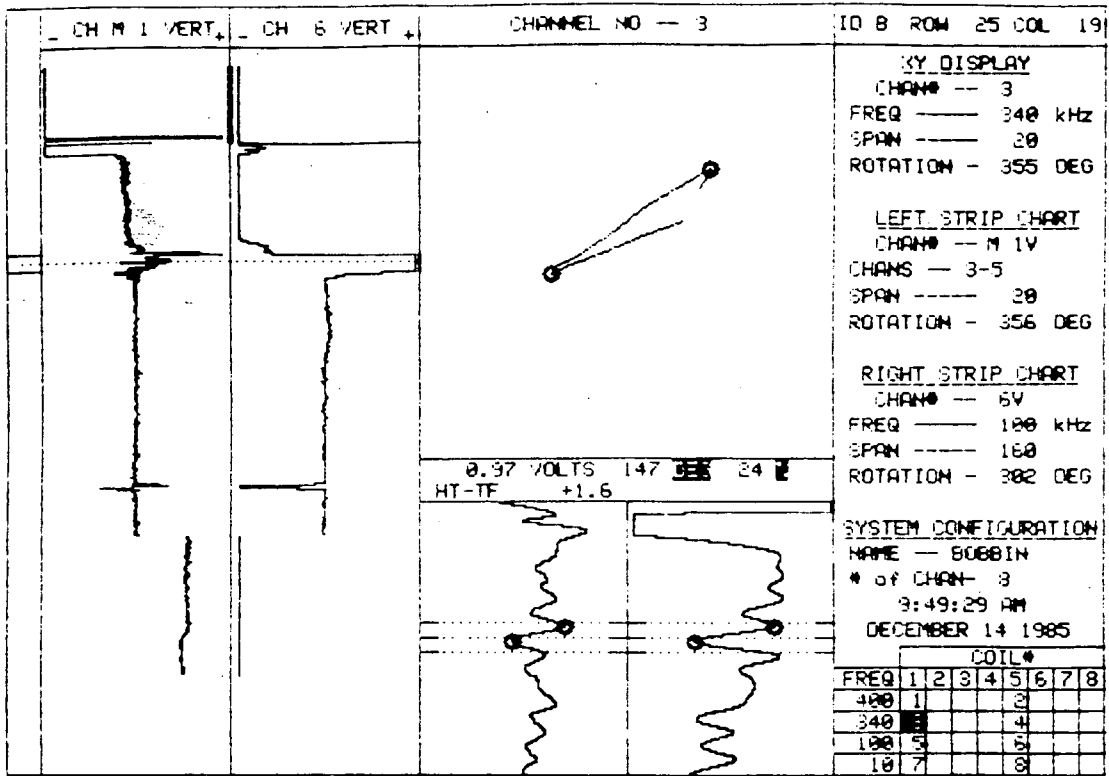
10 ZETEC Inc. - 1983
 Edition 12.0 Rev 1



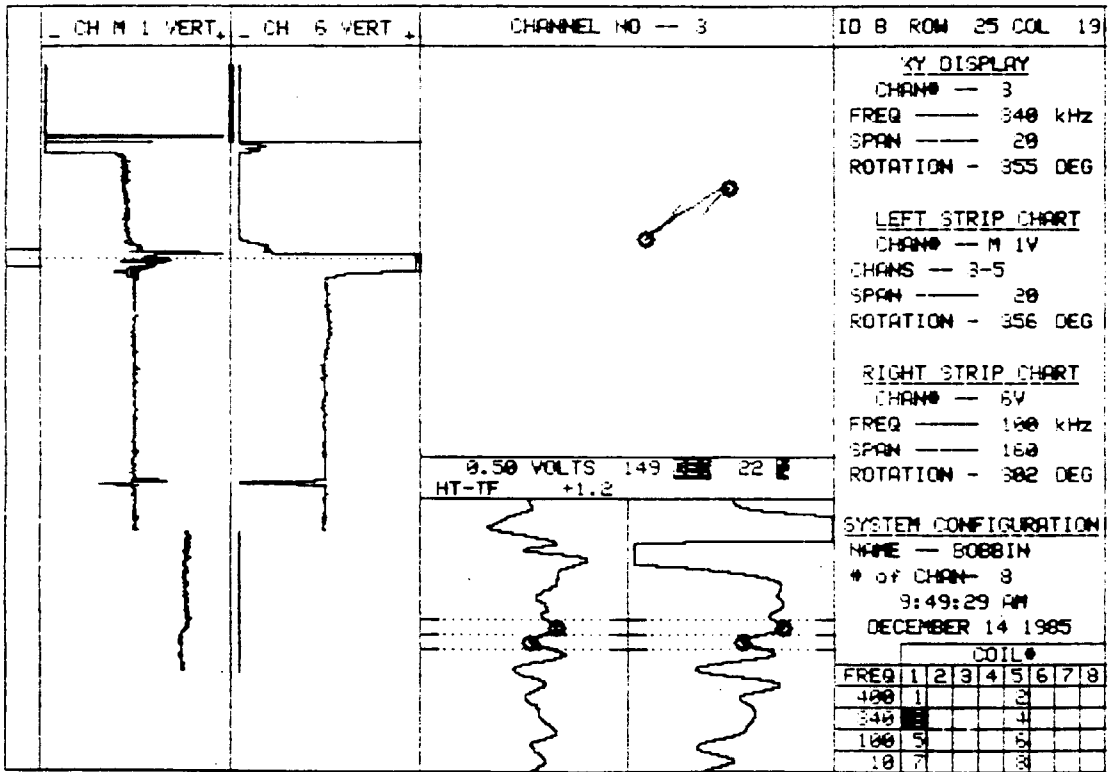
PLIGHT SOURCE 0150 HUP 1 UNIT 6 3.3 LED DATE 12.13.85

0.000000
 Channel 1
 FREQ --- 100 MHz
 SPAN --- 20
 POSITION - 155 DEG
 REF SOURCE - CORET
 CHAN - 1 to
 CHAN# --- 1-5
 SPAN --- 20
 POSITION - 158 DEG
 EIGHT SOURCE - CORET
 CHAN# --- 6V
 FREQ --- 100 MHz
 SPAN --- 150
 POSITION - 302 DEG
 SYSTEM CONFIGURATION
 NAME --- BOEIN
 * of CHAN - 8

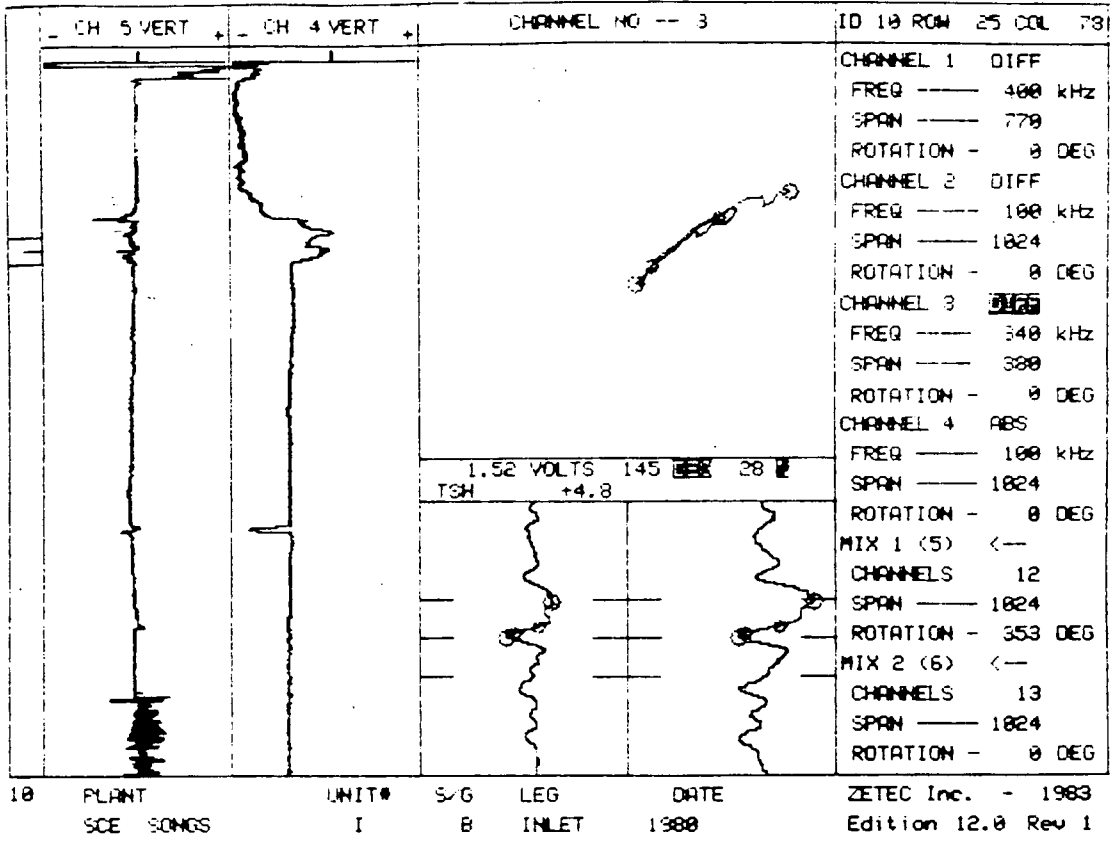


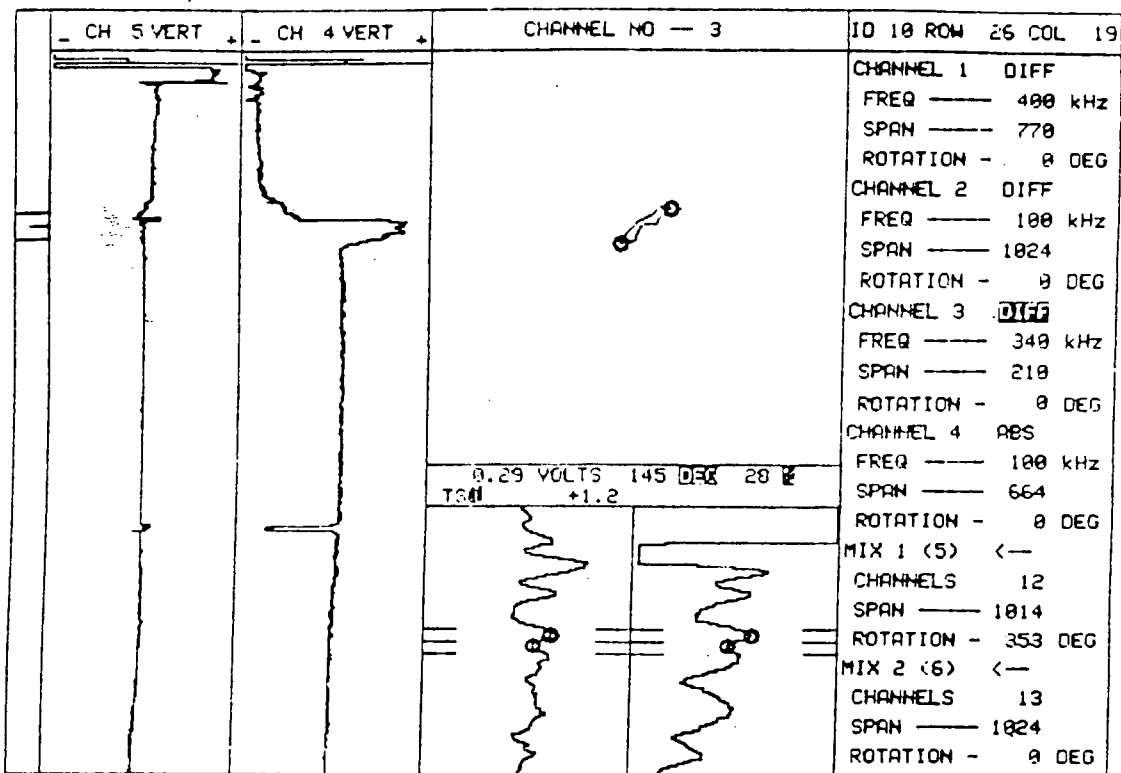


15 PLANT SONGS DISK H03 UNIT# 1 S/G 8 LEG HOT DATE 12/13/85



15 PLANT SONGS DISK H03 UNIT# 1 S/G 8 LEG HOT DATE 12/13/85



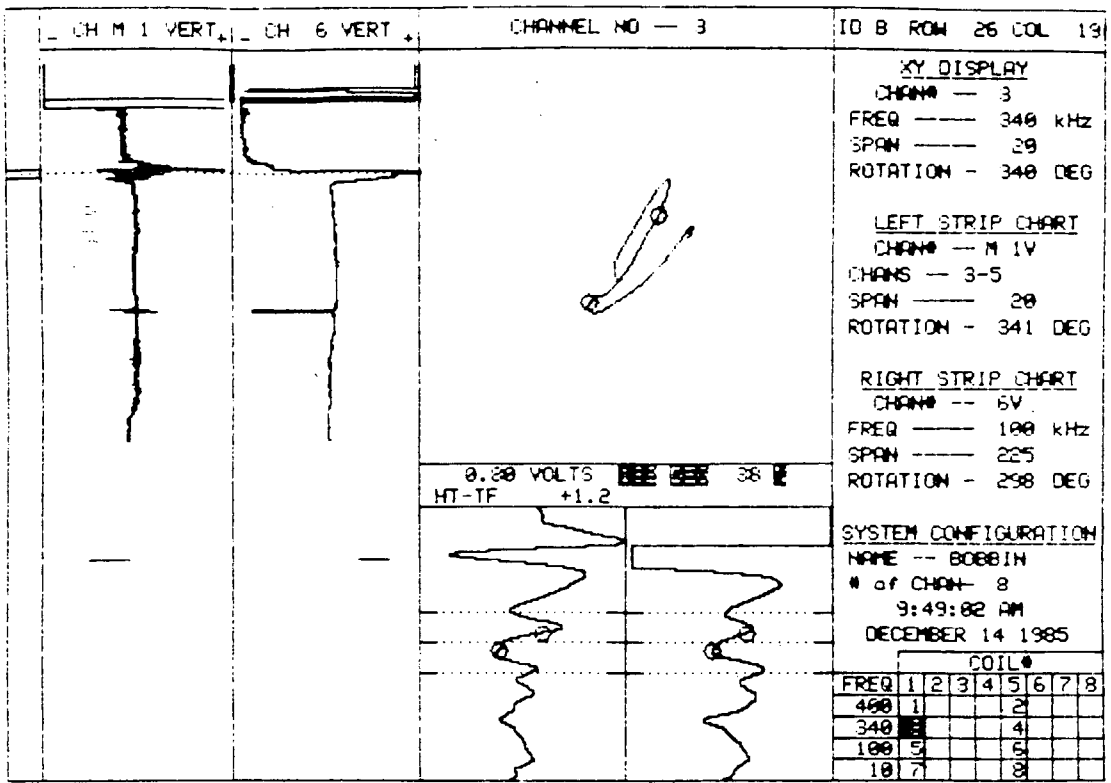


10 PLANT
SCE SONGS

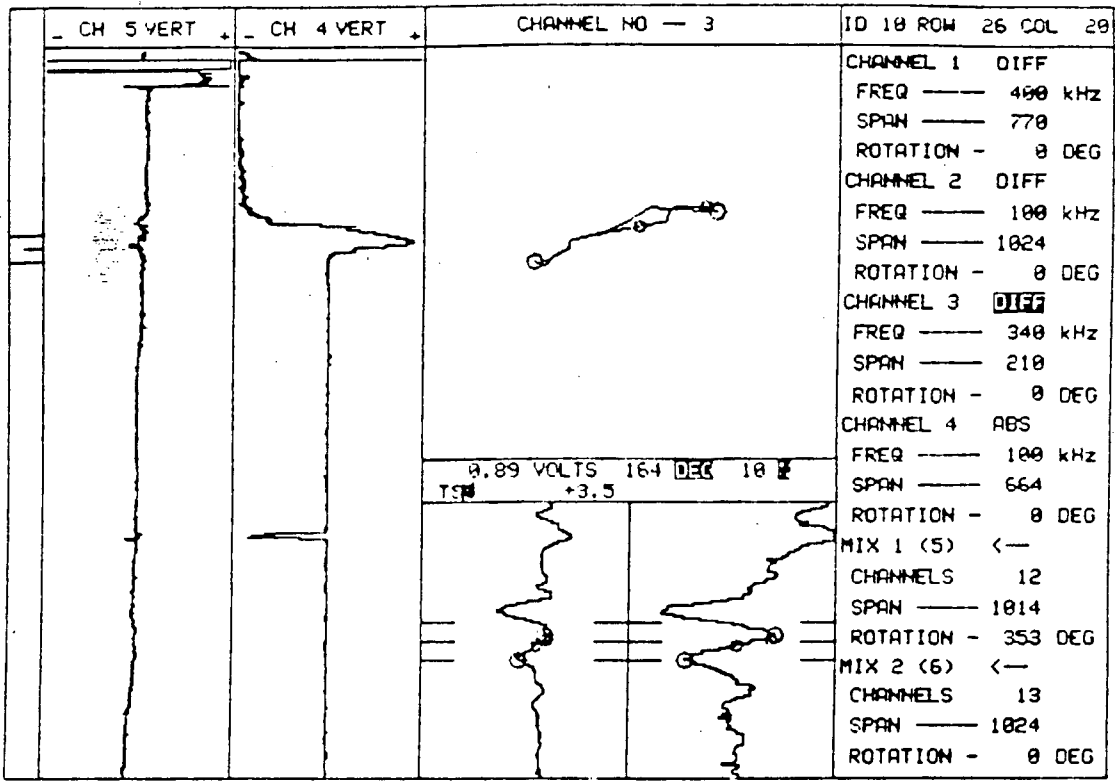
UNIT# I
S/G 8
LEG INLET

DATE
1980

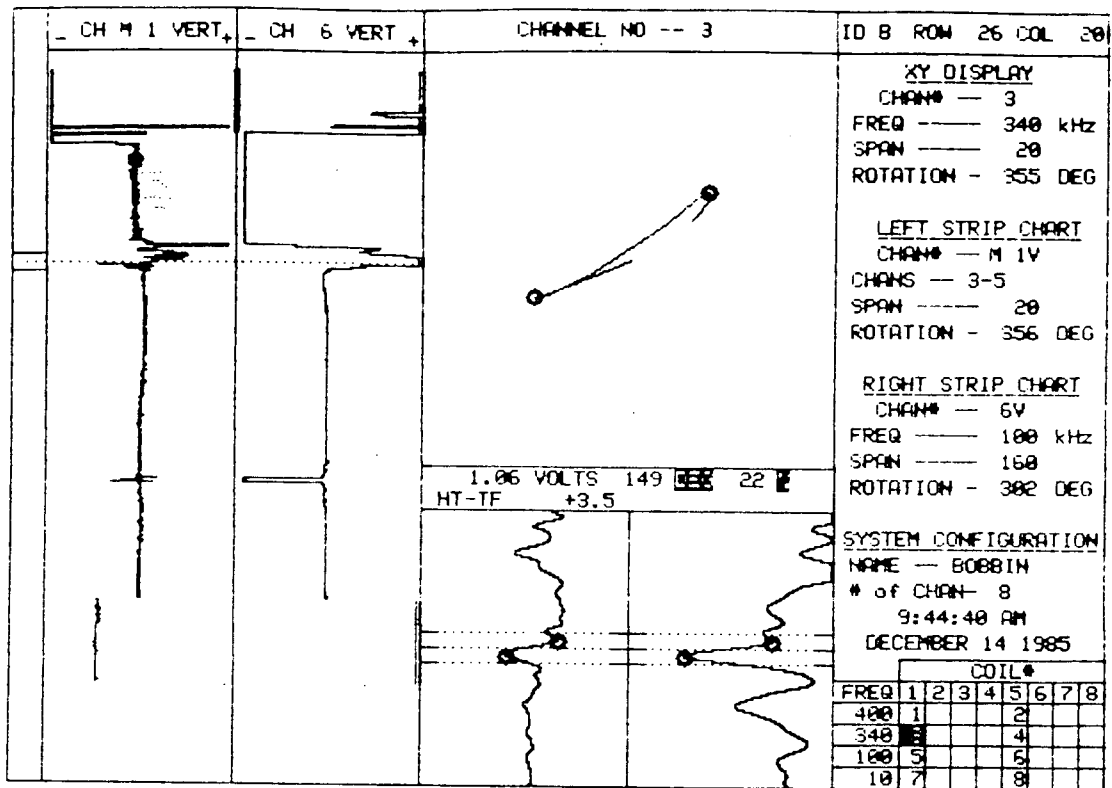
ZETEC Inc. - 1983
Edition 12.0 Rev 1



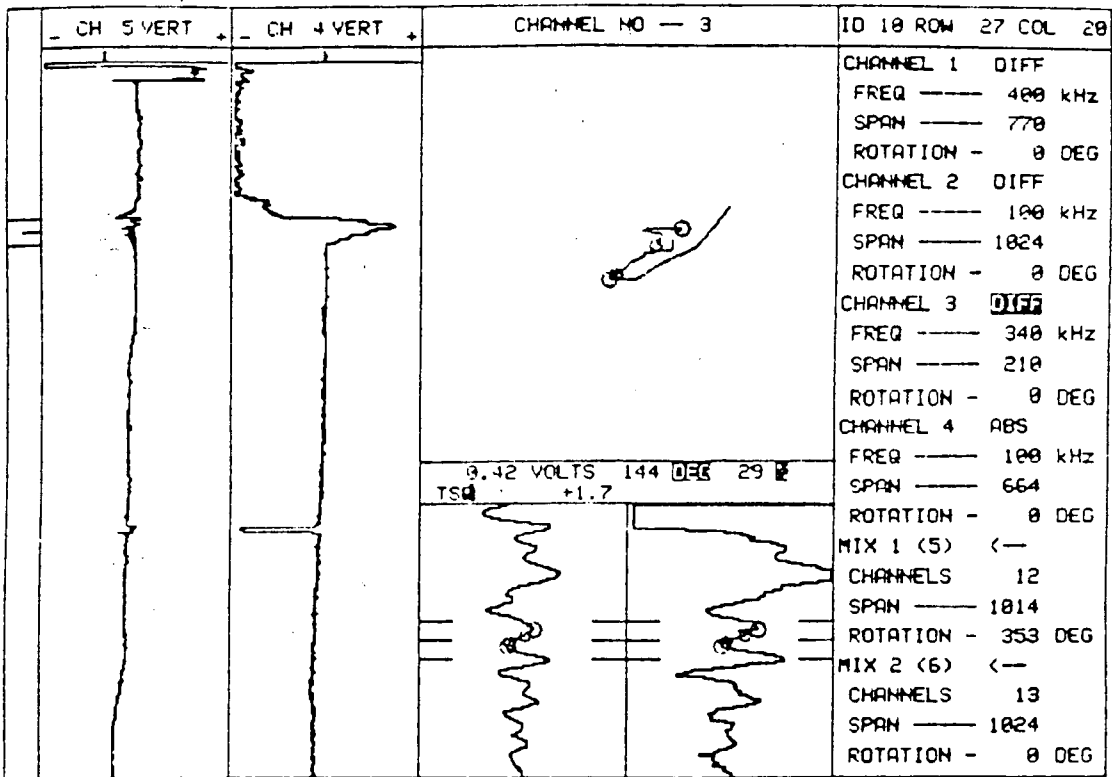
25 PLANT SONGS REEL H84 UNIT# 1 S/G B LEG INLET DATE 12/22/85



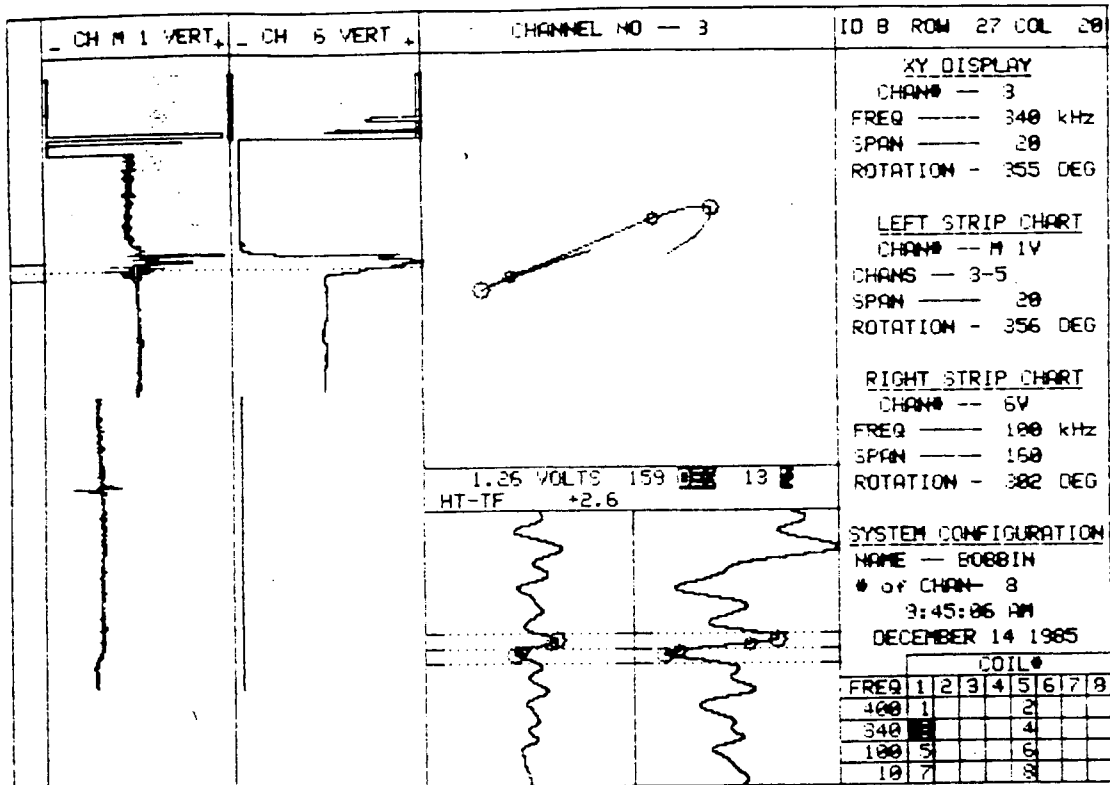
10	PLANT	UNIT#	S/G	LEG	DATE	ZETEC Inc. - 1983
	SCE SONGS	I	B	INLET	1980	Edition 12.0 Rev 1



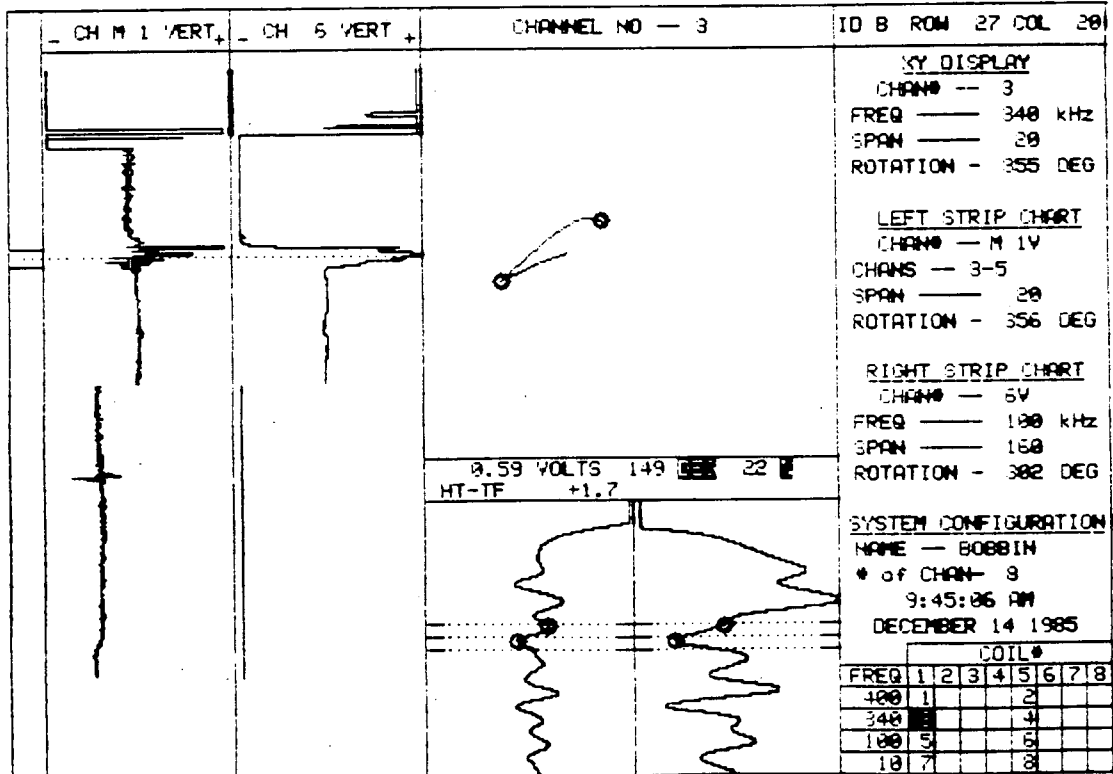
15 PLANT SONGS DISK H03 UNIT# 1 S/G B LEG HOT DATE 12/13/85



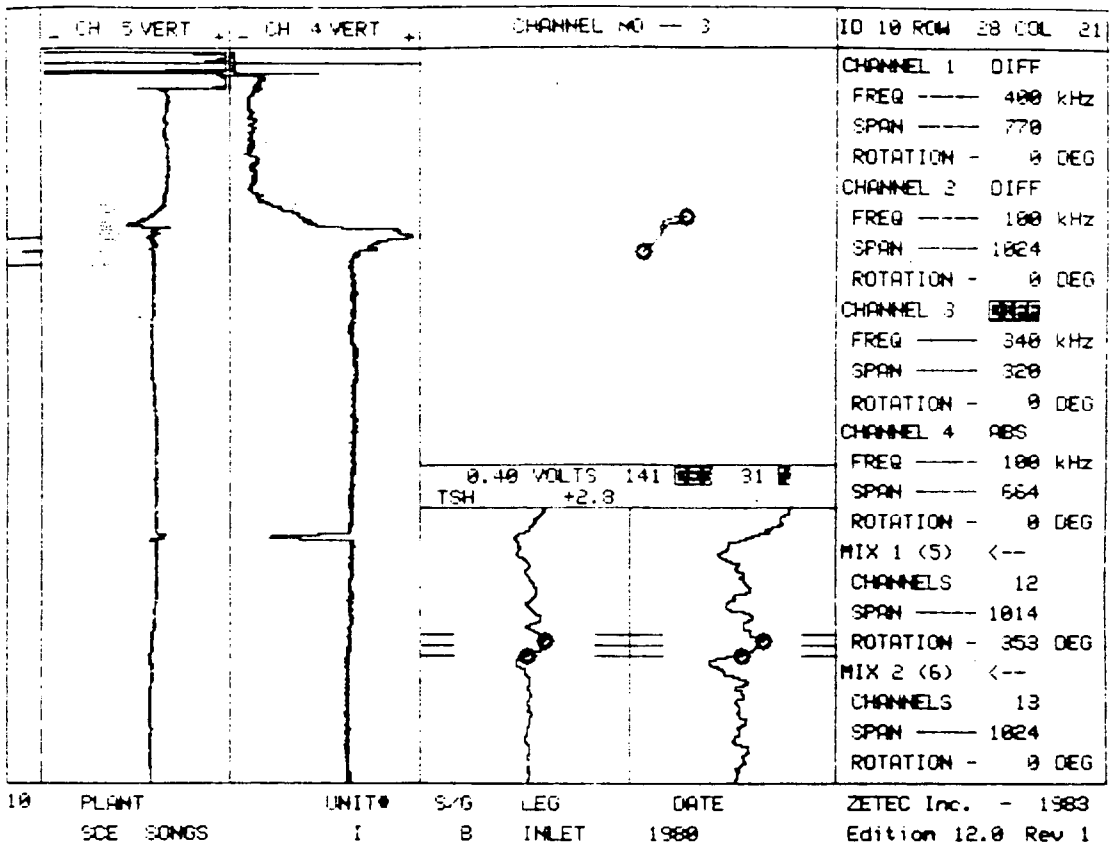
10	PLANT	UNIT#	S/G	LEG	DATE	ZETEC Inc. - 1983
	SCE SONGS	I	B	INLET	1980	Edition 12.0 Rev 1

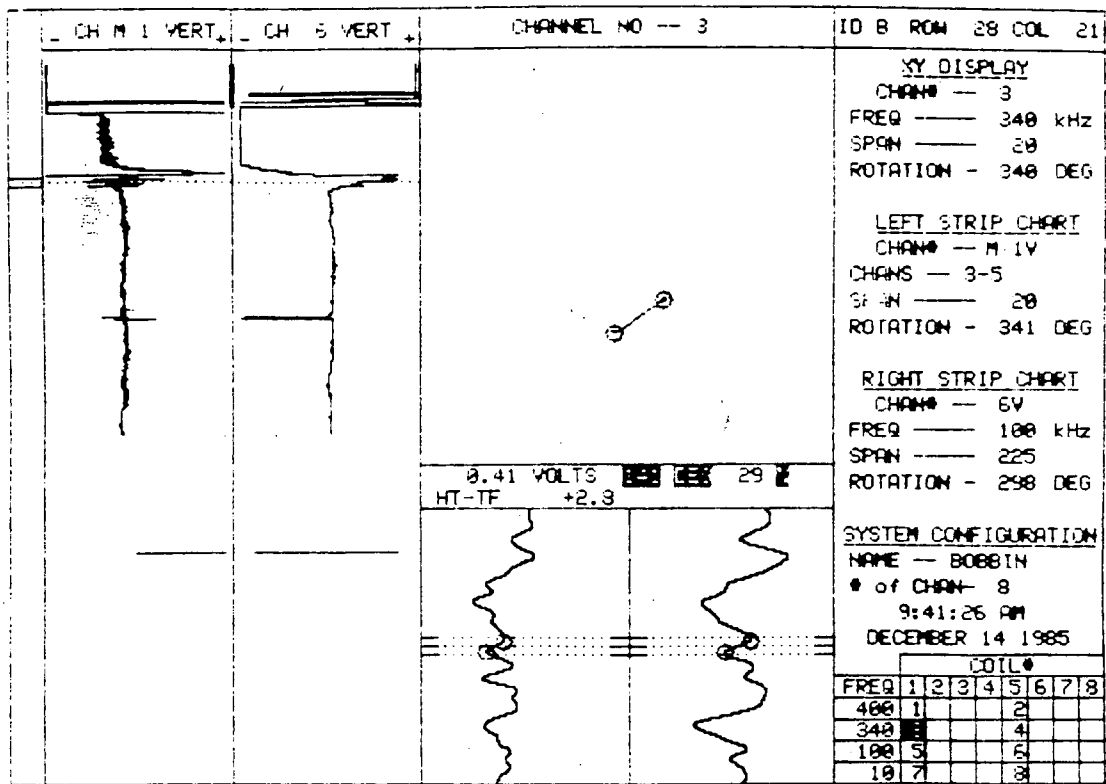


15 PLANT SONGS DISK H03 UNIT# 1 S/G B LEG HOT DATE 12/13/85

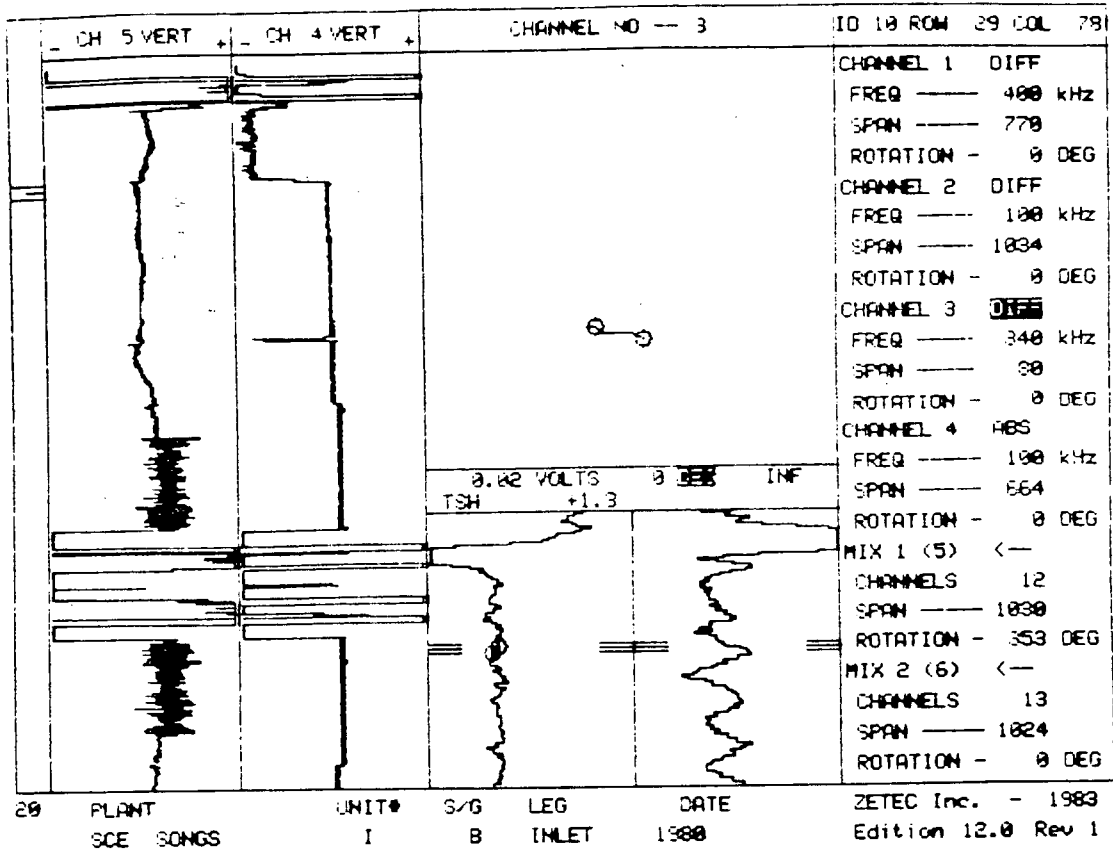


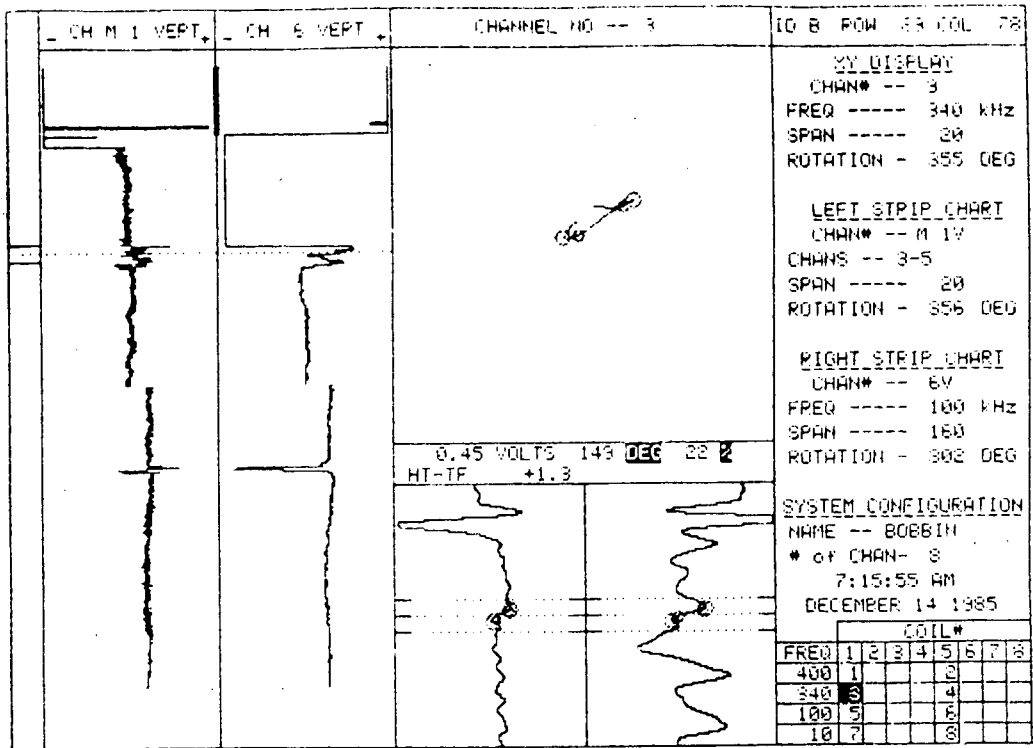
15 PLANT SONGS DISK H03 UNIT# 1 S/G B LEG HOT DATE 12/13/85



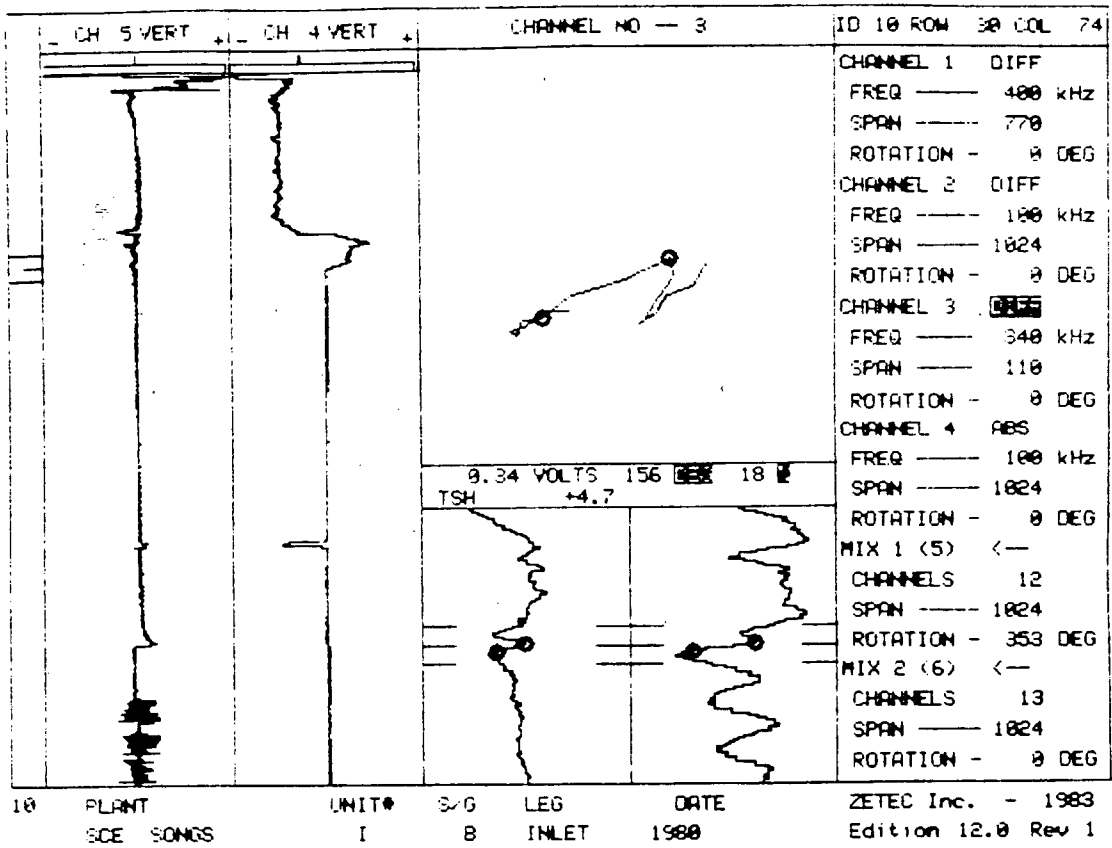


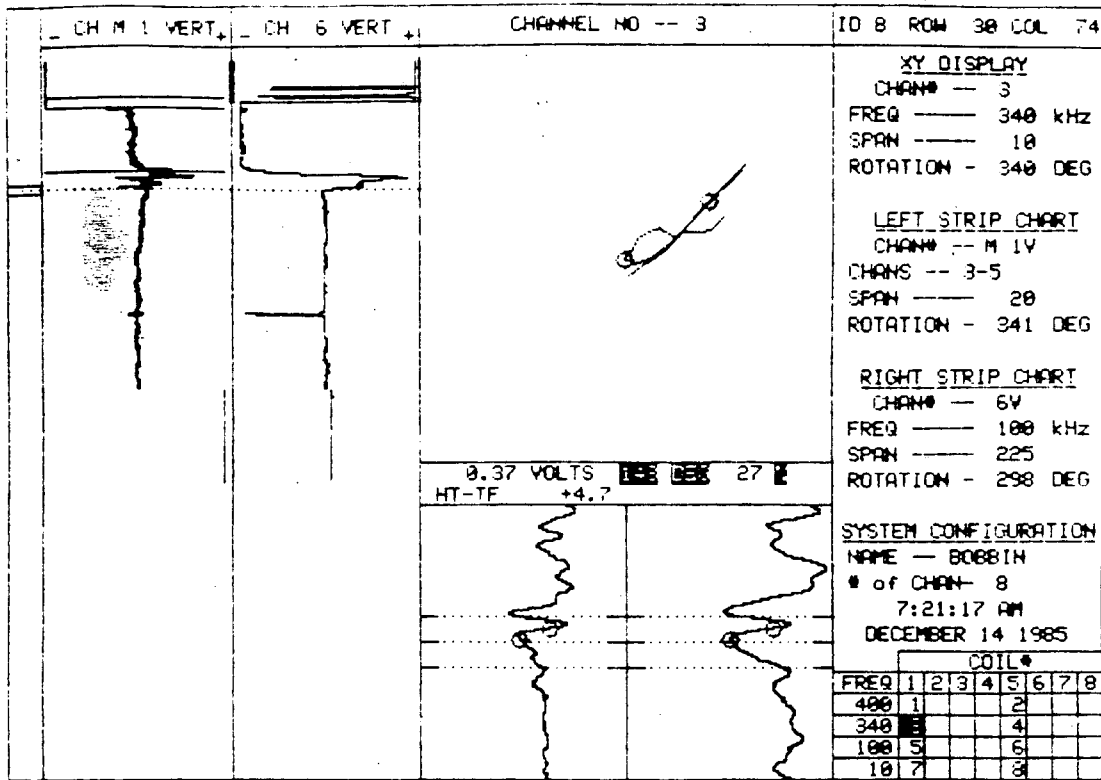
25 PLANT SONGS REEL H04- UNIT# 1 S/G B LEG INLET DATE 12/22/85



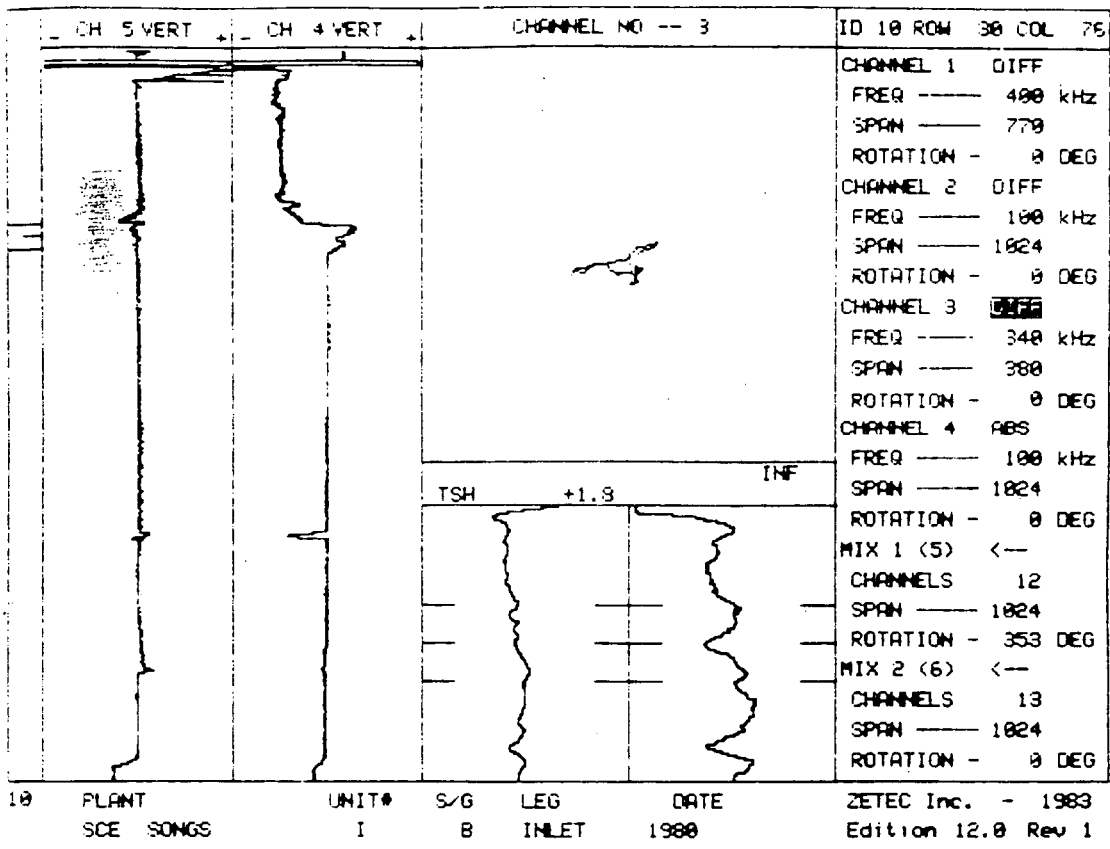


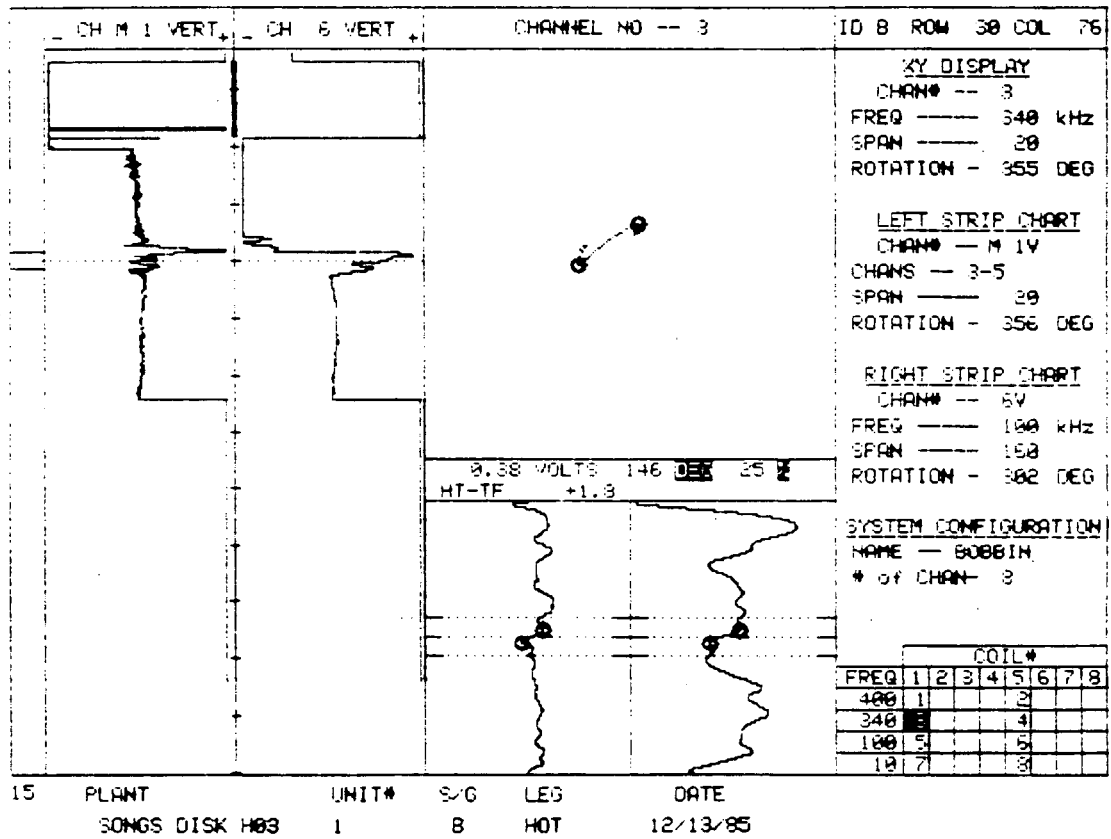
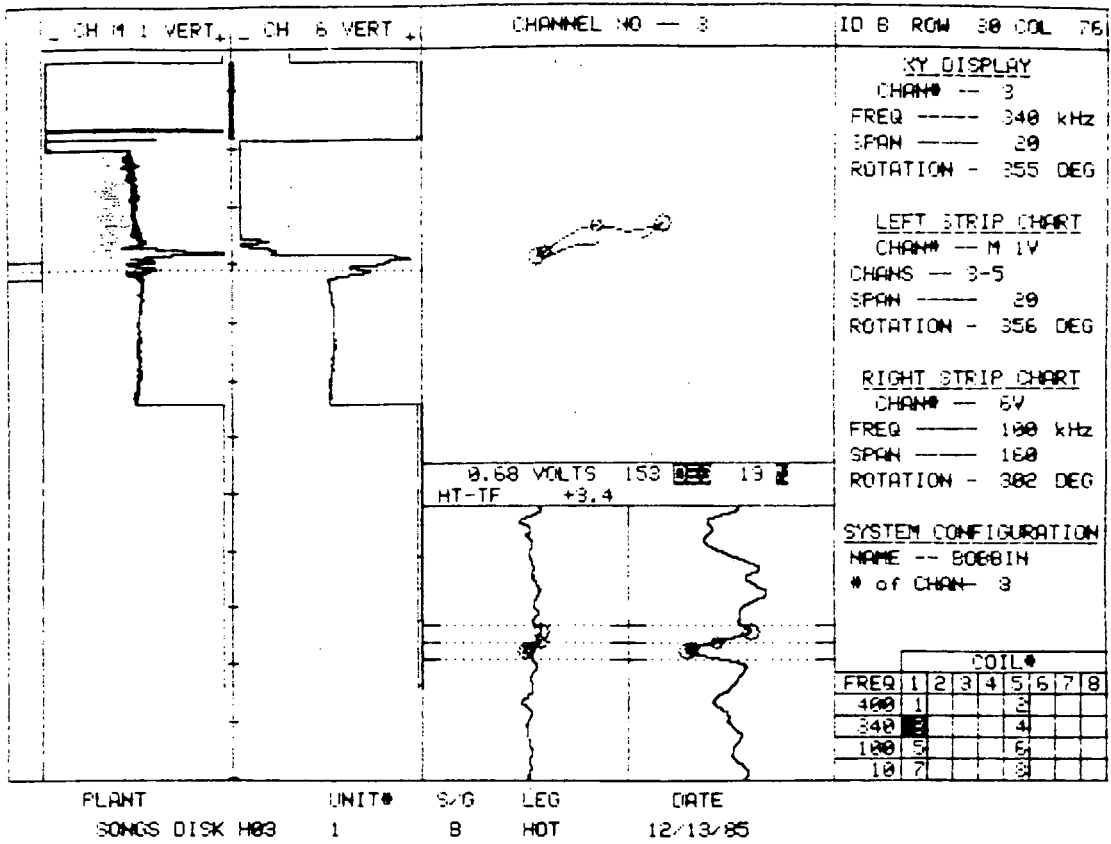
15 PLANT SONGS DISK HQ2 UNIT# 1 SAG B LEG HOT DATE 12/13/85

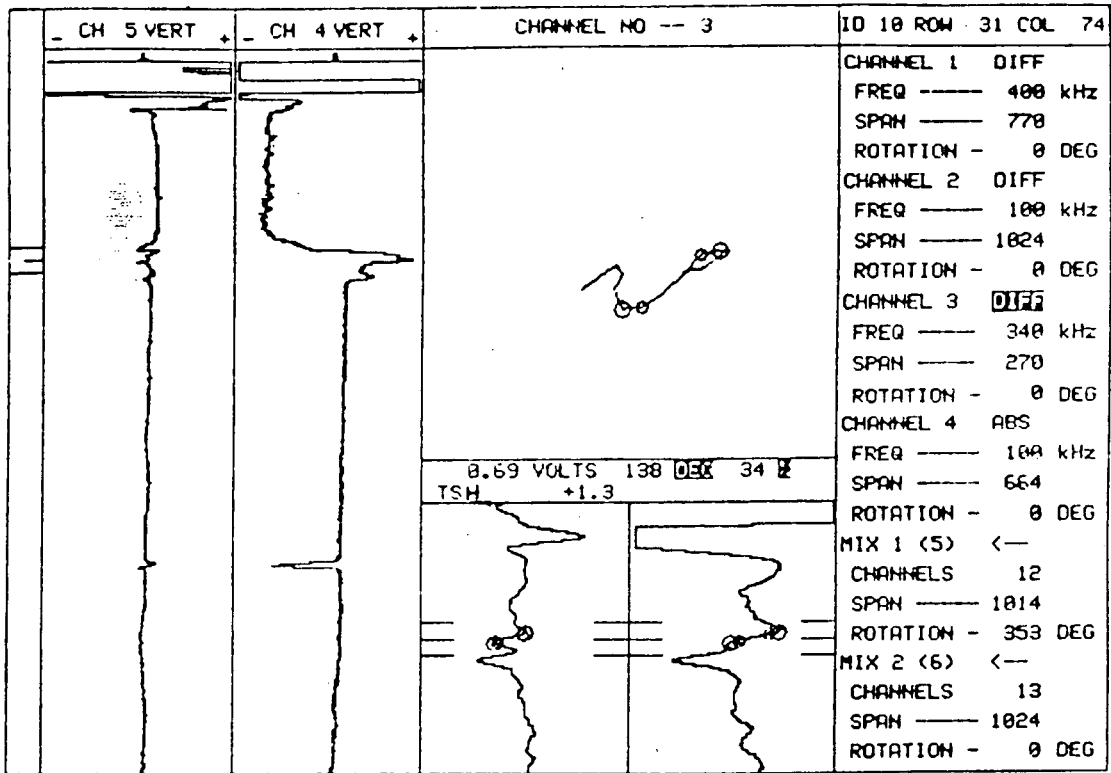




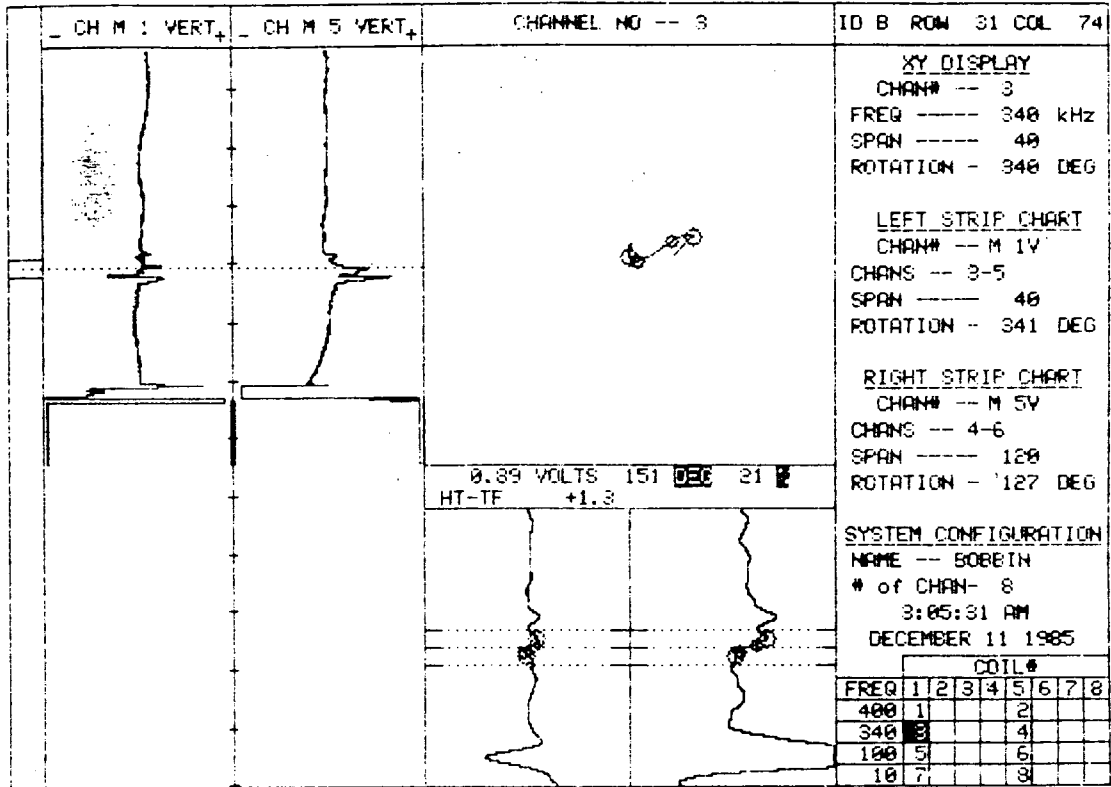
25 PLANT SONGS REEL H04- UNIT# 1 S/G 8 LEG INLET DATE 12/22/85



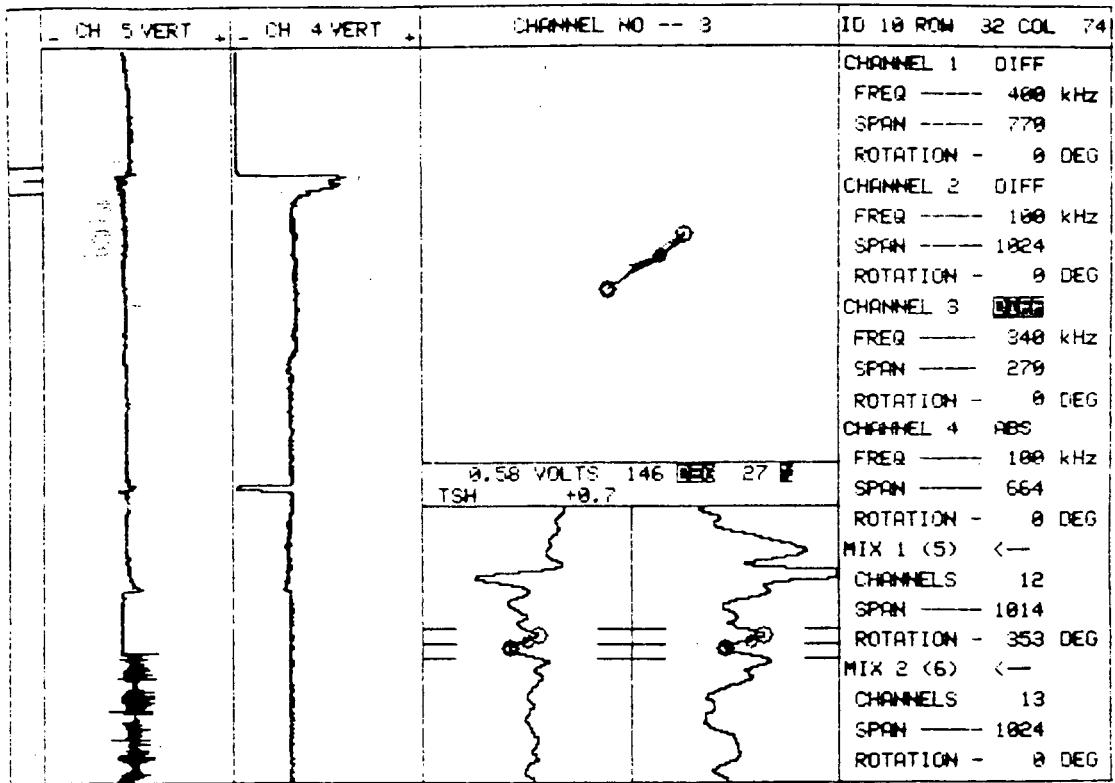




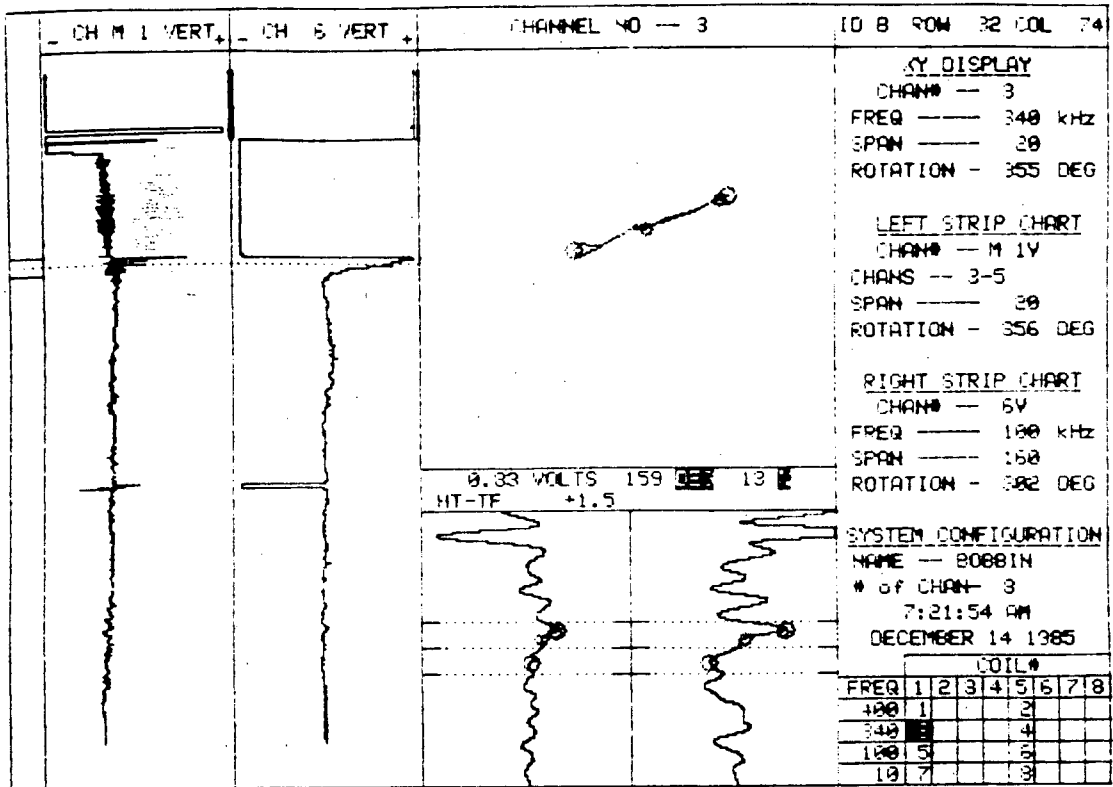
10	PLANT	UNIT#	S/G	LEG	DATE	ZETEC Inc. - 1983
	SCE SONGS	I	B	INLET	1980	Edition 12.0 Rev 1



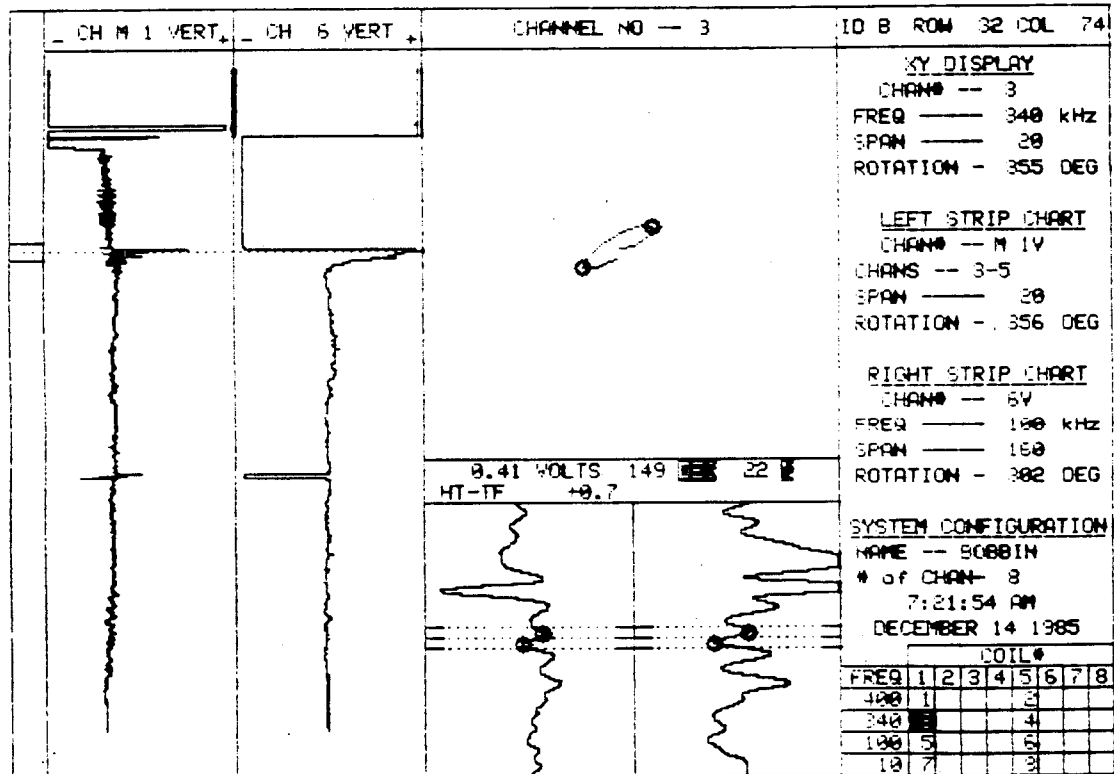
15 PLANT UNIT# S/G LEG DATE
 SONGS DISK 004 1 B OUTLET 12/11/85



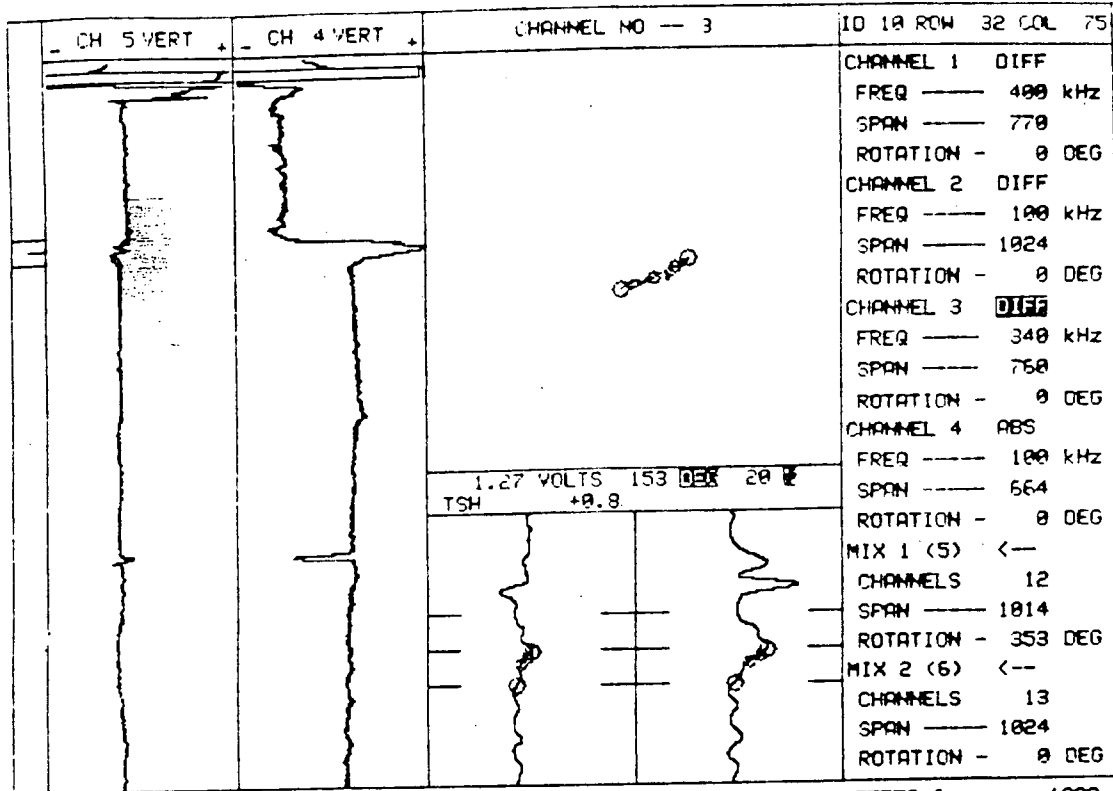
10 PLANT SCE SONGS UNIT# I S/O 8 LEG INLET DATE 1988 ZETEC Inc. - 1983 Edition 12.0 Rev 1



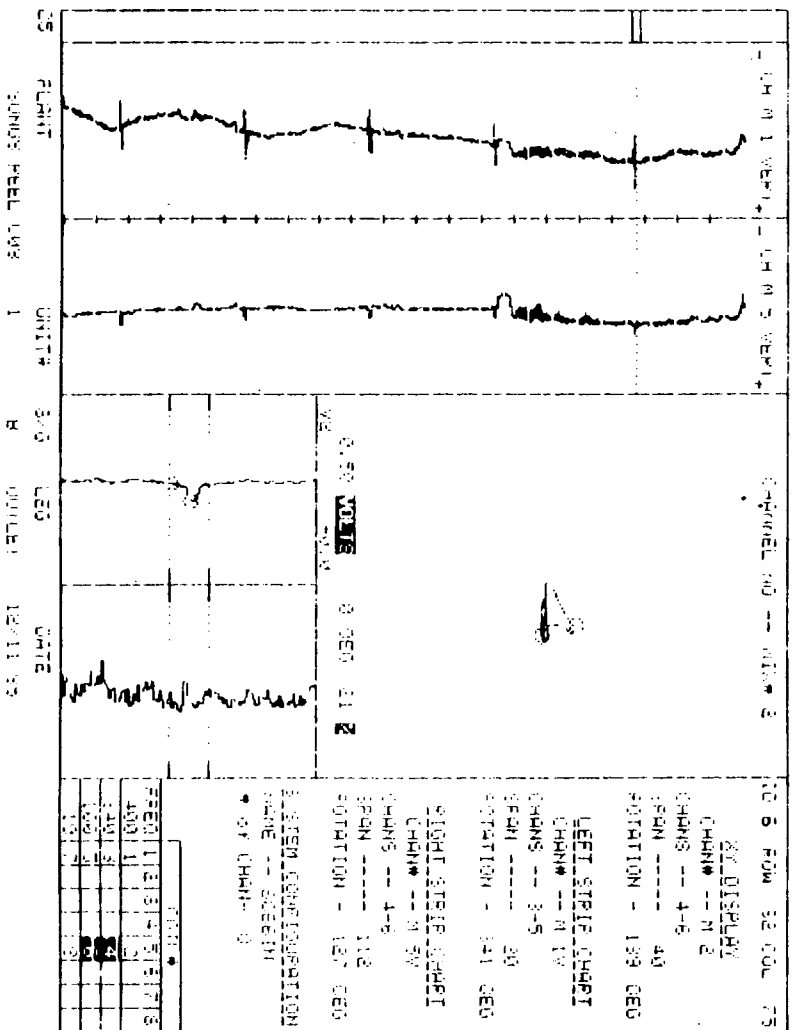
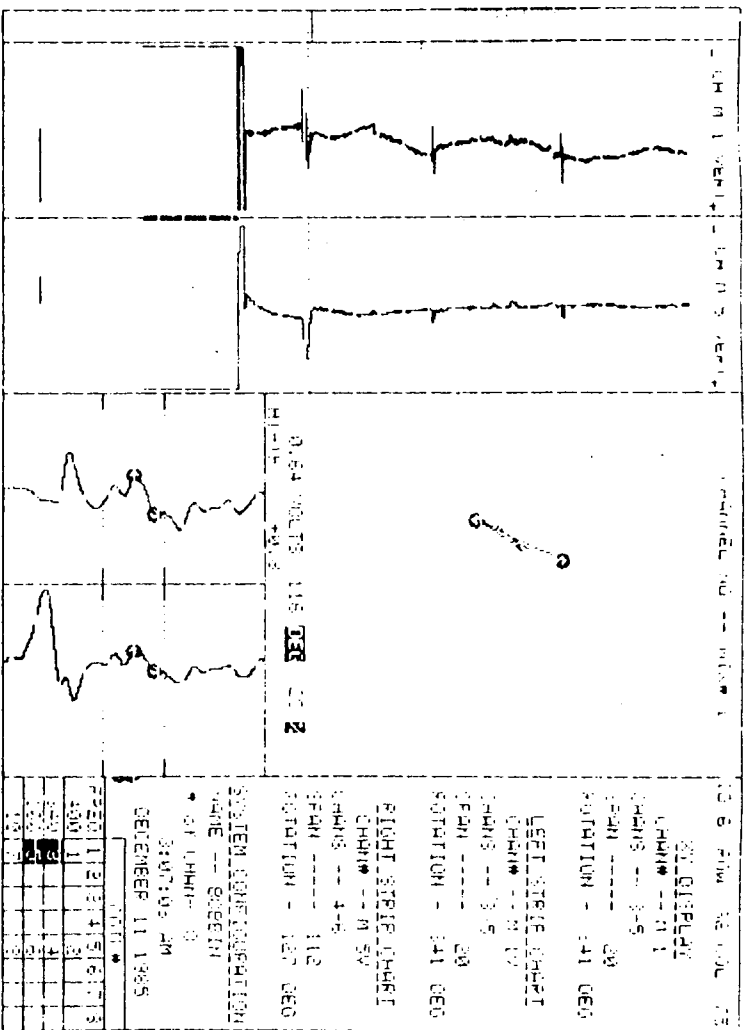
15 PLANT SONGS DISK H03 UNIT# 1 S/G 8 LEG HOT DATE 12/13/85



15 PLANT SONGS DISK H03 UNIT# 1 S/G 8 LEG HOT DATE 12/13/85

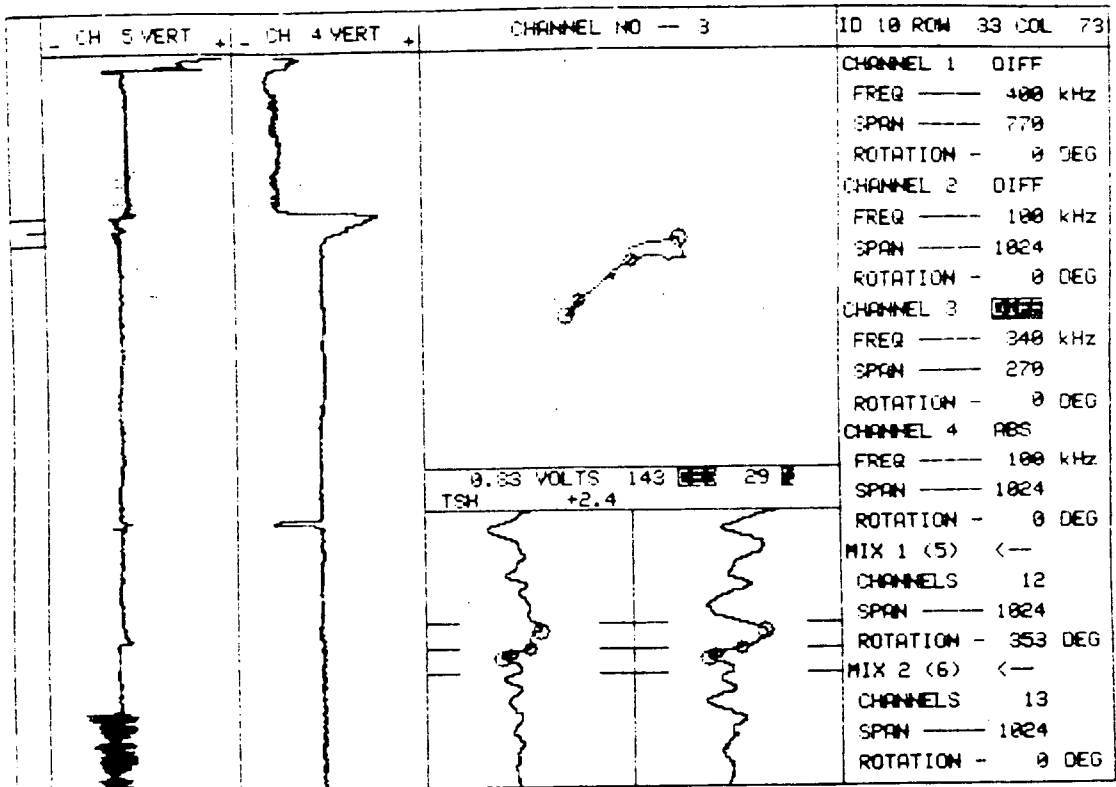


10	PLANT	UNIT*	S/G	LEG	DATE	ZETEC Inc. - 1983
	SCE SONGS	I	B	INLET	1980	Edition 12.0 Rev 1



CS PRINT 3-0 DEG DATE
 SOUND REEL LWS 1 UNIT# R W/LEL 12/11/93

CS PRINT 3-0 DEG DATE
 SOUND REEL LWS 1 UNIT# R W/LEL 12/11/93



ID 10 ROW 33 COL 73

CHANNEL 1 DIFF
 FREQ ——— 400 kHz
 SPAN ——— 770
 ROTATION - 0 DEG

CHANNEL 2 DIFF
 FREQ ——— 100 kHz
 SPAN ——— 1024
 ROTATION - 0 DEG

CHANNEL 3 ~~DIFF~~
 FREQ ——— 340 kHz
 SPAN ——— 270
 ROTATION - 0 DEG

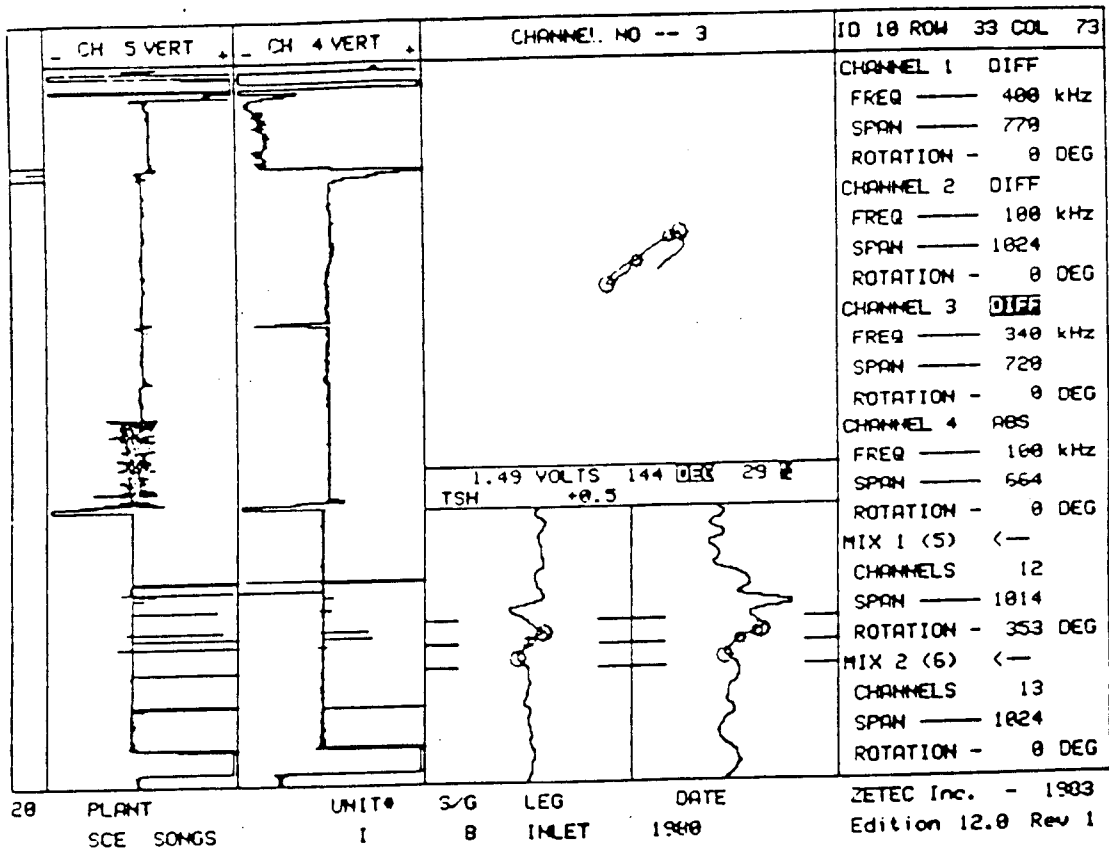
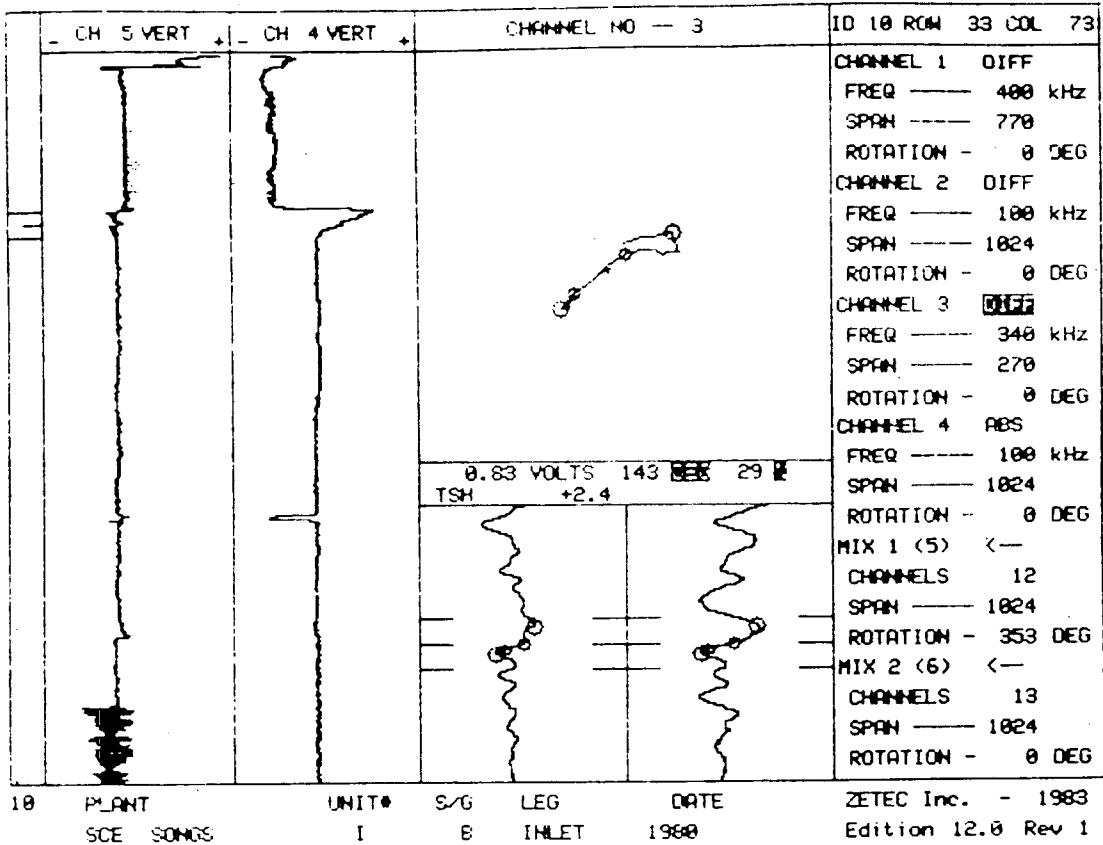
CHANNEL 4 ABS
 FREQ ——— 100 kHz
 SPAN ——— 1024
 ROTATION - 0 DEG

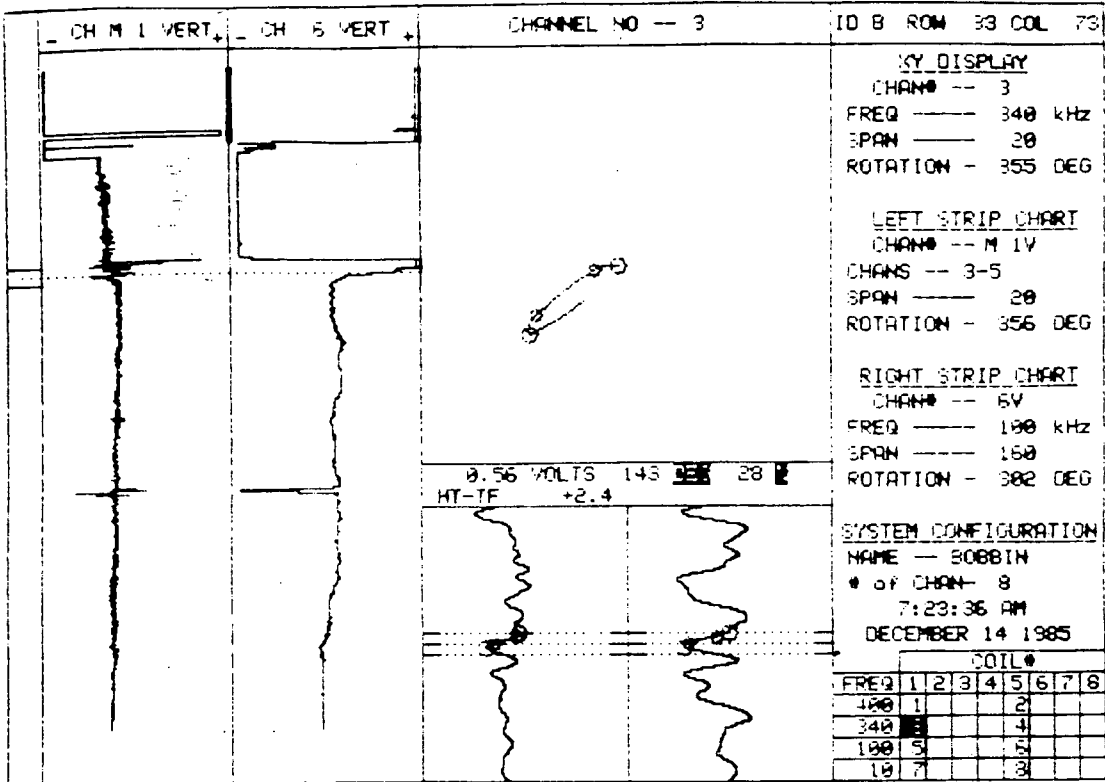
MIX 1 (5) <—
 CHANNELS 12
 SPAN ——— 1024
 ROTATION - 353 DEG

MIX 2 (6) <—
 CHANNELS 13
 SPAN ——— 1024
 ROTATION - 0 DEG

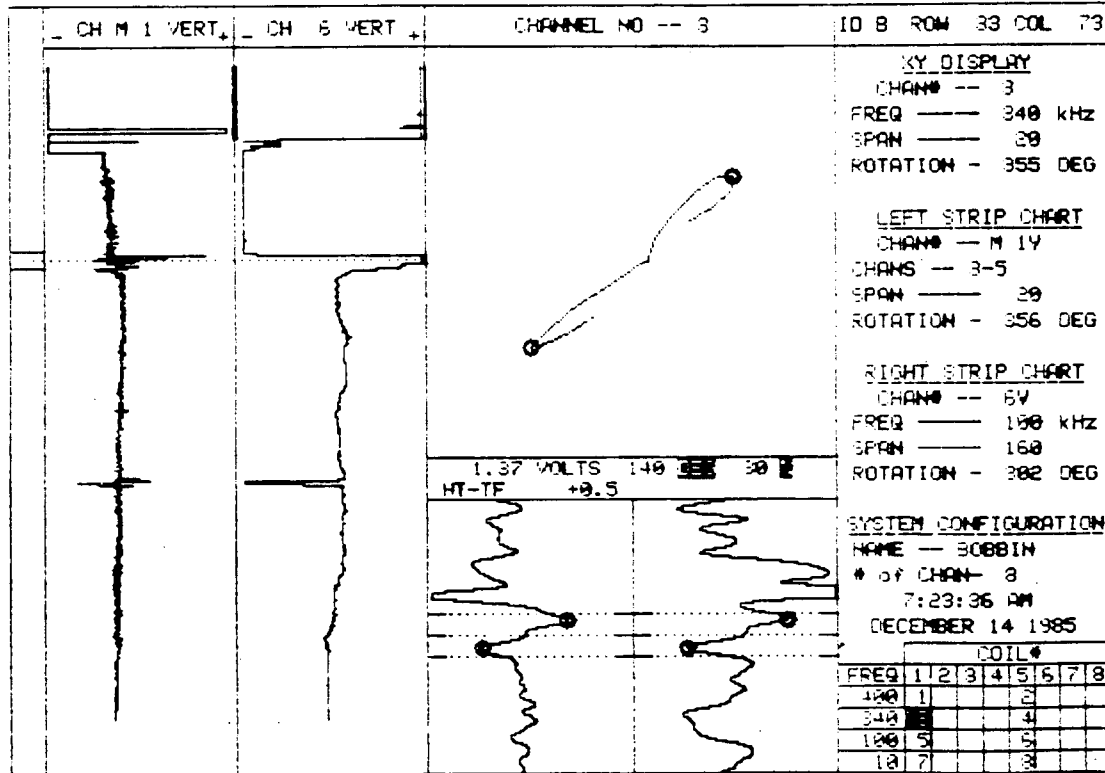
0.83 VOLTS 143 ~~0.83~~ 29 ~~1~~
 TSH +2.4

10 PLANT SCE SONGS UNIT# I S/G B LEG INLET DATE 1988 ZETEC Inc. - 1983 Edition 12.0 Rev 1

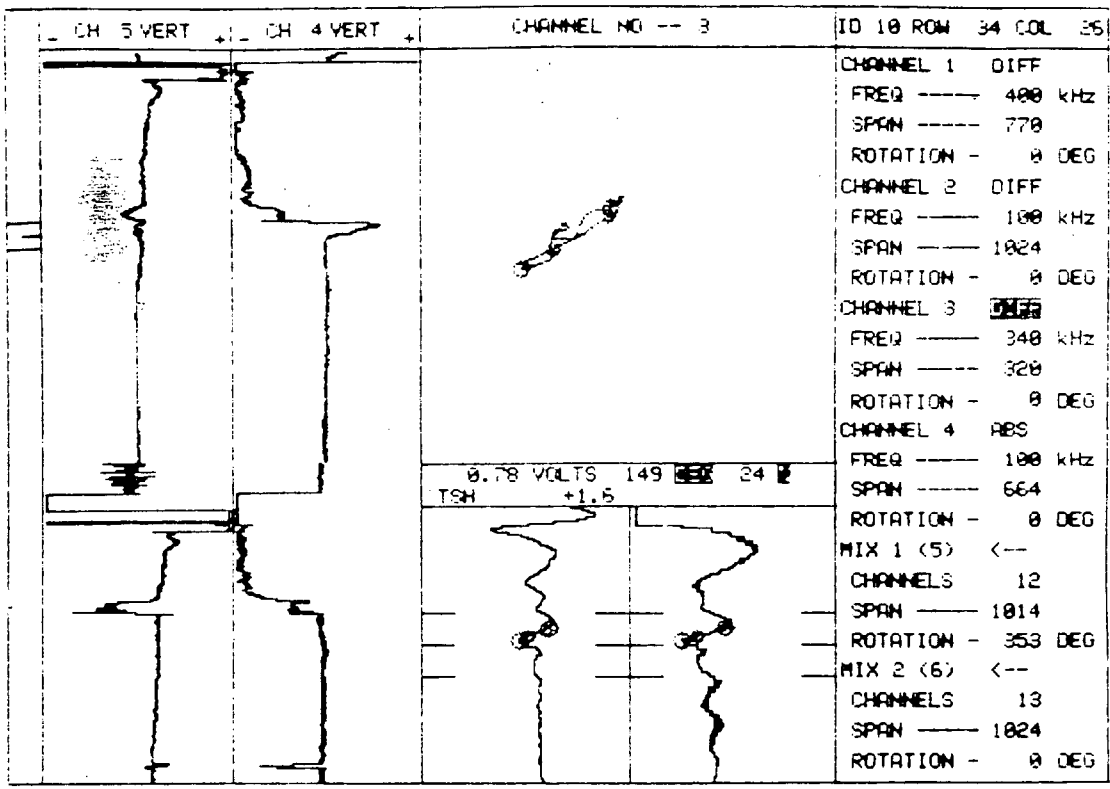




15 PLANT SONGS DISK H03 UNIT# 1 S/G 8 LEG HOT DATE 12/13/85



15 PLANT SONGS DISK H03 UNIT# 1 S/G 8 LEG HOT DATE 12/13/85

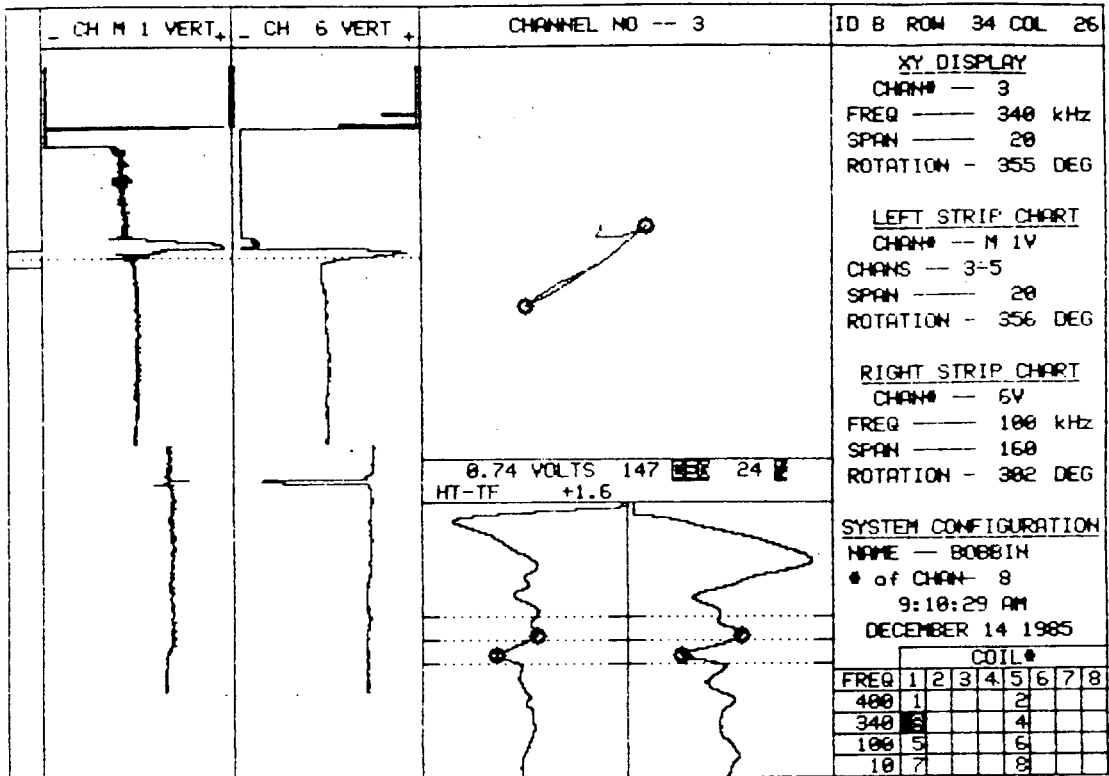


ID 10 ROW 34 COL 25
 CHANNEL 1 DIFF
 FREQ ---- 400 KHZ
 SPAN ---- 770
 ROTATION - 0 DEG
 CHANNEL 2 DIFF
 FREQ ---- 100 KHZ
 SPAN ---- 1024
 ROTATION - 0 DEG
 CHANNEL 3 ~~DIFF~~
 FREQ ---- 340 KHZ
 SPAN ---- 320
 ROTATION - 0 DEG
 CHANNEL 4 ABS
 FREQ ---- 100 KHZ
 SPAN ---- 664
 ROTATION - 0 DEG
 MIX 1 (5) <--
 CHANNELS 12
 SPAN ---- 1014
 ROTATION - 353 DEG
 MIX 2 (6) <--
 CHANNELS 13
 SPAN ---- 1024
 ROTATION - 0 DEG

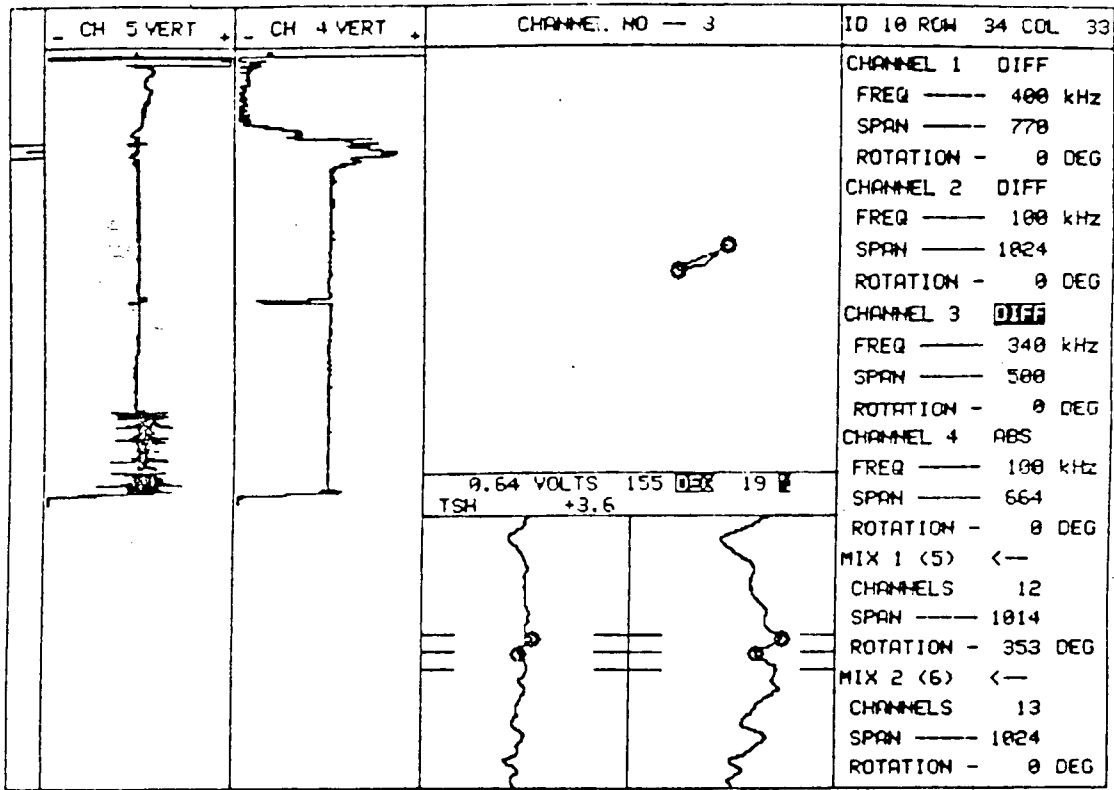
0.78 VOLTS 149 24
 TSH +1.5

10 PLANT SCE SONGS UNIT# I S/G B LEG INLET DATE 1980

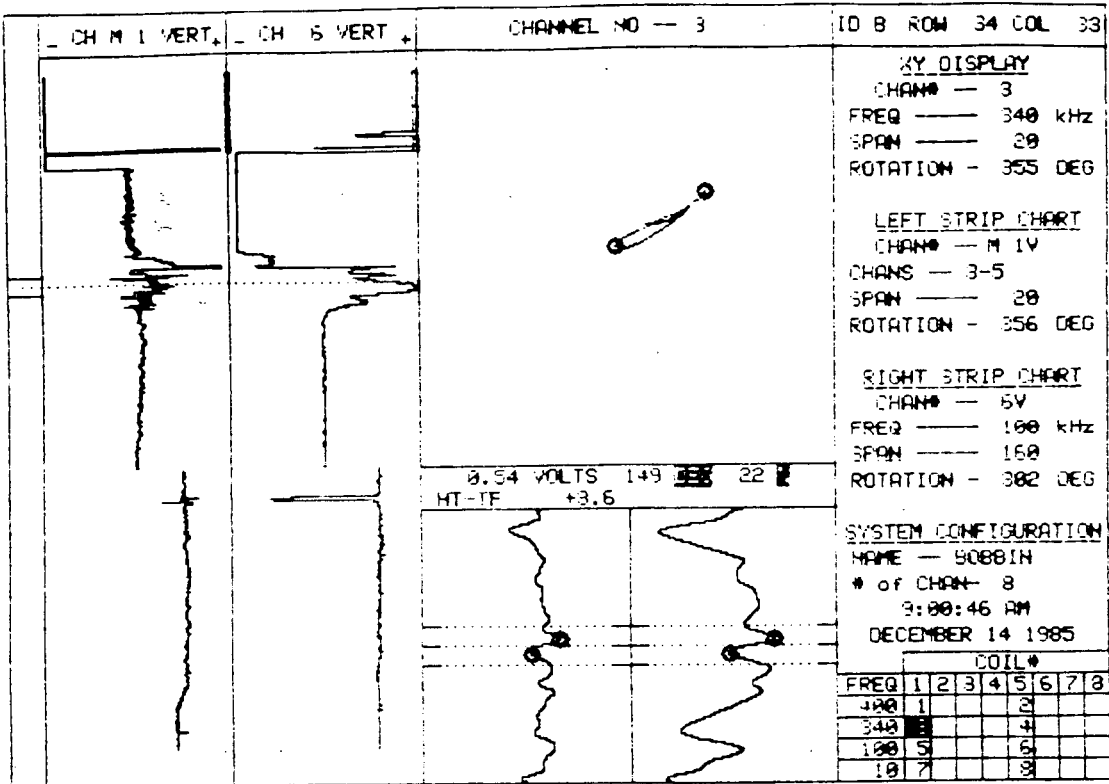
ZETEC Inc. - 1983
 Edition 12.0 Rev 1



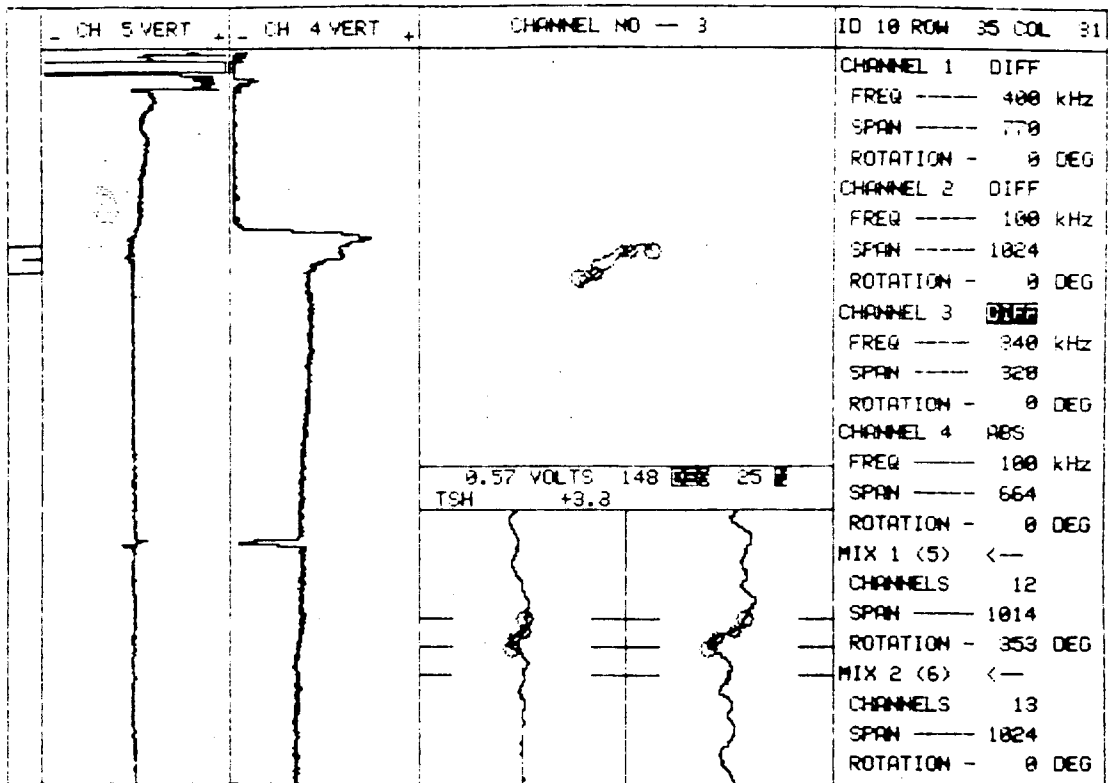
15 PLANT SONGS DISK H83 UNIT# 1 S/G B LEG HOT DATE 12/13/85



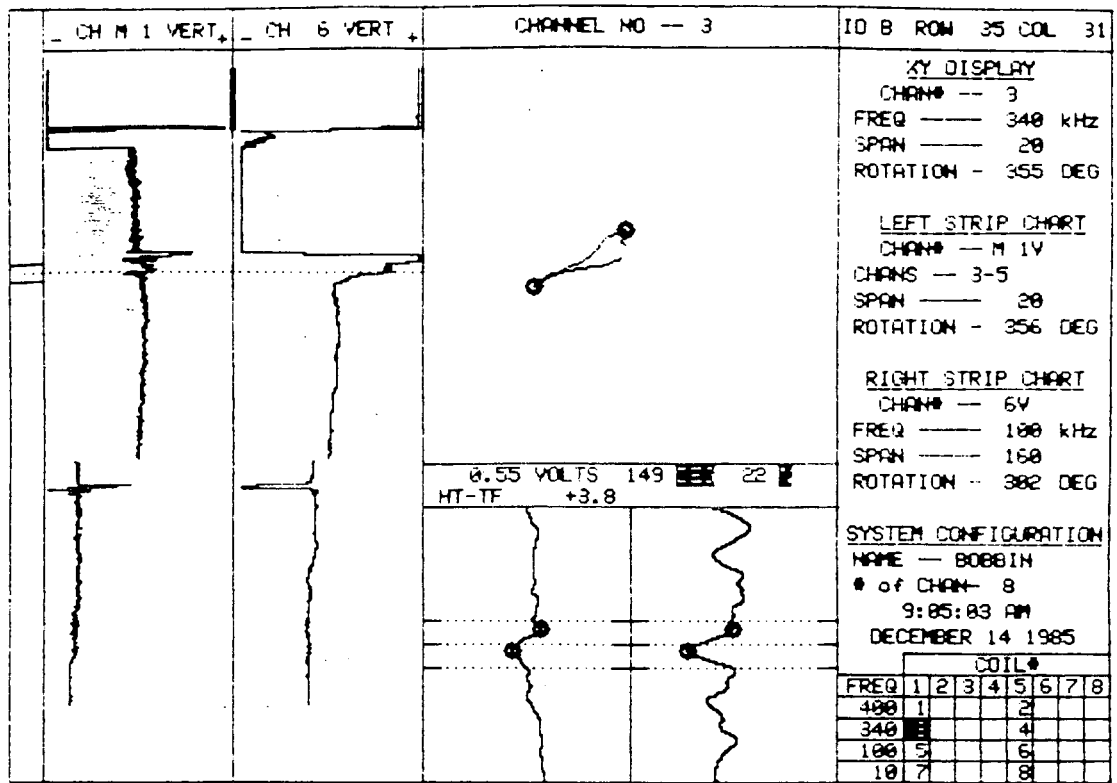
20	PLANT	UNIT#	S/G	LEG	DATE	ZETEC Inc. - 1983
	SCE SONGS	I	B	INLET	1988	Edition 12.0 Rev 1



15 PLANT SONGS DISK H03 UNIT# 1 S/G B LEG HOT DATE 12/13/85

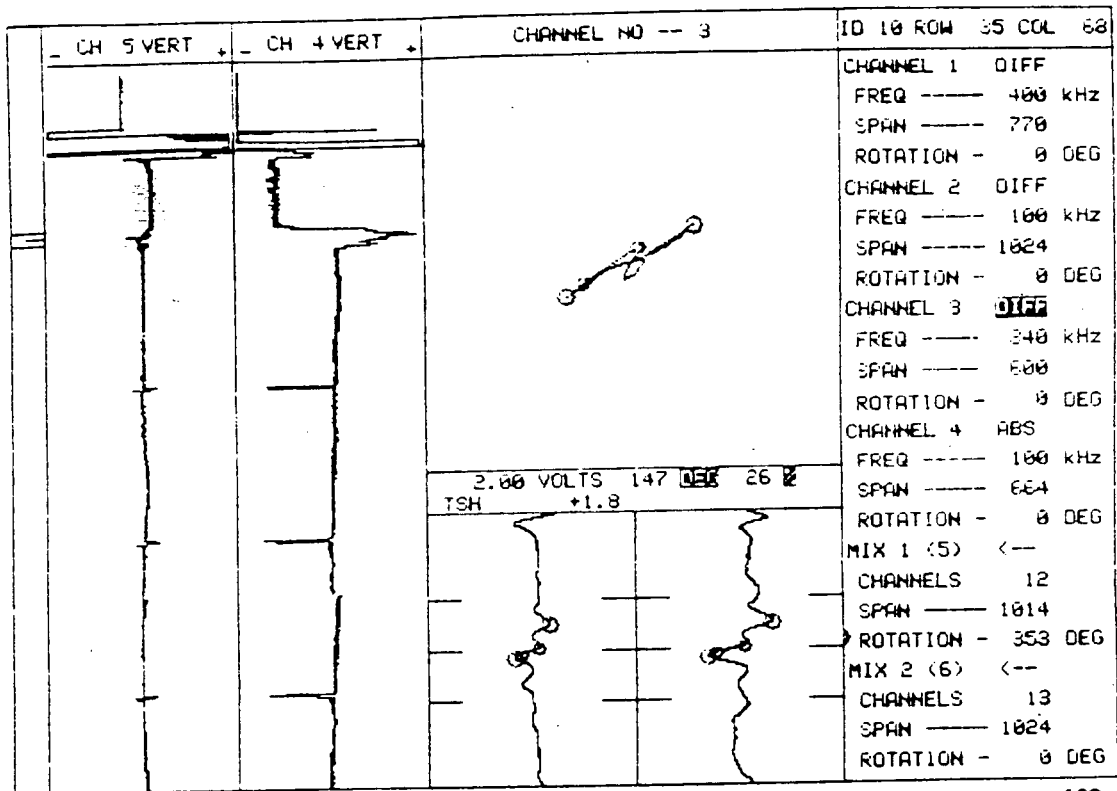


10 PLANT SCE SONGS UNIT# I S/G B LEG INLET DATE 1980 ZETEC Inc. - 1983 Edition 12.0 Rev 1



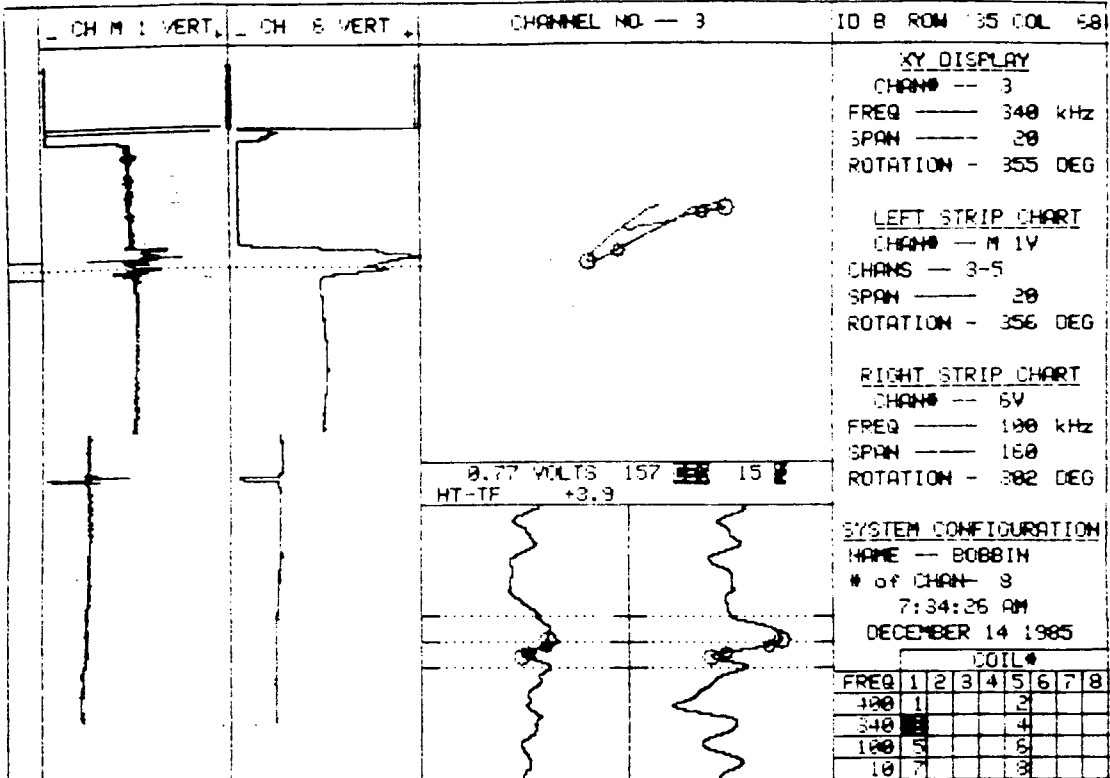
COIL#								
FREQ	1	2	3	4	5	6	7	8
400	1				2			
340	3			4				
100	5			6				
10	7			8				

15 PLANT SONGS DISK H03 UNIT# 1 S/G B LEG HOT DATE 12/13/85

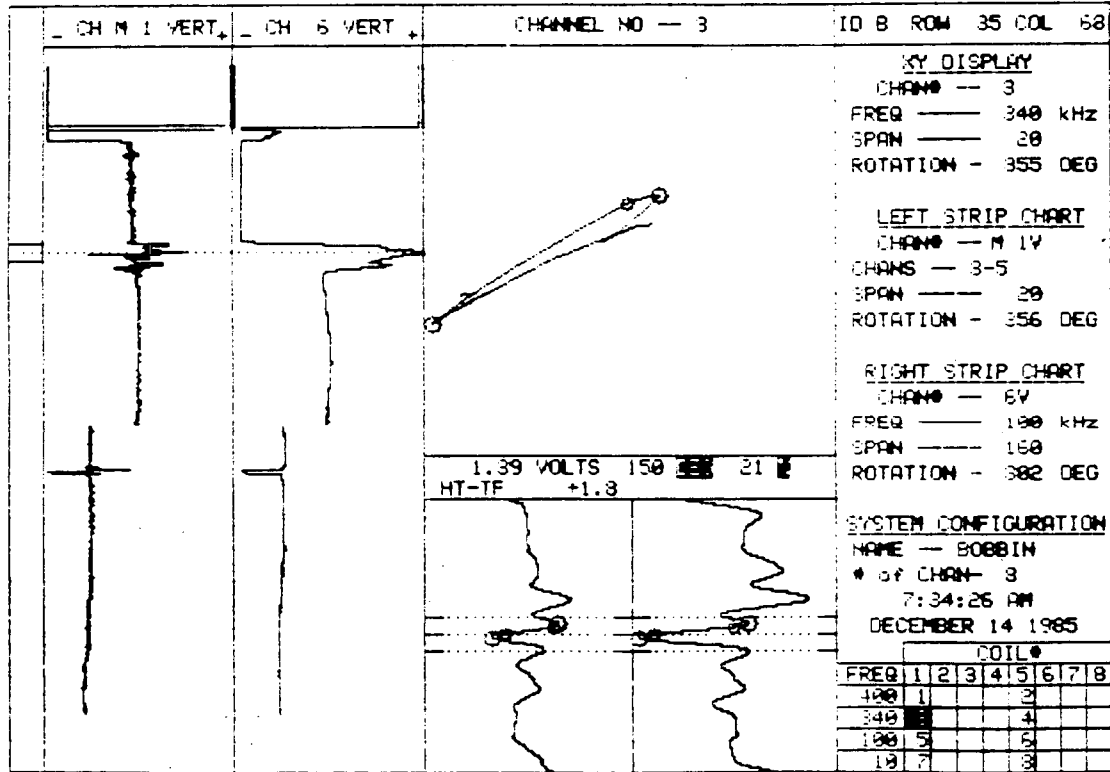


20 PLANT SCE SONGS UNIT# I S/G B LEG INLET DATE 1980

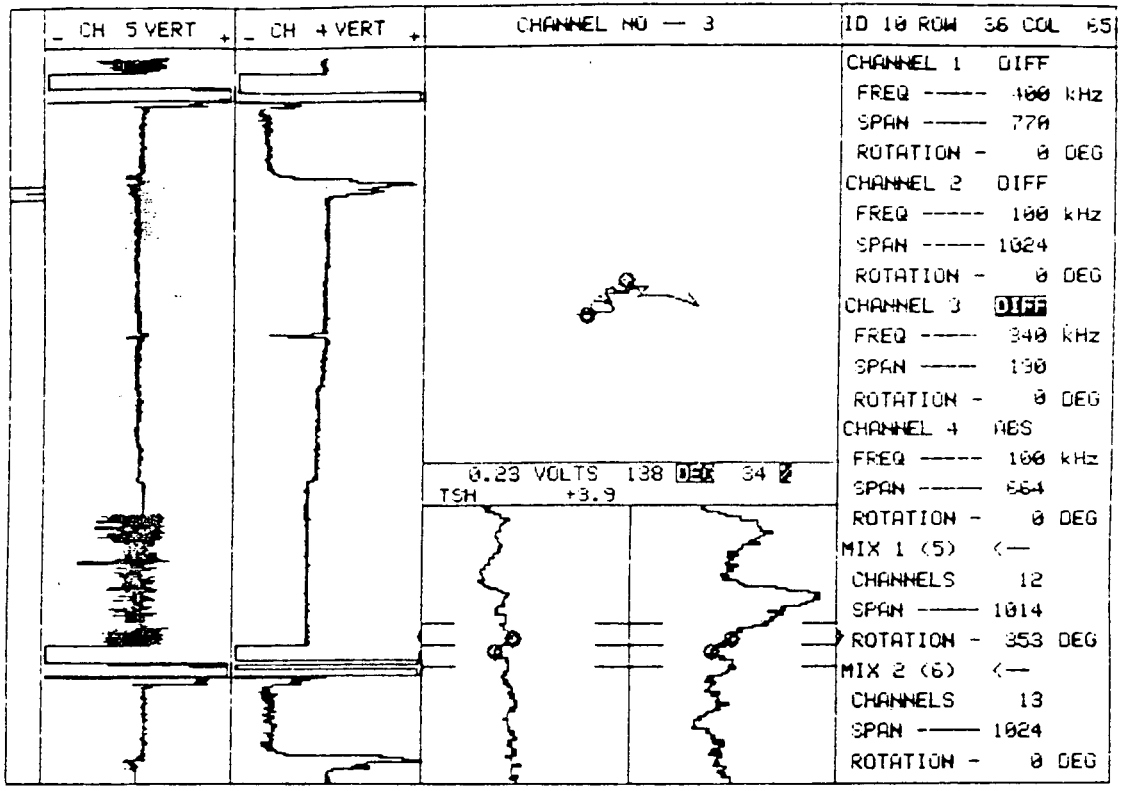
ZETEC Inc. - 1983
Edition 12.0 Rev 1



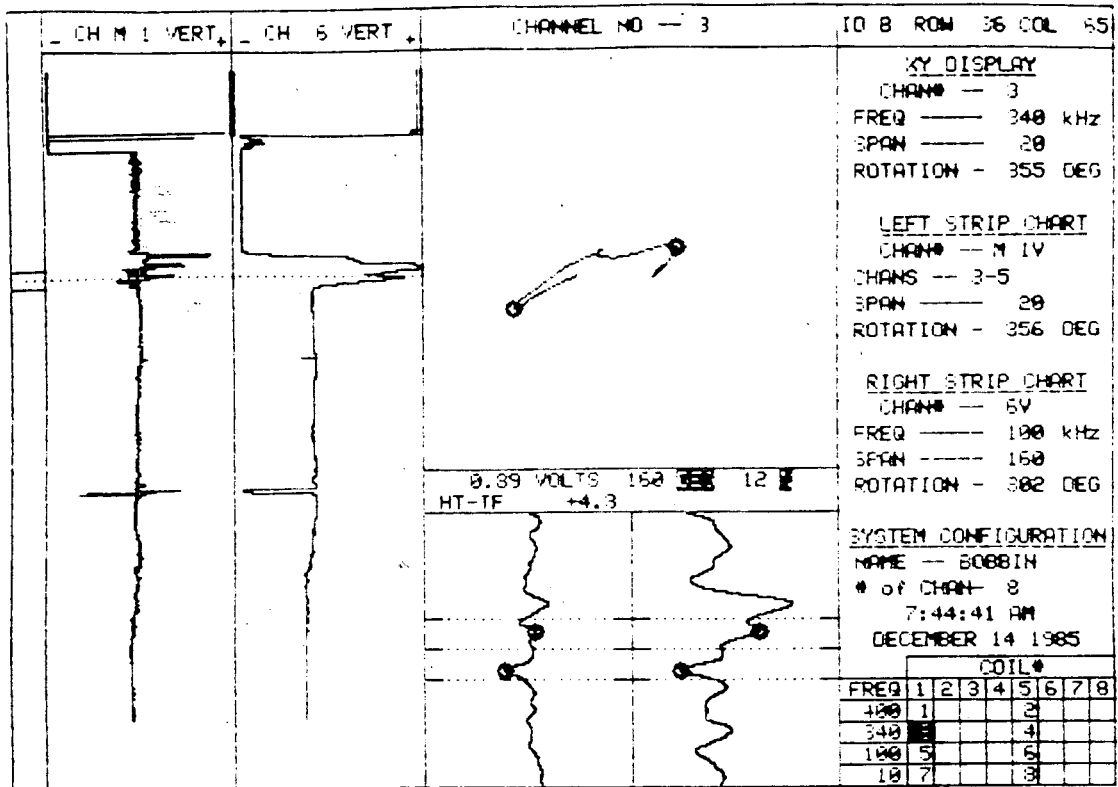
15 PLANT SONGS DISK H03 UNIT# 1 S/G B LEG HOT DATE 12/13/85



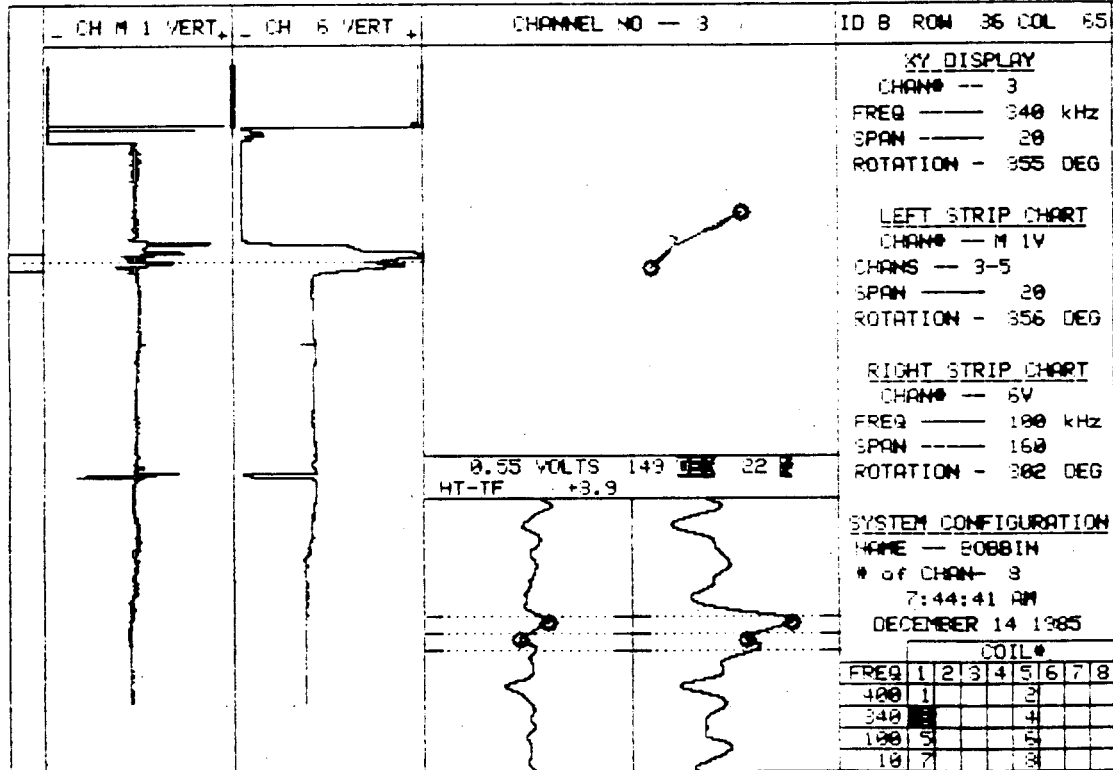
15 PLANT SONGS DISK H03 UNIT# 1 S/G B LEG HOT DATE 12/13/85



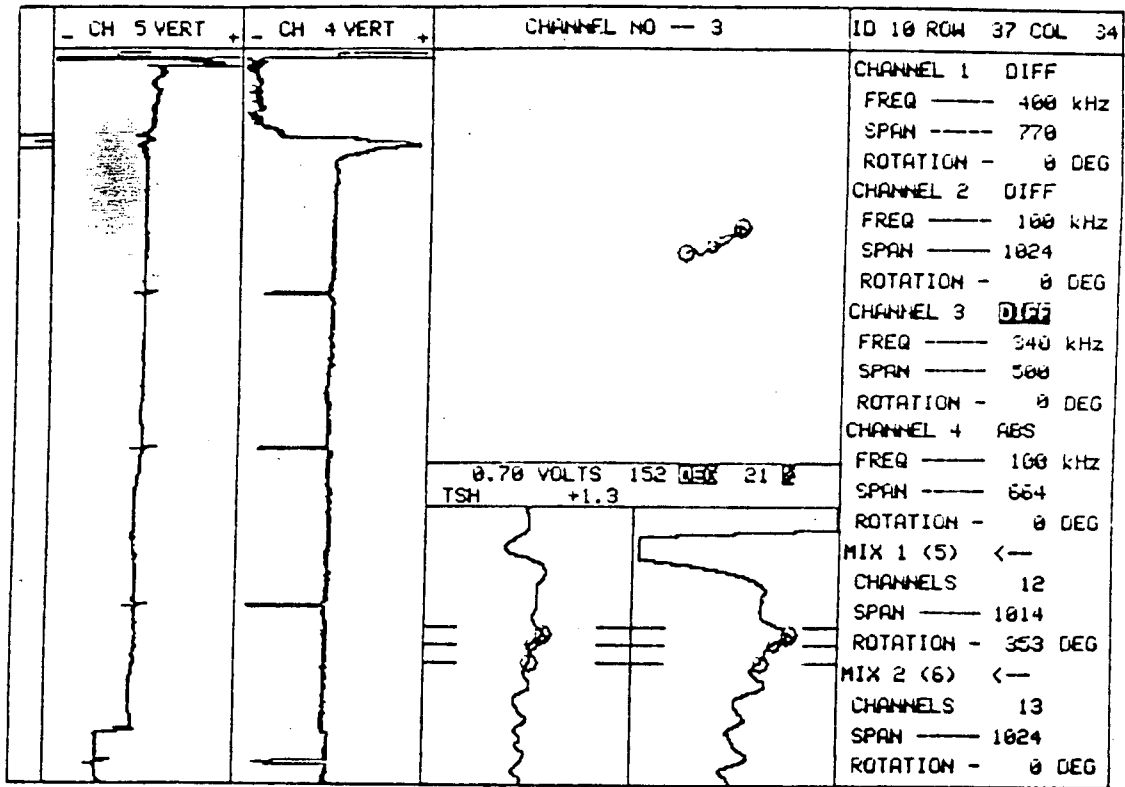
20 PLANT SCE SONGS UNIT# I S/G B LEG INLET DATE 1980 ZETEC Inc. - 1983 Edition 12.0 Rev 1



15 PLANT SONGS DISK H03 UNIT# 1 S/G B LEG HOT DATE 12/13/85

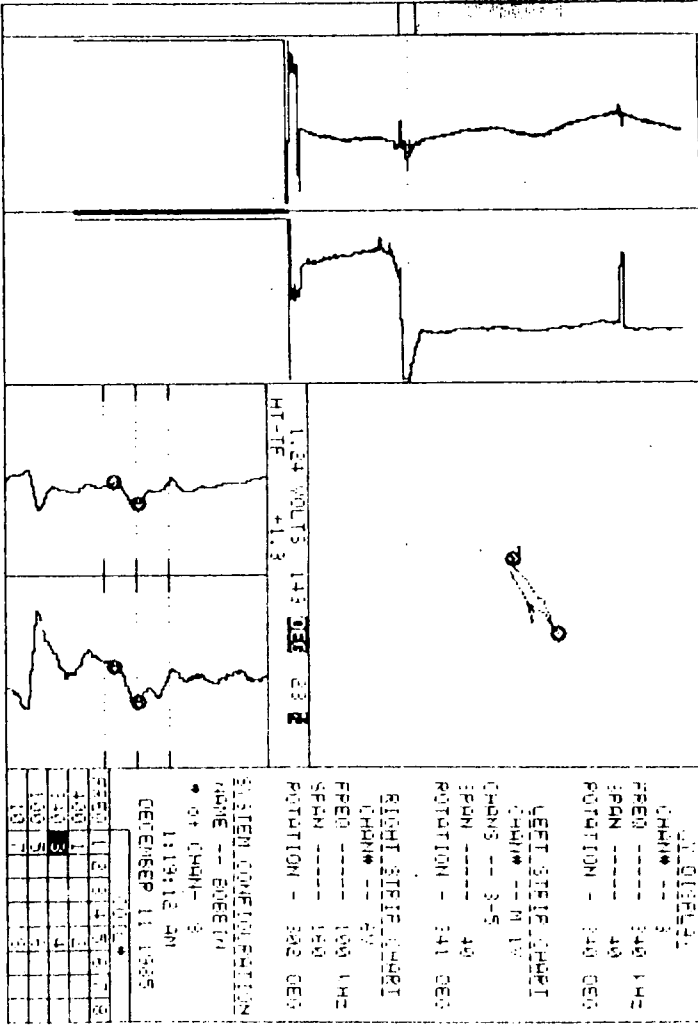


15 PLANT SONGS DISK H03 UNIT# 1 S/G B LEG HOT DATE 12/13/85



20 PLANT SCE SONGS UNIT# I S/G B LEG INLET DATE 1980 ZETEC Inc. - 1983 Edition 12.0 Rev 1

CH 1 - CRT CH 2 - CRT CHANNEL NO - 3 NO 8 50M 17 10 14

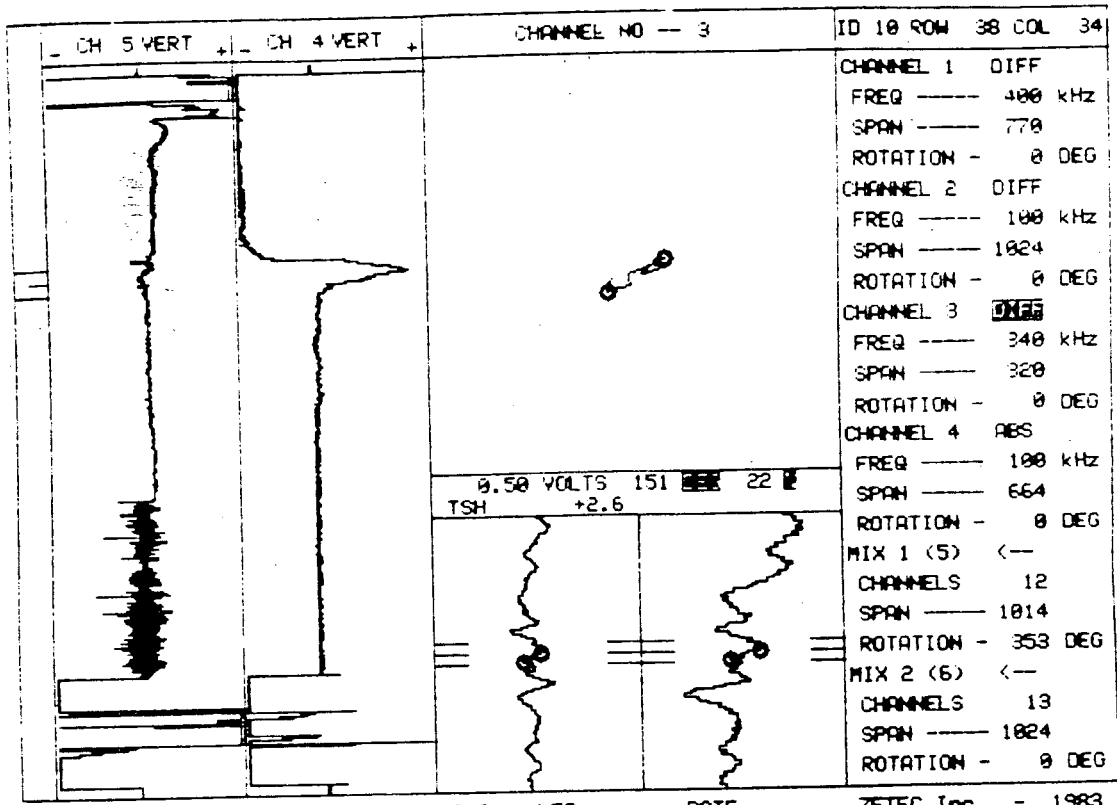


15 PLANT SONGS REEL 002 UNIT# 1 3.0 LEO 8 OUTLET DATE 12/11/89

ALGIBEL
 CHAN# --- 3
 FEED --- 340 LHZ
 SPAN --- 4M
 ROTATION - 340 DEG
 LEFT STEER CHART
 CHAN# --- N 10
 SPAN --- 3-5
 ROTATION - 341 DEG
 RIGHT STEER CHART
 CHAN# --- 20
 FEED --- 100 LHZ
 SPAN --- 100
 ROTATION - 342 DEG

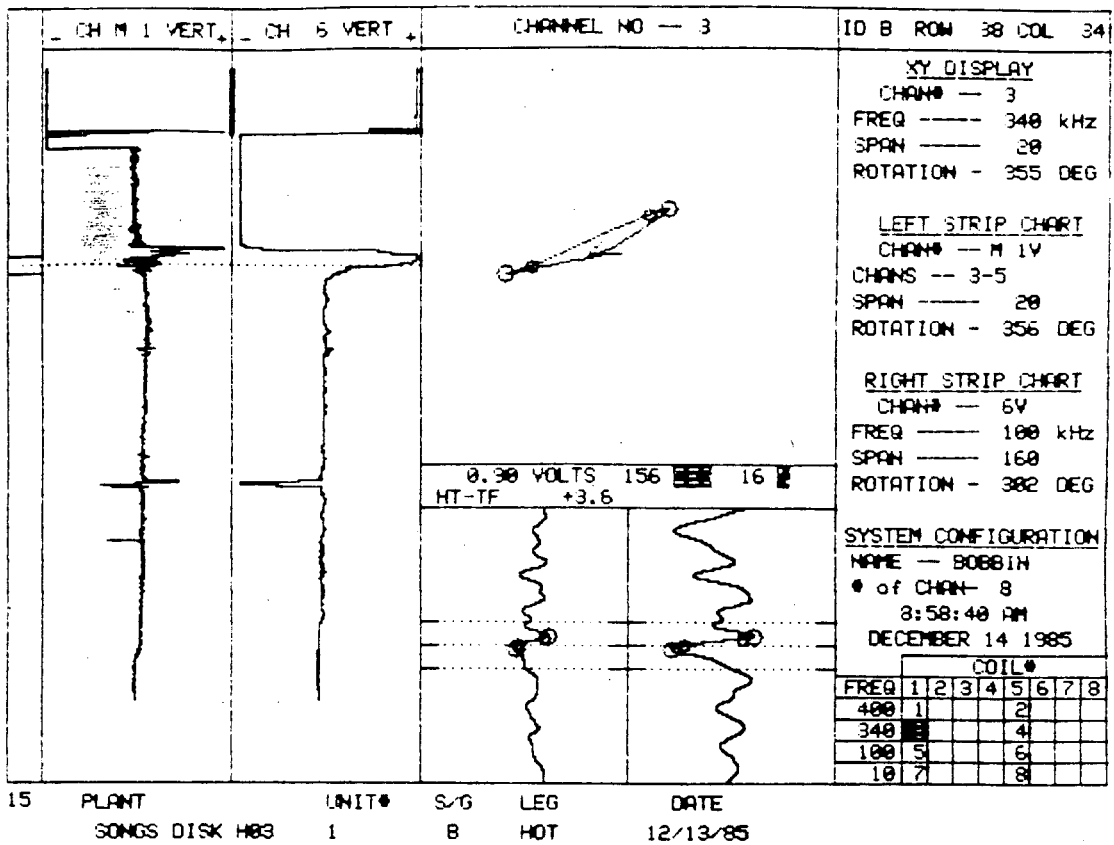
SYSTEM CONFIGURATION
 NAME --- 80667M
 * of CHAN - 2
 11/9/12 AM
 DEC 20/89 11 1989

FEED	1	2	3	4	5	6	7	8
SPAN	1	2	3	4	5	6	7	8
ROT	1	2	3	4	5	6	7	8

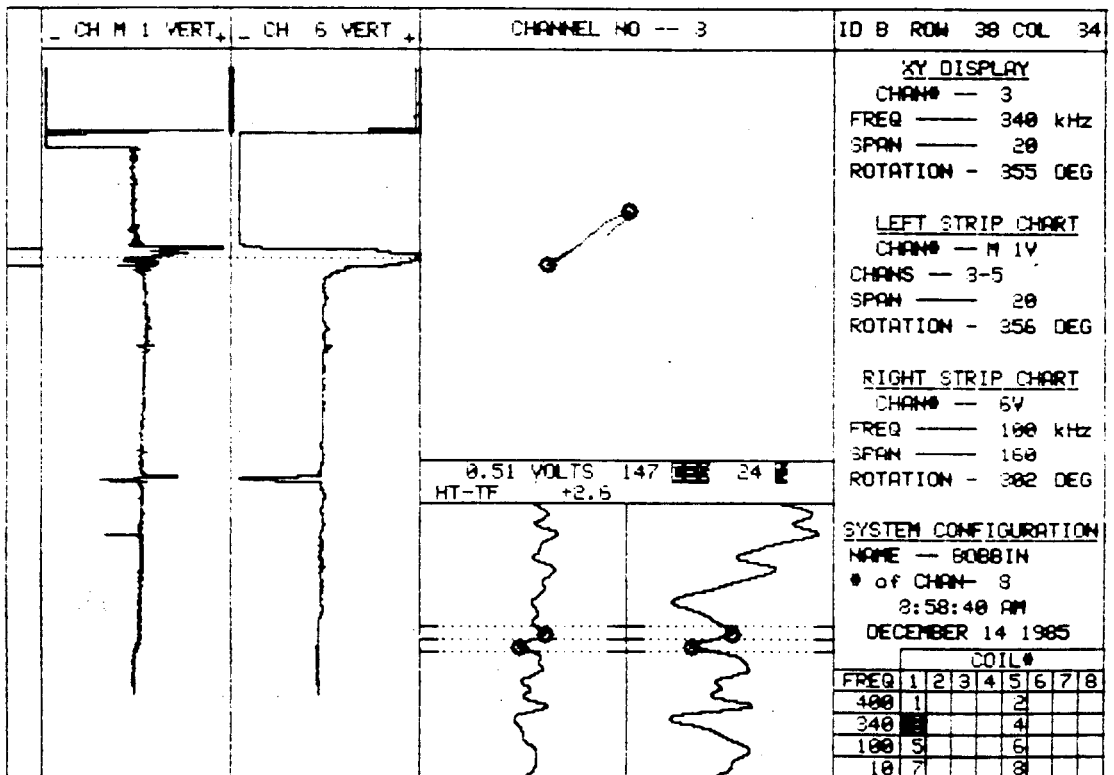


0.50 VOLTS 151 DIV 22 DIV
TSH +2.6

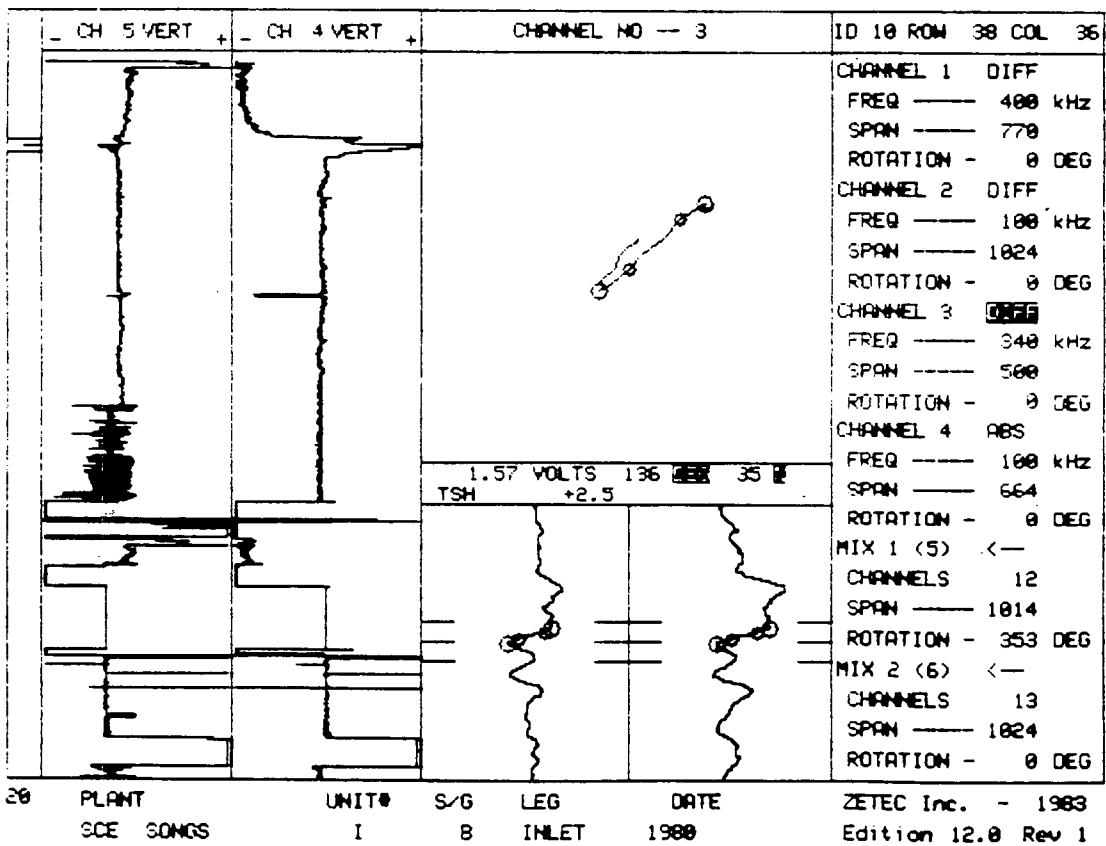
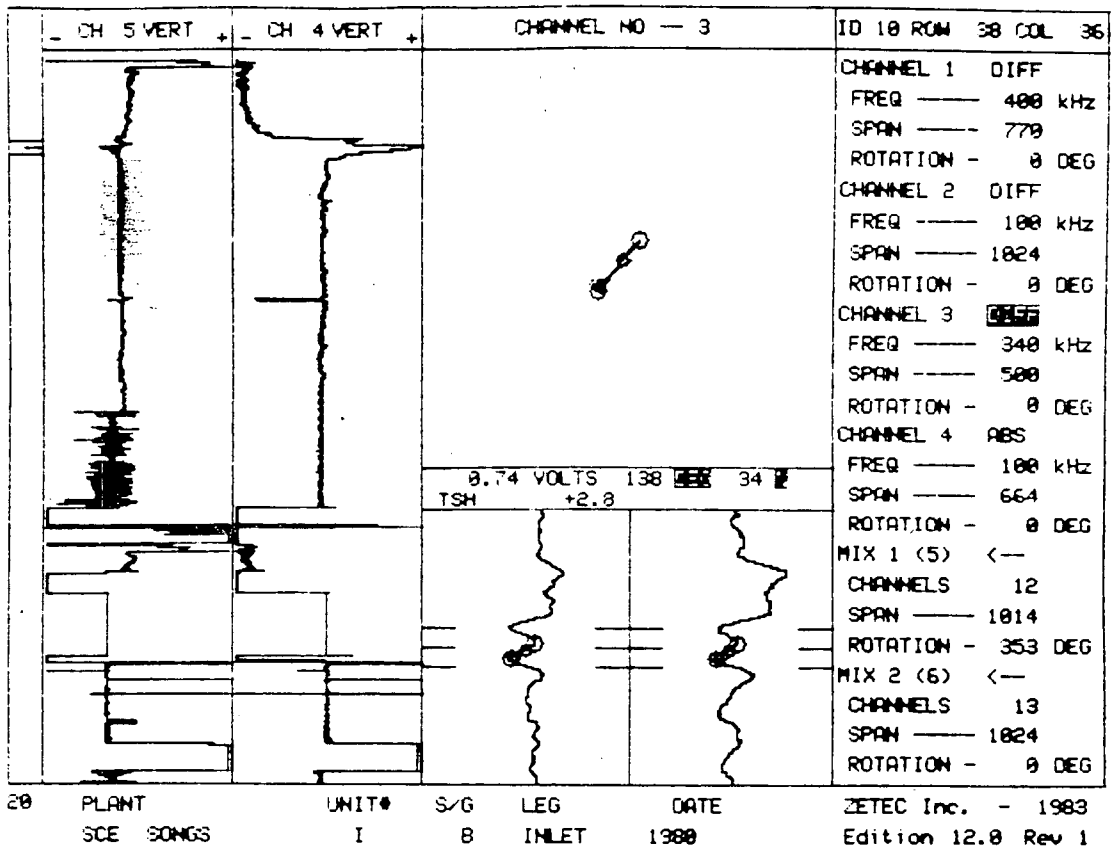
10 PLANT UNIT# S/G LEG DATE ZETEC Inc. - 1983
SCE SONGS I B INLET 1980 Edition 12.0 Rev 1

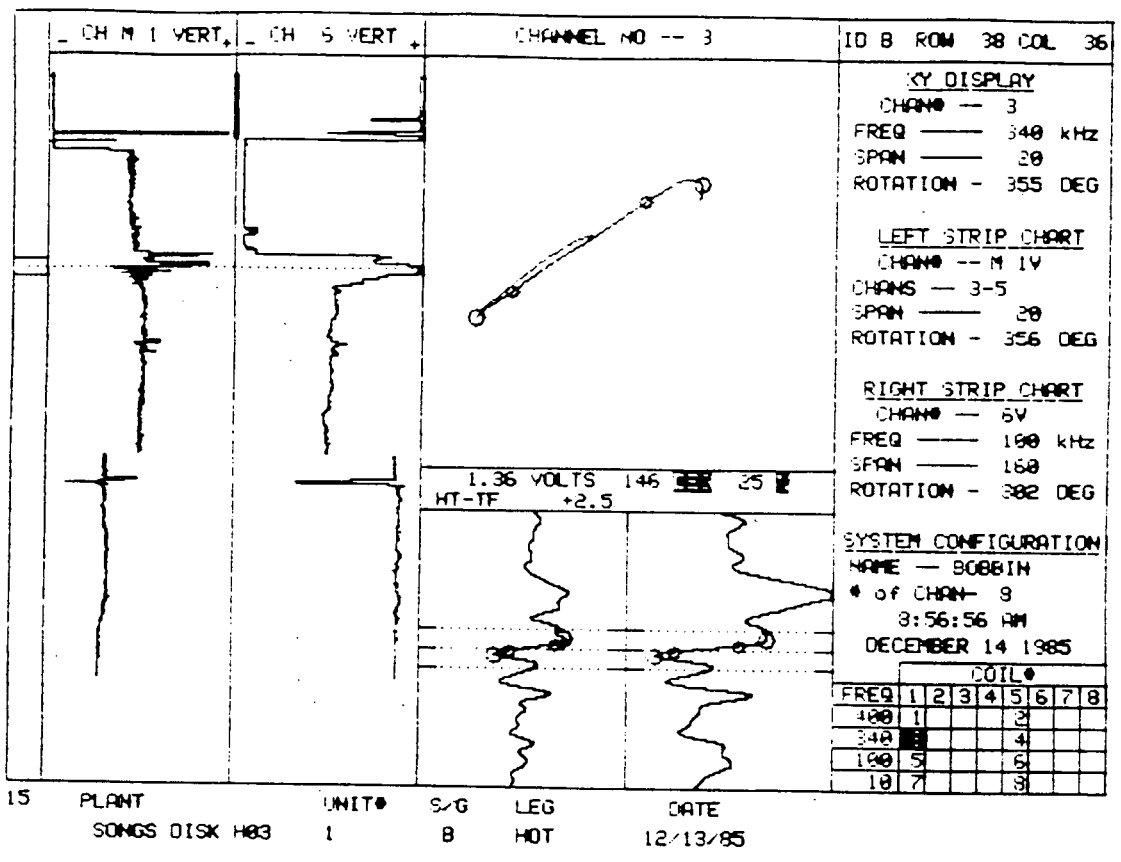
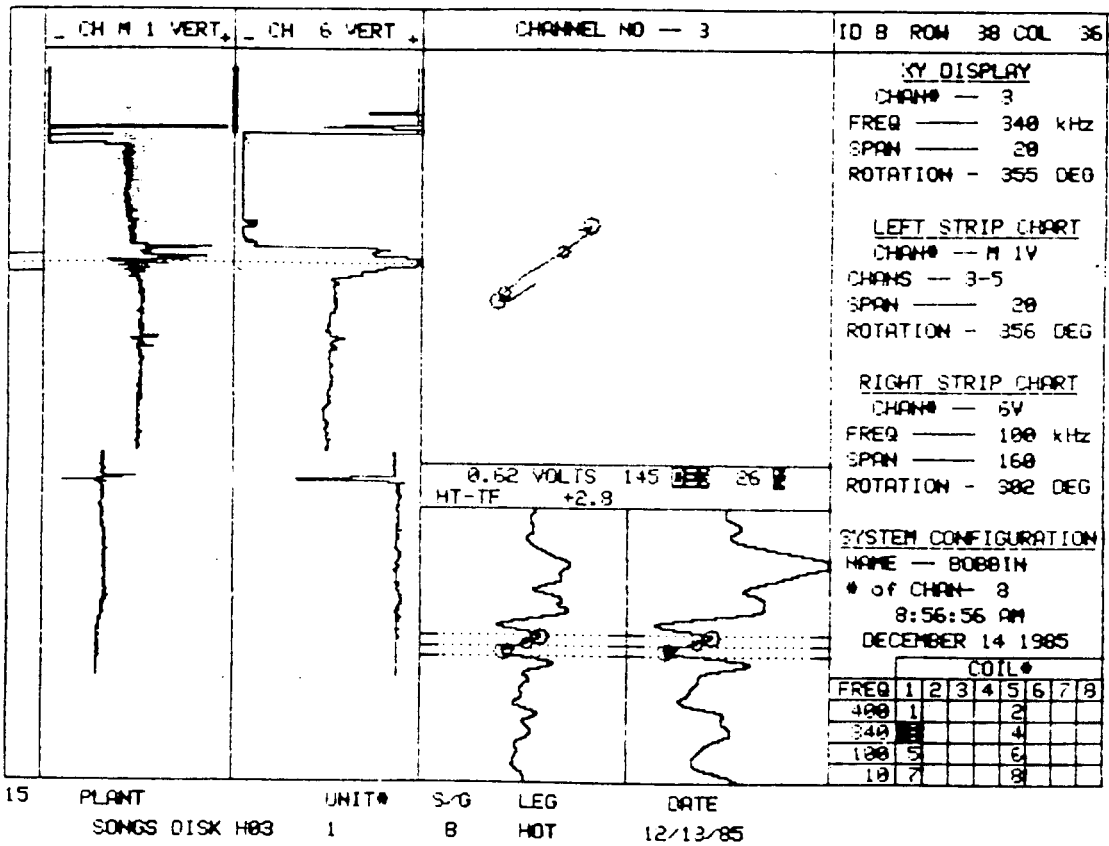


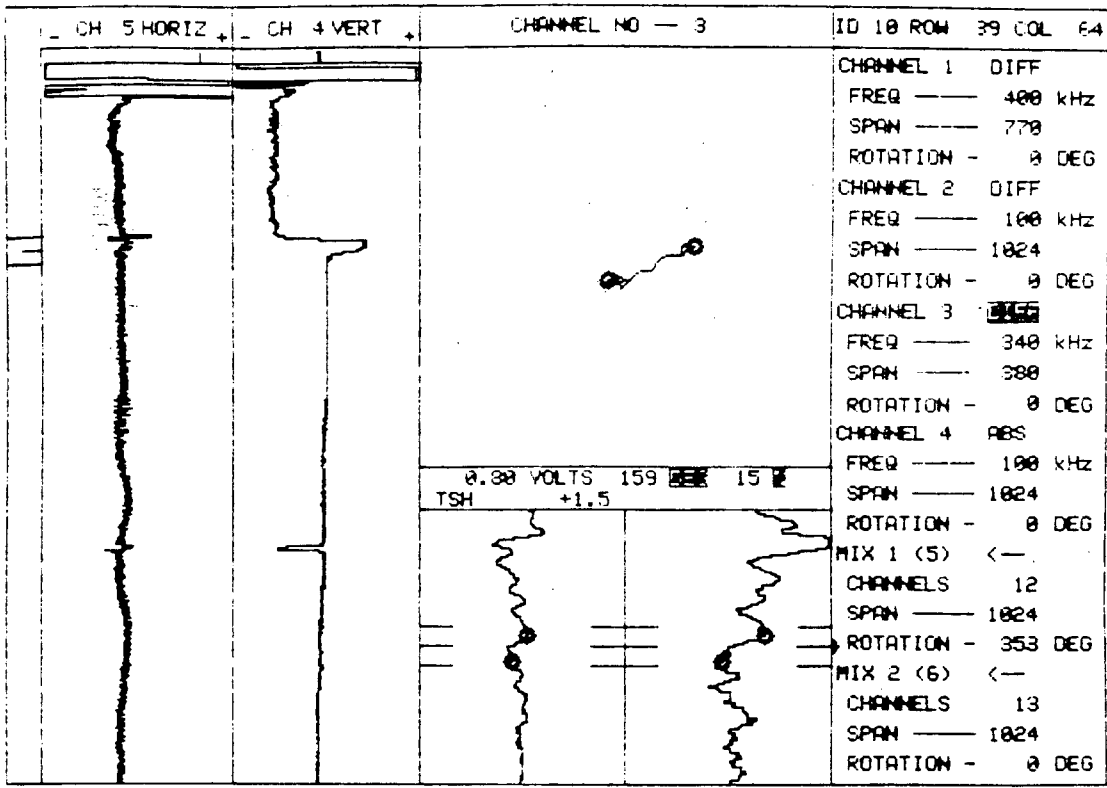
15 PLANT SONGS DISK H83 UNIT# 1 S/G B LEG HOT DATE 12/13/85



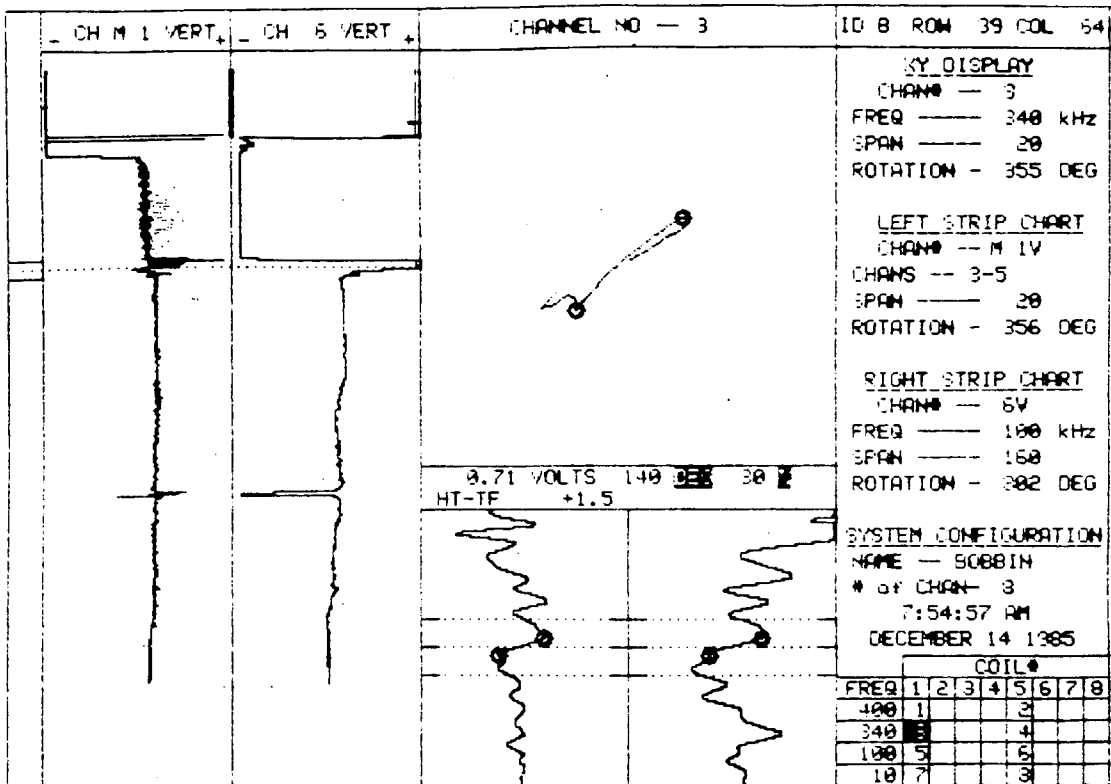
15 PLANT SONGS DISK H83 UNIT# 1 S/G B LEG HOT DATE 12/13/85



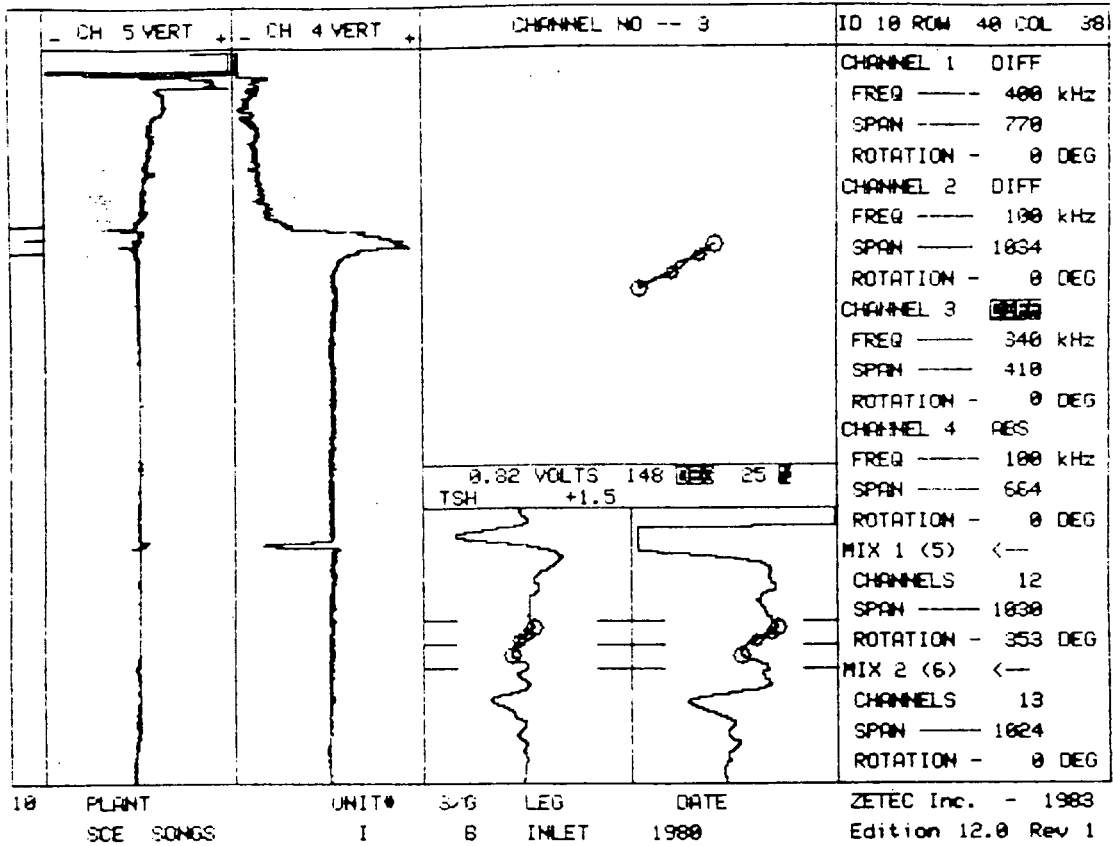


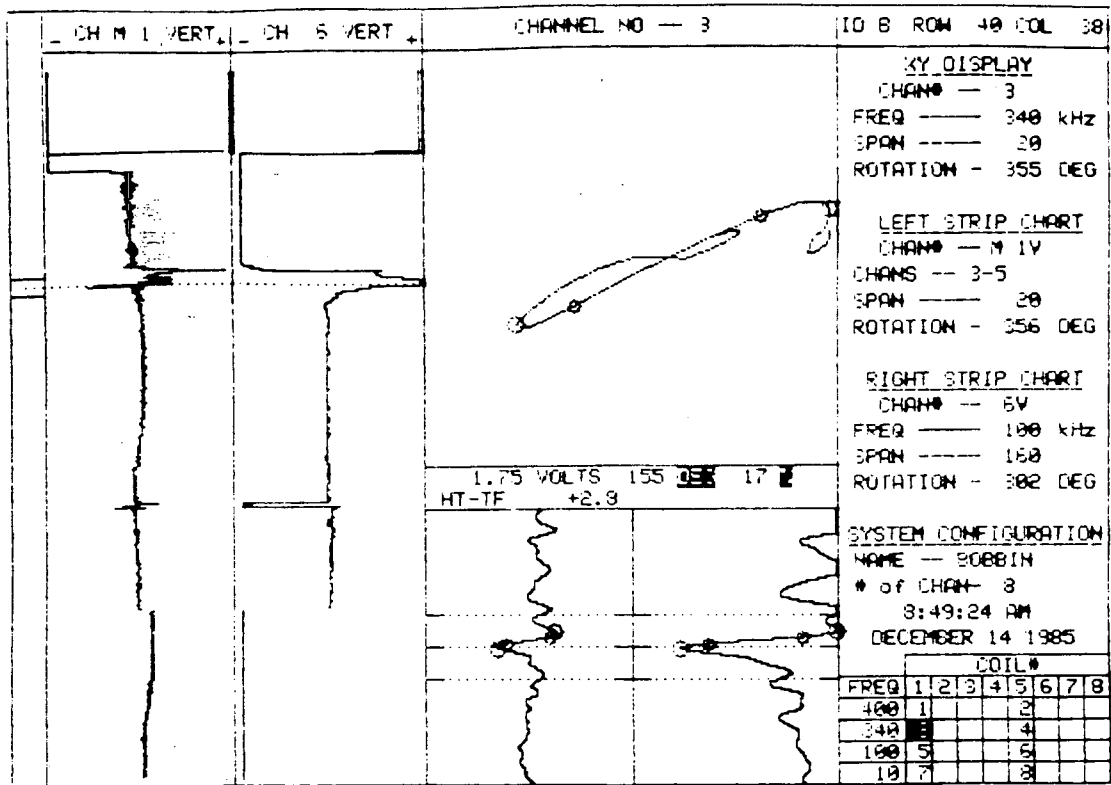


10	PLANT	UNIT#	S/G	LEG	DATE	ZETEC Inc. - 1983
	SCE SONGS	I	B	INLET	1980	Edition 12.0 Rev 1

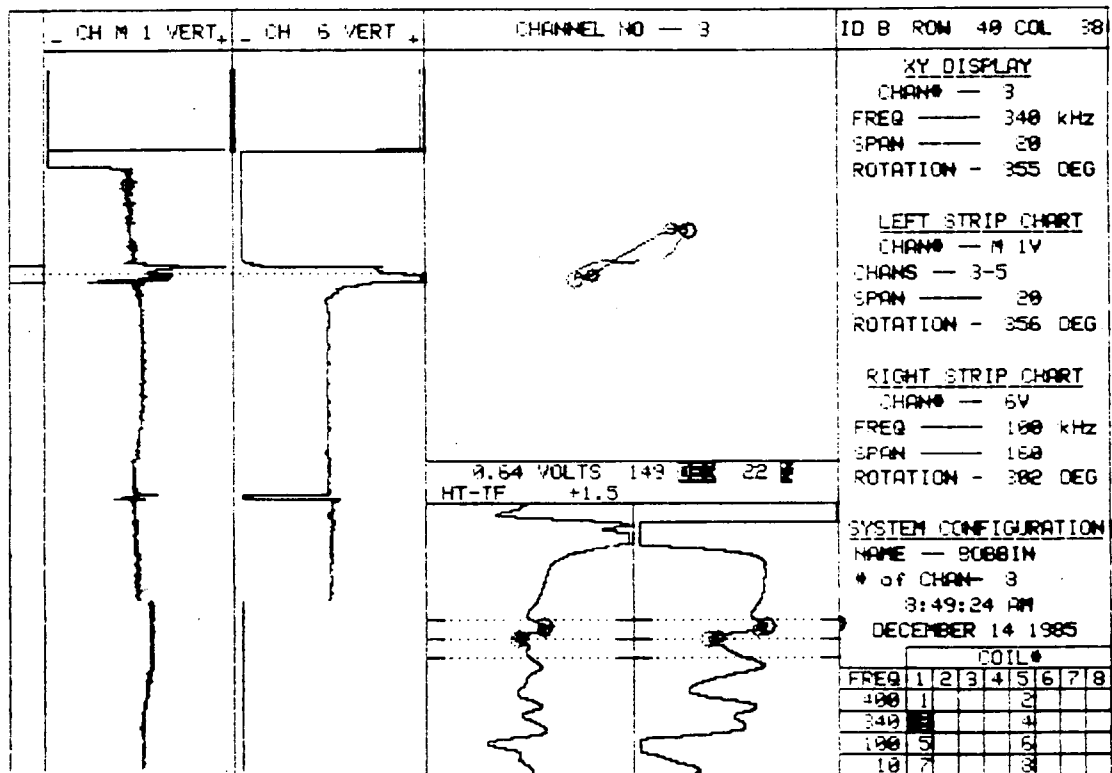


15 PLANT SONGS DISK H83 UNIT# 1 S/G 8 LEG HOT DATE 12/13/85

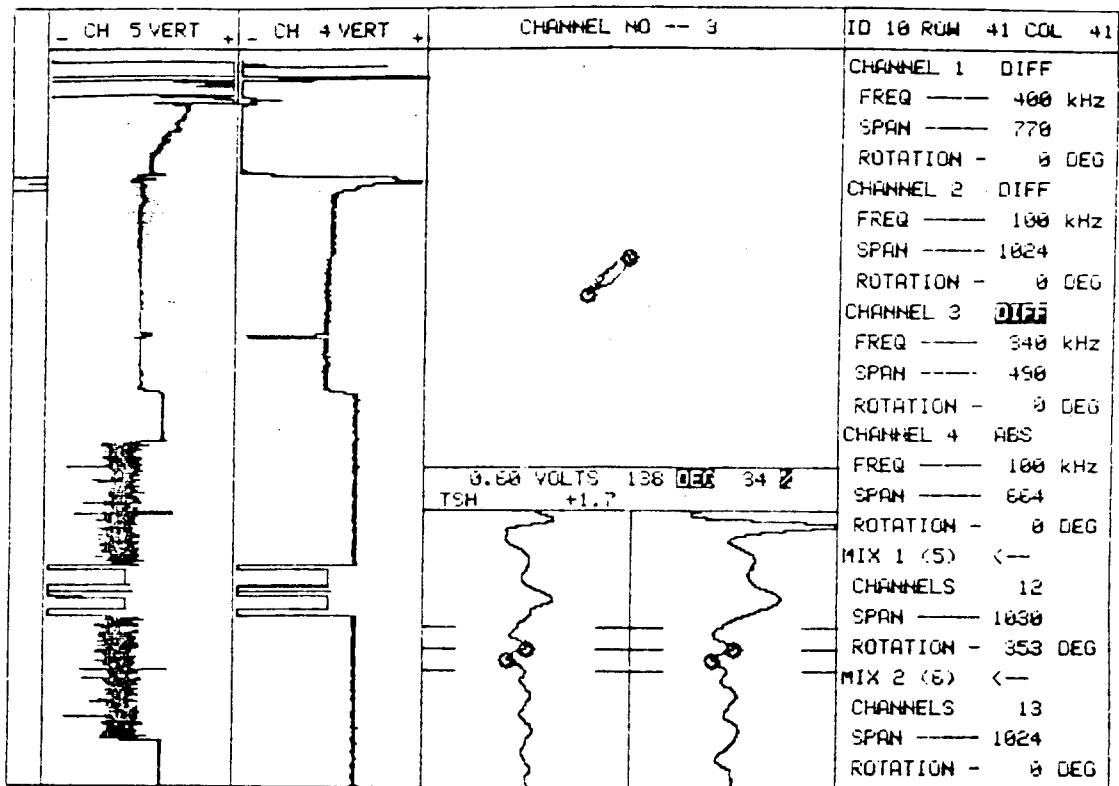




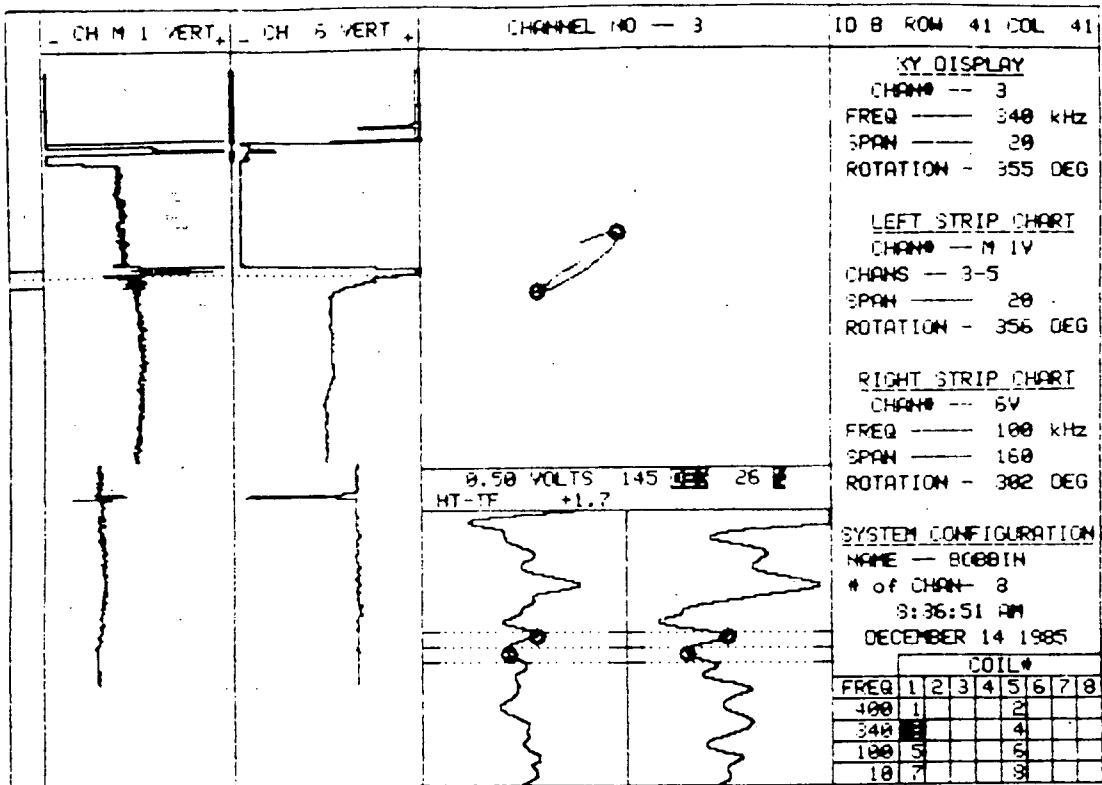
15 PLANT SONGS DISK H03 UNIT# 1 S/G B LEG HOT DATE 12/13/85



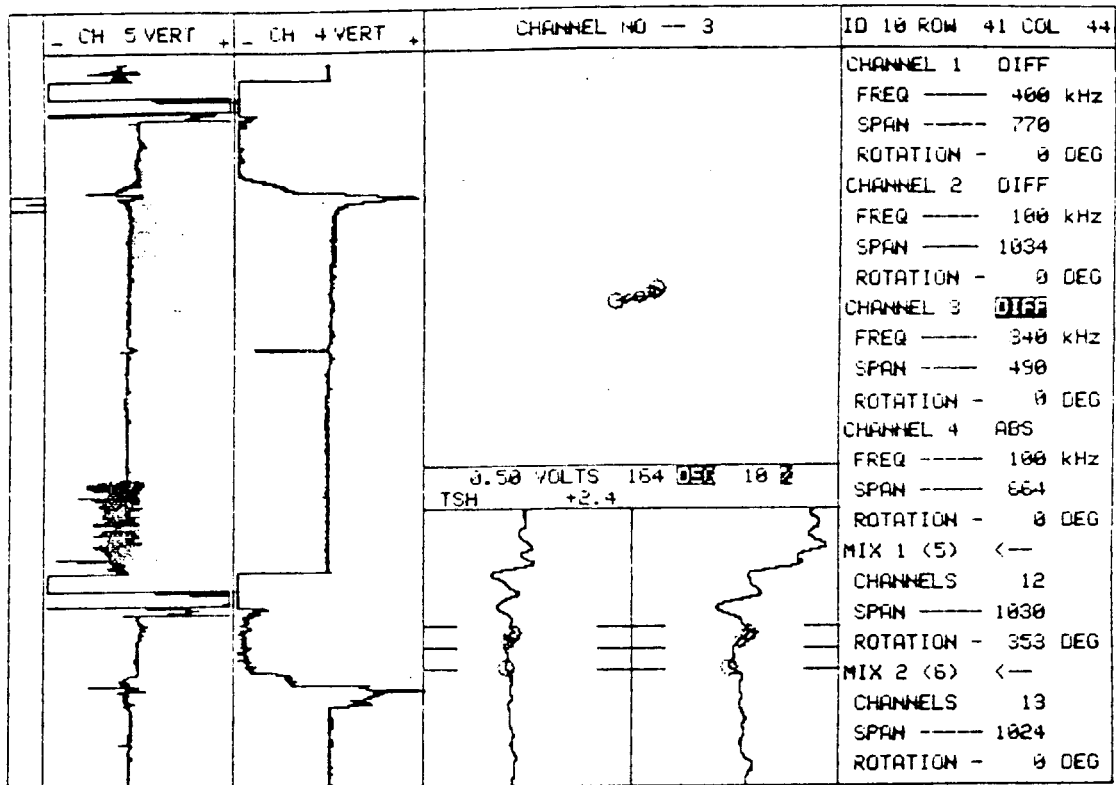
15 PLANT SONGS DISK H03 UNIT# 1 S/G B LEG HOT DATE 12/13/85



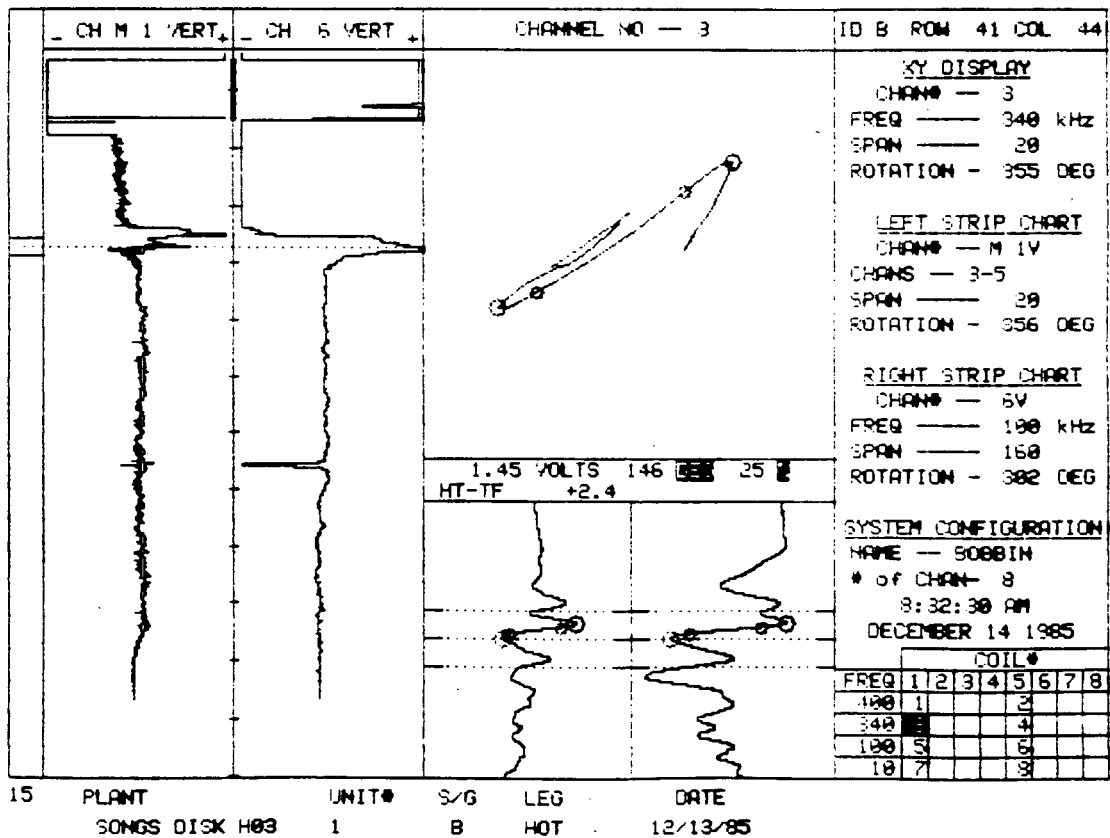
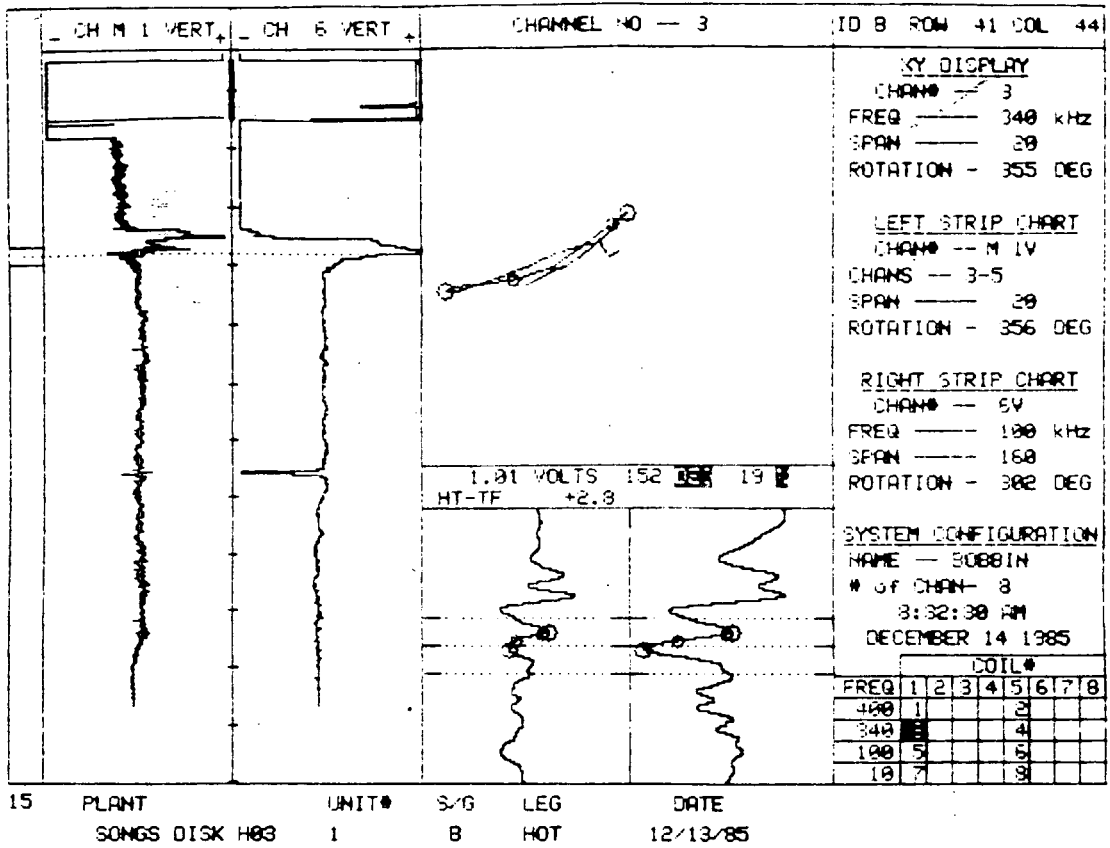
20	PLANT	UNIT#	S/G	LEG	DATE	ZETEC Inc. - 1983
	SCE SONGS	I	B	INLET	1980	Edition 12.0 Rev 1

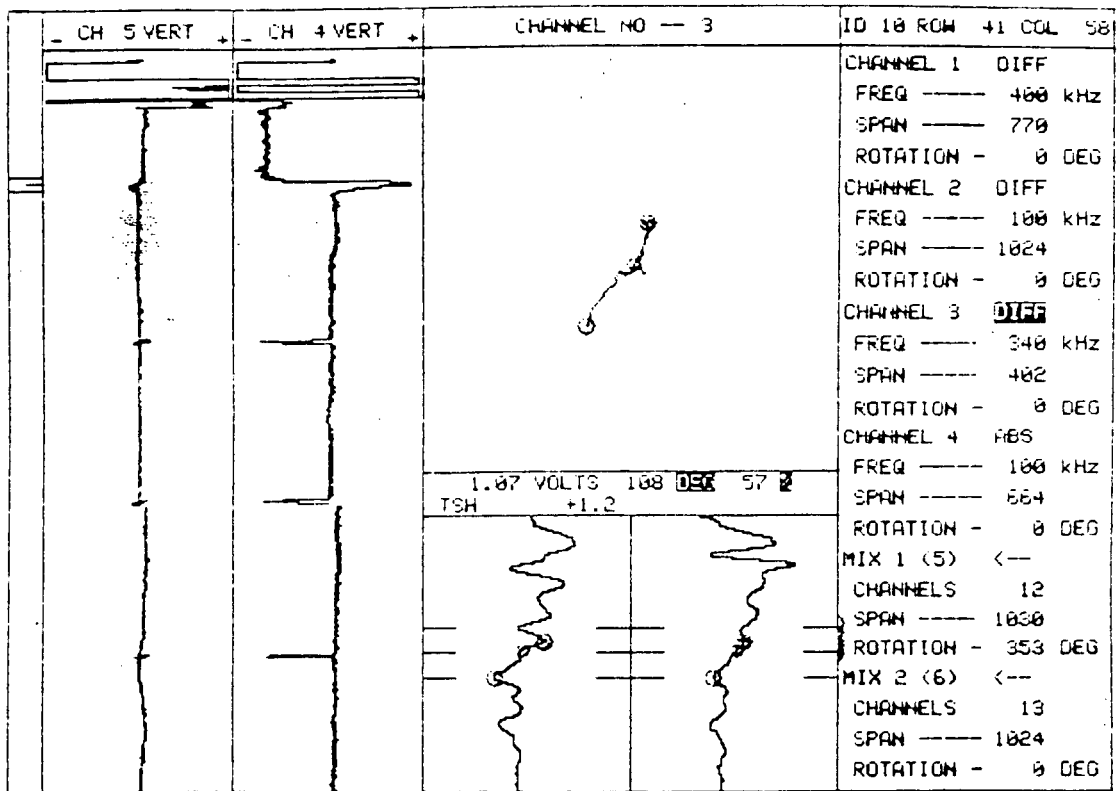


15 PLANT SONGS DISK H03 UNIT# 1 S/G B LEG HOT DATE 12/13/85

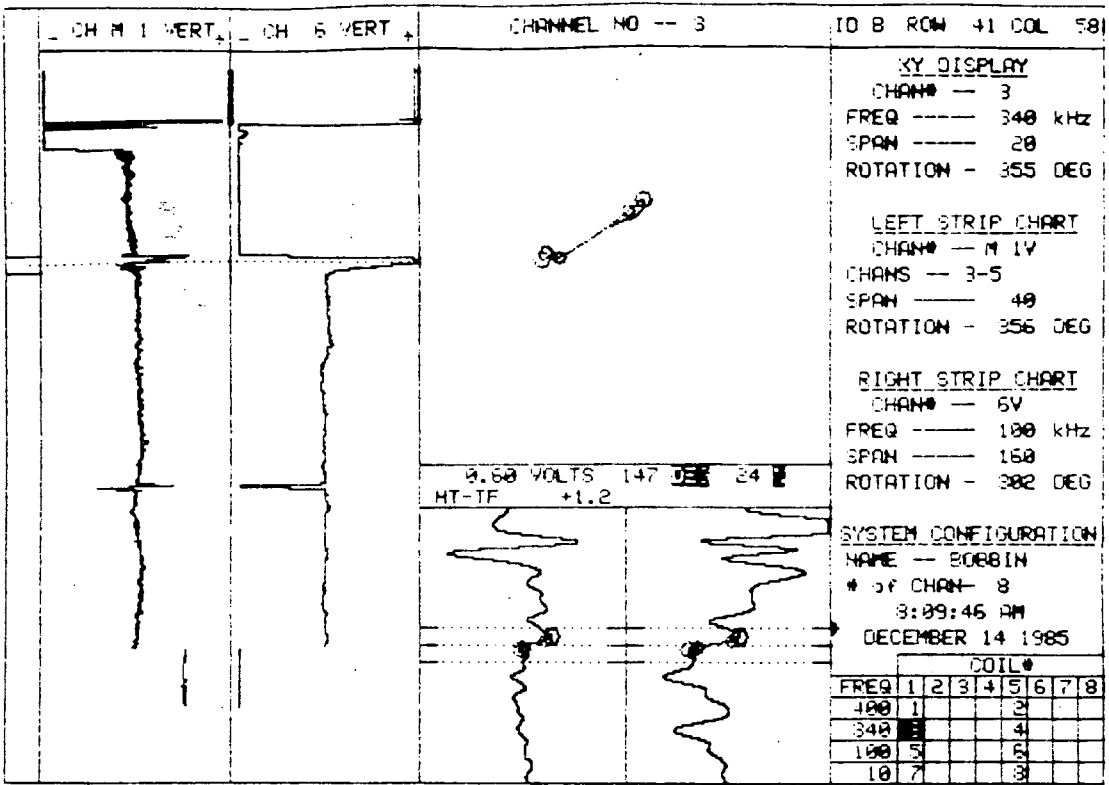


20 PLANT UNIT# S/G LEG DATE ZETEC Inc. - 1983
 SCE SONGS I B INLET 1988 Edition 12.0 Rev 1

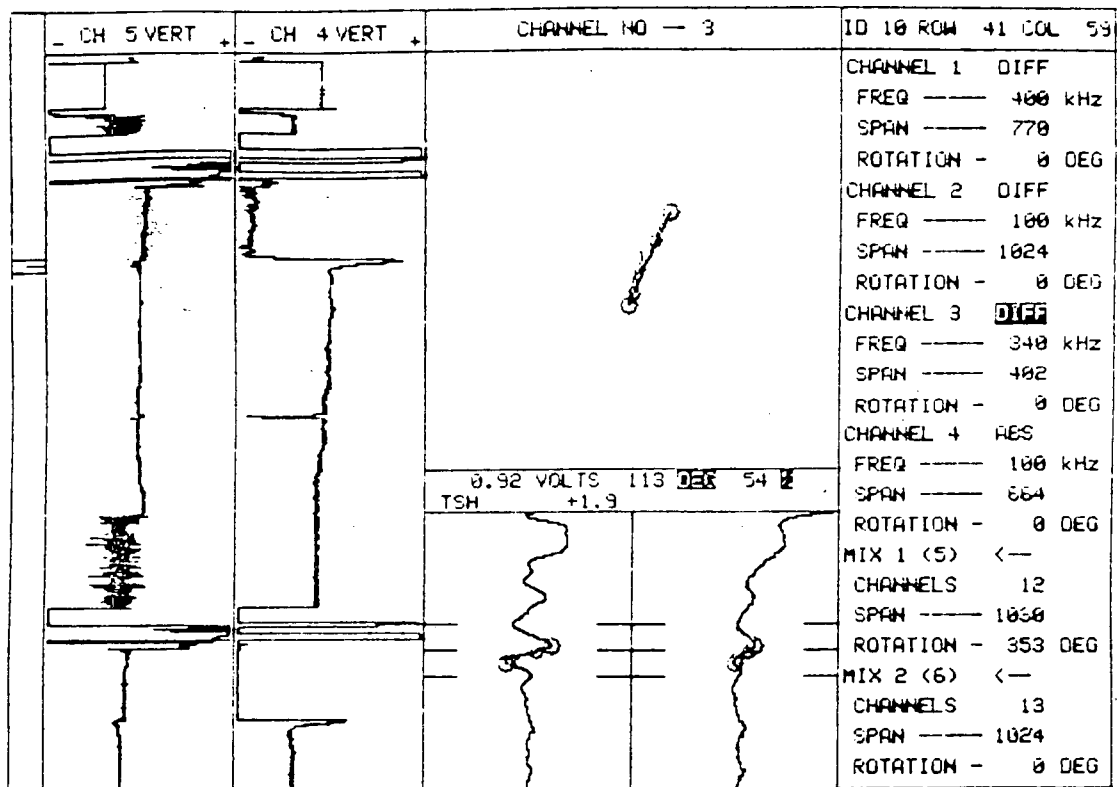




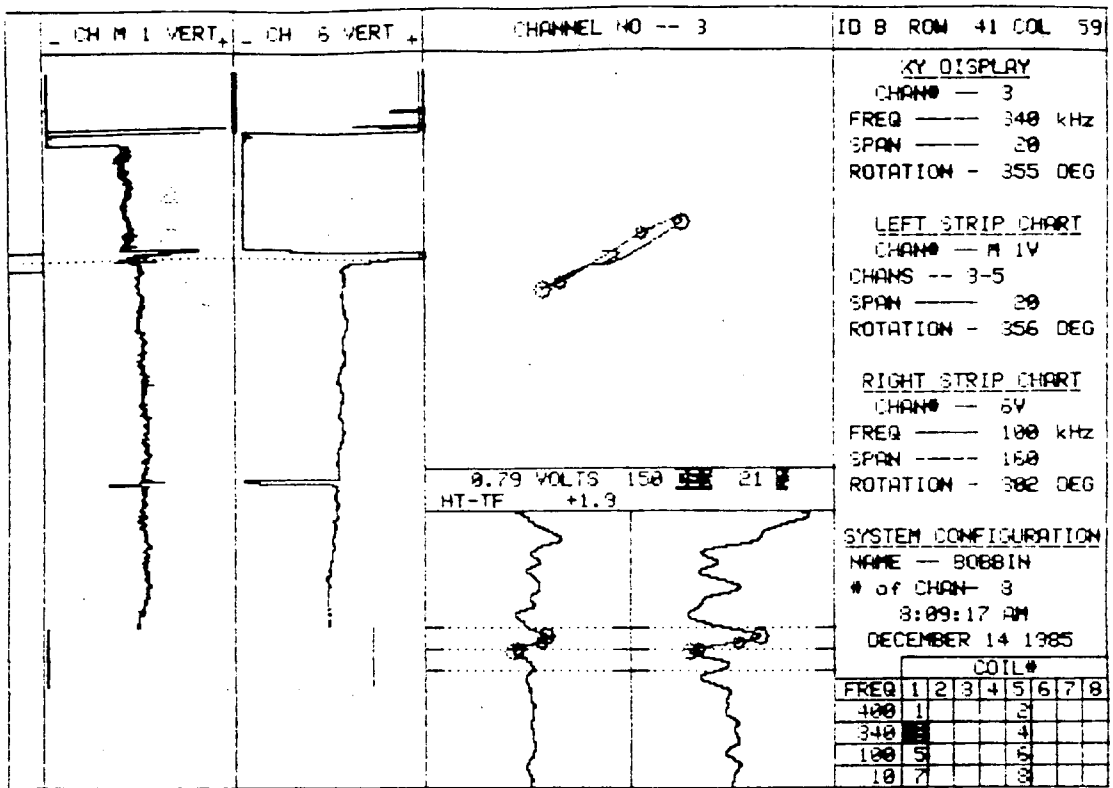
20 PLANT SCE SONGS UNIT# I S/G B LEG INLET DATE 1980 ZETEC Inc. - 1983 Edition 12.0 Rev 1



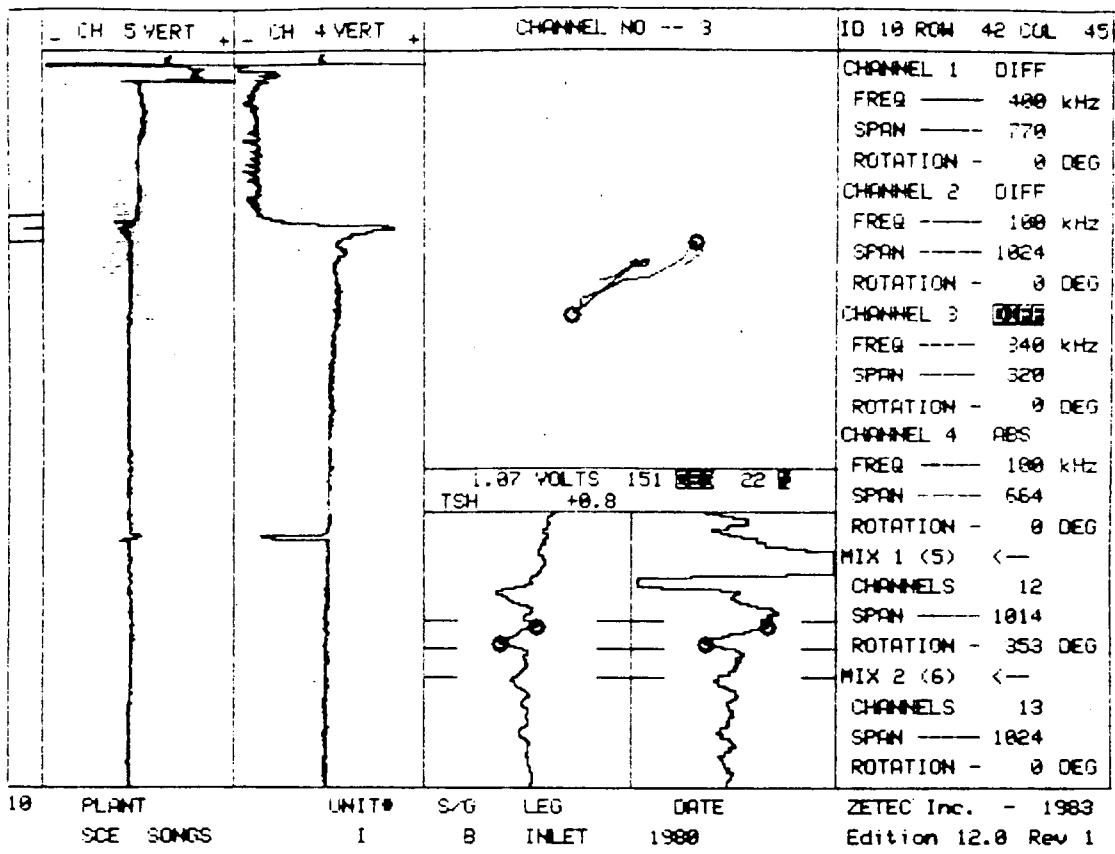
15 PLANT UNIT# S/G LEG DATE
 SONGS DISK H03 1 B HOT 12/13/85

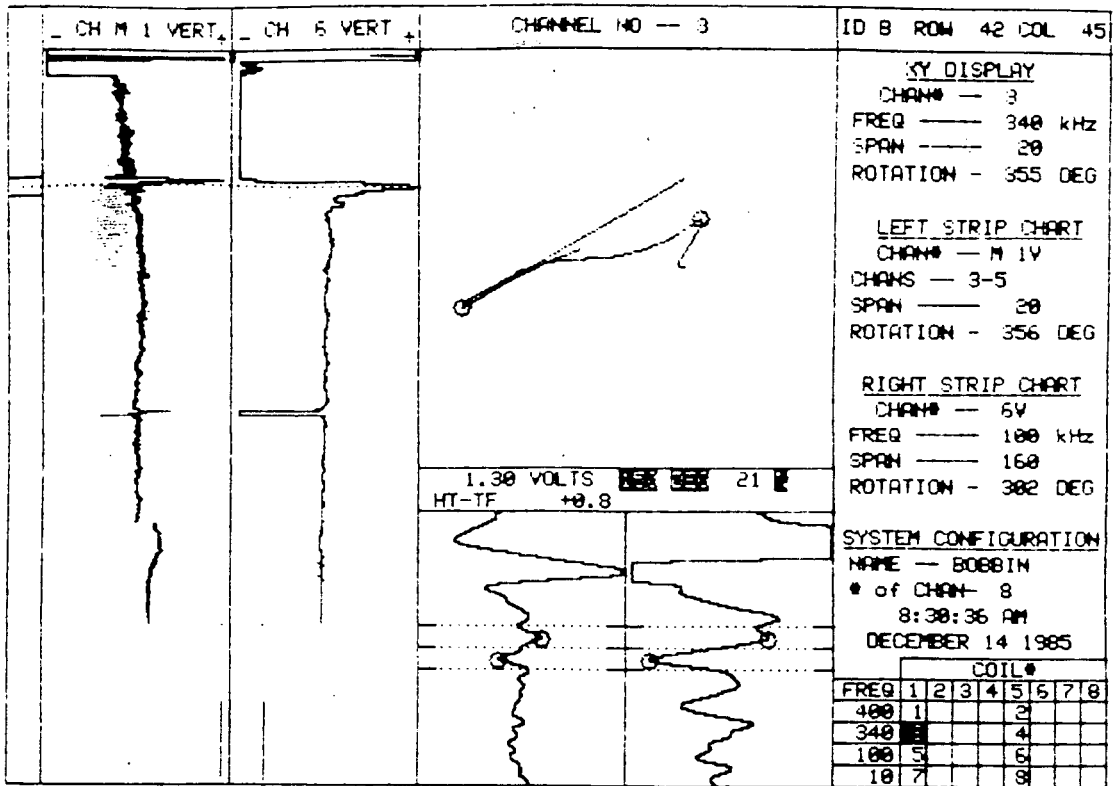


30	PLANT	UNIT#	S/G	LEG	DATE	ZETEC Inc. - 1983
	SCE SONGS	I	B	INLET	1980	Edition 12.0 Rev 1

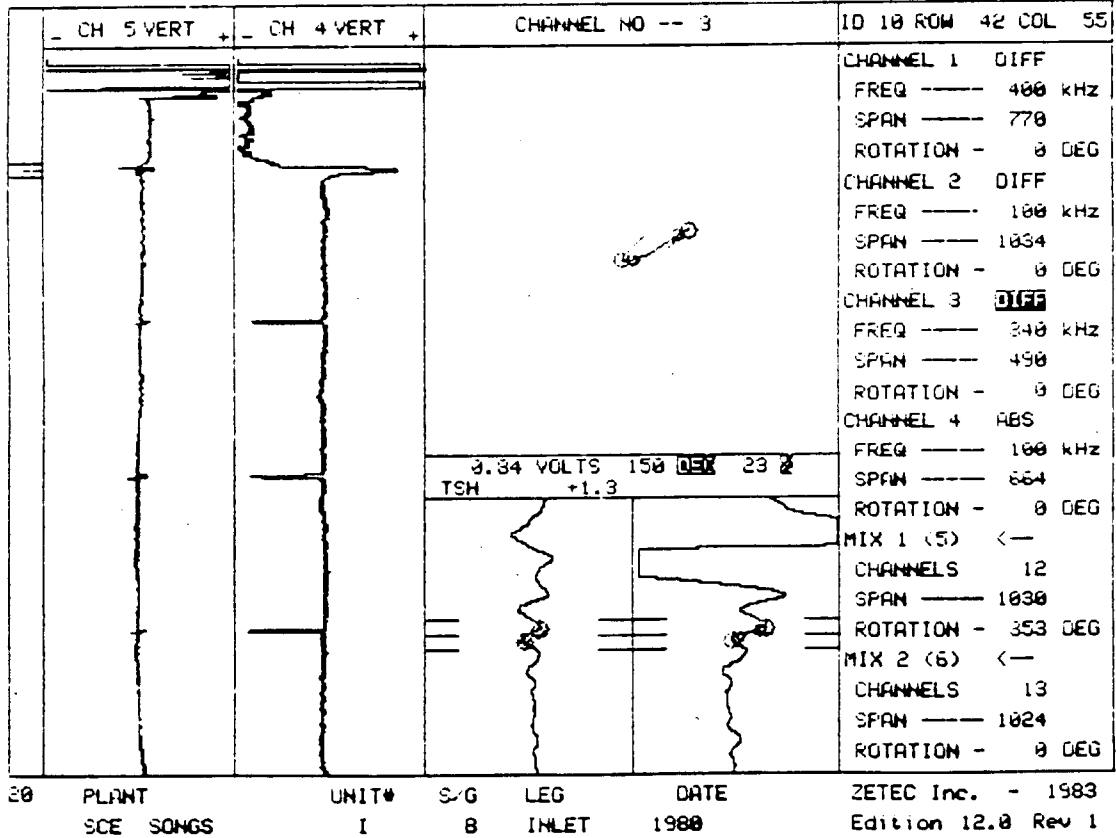
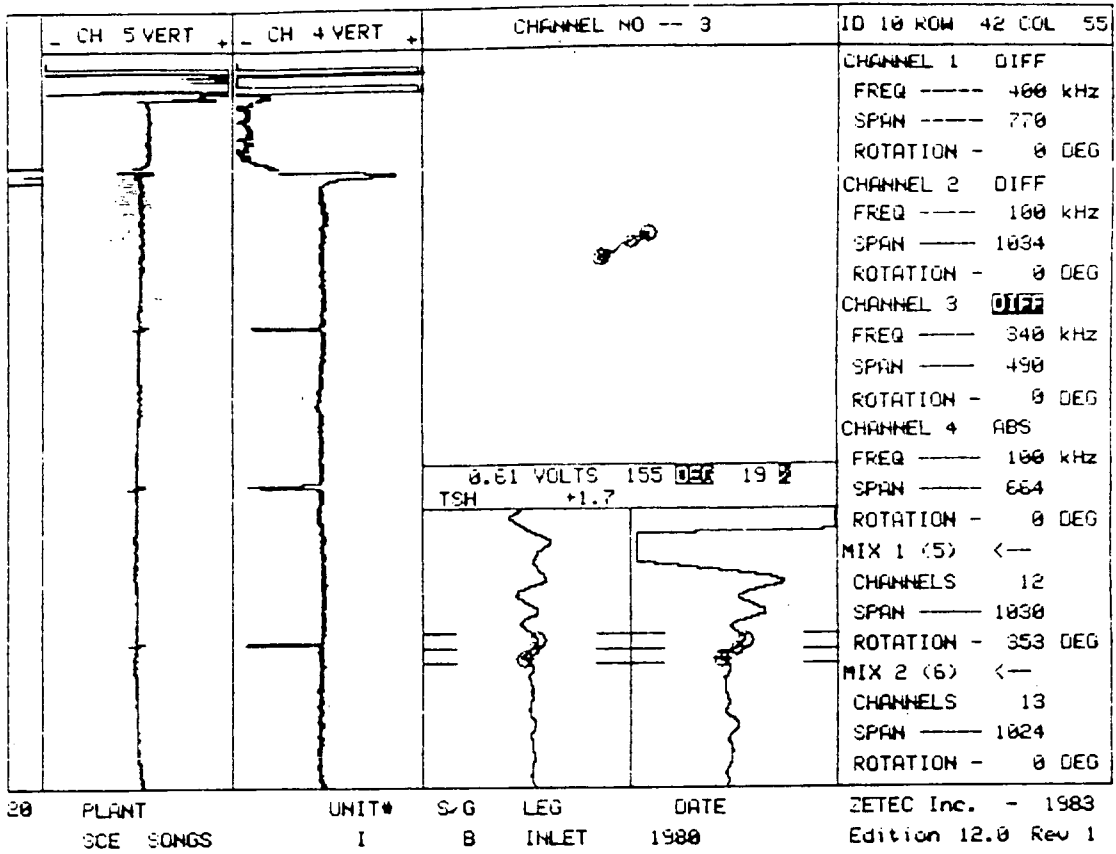


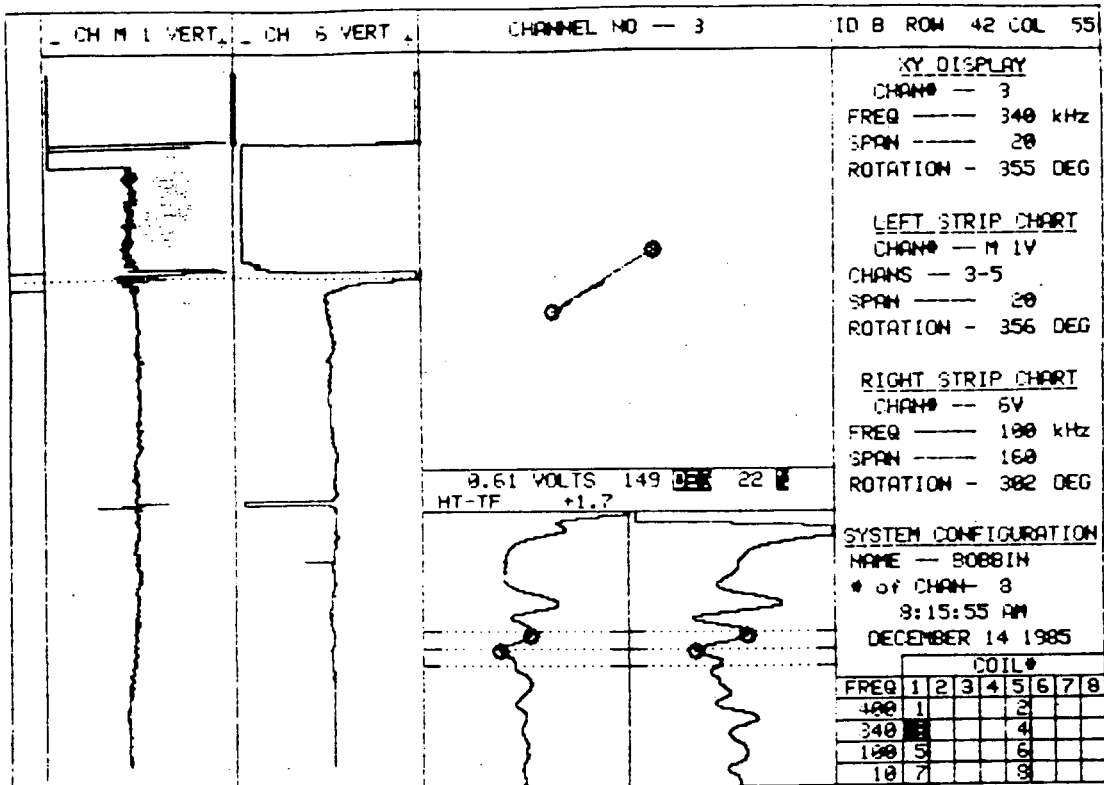
15 PLANT SONGS DISK H03 UNIT# 1 S/G 8 LEG HOT DATE 12/13/85



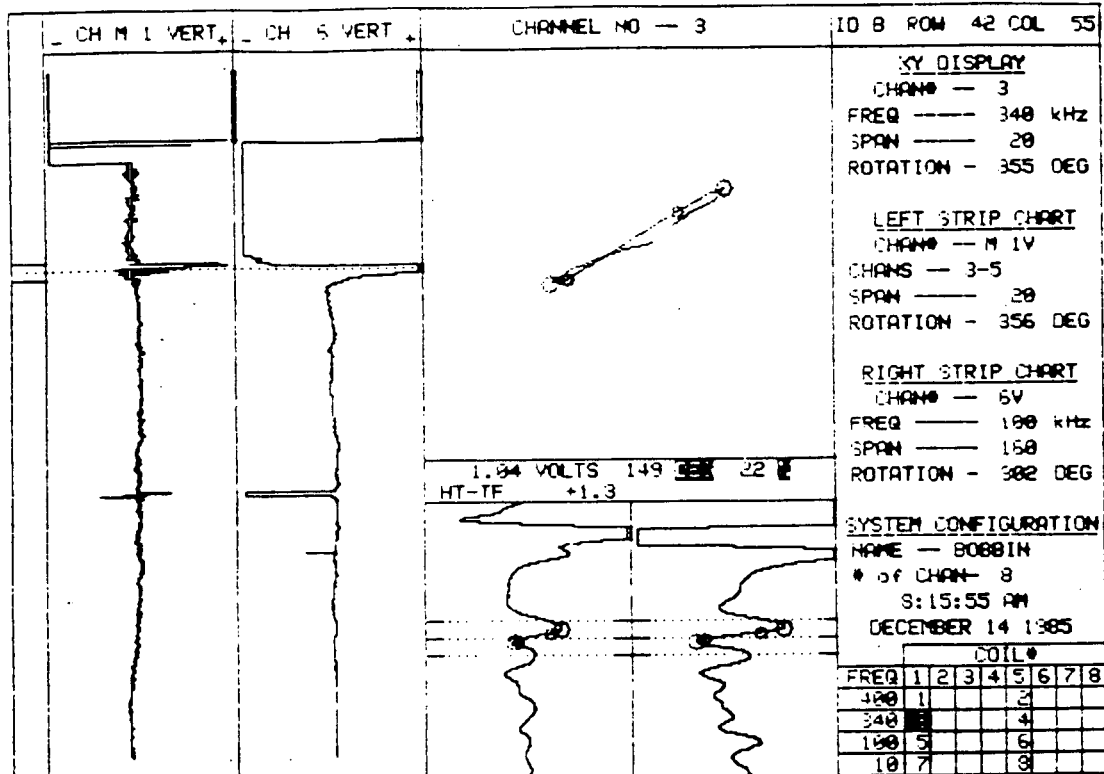


15 PLANT UNIT# S/G LEG DATE
 SONGS DISK H83 1 B HOT 12/13/85

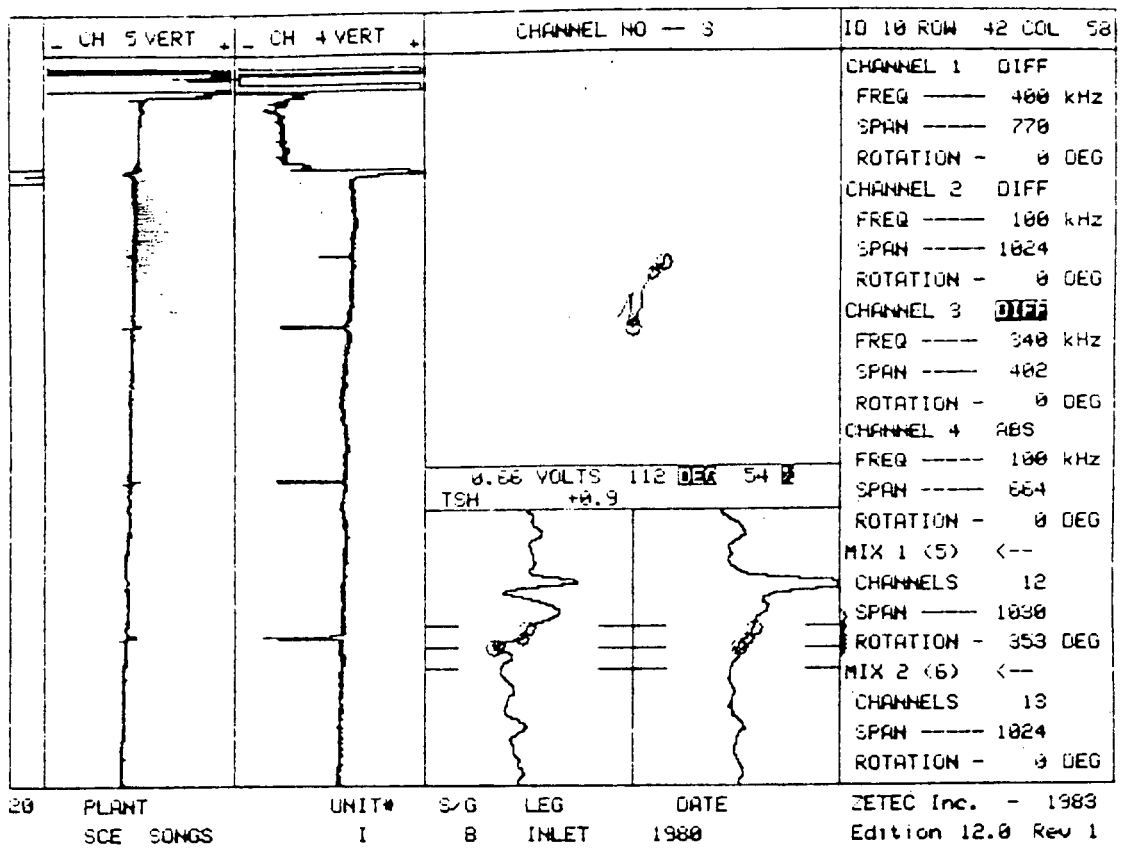




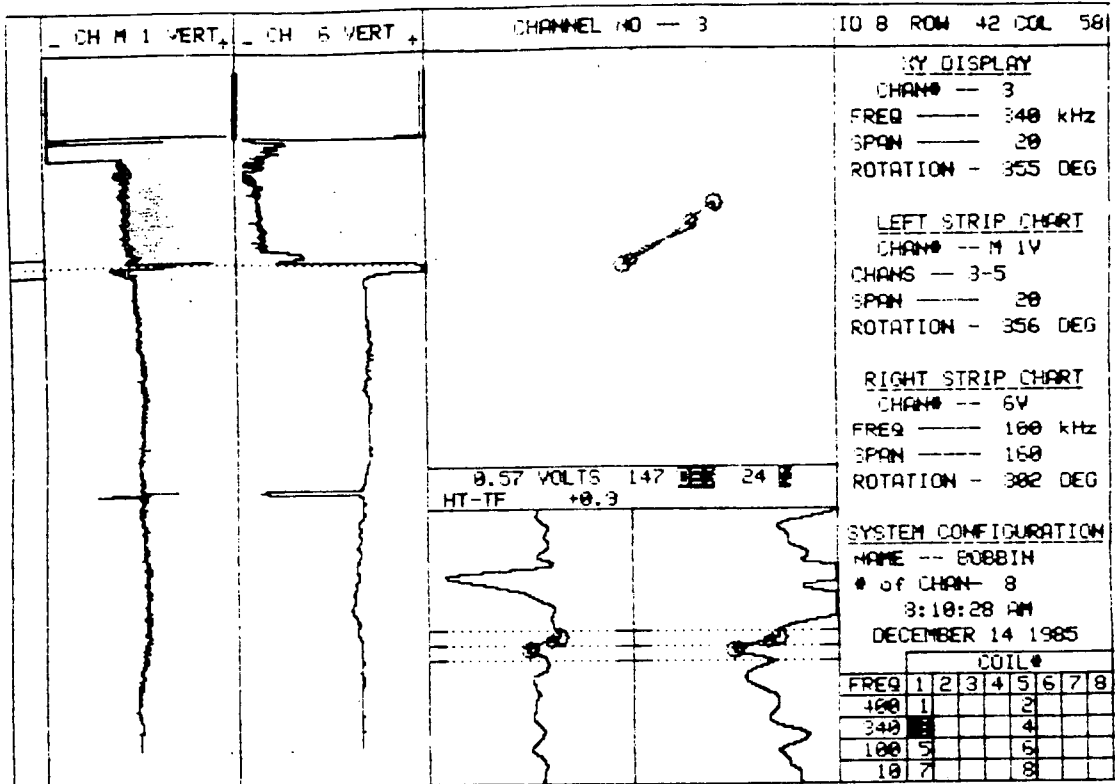
15 PLANT SONGS DISK H03 UNIT# 1 S/G 8 LEG HOT DATE 12/13/85



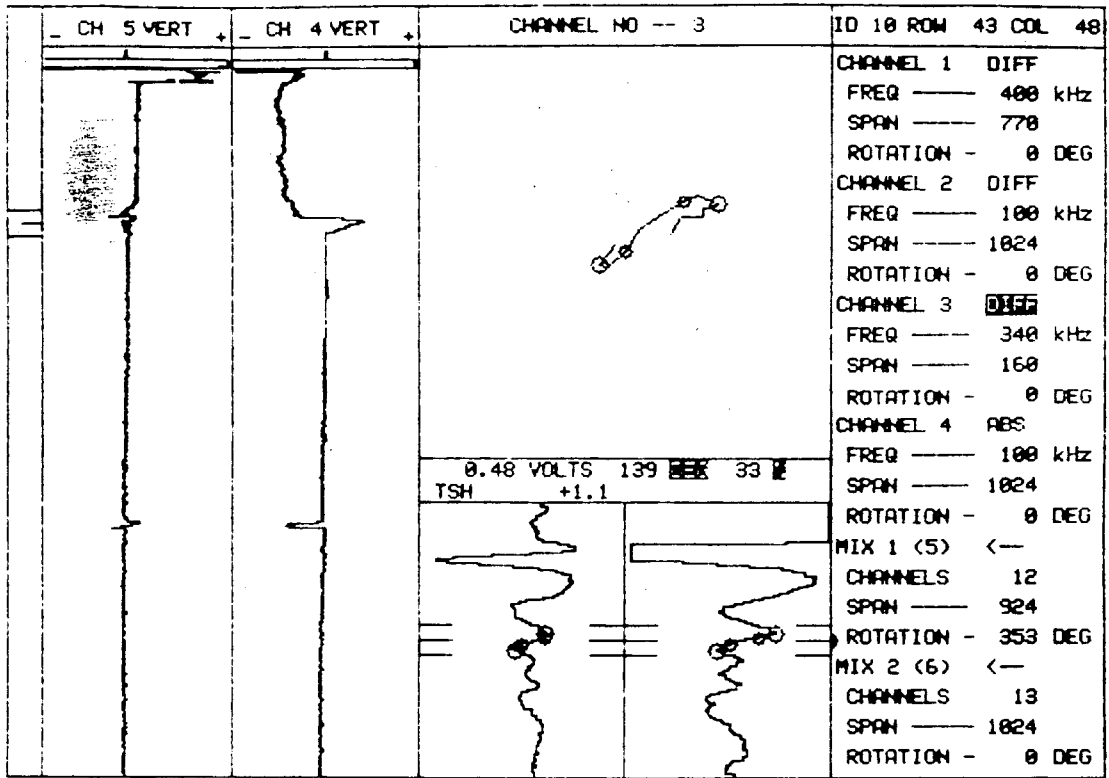
15 PLANT SONGS DISK H03 UNIT# 1 S/G 8 LEG HOT DATE 12/13/85



0.66 VOLTS 112 DEG 54 2
TSH +0.9



15 PLANT SONGS DISK H03 UNIT# 1 S/G B LEG HOT DATE 12/13/85



0.48 VOLTS 139 ~~EEK~~ 33 ~~E~~
TSH +1.1

10	PLANT	UNIT#	S/G	LEG	DATE	ZETEC Inc. - 1983
	SCE SONGS	I	B	INLET	1980	Edition 12.0 Rev 1

