Schlumberger

DUAL INDUCTION GAMMA RAY / SP 5"

COUNTY	COLUMBIA
FIELD	MIST GAS STORAGE
LOCATION	N 86-47-54 W 2085.04 & S 03-12-06
WELL	IW 32-22-65
COMPANY	NORTHWEST NATURAL GAS CO.

COMPANY NORTHWEST NATURAL GAS CO.

WELL IW 32-22-65

FIELD MIST GAS STORAGE

COUNTY: COLUMBIA **STATE:** OREGON

LOCATION
N 86-47-54 W 2085.04' & S 03 12 06
1827.47' FROM THE NE COR. OF SEC 22

Other Services:
INDUCTION
SONIC
FMS
DENSITY
NEUTRON
GAMMA RAY

API SERIAL NO.	SECT.	TWP.	RANGE
36-009-00325	22	6N	5W

Permanent Datum	GROUND LEVEL	**Elev.** 822.1 F		**Elev.:** K.B.838.1 F
Log Measured From	KELLY BUSHING	16.0 F	**above Perm. Datum**	D.F.
Drilling Measured From	KELLY BUSHING			G.L.822.1 F

Date	25-NOV-1997		02 DEC 1997			
Run No.	ONE		TWO			
Depth Driller	1826.0 F		2600.0 F			
Depth Logger (Schl.)	1821.0 F		2590.0 F			
Btm. Log Interval	1820.0 F		2590.0 F			
Top Log Interval	0.0 F		1800.0 F			
Casing-Driller	13 3/8" @ 377.0 F	8 5/8"	@ 1802.0 F		@	
Casing-Logger	376.0 F					
Bit Size	@		@		@	
Type Fluid in Hole	LSND		FLO PRO			
Dens. | **Visc.**	10.00 LB/G	56.0 S	8.60 LB/G	48.0 S		
pH | **Fld. Loss**	8.0		10.0			
Source of Sample	FLOWLINE		FLOWLINE			
Rm @ Meas. Temp.	1.510 OHMM @ 85.0 DEGF		.360 OHMM @ 74.0 DEGF			
Rmf @ Meas. Temp.	.880 OHMM @ 68.0 DEGF		.381 OHMM @ 68.0 DEGF			
Rmc @ Meas. Temp.	.511 OHMM @ 68.0 DEGF		.324 OHMM @ 68.0 DEGF			
Source: Rmf | **Rmc**	CELL	CELL	CELL	CELL		
Rm @ BHT	1.323 OHMM @ 98.0 DEGF		.268 OHMM @ 102. DEGF			
TIME **Circulation Ended**	23:50 24-NOV-97		04:00 02-DEC-1997			
TIME **Logger on Bottom**	SEE LOG					
Max. Rec. Temp.	98.0 DEGF		102. DEGF			
Equip. | **Location**	8303	BAKERSFIELD	8303	BAKERSFIELD		
Recorded By	GREG PERRY		GREG PERRY			
Witnessed By	MR. MEYER / MR. THOMAS		MR. MEYER / MR. THOMAS			

The well name, location and borehole reference data were furnished by the customer

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 interpretations made by any of our officers, agents or employees. These interpretations are also subject to Clause 4 of our General Terms and Conditions as set out in our current Price Schedule

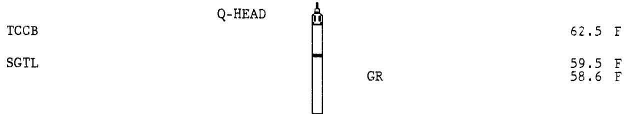
Run No.	ONE		TWO	
Service Order No.				
Drilling Fluid Level	0.0 F		0.0 F	
Salinity				
Rmf @ BHT	.629 OHMM @ 98.0 DEGF		.262 OHMM @ 102. DEGF	
Rmc @ BHT	.365 OHMM @ 98.0 DEGF		.223 OHMM @ 102. DEGF	
Logging Speed	1800.0 F/HR			
EQUIPMENT DATA				
Tool Number 1	DIS 151			
Tool Number 2	DIC 159			
Tool Number 3	SLSWA			
Tool Number 4	SLC432			
Tool Number 5	SGC 483			
Tool Number 6	TCCB 1289			
Tool Number 7	GPIT			
Tool Number 8	FMS			
Tool Number 9	DRS 4768			
Tool Number 10	NSCE 2979			
Tool Number 11	CNTH 1345			
Tool Number 12	AMS			

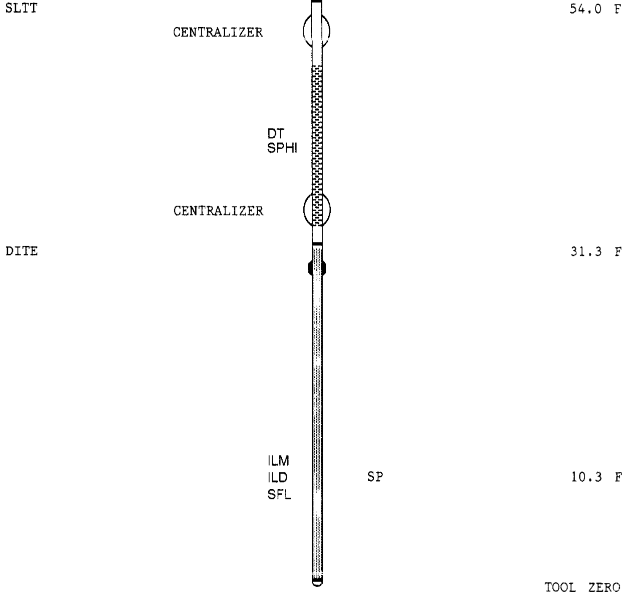
REMARKS:

RAN FLEX JOINTS ON INDUCTION AND SONIC.
RAN 6 ARM FINS ON SONIC.
RAN FLEX JOINTS ABOVE AMS.
DID NOT TAG TD DUE TO PUSHDOWN TOOLS.

CREW: DAN LEE.
TLC: DAVID BLYTHE.
THANKS FOR CHOOSING SCHLUMBERGER!!!!

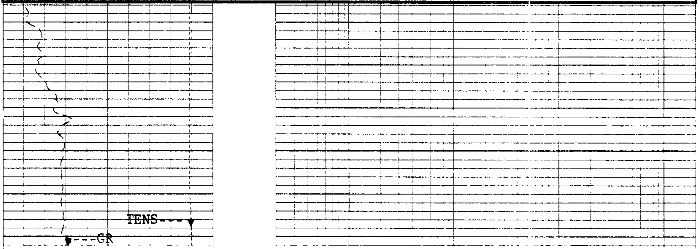
LOGGING TOOL STRING SKETCH

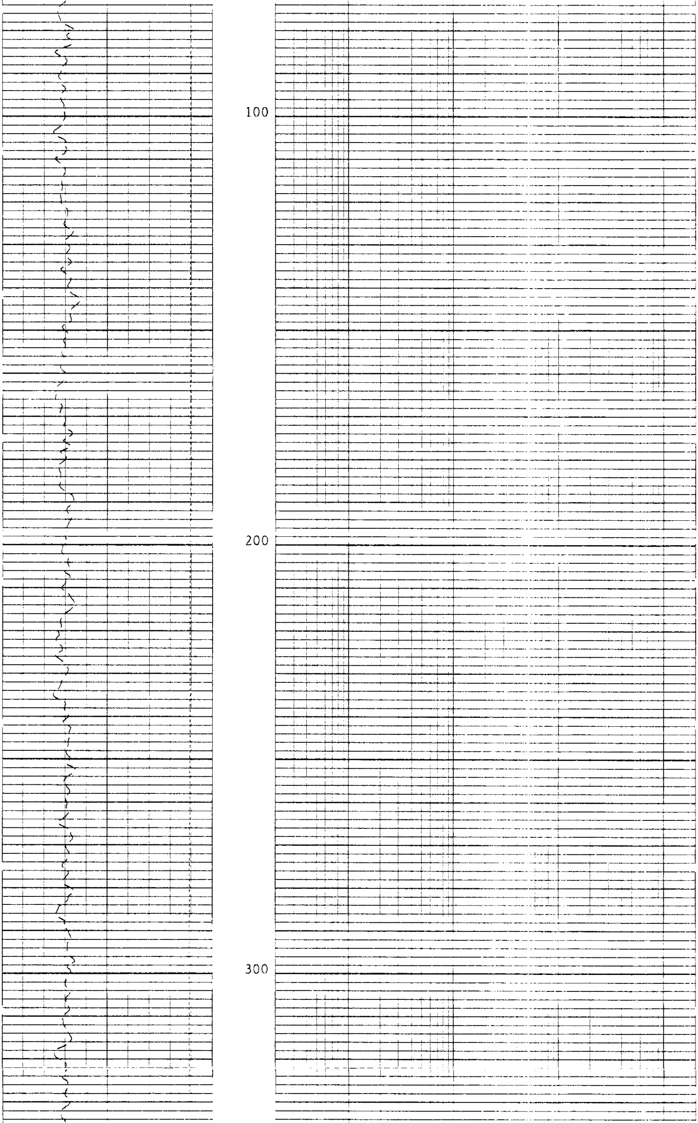


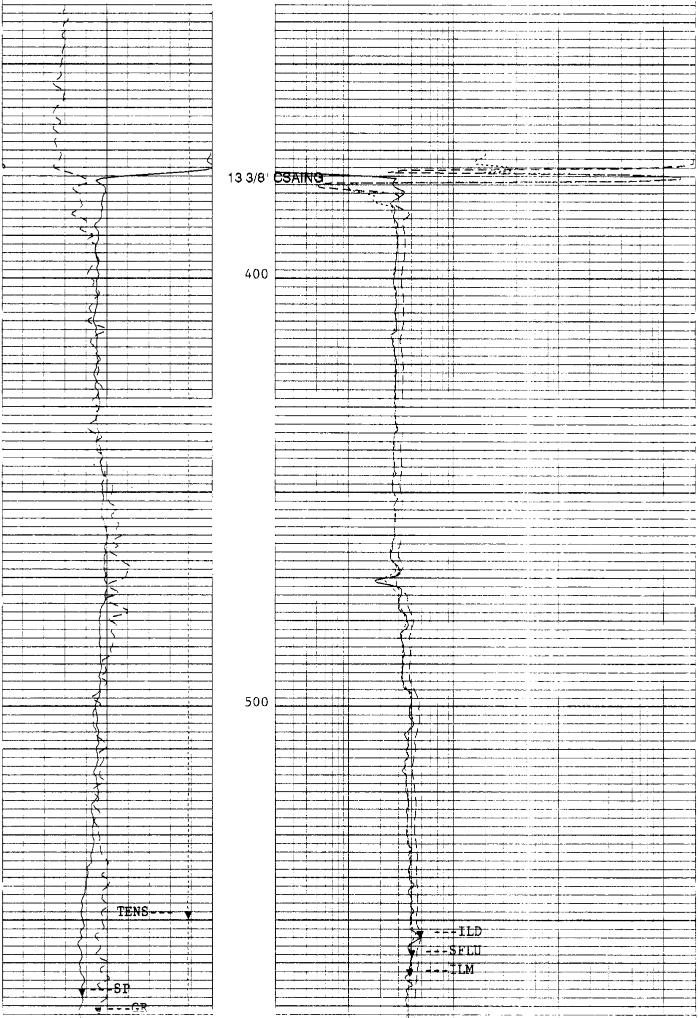


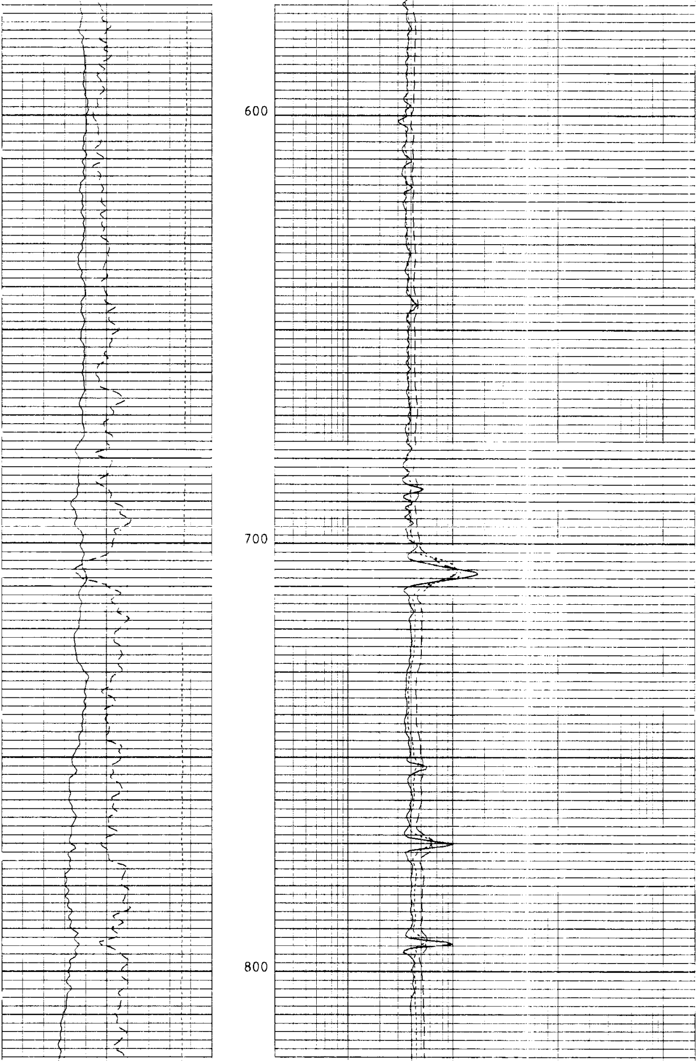
TOTAL TOOL STRING LENGTH IS 64.7 F.
TOTAL TOOL STRING WEIGHT IS 1032. LB IN AIR.

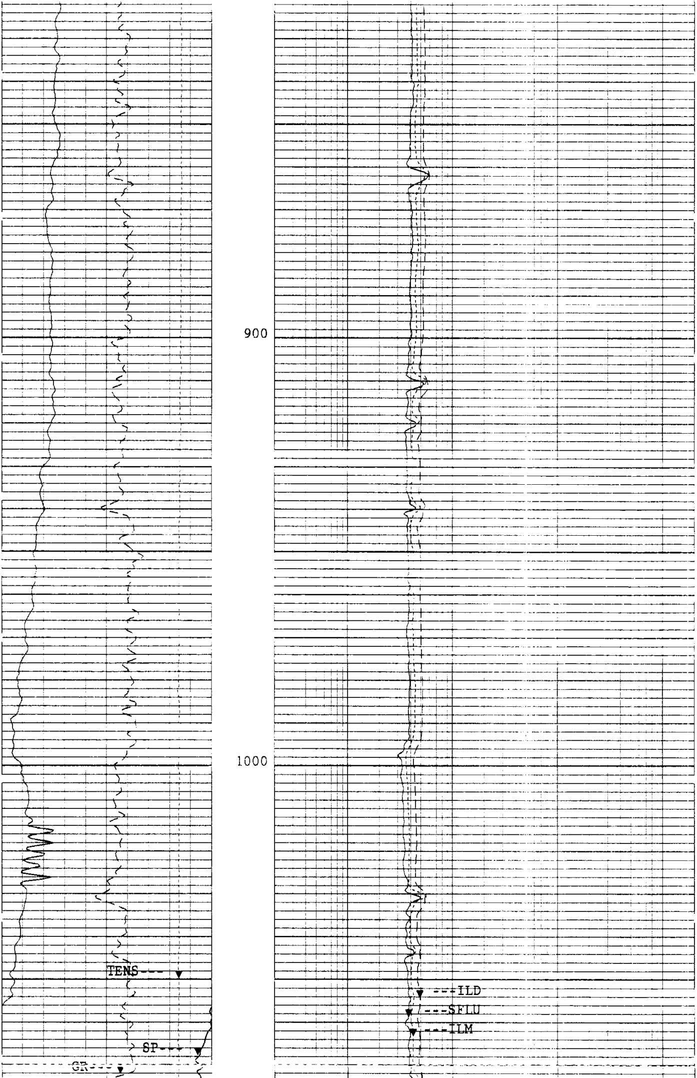
MAIN PASS

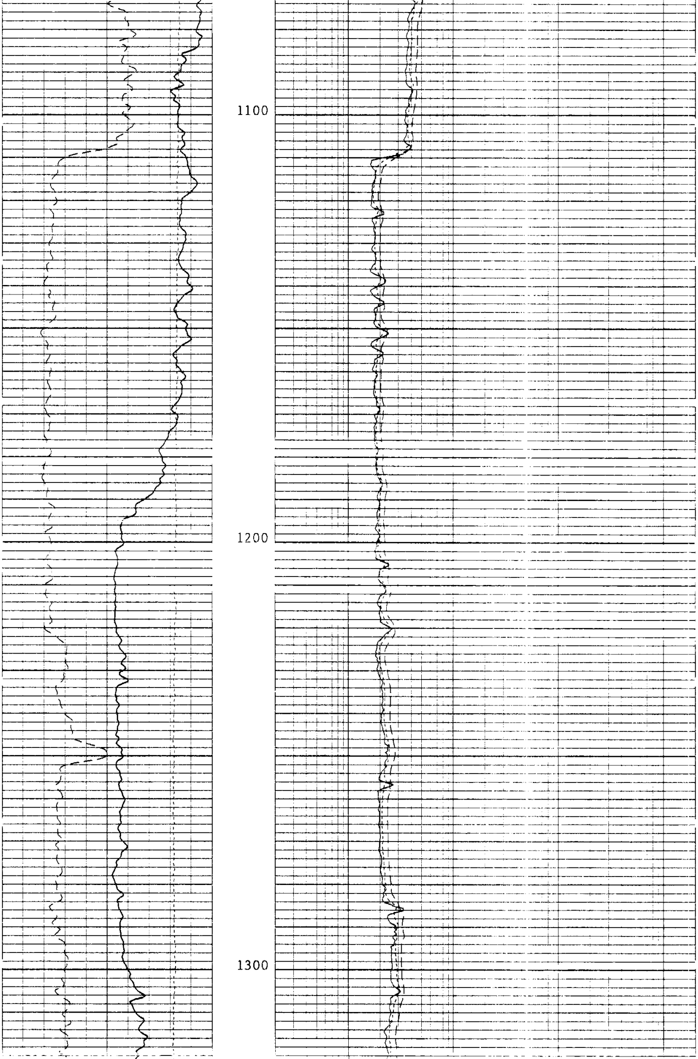


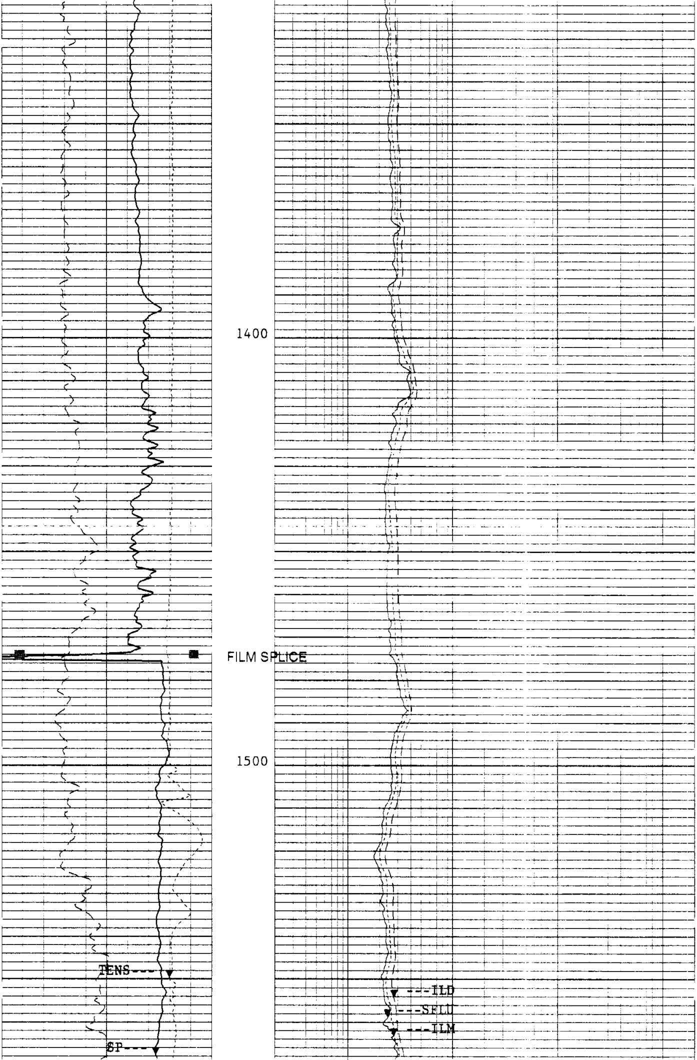


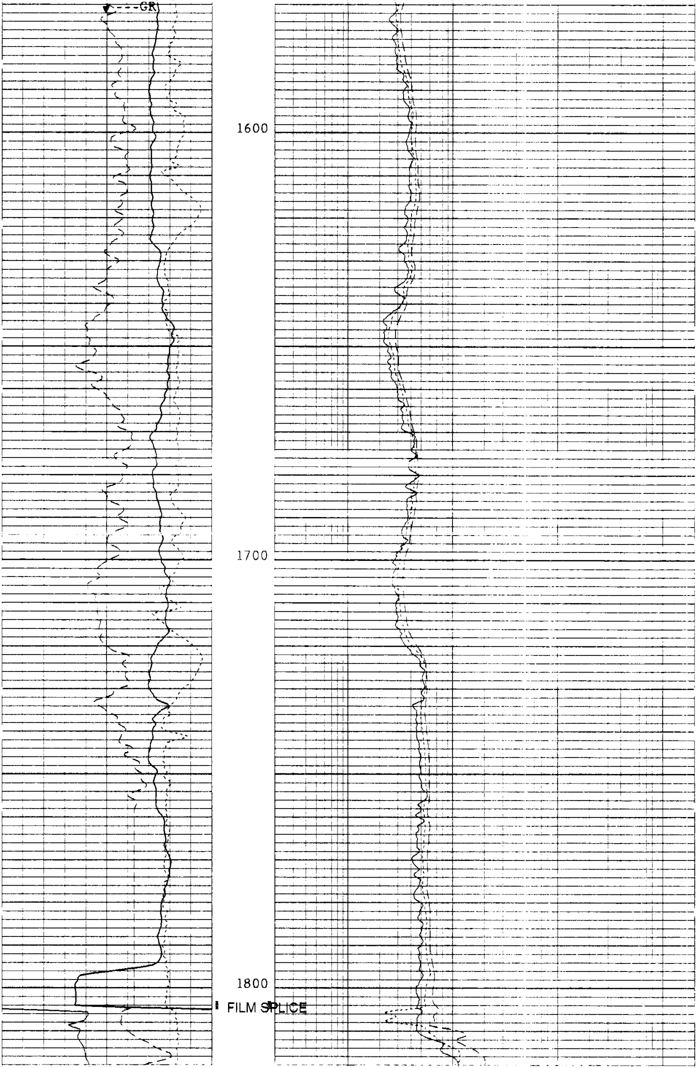


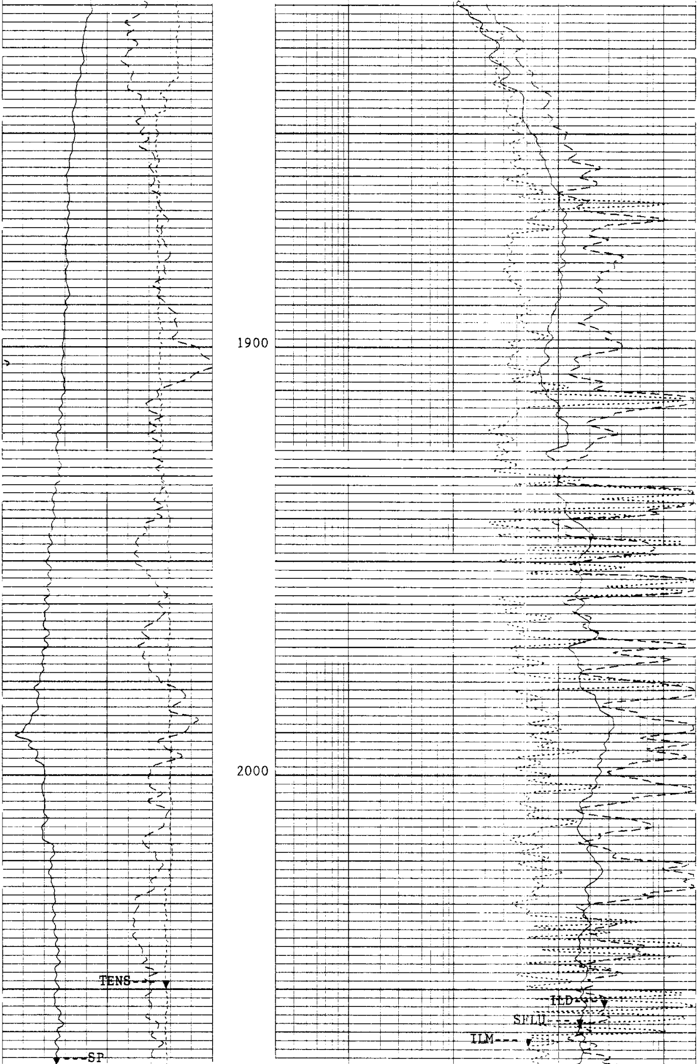


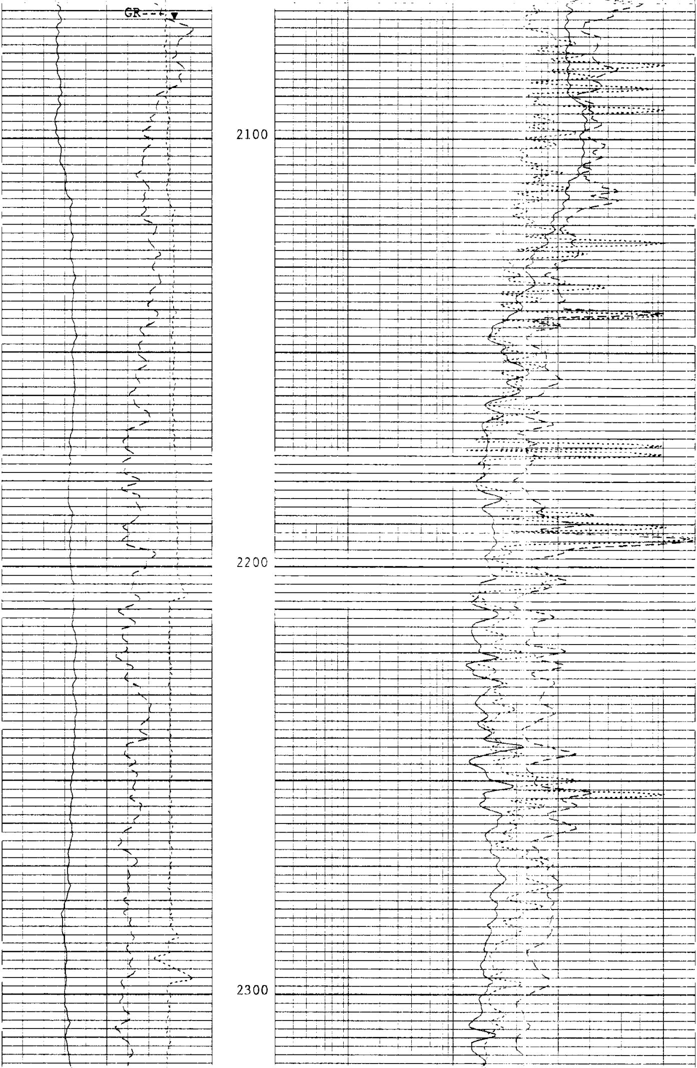


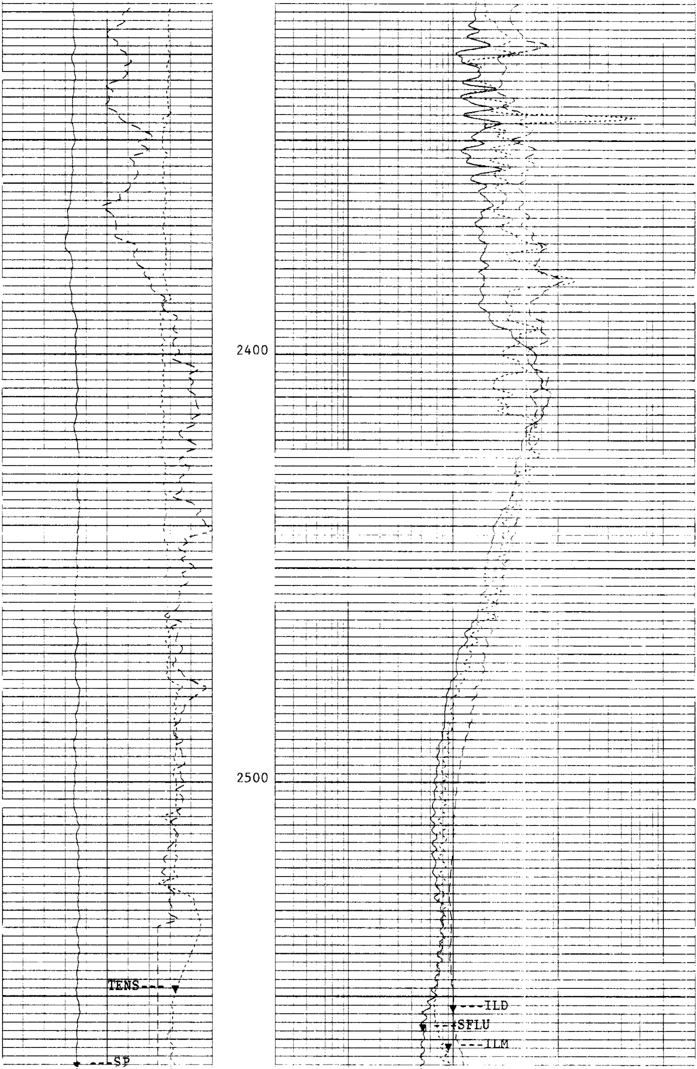


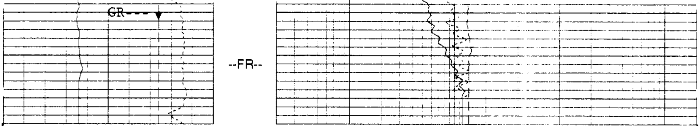












5"/100'

CP 44.2 FILE 115 02-DEC-1997 14:31

INPUT FILE(S) CREATION DATE
9 02-DEC-1997 12:54

TENS(LBF)	10000.	0.0	ILD(OHMM)	.20000	2000.0
SP(MV)	-50.00	50.000	SFLU(OHMM)	.20000	2000.0
GR(GAPI)	0.0	150.00	ILM(OHMM)	.20000	2000.0

SENSOR MEASURE POINT TO TOOL ZERO

MTEM	71.8	FEET	SP	10.3	FEET
GR	62.6	FEET	MRES	71.8	FEET
SRAT	39.1	FEET	AMPL	41.6	FEET
TT1	40.6	FEET	CBL	41.6	FEET
TT3	37.8	FEET	TT2	41.6	FEET
TO	41.6	FEET	TT4	36.8	FEET
TTSL	41.6	FEET	TT	41.6	FEET
IXM	6.0	FEET	CBSL	41.6	FEET
IXD	9.5	FEET	IRM	6.0	FEET
SPA	10.3	FEET	ITEM	6.5	FEET
SFC	6.5	FEET	SFB	6.5	FEET
IRD	9.5	FEET	SFV	6.5	FEET
HTEN	0.0	FEET	TENS	0.0	FEET
NOIS	0.0	FEET			

PARAMETERS

NAME	VALUE	UNIT	NAME	VALUE	UNIT
SMB	DISA		VDLR	2IN	
TOCA	DISA		RATE	15	HZ
DG	AUTO		DETE	E2	
NMSG	180	US	CBLG	35	US
AMPL	2		CBL	2	
WFM	1		SS	FAST	
TOD	DISA		SLC	UA	
DTF	189.000	US/F	DTM	56.0000	US/F
CDTS	100.000		SPFS	R-H	
PP	NORM		DO	3.00000	F
WMUD	8.60000	LB/G	TD	32768.0	F
IFRS	20	KHZ	SBR	1.00000	OHMM
MXE2	39.0062	MM/M	DXE2	124.493	MM/M
MRE2	17.0971	MM/M	DRE2	11.5626	MM/M
MPH2	-1.08185	DEG	DPH2	-.001757	DEG
MGF2	1.05831		DGF2	1.00935	
DESP	DISA		SFLE	ALLO	
DCAS	-50000.0	F	ITEN	ALLO	
DEVI	85.0000	DEG	DSES	H48	
IPRO	STAN		IPHA	NORM	
DWCO	512		DSIN	5	US
DDEL	200	US	NCJT	GSRY	
GTSE	TEMP		SHT	45.0000	DEGF
BHT	85.0000	DEGF	DTCI	0.0	F
SPAE	DISA		BS	7.87500	IN
BHS	OPEN				

REPEAT SECTION

ACCUMULATED INTEGRATION VALUES SUMMARY:

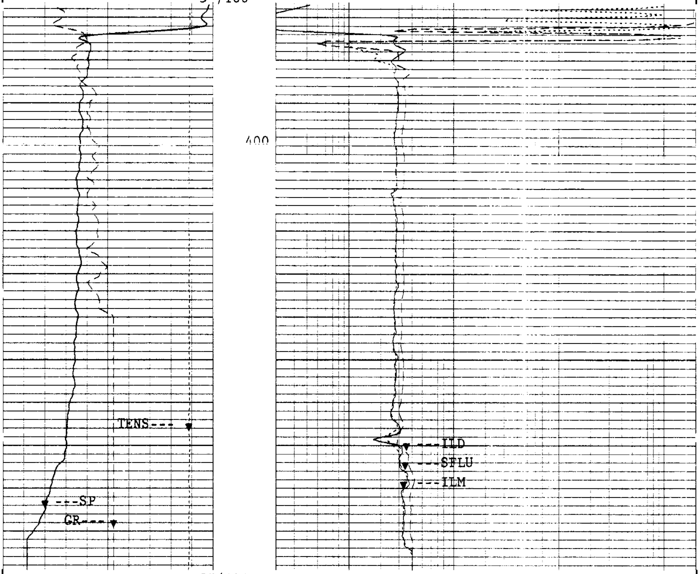
Integrated Transit Time: .0193556 S FROM 498.500 F TO 366.500 F

Curve	Left	Right
TENS(LBF)	10000.	0.0
SP(MV)	-50.00	50.000
GR(GAPI)	0.0	150.00
ILD(OHMM)	.20000	2000.0
SFLU(OHMM)	.20000	2000.0
ILM(OHMM)	.20000	2000.0

CP 44.2 FILE 1 25-NOV-1997 20:12

INPUT FILE(S) CREATION DATE
87 25-NOV-1997 03:35

5"/100'



5"/100'

CP 44.2 FILE 1 25-NOV-1997 20:11

INPUT FILE(S) CREATION DATE
87 25-NOV-1997 03:35

TENS(LBF)		ILD(OHMM)	
10000.	0.0	.20000	2000.0
SP(MV)		SFLU(OHMM)	
-50.00	50.000	.20000	2000.0
GR(GAPI)		ILM(OHMM)	
0.0	150.00	.20000	2000.0

SENSOR MEASURE POINT TO TOOL ZERO

```
DITE 10.3   FEET                            SGTL 62.6   FEET
AMS  71.8   FEET                            DTT   3.0   FEET
SLTT 41.6   FEET
```

PARAMETERS

```
NAME  VALUE        UNIT               NAME  VALUE        UNIT

SMB   DISA                            VDLR  2IN
TOCA  DISA                            RATE  15           HZ
DG    AUTO                            DETE  E2
NMSG  180          US                 CBLG  35           US
AMPL  2                               CBL   2
WFM   1                               SS    FAST
TOD   DISA                            SLC   UA
DTF   189.000      US/F               DTM   56.0000      US/F
CDTS  100.000                         SPFS  R-H
PP    NORM                            DO    0.0          F
WMUD  10.0000      LB/G               TD    32768.0      F
IFRS  20           KHZ                SBR   1.00000      OHMM
MXE2  39.0062      MM/M               DXE2  124.493      MM/M
MRE2  17.0971      MM/M               DRE2  11.5626      MM/M
MPH2  -1.08185     DEG                DPH2  -.001757     DEG
MGF2  1.05831                         DGF2  1.00935
DESP  DISA                            SFLE  ALLO
DCAS  -50000.0     F                  ITEN  ALLO
DEVI  0.0          DEG                DSFS  H48
IPRO  STAN                            IPHA  NORM
DWCO  512                             DSIN  5            US
DDEL  200          US                 NCJT  GSRY
GTSE  TEMP                            SHT   45.0000      DEGF
BHT   85.0000      DEGF               DICI  0.0          F
SPAE  DISA                            BS    12.2500      IN
BHS   OPEN
```

CALIBRATIONS

BEFORE SURVEY CALIBRATION Summary

```
  Performed:    02-DEC-1997 12:54
  Program File: TOH     (Version     44.2     95/07/25   95/07/25)


SGTL            Detector Calibration Summary

             MEASURED
           BKGD     JIG          CALIBRATED          UNITS
    GR      35      192             165              GAPI

Back: 29-AUG-1997 10:04   Jig: 29-AUG-1997 10:08   Comp: 29-AUG-1997 10:08


DITE            Electronics Calibration Summary

Sonde SN#: 151
Cartridge SN#: 159
Induction Freq: 20  KHz

Induction Electronics:

      Offset   Valid Range     Gain  Valid Range      Phase   Valid Range
      (MM/M )    (MM/M )       (--)     (---)         (DEG.)    (DEG.)
```

```
  IRD    7.9 -117. => 133.     .986    .84 => 1.18
  IXD   20.0 -105. => 145.     .993    .84 => 1.19     8.64  -5.89 => 24.11
  IRM   26.1 -199. => 251.     .999    .85 => 1.20
  IXM     .3 -224. => 226.     .959    .81 => 1.15     8.11  -6.49 => 23.51

SFL Electronics:

       Offset  Valid Range    Units      Gain   Valid Range

  SFV     .5  -14.5 => 15.5   MV          .99   .84 => 1.19
  SFC    -.0     -.6 =>   .6   MA          .99   .84 => 1.18

Plus Measurement performed at: 02-DEC-1997 12:53

Shop cals used were performed: 29-AUG-1997 11:39

   CP 44.2          FILE    8      02-DEC-1997 12:53
```

```
                SHOP Summary


  Performed:     20-OCT-1997 09:46
  Program File: CCSHOP (Version     44.2    95/07/25  95/07/25)


DITE            Calibration Summary

Sonde Serial Number: 151
Cartridge Serial Number: 159


                        SHOP CONSTANTS

Test Loop Calibration:  Calibration of internal reference
                        to test loop standard


        Cons.   Gain      Valid Range       Cons.   Phase   Valid Range
                (---)       (---)                   ( DEG )   ( DEG )

10KHz:
  ILD:  DGF1     .999    .900 => 1.100    DPH1       .15  -1.50 =>  1.50
  ILM:  MGF1    1.054    .900 => 1.100    MPH1      -.32  -1.50 =>  1.50

20KHz:
  ILD:  DGF2    1.009    .900 => 1.100    DPH2      -.00  -2.00 =>  2.00
  ILM:  MGF2    1.058    .900 => 1.100    MPH2     -1.08  -3.00 =>  1.00

40KHz:
  ILD:  DGF4    1.023    .900 => 1.100    DPH4     -1.09  -4.00 =>  2.00
  ILM:  MGF4    1.083    .900 => 1.100    MPH4     -2.65  -5.00 =>  1.00


Sonde Error Corrections:  Correction for sonde response in Zero
                          Conductivity Environments

            Cons.  Sonde Error    Valid Range
                   Correction
                    (MM/M )        (MM/M )

10KHz:
  IRD SEC:  DRE1      31.60      -50.0 => 125.0
  IXD SEC:  DXE1     221.33     -250.0 => 350.0
  IRM SEC:  MRE1      63.89      -50.0 => 140.0
  IXM SEC:  MXE1      27.25    -1300.0 =>1300.0
```

```
20KHz:
  IRD SEC:  DRE2       11.56      -30.0 =>  30.0
  IXD SEC:  DXE2      124.49     -125.0 => 200.0
  IRM SEC:  MRE2       17.10      -50.0 =>  50.0
  IXM SEC:  MXE2       39.01     -650.0 => 650.0

40KHz:
  IRD SEC:  DRE4        1.24      -15.0 =>  15.0
  IXD SEC:  DXE4       79.27      -75.0 => 125.0
  IRM SEC:  MRE4        3.45      -30.0 =>  30.0
  IXM SEC:  MXE4       46.63     -350.0 => 350.0


NOTE: All Sonde Error Corrections have been normalized to 25 DegC.


               Shop Electronic Calibration Summary

Electronic Calibration:  Calibration of System Electronics
                         using the internal reference

Induction Electronics:

      Offset    Valid Range     Gain  Valid Range     Phase   Valid Range
      (MM/M )    (MM/M )        (--)     (---)        (DEG.)    (DEG.)

10 KHz:
  IRD    20.1 -375. => 375.     .936    .75 => 1.25
  IXD    47.4 -375. => 375.     .942    .75 => 1.25    10.99   -5.00 => 20.00
  IRM    64.2 -900. => 900.     .954    .75 => 1.25
  IXM     1.5 -900. => 900.     .917    .75 => 1.25     8.98   -5.00 => 20.00

20 KHz:
  IRD     8.0 -150. => 150.     .983    .75 => 1.25
  IXD    19.6 -150. => 150.     .989    .75 => 1.25     9.11   -5.00 => 20.00
  IRM    26.2 -350. => 350.     .997    .75 => 1.25
  IXM      .7 -350. => 350.     .958    .75 => 1.25     8.51   -5.00 => 20.00

40 KHz:
  IRD     5.2 -100. => 100.     .979    .75 => 1.25
  IXD    13.1 -100. => 100.     .984    .75 => 1.25    24.78 -10.00 => 35.00
  IRM    17.0 -200. => 200.    1.003    .75 => 1.25
  IXM      .5 -200. => 200.     .964    .75 => 1.25    25.13 -10.00 => 35.00

SFL Electronics:

       Offset  Valid Range    Units      Gain   Valid Range

  SFV     .5   -16.0 => 16.0    MV         .988   .75 => 1.25
  SFC    -.0     -.7 =>   .7    MA         .987   .75 => 1.25


DITE            Electronics Calibration Summary

Sonde SN#: 151
Cartridge SN#: 159
Induction Freq: 20  KHz

Induction Electronics:

      Offset    Valid Range     Gain  Valid Range     Phase   Valid Range
      (MM/M )    (MM/M )        (--)     (---)        (DEG.)    (DEG.)

  IRD     8.0 -117. => 133.     .982    .84 => 1.18
  IXD    19.6 -105. => 145.     .988    .84 => 1.19     9.13   -5.89 => 24.11
  IRM    26.2 -199. => 251.     .995    .85 => 1.20
  IXM      .7 -224. => 226.     .956    .81 => 1.15     8.57   -6.49 => 23.51

SFL Electronics:

       Offset  Valid Range    Units      Gain   Valid Range

  SFV     .5   -14.5 => 15.5    MV         .99   .84 => 1.19
  SFC    -.0     -.6 =>   .6    MA         .99   .84 => 1.18

   CP 44.2           FILE    0       20-OCT-1997 09:45



                SHOP Summary
```

```
  Performed:    12-AUG-1997 11:13
  Program File: CCSHOP (Version    44.2    95/07/25  95/07/25)


CNTH            Detector Calibration Summary

      CNC #                 : 4431
      Neutron Source #      : 2576
      Thermal Housing #     : 4431
      Alpha detectors       : Yes

          Input     Plus      Shop    Gain     Shop
                 Reference    Tank             Bkg
                   Counts    Counts           Counts

          CNTC    6031.00   5998.75   1.005    24.754
          CFTC    2793.00   2640.31   1.058    30.245

          RATIO     2.159     2.272

          Shop Counts temperature and housing size corrected

Shop Tank Calibration done: 12-AUG-1997 11:13

   CP 44.2            FILE     0       12-AUG-1997 11:13



                SHOP Summary


  Performed:    12-AUG-1997 14:06
  Program File: CCSHOP (Version    44.2    95/07/25  95/07/25)


LDTD            Detector Calibration Summary

        Density Resistivity Sonde Number     :  4768
        Nuclear Service Cartridge Number     :  2979
        Powered Detector Housing Number      :  1989
        Powered Gamma-Gamma Detector Number :  1989
        LDT Logging Source Number            :  1925
        LDT Calibration Mode                 :  WATE

                     Master Calibrated
                    Bkgd   Al+Fe     Al   Units
              LL    19.9    91.5   100.0   CPS
              LU    76.0   137.2   150.3   CPS
              LS    58.0   160.1   175.1   CPS
            LITH     5.6    42.3    66.5   CPS
             SS1    18.2   174.5   191.0   CPS
             SS2    12.4   250.6   271.1   CPS

          HV Settings          Detector Resolutions
        HV LS:  1230.1 V             LS:  8.7 %
        HV SS:  1201.1 V             SS:  8.7 %

                  Spectrum Quality Ratios
          Computed Value       Nominal Value    Tolerance
   QRLS           .666                 0.65        +/- 0.05
   QRSS           .704                 0.72        +/- 0.10
   QRLI           .380                 0.39        +/- 0.06
   QLIR          1.436                 1.39        +/- 0.06
   QR            1.000                 1.00        +/- 0.02

Shop Block Calibration done: 12-AUG-1997 13:57

   CP 44.2            FILE     0       12-AUG-1997 14:06
```

COMPANY NORTHWEST NATURAL GAS CO.

WELL IW 32-22-65

FIELD MIST GAS STORAGE

COUNTY: COLUMBIA **STATE:** OREGON

SCHL.	**FR**	2590.0 F
SCHL.	**TD**	2590.0 F
DRLR.	**TD**	2600.0 F
Elev:	**KB**	838.1 F
	DF	
	GL	822.1 F

Schlumberger

DUAL INDUCTION GAMMA RAY / SP 5"