

**Weatherford****PHOTO DENSITY  
COMPENSATED NEUTRON  
LOGS**

COMPANY

EAST CHEYENNE GAS STORAGE LLC

WELL

ECGS No 6-15 WPD002-1

FIELD

PEETZ WEST

PROVINCE/COUNTY

LOGAN

COUNTRY/STATE

USACOLORADO

LOCATION

1611' FNL &amp; 999' FWL

SEC

TWP  
6 11N RGE  
52WOther Services  
MAI  
CMI

API Number

05-075-09401

Permit Number

Permanent Datum GL, Elevation 4556 feet

Log Measured From KB

Drilling Measured From KB

Date

13-NOV-2012

Elevations:  
KB 4570.00  
DF 4569.00  
GL 4556.00

Run Number

ONE

Depth Driller

5270.00 feet

Depth Logger

5265.00 feet

First Reading

5211.00 feet

Last Reading

4200.00 feet

Casing Driller

1228.00 feet

Casing Logger

1226.00 feet

Bit Size

8.750

inches

Hole Fluid Type

WBM

Density / Viscosity

9.90 g/cc 53.00 CP  
9.00 7.20 ml/30Min

PH / Fluid Loss

FLOWLINE

Sample Source

3.10 @ 85.7 ohm-m

Rm @ Measured Temp

2.48 @ 85.7 ohm-m

Rmf @ Measured Temp

3.72 @ 85.7 ohm-m

Rmc @ Measured Temp

CALC

Source Rmf / Rmc

1.70 @159.0 ohm-m

Rm @ BHT

4 HOURS

Time Since Circulation

159.00 deg F

Max Recorded Temp

COMPACT

Equipment Name

13037 RK SPR

Equipment / Base

B.ROSSER

Recorded By

A. ASHBY

Witnessed By

L. CARRASCO

**BOREHOLE RECORD**

Last Edited: 13-NOV-2012 08:43

Bit Size  
inches

8.750

Depth From  
feet

1226.00

Depth To  
feet

5270.00

**CASING RECORD**

Type

Size  
inches

9.625

Depth From  
feet

0.00

Shoe Depth  
feet

1226.00

Weight  
pounds/ft

36.00

**REMARKS**

SOFTWARE VERSION 13.02.6600

TOOLS RUN: MCG, MDN, MPD, MIM, MIE, MFE, MAI RUN IN COMBINATION.

HARDWARE:

MPD: 8" PROFILE PLATE USED.

MAI: TWO 1 INCH STANDOFFS USED.

MDN: DUAL BOWSPRING USED.

MIM: CENTRALIZER BOWSPRING USED.

2.65 G/CC DENSITY MATRIX USED TO CALCULATE POROSITY FROM TD TO BOTTOM OF FORT HAYES FORMATION(TD TO 4700FT).

2.71 G/CC DENSITY MATRIX USED TO CALCULATE POROSITY IN FORT HAYES AND NIOBRARA FORMATION (4700 FT TO 4200 FT).

TIGHT PULLS, BOREHOLE SIZE AND RUGOSITY WILL AFFECT REPEATABILITY AND DATA QUALITY.

ALL INTERVALS LOGGED AND SCALED PER CUSTOMER'S REQUEST.

IMAGE LOG RAN OVER BOTTOM 500 FT.

LATITUDE: 40.95937

LONGITUDE: -103.22532

TOTAL HOLE VOLUME FROM TD TO SURFACE CASING =1720 CUBIC FEET

ANNULAR VOLUME WITH 7 INCH PRODUCTION CASING FROM TD TO SURFACE CASING =652 CUBIC FEET

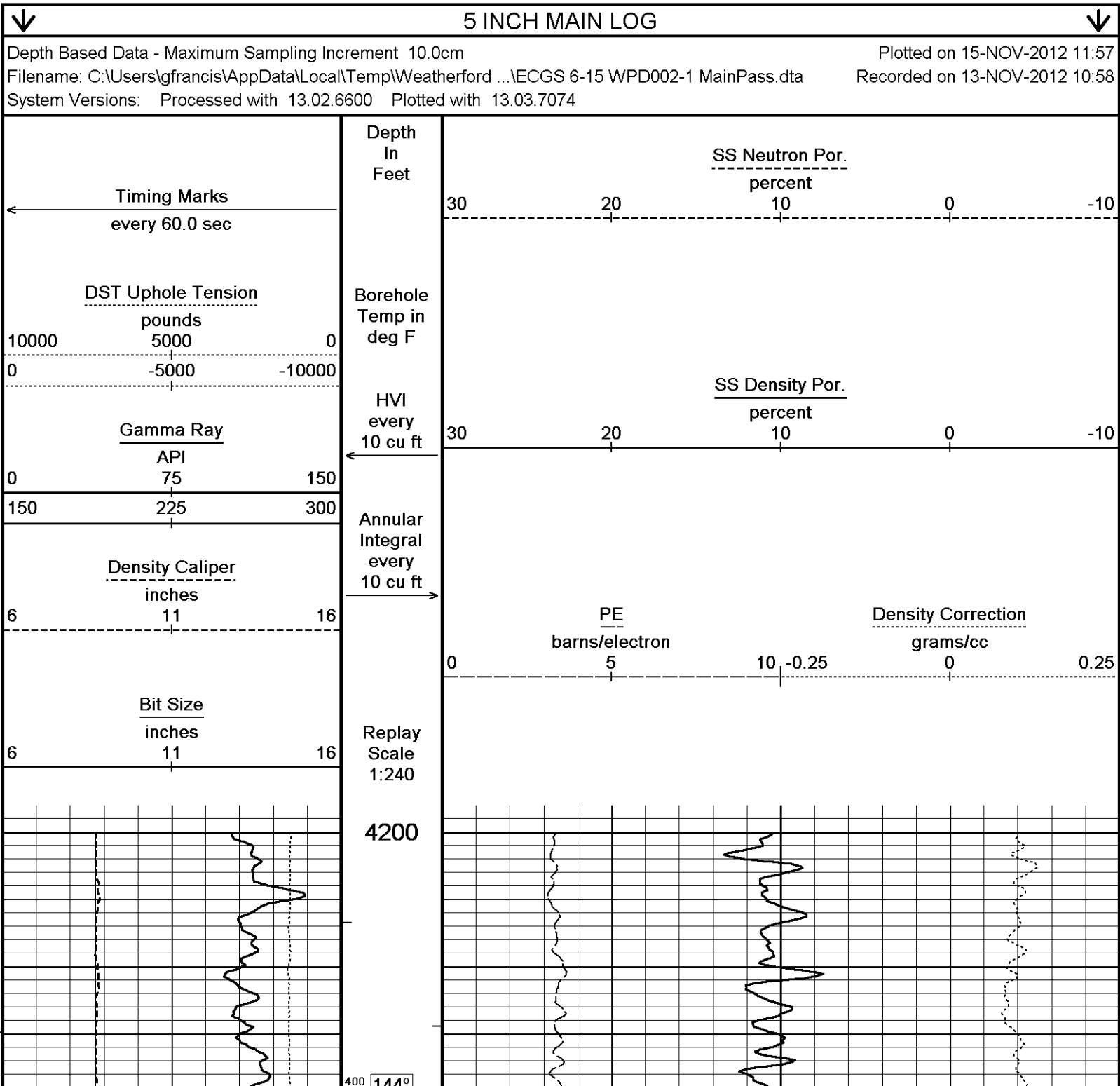
TOTAL VOLUME FROM TD TO 4200 FT =415 CUBIC FEET

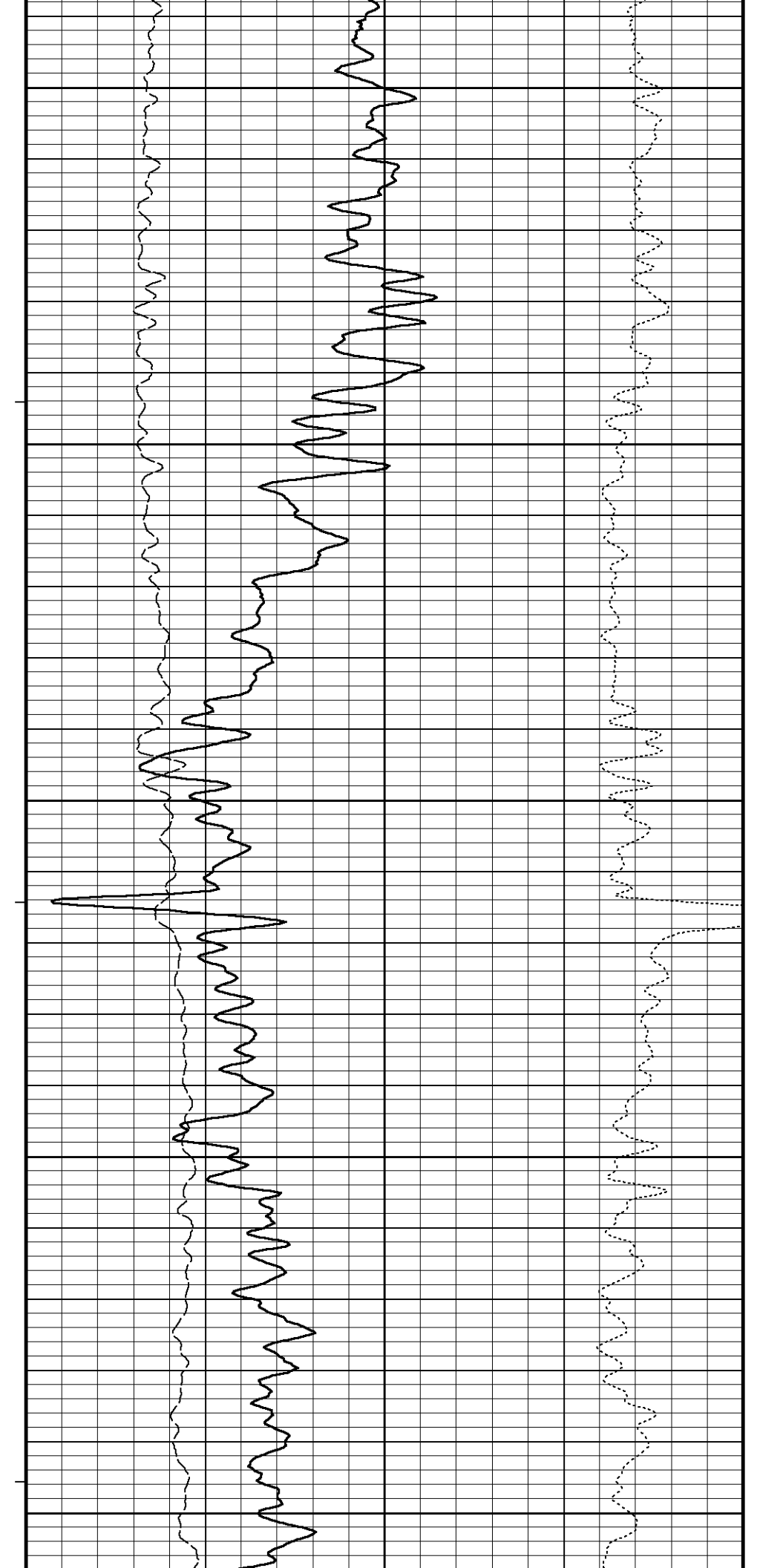
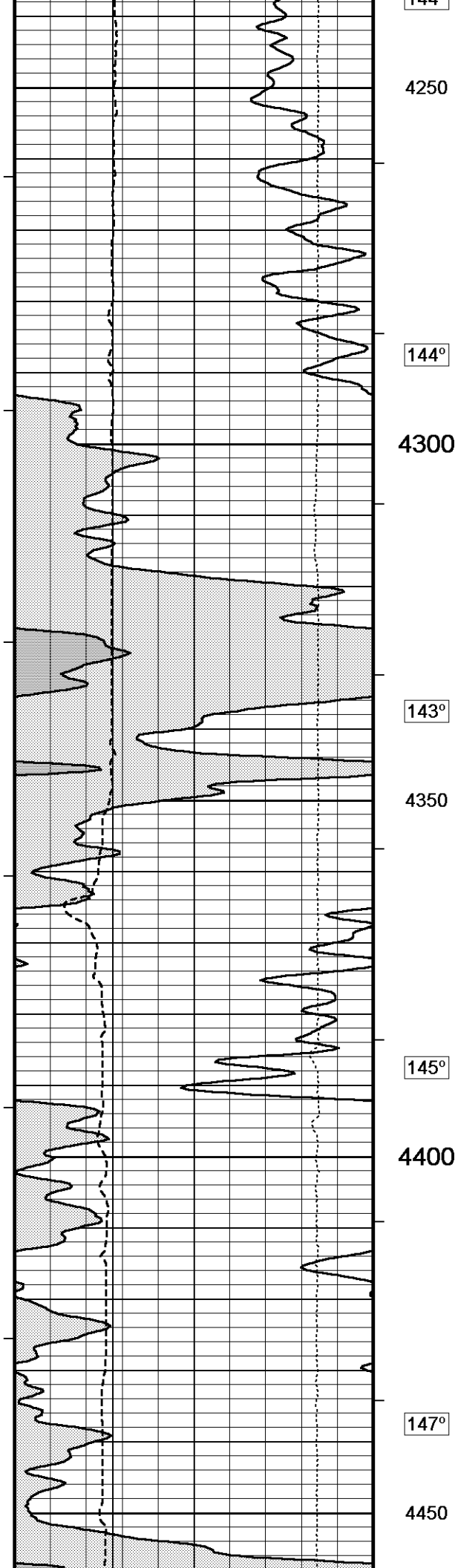
ANNULAR VOLUME WITH 7 INCH PRODUCTION CASING FROM TD TO 4200 FT =145 CUBIC FEET

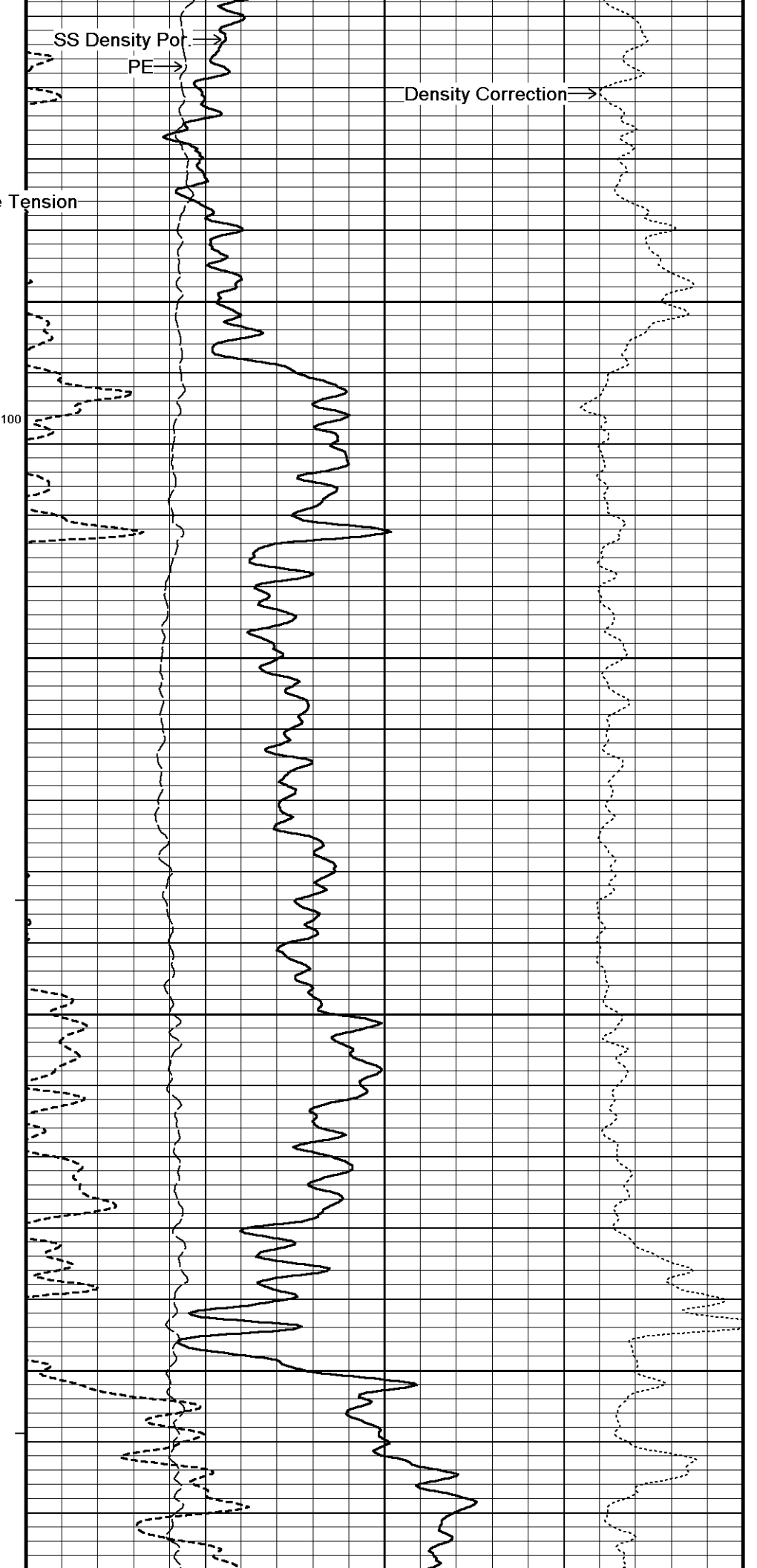
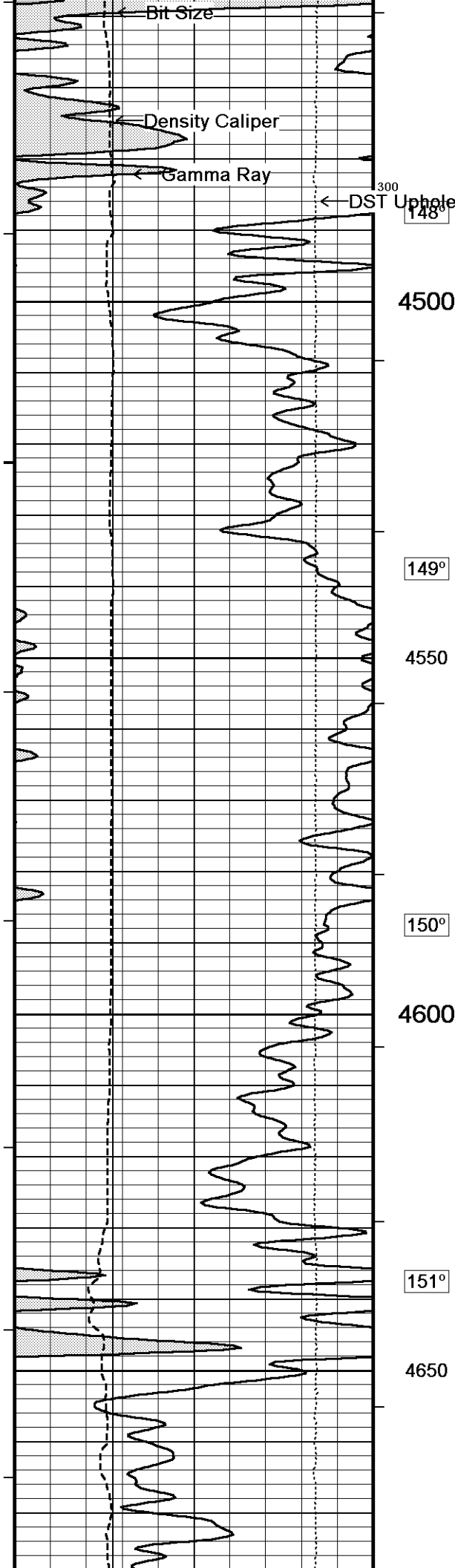
SERVICE ORDER: 3535305

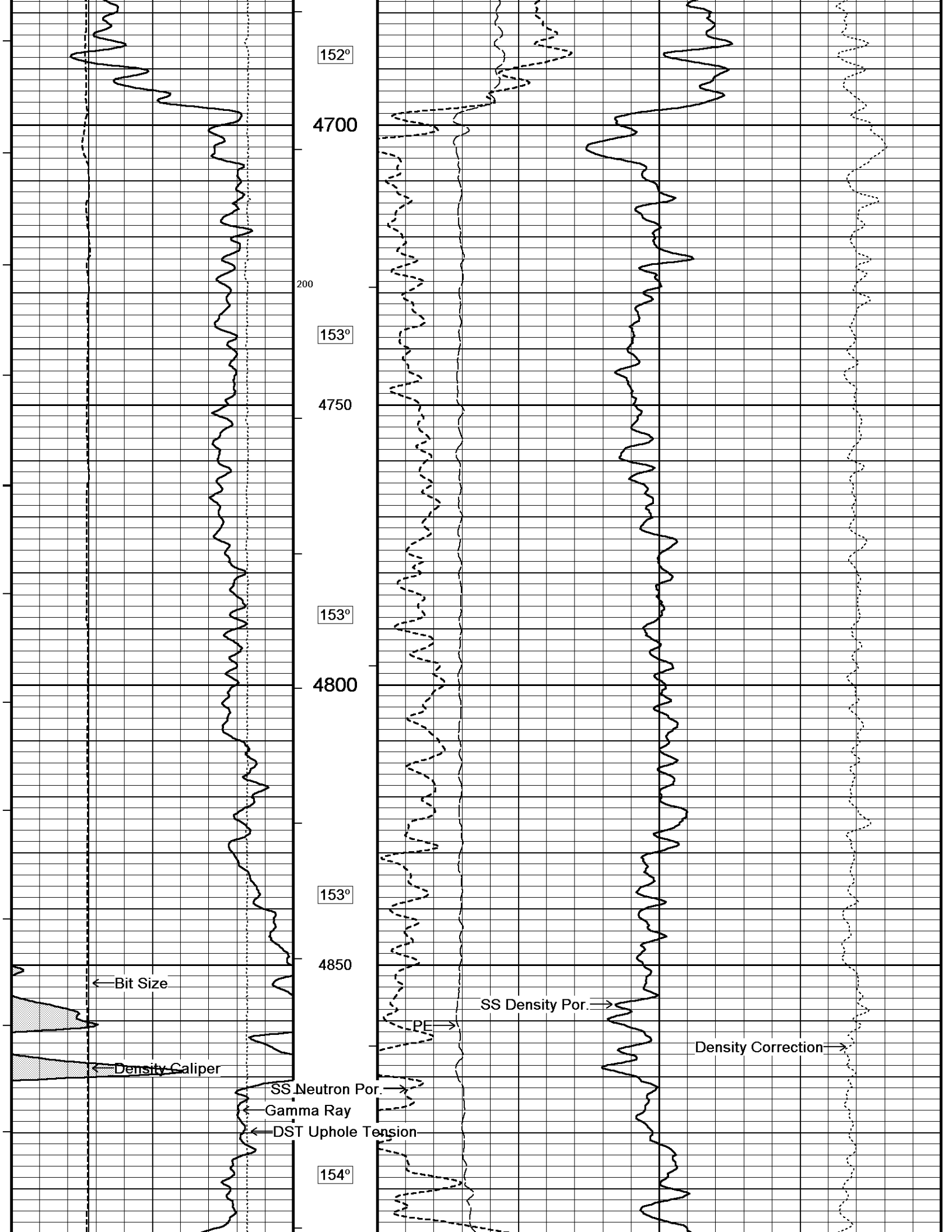
RIG: CADE 22

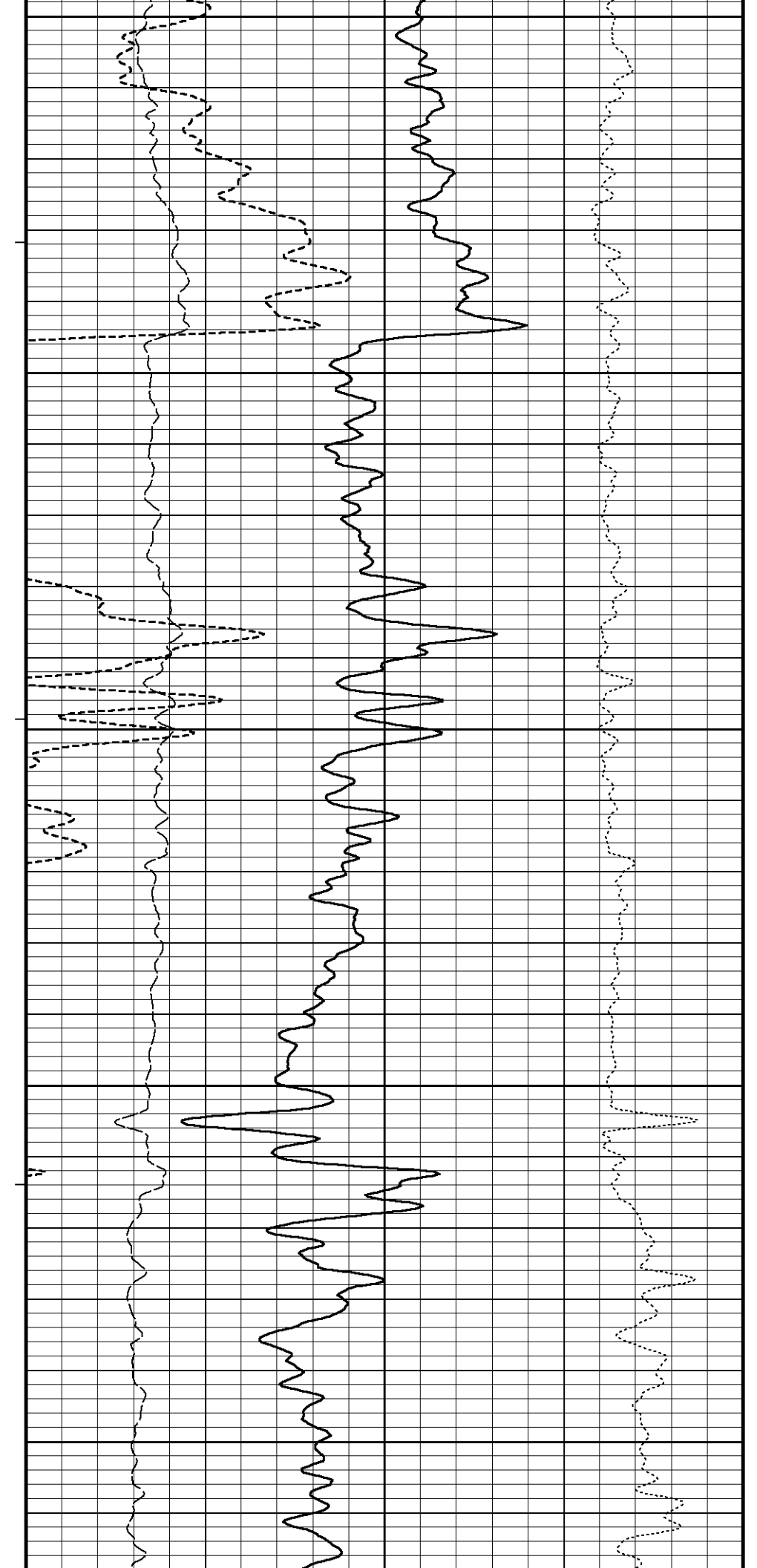
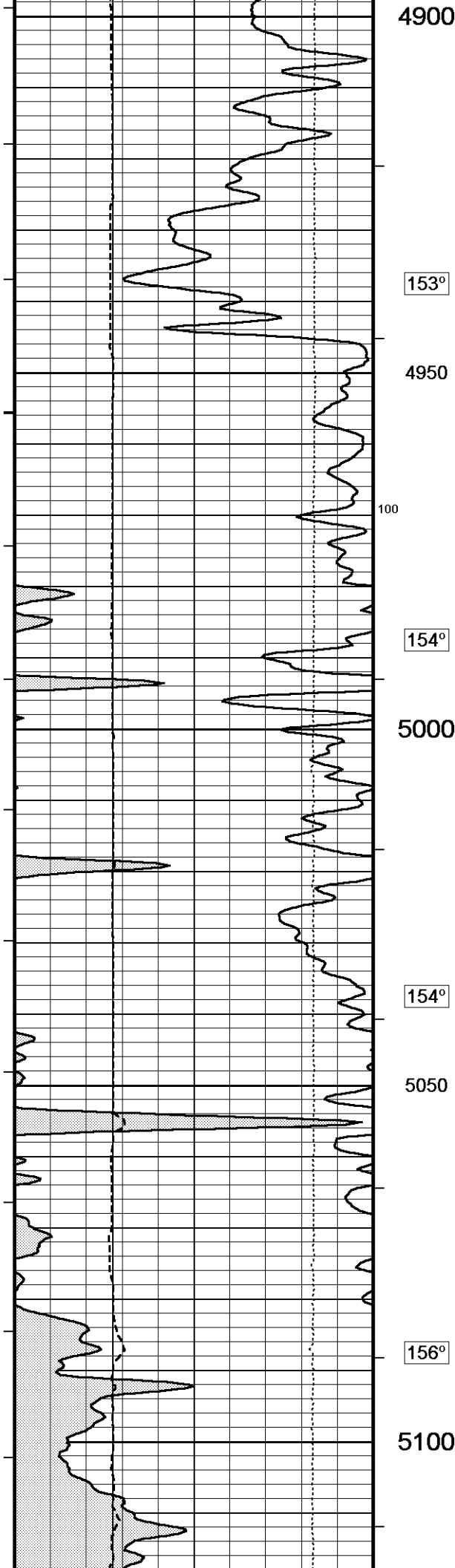
All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not, guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or wilful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to our general terms and conditions in our price schedule.

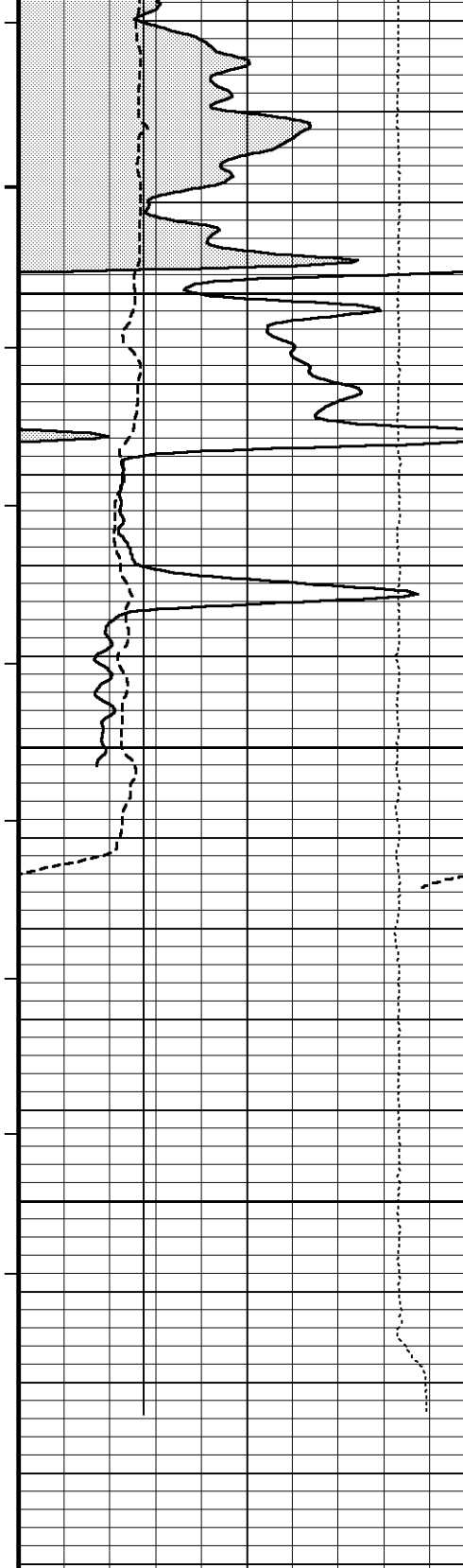












158°

5150

157°

5200

5250

TD

Depth  
In  
Feet

Borehole  
Temp in  
deg F

HVI  
every

Timing Marks  
every 60.0 sec

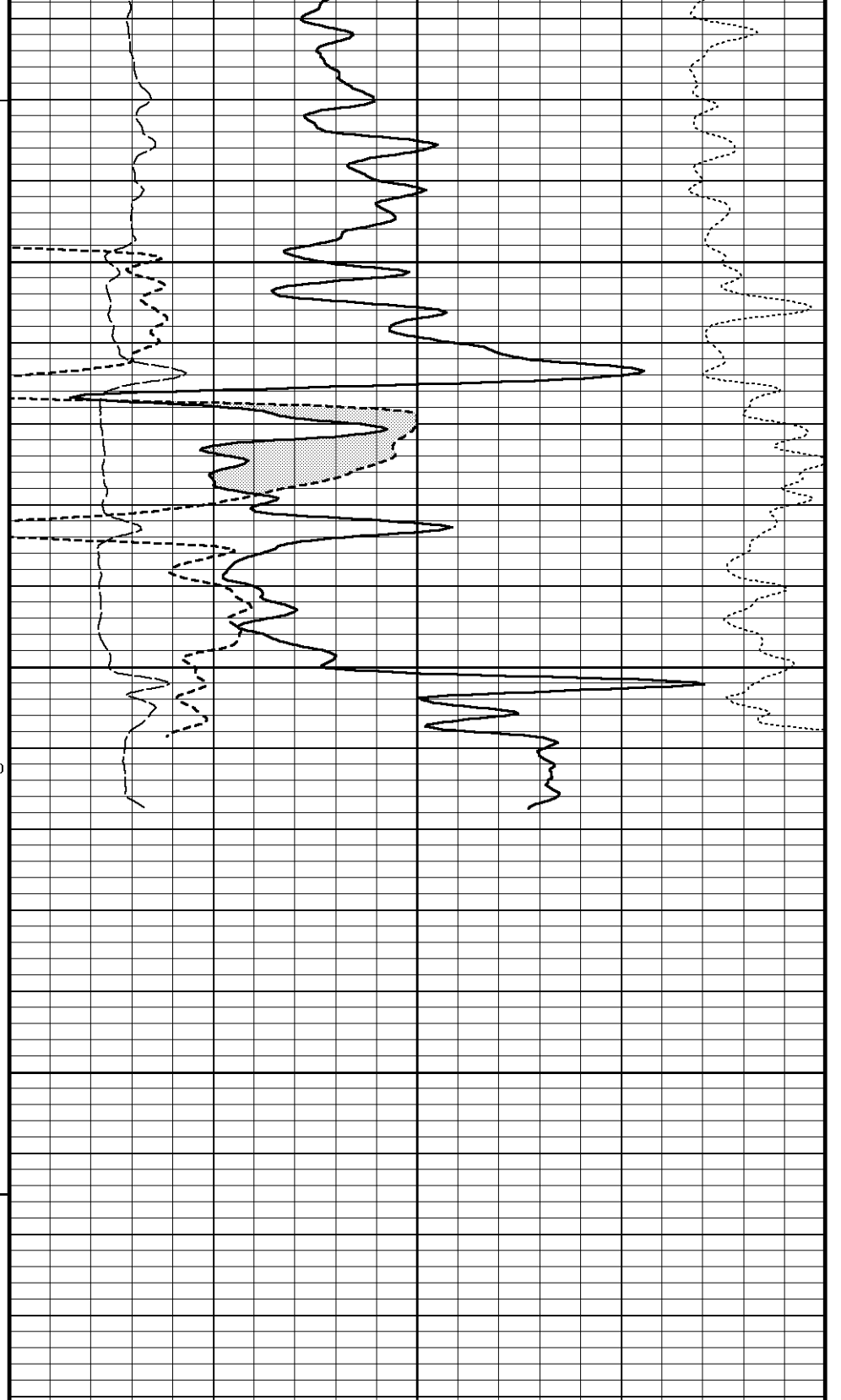
DST Uphole Tension

pounds

10000 5000 0

0 -5000 -10000

Gamma Ray



SS Neutron Por.

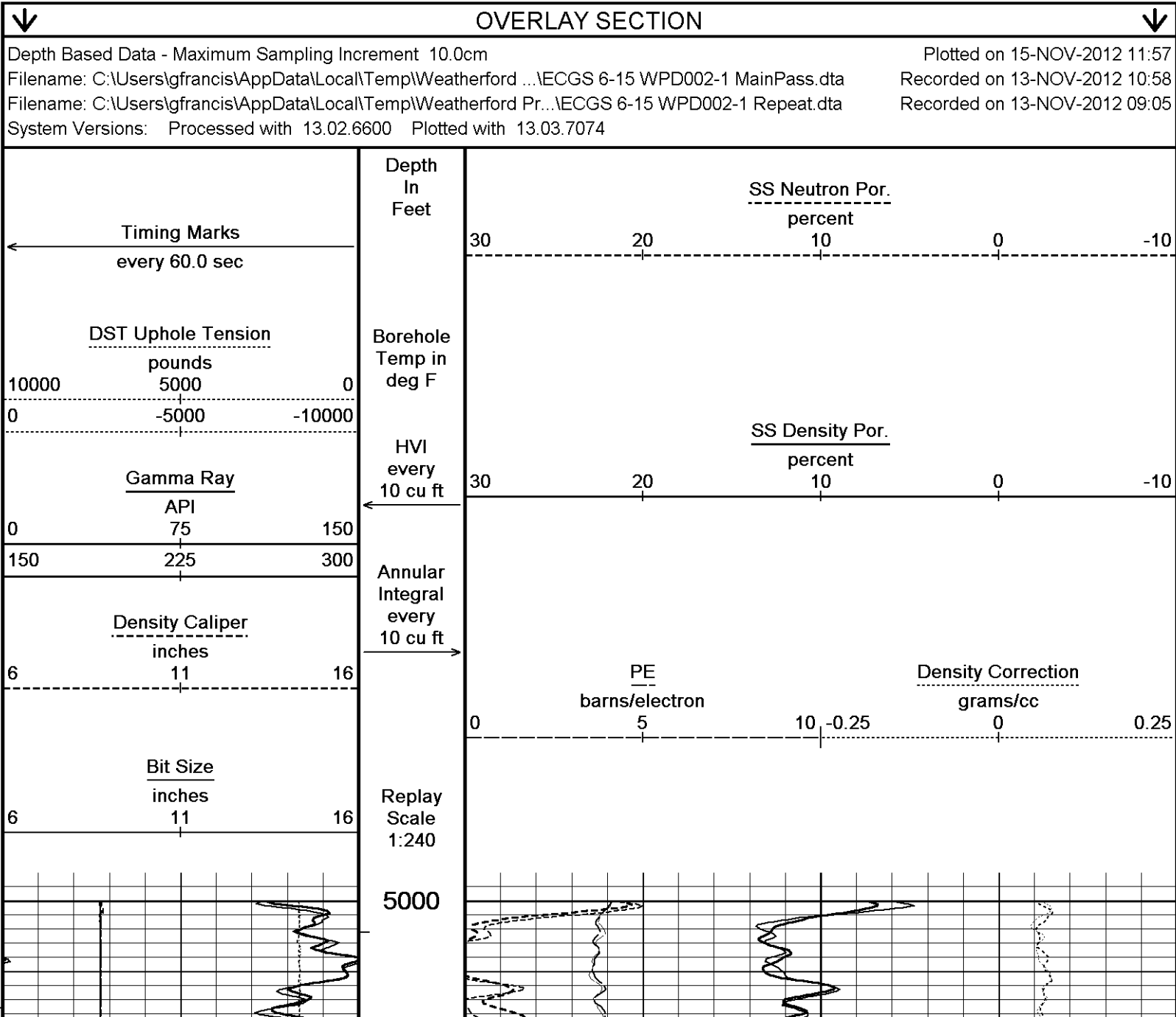
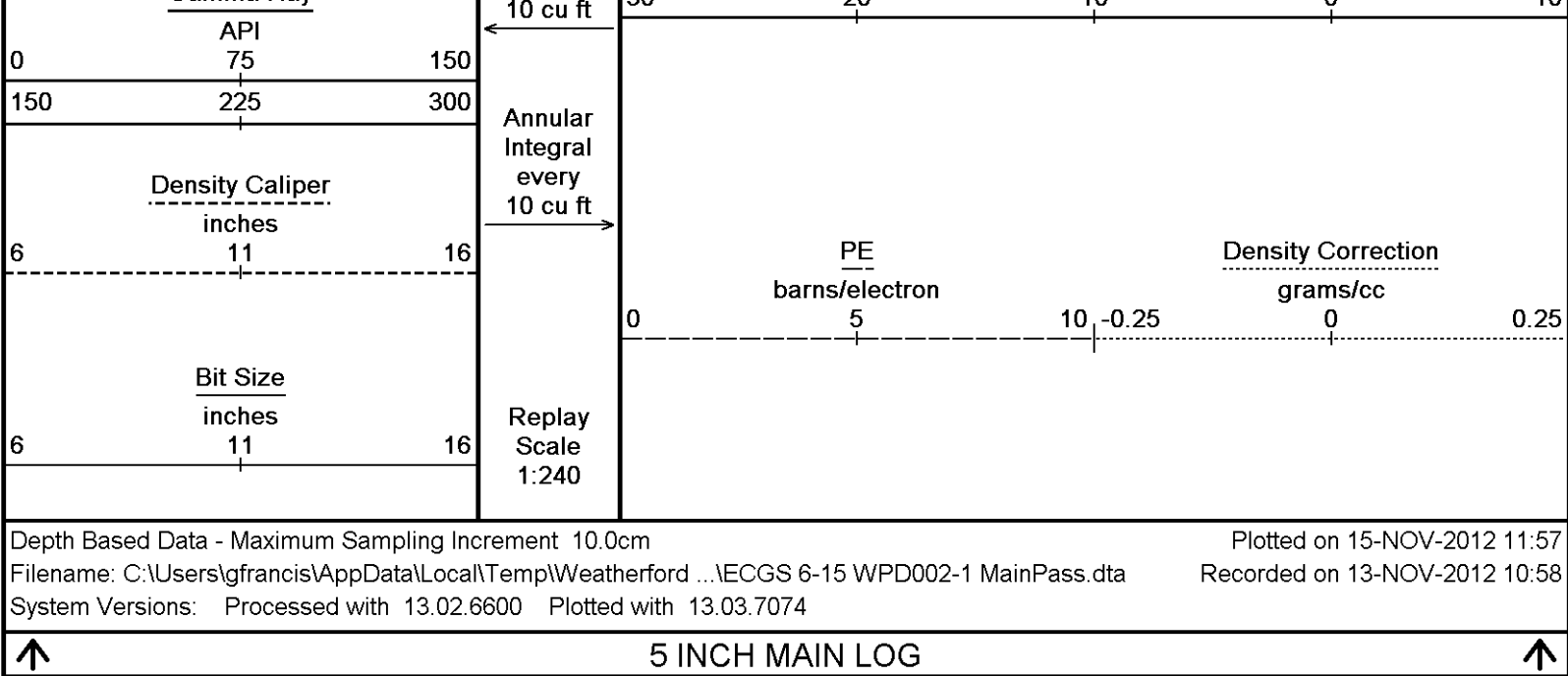
percent

30 20 10 0 -10

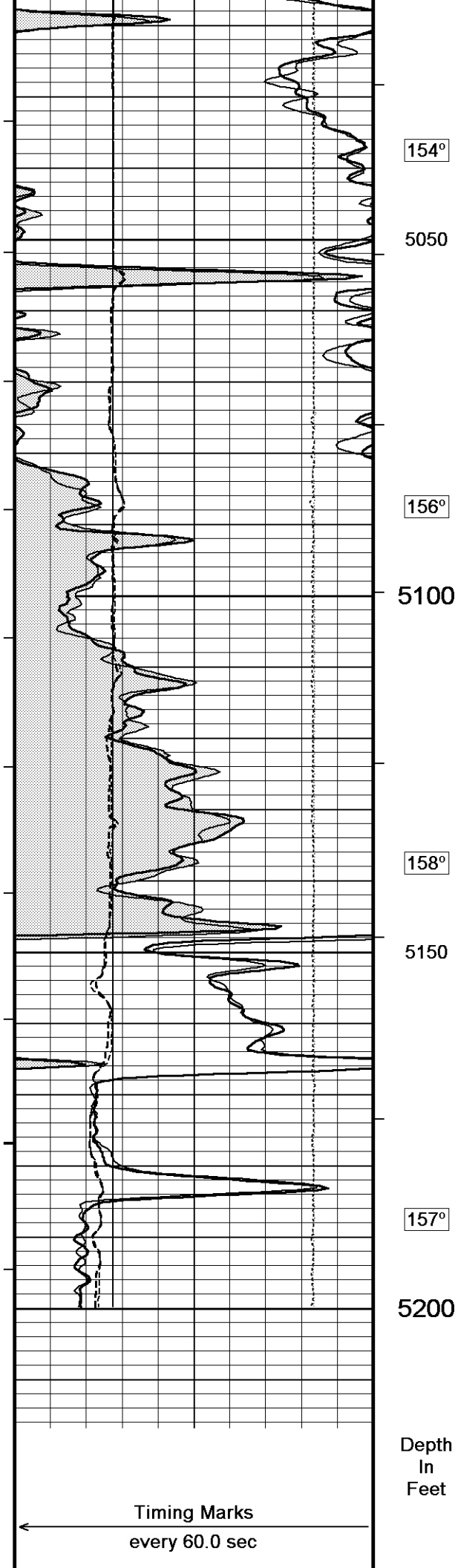
SS Density Por.

percent

30 20 10 0 -10







154°

5050

156°

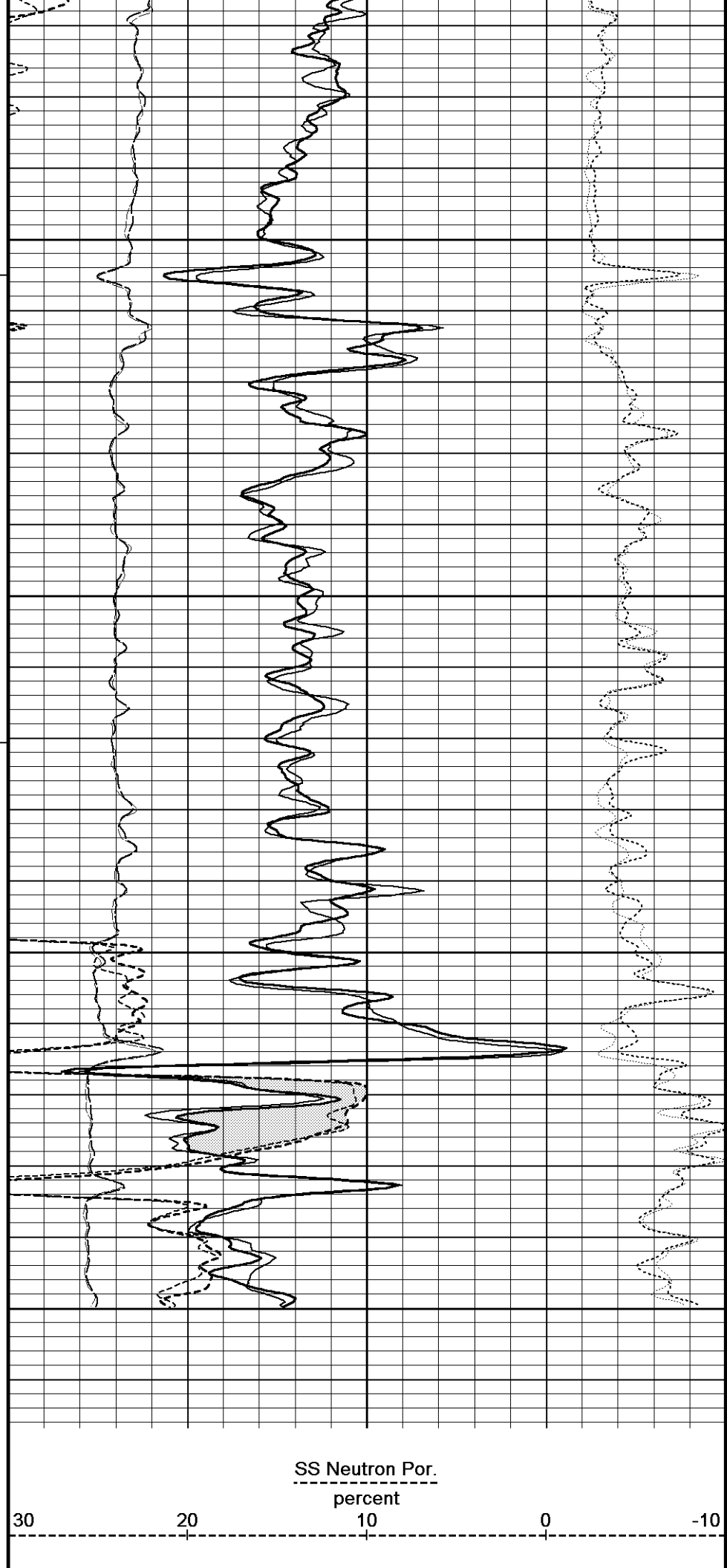
5100

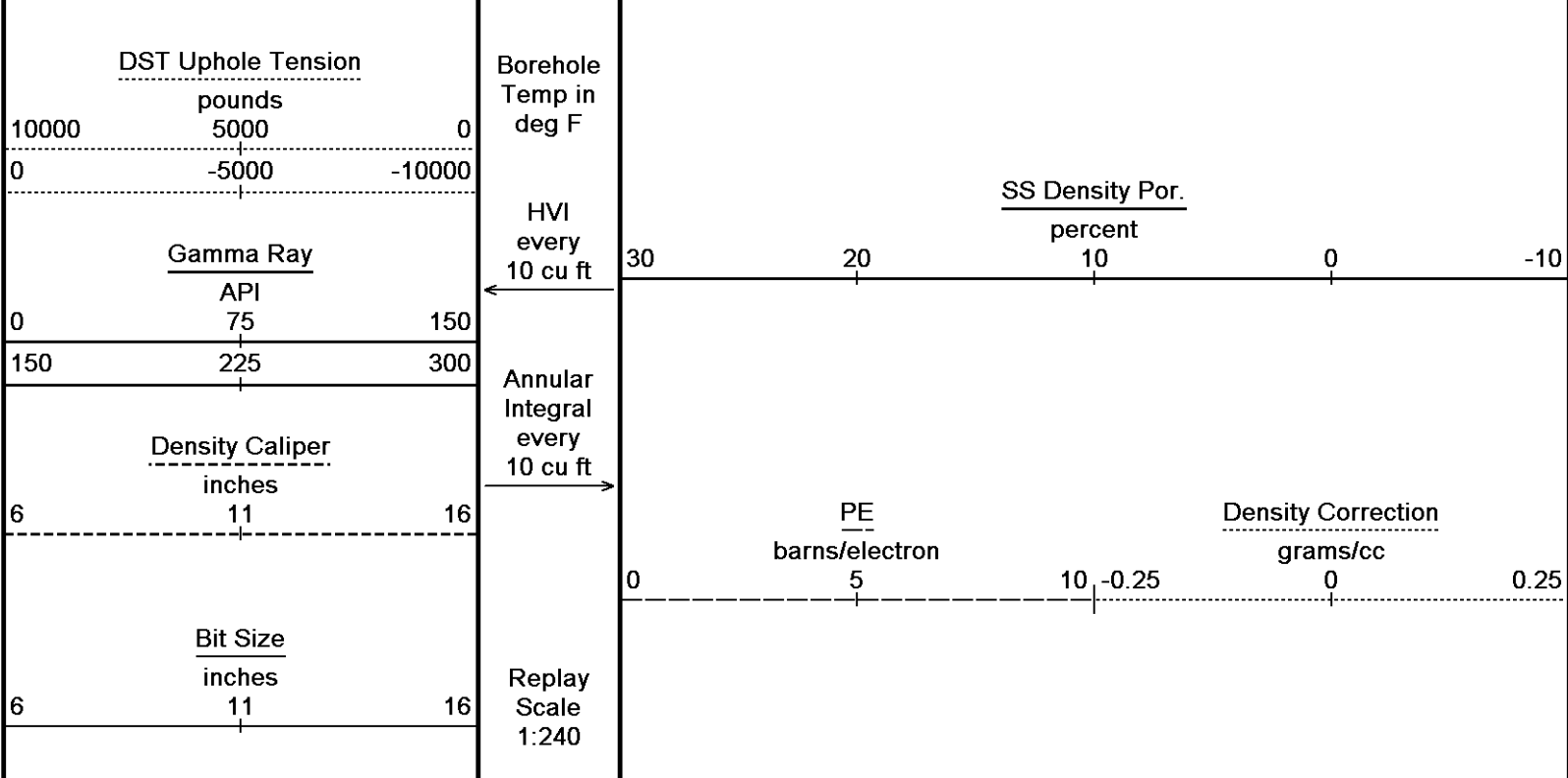
158°

5150

157°

5200





Depth Based Data - Maximum Sampling Increment 10.0cm
Plotted on 15-NOV-2012 11:57

Filename: C:\Users\gfrancis\AppData\Local\Temp\Weatherford ...IECGS 6-15 WPD002-1 MainPass.dta
Recorded on 13-NOV-2012 10:58

Filename: C:\Users\gfrancis\AppData\Local\Temp\Weatherford Pr...IECGS 6-15 WPD002-1 Repeat.dta
Recorded on 13-NOV-2012 09:05

System Versions: Processed with 13.02.6600 Plotted with 13.03.7074

↑

OVERLAY SECTION

↑

↓

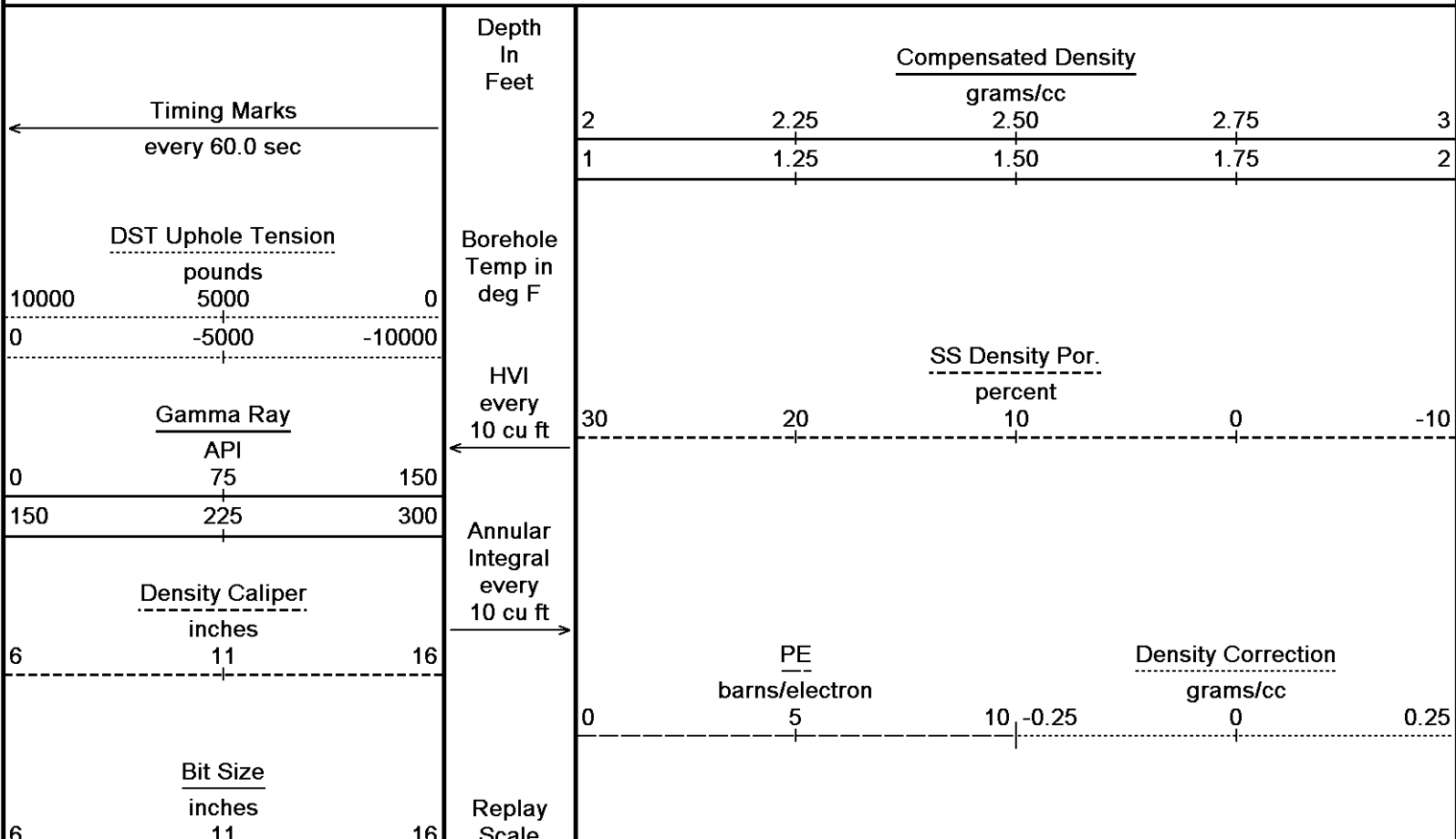
5 INCH MAIN LOG

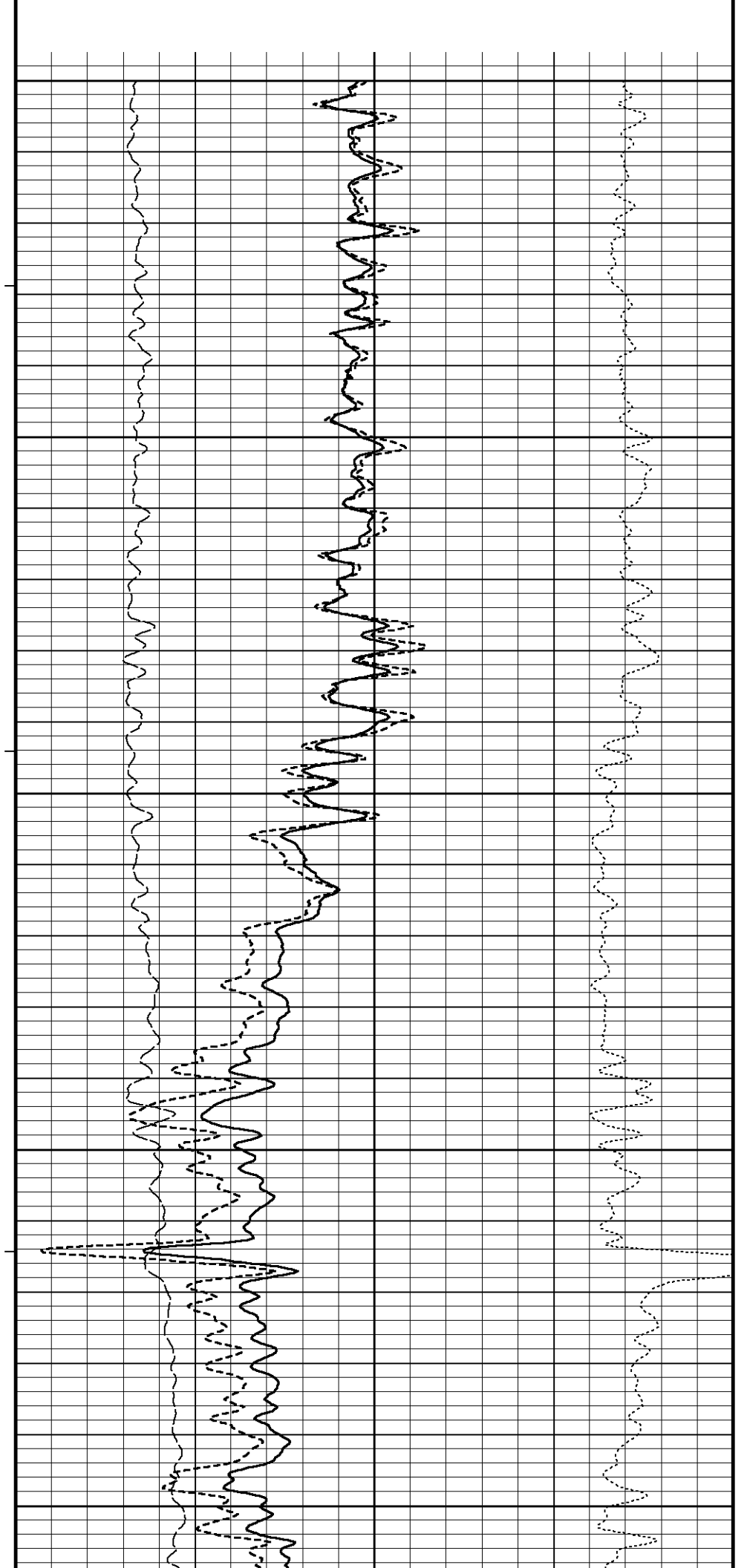
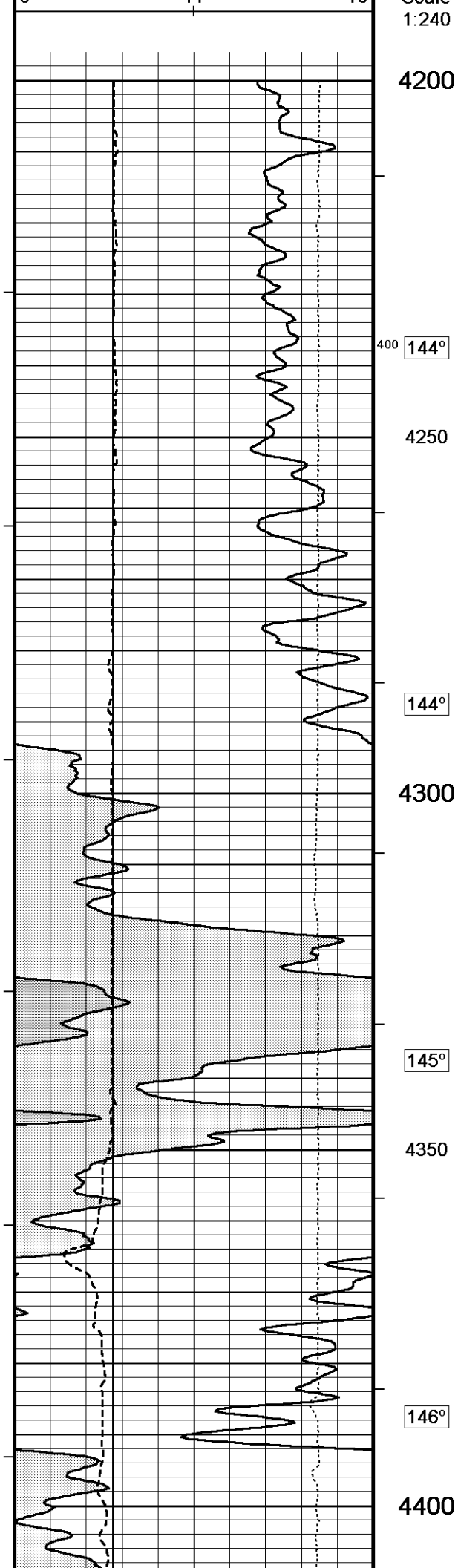
↓

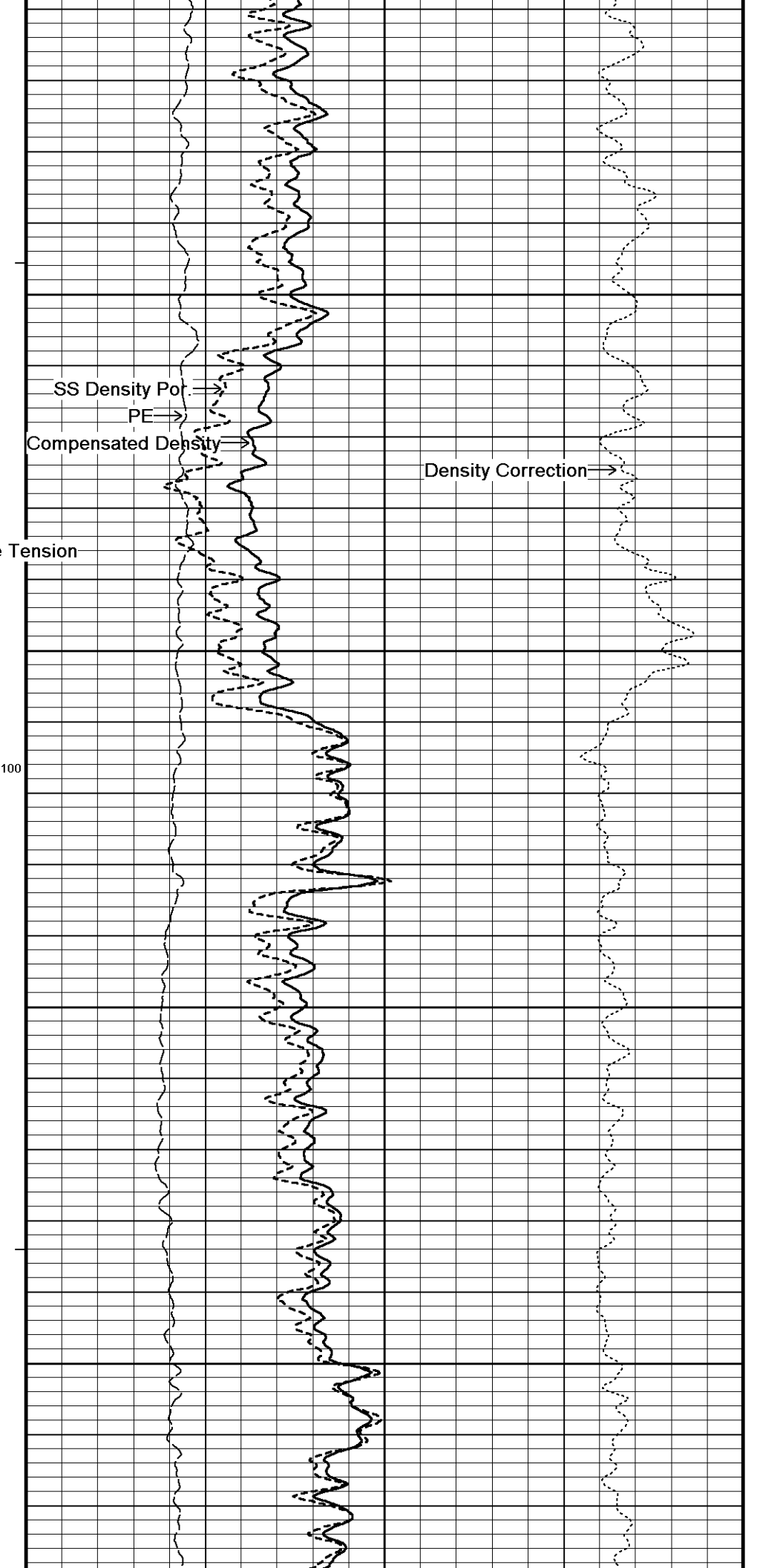
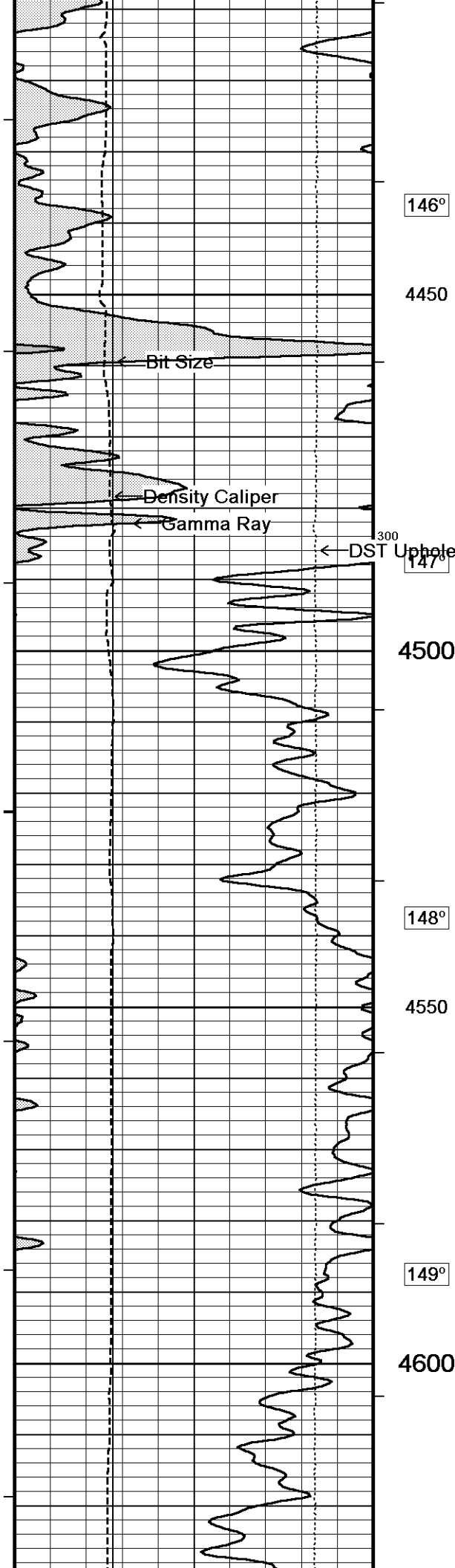
Depth Based Data - Maximum Sampling Increment 10.0cm
Plotted on 15-NOV-2012 11:57

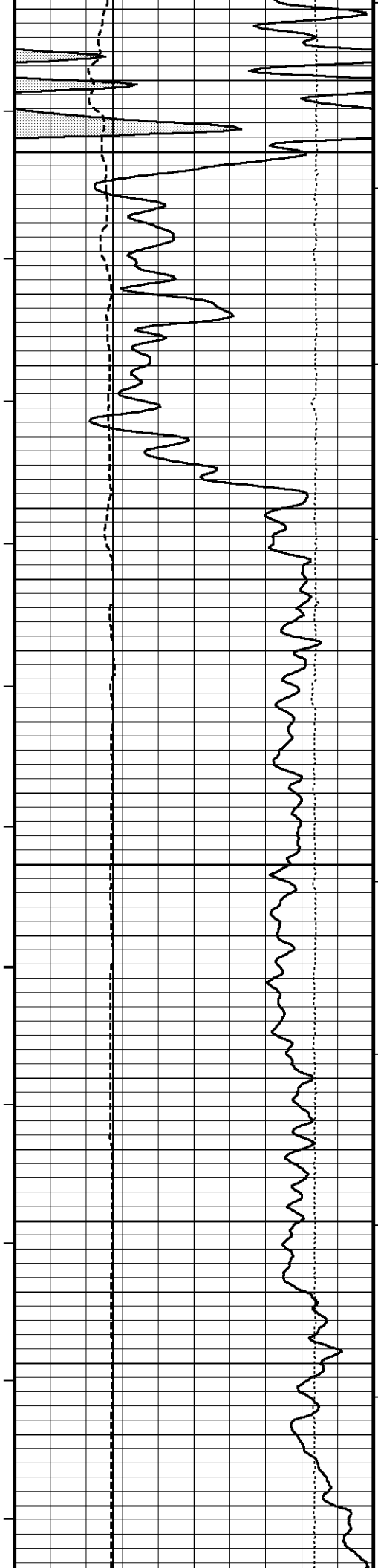
Filename: C:\Users\gfrancis\AppData\Local\Temp\Weatherford ...IECGS 6-15 WPD002-1 MainPass.dta
Recorded on 13-NOV-2012 10:58

System Versions: Processed with 13.02.6600 Plotted with 13.03.7074

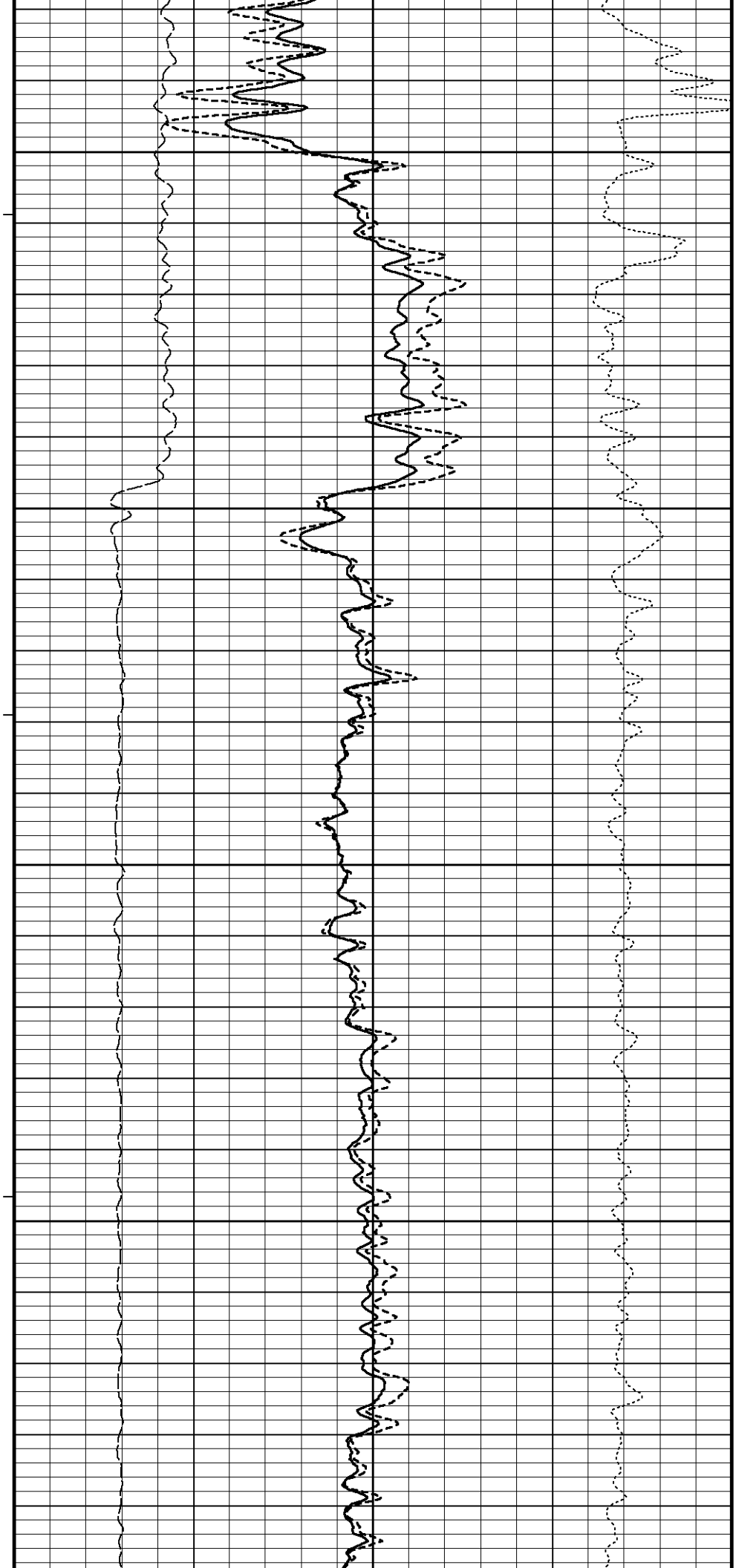


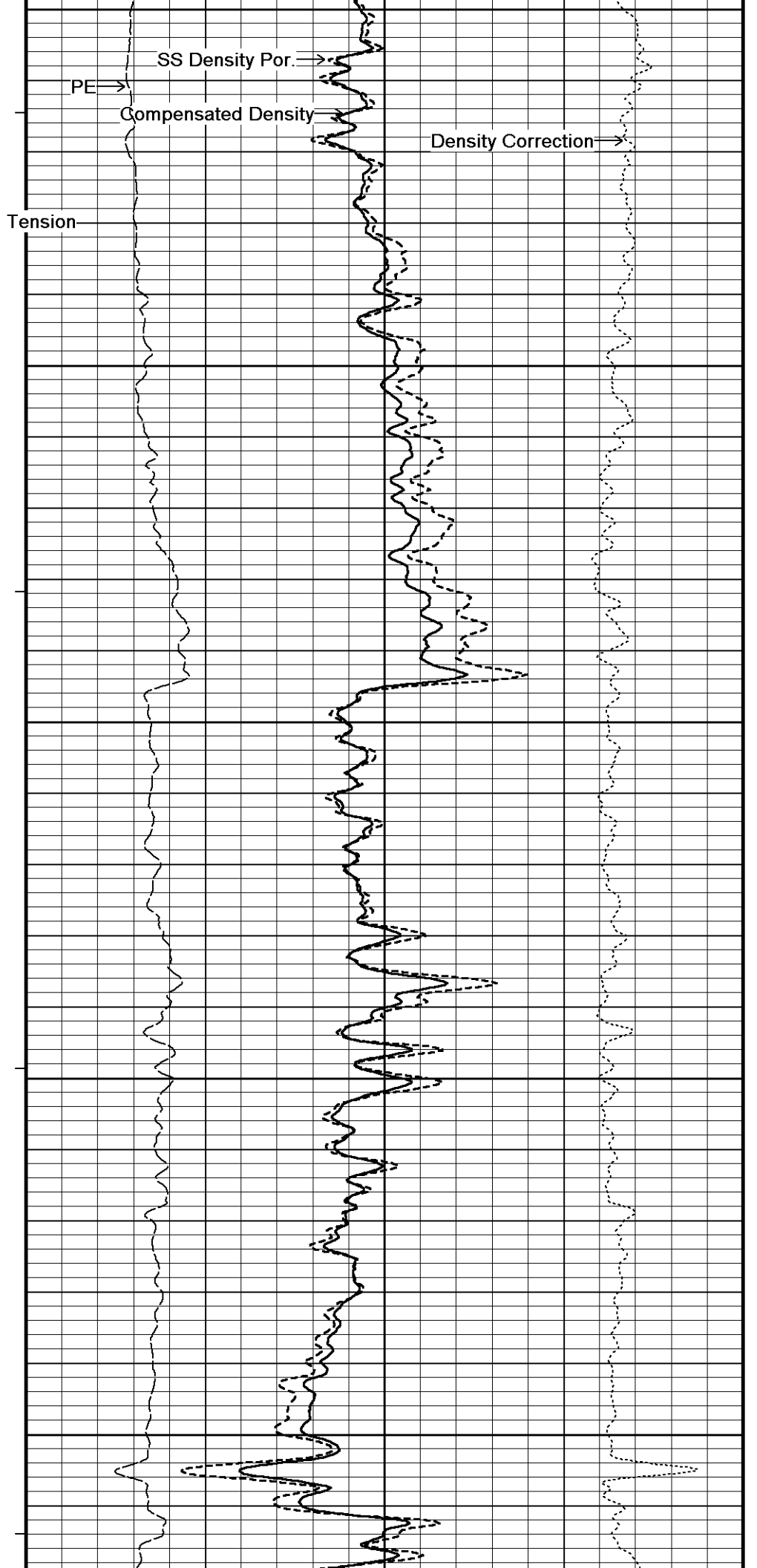
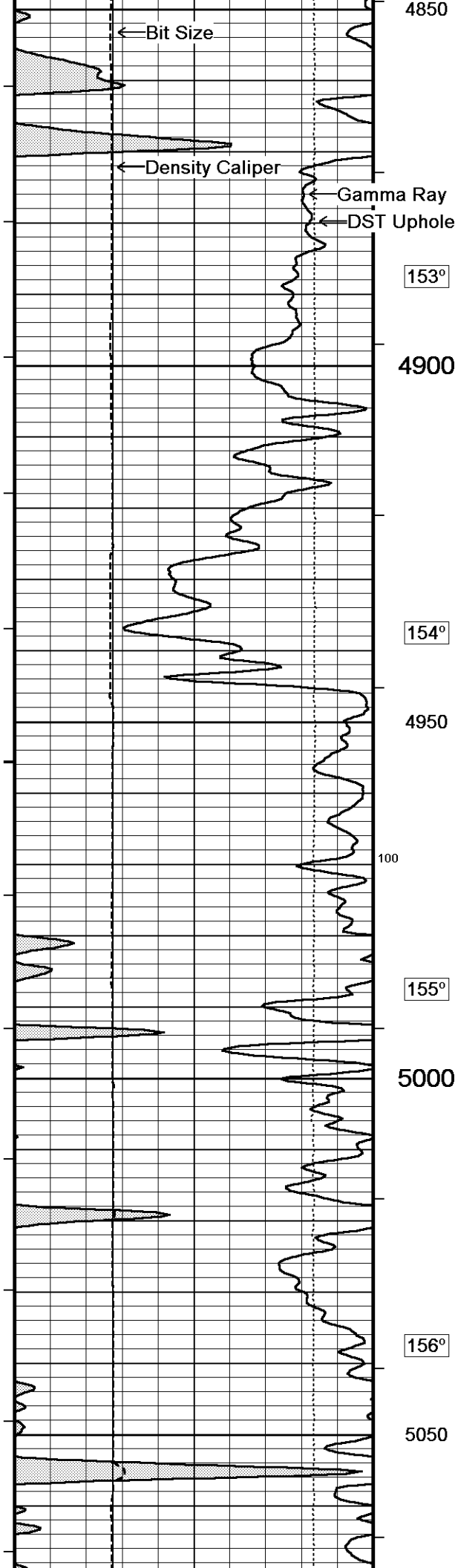


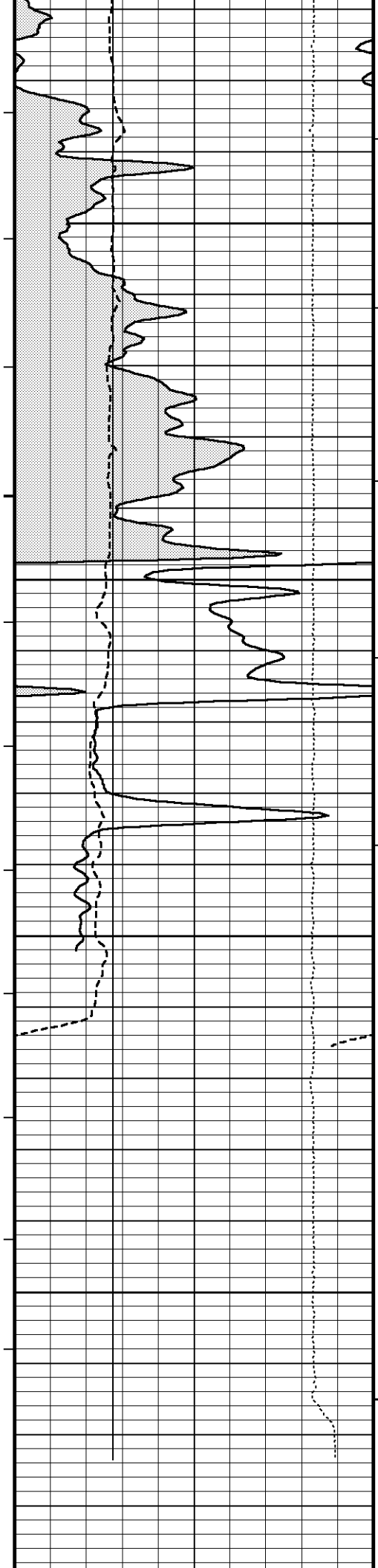




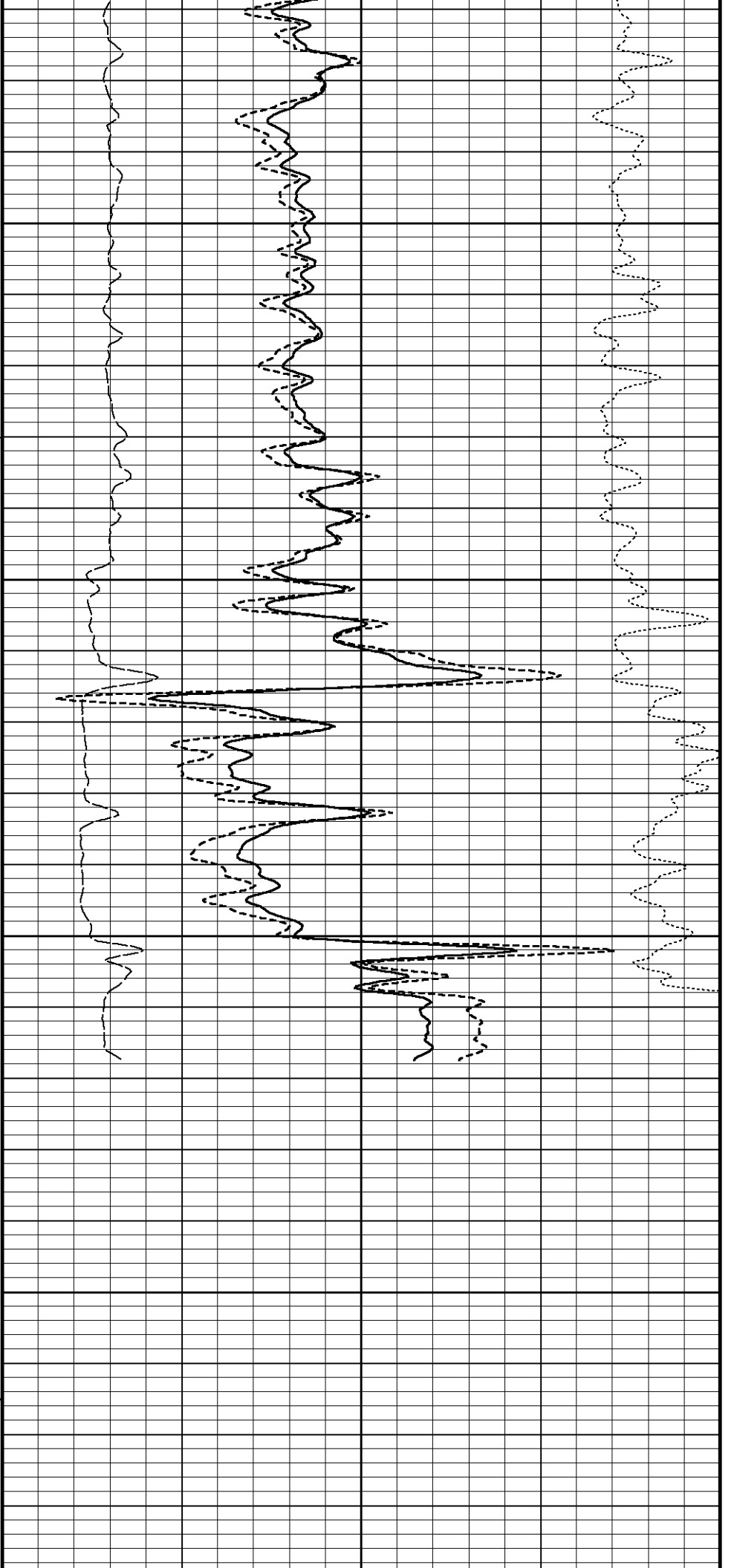
150°  
4650  
151°  
4700  
200  
151°  
4750  
152°  
4800  
153°

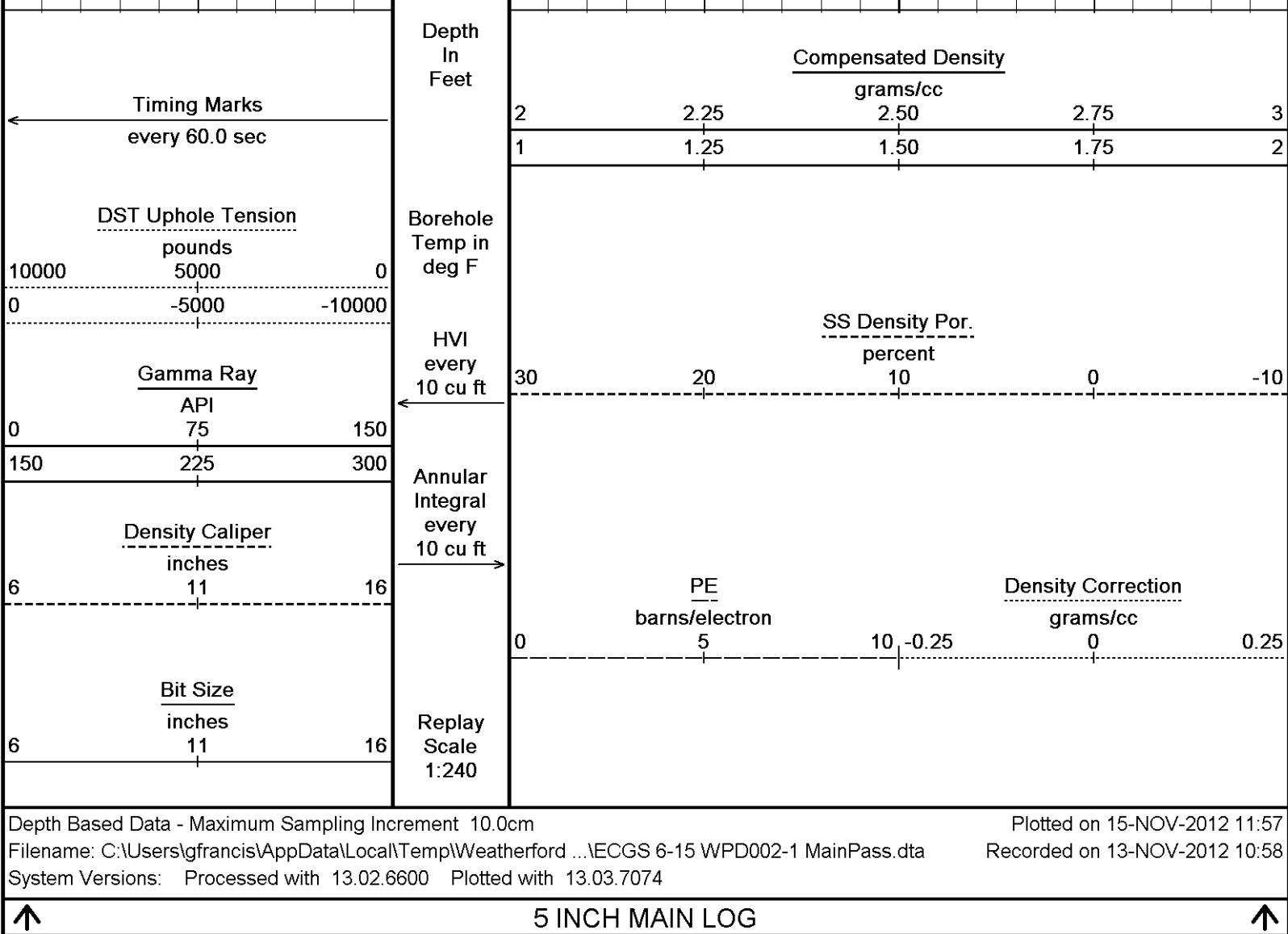






158°  
5100  
159°  
5150  
158°  
5200  
0  
159°  
5250  
TD





BEFORE SURVEY CALIBRATION			
C:\Users\gfrancis\AppData\Local\Temp\Weatherford PreView\0\IECGS 6-15 WPD002-1 Repeat.dta			
Down-hole Tension Calibration All 000			Field Calibration on 24-OCT-2010 03:34
Reading No	Measured		
1	15659.85	0.00	
2	15734.68	370.00	
General Constants All 000			Last Edited on 13-NOV-2012,08:47
General Parameters			
Mud Resistivity	3.100	ohm-metres	
Mud Resistivity Temperature	85.700	degrees F	
Water Level	0.000	feet	
Density/Neutron Processing	Wet Hole		
Hole/Annular Volume and Differential Caliper Parameters			
HVOL Method	Single Caliper		
HVOL Caliper 1	Density Caliper		
HVOL Caliper 2	N/A		
Annular Volume Diameter	7.000	inches	
Caliper for Differential Caliper	Density Caliper		
Rwa Parameters			
Porosity used	Base Density Porosity		
Resistivity used	Array Ind. One Res Rt		
RWA Constant A	0.610		
RWA Constant M	2.150		



Reading No	Measured	Calibrated (lbs)
1	15164.23	0.00
2	16641.18	500.00

## High Resolution Temperature Calibration MCG-D.K 483

Field Calibration on 06-JUL-2012 14:06

	Measured	Calibrated (Deg F)
Lower	0.00	0.00
Upper	0.00	0.00

## High Resolution Temperature Constants MCG-D.K 483

Last Edited on

Pre-filter Length	11
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## SP Calibration MCG-D.K 483

Field Calibration on 06-JUL-2012 14:06

	Measured	Calibrated (mV)
Reference 1	100.6	100.1
Reference 2	-98.9	-100.1

## Gamma Calibration MCG-D.K 483

Field Calibration on 12-NOV-2012 13:13

	Measured	Calibrated (API)
Background	74	50
Calibrator (Gross)	786	530
Calibrator (Net)	712	480

## Gamma Constants MCG-D.K 483

Last Edited on 13-NOV-2012,04:36

Gamma Calibrator Number	GRCC-112	
Mud Density	1.00	gm/cc
Caliper Source for Processing	Density Caliper	
Tool Position	Eccentred	
Concentration of KCl	0.00	kppm

## Neutron Calibration MDN-B.A 227

Base Calibration on 15-OCT-2012 15:48

Field Check on 12-NOV-2012 13:22

Base Calibration					
		Measured		Calibrated (cps)	
		Near	Far	Near	Far
		2896	90	3714	110
Ratio		32.069		33.764	
Field Calibrator at Base					
				Calibrated (cps)	
				1658	2365
Ratio				0.701	
Field Check					
				Calibrated (cps)	
				1633	2356
Ratio				0.693	

## Neutron Constants MDN-B.A 227

Last Edited on 13-NOV-2012,04:35

Neutron Source Id	P44382B	
Neutron Jig Number	NEC43	
Epithermal Neutron	No	
Caliper Source for Processing	Density Caliper	
Stand-off	0.00	inches
Mud Density	1.00	gm/cc
Limestone Sigma	7.10	cu
Sandstone Sigma	7.00	cu
Dolomite Sigma	4.70	cu
Formation Pressure Source	None	
Formation Pressure	N/A	kpsi
Temperature Source	None	
Temperature	N/A	degrees F
Mud Salinity	0.00	kppm
Salinity Correction	Not Applied	
Formation Fluid Salinity Source	None	
Formation Fluid Salinity	N/A	kppm
Barite Mud Correction	Not Applied	

Magnetic Declination	0.00	degrees	East
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Magnetometer Parameters MIE-A.A 174			
Date Of Last Magnetometer Calibration		01-JAN-1998	
	X Magnetometer	Y Magnetometer	Z Magnetometer
Slope	-1.000000	-1.010750	-0.999300
Offset	0.009287	-0.020140	0.013025

Magnetometer Constants MIE-A.A 174			Last Edited on
Magnetometer Calibrator Number		000	

Accelerometer Parameters MIE-A.A 174			
Date Of Last Accelerometer Calibration		01-JAN-1998	
	X Accelerometer	Y Accelerometer	Z Accelerometer
Slope	-1.108610	-1.104030	-1.096720
Offset	0.005796	-0.001009	0.012654

Accelerometer Constants MIE-A.A 174			Last Edited on 23-APR-2009,07:34	
Accelerometer Calibrator Number		000		
Accelerometer Temperature Characterisation				
X Accelerometer				
Serial Number		644		
Calibration Date		19-Aug-2008		
	B0	B1	B2	B3
Bias(g)	0.00000e+000	8.97681e-006	-1.88894e-008	1.27694e-010
	SF0	SF1	SF2	SF3
Scale Factor(mA/g)	3.00000e+000	2.72633e-004	2.24457e-007	1.11567e-009
Y Accelerometer				
Serial Number		679		
Calibration Date		24-Aug-2008		
	B0	B1	B2	B3
Bias(g)	0.00000e+000	2.76667e-005	-1.48113e-008	9.65949e-011
	SF0	SF1	SF2	SF3
Scale Factor(mA/g)	3.00000e+000	2.60693e-004	5.14448e-007	-1.83309e-010
Z Accelerometer				
Serial Number		687		
Calibration Date		30-Aug-2008		
	B0	B1	B2	B3
Bias(g)	0.00000e+000	-2.68884e-005	4.88649e-009	-1.07028e-011
	SF0	SF1	SF2	SF3
Scale Factor(mA/g)	3.00000e+000	2.65798e-004	2.86695e-007	9.16986e-010

Caliper Calibration MIE-A.A 174				Base Calibration on 13-NOV-2012 03:57	
				Field Calibration on 13-NOV-2012 03:58	
Base Calibration					
Reading No	Pads 1-5 Meas.	Pads 3-7 Meas.	Calibrator Size (in)		
1	26539	26547	5.96		
2	36989	37140	7.99		
3	46454	46711	9.86		
4	55567	58265	11.93		
5	0	0	0.00		
Reading No	Pad 2 Meas.	Pad 4 Meas.	Pad 6 Meas.	Pad 8 Meas.	Calibrator Size (in)
1	26424	25773	25566	25741	5.96
2	35767	34710	33739	34118	7.99
3	43766	42899	41717	42151	9.86
4	51706	54174	52590	50282	11.93
5	0	0	0	0	0.00
Field Calibration					
	Measured	Measured	Actual		
	Pads 1-5 Caliper(in)	Pads 3-7 Caliper(in)	Caliper(in)		
	8.02	7.97	7.99		

Measured	Measured	Measured	Measured	Actual
Pad 2 Caliper(in) 4.00	Pad 4 Caliper(in) 3.96	Pad 6 Caliper(in) 3.99	Pad 8 Caliper(in) 4.05	Caliper(in) 7.99
Caliper Constants MIE-A.A 174				Last Edited on 13-NOV-2012,03:53
Caliper Difference for BRKT		0.120	inches	
Imager Pad Check MIE-A.A 174				Field Check on
Pad 1	Pad Not Tested	Pad 5	Pad Not Tested	
Pad 2	Pad Not Tested	Pad 6	Pad Not Tested	
Pad 3	Pad Not Tested	Pad 7	Pad Not Tested	
Pad 4	Pad Not Tested	Pad 8	Pad Not Tested	
Compact Micro Imager Constants MIE-A.A 174				Last Edited on 13-NOV-2012,04:35
Sonde Configuration		Imager Mode		
Arm-Pad Kit		Normal Pads (12.25 in)		
Arm-Pad Kit Serial Number				
Centre Pad 1 Rotational Offset		0.00	degrees	
Image/Borehole Ovality Reference		Azimuth of Pad 1		
Non Active Buttons		Omit		
Search Angle		0.00	degrees	
Correlation Interval		3.28	feet	
Correlation Step		1.64	feet	
Current Offset		0.0000	mAmp	
Squasher Start		N/A	mAmp	
Image Processing		Enabled		
FE Calibration MFE-A.A 66				Base Calibration on 15-OCT-2012 13:42 Field Check on 12-NOV-2012 13:15
Base Calibration				
	Measured	Calibrated (ohm-m)		
Reference 1	0.0	0.0		
Reference 2	997.0	126.8		
Base Check		272.6		
Field Check		272.7		
FE Constants MFE-A.A 66				Last Edited on 13-NOV-2012,04:34
Running Mode		No Sleeve		
MFE K Factor		0.1268		
Caliper Source for FE correction		Density Caliper		
Caliper Value for FE correction		N/A	inches	
Rm Source for FE correction		Temperature Corr		
Temp. for Rm Corr.		MCG External Temperature		
Stand-off		1.0	inches	
FE Calibration MAI-A.A 165				Base Calibration on 12-FEB-2009 10:30 Field Check on 04-APR-2009 14:52
Base Calibration				
	Measured	Calibrated (ohm-m)		
Reference 1	0.0	0.0		
Reference 2	976.9	126.8		
Base Check		277.9		
Field Check		278.3		
FE Constants MAI-A.A 165				Last Edited on 04-APR-2009,15:12
Running Mode				
MFE K Factor				
Caliper Source for FE correction		Density Caliper		
Caliper Value for FE correction		N/A	inches	
Rm Source for FE correction		Temperature Corr		
Temp. for Rm Corr.		MCG External Temperature		
Stand-off		1.0	inches	
High Resolution Temperature Calibration MAI-A.A 165				Field Calibration on 10 OCT 2011 15:43

		Measured	Calibrated(Deg F)		Field Calibration on 10-OCT-2011,13:43
Lower		50.00	50.00		
Upper		75.00	75.00		
High Resolution Temperature Constants MAI-A.A 165					Last Edited on 15-OCT-2012,13:33
Pre-filter Length		11			
Induction Calibration MAI-A.A 165					Base Calibration on 15-OCT-2012,13:08 Field Check on 12-NOV-2012 13:09
Base Calibration					
Test Loop Calibration		Measured		Calibrated (mmho/m)	
Channel	Low	High	Low	High	
1	17.2	469.6	9.3	966.2	
2	6.7	392.8	7.6	821.4	
3	4.2	262.3	5.2	566.0	
4	1.6	136.6	2.6	279.2	
Array Temperature		75.0	Deg F		
Channel		Base Check (mmho/m)		Field Check (mmho/m)	
	Low	High	Low	High	
1	12.9	3869.0	11.7	3869.6	
2	28.4	3433.8	28.0	3434.9	
3	26.7	3021.4	26.5	3022.8	
4	19.7	2016.0	19.6	2017.1	
Deep	17.3	2011.3	17.2	2012.6	
Medium	37.6	3970.8	37.4	3972.6	
Shallow	41.2	5011.9	40.6	5012.9	
Array Temperature		69.2	53.8	Deg F	
Induction Constants MAI-A.A 165					Last Edited on 13-NOV-2012,04:34
Induction Model		RtAP-WBM			
Caliper for Borehole Corr.		Density Caliper			
Hole Size for Borehole Correction		N/A	inches		
Tool Centred		No			
Stand-off Type		Fins			
Stand-off		1.00	inches		
Number of Fins on Stand-off		6.0000			
Stand-off Fin Angle		60.00	degrees		
Stand-off Fin Width		0.0500	inches		
Borehole Corr. Rm Source		Temperature Corr			
Temp. for Rm Corr.		MCG External Temperature			
Squasher Start		0.0020	mhos/metre		
Squasher Offset		N/A	mhos/metre		
Borehole Normalisation					
DRM1	0.0000	DRC1	0.0000		
DRM2	0.0000	DRC2	0.0000		
MRM1	0.0000	MRC1	0.0000		
MRM2	0.0000	MRC2	0.0000		
SRM1	0.0000	SRC1	0.0000		
SRM2	0.0000	SRC2	0.0000		
Calibration Site Corrections					
Channel 1	0.00		mmhos/metre		
Channel 2	0.00		mmhos/metre		
Channel 3	0.00		mmhos/metre		
Channel 4	0.00		mmhos/metre		
Apparent Porosity and Water Saturation Constants					
Archie Constant (A)		1.00			
Cementation Exponent (M)		2.00			
Saturation Exponent (N)		2.00			
Saturation of Water for Apor		100.00	percent		
Resistivity of Water for Apor and Sw		0.05	ohm-m		
Resistivity of Mud Filtrate for Sw		0.00	ohm-m		
Source for Rt		0.00			
Source for Rxo		0.00			

## Base Calibration

Reading No	Measured	Calibrator Size (in)
1	15007	4.00
2	23645	5.96
3	32400	7.99
4	40464	9.86
5	49760	11.93
6	N/A	N/A

## Field Calibration

Measured Caliper (in)	Actual Caliper (in)
7.94	7.99

## Photo Density Calibration MPD-C.A 195

Base Calibration on 15-OCT-2012 14:12

Field Check on 12-NOV-2012 13:30

## Density Calibration

Base Calibration	Measured		Calibrated (sdu)	
	Near	Far	Near	Far
Reference 1	38135	13267	52994	19128
Reference 2	18092	1824	25188	2558

## Field Check at Base

670.1 775.1

## Field Check

670.6 777.0

## PE Calibration

Base Calibration	WS	Measured		Calibrated
		WH	Ratio	Ratio
Background	122	602		
Reference 1	13157	38045	0.348	0.309
Reference 2	5216	18018	0.292	0.274

## Field Check at Base

122.4 602.2

## Field Check

121.8 604.5

## Density Constants MPD-C.A 195

Last Edited on 13-NOV-2012,08:48

Density Source Id	2859GW
Nylon Calibrator Number	527
Aluminium Calibrator Number	527
Density Shoe Profile	8 inch
Caliper Source for Processing	Density Caliper
PE Correction to Density	Not Applied
Mud Density	1.18 gm/cc
Mud Density Z/A Multiplier	1.11
Mud Filtrate Density	1.00 gm/cc
Dry Hole Mud Filtrate Density	1.00 gm/cc
DNCT	0.00 gm/cc
CRCT	0.00 gm/cc
Density Z/A Correction	Hybrid
Matrix Density (gm/cc)	Depth (ft)
2.68	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00

SHA-J.B Compact Swivel Head Adaptor

SHA-J.B 511 LG: 2.30 ft WT: 22.0 lb OD: 2.24 in

Compact Comms Gamma

MCG-D.K 483 LG: 8.70 ft WT: 63.9 lb OD: 2.24 in

Compact Neutron

MDN-B.A 227 LG: 5.04 ft WT: 50.7 lb OD: 2.24 in

Compact Density/Caliper

MPD-C.A 195 LG: 9.59 ft WT: 90.4 lb OD: 2.45 in

MIS-D.B Compact Inline Bowspring sub

MIS-D.B 696 LG: 5.70 ft WT: 33.1 lb OD: 2.24 in

SKJ-D.A Compact Knuckle Joint

SKJ-D.A 112 LG: 2.17 ft WT: 24.3 lb OD: 2.24 in

MIS-E.A Compact Inline Standoff sub

MIS-E.A 334 LG: 2.14 ft WT: 15.4 lb OD: 2.24 in

SKJ-D.A Compact Knuckle Joint

SKJ-D.A 143 LG: 2.17 ft WT: 24.3 lb OD: 2.24 in

SHA-J.B Compact Swivel Head Adaptor

SHA-J.B 574 LG: 2.30 ft WT: 22.0 lb OD: 2.24 in

SHA-J.B Compact Swivel Head Adaptor

SHA-J.B 510 LG: 2.30 ft WT: 22.0 lb OD: 2.24 in

Compact MMI Memory Section

MIM-A.A 174 LG: 4.65 ft WT: 26.5 lb OD: 2.24 in

Compact MMI Electrode Section

MIE-A.A 174 LG: 13.96 ft WT: 99.2 lb OD: 4.09 in

SKJ-D.A Compact Knuckle Joint

SKJ-D.A 66 LG: 2.17 ft WT: 24.3 lb OD: 2.24 in

Compact Focussed Electric

MFE-A.A 66 LG: 6.05 ft WT: 48.5 lb OD: 2.24 in

Compact Induction

MAI-A.A 165 LG: 10.81 ft WT: 48.5 lb OD: 2.24 in

Total Length: 80.03 ft Weight: 615.1 lb



72.44 ft GRGC - Gamma Ray

65.98 ft NPRS - Sandstone Neutron Por.

65.98 ft NPRL - Limestone Neutron Por.

58.74 ft CLDC - Density Caliper

56.81 ft DPRS - Sandstone Density Por.

56.81 ft DPRL - Limestone Density Por.

56.81 ft DEN - Compensated Density

56.81 ft DEN - Compensated Density

56.81 ft DCOR - Density Correction

56.75 ft PDPE - PE

13.72 ft FEFC - Shallow FE (Phase Corr.)

7.38 ft AIAT - MAI Array Temperature

3.34 ft CTAO - Array Ind. One Cond Ct

3.34 ft R850 - Array Ind. One Res 85

3.34 ft R600 - Array Ind. One Res 60

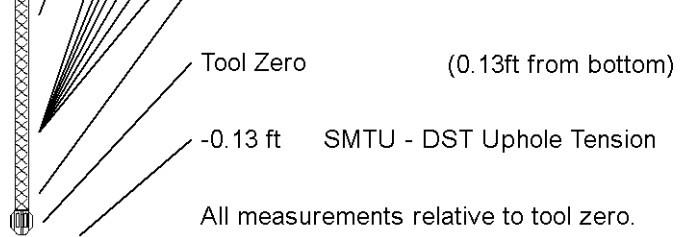
3.34 ft R400 - Array Ind. One Res 40

3.34 ft R300 - Array Ind. One Res 30

3.34 ft R200 - Array Ind. One Res 20

3.34 ft RTAO - Array Ind. One Res Rt

0.23 ft SPCG - Spontaneous Potential



COMPANY	EAST CHEYENNE GAS STORAGE LLC
WELL	ECGS No 6-15 WPD002-1
FIELD	PEETZ WEST
PROVINCE/COUNTY	LOGAN
COUNTRY/STATE	USA/COLORADO

Elevation Kelly Bushing	4570.00	feet	First Reading	5211.00	feet
Elevation Drill Floor	4569.00	feet	Depth Driller	5270.00	feet
Elevation Ground Level	4556.00	feet	Depth Logger	5265.00	feet



PHOTO DENSITY  
COMPENSATED NEUTRON  
LOGS

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