PL 115
EXPLORATION WELL RÉSUMÉ
9/3-1

NSEP 87-09
FEBRUARY 1987

A/s Norske Shell

A/S NORSKE SHELL

WELL RESUME 9/3-1

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EXPLORATION WELL RESUME

Well 9/3-1

A/S Norske Shell, Risavika
February, 1987

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1. GENERAL INTRODUCTION

On 6th September, 1985, Norske Shell was awarded a 30% interest in, and the operatorship of Licence PL 115, with partners Statoil (50%), Tenneco (15%) and DNO (5%). Licence PL 115, covering the whole of Block 9/3, was awarded in Phase A of the 10th Concession Round.

Well 9/3-1 was drilled to a TD of 1971.5 m in Triassic red-beds of the Skagerak Formation, lying immediately beneath the target Middle Jurassic reservoir sands of the Sandnes and Bryne Formations. The well was plugged and abandoned as a dry hole on 4 September 1986, having failed to find any significant indications of hydrocarbons, but having satisfied the one well drilling commitment of the licence.

Well 9/3-1

Summary of Well Data:

Well Classification:	Exploration
Location Coordinates:	N 57° 49' 45.19"
(Final)	E 04° 45' 58.38"
Water Depth:	99 m
Derrick Floor Elevation:	25 m
Contractor, Rig:	Dolphin Drilling A/S, Borgny Dolphin
BOP-Stack:	10,000 psi, 18 3/4"
Mudlogging Contractor:	Gearhart Geodata Services Ltd.
Start of Operations:	22.07.86
Spudded:	29.07.86
Completed:	06.09.86
Objectives:	To test sandstones in the Middle Jurassic Vestland Group (Sandnes and Bryne Formations) in a salt-induced domal trap developed at the edge of the Stavanger Platform.
Total depth:	1972 m (bdf)
Formation at TD:	Triassic red-beds.
Results:	No hydrocarbons were encountered.
Total costs estimate:	49,161,000 NOK
Present status:	Plugged and abandoned as a dry hole.

Logs:	ISF/LSS/GR	
	LDL/CNL/GR	
	SHDT/GR	
	SWS	
	DIL/LSS/GR	
	LDL/CNL/NGL	
	DLL/MSFL/GR	
	RFT	
	CBL/VDL	
Cored Intervals:	1798 - 1814 m	
Sidewall Samples:	Attempted:	90
	Recovered:	70 (78%)
Casing Record:	30"	205 m
	20"	528 m
	13 3/8"	1349 m

2. SITE SURVEY REPORT

2.1 Introduction

A/S Norske Shell commissioned A/S Geoteam to conduct a rig site survey at location 9/3-A. Field work was carried out with M/V "GeoScanner" between 10 and 29 December 1985.

The purpose of the survey was to obtain bathymetric information and to detect any seabed obstructions or potential sub-seabed hazards to drilling operations by a semi-submersible drill rig.

Echo-sounder and side-scan sonar equipment were used to map bathymetry and seabed features. A deep towed sparker and an analogue sparker were used to investigate the shallow strata. Digitally recorded multi-channel airgun data were used to investigate the deeper strata and to map the presence of any shallow gas pockets.

2.2 Survey Programme

The site survey area was covered by 28 NNW-SSE and 12 WNW-ENE profiles, utilizing echo-sounder, side-scan sonar, deep towed sparker and analogue sparker. The four outer NNW-SSE profiles on each side were spaced 200 metres apart, while the rest of the profiles in the same direction were spaced 175 m apart. The line lengths were 5.5 km, except for two profiles with lengths of 4 km and 2.5 km respectively. The WNW-ESE profiles were spaced 500 metres apart with lengths of 4.5 km.

Twentyfour highresolution seismic profiles were shot with digital equipment. Sixteen lines were aligned in the NNW-SSE direction and eight in the WSW-ENE direction. The line lengths varied from 4.5 to 9 km. The central lines in the NNW-SSE direction were spaced from 250 to 500 metres apart. The profiles shot in the WSW-ENE direction were spaced 300 metres apart.

For the purpose of the site survey, seven central NNW-SSE lines with lengths reduced to 4 km were processed, as well as eight central WSW-ENE lines with lengths reduced to 2 km.

2.3 Summary

Survey target position:	Latitude N 57^{o} 49' 36"	
	Longitude E 04^{o} 46' 30.8"	
Water depth:	99 metres	
Seabed slope:	Negligible	
Seabed condition:	Sandy top layer	
Seabed hazards:	None	
Sub-seabed conditions:	98-118 m	Sand layer
	118-165 m	Interlayered sand and clay
	165-190 m	Stiff glaciomarine clay
	190-195 m	Interlayered sand and clay Coarser material at the base
	195-221 m	Claystone
	221-250 m	Sandstone layer
	250-428 m	Claystone
	428-483 m	Sandstone
	483- ? m	Claystone
Drilling hazards:	Possibility of boulders occurring at and just above the erosion surface at 195 m. Potentially gas charged sandstone layers at 221 and 428 m.	

In the event, no shallow gas problems were encountered.

SURVEY REPORT
FOR
A/S NORSKE SHELL

NAVIGATION AND POSITIONING OF
DRILLING RIG "BORGNY DOLPHIN" AT
WELL LOCATION 9/3-C.

RSN REF 1917 (Rev. O)

Prepared by:
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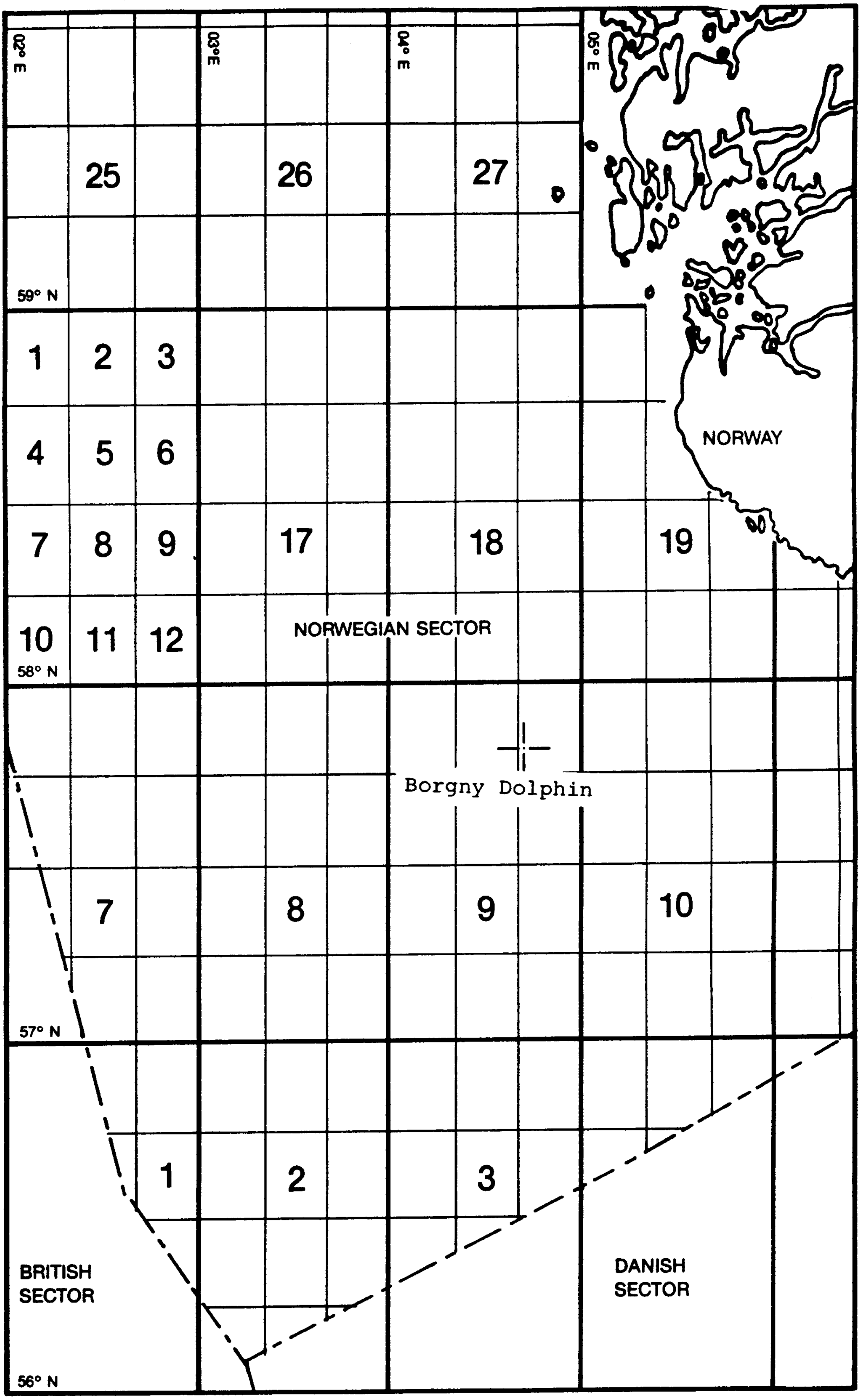
DAMSGÅRDSGATEN 167
5031 LAKSEVÅG

RACAL

REPORT CONTENTS

LOCATION MAP



1. ABSTRACT

This report describes the positioning services provided by Racal Survey Norge A/S to A/S Norske Shell, during the period 26 July to 5 August 1986, for the positioning of the Drilling Rig "Borgny Dolphin" at well location 9/3-C in the Norwegian sector of the North Sea (Ref. Location Map).

The final position of the "Borgny Dolphin's" well centre was obtained by a transit satellite translocation between the drilling rig and the first order geodetic point at Eigeberg, near Sola. The results of this are given below:

Latitude	: 57 deg. 49′ 45.19" N
Longitude	: 04 deg. 45′ 58.38 E (ED-1950)
Rig Heading	: 314 deg. (True)
No. of simultaneous passes:	32

This position is 12.5 m on a bearing of 146.3 deg (true) from the intended location.

Note: The rig moved after the Pulse/8 equipment had been demobilized therefore the above position does not correspond to the Pulse/8 position given in this report.

Bergen, 18 August 1986
RACAL SURVEY NORGE A/S

John A Vint

John A. Vint
STAFF/QC SURVEYOR

2. REQUIREMENTS

The requirements for this project were stated in contract number C86084 between A/S Norske Shell and Racal Survey Norge A/S, and can be summarised as follows:

1. To navigate the drilling rig "Borgny Dolphin" to well location 9/3-C using Pulse/8.

2. To position the "Borgny Dolphin" at well location 9/3-C using Pulse/8, the intended position being given as follows:

   Latitude : 57 deg. 49′ 45.52" N (ED-1950)
   Longitude: 04 deg. 45′ 57.96" E

3. To derive the position of the well centre by satellite translocation between the rig and the first order geodetic point at Eigeberg.

3. NAVIGATION PROCEDURE

Upon arrival on the rig, the Racal Survey personnel reported to the Clients Rep. at which time a discussion took place as to how the rig would leave its present location and move onto the next location. On completion of this discussion, all the navigation equipment was set up and check fixes taken before leaving location. The rig position was monitored during the recovery of anchors and the tow to the next location.

The final positioning at the intended location was carried out using Pulse/8 and the position was continuously monitored during the anchor running. Once the anchors had been run and tensioned, the JMR-4 receivers on board the rig and at Eigeberg were initiatized in the 3D survey mode, for the translocation.

Once the translocation had began, position data from Pulse/8 was logged for post-processing upon return of the data to the office in Bergen. After all the Pulse/8 equipment had been demobilized, the Rig moved, and therefore there is no Pulse/8 position for the final location.

Once enough data had been collected to compute the translocation, instructions were given to demobilize all the JMR equipment.

4. SPHEROID AND PROJECTION DATA

4.1 Spheroid Constants

Throughout this report, geographical coordinates are quoted in one of two datums, WGS72 the Transit satellite datum, and European Datum 1950 (ED-1950). Due to this, each set of geopraphical coordinates in this report will be annotated with the correct datum. The constants for these datums are listed below:

Constant	WGS72	ED-1950
Semi-major axis (a)	6 378 135.000	6 378 388.000
Semi-minor axis (b)	6 356 750.520	6 356 911.946
Eccentricity Squared	0.006 694 318	0.006 722 670
Reciprocal Flattening	298.26	297.00

4.2 Projection Constants

All the grid coordinates in this report are in terms of the Universal Transverse Mercator (UTM) Projection on the ED-1950 Geodetic Datum. The constants for this are listed below:

Zone	31
Central Meridian (CM)	3 deg. East
Latitude of Origin	0 deg. North
False Easting	500 000 m
False Northing	0 m
Scale Factor on CM	0.9996

5. RADIO NAVIGATION POSITION FIX COMPUTATIONS

5.1 Pulse/8 Computations

The primary positioning system for the positioning of the "Borgny Dolphin" at well location 9/3-C was Pulse/8 (Ref. Appendix VI for chain and coordinate data). The coordinates of this location were supplied by Norske Shell, and are as follows:

Latitude : 57 deg. 49′ 45.52" N (ED-1950)
Longitude: 04 deg. 45′ 57.96" E

Which convert to the following UTM grid coordinates:

Easting : 604 887 m (Zone 31, CM 3 deg. East,
Northing : 6 411 221 m ED-1950).

During the positioning of the "Borgny Dolphin" at this location, Pulse/8 patterns 1-2, 1-3, and 1-5 in the Southern North Sea chain were used, and have the following configuration:

1 Microsecond time difference is equivalent to:
Pattern 1-2 : 206 metres
Pattern 1-3 : 167 metres
Pattern 1-5 : 273 metres

Direction of patterns:
Pattern 1-2 : 133 deg.
Pattern 1-3 : 203 deg.
Pattern 1-5 : 054 deg.

In order to correct for systematic biases in the observed pattern data the following (C-O) values, supplied by Norske Shell, were applied to the raw observed pattern readings before any position fix computations were carried out:

Pattern 1-2 : +.07 microsecond
Pattern 1-3 : -.21 microsecond
Pattern 1-5 : -.11 microsecond

Once the rig was on location with the anchors fully tensioned, a set of 1000 Pulse/8 pattern readings were logged during the period 1031 hours and 1131 hours on 29 July 1986.

On completion of the logging, the raw pattern readings were listed and any erroneous data edited. This resulted in the following number of pattern readings being used in the final Pulse/8 solution:

Pattern 1-2 : 1000 readings
Pattern 1-3 : 1000 readings
Pattern 1-5 : 1000 readings

Plots of the Pulse/8 system performance, can be seen in Appendix II.

Therefore the data used in the final Pulse/8 position fix computation is listed below:

Pattern	Mean Observed	(C-O)	Corrected Observed	Weight	Residuals in Metres
1-2	11191.76	+0.07	11191.83	1.76	+ 5
1-3	25797.03	-0.21	25796.82	2.66	- 7
1-5	50557.20	-0.11	50557.09	1.00	+17

The above data was then entered into an offline "least squares" program on the GNS26 computer system and the following coordinates obtained for the Pulse/8 antenna position:

Easting : 604 879 m (Zone 31, CM 3 deg. East,
Northing: 6 411 260 m ED-1950).

By applying the offset corrections given in Appendix VI the following position for the rig's derrick centre was obtained:

Easting : 604 893 m (Zone 31, CM 3 deg. East,
Northing: 6 411 226 m ED-1950).

These convert to geographical coordinates of:

Latitude : 57 deg. 49′ 45.7" N (ED-1950)
Longitude: 04 deg. 45′ 58.3" E

This position is 8 m on a bearing 52 deg. (true) from the intended position.

5.2 Accuracy Considerations

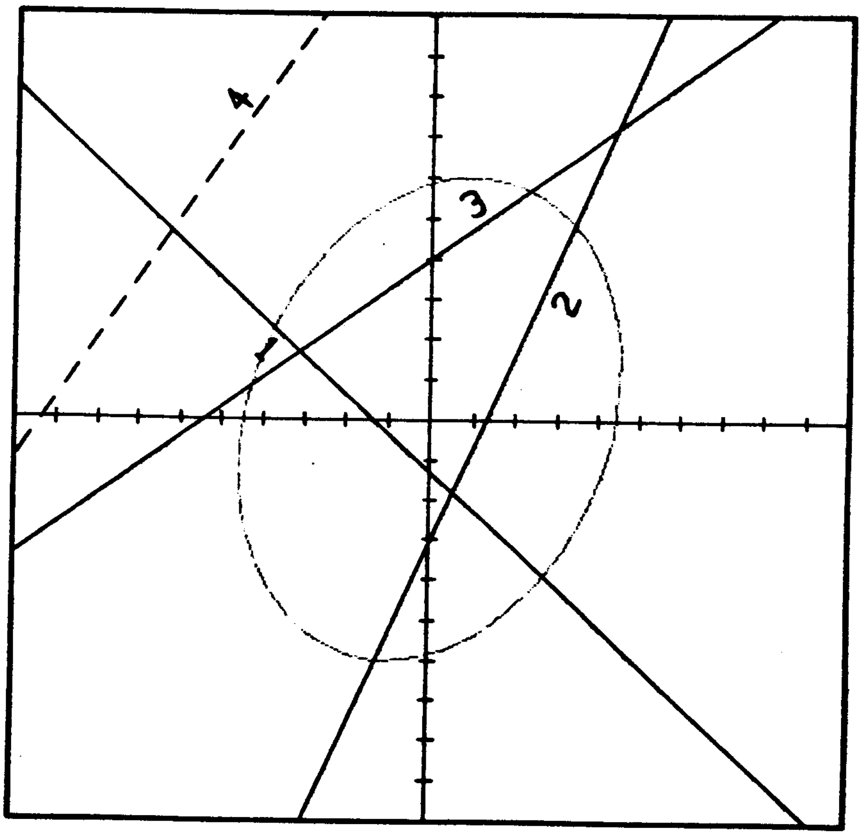
The theoretical error elipse for a Pulse/8 position fix at the final location is shown below, along with the lines of position of the final pattern readings. The details of the elipse are as follows:

Semi-major axis	30.8m
Semi-minor axis	19.0m
Orientation	018.9 deg (grid)

Hence based on a pattern standard deviation of 0.10 micro-seconds we would estimate the repeatable accuracy of the chain to be 24.9 m at this point.

The absolute accuracy is totally dependant upon the C-O values applied.

LOP	PATT.
1	1-2
2	1-3
3	1-5
4	1-4



Grid Tick=5 M

6. TRANSIT SATELLITE TRANSLOCATION POSITION FIX COMPUTATIONS

6.1 Observations

The satellite observations on the "Borgny Dolphin" began once the rig was in its final position, but after five days due to drilling difficulties the rig had to move and the translocation was restarted. A total of 52 single point passes were recorded by the JMR-4 Satellite Receiver onboard the rig between 1934 hours on 01 August and 1440 hours on 05 August 1986. This gives an average of one single point pass every 105 minutes.

A second JMR-4 satellite receiver was placed on the first order geodetic point at Eigeberg. The coordinates of this point were supplied by Statens Kartverk as:

Latitude	: 58 deg. 51′ 04.4390" N	(ED-1950)
Longitude	: 05 deg. 35′ 14.1342" E	
Ellipsoidal Height:	98.04 m (above NN54)	

Statens Kartverk have also supplied a geoid/spheriod separation value of 6.70 m for Eigeberg and the height of the antenna electrical centre above the monument was measured to be 0.43 m. Therefore an elipsoidal height of 105.17 m was used for the translocation.

A total of 47 single point passes were recorded by the JMR-4 Satellite Receiver at Eigeberg between 2026 hours on 01 August and 1704 hours on 05 August 1986. This gives an average of one single point pass every 118 minutes.

From all these passes, a total of 37 were observed simultaneously at both sites.

6.2 Datum Change

The computation of the recorded satellite data was carried out in the Satellite Geodetic System (WGS72) and the translocated position derived therefore refers to this datum. As the final coordinates for the rig are required in ED-1950 a transformation must be applied to convert the coordinates from WGS72 to ED-1950.

The parameters used are those recommended during a meeting of the National Survey Organisations with concessionary interests in the North Sea (Ref. Ordnance Survey Professional Paper No. 30). These are applicable to the European Continental Shelf North of latitude 47 deg. N and to the North Sea south of latitude 64 deg. N, and are as follows:

DX + 83.0 m
DY + 110.0 m
DZ + 118.0 m

Note: The above parameters are to convert from Cartesian Coordinates (WGS72) to Cartesian Coordinates (ED-1950). To convert from ED-1950 to WGS72, the mathematical sign of all the parameters must be changed.

6.3 Processing

During the field operations, all the raw satellite data was recorded on magnetic tapes by the JMR-4 satellite receivers. This information was then analized and reprocessed by Racal Survey Norge in Bergen using a satellite processing package designed by EDO of Canada to run on an IBM personal computer (Ref. Appendix III).

For the data collected at both sites, a total of 37 passes were observed simultaneously of which 32 were accepted by the translocation solution. The balance of these passes is shown below:

Site	North	South	East	West	Total
Eigeberg	10	22	13	19	32
Borgny Dolphin	10	22	13	19	32

Each pass taken into the solution also had a minimum of 12, 30 second doppler counts with a moderate or good signal strength. The program was set to reject doppler counts with a weak signal strength (a full listing of the initialization parameters can be seen in Appendix III).

The quality of data collected in a translocation is normally characterized by the Root Mean Square (RMS) value of the scatter of the doppler counts for any particular pass. During this translocation the data collected at Eigeberg was very good, and was reflected by a mean RMS value for that site of 0.24 m which is less than the expected RMS value of 0.25 m for data collected on land. The data collected on the "Borgny Dolphin" was also good, and the mean RMS value was 0.55 m, which is only slightly higher than the expected value of about 0.50 m for data collected an a semi-submersible drilling rig.

Despite the slightly larger than usual doppler RMS value on the "Borgny Dolphin" the one sigma values in position were still very good:

Latitude : 0.28 m
Longitude : 0.51 m
Height : 0.36 m

This gave a resulting one sigma value for the horizontal position of 0.58 m. In addition to this, the statistical results were also very good. The variance factor for the adjustment was 1.03, which indicates a good, well balanced and correctly weighted adjustment (for a perfect adjustment the variance factor would be 1.00) and there were 1218 degrees of freedom (redundant doppler counts). The full final adjustment output can be seen in Appendix III.

6.4 Results and Reduction to Well Centre.

The coordinates of the reference point antenna are as follows:

Latitude	: 58 deg. 51′ 04.4390" N	(REF. POINT
Longitude	: 05 deg. 35′ 14.1342" E	ED-1950)
Elipsoidal Height:	105.17 m	

By the application of the datum transformation parameters in section 6.2 the following differences were derived to transform the above coordinates to WGS72.

Delta Latitude : - 2.016"
Delta Longitude : - 6.323"
Delta Height : +36.73 m

This results in the following coordinates for the reference point:

Latitude	: 58 deg. 51′ 02.423" N	(REF. POINT
Longitude	: 05 deg. 35′ 07.811" E	WGS72)
Elipsoidal Height:	141.90 m	

The translocation program was then run with the above coordinates held fixed. This resulted in the following translocated position for the JMR-4 antenna on the "Borgny Dolphin":

Latitude	: 57 deg. 49′ 43.963" N	(RIG ANTENNA
Longitude	: 04 deg. 45′ 51.034" E	WGS72)
Elipsoidal Height:	65.21 m	

By application of the datum transformation parameters in Section 6.2, the following differences were derived:

Delta Latitude : +2.190"
Delta Longitude: +6.224"
Delta Height : -38.66 m

This results in the following coordinates for the antenna:

Latitude : 57 deg. 49′ 46.153" N (RIG ANTENNA
Longitude : 04 deg. 45′ 57.258" E ED-1950)
Elipsoidal Height: 26.55 m

which convert to the following UTM grid coordinates:

Easting : 604 874.96 m (Zone 31, CM 3 deg. East,
Northing: 6 411 240.17 m ED-1950).

By applying the offset corrections in Appendix VI, the following position was obtained for the well centre:

Easting : 604 894.2 m (Zone 31, CM 3 deg. East,
Northing: 6 411 210.8 m ED-1950).

This converts to the following geographical coordinate:

Latitude : 57 deg. 49′ 45.19" N (ED-1950)
Longitude: 04 deg. 45′ 58.38" E

This position is 12.5 m on a bearing 146.3 deg. (true) from the intended location.

The antenna height above the ED-1950 elipsoid was 26.55 metres and the distance from sea level to the antenna was measured to be 22.0 metres, thus the geoidal height at this point is 4.6 metres (Ref. Appendix V).

6.5 Accuracy Considerations

Considering the one sigma values, the mean doppler RMS values and the east/west balance of the passes, from the processing alongwith additional errors due to datum changes, we feel that the accuracy of the position of the JMR antenna on the "Borgny Dolphin" is within +/- 2m relative to the antenna position at Eigeberg. This is within the usual figure quoted for translocation in European area.

We also feel that errors in the rigs gyro compass and taped offsets to the well centre could contribute another error of upto +/- 1.5 m.

As the two errors are independant of each other, they can be combined by simple addition to give an estimated error for the "Borgny Dolphin"s well centre of +/- 3.5m.

7. COMPARISON BETWEEN POSITION FIX COMPUTATIONS.

7.1 Pulse/8 and Satellite Single Point Position

Due to the fact that the "Borgny Dolphin" moved once the Pulse/8 equipment was demobilized, the comparisons in this section to derive new C-O values have been made with a single point satellite solution taken before the move.

The Well Centre Position derived from 43 3D satellite passes, with an orientation of 312.5 deg. from grid north for the rig is:

Easting : 604 871 m (UTM Zone 31, CM 3 deg. East,
Northing: 6 411 193 m ED-1950)

The Well Centre Position derived by Pulse/8 using patterns 1-2, 1-3, and 1-5 in the Southern North Sea Chain, and with the same orientation as above is:

Easting : 604 893 m (UTM Zone 31, CM 3 deg. East,
Northing: 6 411 226 m ED-1950)

This gives a deviation of 40 metres on a bearing of 033 deg. (grid) from the satellite single point position to the Pulse/8 fixed position. This is represented diagrammatically along with the deviations from the intended location on the next page.

To enable a comparison to be made between the Pulse/8 (C-O) values used for navigation, and those values derived from the satellite single point fixed position, the position of the well centre derived by this method was converted to the Pulse/8 antenna position by applying the offsets shown in Appendix VI. These coordinates are as follows:

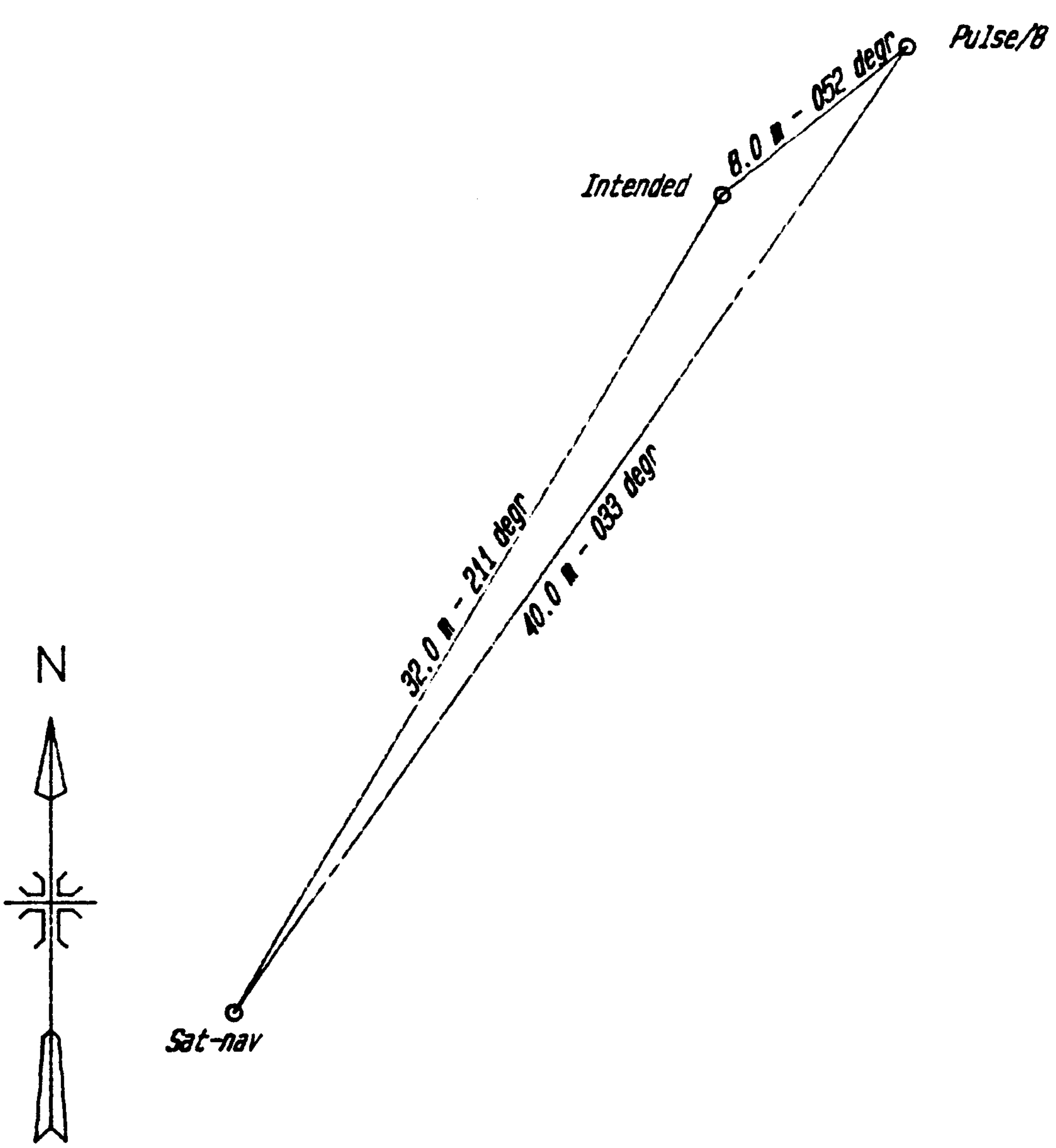
Easting : 604 857 m (UTM Zone 31, CM 3 deg. East,
Northing: 6 411 227 m ED-1950)

Pulse/8 pattern readings were then computed for this location and are as follows:

Pattern 1-2S : 11191.99
Pattern 1-3S : 25796.90
Pattern 1-4S : 38763.94
Pattern 1-5S : 50556.98

DEVIATION BETWEEN INTENDED POSITION
SATELLITE AND PULSE/8 POSITION

SCALE 1 : 250



Using the mean observed pattern values, new (C-O) values for this location can be established as follows:

Pattern	Computed	Observed	(C-O)
1-2	11191.99	11191.76	+0.23
1-3	25796.90	25797.03	-0.13
1-4	38763.94	38764.10	-0.16
1-5	50556.98	50557.20	-0.22

8. PERSONNEL AND EQUIPMENT

8.1 Personnel

The following personnel from Racal Survey Norge A/S were employed on this project:

BORGNY DOLPHIN
S. HØYDAL - Senior Positioning System Engineer
S. O. RUNDHOVDE - Senior Positioning System Engineer

EIGEBERG
J. STENBECK - Positioning System Engineer

8.2 Equipment

BORGNY DOLPHIN
2 x Pulse/8 Receivers c/w antennae and cables
2 x HP 9826 Computers
2 x HP 2673A Printers
2 x CD 233 Video Monitors
2 x HP 9121 Dual Disc Drives
2 x Racal 90180 Interfaces
1 x JMR-4 Satellite Receiver c/w antenna and cables.

EIGEBERG
1 x JMR-4 Satellite Receiver c/w antenna and cables.

Appendix I

SUMMARY OF EVENTS

SUMMARY OF EVENTS

Date	Time	Event
26.07.86	1245	Personnel and equipment departed from Flesland
	1330	Personnel and equipment arrived at "Borgny Dolphin".
	1400	Began mobilization of equipment
	1600	Equipment mobilized
27.07.86		Rig was in transit to well 9/3-C.
28.07.86	0400	Began final approach to well 9/3-C.
	0545	Dropped first anchor, No 7.
	0610	Rig was on location.
	1545	Completed anchor running
	1930	Anchors tensioned
	1945	Initialized JMR-4 in 3D mode for translocation.
29.07.86	1031	Began Pulse/8 logging.
	1131	Completed Pulse/8 logging.
30.07.86		Continued with translocation
31.07.86	1900	Translocation aborted, rig began to move.
01.08.86	1934	Recommenced Translocation.
02.08.86		Continued translocation
03.08.86		Continued translocation
04.08.86		Continued translocation
05.08.86	1440	Completed translocation.
	1600	Personnel and equipment departed "Borgny Dolphin".

Appendix II

PLOTS OF RADIONAVIGATION SYSTEM PERFORMANCE

Racal Survey Norge A/S

ANALYSIS REPLAY

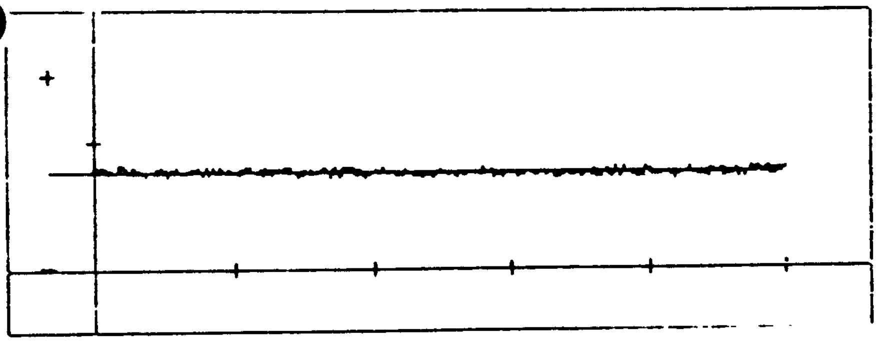
Job Description :- BORGNY DOLPHIN SHELL 9/3-C

PATTERN DEVIATION :

Pattern1	Pattern2	Pattern3	Pattern4
.02	.05	.02	.02

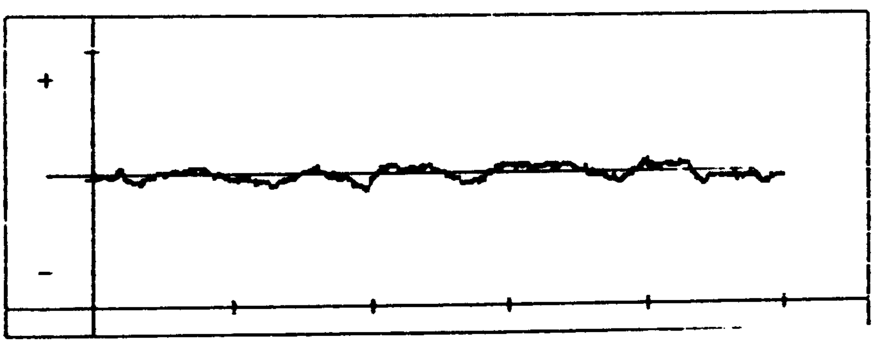
PATTERN 1 (see graph below)
X AXIS (Horizontal) UNITS :- 200 Passes
Y AXIS (Vertical) UNITS :- 1 Lanes

MEAN PATTERN VALUE :- 11191.76



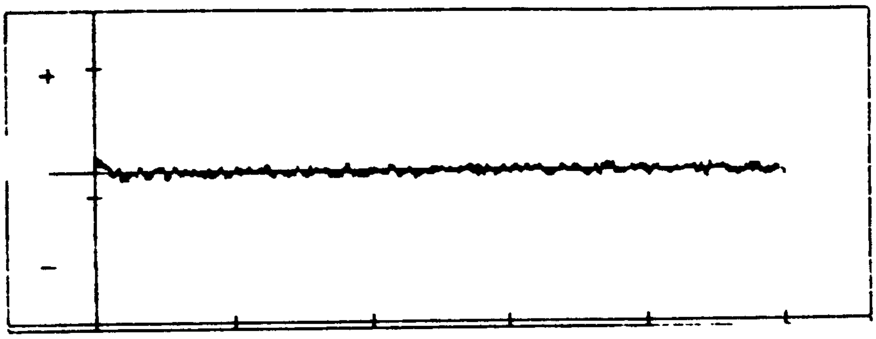
PATTERN 2 (see graph below)
X AXIS (Horizontal) UNITS :- 200 Passes
Y AXIS (Vertical) UNITS :- 1 Lanes

MEAN PATTERN VALUE :- 25797.03



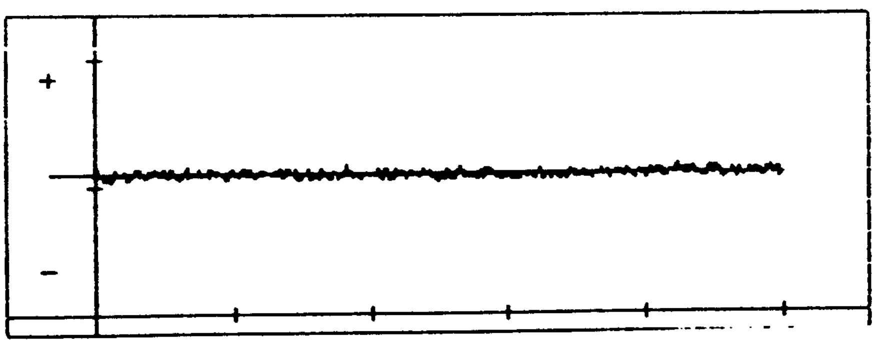
PATTERN 3 (see graph below)
X AXIS (Horizontal) UNITS :- 200 Passes
Y AXIS (Vertical) UNITS :- 1 Lanes

MEAN PATTERN VALUE :- 50557.2



PATTERN 4 (see graph below)
X AXIS (Horizontal) UNITS :- 200 Passes
Y AXIS (Vertical) UNITS :- 1 Lanes

MEAN PATTERN VALUE :- 38754.1



Appendix III

TRANSLOCATION PROCESSING DATA LISTINGS

Introduction to "Caliper"

The "Caliper" processing system is a package for processing transit satellite data. The system provides a complete processing facility for the office and allows for single station and multistation positioning for upto 10 sites. The program is a semi-short arc program designed to run on the IBM XT personal computer and solves for the X,Y,Z coordinates of each site, the offset frequency of each pass, three orbital parameters, receiver delay correction and an additional refraction correction parameter. The solution may be run as a free floating system i.e. all the stations are allowed to freely seek the position which best fits the data, or any site may be constrained to any degree. The solution is also presented in latitude, longitude and height.

The following pages describe and present the processing outputs from "Caliper".

Expanation of Data Base Listing

This is a summary of the satellite doppler data loaded into the "Caliper" data base prior to the commencement of the processing. The listings on the following pages show the data from this computation, and is in three parts:

a. A summary of the number of satellites observed at each site

b. A summary of the present satellites in the "Caliper" alert tables. Column 1 is the satellite identity and column 2 the Julian Day when it was last observed.

c. The final part is a pass by pass summary of the data. The data is ordered across the rows as follows:
   1. pass number
   2. satellite identity
   3. Julian day and time of observation
   4. the number of 30 second doppler counts observed at each site.

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MULTI-SITE DATA BASE OPERATIONS DATE: 08-07-1986 TIME: 11:29:58

NUMBER of PASSES ALREADY IN DATA BASE: 37

	SITES									
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
NUMBER of PASSES at EACH SITE :	37	37	0	0	0	0	0	0	0	0

PRESENT ALERT TABLE

30	217
20	217
48	217
11	217
50	217
13	216
0	0
0	0
0	0
0	0

***** SUMMARY OF PASSES IN DATA BASE FOLLOWS :

	NUMBER of DOPPLERS at each SITE									
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
PASS# 1 SAT 48 TIME 213 18:26	30	30	0	0	0	0	0	0	0	0
PASS# 2 SAT 11 TIME 213 21:36	31	31	0	0	0	0	0	0	0	0
PASS# 3 SAT 20 TIME 214 1:48	30	29	0	0	0	0	0	0	0	0
PASS# 4 SAT 48 TIME 214 3:14	35	30	0	0	0	0	0	0	0	0
PASS# 5 SAT 13 TIME 214 3:46	31	31	0	0	0	0	0	0	0	0
PASS# 6 SAT 48 TIME 214 5: 2	35	33	0	0	0	0	0	0	0	0
PASS# 7 SAT 30 TIME 214 7:40	34	34	0	0	0	0	0	0	0	0
PASS# 8 SAT 20 TIME 214 12: 2	34	33	0	0	0	0	0	0	0	0
PASS# 9 SAT 48 TIME 214 14:24	33	34	0	0	0	0	0	0	0	0
PASS# 10 SAT 30 TIME 214 16:58	34	34	0	0	0	0	0	0	0	0
PASS# 11 SAT 48 TIME 214 18: 2	33	33	0	0	0	0	0	0	0	0
PASS# 12 SAT 30 TIME 214 20:34	25	32	0	0	0	0	0	0	0	0
PASS# 13 SAT 20 TIME 214 22:54	28	26	0	0	0	0	0	0	0	0
PASS# 14 SAT 20 TIME 215 2:24	29	26	0	0	0	0	0	0	0	0
PASS# 15 SAT 30 TIME 215 5:18	35	31	0	0	0	0	0	0	0	0

```
PASS#  16 SAT 30 TIME 215  7: 4    35  35  0  0  0  0  0  0  0  0
PASS#  17 SAT 13 TIME 215 15: 4    24  35  0  0  0  0  0  0  0  0
PASS#  18 SAT 48 TIME 215 15:50    35  35  0  0  0  0  0  0  0  0
PASS#  19 SAT 48 TIME 215 17:40    32  33  0  0  0  0  0  0  0  0
PASS#  20 SAT 50 TIME 215 20:24    32  33  0  0  0  0  0  0  0  0
PASS#  21 SAT 13 TIME 216  2: 6    35  32  0  0  0  0  0  0  0  0
PASS#  22 SAT 13 TIME 216  3:52    31  31  0  0  0  0  0  0  0  0
PASS#  23 SAT 48 TIME 216  6: 4    31  34  0  0  0  0  0  0  0  0
PASS#  24 SAT 50 TIME 216 10:36    35  35  0  0  0  0  0  0  0  0
PASS#  25 SAT 20 TIME 216 11:32    33  29  0  0  0  0  0  0  0  0
PASS#  26 SAT 13 TIME 216 16: 2    33  17  0  0  0  0  0  0  0  0
PASS#  27 SAT 48 TIME 216 17:16    31  35  0  0  0  0  0  0  0  0
PASS#  28 SAT 30 TIME 216 19:24    34  34  0  0  0  0  0  0  0  0
PASS#  29 SAT 50 TIME 216 20: 0    33  34  0  0  0  0  0  0  0  0
PASS#  30 SAT 20 TIME 217  0: 8    27  15  0  0  0  0  0  0  0  0
PASS#  31 SAT 13 TIME 217  1:16    34  29  0  0  0  0  0  0  0  0
PASS#  32 SAT 20 TIME 217  1:52    29  29  0  0  0  0  0  0  0  0
PASS#  33 SAT 13 TIME 217  3: 2    33  33  0  0  0  0  0  0  0  0
PASS#  34 SAT 48 TIME 217  3:54    35  29  0  0  0  0  0  0  0  0
PASS#  35 SAT 48 TIME 217  5:42    33  33  0  0  0  0  0  0  0  0
PASS#  36 SAT 11 TIME 217 10:54    32  31  0  0  0  0  0  0  0  0
PASS#  37 SAT 11 TIME 217 12:40    34  33  0  0  0  0  0  0  0  0

      ***** SUMMARY FINISHED

     ********* Returning to Main Menu *******
```

Explanation of Fix Calculation Listing

Before processing the data, the operator of Caliper has the option of altering some of the editing critera used in the program. The following general options apply to all the sites involved in the fix computation.

LINE 1 - NUMBER OF SITES
This is the number of sites which the operator would like to be used in the computation.

LINE 2 - NUMBER OF PASSES
This defines the passes which the operator would like to be used in the computation.

LINE 3 - NUMBER OF INTERATIONS
This defines the number of times which the program will iterate before printing the final position. The solution normally converges fully after 4 iterations (Default=2).

LINE 4 - ELIPSOID
This is the definition of the elipsoid on which the final positions will be presented (Default=WGS72).

LINE 5 - MINIMUM NUMBER OF DOPPLERS
This is the minimum number of 30 second doppler count which the operator will allow the pass to have to be included in the solution (Default=16).

LINE 6 - HORIZON EDIT ANGLE
Data from low elevation angles is usually distorted due to uncorrectable tropospheric refraction effects. This option allows the operator to decide on the elevation angle below which doppler counts will be rejected by the program at both ends of the pass (Default=5 deg.).

LINE 7 AND 8 - ELEVATION EDITING
This defines the maximum and minimum elevation angle which the pass must be between at closest approach to be accepted into the solution. (Default=Minimum 15 deg. Maximum 75 deg.).

LINE 9 - SYMMETRY EDITING

This variable allows the operator to define the type of data editing to be carried out during the computation (Default=1).

Criteria = 1 : All available each site will be processed.

Criteria = 2 : Data at each site is reduced by removing data from lower elevation angles until all sites have the same number of valid data points.

Criteria = 3 : Only data taken in a common time frame is accepted but all valid data from each site during this time frame is used for processing.

Criteria = 4 : Data taken in a common time frame is accepted and is edited in the same manner as for Criteria = 2.

Criteria = 5 : Only the data recorded at all sites simultaneously is used.

LINE 10 - SIGNAL STRENGHT EDIT

This allows editing of the doppler data of the 150MHZ and 400MHZ channels based on the strength of the signals (Default=1).

Criteria = 7 : Only doppler data with a strong signal level will be used.

Criteria = 3 : Only doppler data with a moderate or strong signal level will be used.

Criteria = 1 : Doppler data with a weak, moderate or strong signal level will be used.

Criteria = 0 : Switches this editing off, and all doppler data is used.

LINE 11 - A "PRIORI" VARIANCE FACTOR

This is the a "priori" variance of unit weght which is used to scale the adopted matrix for the observed dopplers and the weight matérices for the parameters. This is also used in the 99% Chi-squared test to eliminate bad passes (Default:1.4).

LINE 12 - RESIDUAL EDIT CRITERIA

When set to n, the program will edit out any doppler interval with a residual greater than n times the RMS values for the particular pass (Default=3).

LINE 13 - SATELLITE ORBITAL CONSTRAINTS

These are the error estimates for the along-track, across-track and radial-component of the satellite orbit in metres(Default= along 25 m, Across 5 m, Radial 10 m).

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FIX CALCULATION ADJUSTMENT   DATE: 08-08-1986   TIME: 09:10:07

****

```
NUMBER OF SITE(S) TO PROCESS=  2
PROCESS FROM PASS    1 TO PASS 500
MAXIMUM NUMBER OF ITERATIONS=  4
ELLIPSOID:SEMI MAJOR AXIS= 6378135.00 FLATTENING=1/298.26000
MINIMUM NUMBER OF DOPPLERS FOR ACCEPTABLE PASS= 12
DATA TAKEN BELOW AN ELEVATION ANGLE OF 5.0 WILL BE DELETED
MINIMUM ELEVATION AT CLOSEST APPROACH FOR AN ACCEPTABLE PASS=15.0
MAXIMUM ELEVATION AT CLOSEST APPROACH FOR AN ACCEPTABLE PASS=78.0
SYMMETRY EDITING CRITERIA= 1
LOWEST ACCEPTABLE SIGNAL STRENGTH= 3
APRIORI VARIANCE FACTOR= 1.4
RESIDUAL EDITING CRITERIA= 3.0
SATELLITE TRACK ORBITAL CONSTRAINTS:
                                        ALONG  TRACK= 25.0
                                        ACROSS TRACK=  5.0
                                        RADIAL TRACK= 10.0
```

****

Explanation of Site Initialization Printout

As with the fix calculation options the operator of "Caliper" also has the option to alter variables specific to each site as listed below:

LINE 1 - SITE NUMBER AND STATION NAME
This allows the operator to define the site number in accordance with the data base contents and also define a name for it which is included on all future printouts.

LINES 2,3 AND 4 - LATITUDE, LONGITUDE AND HEIGHT
This is the latitude, longitude and height of the site. For the fixed site in a translocation, these should be exact, but for any other site, they need only be correct to with 100 km.

LINE 5 - RECEIVER TYPE
This defines the receiver which was deployed on the particular site, JMR-A = JMR-4/JMR-4A, S2000 = JMR-2000, OTHER = MAGNAVOX or JMR-1.

LINE 6 - RECEIVER WEIGHT
This is the estimate of the RMS of the doppler counts that were measured by the receiver at a particular site. This reflects the quality of the data such as the ammount of noise, oscillator drift etc.

LINE 7 - RECEIVER DELAY
The receiver delay is a factory calibration number for a particular receiver type. It is allowed to vary in the solution, therefore deviations of a particular receivers delay from this number tends to be corrected within the bounds of the receiver delay constraint entry. This delay is input in microseconds.

LINE 8 - DELAY CONSTRAINT
This is the ammount in microseconds which the receiver delay is allowed to vary in the solution (Default=100).

LINE 9 - REFRACTION CORRECTION
This variable is the error estimate of the tropospheric refraction correction as a percentage (Default=10).

LINE 10 - STATION CONSTRAINT

This variable is used to fix the station coordinates. If the entry is left at .00 the station is unconstrained. If a number is entered, then this number is the distance (in metres) which the processing will allow the station to move. Constraining would normally only be applied to the reference station in a translocation or network adjustment.

LINE 11 - SYMMETRY EDITING RATIO

These two digit´s specify a ratio which define the maximum imbalance data can have around the point of closest approach before the pass is rejected by the program.

LINE 12 - METEOROLOGICAL DATA

This point allows the operator to input meteorological data to allow a second refraction correction to be applied. If pass data has been recorded in the pass header, then the program can be made to use this.

```
SITE #  1  STATION NAME : " EIGEBERG "
LATITUDE = +  58 51  2.423
LONGITUDE= +   5 35  7.811
HEIGHT=  141.90
RECEIVER TYPE=JMR-A
RECEIVER WEIGHT=   .42
RECEIVER DELAY =450.0
DELAY CONSTRAINT =100.0
TROPO. CONSTRAINT =10.0
STATION CONSTRAINT=     .01
SYMMETRY EDITING =21
THE FOLLOWING MET DATA WILL BE CONSIDERED
TEMPERATURE= 13.1
PRESSURE    = 1011.5
HUMIDITY    =  .8
```
****

```
SITE #  2  STATION NAME : " B DOLPHI  "
LATITUDE = +  57 49 44.000
LONGITUDE= +   4 45 51.000
HEIGHT=   63.00
RECEIVER TYPE=JMR-A
RECEIVER WEIGHT=   .60
RECEIVER DELAY =450.0
DELAY CONSTRAINT =100.0
TROPO. CONSTRAINT =10.0
STATION CONSTRAINT=     .00
SYMMETRY EDITING =21
THE FOLLOWING MET DATA WILL BE CONSIDERED
TEMPERATURE= 13.1
PRESSURE    = 1011.5
HUMIDITY    =  .8
```
****

Explanation of the Final Adjustment Output

The final adjustment output of "Caliper" is in three parts as listed below:

PART 1 - ADJUSTMENT STATUS
This section includes the number of passes processed, accepted, and rejected with the reason for their rejection, the number of doppler intervals processed and statistical results.

PART 2 - SITE SOLUTIONS
This shows latitude, longitude and height, the one sigma values for the same, the 3D cartesian coordinates and the mean receiver nuisance parameters for each site.

PART 3 - MEAN ORBITAL PARAMETERS

Note: passes can be rejected for the following reasons:

ELEVATION - The satellite was outside the maximum and minimum elevation angles at point of closest approach.

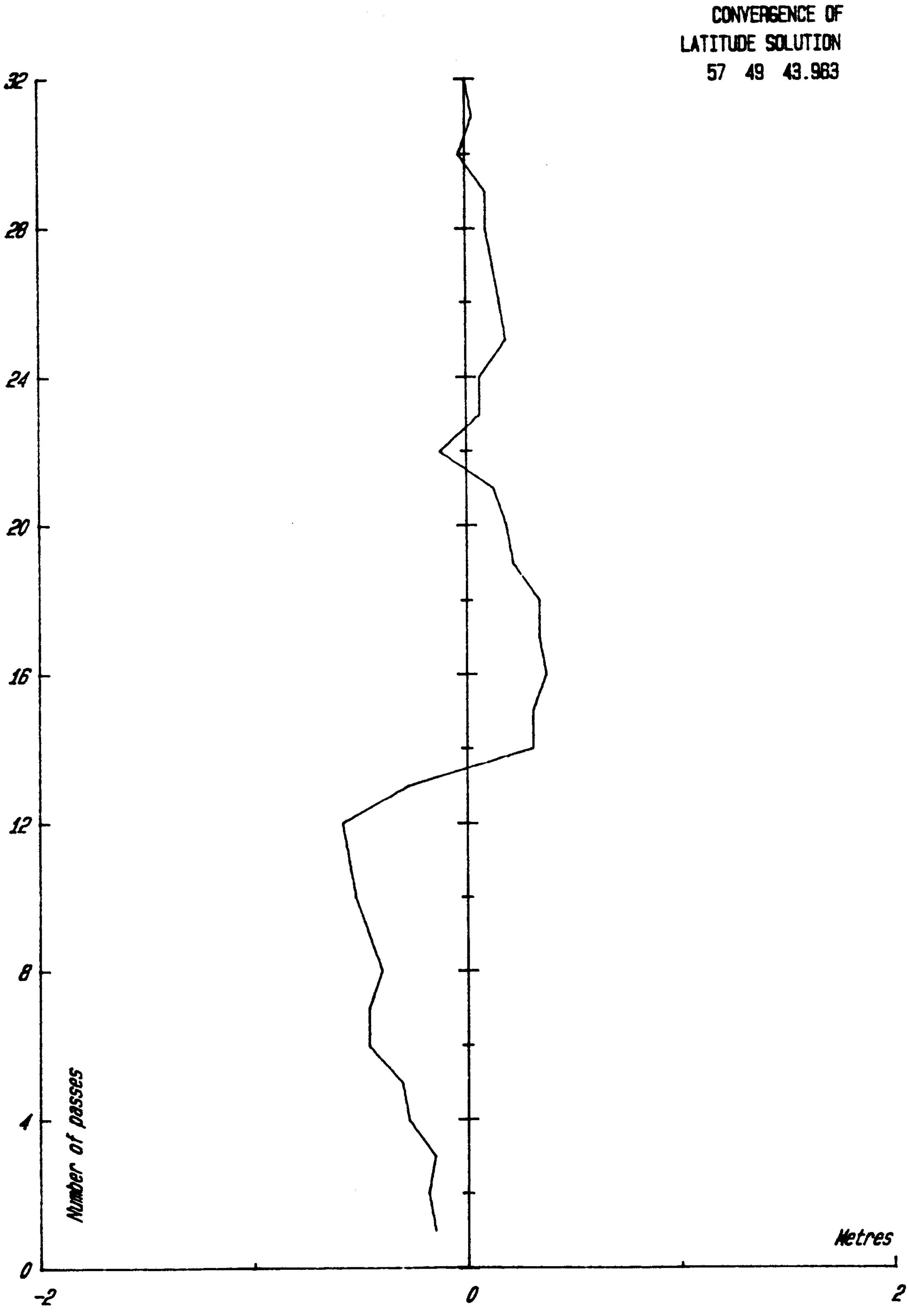
INSUFFICIENT DATA - The pass was not observed at the site concerned, the pass was rejected due to site symmetry, or the pass was rejected because there were less than the required number of doppler intervals after editing.

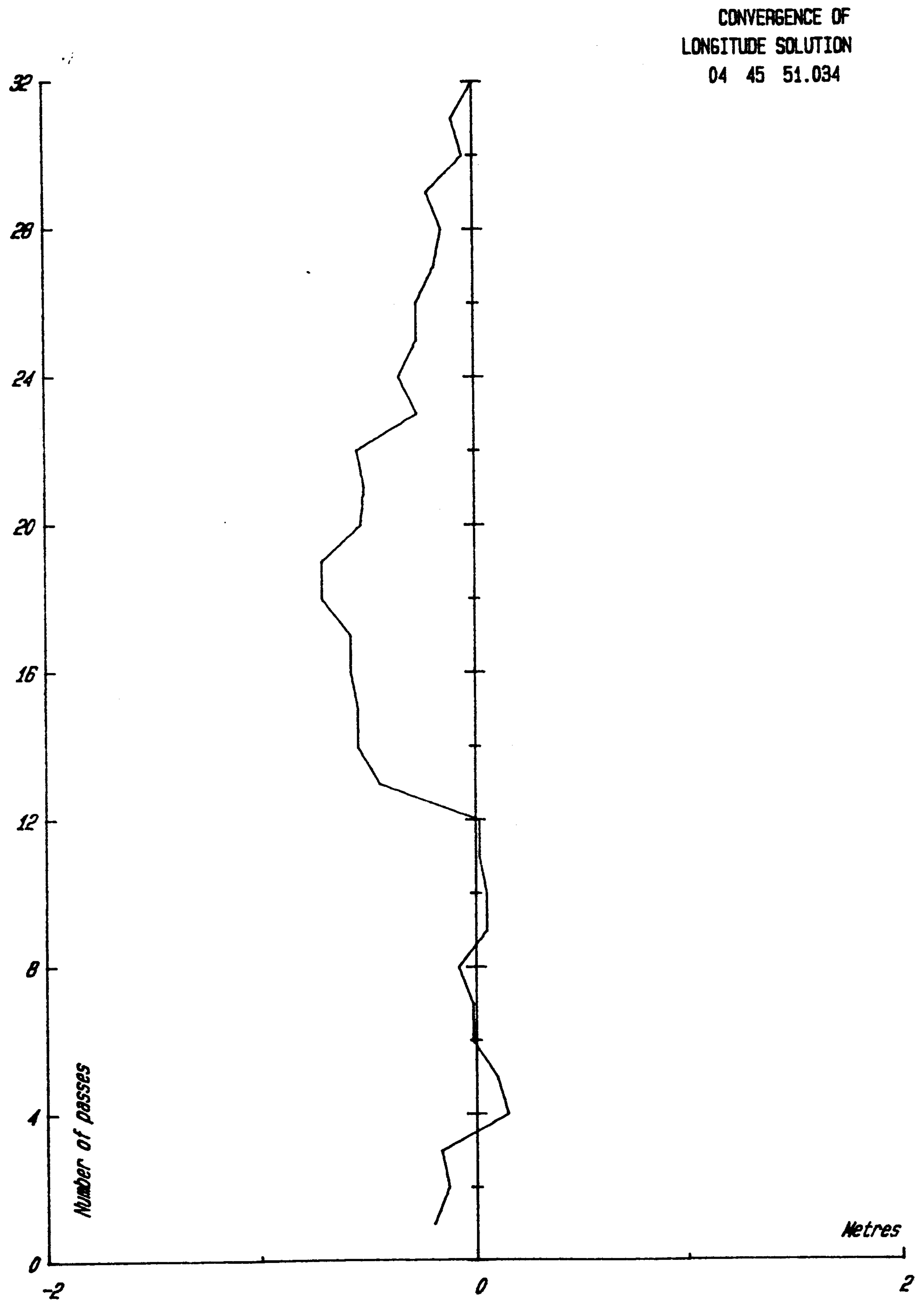
CHI-SQUARE TEST - This is a test on the general quality of the data, and passes rejected by this method are due to noisy data.

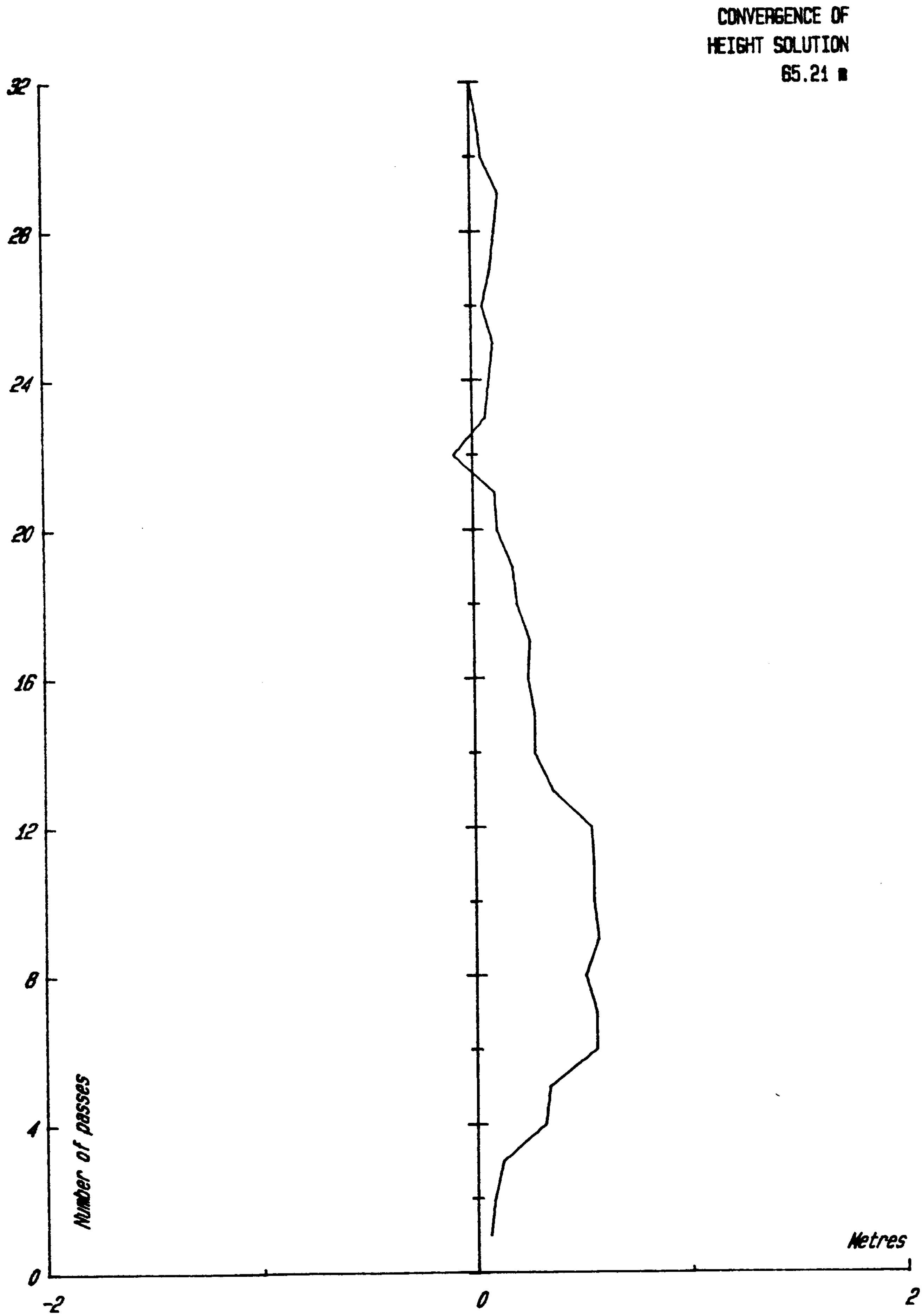
```
                        FINAL ADJUSTMENT OUTPUT
                        ( FOR  4 ITERATION(S) )
*****************************************************************************

ADJUSTMENT STATUS :
*******************
PASSES PROCESSED     :   37    PASSES ACCEPTED :   32    PASSES REJECTED :    5

PASSES REJECTED FOR : ELEVATION=  0 INSUFFICIENT DATA=  3  CHI-SQUARE TEST=  2

DOPPLERS PROCESSED   :  1512 REJECTION: SIGNAL EDITED= 260 RESIDUAL EDITED=  43
                                        SYMMETRY EDIT=    0 HORIZON EDITED = 243
STATISTICAL RESULTS :  DEGREES OF FREEDOM=  1218  VARIANCE FACTOR= 1.03

SITE(S) SOLUTION :
******************

SITE#  1 STATION NAME : " EIGEBERG "

        LATITUDE =+58 51  2.423  LONGITUDE =+  5 35  7.811  HEIGHT =  141.90
          SIGLAT =   .01(m.)         SIGLON =   .01(m.)      SIGHGT =   .01(m.)

        X =  3291708.01 m.  Y =   321913.94 m.  Z = 5435470.39 m.

MEAN RECEIVER NUISANCE PARAMETERS :

        OFFSET FREQ. = -8.5534  TROPO. REFRAC. =  4.82  RCV. DELAY =447.96
                STD. =   .0916             STD =  9.98          STD = 41.49

SITE#  2 STATION NAME : " B DOLPHI "

        LATITUDE =+57 49 43.963  LONGITUDE =+  4 45 51.034  HEIGHT =   65.21
          SIGLAT =   .28(m.)         SIGLON =   .51(m.)      SIGHGT =   .36(m.)

        X =  3392482.99 m.  Y =   282738.78 m.  Z = 5375667.68 m.

MEAN RECEIVER NUISANCE PARAMETERS :

        OFFSET FREQ. =  4.3630  TROPO. REFRAC. =  4.61  RCV. DELAY =448.97
                STD. =   .1659             STD =  7.00          STD = 36.20

MEAN ORBITAL PARAMETERS :
*************************

       ALONG TRACK =-12.13  ACROSS TRACK =  2.24  RADIAL =  1.69
               STD = 19.31           STD =  4.25     STD = 13.61
```

Appendix IV

CONVERGENCE OF TRANSLOCATED POSITION


CONVERGENCE OF
LATITUDE SOLUTION
57 49 43.963
32
28
24
20
16
12
8
4
0
Number of passes
Metres
-2
0
2


CONVERGENCE OF
LONGITUDE SOLUTION
04 45 51.034
32
28
24
20
16
12
8
4
0
Number of passes
Metres
-2
0
2

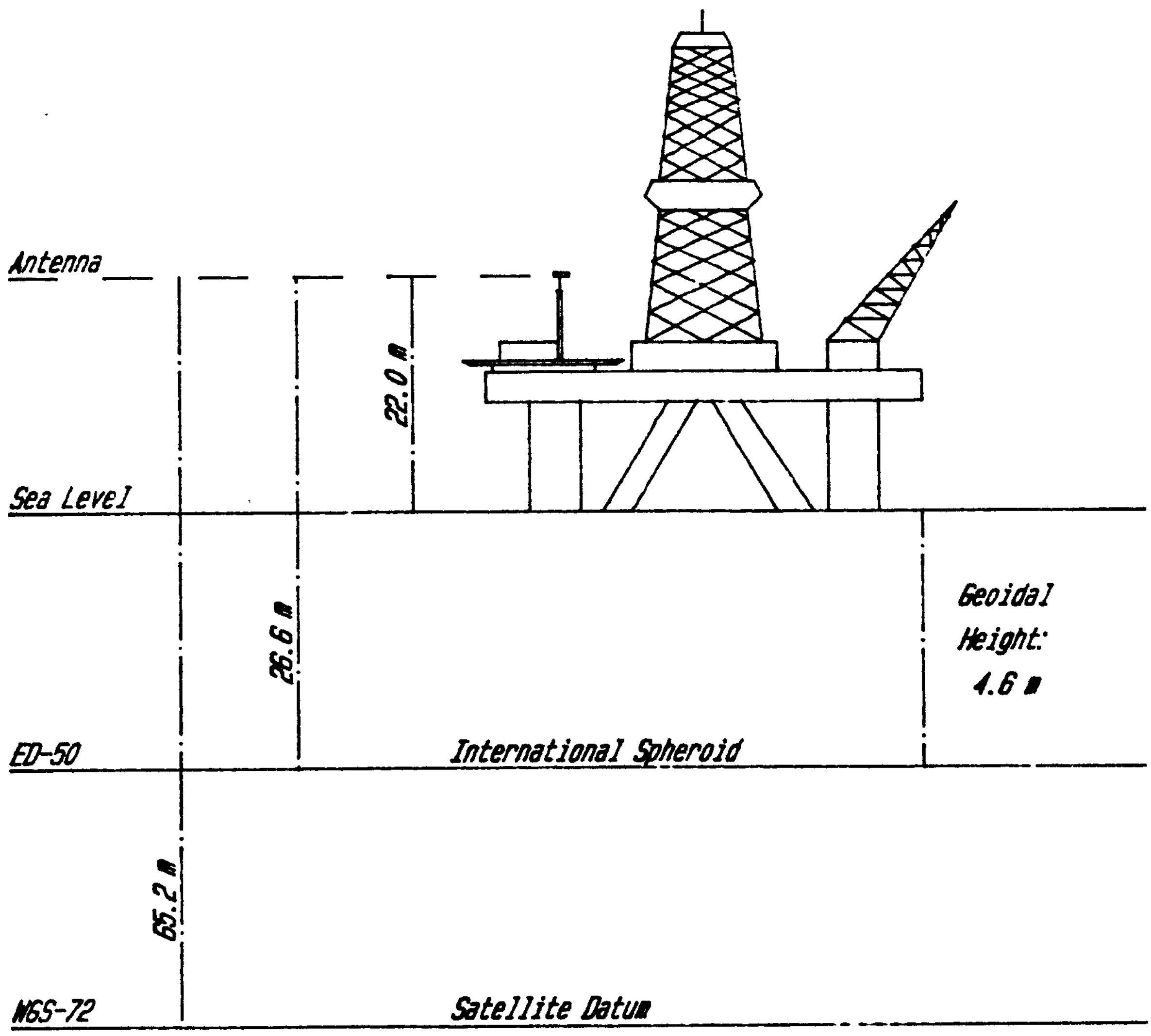

CONVERGENCE OF
HEIGHT SOLUTION
65.21 m
Number of passes
32
28
24
20
16
12
8
4
0
-2
0
2
Metres

Appendix V

GEOIDAL HEIGHT

GEOIDAL HEIGHT

NOT TO SCALE

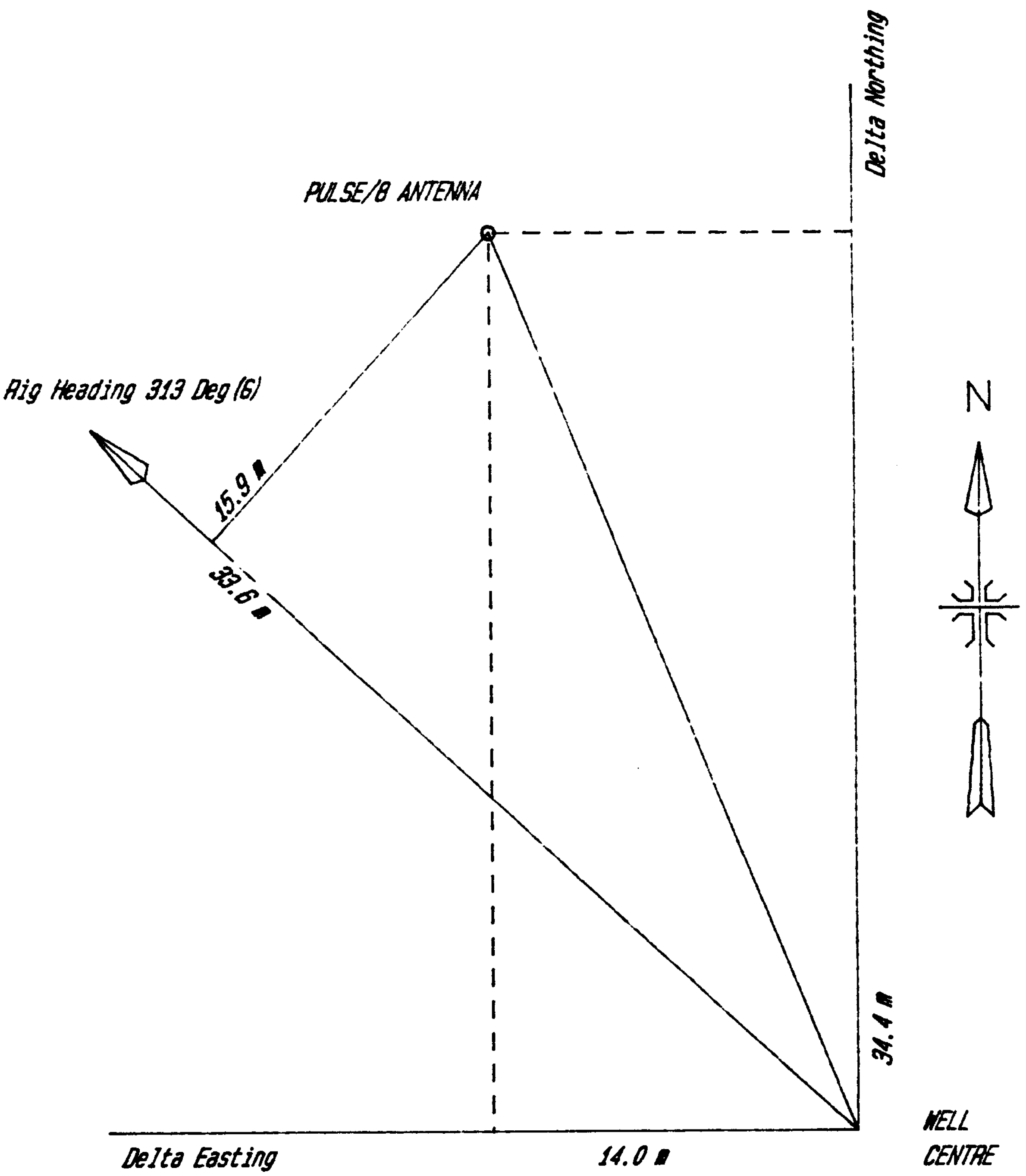


Appendix VI

ANTENNAE OFFSET DIAGRAMS

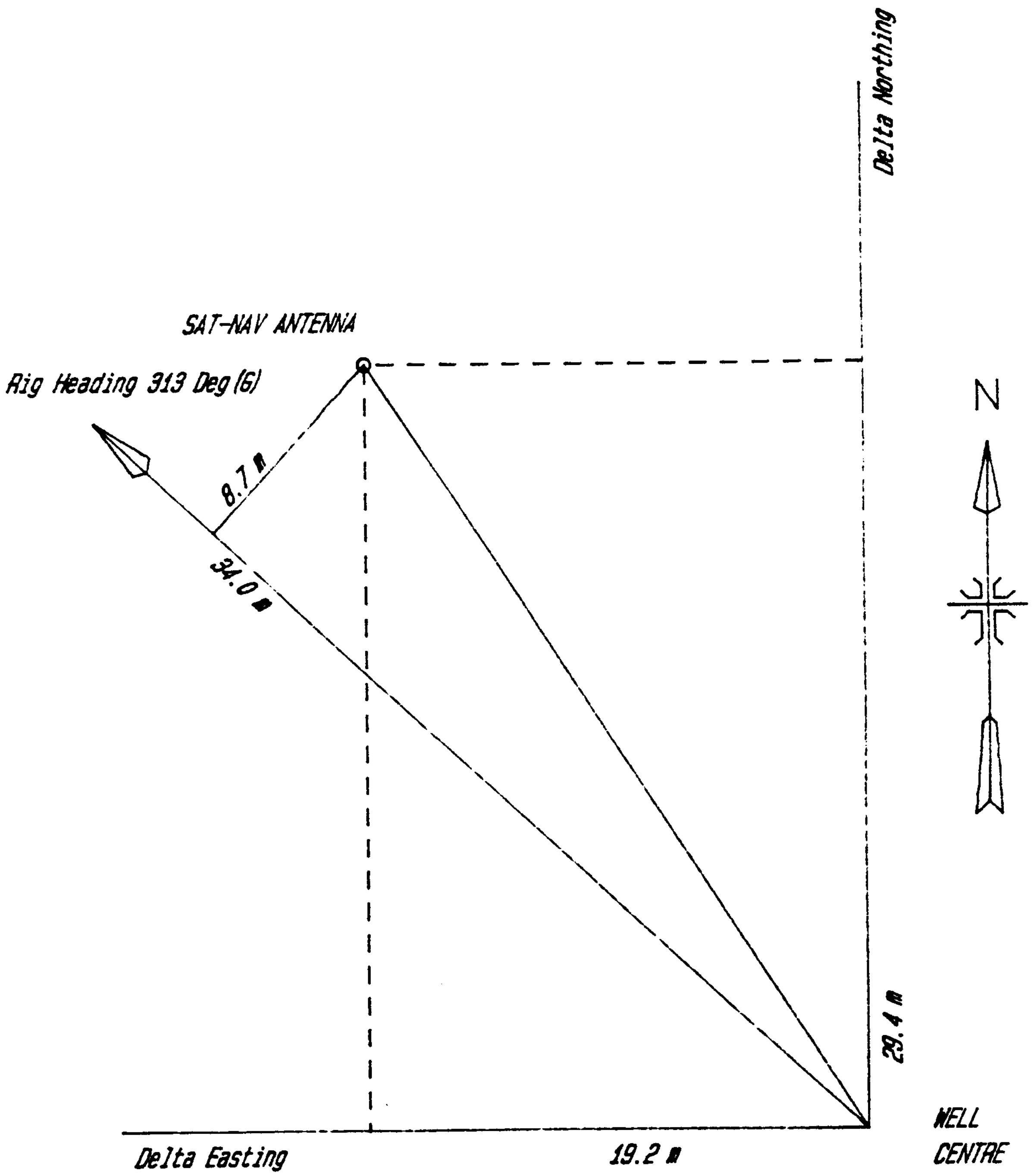
CONVERSION FROM PULSE/8 ANTENNA
TO WELL CENTRE POSITION

SCALE 1 : 250



CONVERSION FROM SATELLITE ANTENNA
TO WELL CENTRE POSITION

SCALE 1 : 250



Appendix VII

RADIONAVIGATION CHAIN AND STATION DATA

Chain Data for Pulse/8 Southern Chain.

1 St. Fergus
57-33-17.275 N 01-48-32.883 W E 212 345.774 N 6 389 487.523

2 Utsira
59-18-27.088 N 04-51-48.823 E E 606 106.034 N 6 575 932.130
Delay 10500.0 Last Lane Pat 1-2, 13 408.815

3 Roemoe
55-04-46.225 N 08-32-42.539 E E 853 839.804 N 6 117 829.606
Delay 23500.0 Last Lane Pat 1-3, 28 150.428

4 Krummhorn
53-29-58.637 N 07-03-14.119 E E 768 856.683 N 5 935 628.929
Delay 36000.0 Last Lane Pat 1-4, 40 794.329

5 Happisburgh
52-50-06.496 N 01-31-06.164 E E 400 187.691 N 5 855 083.010
Delay 48000.0 Last Lane Pat 1-5, 51 781.128

All coordinates are UTM Zone 31, CM 3 deg. East on ED-1950 datum.

Group Repetition Interval 75700, Fx 100.0 Prop. Speed 299594.0

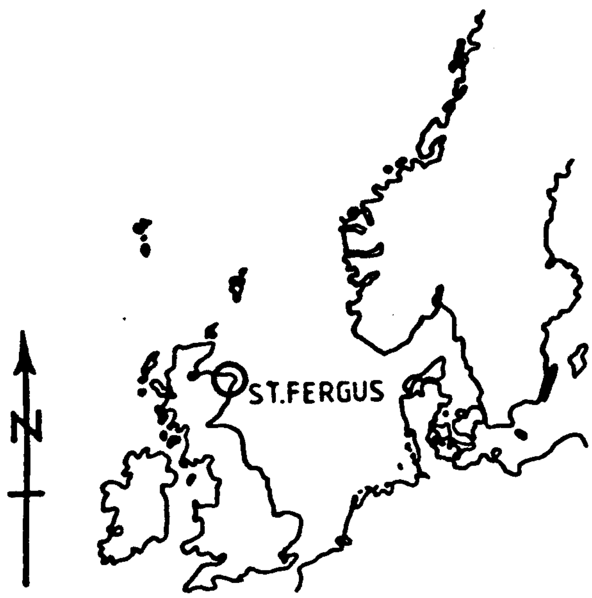
Racal Survey Norge A/S

STATION DESCRIPTION

RACAL

STATION NAME	St. Fergus
Station Type	Pulse/8 Master
LATITUDE	57° 33' 17.275" N
LONGITUDE	01° 48' 32.883" W
Depending on	U.K. National
at Latitude	
& Longitude	
SPHEROID & DATUM	Hayford International European Datum 1950
GRID EASTING	212 345.774
GRID NORTHING	6 389 487.523
Est. accuracy	+/- 0.25 metres
GRID ZONE & CM	UTM Zone 31, 3° E
False Easting	500 000 m
False Northing	0 m
STN.ELEVATION	
Date Surveyed	25.02.75

LOCATION SKETCH

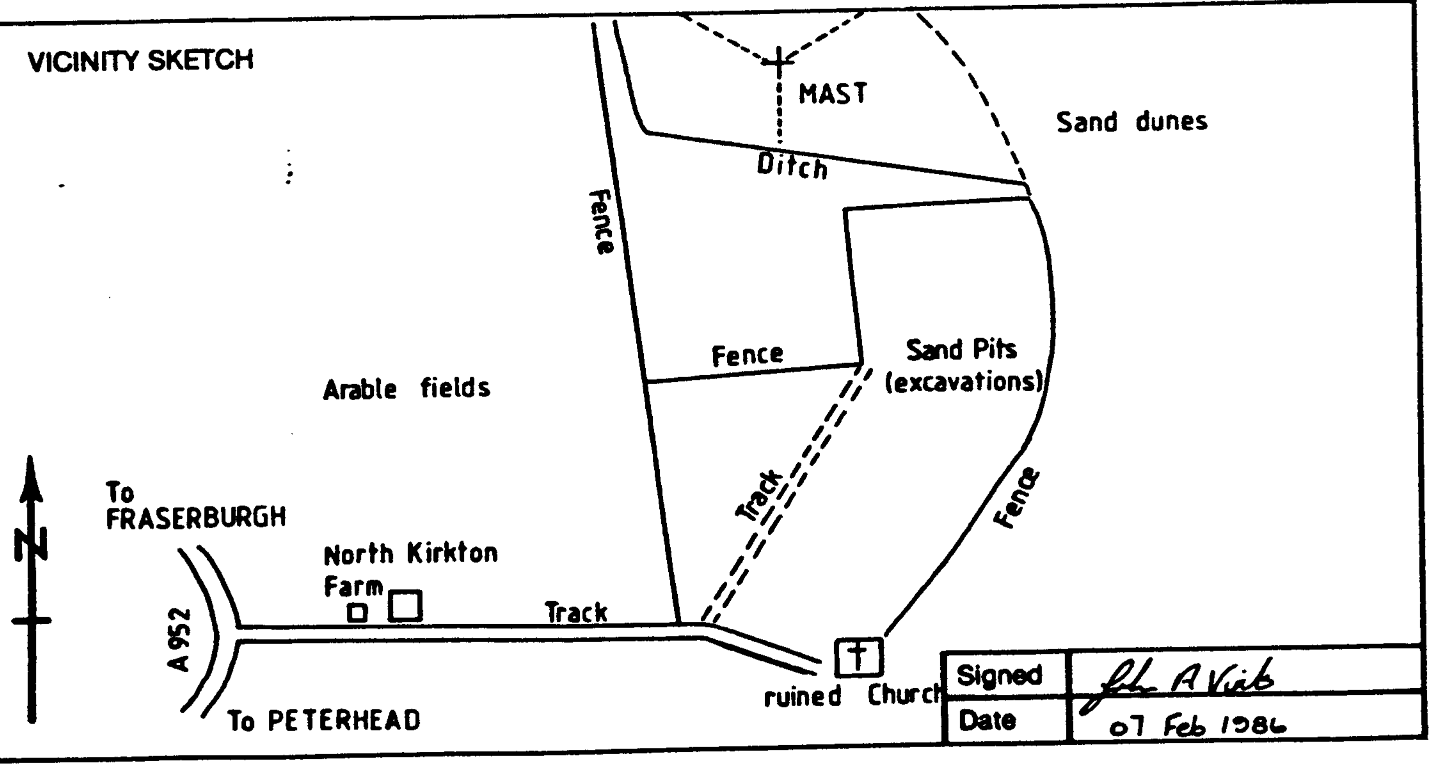


STATION & WITNESS MARK DATA

DESCRIPTION OF ACCESS, SITE OWNER/TENANT

Mast is 300' high, situated in north end of pasture park with grass covered sand dunes to east and north and fenced arable fields to west. Park is north of the end of the track from North Kirkton Farm. There are 30 concrete block radiating from the mast at 00°, 120° and 240° for 300 feet. The ground is flat but soft, often with surface water lying during wet periods.

VICINITY SKETCH



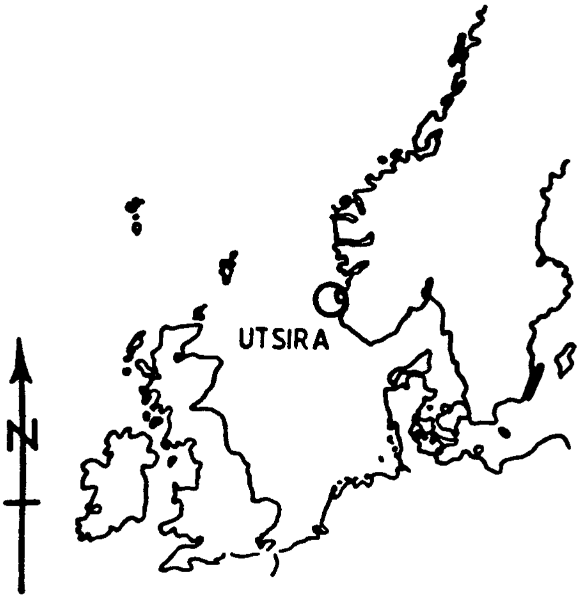
Signed	*[signature]*
Date	07 Feb 1986

Racal Survey Norge A/S

STATION DESCRIPTION

RACAL

LOCATION SKETCH



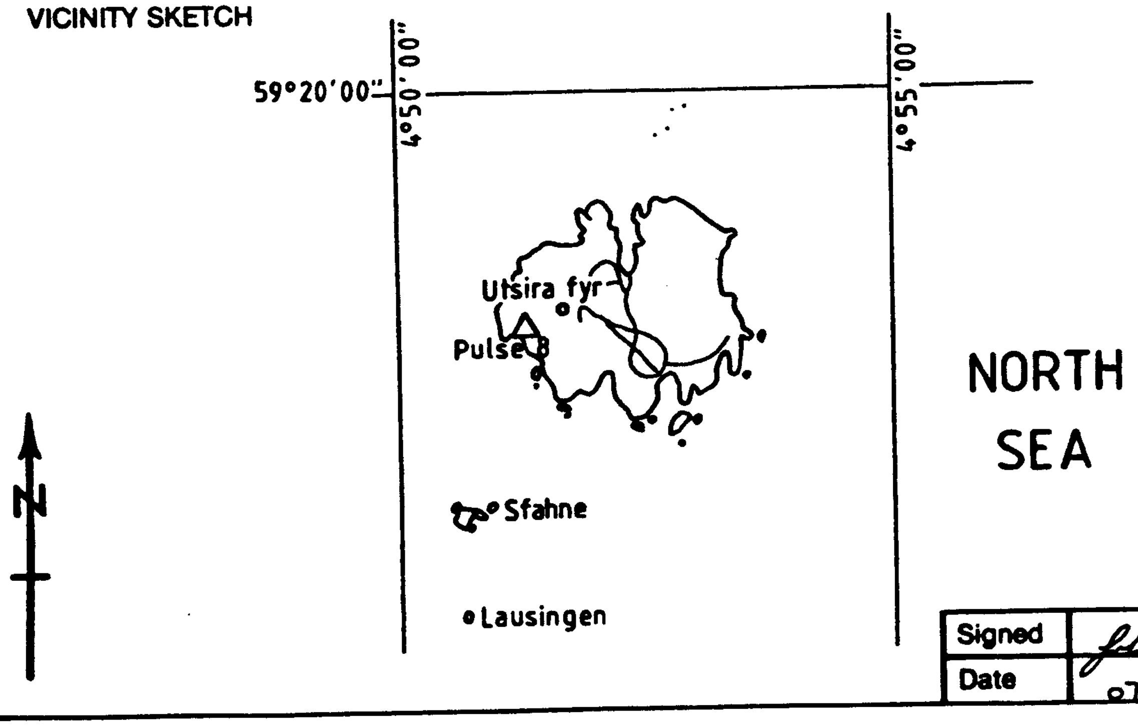
STATION NAME	UTSIRA
Station Type	Pulse/8
LATITUDE	59° 18' 27.088" N
LONGITUDE	04° 51' 48.823" E
Depending on	NGO
at Latitude	
& Longitude	
SPHEROID & DATUM	Hayford International European Datum 1950
GRID EASTING	606 106.034
GRID NORTHING	6 575 932.130
Est. accuracy	+/- 0.5 m
GRID ZONE & CM	UTM Zone 31, 3° E
False Easting	500 000 m
False Northing	0 m
STN.ELEVATION	Ca. 5 m
Date Surveyed	December 1975

STATION & WITNESS MARK DATA

DESCRIPTION OF ACCESS, SITE OWNER/TENANT

Mast is 300' high and is the only high mast on the island.

VICINITY SKETCH



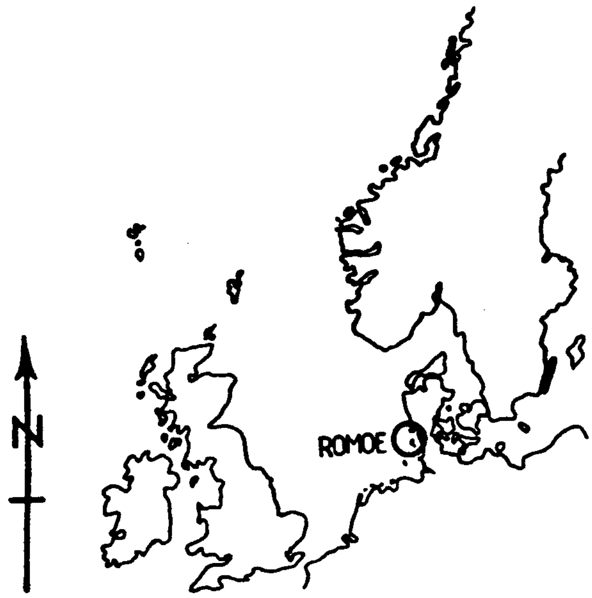
Signed	*[signature]*
Date	07 Feb 1986

Racal Survey Norge A/S

STATION DESCRIPTION

RACAL

LOCATION SKETCH

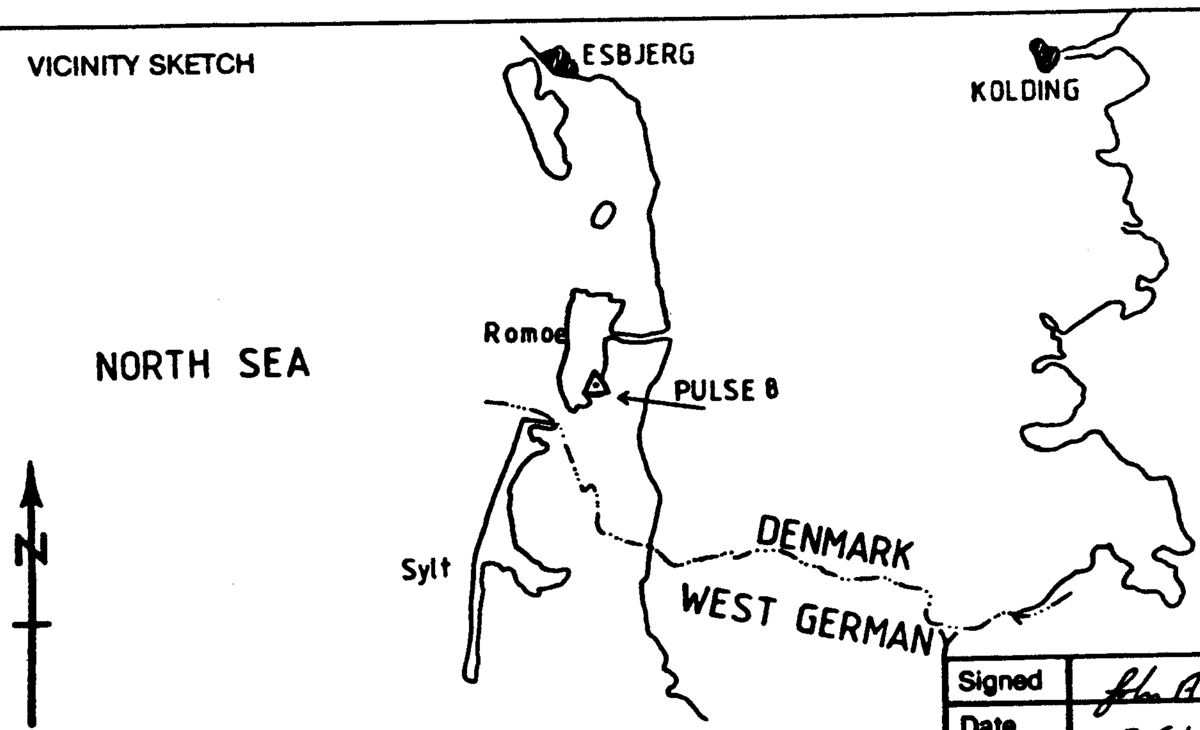


STATION NAME	ROMOE
Station Type	Pulse/8
LATITUDE	55° 04' 46.225" N
LONGITUDE	08° 32' 42.539" E
Depending on	
at Latitude	
& Longitude	
SPHEROID & DATUM	Hayford International European Datum 1950
GRID EASTING	853 839.804
GRID NORTHING	6 117 829.606
Est. accuracy	
GRID ZONE & CM	UTM Zone 31, 3° E
False Easting	500 000m
False Northing	0m
STN.ELEVATION	
Date Surveyed	September 1976

STATION & WITNESS MARK DATA

DESCRIPTION OF ACCESS, SITE OWNER/TENANT

VICINITY SKETCH



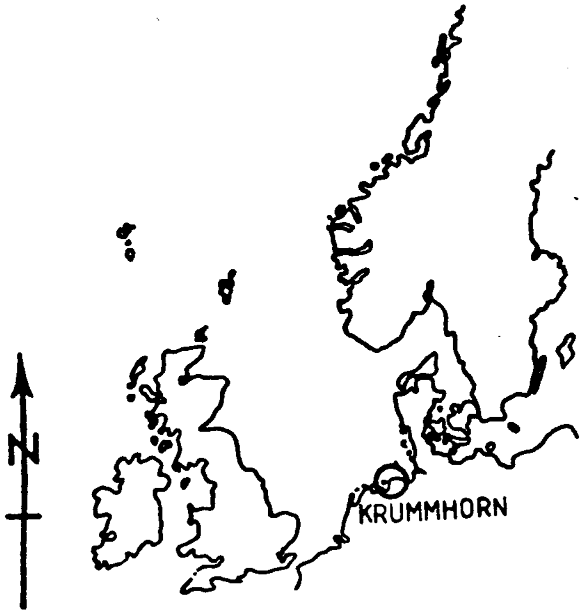
Signed	[signature]
Date	07 Feb 198_

Racal Survey Norge A/S

STATION DESCRIPTION

RACAL

LOCATION SKETCH

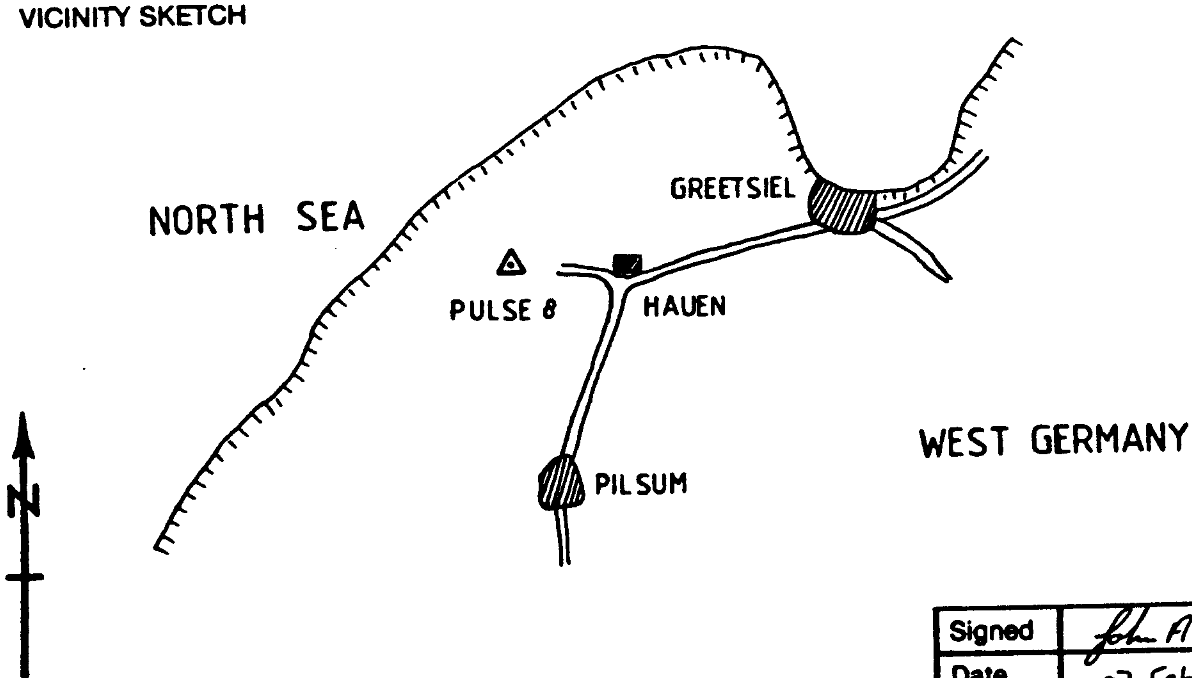


STATION NAME	KRUMHORN
Station Type	Pulse/8
LATITUDE	53° 29' 58.637" N
LONGITUDE	07° 03' 14.119" E
Depending on	
at Latitude	
& Longitude	
SPHEROID & DATUM	Hayford International European Datum 1950
GRID EASTING	768 856.683
GRID NORTHING	5 935 628.929
Est. accuracy	+/- 0.10 m
GRID ZONE & CM	UTM Zone 31, 3° E
False Easting	+ 500 000 m
False Northing	0 m
STN.ELEVATION	
Date Surveyed	

STATION & WITNESS MARK DATA

DESCRIPTION OF ACCESS, SITE OWNER/TENANT

VICINITY SKETCH



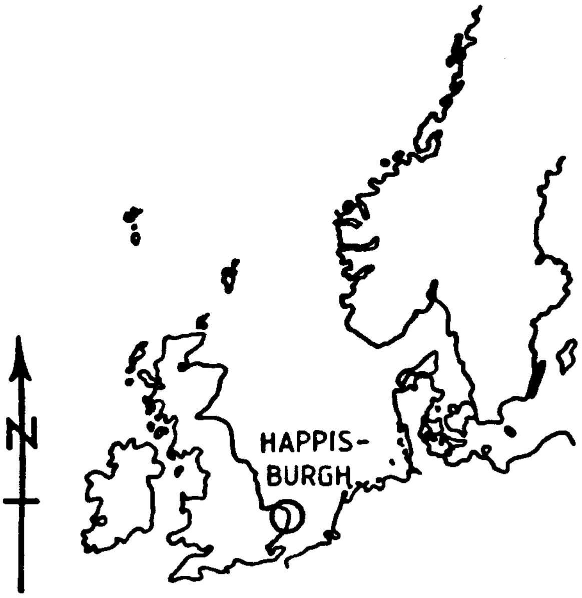
Signed	John A Vink
Date	07 Feb 1986

Racal Survey Norge A/S

STATION DESCRIPTION

RACAL

LOCATION SKETCH



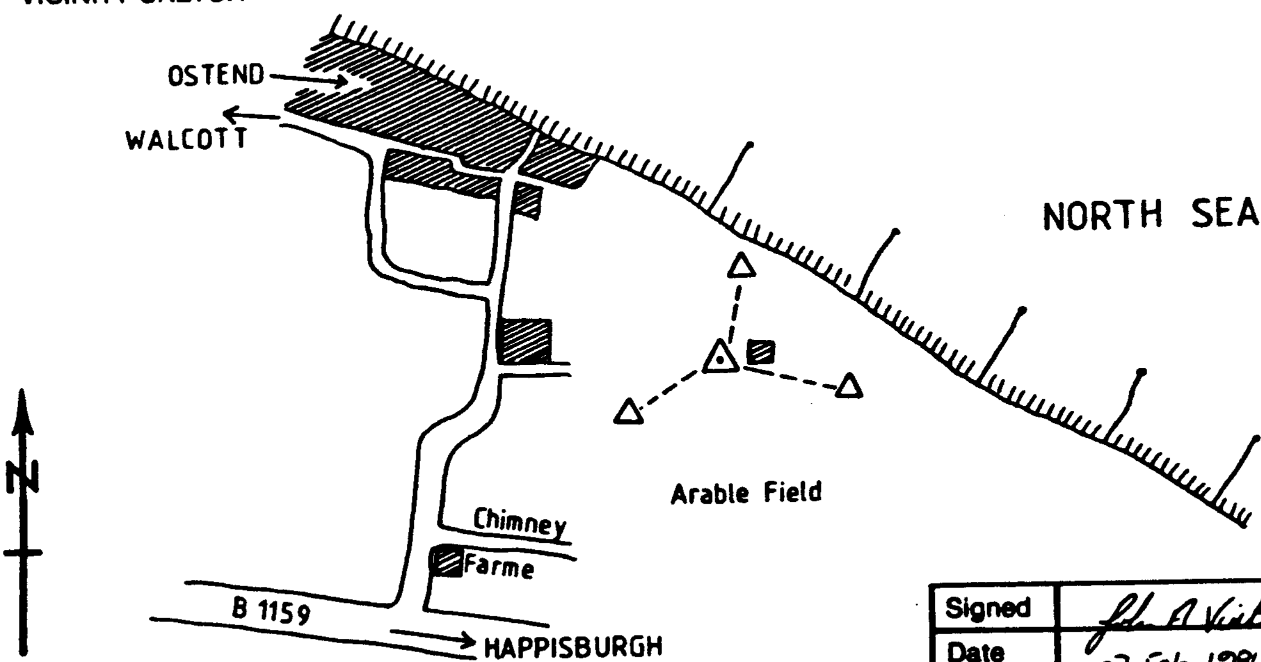
STATION NAME	HAPPISBURGH
Station Type	Pulse/8
LATITUDE	52° 50' 06.496" N
LONGITUDE	01° 31' 06.164" E
Depending on	OSGB 36
at Latitude	
& Longitude	
SPHEROID & DATUM	Hayford International European Datum 1950
GRID EASTING	400 187.691
GRID NORTHING	5 855 083.010
Est. accuracy	
GRID ZONE & CM	UTM Zone 31, 3° E
False Easting	500 000 m
False Northing	0 m
STN.ELEVATION	15 m
Date Surveyed	August 1975

STATION & WITNESS MARK DATA

DESCRIPTION OF ACCESS, SITE OWNER/TENANT

A 300' high mast situated on farmland next to the village of Bacton. Can be reached by following the B1159 from Happisburgh taking a right turn to Ostend village.

VICINITY SKETCH



Signed	*[signature]*
Date	07 Feb 1986

Appendix VIII

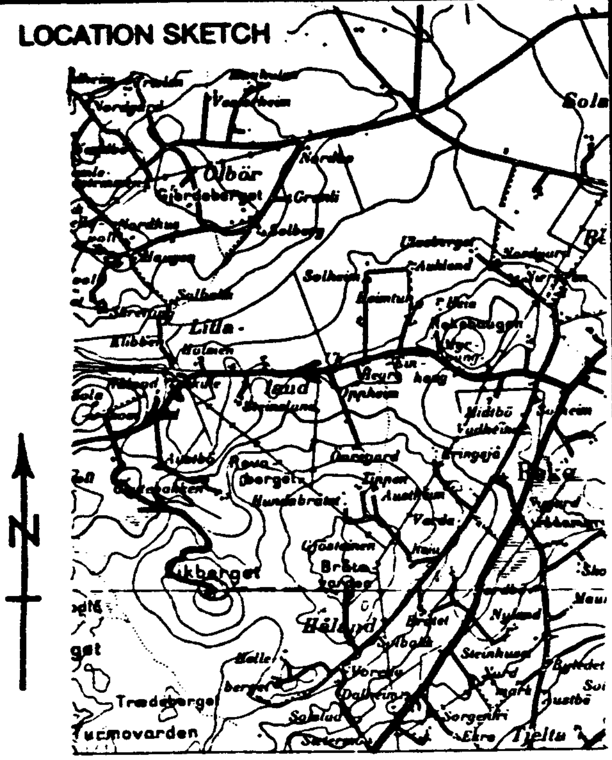
SATELLITE REFERENCE POINT DETAILS

Racal Survey Norge A/S

STATION DESCRIPTION

RACAL

LOCATION SKETCH



STATION NAME	Eigeberg
Station Type	First Order Trig. Point
LATITUDE	58° 51' 04.4390" N
LONGITUDE	05° 35' 14.1342" E
Depending on	
at Latitude	
& Longitude	
SPHEROID & DATUM	Hayford International European Datum 1950
GRID EASTING	303 129.43 m
GRID NORTHING	6 528 657.14 m
Est. accuracy	
GRID ZONE & CM	UTM Zone 32, CM 9° E
False Easting	500 000 m
False Northing	0 m
STN.ELEVATION	98.04 m (above NN54)
Geoidal Height	6.70 m (Tscherning)

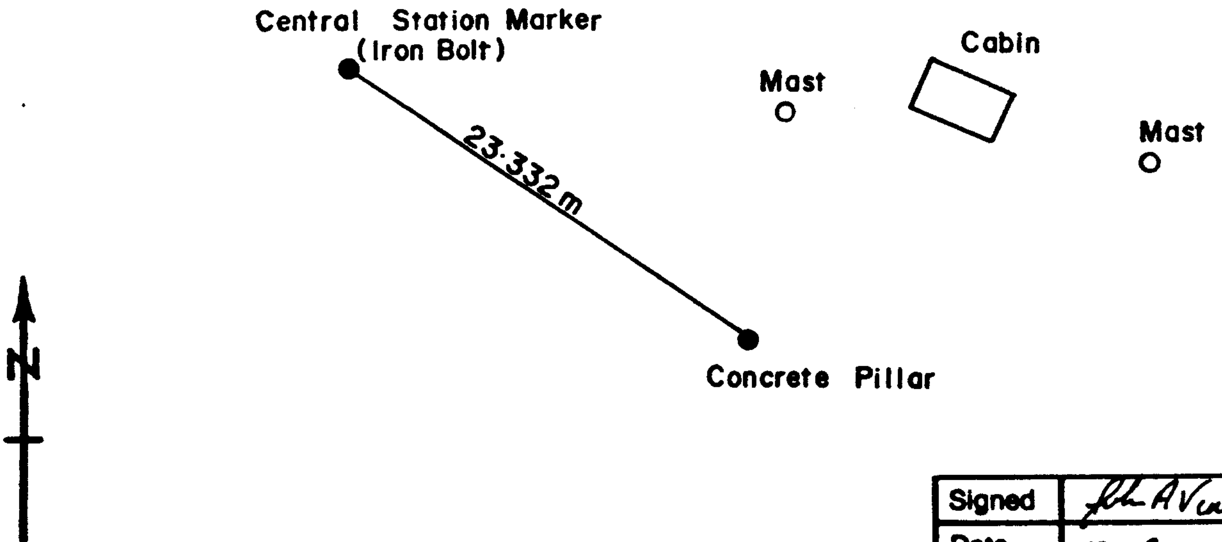
STATION & WITNESS MARK DATA

Concrete Pillar

DESCRIPTION OF ACCESS, SITE OWNER/TENANT

From Sola Airport head south along the 480. Turn right to Litlaland, after approximately 1.7km turn left to Bakkevoll. 500m up this track turn left onto the track leading up to Eigeberg.

VICINITY SKETCH



Signed	*[signature]*
Date	19 August 1986

4. DRILLING HISTORY WELL 9/3-1

The rig Borgny Dolphin commenced moving from the 7120/1-1R well location at 02:00 hrs on 22.07.86 and arrived on the 9/3-A location at 05:00 hrs on 28.07.86. The rig was manoevered onto location with the Decca Main Chain, Pulse/8 and Transit Satelite System, the anchors were run and the rig ballasted to drilling draught.

A seafloor penetration test resulted in only 15 cm penetration with 15000 lbs weight on a 26" bit and the following distances were established:

- Seabed 124 m BDF
- Water depth 99 m

Due to the hard seabed the skirt of the temporary guide base was cut at 20 cm. The temporary guide base was run and landed on seabed at an angle of zero degrees on the slope indicator. At 15:00 hrs on 29.07.86 well 9/3-1 was spudded using a 26" bit and a 36" hole opener assembly, and the hole was drilled to 215 m BDF. When pulling out for 30" casing, tight hole was observed between 137 and 150 m. Attempts to wash and ream the hole were made and the string was pulled to run 30" casing. The 30" casing and the permanent guide base were made up and lowered to 130 m BDF, where the casing stood up. Several attempts were made to pass the hold up depth, but with no success. Further investigation with the ROV showed a considerable subsidence of the TGB (possibly up to 4.5 m). It was then decided to pull the casing, move the rig and respud the well. The Temporary Guide Base was sucessfully fished and seabed inspections with the ROV indicated a 1.5 m deep crater with a diameter of 14 m. Attempts to find the well itself with the ROV were unsuccessful and it was assumed that the well had caved in.

The rig was moved several times by pulling the anchor chains in order to respud. Six attempts were made before the TGB was sucessfully set with the skirt and anti-rotating dogs through the hard top layer.

The final rig position was:

N 57^{o} 49' 45.19"
E 04^{o} 45' 58.38"

The Temporary Guide Base was run and landed on seabed at an angle of zero degrees. The following distances on the new location were established:

- Seabed 124 m BDF
- Water depth 99 m

Well 9/3-1, was respudded at 13:30 hrs 01.08.86 using a 26" bit and a 36" hole opener assembly. The 36" hole was drilled to 215 m, with a maximum inclination of 2 degrees. While drilling the hole the temporary guidebase sunk 2-3 meters into the seabed.

7 joints of 30" casing (X-52, 310 lbs/ft and 457 lbs/ft for the housing joint) were run and landed with the permanent guide base and the angle of the guide base was zero degrees. The casing was cemented with the shoe at 204.5 m (BDF) and good cement returns to seabed were observed throughout the displacement. (Note: 200 percent excess cement slurry was pumped over and above theoretical open hole annulus volume).

The marine riser with hydraulic pin connector and dump valve were run and latched onto the 30" housing, the diverter system was function tested and pressure tested to 60 psi. The shaker valve and both overboard line valves were leaking.

The cement was drilled out from 193 m with an 8½" bit and a 26" underreamer and the well was displaced to a seawater/bentonite mud. An 8½" pilot hole was thereafter drilled to 540 m through the zones at 243 and 460 m identified on the site survey as possibly gas bearing. A maximum gas reading of 0.008 percent C1 was recorded when drilling the pilot hole at 370 m.

After reaching 540 m the ISF/LSS/GR/SP log was run. After standing up at 220 m with the logging tool, a check trip was made and the following logs were run without further difficulties:

ISF/LSS/GR/SP (Run nr. 1)
LDL/CNL/GR/CAL (Run nr. 1)

There were no indications of gas on the logs.

The hole was displaced to seawater in two stages: at 204 m and at TD and monitored for gas flow at the dump valve at each stage. No flow was observed. 1.03 SG viscous mud was spotted in the open hole before the string was pulled.

The pilot hole was opened to 26" down to 540 m with a 26" bit using sea water and high viscous pills on connections. 17 hours were lost on changing out a faulty motor on mud pump no. 2. On the following wiper trip a ledge at 215 m was reamed and high viscous mud was spotted in the open hole section before the string was pulled.

35 joints of 20" (X-52, 129 lbs/ft, Vetco LS-LH) casing were run on HWDP and cemented with the shoe at 528 m. (As no indications of gas were observed during drilling and logging the 26" hole section, a normal cement slurry was used compared to the thixotropic anti-gas migration slurry normally used when shallow gas is anticipated).

During displacing the cement the plug did not shear and the cement was displaced to theoretical volume (no bump) using the rig pumps. The BOP was run on the marine riser and successfully tested.

A 17½" bit was run to 514 m (baffle collar) and the casing was successfully pressure tested to 750 psi. The plug, baffle collar and guide shoe were drilled and 5 m of contaminated cement was washed down to 540 m whereafter a leak off test was performed to an equivalent stabilized mud weight of 1.24 SG. 197 m 2-7/8" tubing was run in on 5" drill pipe to 540 m and attempts to break circulation with maximum 3000 psi on the string were not successfull. The string was pulled and the tubing was found blocked 1 m above the mule shoe.

The string was cleaned and run back in to 540 m whereafter 30 bbls of 15.8 ppg cement slurry were spotted on bottom and 3.5 bbls were squeezed with maximum 400 psi surface pressure.

A 17½" bit was run and top of cement was tagged at 506.5 m. The cement and 5 meters of new formation were drilled displacing the hole to KCl polymer mud of 1.15 SG containing 15 ppg KCL whereafter a leak off test was performed to 1.40 SG equivalent mud weight.

17½" hole was drilled to 1360 m. Minimal gas levels were recorded during the whole interval with an average background reading of 0.01 percent C1 and with peaks of 0.025 percent C1 at 880 and 900 m.

The following logs were run:

ISF/LSS/SP/GR	(Run no. 2)	
LDL/CNL/GR/CAL	(Run no. 2)	
SHDT	(Run no. 1)	
SWS	(Run no. 1)	30 shots, 25 recovered, 5 lost

Following a wiper trip 105 joints of 13-3/8" (N80, 72 lbs/ft buttress) casing were run on HWDP and cemented with the shoe at 1349 m, whereafter the casing was successfully pressure tested to 3000 psi upon bumping the plug.

A 12-1/4" bit was run and top of cement tagged at 1331 m. The cement and 5 meters of new formation were drilled, whereafter a formation limit test was carried out to a stabilized equivalent mud weight of 1.80 SG.

Drilling of 12-1/4" hole proceded to 1483 m, with a 1.25 SG KCL polymer mud allowing the KCL content to drop, when 74 m of fill were experienced upon taking a single shot survey. The mud weight was increased to 1.40 and the KCL content was raised to 15 ppb. Drilling continued with considerable hole problems. Top reservoir was encountered at 1788 m. A formation limit test was successfully carried out to 1.65 SG and the mud weight was increased further to 1.55 SG in an attempt to combat the hole problems.

The following interval was cored, using a 12-1/4" fiberglass sleeve coring assembly

Core no. 1 1798 - 1814 m. Recovery 46%

During coring a 200 psi pressure increase was observed at 1814 m and upon retrieving the core the inner barrel was found parted 6.10 m from the top.

Drilling of 12-1/4" hole proceeded to 1884 m when the bit was pulled for the weekly BOP test.

During handling of bushings the T-bar lifting handle dropped in the hole and two attempts on fishing the T-bar with a 10.5" magnet run on HWDP were unsuccessful. Upon retrieving the wearbushing the T-bar was found stuck in same, whereafter the BOP-test was successfully carried out.

Drilling of 12-1/4" hole resumed to 1954 m where the string got differentially stuck making a connection. 45 bbls pipe lax was spotted across the assembly and the string was pulled free with 300,000 lbs overpull. Drilling was again continued reducing the mud weight to 1.50 SG and TD was reached at 1971.5 m after a minimum of 10 m of penetration of Triassic age was confirmed.

The following logs were run:

ISF/LSS/SP/GR	(Run no. 3)	
LDL/CNL/NGT/CAL	(Run no. 3)	
DLL/MSFL/GR	(Run no. 1)	
SHDT	(Run no. 2)	
SWS	(Run no. 2)	60 shots, 45 recovered 14 lost, 1 empty.
RFT	(Run no. 1)	
CBL/VDL	(Run no. 2)	
VSP	(Run no. 1)	

A 2-7/8"cement stinger was run in hole on 5" drill pipe to TD and abandonment cement plug no. 1 was set from 1971.5 m to 1910 m.

The cement stinger was pulled to 1900 m and abandonment cement plug no. 2 was set from 1900 - 1700 m. A 12-1/4" bit was run in hole and top of cement was tagged at 1696 m.

220 m of 2-7/8" cement stinger was run in hole on 5" DP to 1475 m whereafter a viscous pill was spotted from 1475 - 1400 m, the string was pulled up to 1400 m and abandonment cement plug no. 3 was set from 1400 - 1200 m. The plug was tagged with a 12-1/4" bit at 1216 m and successfully pressure tested to 1000 psi for 15 mins. Open ended 5" drill pipe with a mule shoe was run in hole to 190 m and a Schlumberger lubricator installed on top. Schlumberger was rigged up and run in hole with a 13-3/8" casing punching tool. The 13-3/8" casing was perforated at 201 m with 500 psi surface pressure to check for communication between the 13-3/8" annulus and the formation. No pressure drop was observed on surface. Schlumberger was rigged down and the string was pulled. A casing cutter assembly was run in hole and the 13-3/8" casing was cut at 225 m.
After the 13-3/8" was cut, the mud level dropped in the riser, and it was assumed that the 20" csg also had been cut. The riser was filled with seawater, 120 bbls, and the well was observed stable before the cutter assembly was pulled out and a casing spear was RIH to retrieve the 13-3/8" casing. Attempts to pull out the 13-3/8" casing failed and the spear was pulled. 220 m of 2-7/8" cement stinger on 5" DP was RIH to 450 m and a viscous pill was spotted from 450 - 375 m. The string was pulled up to 375 m and abandonment cement plug no. 4 was set from 375 - 230 m. The string was pulled back to 220 m and abandonment cement plug no. 5 was set squeezing 98 bbls slurry into the 13-3/8" x 20" casing annulus and 26" open hole. After waiting on cement, the top of cement was tagged at 227 m whereafter 112 m of 2-7/8" cement stinger was run in hole on 5" DP to 227 m and cement plug no. 6 was set from 227 - 150 m with no returns. The plug was tagged with an 8½" bit at 218 m. The final abandonment cement plug no. 7 was set from 218 - 150 m with 100 pct returns, and TOC was tagged at 158 m and weight tested to 10000 lbs. The marine riser and the BOP were pulled. The 18-3/4" wellhead was inspected with the underwater TV camera and the 13-3/8" wear bushing was observed to be protruding above the wellhead whereafter the wear bushing was retrieved. The wellhead explosive severing tool was run in hole on the

rig-sandline, and the 13-3/8", 20" and 30" casing were cut at 130 m.

The 18-3/4" H-4 connector was run on a jarring assembly and 5" DP and latched on to the 18-3/4" housing. The Permanent Guide Base, 30", 20" on 13-3/8" stumps were retrieved, but the Temporary Guide Base remained on seabed (subsided +/- 4 m below the mud line). A Temporary Guide Base fishing hook assembly was made up and run but attempts to fish the TGB failed. After a ROV seabed survey, the guide wires were cut and anchor handling commenced. At 02:00 hrs 05.09.86 the rig was on tow to Lyngdal (Rosfjord) and after 15 hrs waiting on weather and daylight to enter the fjord, the tow continued to Agnefest, the stack location. The rig went off contract 21:30 hrs 06.09.86.

BIT RECORD SUMMARY WELL NO 9/3-1

RUN NO.	BIT NO.	BIT SIZE INCH	EMFGR/TYPE	JET SIZE 1	2	3	4	DEPTH OUT	MTRS	HRS	WOB (1000 LBS)	RPM	PUMP PRESS (PSI)	GPM	MUD WT	VIS	CODE T	B	G	REMARKS
1	1	26 36	SEC S35J H/O	22 20	22 20	22 20	- 20	215	91	11.5	8-10	100	900	1000	S/W		1	1	I	Boulders at +/- 130 m.
2	1RR	26 36	Sec S35J H/O	22 20	22 20	22 20	- 20	215	91						S/W					Respudded 9/3-1
3	2	14-3/4 26	HTC R1 Servco U/R	16 16	16 16	16 16	- -	220 219	5 4	0.4	15	70	1850	1000	S/W		1 1	1 1	I I	Drilled cmt 193-215 m + new form 215 - 220 m.
4	3	8½	HTC X3A	16	16	16	-	540	320	8	3/10	100/120	700	400	S/W		3	3	1/16	8½" pilot hole.
5	1RR	26	S35J	22	22	22	-	219/540	321	10	5/10	100/120	1850	1103	S/W		1	1	I	Open up 8½" pilot hole.
6	4	17½	S35J	18	18	18	-	540	(5)	0.9	5/10	50/100	1750		S/W		1	1	I	Drilled 20" shoe track.
7	4RR	17½	S35J	18	18	18	-	703	33.5 cmt. 16.8 form	2.3 9.5	20/35	100/110	2600		1	19	5	4	1/16	Chalk and Lst.
8	5	17½	S13G	18	18	18	-	1360	657	60 11	35/45	100/110	3100		1	20	5	4	1/16	Slt, Clst
9	5RR	17½	S13G	18	18	18	-	1360	0	0	0	0	3100		1	20	5	4	1/16	Checktrip.
10	5RR	17½	S13G	18	18	18	-	1360	0	0	0	0	3100		1	20	5	4	1/16	Checktrip.
11	6	12-1/4	Sec/S44	14	14	14	-	1584	224	41	35/40	110	2600	600	1.22	45	6	4	I	
12	7	12-1/4	Reed/HP13	14	14	14	-	1798	214	26.5	35/40	115	2800/3100	600	1.35 1.40	60	3	3	I	
13	7RR	12-1/4	Reed/HP13	14	14	14	-	1798							1.55	55	3	3	I	Check trip.
14	8	12-1/4	Reed Weasel III	-	-	-	-	1814	16	3½	6/20	120/150	1500	470	1.55	52	10%			Coring.
15	9	12-1/4	Smith SDGH	14	14	14	-	1885	71	12½	30/45	100/120	3300	580	1.55	56	6	2	I	
16	10	12-1/4	Reed HP21	16	16	16	-	1911	26	14 19	30/55	120/90	2900	600	1.55	54	4	4	I	
17	11	12-1/4	HTC/J33	16	16	16	-	1953	42	16.5	35/40	80	2950	610	1.55	54	1	2	I	Differential sticking.
18	11RR	12-1/4	HTC/J33	16	16	16	-	1971.5	18.5	4.5	35	80	2700	610	1.50	53	2	3	I	
19	11RR	12-1/4	HTC/J33	16	16	16	-	1971.5	WIPER TRIP DURING LOGGING.						1.50	53	2	3	I	

TABLE 4.1

FORMATION LEAK OFF TEST DATA WELL 9/3-1

NO.	DATE	CASING		HOLE		MUD Wt. IN USE		MAX.EQUIVALENT MUD Wt.		STAB. EQUIVALENT MUD Wt.		REMARKS:
		SIZE (")	DEPTH (M)	SIZE (")	DEPTH (M)	SG	PSI/ 1000 FT	SG MAX/STAB	PSI/ 1000 FT MAX/STAB	SG	PSI/1000 FT	
1A	10/8	20	528	26	540	1.03	446	1.26	546	1.24	537	
1B	11/8	20	528	26	545	1.15	498	1.40	606	1.40	606	Squeezed 20" shoe drilled 5 m new form.
2	19/8	13-3/8	1349	17½	1365	1.215	526	1.80	779	1.80	779	Limit test.

TABLE 4.2

DEVIATION DATA WELL NO. 9/3-1

(MAGNETIC DECLINATION 4^{o} W. OF TRUE NORTH)

(DISTANCE FROM DRILL FLOOR (DF) TO MEAN SEA LEVEL (MSL) = 25 M)

Rig coordinates:
N 57 Deg 49' 45.19"
E 04 Deg 45' 58.38"
in UTM: N 6411210.8 m
Zone 34 E 604894.2 m

DEPTH AH (M.BDF)	ANGLE (DEGREE FROM VERT.)	DIRECTION (DEGREE MAGNETIC)	DIRECTION (DEGREE TRUE)	DEPTH T.V. MBDF	NORTHING (M.FROM LOCN)	EASTING (M.FROM LOCN)	DOG LEG (^{o}/ 100 M)
124	Tie in coordinates		0	124	0	0	-
210	2	-	145*	209.98	- 1.23	0.86	2.33
319	2-1/4	-	145*	318.91	- 4.54	3.18	0.23
425	2	-	145*	424.83	- 7.76	5.43	0.24
539	2	-	145*	538.77	- 11.02	7.72	0.00
549	1	149	145	548.36	- 11.23	7.87	0.00
634	0.5	140	136	633.75	- 12.11	8.55	0.60
697	1.5	123	119	696.74	- 12.71	9.46	1.64
799	1.5	143	139	798.71	- 14.36	11.50	0.51
896	1.5	125	121	895.68	- 15.97	13.43	0.48
1002	1	131	127	1001.65	- 17.24	15.35	0.49
1099	0.25	095	91	1098.65	- 17.76	16.24	0.84
1205	0.5	140	136	1204.65	- 18.10	16.79	0.35
1354	1	157	154	1353.63	- 19.73	17.81	0.37
1445	1.75	136	132	1444.61	- 21.38	19.19	0.99
1551	1.50	108	104	1550.57	- 22.80	21.74	0.78
1579	1.75	145	141	1578.56	- 23.22	22.36	3.78
1677	2.75	105	101	1676.49	- 24.83	25.61	1.84
1792	4.50	103	99	1791.25	- 26.06	32.78	1.53
1879	5	103	99	1877.95	- 27.19	39.89	0.57
1971.5 (TD)	5*	-	99*	1970.10	- 28.45	47.86	0.00

* Extrapolated values.

Based upon minimum curvature calculations. The bottom hole displacement is 55.68 m in the direction of AZ.120.73 degs (TN).
Bottom hole displacement is relative to wellhead.
Note: Survey points from Totco's and Magnetic Single Shots.

TABLE 4.3

JOB DATE	JOB DESCRIPTION	HOLE SIZE/ DEPTH (M. BDF)	CASING SHOE (M.BDF)	CEMENT TYPE	SACKS USED	SLURRY WEIGHT (PPG)	MIXWATER	ADDITIVES	LOSSES (BBLS)	REMARKS
02.08.86	30" Casing	36"/215	204.5	Class G	1711	lead: 13.2 PPG Tail: 15.8 PPG	 S.Water S.Water	 0.36 GPS Econolite 3% BWOC $CaCl_2$ (77%)	- -	Cement 30" casing under tension due to subsidence of TGB. Top housing at 121.5 m BDF.
09.08.86	20" casing	26"/540 m	528	Class G	1898	Lead: 13.2 PPG Tail: 15.9 PPG	 F.Water F.Water	 0.36 GPS econolite 1% BWOC $CaCl_2$	-	WOC without bleeding off the differential pressure.
10.08.86	20" casing squeeze job	17½"/535 m	528 m	Class G	266	15.8 PPG	F.Water	1% BWOC $CaCl_2$	-	
18.08.86	13-3/8" casing	17½"/1360	1349 m	Class G	1900	Lead: 13.2 Tail 15.8	 F.Water F.Water	 Lead: 0.36 GPS econolite Tail: 0.22 GPS CFR-2 l	-	
31.08.86	Abandonment plug no. 1	17½"/1971.5	-	Class G	146	15.8 PPG	F.Water	0.09 GPS HR-6 l	-	Abandonment plug no. 1 1971.5 - 1910 m
31.08.86	Abandonment plug no. 2	17½"/1900	-	Class G	517	15.8 PPG	F.Water	0.09 GPS HR-6 l	-	Abandonment plug no. 2 (1900 - 1700 m) tagged TOC at 1696
01.09.86	Abandonment plug no. 3	17½"/1400	-	Class G	518	15.8 PPG	F.Water	0.22 GPS CFR-2 l	-	Abandonment plug no. 3 (1400 - 1200 m). Tagged TOC at 1210 m.
02.09.86	Abandonment plug no. 4	Inside 13-3/8 csg/ 375	-	Class G	338	15.8 PPG	S.Water	2% BWOC $CaCl_2$	No returns	Abandonment plug no. 4 (375 - 230 m). Cuts in 13-3/8 & 20" csg at 225 m, no returns to surface.
02.09.86	Abandonment plug no. 5	Inside 13-3/8 csg/ 230	-	Class G	480	15.8 PPG	S.Water	2% BWOC $CaCl_2$	No returns	Abandonment plug no. 5. Squeeze thru cut 13-3/8" and 20" csg. Tagged TOC at 227 m.
02.09.86	Abandonment plug no. 6	Inside 13-3/8 csg 227	-	Class G	182	15.8 PPG	S.Water	2% BWOC $CaCl_2$	No returns	Abandonment plug no. 6: (227-150 m) Tagged TOC at 218 m.
03.09.86	Abandonment plug no. 7	Inside 13-3/8" csg/ 218	-	Class G	159	15.8 PPG	S.Water	2% BWOC $CaCl_2$	-	Abandonment plug no. 7 (218-150 m) Tagged TOC at 158 m.

TABLE 4.4

CASING DATA WELL NO 9/3-1

DATE RUN	SIZE	GRADE	WT/FT	COUPLING	SHOE DEPTH (MBDF)	REMARKS
02.08.86	30"	X-52	Housing jnt: 457 lbs/ft Rest: 310 lbs/ft	Vetco ST-2	204.5 m BDF	Cement 30" casing in tension due to subsidence of TGB.
09.08.86	20"	X-52	129 lbs/ft	Vetco LS-LH	528 m BDF	dart failed to shear. overdisplaced cmt.
18.08.86	13-3/8	N-80	72 lbs/ft	BTC	1349 m BDF	

TABLE 4.5

TABLE 4.6

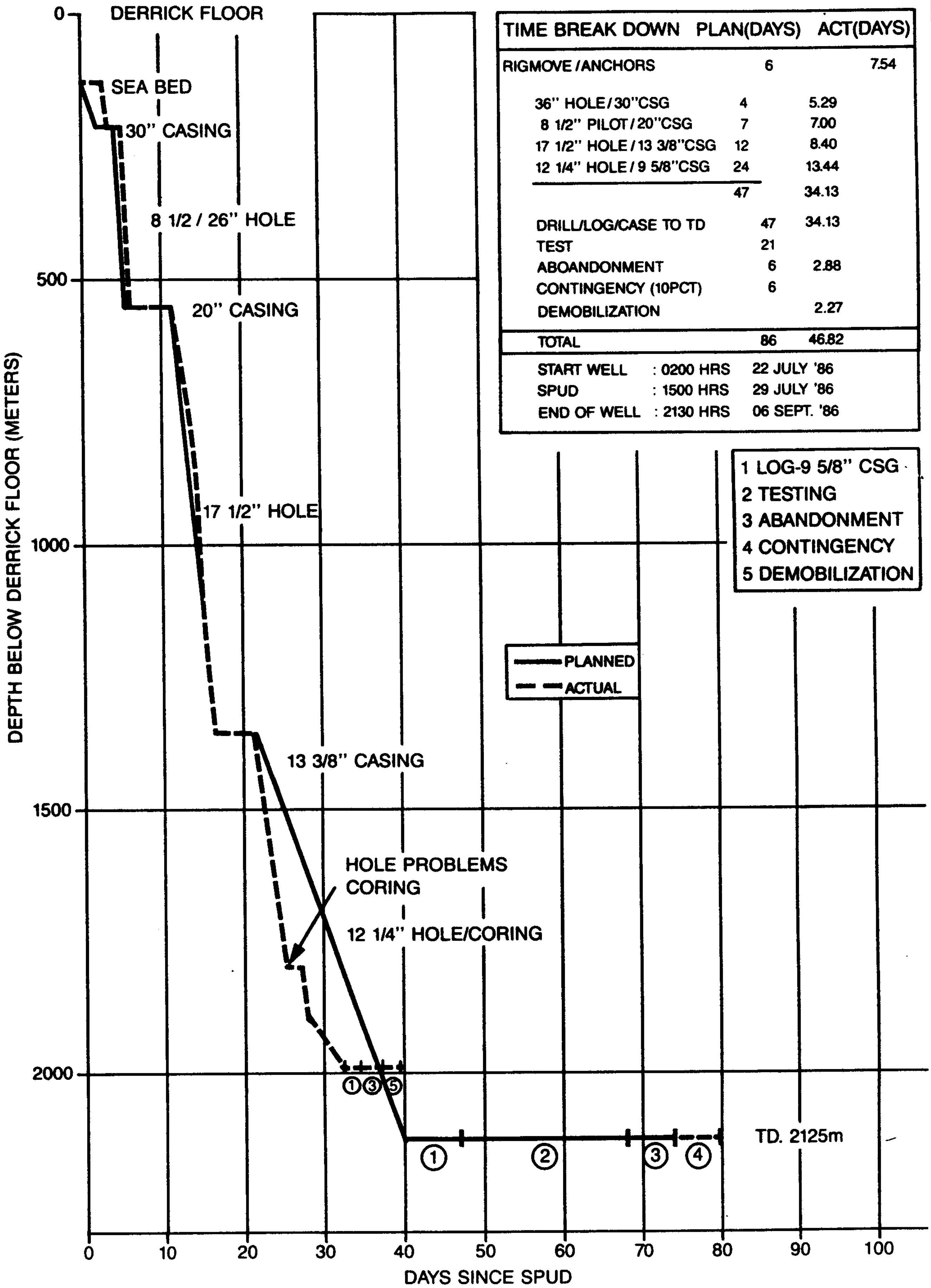
TIME ALLOCATION 9/3-1

Started well at 02:00 hrs 22.07.86.
Spudded well at 15:00 hrs 29.07.86.
Finished well at 21:30 hrs 06.09.86.

PHASE	ITEM	JULY	AUG.	SEPT.	TOTAL HRS	%
PREPARATION	- Towing	147			147	13.08
	- Laying/ pulling anchors	14.5			14.5	1.29
	- General preparation	27	13.5		40.5	3.61
	Sub total	188.5	13.5		202	17.98
DRILLING	- Bit on bottom	17	251		268	23.85
	- Round tripping	4.5	111		115.5	10.28
	- Reaming/ enlarging	2	38		40	3.56
	- Circulation/ condition mud		31.5		31.5	2.81
	- Condition hole for casing	3	14.5		17.5	1.56
	- Running casing/drilling cement	17.5	30		47.5	4.22
	- Leak off test		5.5		5.5	0.49
	- Cementing & WOC		33		33	2.94
	- Running/ pulling riser BOP		27		27	2.41
	- Flanging up and testing		35		35	3.12
	- Repairs (pumps/ drawworks)		28		28	2.49
	- Surveys	0.5	24.5		25	2.23
	- Waiting on weather		6		6	0.53
	- Fishing, stuck pipe	5	7		12	1.07
	Sub total				691.5	61.55
EVALUATION	- Coring (on bottom)		4		4	0.36
	- Round trip with core barrel		7		7	0.62
	- Circulating for samples/ condition hole for coring		2.5		2.5	0.22
	- Recovery of core		3		3	0.27
	- Condition hole for logging		4.5		4.5	0.40
	- Logging		64		64	5.69
	- RFT testing		3		3	0.27
	- Waiting on weather		0.5		0.5	0.04
	Sub total				88.5	7.87
SUSPENSION	- Plugging back and WOC			36	36	3.20
	- Cut/retrieving casing			17	17	1.51
	- Pull riser/BOP stack			10	10	0.89
	- Lay down string			9.5	9.5	0.85
	- Fishing			9.5	9.5	0.85
	- Preparing for rigmove			5	5	0.45
	- Anchor handling/off loading			24.5	24.5	2.18
	- Tow			13.5	13.5	1.20
	- Waiting on weather			16.5	16.5	1.47
	Sub total				141.5	12.58
		TOTAL HOURS:			1123.5	100.000
		Total time:		46 days	19.5 hrs	

FIG. 4.1

9/3-1 DRILLING PROGRESS CURVE



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TIME COST CURVE 9/3-1

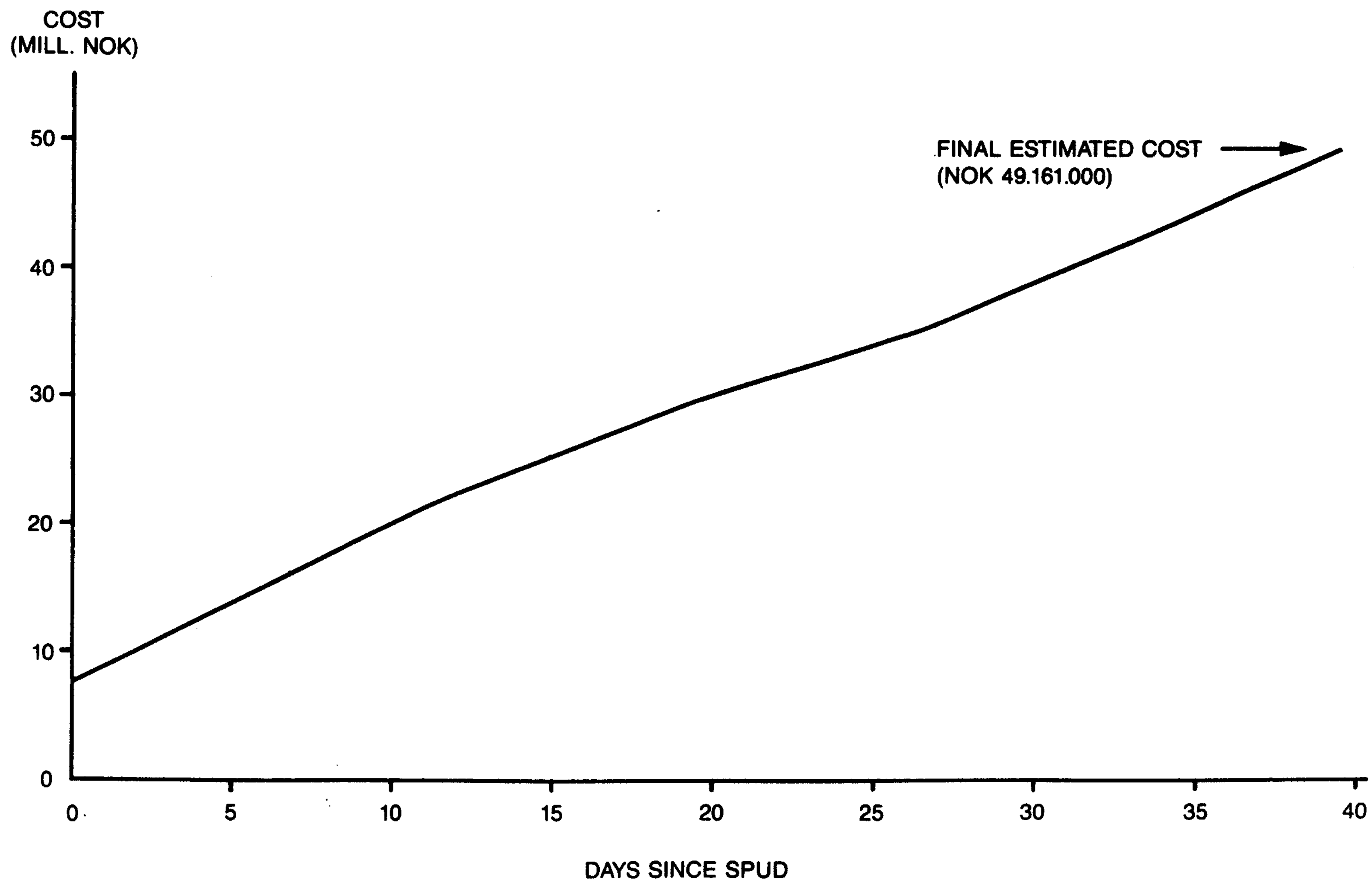


FIG.4.2

5. MUD REPORT

The mud report, prepared by Gearhart Geodata Services Ltd., was distributed to NPD and Partners 03.10.86.

6. GEOLOGICAL REPORT

Introduction

Well 9/3-1 is located in the south-western part of Block 9/3 on seismic line 85-2261 (SP 105).

Final coordinates were:

N 57^{o} 49' 45.19"
E 04^{o} 45' 58.38"

The objective of the well was to test Middle Jurassic sandstones in a salt induced domal trap developed at the edge of the Stavanger Platform.

The well did not encounter any hydrocarbons.

6.1 Sample Collection

Ditch Cuttings

Cuttings samples were collected every 10 m from 205 to 1349 m and every 3 m in the interval 1349 m to 1972 m (TD).

The cuttings log was distributed to NPD and partners 16.10.86.

Sidewall Samples

Sidewall samples were shot in all hole sections below 20" casing. A total of 90 samples were attempted, 70 of which were recovered.

The table below summarises the distribution of the sidewall cores at different intervals in the hole.

NUMBER OF SIDEWALL SAMPLES: TABLE 6.1

Hole size	Interval (m bdf)	No. of shots	No. of SWS recovered
17 1/2"	540 - 1360	30	25
12 1/4"	1360 - 1972	60	45
		90	70

Cores

One conventional core was cut:

Core no. 1: 1798 - 1814 m, recovery 44%.

A detailed lithological description of the core is presented in Enclosure 3.

6.2 Stratigraphy

A biostratigraphic study of exploration well 9/3-1 was undertaken to achieve a comprehensive understanding of the whole well, from the Tertiary down to the Triassic. Analyses were carried out on 8 core, 57 sidewall and 24 cuttings samples. Results were integrated with log analysis for the Tertiary and Cretaceous intervals.

Micropalaeontological and nannoplankton analyses were carried out at Shell's Research Laboratory in Holland whilst palynological and palynofacies analyses were carried out at A/S Norske Shell, Stavanger. The biostratigraphic breakdown is based on internationally recognized species, whereas the palynofacies studies are based on in-house studies.

Formation tops and the biostratigraphic subdivision are presented in Tables 6.2 and 6.3 respectively. The subdivisions are also displayed on the completion log and the well summary sheet (Enclosures 1 and 2).

A lithological description of the different formations is presented below.

Nordland/Hordaland Group (Sea floor (99 m bdf) - 454 m)

From seafloor (124 mbdf) to 217 m no returns to surface.

Light to dark grey, very soft and sticky, homogenous clay was encountered. The clay was occasionally glauconitic, calcareous or contained traces of pyrite or quartz grains.

Rogaland Group (454 - 532 m)

Balder Formation (454 - 468 m)

Sandy tuff; purple-grey-white, speckled, intercolated with multicoloured claystone often pyritic and calcareous.

Sele Formation (468 - 476 m)

The formation consits of brown-grey-green soft claystone which is occasionally calcareous and carbonacerous.

Lista Formation (486 510 m)

The Lista Formation is a predominately shaly sequence with minor silty and sandy intervals.

Maureen Formation (519 - 532 m)

This formation contains medium to dark grey shale sequences, limestone layers and light grey marl layers.

Chalk Group (532 - 852 m)

Ekofisk Formation (532 - 580 m)

Whitish limestone, occasionally chalky with traces of light grey - light brown chert in the lower part.

Tor Formation (580 - 754 m)

The formation consists of medium to light grey limestone, occasionally slightly argillaceous.

Hod Formation (754 - 852 m)

Mainly light limestone, chalky in parts.

Cromer Knoll Group (852 - 1433 m)

Sola Formation (52 - 915 m)

Consists mainly of dark grey claystone with traces of marl, limestone, dolomite and sand.

Valhall Formation (915 - 1433 m)

The upper part of the formation consists of medium grey claystone with sandy streaks, and is occasionally calcareous. The lower part is becoming more silty and argillaceous.

Boknfjord Group (1433 - 1788 m)

Flekkefjord Formation (1433 - 1488 m)

Consists of silty claystone.

Sauda Formation (1488 - 1686 m)

Silty claystone, occasionally with stringers of dolomite.

Tau Formation (1686 - 1749 m)

Medium to dark grey claystone, occasionally silty. In the middle part the formation is carbonaceous.

Egersund Formation (1749 -1788 m)

Shaly sequence interbedded with dolomite and sandstone streaks.

Vestland Group (1788 - 1955 m)

Sandnes Formation (1788 - 1814 m)

Fine to medium grained and moderately sorted sandstone with minor traces of clay and limestone.

Bryne Formation (1814 - 1955 m)

Fine to coarse grained sandstone occasionally interbedded with silt, shale, claystone and coal.

New Red Group (1955 - 1972 m)

Skagerak Formation

Locally redish fine to coarse grained sandstone with traces of red-brown silty claystone and shale.

FORMATION TOPS WELL 9/3-1 TABLE 6.2.1

	m bdf
Hordaland/Nordland Group	124
Rogaland Group	454
Balder Formation	454
Sele Formation	468
Lista Formation	476
Maureen Formation	519
Chalk Group	532
Ekofisk Formation	532
Tor Formation	580
Hod Formation	754
Cromer Knoll Group	852
Sola Formation	852
Valhall Formation	915
Boknfjorden Group	1433
Flekkefjord Formation	1433
Sauda Formation	1495
Tau Formation	1686
Egersund Formation	1748
Vestland Group	1787.5
Sandnes Formation	1787.5
Bryne Formation	1813.5
New Red Group	1955
Skagerak Formation	1955
TD	1972

m bdf		
At 225 m	:	Oligocene-Middle Miocene (?Oligocene)
300-340 m	:	Oligocene-Early Miocene (?Oligocene)
380-510 m	:	Eocene
520-550 m	:	Late Cretaceous or Palaeocene
614-682 m	:	Late Maastrichtian (NK 25-26)
At 739 m	:	Late Campanian (NK 19-22)
At 796 m	:	Late Santonian-Early Campanian (?Early Campanian (NK 16-18))
At 842 m	:	Santonian (NK 14-17)
865-962 m	:	Late Aptian-Earliest Albian (NK 7c)
1015-1029 m	:	Early Aptian (NK 7a-b)
1053-1118 m	:	Barremian?
1133-1242 m	:	Hauterivian (NK 4)
1272-1340 m	:	ND
At 1357 m	:	Late Berriasian/Early Valanginian (NK 2)
At 1416 m	:	Late Berriasian (J.11.2)
1435-1456 m	:	Early Berriasian (J.11.1)
1495-1558 m	:	Early/Late Portlandian (J.10.1/J.10.2)
1576-1697 m	:	Early Portlandian (J.10.1)
1703-1715.5 m	:	ND
At 1728 m	:	Mid to Late Kimmeridgian (J.9.2-J.9.3)
1733-1736 m	:	Mid Kimmeridgian (J.9.2)
1748-1759 m	:	Early Kimmeridgian (J.9.1)
1771-1789 m	:	Oxfordian (J.6-J.8)
1798.6-1807 m	:	Mid Callovian (J.5.2)
1815.5-1938 m	:	Bajocian-Bathonian (J.3-J.4)
At 1940 m	:	Late Toarcian-Aalenian (J.2.3)
1948-1969 m	:	ND/NF

6.3 Hydrocarbon Indications

No fluorescence or other hydrocarbon indications were observed on cuttings or on any of the 70 SWS recovered. The following is a brief description of gas readings as encountered whilst drilling. The peaks are indicated on the completion log (Encl. 1).

Quarternary/Tertiary (SF - 532 mbdf)

Only traces of C_1 were encountered, with readings 0.001%-0.01%.

Chalk Group (532 - 852 mbdf)

C_1 readings 0.001%-0.01%.

Cromer Knoll Group (852 - 1433 mbdf)

Small increase in gas readings, consisting of 0.01-0.02% C_1l

Boknfjord Group (1433 - 1787 mbdf)

Only 0.01% C_1, in upper parts, falling off to 0.005%. Increasing from 1700 m to 0.06% peak at 1710-1730 m, and 0.01-0.02% down to base of sequence.

Vestland Group (1787.5 - 1955 mbdf)

C_1 readings of 0.01-0.02%, reaching a peak of 0.045% around 1835 m (top of Bryne Fm.) decreasing to 0.01-0.01% and falling to 0.005% at base.

6.4 Seismic Calibration

Velocity Survey

A check shot survey was carried out between 400 m and 1960 m (BDF) by Schlumberger. After the first shot at 400 m, shots were taken at 50 m intervals between 490 m and 1350 m followed by shots at 20 m intervals down to 1960 m. A total of 51 shots were recorded.

These shots were also used to produce a zero offset VSP.

Acoustic Impedance/Synthetics

An acoustic impedance trace has been derived from the sonic log (calibrated with check shots) and the density log.

The synthetic seismograms were processed with a minimum phase wavelet and a zero phase Ricker wavelet and have been displayed at normal and reverse polarities. The zero phase version with normal polarity is shown in Enclosure 3.

Stratigraphic Identification of Reflectors

The synthetic seismogram has been spliced into seismic line 85-2261 (Enclosure 4). The fit of both is excellent giving a good correlation to the geological markers.

A summary of the two way travel times (datum MSL) and the formation tops (datum DF) is given in Table 6.4.

TWO-WAY REFLECTION TIMES TO FORMATION TOPS

TABLE 6.4

FORMATION	Depth (m bdf)	TWT (sec m.s.l.)
Balder	454	0.499
Sele	468	0.514
Lista	476	0.523
Maureen	519	0.569
Ekofisk	532	0.583
Tor	580	0.618
Fault		
Hod	754	0.731
Sola	852	0.798
Valhall	915	0.852
Flekkefjord	1433	1.269
Sauda	1487	1.310
Tau	1686	1.456
Egersund	1748,5	1.505
Sandnes	1787,5	1.531
Bryne	1813,5	1.547
Skagerak	1955	1.626

6.5 Geological Setting

The Egersund Sub-Basin, which forms part of the Norwegian-Danish Basin, lies some 100-200 km southwest of Stavanger. The northern part of the Sub-Basin is a NNE-SSW trending Triassic half-graben between the Caledonian basement of the Stavanger Platform and the Sele High. Further northward, the Sub-Basin is separated from the Stord Basin by a saddle over which the Triassic thins, and north of which Zechstein salt is absent. In the southern part of the Sub-Basin, where a NW-SE orientation dominates, the tilted Triassic graben is less conspicuous. The Sub-Basin's southwestern boundary is the Flekkefjord High.

Structural development during the Mesozoic was influenced by movement of Zechstein salt triggered by transcurrent movements along the Tornquist Zone. In Early Cretaceous times, the southern part of the Sub-Basin became clearly differentiated from the Norwegian-Danish Basin, and thickness variations associated with salt related faulting became more evident. During Late Cretaceous and Early Tertiary times, Alpine orogenic events triggered further halokinetic movements, and caused the inversion of the southern part of the sub-Basin along its NW-SE oriented boundaries. Intra-Chalk onlap can be clearly observed along the Stavanger Platform.

In the area of the Egersund Sub-Basin, hydrocarbons were found in wells 17/12-1 (Bream), 17/12-2 (Brisling) and 18/10-1. All the hydrocarbons are in sandstones of the Middle Jurassic Vestland Group, capped by Upper Jurassic and Lower Cretaceous claystones. All three structures are underfilled with only 10-30% of the trap volume hydrocarbon-bearing. API gravities for the oils encountered vary from 28^0 to 36^0, and geochemical analysis indicates that the oils were generated from similar source rocks with a low maturity. In the case of Brisling, there is evidence of slight bacterial degradation.

The kitchen area to the southwest of Block 9/3 is closely related to a Lower Cretaceous depocentre. The Tau Formation source rock shows a predominantly low to intermediate maturity level for oil generation (VR/E = 0.62-0.80) which was first reached in

Late Eocene to Early Oligocene times at approximately 2800 m depth of burial.

Middle Jurassic Vestland Group reservoirs provide a simple hydrocarbon migration path for interbedded source rocks, if any. However, for the Tau Formation "hot shales" to charge the stratigraphically underlying Vestland Group, downwards migration has to take place through the intervening Egersund Formation. The latter consists of silty claystones with local calcite stringers and is believed to be present over most of the area. In well 9/3-1 it is 40 m thick. Updip migration of hydrocarbons may be enhanced by faulting which is, however, best developed on the margins of the Bream and Brisling kitchens.

The total absence of any hydrocarbon shows in well 9/3-1, both in the target reservoir interval which was adequately developed (167.5 m gross) and in the Cretaceous and Upper Jurassic overburden strongly suggests that no hydrocarbons have been expelled from the adjacent kitchen even if they have been generated.

6.6 Reservoir Geology

The principal reservoir potential in Block 9/3 lies in the Middle Jurassic Vestland Group, which consists of the fluvio-deltaic Bryne Formation separated by a hiatus from the overlying coastal to shallow marine Sandnes Formation. The Bryne Formation is characterised by good sands with interbedded shales and coals most abundant in the lower part of the formation. The thickness of the formation varies from 0-150 m. In contrast, the Sandnes Formation is a generally cleaner sand body up to 75 m thick. Whenever both formations are present, the Sandnes Formation is always the thinner of the two. In well 9/3-1 the Vestland Group was found to be 167.5 m thick with porosities up to 29.5%. Permeability measurements from the core in the Sandnes Formation give an average value of about 1000 mD, but as high as 4700 mD in one instance.

Within the Bryne Formation, argillaceous/coaly interbeds predominate in the northern part of the Sub-Basin, whilst sand bodies are better developed farther south. The highest net to gross ratios (70-90%) are found where gross reservoir thickness is at a minimum.

Sands within the Triassic Skagerak Formation show poor sorting and high clay content, as well as diagenetic changes that have strongly affected reservoir properties. This unit is, therefore, considered to be a waste zone.

6.7 Dipmeter Survey

A dipmeter was run over the interval 530-1979 m, giving the following general readings:

Chalk Group (532 - 852 m)

Ekofisk Formation (532 - 580 m)

In the upper part, this interval gives complicated dip patterns. From 550 m, dips increase gradually from 2-30^{o} with variable orientation.

Tor Formation (580 - 754 m)

Upper part with many unreliable readings and varied orientation with 10-50^{o} dip. Below 620 m mainly 5-20^{o} dip in NW direction. Basal part shows gradual increase and decrease in dips.

Hod Formation (754 - 852 m)

Very consistant dip of 5-6^{o} to the NW.

Cromer Knoll Group (852 - 1433 m)

Sola Formation (852 - 915 m)

Mainly unreliable readings with highly varied orientation, concentrated at 10-40^{o} NW.

Valhall Formation (915 - 1443 m)

Many unreliable readings 10-40^0, mainly NW-W. From about 1200 m with NW orientation.

Boknfjord Group (4133 - 1787.5 m)

Flekkefjord Formation (1433 - 1487.5 m)

Many unreliable readings with 10-30^0 dips NW-W, slightly steeper dips in uppermost part.

Sauda Formation (187 - 1686 m)

Mainly 10-30^0 dips NW, but bimodally NW-SW orientation at basal part.

Tau Formation (1686 - 1748.5 m)

5-20^0 dips NW, somewhat steeper at top of interval.

Egersund Formation (1748.5 - 1787.5 m)

8-20^0 dips, all in NW direction.

Vestland Group (1787.5 - 1955 m)

Sandnes Formation (1787.5 - 1814 m)

Very similar to Egersund Formation, with 8-20^0 dips NW.

Bryne Formation (1814 - 1955 m)

To 1850 m, very similar to Egersund and Sandnes Formation with 8-20^0 dips, all to NW. Below somewhat steeper: 6-30^0 NW.

New Red Group (1955 - 1972 m)

Skagerak Formation (1955 - 1972 m)

8-20^0 dips, mainly NW orientation.

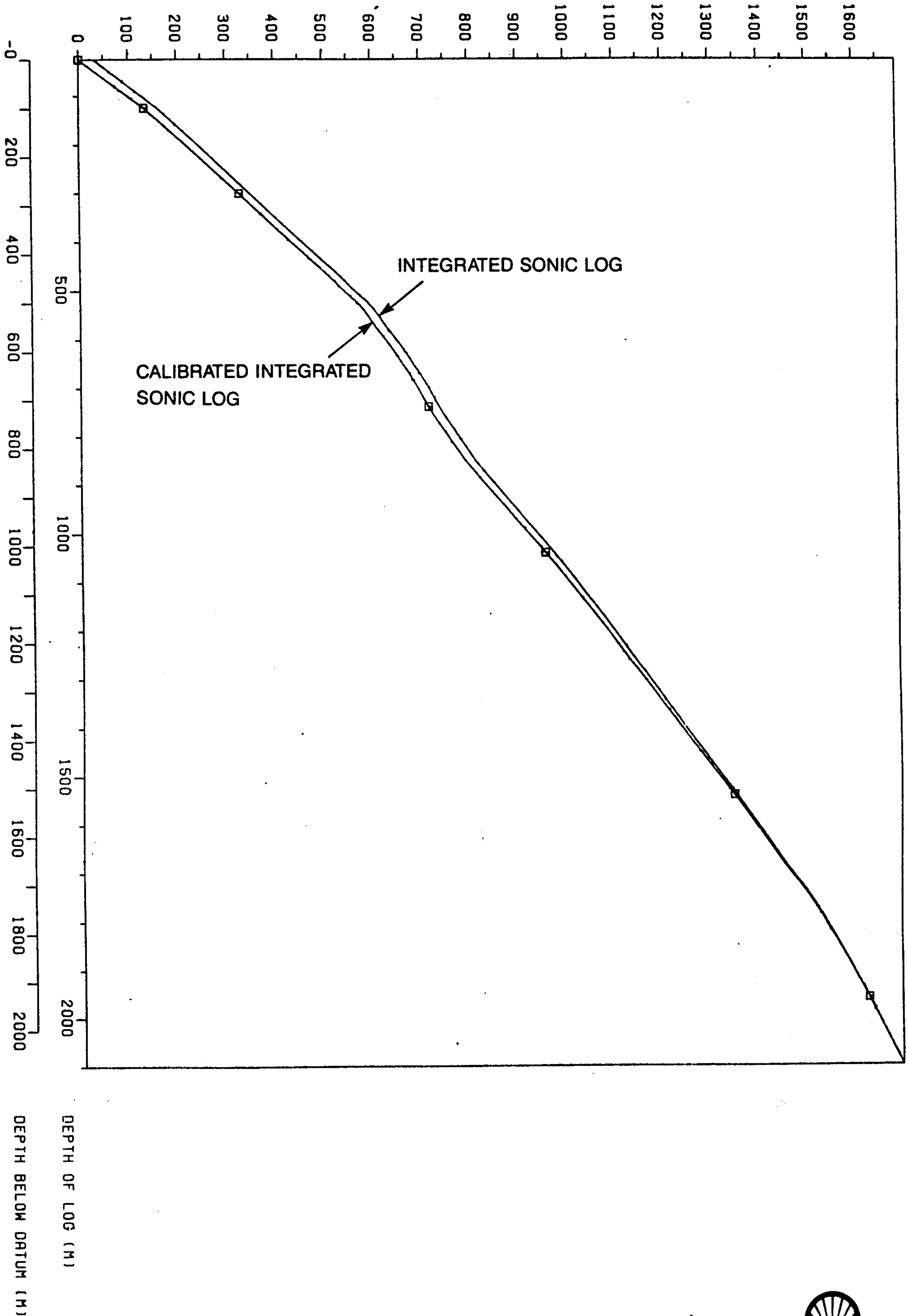
6.8 Conclusions

Well 9/3-1 penetrated a total of 167 m of sands and shales assigned to the Middle Jurassic Vestland Group (Sandnes and Bryne formations) between 1788 m and 1955 m bdf, at which depth the well passed unconformably into sandstones of the Triassic Skagerak Formation. The Vestland Group sandstones were found to be of good reservoir quality but entirely water-bearing. Furthermore, apart from a small increase in the methane count across the source rock interval in the Upper Jurassic Tau Formation (1700-1720 m bdf), the Upper Jurassic and Lower Cretaceous shales and claystones yielded an extremely low methane count throughout. This indicates lack of hydrocarbon charge from the kitchen some 13 km to the southwest, rather than seal failure at the crest of the structure.

The anomalously high heat flux recorded in well 9/3-1 can be attributed to the focussing effect of heat flux induced by the juxtaposition of the Stavanger Platform Basement fault and the diapir beneath 9/3-1 against the clastic section in the Egersund sub-basin. To preserve a realistic isotherm profile across the basin margin, a lower heat flow is advocated in the kitchen area southwest of the well. Re-calculation of thermal maturity at the level of the Upper Jurassic source rocks now indicates that, in the deepest part of the kitchen, they have only recently entered the zone of oil generation. It is believed that in this situation thermodynamic energy levels are too low to expel liquid hydrocarbons even if they have been generated.

FIG.6.1

TWO-WAY TIME VERSUS DEPTH WELL 9/3-1



7. PETROPHYSICAL EVALUATION

A summary of the wireline logs run by Schlumberger is presented in Table 7.1. All logs run were of good quality. A plot of the main logs run and the results of the petrophysical evaluation over the objective interval is attached as Enclosure 9. All sands are interpreted as water bearing.

One core was taken in the well, the measurements on which are attached as Appendix 2. It was found necessary to depth match the core measurements to the loggers depth by adding 2 m to the core depth. The core measurements included in the plot, (Enclosure 6) are shown depth corrected.

7.1 Porosity Calculation

Porosity was calculated from the density log recorded by the Litho-Density Tool (LDT). A matrix density of 2.66 grams/cc, which corresponds to the average grain density measured on core samples, was used in the calculation. A histogram of the grain densities measured on the core samples is attached as Enclosure 10.

A fluid density of 1.07 gm/cc was used in the porosity calculation. This gives a good match between core and log data and agrees well with the expected density based on mud filtrate resitivity measurements.

7.2 True Formation Resistivity (Rt)

Due to the low formation resistivity in the sands, the borehole effect corrected Deep Induction Log was taken as the best measurement of Rt. Borehole correction parameters were taken from log heading information i.e. a stand-off of 1½ inches and a mud resistivity of 0.074 ohm-metres.

7.3 Hydrocarbon Saturation and Formation Water Resistivity

An Archie model was used to evaluate the sand intervals. The cementation factor m and the saturation exponent n were taken as 2.00. The formation water resitivity, Rw, was derived by log analysis. A value of 0.025 ohm-metres was found, which at a bottom hole temperature of 71^{o}C implies a formation water salinity of 170,000 ppm NaCl equivalent and an in-situ formation water density of 1.12 grams/cc. This agrees well with the formation pressure gradient derived from RFT pressure measurements.

SUMMARY OF LOGGING OPERATIONS WELL 9/3-1 <u>TABLE 7.1</u>

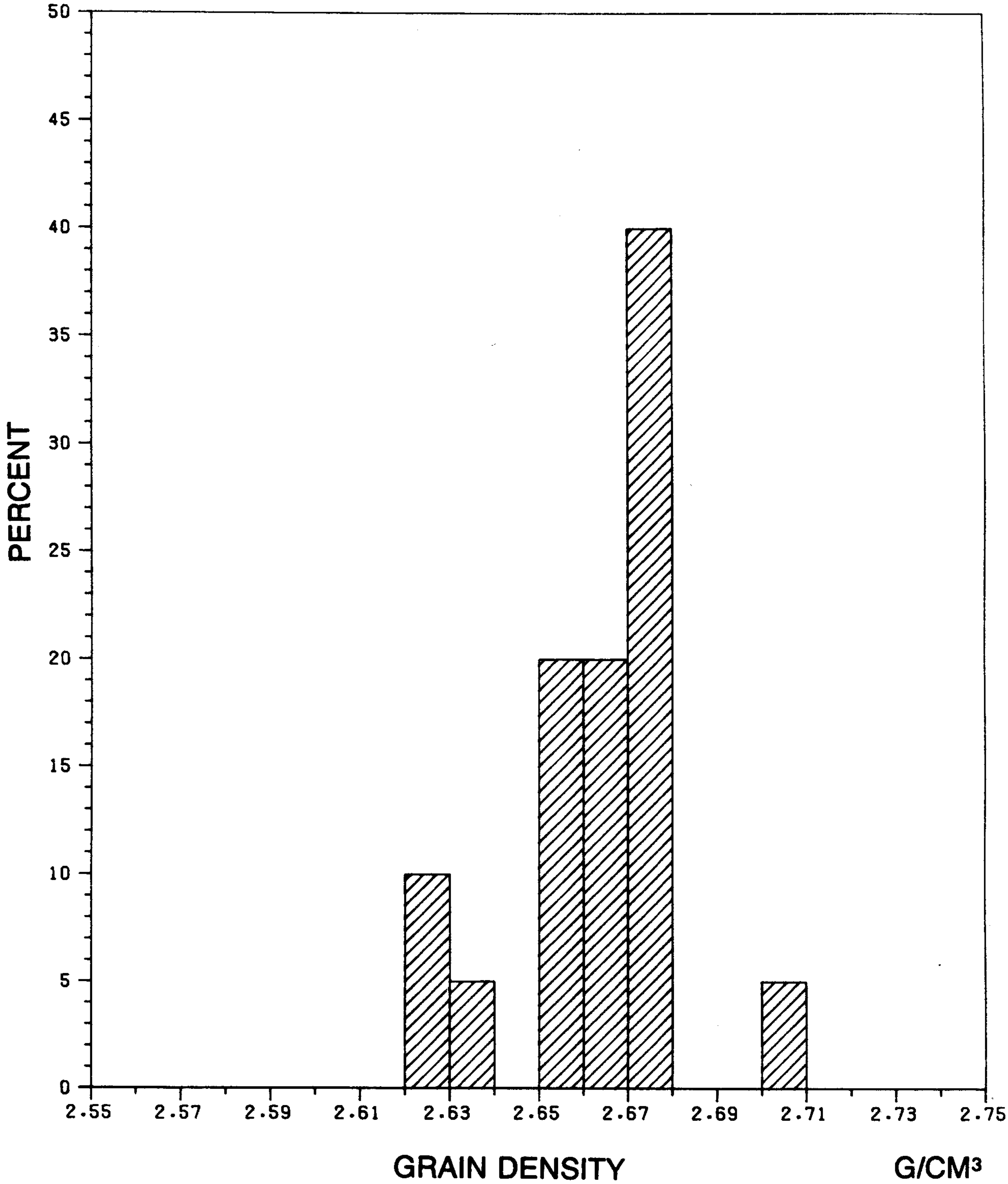
LOGGING CONTRACTOR: SCHLUMBERGER RIG: BORGNY DOLPHIN DFE: 25 M

DEPTH CASING M AHBDF	DEPTH DRILLER M AHBDF	BIT SIZE INCHES	LOG TYPE	RUN NO.	INTERVAL LOGGED M AHBDF	DATE	REMARKS
204.5	540	8.50	ISF/LSS/GR	1	540- 204	05.08.86	LOGGING IN
			LDL/CNL/GR	1	540- 204	05.08.86	PILOT HOLE.
528	1360	17.50	ISF/LSS/GR	2	1356- 529	16.08.86	
			LDL/CNL/GR	2	1356- 529	16.08.86	
			SHDT/GR	1	1354- 529	16.08.86	
			SWS	1	REC.25	17.08.86	
1349	1972	12.25	DIL/LSS/GR	3	1979-1350	29.08.86	
			LDL/CNL/NGL	3	1971-1350	30.08.86	
			DLL/MSFL/GR	1	1967-1350	30.08.86	
			SHDT	2	1972-1350	30.08.86	
			RFT	1	8 PRES.	31.08.86	
			SWS	2	REC.45	30.08.86	
			VSP	1		31.08.86	
			CBL/VDL	1	1335- 230	31.08.86	(13-3/8"CSG)

FIG.7.1

WELL 9/3-1

DISTRIBUTION OF GRAIN DENSITY MEASURED ON CORE 1



8. WIRELINE FORMATION TESTS

A Repeat Formation Tester (RFT) was run in the 12 1/4" hole, and 8 pressure tests were recoreded. All pressure tests are interpreted to give good formation pressure. The pressures were recorded using a Schlumberger Strain Gauge. No attempts were made to take any formation fluid samples.

Mud hydrostatic pressures before and after the pressure tests exhibited differences less than 5 psi. The mud-gradient was 0.66 psi/ft (1.52 g/cc) (an overbalance to the formation of approx. 1000 psi).

Conclusions

The formation fluid gradient was found to be 0.46 psi/ft (1.07 g/cc), and the formation pressure was 2950 psi (203.3 bar) at 1810 m BDF (1785 m ss).

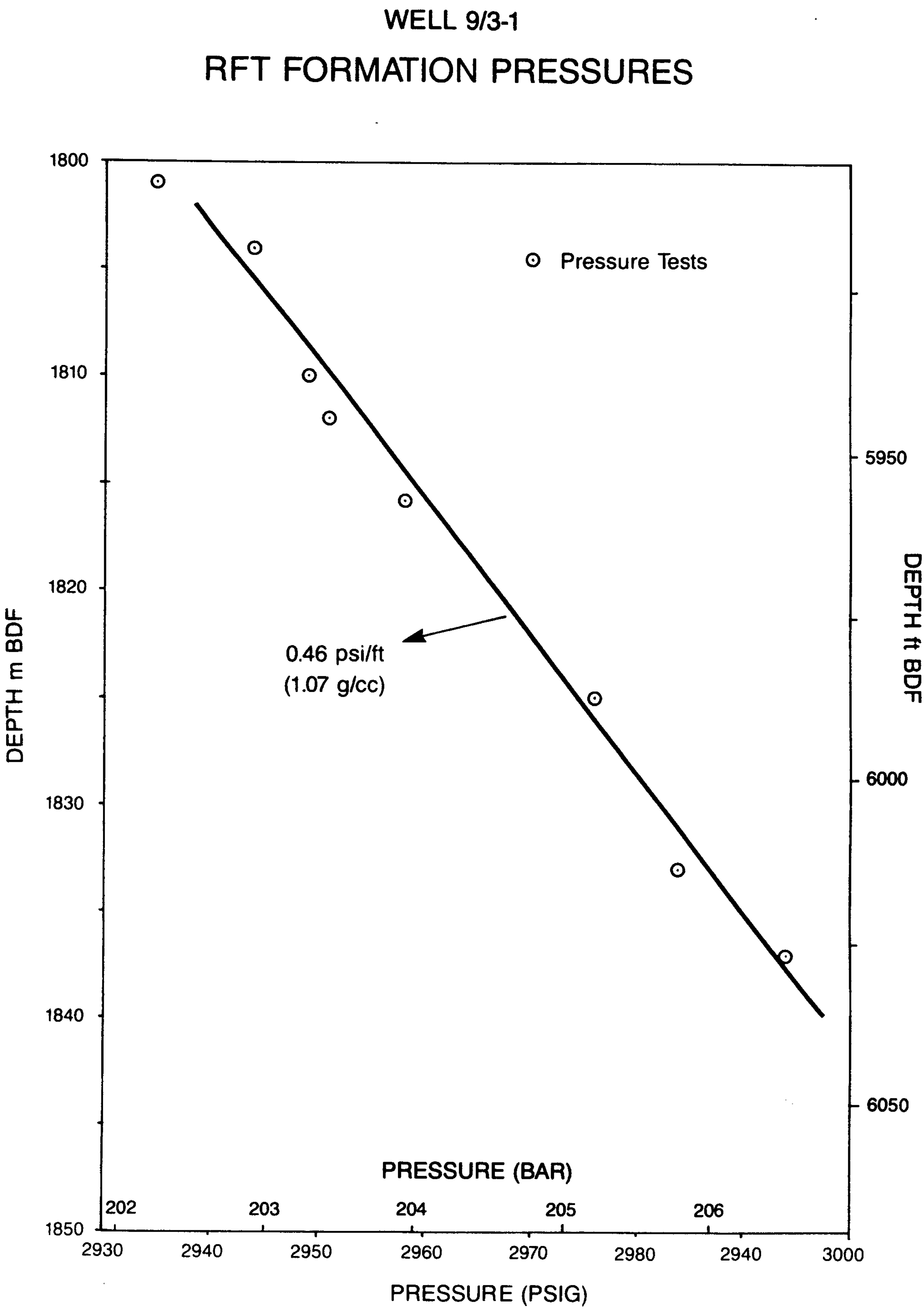
WELL 9/3-1 RFT - PRESSURE DATA

TABLE 8.1

RFT Run : 31.08.86
Bit Size : 12 1/4"
DFE : 25 m (vertical well)
Gauge Type : 10.000 psi Strain Gauge
Gauge Accuracy : 0.13% (+/- 13 psi)
Temp at 1804 m : $122^{o}F$ ($50^{o}C$)

No	Depth (m BDF)	Hydrostatic Mud Press. (psig) Before	After	Formation Pressure (psig)
6	1801	3902	3901	2935
1	1804	3909	3907	2944
7	1810	3924	3921	2949
5	1812	3927	3926	2951
2	1816	3937	3933	2958
4	1825	3955	3955	2976
8	1833	3974	3972	2984
3	1837	3981	3980	2994

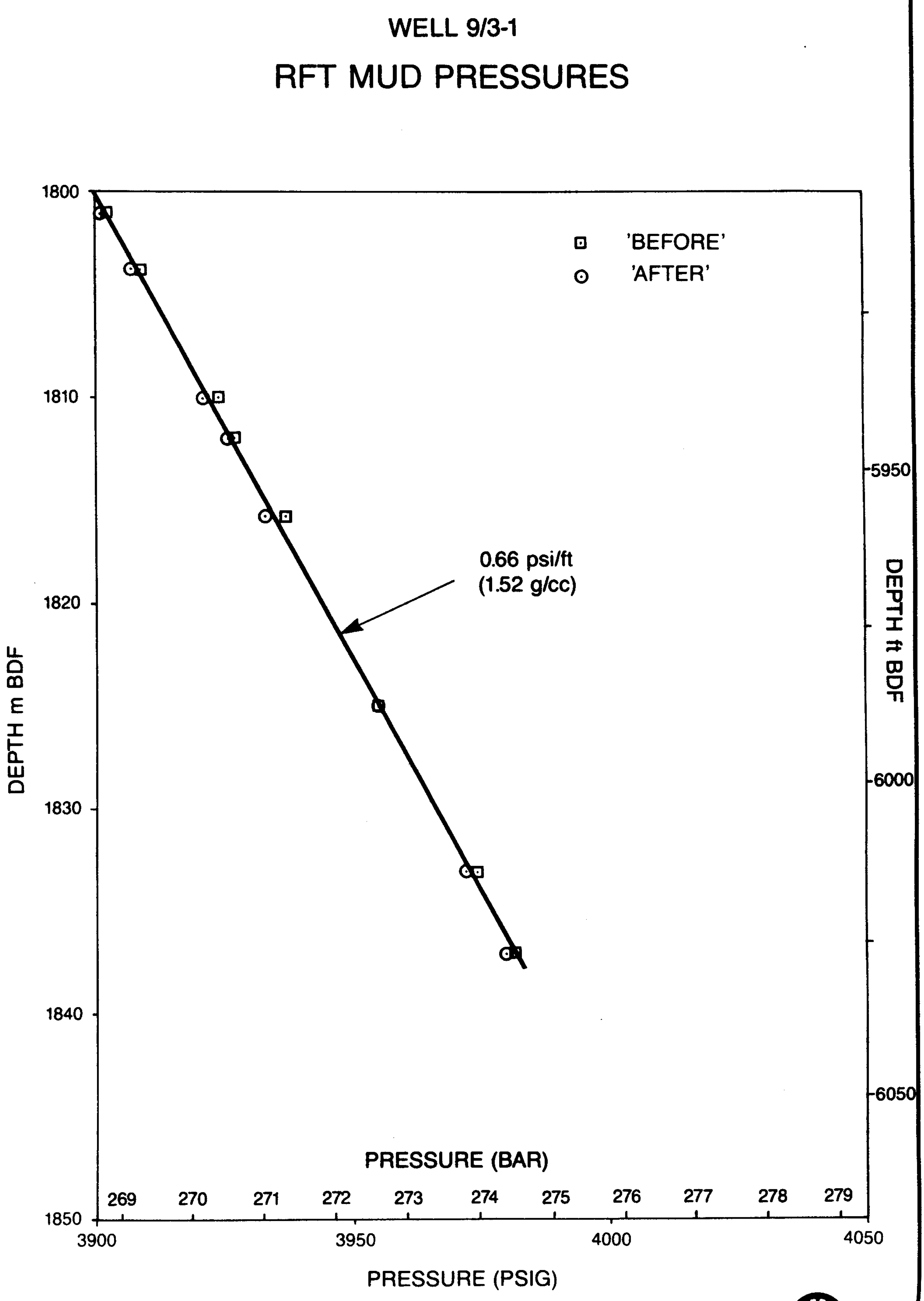
FIG.8.1



A/S Norske Shell

G. 2458/14

FIG.8.2



A/S Norske Shell

G. 2458/15

NSEP 87-9 ENCL.1

A/S NORSKE SHELL, E&P

LOCATION MAP

BREAM
BRISLING
STAVANGER PLATFORM
EGERSUND SUB-BASIN
9/3-1
5°
58°

COMPLETION LOG

SCALE 1:500

EXPLORATION WELL 9/3-1

LOCATION COORDINATES
LATITUDE: 57°49' 45.19"N
LONGITUDE: 04°45' 58.38"E
UTM COORDINATES: X:604894.2 Y:6411210.8

RIG: BORGNY DOLPHIN
CONTRACTOR: DOLPHIN DRILLING
D.F. ELEVATION 25m AMSL
WATER DEPTH; 99m BMSL
TOTAL DEPTH: 1972m BDF
TOTAL DEPTH: 1947m SS
TD FORMATION: TRIASSIC

OPERATOR: NORSKE SHELL
RIG ON LOCATION: 28. July '86
SPUDDING DATE: 01. Aug. '86
ABANDON DATE: 04. Sept. '86
RIG RELEASE DATE: 06. Sept. '86
WELL STATUS: PLUGGED AND ABANDONED AS A DRY HOLE

MUDLOGGING COMPANY: GEARHART GEODATA SERVICES
LOGGING COMPANY: SCLUMBERGER

OBJECTIVES: SANDSTONES OF MIDDLE JURASSIC VESTLAND GROUP
PRODUCTION LICENCE: 115
ROUND: 10A
INTERESTS:

SHELL	30 %
STATOIL	50 %
TENNECO	15 %
DNO	5 %

WELL COMPLETION
TESTING PERIOD: NOT TESTED
TESTED INTERVALS:

COMPLETION LOG PREPARED BY: EPXE/17, EPXT/1/2
DATE FEB.'87

COMPLETION LOG REVISED BY:
INTERVAL:
DATE:

DERRICK | LOGGING | MUD | FILTRATE CAKE

NORSKE SHELL WELL SUMMARY

09/03-01

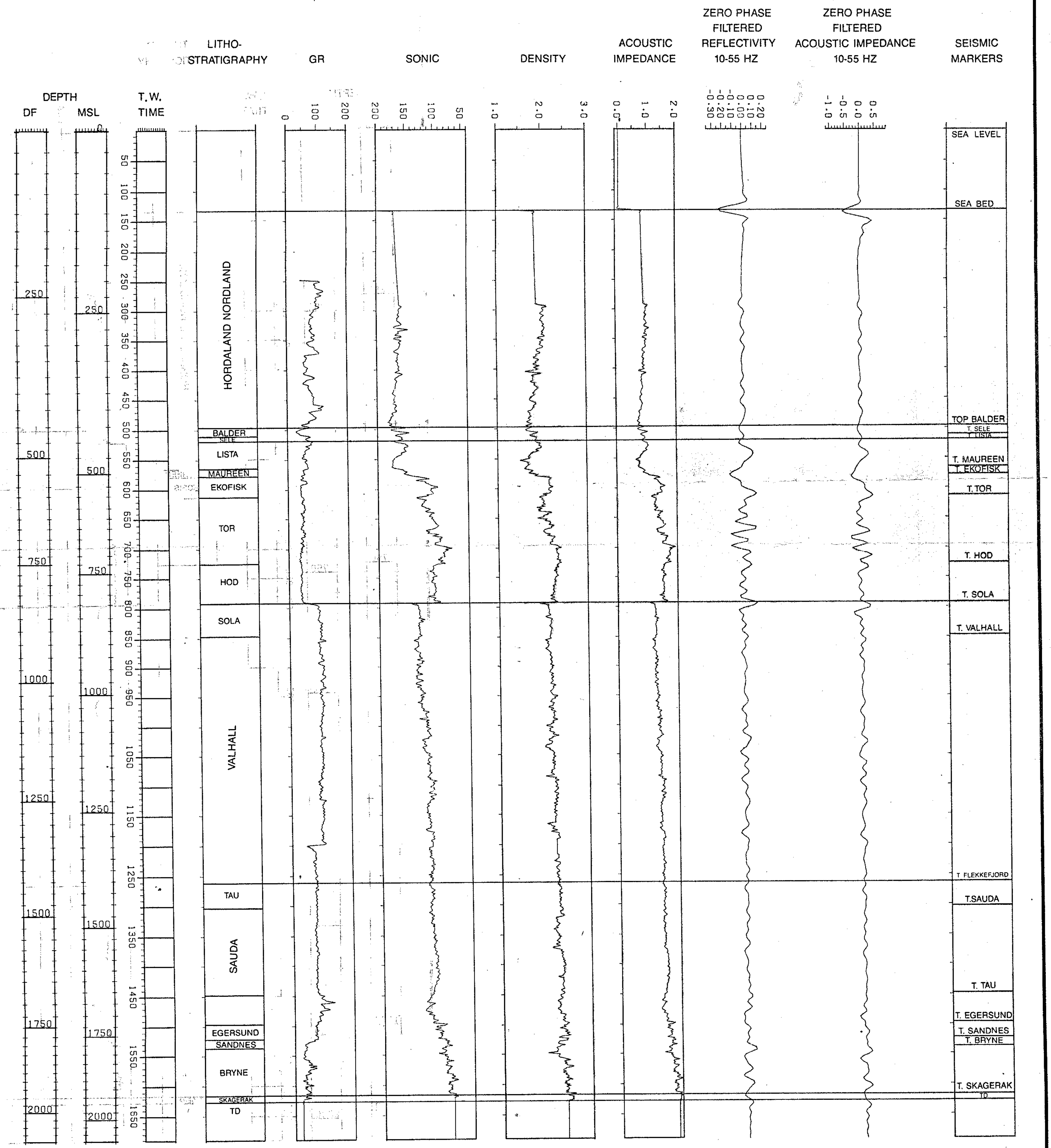
SCALE 1: 2500. | 2 OCT 86

OPERATOR	: SHELL	ELEVATION DF	: 25 M
RIG	: BORGNY DOLPHIN	ELEVATION GL	: -99 M
LONGITUDE	: E 4° 45'58"	TOTAL DEPTH	: 1972 M BDF
LATITUDE	: N 57° 49'45"	SPUDDED	: 86/ 7/29
X-COORDIN.	: 604894.2 +	REACHED TD	: 86/ 8/29
Y-COORDIN.	: 6411210.8 +	COMPLETED	: 86/ 9/ 4
PROJ. SYSTEM	: UTM	STATUS	: E A D
LICENCE	: 115	SHELL SHARE	: 30. %
ROUND NO.	: 10A	BASIN CODE	:
REGEOCODE: 100457454958450		EPWDBCODE: 2030 559333 1 1	

RIG: BORGNY DOLPHIN
GROUP: SHELL, STATOIL, TENNECO, DNO
OBJECTIVE: SANDSTONES OF MIDDLE JURRASIC VESTLAND GROUP IN A SALT INDUCED DOMAL TRAP AT THE EDGE OF THE STAVANGER PLATFORM.
RESULTS: NO HYDROCARBONS WERE FOUND. THE RESERVOIR. ENCOUNTERED AT 1788MBDF, WAS HOWEVER OF GOOD QUALITY, WITH POROSITY UP TO 29 PER CENT AND PERMEABILITY UP TO 4700 MD.

KEY MAP

a·s Norske Shell EXPLORATION & PRODUCTION FORUS		
9/3-1 WELL RESUME WELL SUMMARY		
AUTHOR: EPXE/17	ENCL:	DATE: FEB 1987
REPORT NO.: NSEP 87-9	2	DRAW.NO.: G. 2458/2



A/S Norske Shell LETE- OG UTVINNINGSAVDELINGEN (EXPLORATION AND PRODUCTION)

WELL 9/3-1

SYNTHETIC SEISMOGRAM

AUTHOR: EPXE/17	ENCL.:	DATE: FEB. 1987
REPORT NO.: NSEP 87-9	3	DRAW. NO.: G. 2458/7

RAPORT NR 11

SEISMIC CALIBRATION LOG
(ADJUSTED CONTINUOUS VELOCITY LOG)

Schlumberger
Computer Processed Interpretation

COMPANY	NORSKE SHELL
WELL	9/3-1
FIELD	WILDCAT
COUNTRY	NORWAY

LOCATION COORDINATES
LAT : N/A
LON : N/A
LAND ☐ OFFSHORE ☒

SEISMIC REFERENCE DATUM	MSL		
Permanent datum	SRD = MSL	Elevation	Elevations: KB 25.0 m, DF 25.0 m, GL -99.0 m
Logs measured from	RKB	FEET ☐	
Drilling measured from	RKB	METERS ☒	
Velocity log depths referred to	SRD = MSL		
Velocity log times referred to	SRD = MSL		

Dates of sonic runs	05-AUG-86/16-AUG-86/29-AUG-86
Dates of check shots runs	31-AUG-86
Computing center	SKJ
Analyst	A.C. GULDAHL
Job	S 70955
Well total depth	1960.0 m
Total number of check shots levels	51
Well deviation	-
max at	-

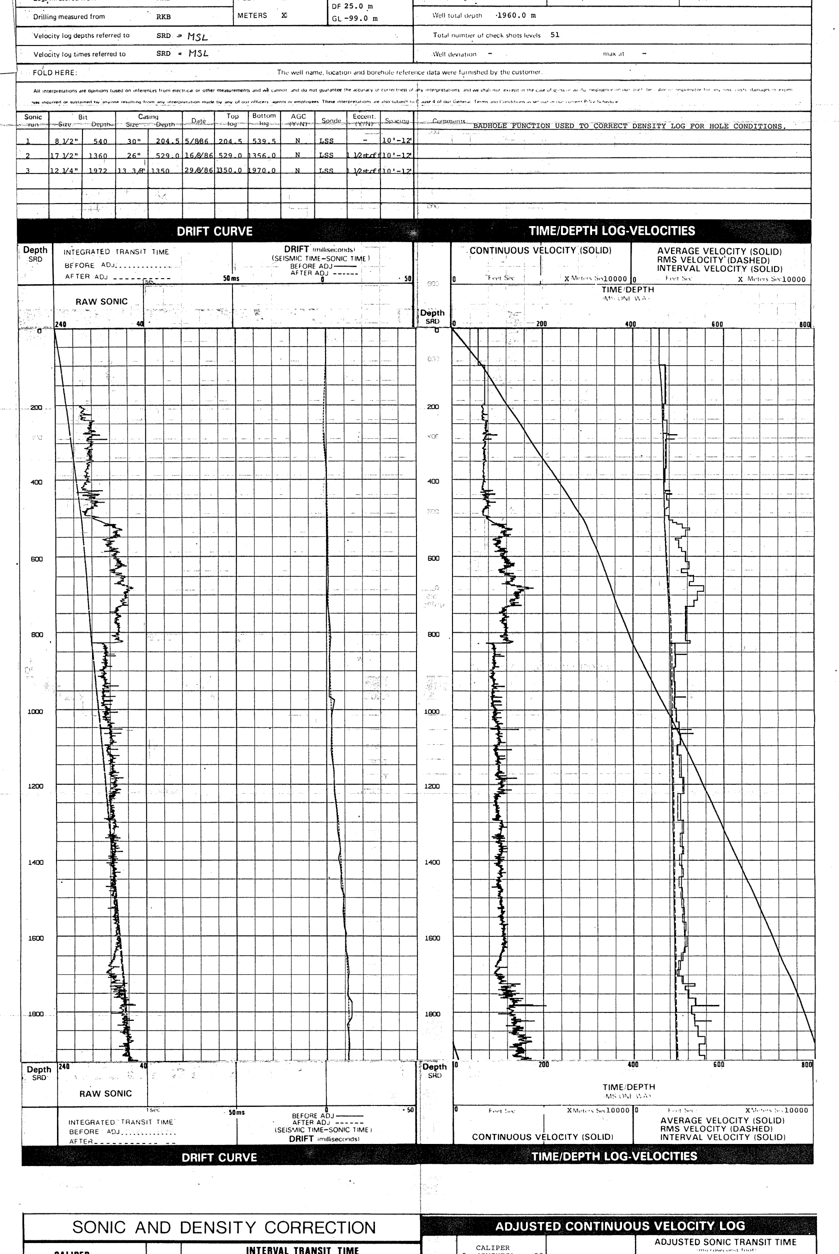
FOLD HERE: The well name, location and borehole reference data were furnished by the customer.

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 interpretation 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.

Sonic run	Bit Size	Bit Depth	Casing Size	Casing Depth	Date	Top log	Bottom log	AGC (Y/N)	Sonde	Eccent. (Y/N)	Spacing
1	8 1/2"	540	30"	204.5	5/8/86	204.5	539.5	N	LSS	-	10'-12'
2	17 1/2"	1360	26"	529.0	16/8/86	529.0	1356.0	N	LSS	1 1/2 stoff	10'-12'
3	12 1/4"	1972	13 3/8"	1350	29/8/86	1350.0	1970.0	N	LSS	1 1/2 stoff	10'-12'

Comments: BADHOLE FUNCTION USED TO CORRECT DENSITY LOG FOR HOLE CONDITIONS.

DRIFT CURVE / TIME/DEPTH LOG-VELOCITIES



SONIC AND DENSITY CORRECTION / ADJUSTED CONTINUOUS VELOCITY LOG

COMPANY	NORSKE SHELL
WELL	9/3-1
FIELD	WILDCAT
COUNTRY	NORWAY

Schlumberger

TIME	V RMS	V INT	DEPTH
0.002	1450	1450	1
0.140	1500	1501	105
0.450	1580	1615	355
0.650	1850	2347	590
0.750	1920	2324	706
0.900	2165	3113	940
1.050	2525	4063	1244
1.440	2790	3402	1908
1.540	2930	4485	2132
1.730	3150	4557	2565
2.240	3540	4624	3744
3.300	4400	5813	6825

215
5

TIME	V RMS	V INT	DEPTH
0.002	1450	1450	1
0.140	1500	1501	105
0.440	1580	1616	347
0.550	1755	2327	475
0.650	1850	2303	591
0.750	2055	3070	744
1.130	2220	2514	1222
1.420	2280	2500	1584
1.620	2525	3838	1968
1.970	2790	3782	2630
2.070	2930	4936	2877
2.350	3380	5694	3674
3.300	4400	6244	6640

455
65

TIME	V RMS	V INT	DEPTH
0.002	1450	1450	1
0.140	1500	1501	105
0.550	1755	1834	481
0.670	1950	2667	641
0.860	2165	2794	906
1.250	2280	2515	1397
1.430	2400	3108	1677
2.000	2930	3959	2805
2.440	3225	4319	3755
3.300	4400	6692	6632

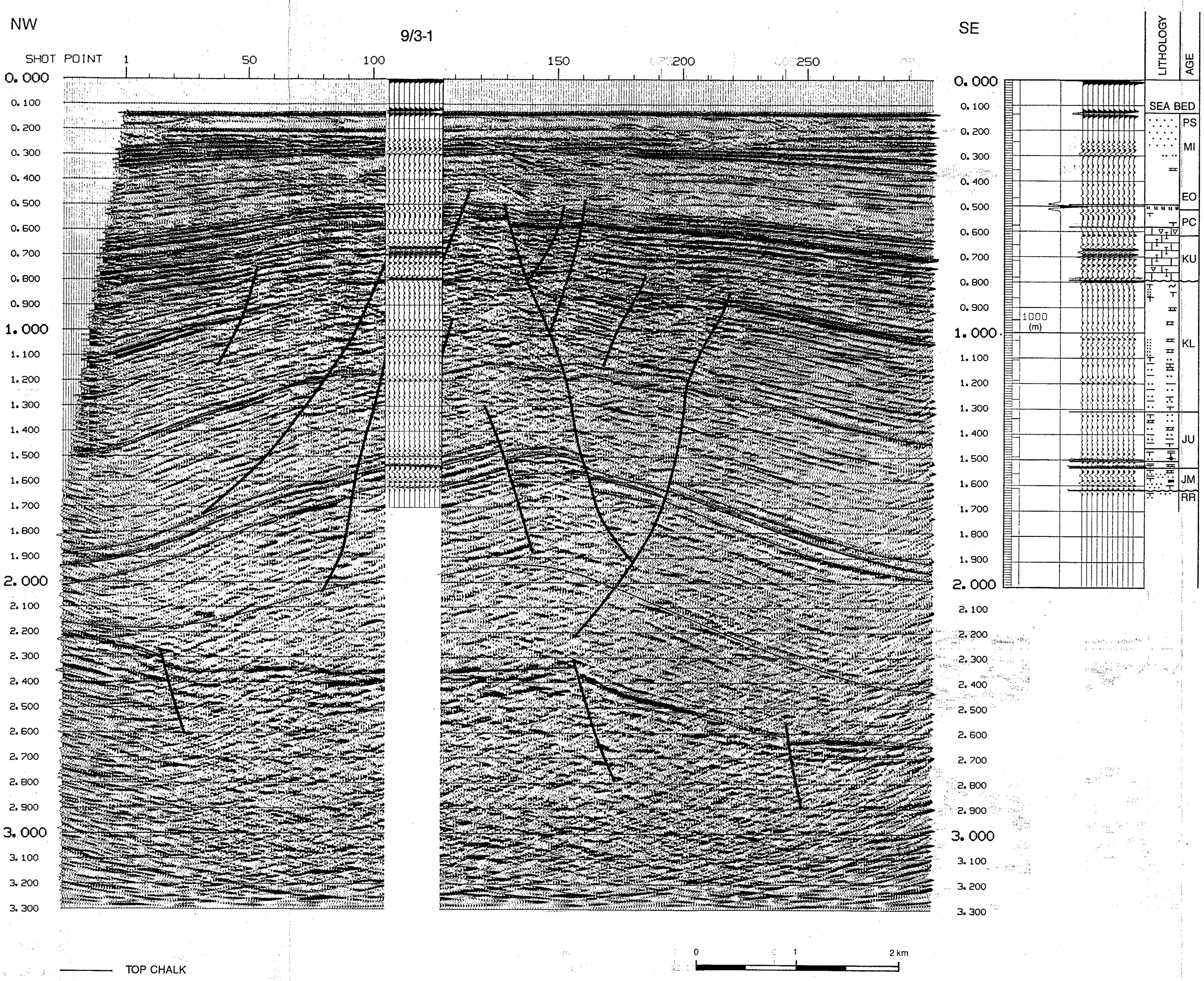
695
125

TIME	V RMS	V INT	DEPTH
0.002	1450	1450	1
0.130	1500	1501	97
0.380	1540	1560	293
0.600	1900	2398	556
0.750	2055	2584	750
0.900	2525	4140	1061
1.220	2720	3205	1573
1.450	2930	3857	2017
1.650	3225	4854	2502
2.440	3540	4121	4130
3.300	4400	6224	6806

935
185

TIME	V RMS	V INT	DEPTH
0.002	1450	1450	1
0.140	1500	1501	105
0.430	1580	1617	339
0.650	1850	2287	591
0.800	2055	2273	799
0.900	2280	3606	979
1.300	2525	3004	1590
1.430	2655	3713	1822
1.650	2930	4309	2296
2.030	3150	3966	3049
2.550	3540	4766	4288
3.300	4400	6525	6735

1175
245



TOP CHALK

BASE CHALK

HORIZON IN THE LOWER CRETACEOUS

BASE TAU/TOP EGERSUND

TOP VESTLAND GROUP

TOP TRIASSIC

TOP ZECHSTEIN

BASE ZECHSTEIN

NORSKE SHELL

NORTH SEA BLOCK 9/3

LINE 85-2261

SP'S 1-310

2400% MIGRATED STACK

RECORDED DEC 1985
PROCESSED JAN 1986

PROCESSED BY
SEISMOGRAPH SERVICE LIMITED
PHOENIX CONTRACT 239 FORUS NORWAY

RECORDING PARAMETERS

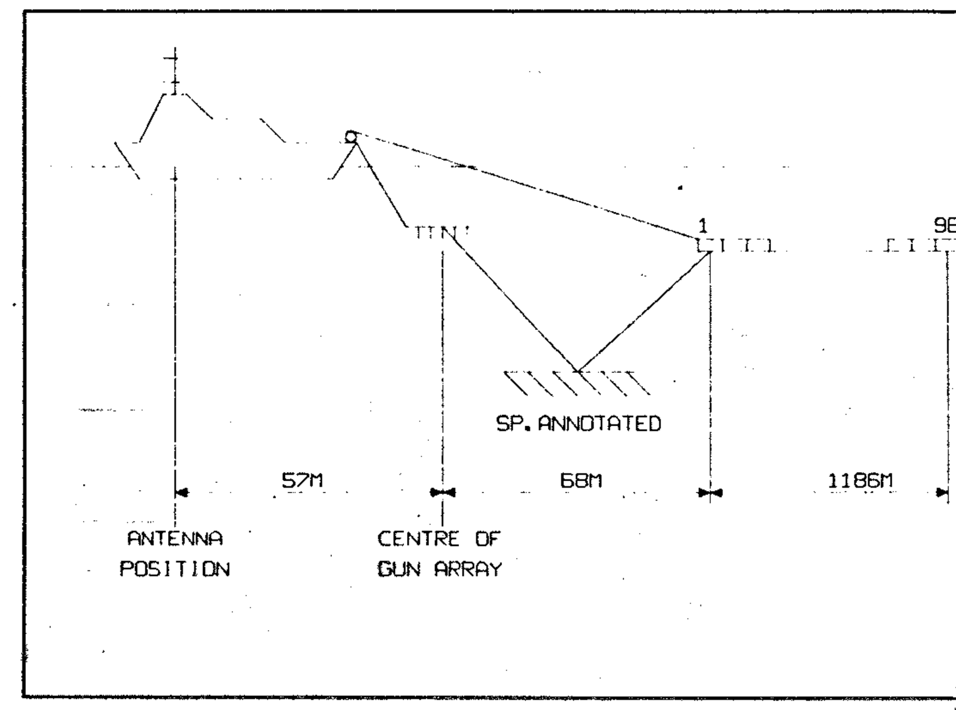
CONTRACTOR
NAME GEOTEAM
VESSEL GEO SCANNER

RECORDING
INSTRUMENT
FORMAT SEG B
GAIN SETTING: I.F.P
FILTER LO: OUT
HI:
DATA LENGTH 4.0 SECS
SAMPLING INTERVAL 2MS
POP INTERVAL 25M
CDP INTERVAL 12.5M

POLARITY
COMPRESSION = NEGATIVE NUMBER

ENERGY SOURCE
AIRGUN

STREAMER
CABLE DEPTH 3-4M
NO. OF GROUPS 96
GROUP INTERVAL 12.5M



PROCESSING SEQUENCE

1 DEMULTIPLEX
2 SPHERICAL DIVERGENCE CORRECTION (TE**0.6T)
3 F.K.FILTER: PASSING DIPS OF -2ms TO +6ms PER TRACE
4 BAND PASS FILTER 3-5-180-200Hz
5 SINGLE WINDOW BASE LEVEL SCALING
6 AVERAGED PREDICTIVE DECONVOLUTION:
ACTIVE LENGTH :300ms PREDICTIVE GAP:20ms
DERIVATION WINDOWS: NEAR TRACE 200-2500ms
FAR TRACE 900-2500ms
APPLICATION WINDOW: 0-6000ms
7 N.M.O. CORRECTION
8 SINGLE WINDOW BASE LEVEL SCALING
9 MUTE: ALLOWING 2# AT SEA BOTTOM 24# AT 1600ms
10 1/N STACK (2400%)
11 F.K.FILTER:PASSING DIPS OF +4ms TO -4ms PER TRACE
12 ADJACENT TRACE SUMMATION
13 FRONT END MUTE: 1600ms AT #1 130ms AT #96
14 DECONVOLUTION :TWO PASSES
A)OPERATOR LENGTH 150 OPERATOR GAP 80
WINDOWS:200-1900 1900-3300
B)OPERATOR LENGTH 200 OPERATOR GAP 28
WINDOWS:200-1900 1700-3300
15 WAVE EQUATION MIGRATION(STACKING VELOCITIES)
16 TIME VARIANT FILTER WITH 200ms WINDOW OVERLAP:

APPLICATION TIME (ms)	CUT OFF (Hz)	BAND PASS (Hz)	CUT OFF (Hz)
0	3	5-140	180
1000	3	5-100	140
2000	3	5-80	100

17 1000 ms WINDOW SCALING & ZERO PHASE CONVERSION

SCALE	DISPLAY POLARITY
HORIZONTAL: 1:25000 VERTICAL: 10CMS/SEC	HYDROPHONE: COMPRESSION TAPE : NEGATIVE DISPLAY : WHITE
PREPARED : S.G.A	SSL JOB:041017

A/S Norske Shell
EXPLORATION & PRODUCTION

9/3-1 WELL RESUME

SEISMIC/SYNTHETIC WELL TIE

AUTHOR: EPXE/17	ENCL:	DATE: FEB. 1987
REPORT NO.: NSEP 87-9	4	DRAW.NO.: G. 2458/8

ENCLOSURE 5A

Schlumberger

MSD*

DIPMETER COMPUTED RESULT

MEAN SQUARE DIP a pad-to-pad interval cor...

* A Mark of Schlumberger

Using the following logs: SHDT Run No.: ONE Zone from 1354 M - 530 M

Company:	A/S NORSKE SHELL
Well:	9/3-1
Field:	WILDCAT
Country:	NORWAY O/S
Reference No:	SKJ.S50133 Processing No: 1
Date Logged:	16 AUG 86 Date Processed: 19 AUG 86
Location:	LAT : 57°49'45.19" LON : 04°45'58.38"
Elevations:	KB: 25.0 M DF: 25.0 M GL: -99.0 M
Permanent Datum:	M.S.L. Depth Units: METRES

G. 2458/10

FOLD HERE 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.

FIELD RECORDING:	Engineer:	See comments.	Location:	ONY	Cyberpack Version:	28.4
COMPUTATION:	Analyst:	A. Sunde	Centre:	SKJ	Baseline:	14.4

COMPUTATION PARAMETERS

CORRELATION PARAMETERS		FOCUSING PARAMETERS
Correlation Interval:	1.00	Focusing option = 2.00
Step Ratio:	.50	(1=Focused on plane normal to Borehole Axis)
Search Angle:	2 X 35°	(2 = Focused on Fixed Plane of 0.00 degrees
The search angle is internally limited to:		dip, and 0.00 Degrees from True North.)
Arctan (Correlation Interval / 2 (Caliper + Electrical Diameter)).		(3 = Previous Dip Result from . .)

AUXILLIARY PARAMETERS

Curve Rejection

KEY
0 = Keep all curves
1 = Reject curve 1
2 = Reject curve 2
3 = Reject curve 3
4 = Reject curve 4
5 = Reject curve 1A
6 = Reject curve 2A
7 = Reject curve 3A
8 = Reject curve 4A
11= Reject Pad 1
12= Reject Pad 2
13= Reject Pad 3
14= Reject Pad 4

Magnetic Declination:	-6.00	Computed on TVD?	NO
Mirror images Rejected?	NO	Electrical Diameter:	1.00
Threshold Above hole deviation:	2	Data Sampling Ratio:	-4.00
Threshold below hole deviation:	2		

Remarks:
Logging Engineers : A.COX, S.HILDEN

ZONE FROM 1354.0 M TO 530.0 M

SCALE = 1/500

ENCLOSURE 5B

Schlumberger

DIPMETER COMPUTED RESULT

MSD*

MEAN SQUARE DIP a pad-to-pad interval cor[relation]

* A Mark of Schlumberger

Using the following logs: SHDT
Run No.: TWO
Zone from 1970 M - 1350 M.

Company: A/S NORSKE SHELL

Well: 9/3-1

Field: WILDCAT

Country: NORWAY O/S

Reference No: SKJ.S50138 Processing No: 1

Date Logged: 30 AUG 86 Date Processed: 5 SEP 86

Location: LAT :: 57°49'45.19' LON :04°45'58.38"

Elevations: KB: 25.0 M DF: 25.0 M GL: -99.0 M

Permanent Datum: M.S.L. Depth Units: METRES

G. 2458/11

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

FIELD RECORDING:	Engineer:	See comments.	Location:	ONY	Cyberpack Version:	28.4
COMPUTATION:	Analyst:	A. Sunde	Centre:	SKJ	Baseline:	14.4

COMPUTATION PARAMETERS

CORRELATION PARAMETERS	FOCUSING PARAMETERS
Correlation Interval: 1.00 M	Focusing option = 2.00
Step Ratio: .50	(1=Focused on plane normal to Borehole Axis)
Search Angle: 2 X 35°	(2 = Focused on Fixed Plane of 0.00 degrees
The search angle is internally limited to:	dip, and 0.00 Degrees from True North.)
Arctan ($\frac{\text{Correlation Interval}}{2\ (\text{Caliper} + \text{Electrical Diameter})}$).	(3 = Previous Dip Result from . .)

AUXILLIARY PARAMETERS

Curve Rejection

KEY
0 = Keep all curves
1 = Reject curve 1
2 = Reject curve 2
3 = Reject curve 3
4 = Reject curve 4
5 = Reject curve 1A
6 = Reject curve 2A
7 = Reject curve 3A
8 = Reject curve 4A
11= Reject Pad 1
12= Reject Pad 2
13= Reject Pad 3
14= Reject Pad 4

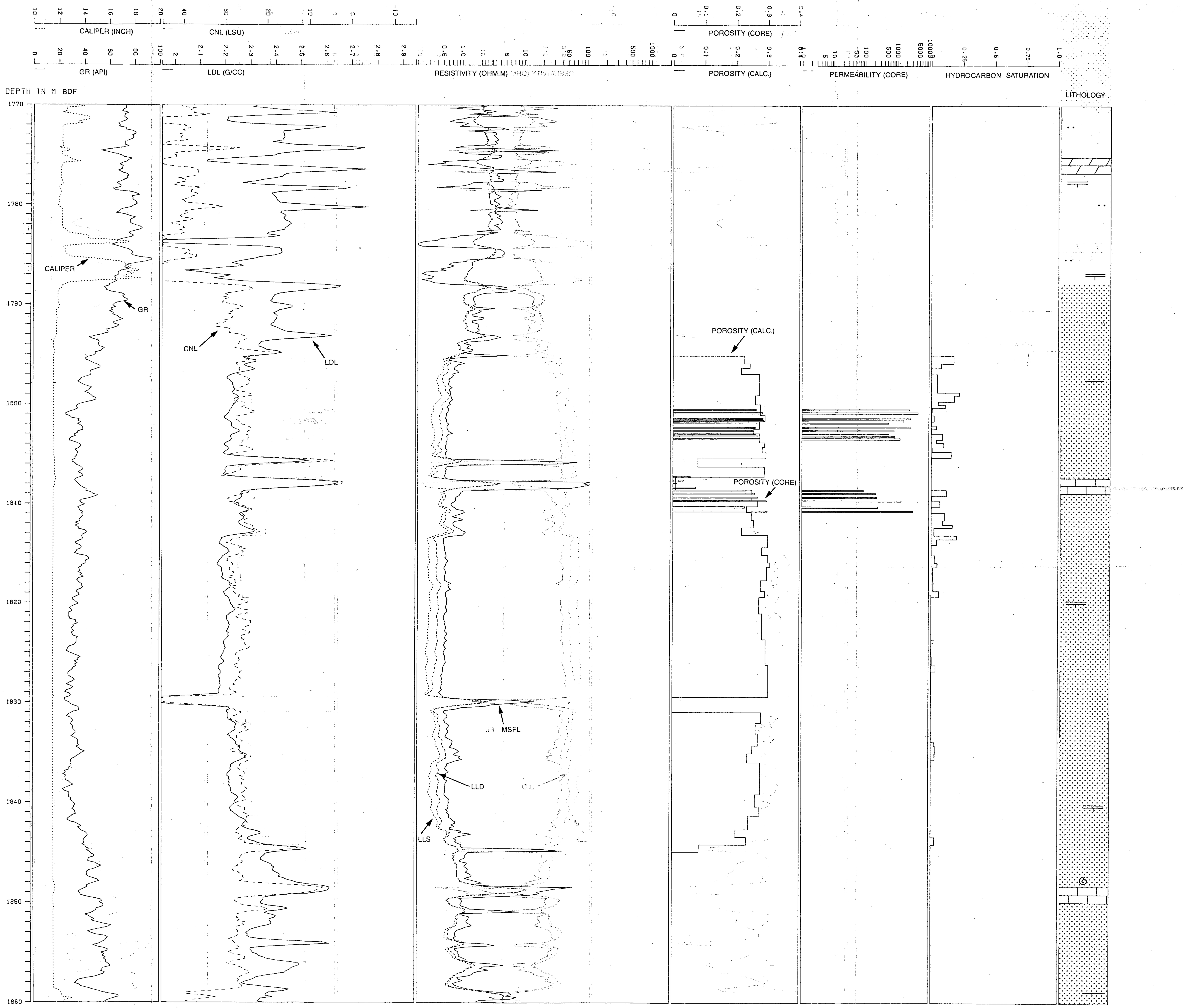
Magnetic Declination:	-6.00 DEG	Computed on TVD?	NO
Mirror images Rejected?	NO	Electrical Diameter:	1.00 IN
Threshold Above hole deviation:	2	Data Sampling Ratio:	-4.00
Threshold below hole deviation:	2		

Remarks:

Logging Engineers : A.COX, S.HILDEN.

ZONE FROM 1970.0 M TO 1350.0 M

SCALE = 1/500



A/S Norske Shell LETE- OG UTVINNINGSAVDELINGEN (EXPLORATION AND PRODUCTION)

9/3-1 WELL RESUME

LOG PANEL

SCALE 1:200

AUTHOR: EPXE/17	ENCL.: 6	DATE: FEB. 1987
REPORT NO.: NSEP 87-9		DRAW. NO.: G. 2458/13

A/S Norske Shell | Well: 9/3-1 | Core No. 1

CORE DESCRIPTION

Cored from: 1798 to 1814 Recovered: 7.40 m 46 % Core size: 5 1/4"

Formation: SANDNES Date: 09.10.86 Described by: CATO BERGE Corehead:

Sheet: 1 of 4

DEPTH & SAMPLES	SEDIMENTARY STRUCTURES & FEATURES	COLOUR	COMPOSITION (& ACCESSORY MINERALS)	CMT	ESTIMATED Ø %	HYDROCARBON INDICATIONS (SMPL FLU / CUT COL / CUT FLU)	GAS %	REMARKS (OIL BLEED DIPS FRACTURES ETC.)
1798		dK med gy	CLST: lumps, subific, silty, tr sst, probably cavings and not part of cored sequence		GOOD POROSITY AND PERMEABILITY	NO SHOWS		
	cm, med angle; (wavy, discon. non parallel cm low-med angle; carb. clay lam	lt-(med) gy	SST: friable, dom mSL-mSU, tr crs SL, (arg)-arg, (micromic), srt(-srt), rnd-(rnd), (sph)-(elong) tr clay lam r tr glauc, inc. amount of mafic minerals; else dom. qtz. (feldsp., mafics)	silica-(arg)				
1798.5	(~) cm-(dm) larger sets with smaller scale x-beds, med angle; very low angle-(horizontal)	ltgy						
1799	low angle-(horizontal)	lt-(med) gy	inc. arg, (srt)	slightly calc; silica-(arg)				
	med angle, lam. var cm-dm in grn size; med-low angle cm; carb clay lam; med. angle cm		SST: friable mSL-mSU, tr crs SU, arg - (arg), carb clay lam/clasts, qtz, feldsp, (mafics),					
1799.5	carb clay clasts; discont. low angle		abd carb. clay lam./ clasts					
1800		lt-(med) gy		slightly clac				

A/S Norske Shell	Well: 9/3-1	Core No. 1

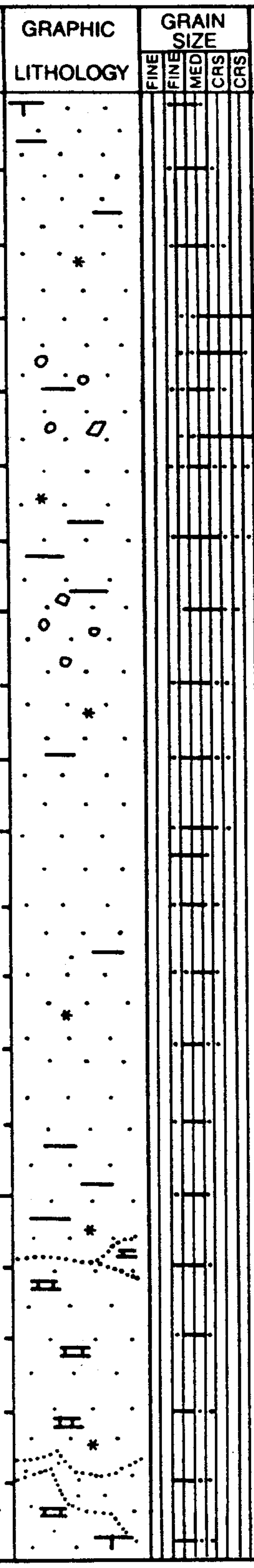
CORE DESCRIPTION

Cored from: 1798 to 1814 Recovered: 7.40 m 46 % Core size: 5 1/4"

Formation: SANDNES Date: 09.10.86 Described by: CATO BERGE Corehead:

Sheet: 2 of 4

DEPTH & SAMPLES	SEDIMENTARY STRUCTURES & FEATURES	COLOUR	COMPOSITION (& ACCESSORY MINERALS)	CMT	ESTIMATED Ø %	HYDROCARBON INDICATIONS (SMPL FLU / CUT COL / CUT FLU)	GAS %	REMARKS (OIL BLEED DIPS FRACTURES ETC)
1800	(=) discont. low angle cm; discont, mod angle abd grain size variation between lam; cm (~) dm; (=) granules (dol.xln)	ltgy	SST: friable, dom mSL-mSU crs SL, loc crser, loc granules (isolated), dom qtz, feldsp, loc inc. mafic min, (arg)-arg, loc arg, (micromic), loc glauc, srt, loc (srt), rnd-(rnd), sph-(elong), loc carb. clay frags, silicaarg cem, loc calc.	slightly calc; non clac	GOOD POROSITY AND PERMEABILITY	NO SHOWS		
1800.5	discont, planar, low angle; inc. clay lam med angle (=) non sharp border to crs sand. Low angle, parallel, discont, granules; (=) discont, parallel low angle	lt- med gy (brn-gy)		slightly calc; calc				
1801	low-med angle, discont, tang-planar; (=)		SST: a/a					
1801.5	med angle- (Trunc) planar carb. clay lams.; pyr; tr discont. parallel, low-med angle; also dolomite; low angle	ltgy	SST: hd, v. calc cem., dom fSU-mSL, (arg). arg, mic, (srt)-srt, rnd-(rnd), (sph), tr glauc	highly calc. cem	TIGHT	light yellow mineral fluorence		
1802								



APPENDIX 1

A/S Norske Shell	Well: 9/3-1	Core No. 1

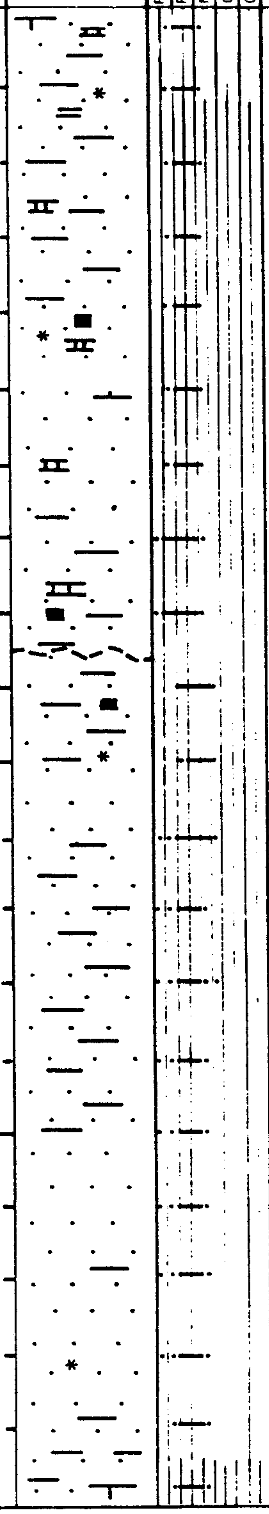
CORE DESCRIPTION

Cored from: 1798 to 1814 Recovered: 7.40 m 46 % Core size: 5 1/4"

Formation: SANDNES Date: 09.10.86 Described by: CATO BERGE Corehead:

Sheet: 3 of 4

DEPTH & SAMPLES	GRAPHIC LITHOLOGY	GRAIN SIZE	SEDIMENTARY STRUCTURES & FEATURES	COLOUR	COMPOSITION (& ACCESSORY MINERALS)	CMT	ESTIMATED Ø %	HYDROCARBON INDICATIONS SMPL FLU	CUT COL	CUT FLU	GAS %	REMARKS (OIL. BLEED DIPS FRACTURES ETC.)
1802			tr low angle primary lamination, mainly disrupted of bioturbation (V,H; H)	ltgy	SST: hd, very calc sem. dom fSL-fsu, arg - (arg), mic, (srt) srt, rnd - (rnd) (sph), tr glauc, tr carb. cly lams clasts.	very calc. cem.	TIGHT	light yellow mineral fluorence		NO SHOWS		
1802.5			within sandlens (mm) (V,H); primary, mod angle, planar non parall; disont. wavy, parallel - non parallel; mostly broken/ disturbed by bioturbation abd sandlenses		lignite - coal frags; abd sandlenses							
1803			(H)	lt-med (brn) gy	SST: friable, dom. fSUmSL, arg-arg, abd cly-carb. cly lams/clasts, (micro-mic). (srt) (ang) - (rnd), (sph) - (elong) tr glauc, pyr		MODERATE POROSITY AND PERMEABILITY					
1803.5			discont. planar-wavy, parallel - non parallel		pyr; glauc							
1804												



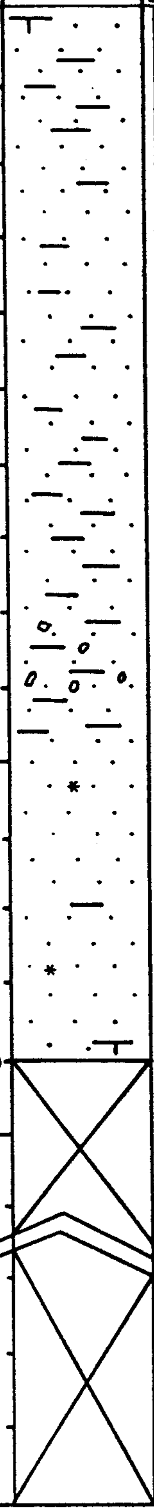
A/S Norske Shell	Well: 9/3-1	Core No. 1

CORE DESCRIPTION

Cored from: 1798 to 1814 Recovered: 7.40 m 46 % Core size: 5 1/4"

Formation: SANDNES Date: 09.10.86 Described by: CATO BERGE Corehead:

Sheet: 4 of 4

DEPTH & SAMPLES	GRAPHIC LITHOLOGY	GRAIN SIZE (FINE, FINE, MED, CRS, CRS)	SEDIMENTARY STRUCTURES & FEATURES	COLOUR	COMPOSITION (& ACCESSORY MINERALS)	CMT	ESTIMATED Ø %	HYDROCARBON INDICATIONS SMPL FLU	CUT COL	CUT FLU	GAS %	REMARKS (OIL BLEED DIPS FRACTURES ETC)
1804			discont. wavy non parallel parallel	lt-med (bln) gy; ltgy	SST: friable, dom fSL-fSU, (mSL), arg-arg, abd cly-carb lams/clasts, (micromic) (srt), loc srt, (ang) - (rnd) (sph) - (elong)	arg-silica	MODERATE POROSITY AND PERMEABILITY			NO SHOWS		
			RUBBLE	lt-med (brn) gy								
1804.5			mm-cm discont. wavy parallel - non parallel abd small sandlenses - tr primary lam granules, isolated (do xln) sharp, non erosive contract		coaly lams/clasts; isolated granules/dol xln	slightly Calc						
1805			"homogenous"	ltgy	SST: friable fsu - mSU, (arg), srt- srt, rnd- (rnd), (sph), mic, tr dkgy speks, loc tr glauc, pyr	non-slightly calc	GOOD POROSITY AND PERMEABILITY					
1805.40												
1814.0												

APPENDIX 2

SIDEWALL SAMPLES

WELL 9/3-1

SIDEWALL CORES

A total of 90 SWC were shot, with 70 recovered. No fluorescence or other hydrocarbon indications were observed in any of the cores.

NO.	DEPTH (mbdf)	RECOVERY (mm)	LITHOLOGY	
1	550	51	CHALK:	wh, soft
2	614	20	CHALK:	wh, mod soft, tr. of chert
3	682	25	CHALK:	wh, mod soft
4	739	25	CHALK:	sh, mod soft
5	796	30	CHALK:	lt gy, mod hd
6	842	13	CHALK:	lt gy-gy, very fine xln, gy chert
7	865	56	CHALK:	dk gy, slty, calc, soft, plastic
8	923	51	CLST:	lt gy-bl, varicol, mod soft, slty, calc
9	962	54	CLST:	dk gy-bl, mod soft, slty
10	1015	54	CLST:	dk gy, mod hd, slty, sltly dry
11	1029	49	CLST:	dk gy-dk brn, mod hd
12	1053	52	CLST:	dk gy, mod hd, dry
13	1078	50	CLST:	dk gy, mod hd, dry
14	1088	LOST		
15	1118	56	CLST:	gy, mod hd, some fine sand
16	1133	50	CLST:	dk gy, mod hd, slty, tr of pyr
17	1140	54	CLST:	dk (blk) gy, (mod) hd, slty
18	1155	LOST		
19	1172	LOST		
20	1187	56	CLST:	bl-gy, spots of lt gy, mod hd, slty?
21	1205	46	CLST:	bl-gy, mod sft, slty/sandy
22	1224	57	CLST:	bl-gy, mod sft, slty
23	1242	50		dk gy-blk, mod sft, slt/fine sand
24	1256	LOST		
25	1272	51	CLST:	bl-gy, mod sft
26	1288	LOST		

NO.	DEPTH (mbdf)	RECOVERY (mm)	LITHOLOGY
27	1301	48	CLST: bl-gy, mod sft, sltly dry
28	1325	55	CLST: dk gy (blk) mod hd, slty
29	1340	52	CLST: dk gy, mod sft, slty
30	1357	55	CLST: bl-gy, sft, plastic, slty
31	1377	LOST	
32	1391	LOST	
33	1405.5	LOST	
34	1416	50	CLST: sft, slty, med gy-(brn), mic
35	1424	LOST	
36	1424	LOST	
37	1435	40	CLST: med gy-(brn)gy, sft-frm, slty, mic
38	1456	45	SLTST/CLST: med gy -(grn)gy, sft-frm, slty, mic
39	1469	LOST	
40	1482.5	LOST	
41	1495	30	SLTST: med gy, sft-frm, mic, slty
42	1509	35	SLTST: med -(dk)gy, frm -(hd), mic, arg, pyr
43	1514	50	SLTST: med gy, frm, m, arg
44	1534	50	SLTST: med gy, frm, mic, arg
45	1558	40	SLTST: med gy, frm, mic, arg
46	1576	40	SLTST: lt gy -(ng)gy, frm, mic, arg
47	1585.5	50	SLTST: lt-med gy, frm, mic, arg
48	1600	50	SLTST: lt-med gy -(gn)gy, frm, mic, arg
49	1608	LOST	
50	1619	45	SLTST: lt-med gy-(gn)gy, frm, mic, arg
51	1626	50	SLTST: med gy, frm, mic, arg
52	1638	LOST	
53	1645	LOST	
54	1657	45	CLST: dk gy, sft-(frm), slty, micromic
55	1674.5	50	CLST: med-dk gy, sft, slty, micromic

NO.	DEPTH (mbdf)	RECOVERY (mm)	LITHOLOGY	
56	1688	30	CLST:	dk gy, sft, slty, micromic
57	1693.5	35	CLST:	dk gy, sft, slty, micromic
58	1697	45	CLST:	dk gy, sft, slty, micromic
59	1699	30	CLST:	dk gy-(bl), slty, sft
60	1701	40	CLST:	dk gy, sft, slty
61	1702	40	CLST:	dk gy-(bl), sft, slty
62	1703	40	CLST:	med-dk gy, sft, slty, incl of (red)brn (org) mat
63	1708	50	CLST:	dk gy, sft, slty
64	1715.5	30	CLST:	med gy, sft, slty
65	1719	20	CLST:	med-dk gy, sft, slty
66	1724	20	CLST:	med gy, sft, slty
67	1728	40	CLST:	med-dk gy, sft, slty
68	1733	50	CLST:	med-dk gy, sft, slty
69	1736	45	CLST:	med gy, sft, slty
70	1741	30	SLTST:	med by-(gn)gy, sandy (fs), arg
71	1748	40	CLST:	lt-med gy, sft, slty
72	1768.5	LOST		
73	1785.5	35	CLST:	dk gy-(bl), sft, slty
74	1815.5	35	SST:	f-med, trans-mlky wh, occ carb, fri, por, mod srt
75	1835.5	30	SST:	f-med gr, -brn, srt, fri, por
76	1852	20	SST:	f-(med), fri, slty, srt, por
77	1861.5	broken up	CLST:	lt brn, sft, slty, tr of coal
78	1869	LOST		
79	1880.5	30	SLTST:	lt brn, sft, sandy, arg
80	1900	LOST		
81	1918.2	20	SST:	brn, f, slty-arg, tr of coal
82	1918.5	15	SST:	f, gy-(gn)gy, slty-arg, fri (srt)

NO.	DEPTH (mbdf)	RECOVERY (mm)	LITHOLOGY	
83	1924	LOST		
84	1930	15	SLTST:	brn, sndy, arg, sft
85	1933	LOST		
86	1938	25	SST:	lt brn, f-m, slty-(arg), (srt)
87	1940	25	SLTST:	bnr, sndy, arg, frm, tr of coal
88	1948	25	SST:	lt gn-wh, f-crs, (srt), fri, (por), occ cem
89	1956	15	SST:	lt gr-(rd)brn, f-m, slty-(arg), (por), occ cem
90	1966	LOST		