HYDRO

Norsk Hydro a.s

☐ **Kontrakt/Agreement**

☒ **Rapport/Report**

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☐ **Tilleggsavtale/Amendment**

Fordeling/Distribution	Tittel/Forfatter(e) Title/Author(s)
Partners NPD N.H.-arkiv, Væ 2 Sd 1	Norsk Hydro a.s. Final Well Report Well: 31/4-9 Licence 055 By B.E.Knudsen

X Fortrolig/Confidential ☐ Hydro-intern ☐ Åpen/Open

Resymé/konklusjon/anbefaling
Summary/Conclusion/Recommendation

Summary of geological and operational activities and processes undertaken in connection with the drilling of well 31/4-9 including: objectives and results, stratigraphy, coring, logging, testing, daily operations, formation pressure, -reports.

Emneord/Keywords			Sider/Pages - Bilag/Appendix
Geology, Operations, Well results, Completion Log			
Divisjon/seksjon/avdeling Division/Section/Dept.	**Kvadrant/Blokk-Brønn Quadrant/Block-Well**		**Tilleggsnr./Amendment No.**
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NORSK HYDRO A.S.

FINAL WELL REPORT

WELL 31/4-6

LICENCE 055

October 1982

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PREFACE

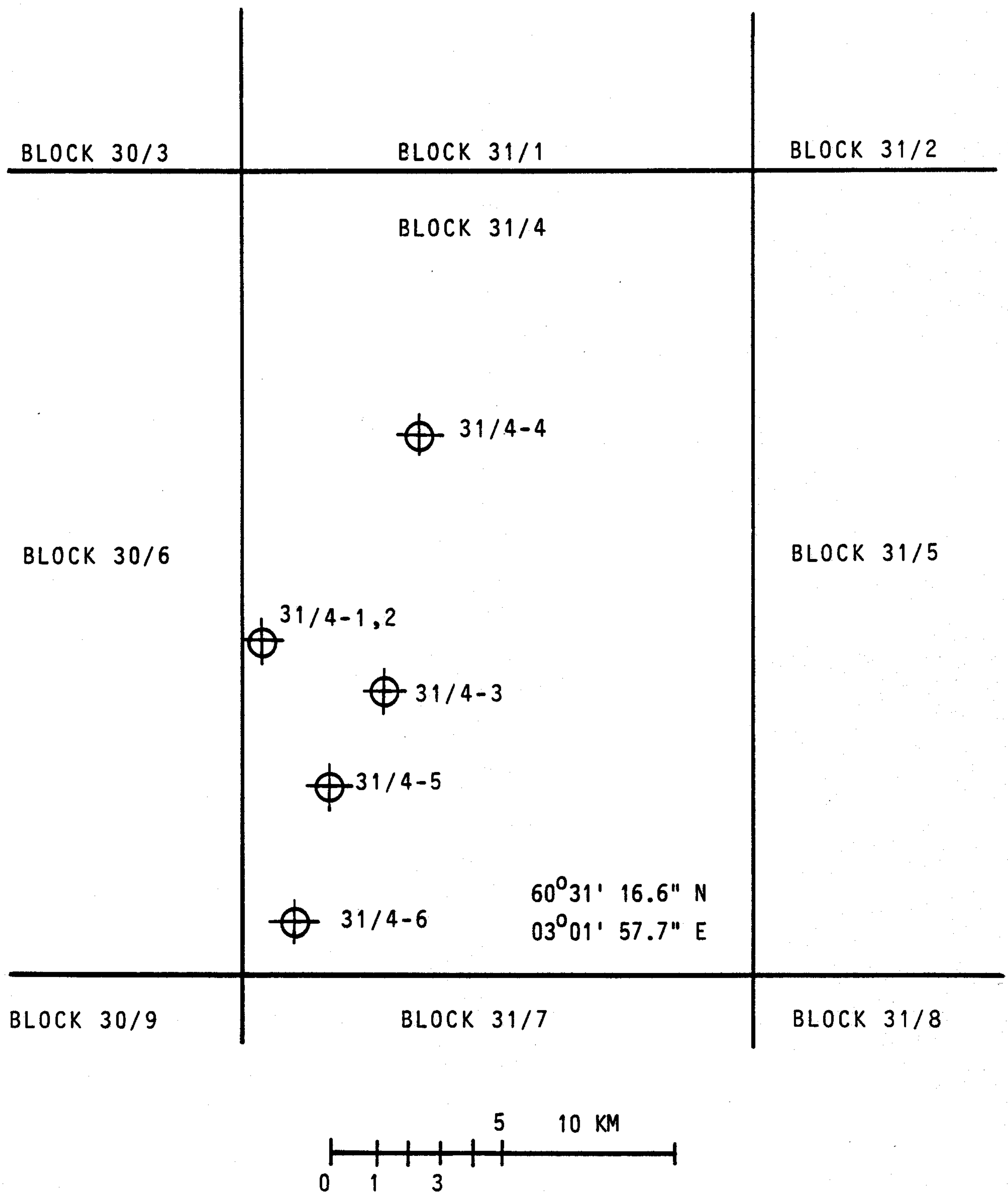
Licence 055 was awarded the Statoil/Norsk Hydro/Esso-group on April 6, 1979 with Norsk Hydro Produksjon a.s. as operator. The licence includes the block 31/4 on Norwegian Continental shelf.

The group consist of the following companies:

Den norske stats oljeselskap, Statoil	50%
Esso Exploration and Production Norway a.s.	20%
Norsk Hydro Produksjon a.s.	15%
Arco Norway Inc.	10%
BP Petroleum Development of Norway a.s.	5%

The well 31/4-6 was drilled by Norsk Hydro Produksjon a.s. on behalf of the Statoil/Norsk Hydro/Esso-group.

LOCATION OF WELL 31/4 - 6



Norsk Hydro Drilling Department	WELL 31/4 - 6	Gr. no.: 3	Fig.: B-3
		Date: 28/9-1982 Sign: Sho / Hes	Dwg. no.: 41

SUMMARY OF WELL DATA

Location:	60°31'16,6"N 03°01'57,7"E
Operator:	Norsk Hydro Produksjon a.s.
Rig:	Nortrym
Contractor:	Golar Nor a.s.
RKB elevation (to MSL):	25 m
Water depth:	130,2 m
Start of operations:	February 25, 1982
Well spudded:	February 28, 1982
Well tsted:	April 14,1982
Well permanently abandoned:	April 20, 1982
T.D.:	2447 m
Formation at T.D.:	Dunlin Group
Status:	Permanently abandoned

WELL PROGRAM

Drilling depths:	36" to 243,5 m 26" to 927 m 17½" to 1865 m 12 1/4" to 2447 m
Casing depths:	30" set at 243 m 20" set at 913 13 3/8" set at 1844 m 9 5/8" set at 2406 m

All depths are given with the referense to RKB.

SECTION A

GEOLOGY

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SECTION A

1. OBJECTIVES

The primary objective of this well was to test the Upper Jurassic "Intra Heather sand II" on the 31/4 B structure in an area where the oil/water contact lies in good quality sandstone.

This structure has been previously tested by the wells 31/4-3 and 5 but the OWC was not defined in either well. In the well 31/4-3 the OWC occured where the permeability of the sandstone decreased considerably and in the well 31/4-5 the hydrocarbon-bearing sandstone sequence terminated against a permeability barrier.

The well was located 4,5 km south west of 31/4-5 and 35 m downdip from the top of tthe "Intra Heather Sand II". Correlations between the 31/4-3 and 5 wells, and better developed low amplitude, low continuity "sigmoidal" and "moundy" internal reflector pattern on the seismic indicated the presence of higher quality sandstones in the interval of the expected OWC in 31/4-6.

The "Intra Heather Sand I" which was oil bearing in well 31/4-3 was not expected to occur in the 31/4-6 well. The Brent Group was not regarded as prospective since it was located downdip from the waterbearing Brent Group in 31/4-5.

Hydrocarbons where not expected to occur in post-Jurassic rocks due to lack of closure and/or reservoir rock.

The well was planned to reach total depth, 70 m into the Dunlin Group at approximately 2400 m. It was regarded as important to penetrate the strong seismic reflectors in the Brent Group in order to correctly calibrate the seismic data on the B structure.

2. RESULTS

A hydrocarbon bearing sandstone interval was encountered in the Upper Jurassic Heather Formation, the "Intra Heather Sand II" with net sandstones of 25 m and a net pay of 12,5 m. As expected the overlying "Intra Heather Sst. I" seen in the 31/4-3 and 5 wells was not present at this location. Below the Heather Formation, the well penetrated 62.5 m of the Brent Group which contained 31 m of net sand with an average porosity of 23.4% and was water saturated. No other reservoir intervals were encountered and the well reached total depth at 2450 m after penetrating 70 m of the Early Jurassic (Early Toarcian) Drake Formation.

The "Intra Heather Sand II" (2156 - 2239 m) is a predominantly fine grained to silty, micaceous to very micaceous, subarcosic carbonaceous and occasionally glauconitic sandstone with a clay matrix and some heavily calcite cemented stringers. It contains a gross sand interval of 83 m with an average porosity of 26.4% and an average water saturation of 43.8% over the pay interval.

Two RFT samples were taken in the well. The first, at 2160.5 m recovered 8 liters of 36.7^{o}API gravity oil, 200.8 cubic feet of gas and 14 liters of formation water/mud filtrate from a 6 gallon sample chamber. The second sample was taken at 2166.5 m and recovered 9 liters of 35.6^{o} API gravity oil, 2100 cubic feet of gas and 11 liters of formation water/mud filtrate.

RFT pressure tests indicate an oil gradient of 0.32 psi/ft and a water gradient of 0.44 psi/ft. The intersection of these two gradients places the oil/water contact at 2172 $\pm$ 1 m in the "Intra Heather Sand II".

Both the reservoir interval and the Brent Group sandstones are normally pressured.

ad820820vn

One production test was performed in the "Intra Heather Sand II" over the interval 2159.5 - 2163.5 m and 2165-2168 m. The well flowed 2841 STB/D of 34.4^{o} API oil and 1352 MSCF/D of 0.727 gravity gas through a 36/64" choke.

Details on log interpretation, RFT and DST results can be found under Section C "Formation Evaluation" and Section D "Well Testing".

3. STRATIGRAPHY

The biostratigraphic evaluation of well 31/4-6 was performed by the laboratories of the Continental Shelf Institute (IKU) in Trondheim, Norway.

The basic material for the analysis was ditch cuttings, but side wall cores and conventional cores were also used.

The biostratigraphic division of the Tertiary interval is partly based on IKU's analysis and partly on log correlation with surrounding wells on the block. Limited micropaleontological analysis in this interval resulted in poorly defined stage boundaries. These could be pinpointed with a greater degree of accuracy by correlation with adjacent wells.

The first analysis was at 270 m in rocks of Pleistocene age which continued down to approximately 340 m and were underlain by 1700 m of Tertiary rocks. A thin interval of Danian age was penetrated at 2060 m and Late Cretaceous sediments of Early Maastrichtian to Late Campanian age occured at 2060.5 m. Sediments of (?) Albian/Cenomanian age occured between 2110-2115 m. Early Cretaceous rocks of Barremian to Hauterivian age were encountered between 2115 and 2120 m and overlay organic rich claystones of Berriasian to Late Portlandian age. Oxfordian sediments were present between 2138 m and 2147.5 m and Middle Jurassic sediments of Early Callovian to Bathonian age extend down to 2170.5 m. A thick Bathonian interval was penetrated at 2177.6 m and rocks of Early Bajocian to Late Toarcian age were defined below 2315 m. The well reached total depth at 2450 m in rocks of Early Toarcian age.

The chrono- and lithostratigraphy of the well is shown on page 6. The lithostratigraphic nomenclature applied is taken in part from Deegen and Scull " A standard lithostratigraphic nomenclature for the Central and Northern North Sea"1977. Jurassic nomenclature is taken from a preliminary report from a Norwegian nomenclature committee.

Norsk Hydro

Oslo Norway

WELL 31/4-6

NOT TO SCALE

DEPTH REF.: K.B. ELEVATION K.B: 25m ALL DEPTH IN METERS (m)

CHRONOSTRATIGRAPHY

SYSTEM	SERIES	STAGE	DEPTH		THICKNESS
		SEA BED	155		
QUATER-NARY			270		
QUATER-NARY		PLEISTOCENE	337		67
			348		
TERTIARY		LATE PLIOCENE	670		322
TERTIARY		MIDDLE / LATE MIOCENE	870		200
TERTIARY		MIOCENE	925		55
TERTIARY			932		
TERTIARY		LATE OLIGOCENE	1170		238
TERTIARY		EARLY OLIGOCENE	1500		330
TERTIARY			1510		
TERTIARY		EOCENE	1800		290
TERTIARY			1810		
TERTIARY		PALEOCENE	2050		240
TERTIARY				2060	
TERTIARY		DANIAN	2062.5		2.5
CRETAC-EOUS	LATE	L. CAMP. - E. MAASTRICHTIAN	2079		16.5
CRETAC-EOUS	LATE			2084	
CRETAC-EOUS	LATE	CAMPANIAN	2109		25
CRETAC-EOUS	EARLY	? ALBIAN - CENOMANIAN	2115		6
CRETAC-EOUS	EARLY	HAUTERIVIAN - BARREMIAN	2120		5
CRETAC-EOUS	EARLY			2123.5	
CRETAC-EOUS	EARLY	BERRIASIAN - L. PORTLAND	2132		8.5
JURASSIC	LATE			2138	
JURASSIC	LATE	OXFORDIAN	2147.5		9.5
JURASSIC	LATE		2149.5		
JURASSIC	LATE - MID.	L. BATH. - E. CALLOV.	2170.5		20
JURASSIC			2177.6		
JURASSIC	MID.	BATHONIAN	2310		132.4
JURASSIC			2315		
JURASSIC	MID.	L. TOARCIAN - E. BAJOCIAN	2354		39
JURASSIC	EARLY	? TOARC. - BAJOC.	2383		29
JURASSIC	EARLY	TOARCIAN (? EARLY)	2425		42
JURASSIC	EARLY		2435		
JURASSIC	EARLY	E. TOARCIAN	2450		15

LITHOSTRATIGRAPHY

GROUP		FORMATION / MEMBER	
	155		
NORDLAND GROUP			676
NORDLAND GROUP	854	UTSIRA FM.	854
HORDALAND GROUP	1810		1810
ROGALAND GROUP		BALDER FM.	1876
ROGALAND GROUP		SELE FM.	1911
ROGALAND GROUP	2061	LISTA FM.	2061
SHETLAND GROUP	2310		2122.5
CHROMER KNOLL GR.	2122.5	KIMM. CLY. FM.	2135.5
HUMBER GROUP		HEATHER FM.	2150
HUMBER GROUP		HEATHER FM. / INTRA HEATHER SAND II	2239
HUMBER GROUP	2317.5	HEATHER FM.	2317.5
BRENT. GR.		NESS. FM.	2356
BRENT. GR.	2380	ETIVE FM.	2380
DUNLIN GR.	2450	DRAKE FM.	2450

4. LITHOSTRATIGRAPHY

This summary is compiled predominantly from ditch cuttings descriptions. Wireline logs were used for assistance in lithological interpretation and to place formation boundaries. Side wall core samples are available from the Late Oligocene (1020 m) and down into the Early Toarcian with the last core recovered at 2448 m. Conventional Cores are available from the Late Jurassic and down into the Middle Jurassic.

4.1. QUATERNARY (155-337 m)

NORDLAND GROUP (135-337 m)

This interval consists of clays with thin stringers of unconsilidated sand. The clay is dark green gray, olive grey and occasionally light to dark grey, soft, sticky, micromicaeous and slightly to very calcareous. In places it is very silty to sandy.

The sand consists of clear quartz grains which are fine to very coarse grained, angular to rounded and unconsolidated. Rock fragments, macro fossil fragments, mica and glauconite occur.

The interval is Pleistocene in age and was deposited in glacical and interglacical, inner neritic conditions.

4.2. TERTIARY 337 - 2062.5)

NORDLAND GROUP (337 - 854 m)

337 - 676 m

This unit is similar to the overlying Quaternary deposits and is composed of clays with stringers of sand as described above. The clays are generally less calcareous and rare thin stringers of hard microcrystalline limestone were noted.

The unit is defined as Late Pliocene age (337 - 670 m) for the most part with the lowermost section (670 - 676 m) being Miocene in age.

An inner neritic environment with glacical conditions in the upper part (above 470 m) is postulated for this interval.

Utsira Formation (676 - 854 m)

The Utsira Formation is the first major sand unit encountered in the well and is composed of loose sand with a few stringers of clay.

The sand is very fine to fine grained at the top but rapidly coarsens downwards. For the most part grain size ranges from very fine to coarse. The grains are subangular to occasionally rounded, loose and made up predominantly of quartz with varying amounts for rock fragments. Rare occurances of a very fine to medium grained calcareous cemented sandstone were noted. Glauconite and macro shell fragments are abundant while traces of pyrite, forarmifera and mica occur throughout the interval.

The clay is similar to the overlying unit.

The interval is Miocene in age and was deposited in a Middle Neritic environment.

HORDALAND GROUP (854 - 1810 m)

854 - 1119 m

This uppermost interval in the Hordaland group consists of a silty claystone, with thin sandstone laminae and stringers and occasional thin limestones. The clay is olive grey to occasionally olive black, soft, sticky, silty grading to siltstone in part, locally sandy, micromicaeous, and rarely pyritic. Traces of glauconite and shell fragments occur and the clay becomes less calcareous downwards.

The sandstone is composed predominantly of very fine grained to silt sized quartz but it occasionally ranges up to medium grained. It is friable with an argillaceous matrix and contains traces of glauconite and pyrite.

The limestone is yellow grey to pale yellow brown, argillaceous, glauconitic and slightly dolomitic.

The interval is Miocene in age down to 925 m and Late Oligocene in age from 932 to 1119 m. Deposition took place in open marine conditions, proberbly in a middle to outer neritic environment.

1119 - 1156.5 m

This interval is formed by a massive sand unit similar to a thinner sand unit seen at approximately the same level in 31/4-3 (1084 - 1101 m). The sand is composed of clear, fine to coarse grained, subangular quartz which contains mica and glauconite. Some thin stringers of olive grey clay occur, mostly near the top at the interval which is totally Late Oligocene in age and was deposited in a similar environment to the overlying interval.

1156.5 - 1505 m

This is a long and fairly homogenus unit composed of claystone with occasional limestone stringers which generally become more dolomitic downwards. The basel section of the interval is clearly defined by both log character and a change in the colour of the claystones which can be correlated with 31/4-2,,3 and 5 at the Oligocene/Eocene boundary.

The claystone is predominantly olive grey and increasingly consolidated with depth. It grades to siltstone in parts and contains traces of mica, glauconite, carbonaceous material and pyrite. It is locally calcareous and contains occasional shell fragments.

Stringers of pale to dark yellow brown limestone occur which are hard, argillaceous, glauconitic and crypto to microcrystalline. These become more dolomitic with depth and increase in frequency between 1440 and 1470 m which produces a log motif which can be seen in other wells in the area.

The interval is Early Oligocene in age and deposition appears to have taken place in an outer neritic environment. The presence of an agglutinated fauna suggests some restricted bottom water conditions.

1505 - 1810 m

This interval, which forms the lowest unit of the Hordaland Group is cleary marked by log and lithology changes at the top (see previous interval) and at the base by the changes into the Balder Formation.

The dominant lithology is a predominantly dark green claystone which becomes moderate brown to grey brown in places. Minor amounts of varicoloured clays also occur. The claystone is silty and locally grades to siltstone. Traces of pyrite, mica and glauconite occur and it varies from noncalcareous to locally very calcareous. Traces of tuffaceous material occur towards the base of the unit. Traces of very fine to fine grained, silty argillaceous sandstone occur in the upper part of the interval and thin stringers of dolomitic limestone occur throughout.

The interval is Middle to Late Eocene in age down to 1670 m and Early Eocene to the base. Deposition took place in an outer neritic environment with restricted bottom water conditions.

ROGALAND GROUP (1810 - 2061 m)

Balder Formation (1810 - 1876 m)

The extent of this unit is marked by its characteristic log motif. It is composed of tuffaceous claystones with thin stringers of dolomitic limestone.

The claystone shows a marked colour change from the overlying interval. It is olive grey to olive black, firm to moderatly hard, blocky to sub fissile occasionally silty with traces of mica and pyrite. It is none calcarcous. Traces of light to medium dark grey, white and dusky yellow brown, friable, sucrosic tuffaceous material occur which are slightly to very calcareous. The dolomitic limestone stringers are similar to those noted above.

Sele Formation (1876 - 1911.5 m)

The Sele Formation is clearly defined by the logs and is generally similar in composition to the Balder Formation but less tuffaceous. It shows more colour variation in the claystones with the appearance of traces which are medium to dark grey and grey brown. It is more calcareous and no pyrite was noted. Rare stringers of limestone occur which are less dolomitic than in the Balder Formation.

Lista Formation (1911.5 - 2061 m)

This basel unit of the Rogaland Group is composed of none tuffaceous claystones, stringers of limestone and some marls near the base.

The claystone is dominantly olive grey to olive black, but differs from the overlying interval by the appearance of dark green grey stringers. Traces of pyrite and glauconite occur and the claystone is predominantly none calcareous. Below 2050 m the claystone grades to an olive grey marl which may represent an equivilent unit to the Maureen Formation. Some evidence of reworking was noted in a side wall core at 2060 m of Danian age.

Thin stringers of medium grey, glauconitic and calcareous siltstone occur throughout the interval. In places this siltstone grades to a very fine grained argillaceous sandstone. Occasional stringers of white to pale yellow brown argillaceous, slightly dolomitic limestone also occur throughout the interval.

According to IKU's new zonation for the Tertiary in the Horda platform area, the Rogaland Group has been dated as Early Eocene down to 1900 m and Late Paleocene from 1925 m. However, in the interest of conformity with all the other wells in the area, the whole of the Rogaland Group will be regarded as being of Paleocene age in this report, except for the bottom meter below 2060 which has been dated as Danian. This Danian interval may extend up to 2050 m.

Deposition down to 2050 m took place in an open marine environment with some restriction of bottom water circulation. Normal marine conditions proberbly existed below 2050 m.

4.3. CRETACEOUS (2061 - 2122.5 m)

SHETLAND GROUP (2061 - 2110.5 m)

The Shetland Group here is composed of two major units: a massive limestone with stringers of claystone and marl down to 2082 m, and secondly, a claystone unit with occasional stringers of limestone and siltstone.

The limestones are white to light grey, occasionally pink grey, firm to hard, crypto to microcrystalline, occasionally chalky and argillaceous in parts grading to marl.

The group is Danian (2061 - 2062.5) at the top with an underlying Early Maastrichtian to Late Campanian interval (2062.5 - 2079 m) and finally the lowest interval (2084 - 2109 m) is wholly Campanian in age. The Group was deposited in a neritic environment.

CROMER KNOLL GROUP (2110 - 2122.5 m)

The Cromer Knoll Group is a continuation of the overlying Shetland Group and is composed of interbedded limestones, marls and claystones. The unit ranges in age from Albian to Cenomanian (2110 - 2115 m). Deposition took place in a neritic environment. However, abundant saprolitic material in a sidewall core at 2120 m suggests some restriction in the environment.

4.4. JURASSIC (2061 - 2450 m)

HUMBER GROUP (2061 - 2314.5 m)

Kimmeridge Clay Formation (2061 - 2135.5 m)

This unit forms the uppermost interval in the Humber Group and is clearly defined on the logs by its characteristic high gamma ray and low sonic patterns. The lithology is also very characteristic consisting of typical "Hot Shale": brown black to black, earthy, silty, micromiceous, carbonaceous, pyritic and noncalcareous. A few thin stringers of chalky limestone occur.

The unit is Berriasian to Late Portlandian in age and was deposited in a low energy, marginal marine environment with stagnent bottom conditions.

The limestones are white to light grey, occasionally pink grey, firm to hard, crypto to microcrystalline, occasionally chalky and argillaceous in parts grading to marl.

The group is Danian (2061 - 2062.5) at the top with an underlying Early Maastrichtian to Late Campanian interval (2062.5 - 2079 m) and finally the lowest interval (2084 - 2109 m) is wholly Campanian in age. The Group was deposited in a neritic environment.

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4.4. JURASSIC (2122.5 - 2450 m)

HUMBER GROUP (2122.5 - 2317.5 m)

Kimmeridge Clay Formation (2122.5 - 2135.5 m)

This unit forms the uppermost interval in the Humber Group and is clearly defined on the logs by its characteristic high gamma ray and low sonic patterns. The lithology is also very characteristic consisting of typical "Hot Shale": brown black to black, earthy, silty, micromicaceous, carbonaceous, pyritic and noncalcareous. A few thin stringers of chalky limestone occur.

The unit is Berriasian to Late Portlandian in age and was deposited in a low energy, shallow marine environment with stagnent bottom conditions.

Heather Formation (2135.5 - 2317.5 m)

(2135.5 - 2149 m)

This interval is composed of a brown grey to olive grey sandy siltstone. Grain size ranges from fine to silt size. The siltstone is hard, with an argillaceous matrix, pyrite and calcareous nodules, abundant mica and some glauconite. Porosity was described as poor. Actual measured porosities on a core in this interval ranged from 11 to 18%.

Intra Heather Sand II (2150-2239m)

This interval is the first sandstone unit in the Jurassic and forms the hydrocarbon bearing reservoir.

The sandstone is composed predominantly of fine to very fine grained quartz which is hard, argillaceous, silty in parts, carbonaceous, locally very micaeous, pyritic and glauconitic in places. Porosity is often reduced by a clay matrix or by a locally well developed calcareous cement which grades into stringers of sandy limestone. Some thin beds of medium to coarse grained sandstone occur which are friable, fairly clean and have a better porosity.

The interval contains coal fragments, plant remains, brachiopod and belemnite fragments and occasional area of fine cross lamination. Large parts of the interval have been bioturbated.

Measured core porosities through the interval range from 16-26% but permeability is generally low.

Heather Formation (2135.5 - 2317.5 m)

(2135.5 - 2150 m)

This interval is composed of a brown grey to olive grey sandy siltstone. Grain size ranges from fine to silt size. The siltstone is hard, with an argillaceous matrix, pyrite and calcareous nodules, abundant mica and some glauconite. Porosity was described as poor. Actual measured porosities on a core in this interval ranged from 11 to 18%.

Intra Heather Sand II (2150-2239m)

This interval is the first sandstone unit in the Jurassic and forms the hydrocarbon bearing reservoir.

The sandstone is composed predominantly of fine to very fine grained quartz which is hard, argillaceous, silty in parts, carbonaceous, in parts very micaeous, pyritic and glauconitic in places. Porosity is often reduced by mica and a clay matrix and by locally well developed calcareous cement which grades into stringers of sandy limestone. A 6 cm thin bed of predominantly very coarse grained sandstone occur which is friable, fairly clean and have a porosity of approx. 30%.

The interval contains coalified wood fragments and ammonite impressions, plant remains, bivalve and belemnite shells and occasional intervals of fine cross and planar lamination. The major part of the interval have been bioturbated.

Measured core porosities through the interval range from 16-26% but permeability is generally low.

2239-2317.5m

The lowest unit of the Heather Formation consists of interbedded and interlaminated, very fine grained sandstone, siltstone and minor amounts of claystone. It has argillaceous laminations and a calcareous cement which locally grades to an argillaceous sandy limestone. Mica, pyrite and carbonaceous material occur through out the interval.

The Humber Group was cored from 2132 m in the Kimmeridge Clay Formation down to 2114.5 m near the base of the "Intra Heather Sand II" (Core No's 1-5) and these cores are described in Appendix 1.

The Heather Formation is Oxfordian from 2138 to 2147.5 m (nearshore deltaic environment with some marine influence), Early Callovian to Late Bathonian from 2149.5 to 2170.5m. (very near shore deltaic environment with occasional marine influences down to 2156.5m) and Bathonian from 2177.6 to 2310 m (near shore marine deposition with some restriction in circulation below 2255m). From 2315m to the base of the Heather Formation at 2317.5 m it is dated as Late Toarcian to Early Bajocian (possibly high energy marginal marine or intertidal environment).

BRENT GROUP (2317.5 - 2380m)

Ness Formation (2317.5 - 2355 m)

The Ness Formation consists of interbedded claystone and sandstone with occasional coal stringers. This unit is defined on lithological grounds and by clear log breaks at the top and base.

The claystone is olive grey, firm to moderatly hard, blky to sub fissile, micaeous, carbonaceous and contains rare fragments of lignite. The sandstone ranges in

2239-2317.5m

The lowest unit of the Heather Formation consists of interbedded and interlaminated, very fine grained sandstone, siltstone and minor amounts of claystone. It has argillaceous laminations and a calcareous cement which locally grades to an argillaceous sandy limestone. Mica, pyrite and carbonaceous material occur through out the interval.

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BRENT GROUP (2317.5 - 2380m)

Ness Formation (2317.5 - 2355 m)

The Ness Formation consists of interbedded claystone and sandstone with occasional coal stringers. This unit is defined on lithological grounds and by clear log breaks at the top and base.

The claystone is olive grey, firm to moderatly hard, blocky to sub-fissile, micaeous, carbonaceous and contains rare fragments of lignite. The sandstone ranges in grain size from occasionally very fine to very coarse, predominantly being medium to very coarse grained: The grains are subangular to rounded and friable with a weak calcareous cement and an grain size from occasionally very fine to very coarse, predominantly being medium to very coarse grained: The grains are subangular to rounded and friable with a weak calcareous cement and an argillaceous matrix which must reduce the porosity. Stringers of a black to dark brown, brittle, micropyritic coal occur throughout the interval which is dated as Late Toarcian to Early Bajocian.

The presence of coals and land derived spores, bisaccates and cuticular material suggests deposition in fresh or brackish water close to a source of land vegetation. Below 2235m, the presence of dinoflagellate cysts and acritiarchs suggests increasing marine influences.

Etive Formation (2355-2380m)

The Etive Formation is a generally clean massive sandstone unit and clearly distingished from the over and underlying formations both on the logs and in the cuttings samples. A thin stringer of very argillaceous sandstone or sandy claystone occurs near the top of the unit.

The sandstone light olive grey to yellow grey in colour and is composed of clear, very fine to very coarse grained, subangular to rounded quarts. It is friable with some weak argillaceous matrix material. Mica, pyrite, glauconite and occasional argillaceous laminae were noted. Porosity is good.

The formation is dated as presumed Toarcian/Bajocian from 2354m was deposited in fairly high energy oxidising conditions.

argillaceous matrix which must reduce the porosity. Stringers of a black to dark brown, brittle, micropyritic coal occur throughout the interval which is dated as Late Toarcian to Early Bajocian.

The presence of coals and land derived spores, bisaccates and cuticular material suggests deposition in fresh or brackish water close to a source of land vegetation.

Etive Formation (2355-2380m)

The Etive Formation is a generally clean massive sandstone unit and clearly distinguished from the over and underlying formations both on the logs and in the cuttings samples.

The sandstone light olive grey to yellow grey in colour and is composed of clear, very fine to very coarse grained, subangular to rounded quarts. It is friable with some weak argillaceous matrix material. Mica, pyrite, glauconite and occasional argillaceous laminae were noted. Porosity is good.

The formation is dated as presumed Toarcian/Bajocian from 2354m and was deposited in fairly high energy oxidising conditions.

DUNLIN GROUP (2380-2450m)

Drake Formation (2380-2450m (T.D.)

The Drake Formation is a claystone unit with a coarsening upwards sequence on the logs, which terminates in a few stringers of silty fine grained sand. The claystone contains interbeds of siltstone and is olive black to olive grey, silty and occasionally finely sandy, carbonaceous, micaeous, pyritic and occasionally calcareous. It grades to an olive grey to dark yellow brown siltstone. The sandstone is fine grained grading down to silt, friable, argillaceous, pyritic, micaeous and has a poor to fair visible porosity. Occasional stringers of limestone occur which are dolomitic in part. The interval is dated as Toarcian (Early?) down to 2425 m and as definate Early Toarcian below 2435 m.

Deposition took place in a marginal marine environment with some restriction of bottom water circulation. Shallow water with fairly high energy conditions, close to the shore face is likely for the upper part of the interval. Somewhat lower energy conditions existed below 2435 m.

5. HYDROCARBON SHOWS

Evaluation of hydrocarbon shows at the wellsite was carried out in a conventional manner. Below 243 m, a complete hydrocarbon total gas detector (50 units = 1%) was operational together with a gas chromatograph for automatic and continious gas analysis, recorded as ppm by volume of C1 through C5.

Hydrocarbon shows on ditch cuttings were evaluated according to Norsk Hydro's "Geologists Wellsite Manual".

5.1 GAS RECORDS

243 - 920 m

Between 0.04 and 0.54% methane (C1) was recorded in this interval of clay with sand stringers and the Utsira Formation. Gas levels were highest in the clay intervals but dropped to below 0.1% in Utsira Formation sands.

920 - 1800 m

Gas levels remained uniformly low, 0.001 - 0.01% C1. throughout the interval of Tertiary clays and limestone stringers of the Hordaland group. Mud weight was increased from 1.03 rd at the top of the interval to 1.35 rd at the base and may account for the paucity of gas.

1800 - 2070 m

A gradual increase in gas was noted over this interval from 0.006 to 0.54% C1. The lithology consisted of clays and limestone stringers of the Rogaland Group with some Cretaceous limestone at the base of the interval. Mud weight was reduced from 1.35 rd to 1.26 rd while drilling the interval and minor amounts of connection gas were noted down to 1900 m.

2070 - 2302 m

This interval consists of Cretaceous clays and limestones, plus siltstones and sandstones of the Upper Jurassic Heather Formation including the "Intra Heather Sand II". The gas varied between 0.007 and 2.0%. Ethane (C2) and propane (C3) were present for the first time in the well. The maximum gas was recorded in a limestone stringer at the top of the Cromer Knoll Group at 2110 m. Gas levels remained below 0.1% while coring the "Intra Heather Sand II" reservoir interval.

2302-2450m

The final interval in the well was composed of Middle and Early Jurassic sandstones, shales and coal stringers. Gas levels varied betwen 0.04 and 1.6% C1 with occasional traces of C2. Gas was generally low, less than 0.3% except while drilling through coal stringers in the Ness Formation between 2320 and 2350 m where maximum gas levels were recorded.

5.2 OIL STAIN AND FLUORESCENCE

2132-2137m

Shows were reported in Core 1 in shales and silstones of Upper Jurassic age. No fluorescence was reported but a uniform, very weak white to yellow white crush cut was noted. These shows were typical for the highly organic "Hot Shale" and were rated as poor.

2148-2170.5

Shows were reported in cores 1-3 in sandstones of Upper Jurassic age beloning to the "Intra Heather Sand II" interval. The cores were described as having a strong hydrocarbon odour and occasionally exhibiting a light brown bleeding oil. Fluorescence was described as being locally patchy to uniform, weak to strong, dull to bright yellow and occasionally yellow white. This fluorescence gave a moderatly fast to instant, yellow white to bright blue white, streaming and flood cut. A light brown visual cut and moderate brown visual residue was noted. This show was rated as good.

2215-2274m

Shows were report in sidewall cores in sandstone taken from 2215, 2262 and 2215 m in the Heather formation. No fluorescence was reported but the cores did occasionally show traces of a slow, weak yellow fluorescent crush cut and traces of a weak yellow fluorescent residue. These shows were rated as poor.

2321-2345m

Weak shows were reported in 4 sidewall cores taken in claystone and sandstone taken over this interval in the Middle Jurassic Ness Formation. These shows were described as for the shows in the above interval and again were rated poor.

2425-2448m

Sidewall cores taken sandstone and claystone in the Drake Formation were reported as having weak shows. These were described as having occasional traces of a slow, weak yellow crush cut and traces of weak yellow fluorescent residue. They were rated poor.

6. CORING

6.1 CONVENTIONAL CORES

A total of five cores were cut in the well. Cores were cut consecuativly from the Kimmeridge Clay Formation and down into the lower part of the "Inter Heather Sand II".

Core 1 was cut from 2132 to 2149 m in the Kimmeridge Clay Formation (5m), through the top interval of the Heather Formation (11m) and into the top of the "Intra Heather Sand II" (1m). 16,3 m (96%) of shale and fine grained sandstone were recovered with poor shows in the Kimmeridge Clay Formation and a good show in the 30 cm of the "Intra Heather Sand II" that were recovered.

Core 2 was cut from 2149 to 2159,5m. 10,5m (100%) of generally fine grained argillaceous sandstone were recovered with good to patchy shows.

Core 3 was cut from 2159,5 to 2178,1 m. 18,6 m (100%) of fine sandstone with stringers of sandy limestone were recovered. Good shows were reported and some bleeding oil observed in the upper part of the core. No shows were reported below 2170,5m.

Core 4 was cut from 2178,1 to 2196,1m. 18,0 m (100%) of fine grained sandstone were recovered with no shows.

Core 5 was cut from 2196,1 to 2214,5m. 18,4m (100%) of fine to very fine grained sandstone with two stringers of sandy limestone with no shows, were recovered.

Correlation between the cores and the logs indicates that core depths are two to three meters shallower than loggers depth.

Description of the cores can be found in Appendix 1.

6.2 SIDE WALL CORES

Side wall cores were taken from 1020m in the Late Oligocene and through out the well down to 2448m in the Early Toacian. A total of 3 runs were made with recoveries of 27, 29 and 27 out of 30 for runs 1 to 3 respectively. A total of 83 out of 90 cores were recovered.

Run 1 from 1850 to 1020m was taken for minerological analysis of the clays.

A detailed description of the cores is given in Appendix 2.

7. WIRELINE LOGGING

The following is a summary of wireline logs run in the well 31/4-6 and shows the dates, logged intervals and run numbers of each log.

Log	Date	Logged Interval	Run No.
ISF/SONIC/GR	4.3.82	155 - 913 m	1.
"	18.3.82	913 - 1861 m	2.
"	31.3.82	1845 - 2214 m	3.
ISF/SONIC/NGT/SP	3.4.82	2115 - 2448 m	4.
FDC/CAL/GR	18.3.82	913 - 1862 m	1.
FDC/CNL/CAL/GR	31.3.82	1845 - 2215 m	2.
LDT/CNL/EPT/GR/CAL	4.4.82	2215 - 2450 m	1.
DLL/MSFL/CAL/GR	31.3.82	2035 - 2212 m	1.
HDT	4.4.82	1845 - 2449 m	1.
VELOCITY SURVEY	5.4.82	360 - 2444 m	1.
CBL/VDL	31.3.82	700 - 1840 m	1.
RFT	4.4.82	2138,5- 2377 m	1.
"	4.4.82	2160,5m (sample)	1.
"	4.4.82	2166,5m (sample)	2.
CST	18.3.82	1020 - 1850 m	1.
"	5.4.82	2035 - 2310 m	2.
"	5.4.82	2065 - 2448 m	3.

8. SPECIAL STUDIES

The biostratigraphic evaluation of the well has been performed by the laboratories of the Continental Shelf Institute (IKU) in Trondheim. The results of this evaluation are contained in the report:

NORSK HYDRO 31/4-6 BIOSTRATIGRAPHY.

APPENDIX 1

CORE DESCRIPTIONS

CORES 1-5

Norsk Hydro a.s

Oslo – Norway

Well no.		Core nos
31/4-6	Core report	**1**

Interval	Area	Cut	Date
2132 - 2142 m	Norwegian North Sea	2132 - 2149 m	27.3.82.

Scale	Well R.K.B.	Recovery	Geologist
1:50	25 m	2132 - 2148.3 m. 96%	Lærkerød/Johnsen

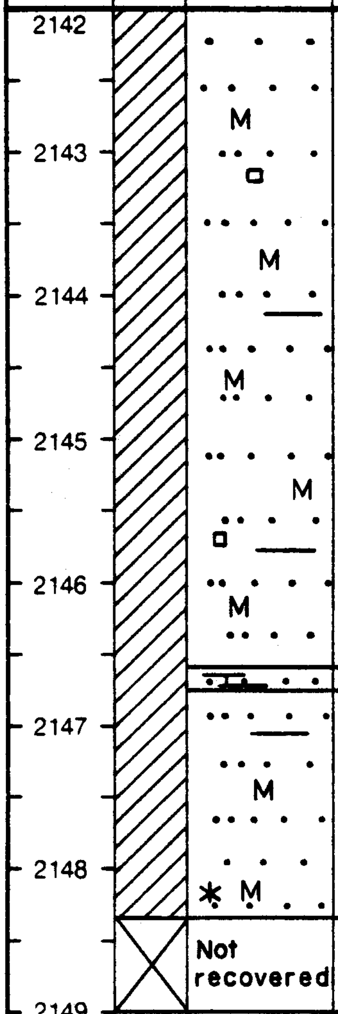
Depth scale	Re-covery	Lithological column	Depths	Lithological descriptions	Shows
2132		M C M		**Sh:** gysh blk. firm - hd. subfis - fis. mic and micro-mic. carb. pyr. non calc. occ plant frags. Thinly lam slt.	No flu. v weak wh - yel wh crush cut.
2133		C C	2133.35 m 2133.55 m	**Sh:** blk grdg **Coal,** foss a/a.	
2134		M		**Sh:** dk gy - brnsh gy. incr slty and bcmg vf sdy. mic. carb occ coal frags. non calc. occ sl calc.	
2135		C		Lam of **Sst/Slst:** brn gy - olv gy. slt - vf. subang. hd - mod hd. mic. carb. v arg. pr. por. no show.	
2136		M			
2137		M	2137 m	**Sst/Slst:** brn gy - olv gy. vf - f. occ grdg **Slst**, hd. subang. v mic. v arg. pyr. occ pyr nods. occ calc nods. occ lam of mgy. vf - f. **Sst**, pred arg mtx. occ sl calc. mod srtd. low vis por. no show.	No flu. v weak flu cut a/a.
2138		M			
2139		M			
2140					
2141		M			
2142					

Norsk Hydro a.s
Oslo – Norway

Well no.		Core nos
31/4-6	Core report	1

Interval	Area	Cut	Date
2142 - 2148.3 m	Norwegian North Sea	2132 - 2149 m	27.3.82

Scale	Well R.K.B.	Recovery	Geologist
1:50	25 m	2132 - 2148.3 m. 96%	Lærkerod/Johnsen



Depths	Lithological descriptions	Shows
	Sst/Slst: a/a.	No show.
2146.6 m – 2146.75 m	**Sst/Slst:** a/a. v hd. calc cmt.	
– 2148.3 m	**Sst:** brnsh gy - olv gy. vf - f. mod hd. ang - subang. v mic. sl pyr. glau. arg mtx. non calc. mod - well srtd. fair vis por.	80% mod strong. yel wh flu. mod strong. medium fast wh - yel wh flu cut. faint yel brn vis resd.
2148.3 m – 2149 m	Not recovered	

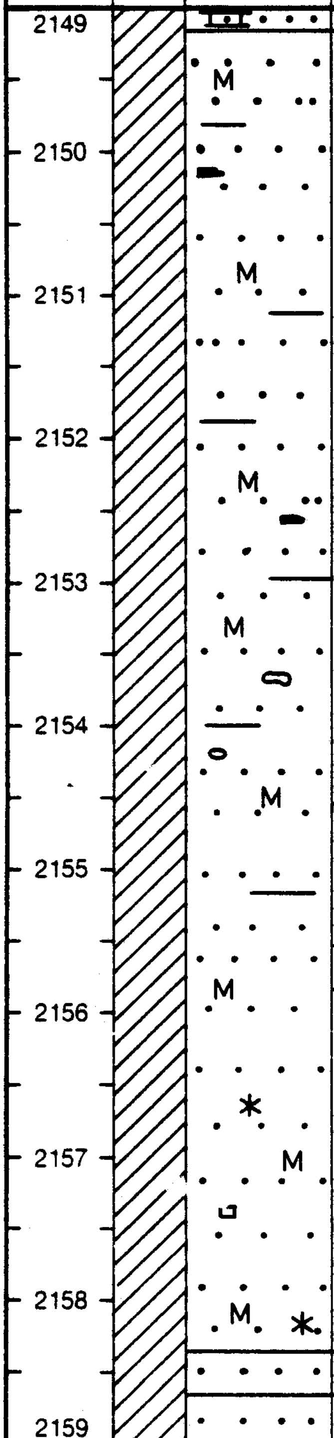
Norsk Hydro a.s

Oslo – Norway

Well no.		Core no s
31/4-6	Core report	2

Interval	Area	Cut	Date
2149 - 2159 m	Norwegian North Sea	2149 - 2159.5 m	28.3.82
Scale	**Well R.K.B.**	**Recovery**	**Geologist**
1:50	25 m	2149 - 2159.5 m. 100%	Lærkerød/Johansen

Depth scale | Re-covery | Lithological column



Depths	Lithological descriptions	Shows
2149.15 m	**Sst:** brn gy - olv gy. vf - f. mod hd. pred subang. mic. arg. top pt calc. cmtd. scat coal frags. foss in pts. occ x-lam, fair vis por.	Patchy faint yel wh flu. mod fast yel - wh - bl wh flu cut.
	Sst homogenous w a few scat foss frags (belemnites?).	No show.
	Occ calc nods (replaced shell frags?)	
2154.6 m	**Sst:** a/a. w show.	20% weak dull yel flu. mod fast bl wh flu cut. v faint lt yel vis resd.
2155.5 m	**Sst:** a/a. no show.	
2155.8 m	**Sst:** dk yel brn. pred f. subang. mic. glau. arg mtx. non calc. mod - well srtd. pyr in pts. occ abn replaced foss. fair - gd vis por.	From 2155.8 m.10 - 100% bright yel flu. fast bl wh - yel wh flu cut. yel brn flood cut. brn vis resd. Strong HC odour.
2158.45 m	**Sst:** yel brn. crs. v fri. subrnd. sm dk mins. gd vis por.	100% bright yel flu. inst bl wh flu cut. brn vis resd. Strong HC odour.
2158.65 m		

Norsk Hydro a.s

Oslo – Norway

Well no. 31/4-6	Core report		Core no s 2
Interval 2159 - 2159.5 m	Area Norwegian North Sea	Cut 2149 - 2159.5 m	Date 28.3.82.
Scale 1:50	Well R.K.B. 25 m	Recovery 2149 - 2159.5 m, 100%	Geologist Lærkerod/Johnsen

Depth scale	Re-covery	Lithological column	Depths	Lithological descriptions	Shows
2159		M *	2159.5 m	**Sst:** as for 2155.8 - 2158.45 m.	Show a/a.
2160					

Norsk Hydro a.s

Oslo – Norway

Well no.		Core no's
31/4-6	Core report	3

Interval	Area	Cut	Date
2159.5 - 2169.5 m	Norwegian North Sea	2159.5 - 2178.1 m	29.3.82.
Scale	**Well R.K.B.**	**Recovery**	**Geologist**
1:50	25 m	2159.5 - 2178.1 m. 100%	Lærkerød/Johnsen

Depth scale	Depths	Lithological descriptions	Shows
2160 – 2161	2160.13 m Sealed samp. 2160.31 m	**Sst:** olv gy - dusky yel. clr Qtz. pred f. occ vf. firm, fri. subang - subrnd. carb in pts. sl mic. rr glau. occ sl calc cmtd. arg mtx. well srtd. gd - fair vis por. Occ carb plant rmns. Sl mic in pts.	70 - 100% bright yel wh flu. bright bl wh. inst strmg flood cut. lt brn vis cut. gd HC odour.
2162 – 2163	2161.8 m	**Sst:** brn blk - m dk gy. f. hd - v hd. subang - subrnd. scat carb mat. mic in pts. well calc cmtd. less cmtd in pts. mod well srtd. pr vis por.	10 - 30% flu in less cmtd pts. no show in well cmtd pts.
2164 – 2165	2163.15 m	**Sst:** gen as for 2159.5 - 2161.8 m. occ orig calc shell frags. bracchiopods w assoc pyr. horizontal lam w concentrations of carb and mica in dk lams. Scat crs mica flakes around 2165 m.	100% flu and cut as for 2159.5 - 2161.8 m. Sm bleeding oil observed.
2166 – 2168	2166.09 m Sealed samp. 2166.28 m	**Sst** homogeneous w horizontal. lams in pts.	
2169		Incr mic from 2169 m.	

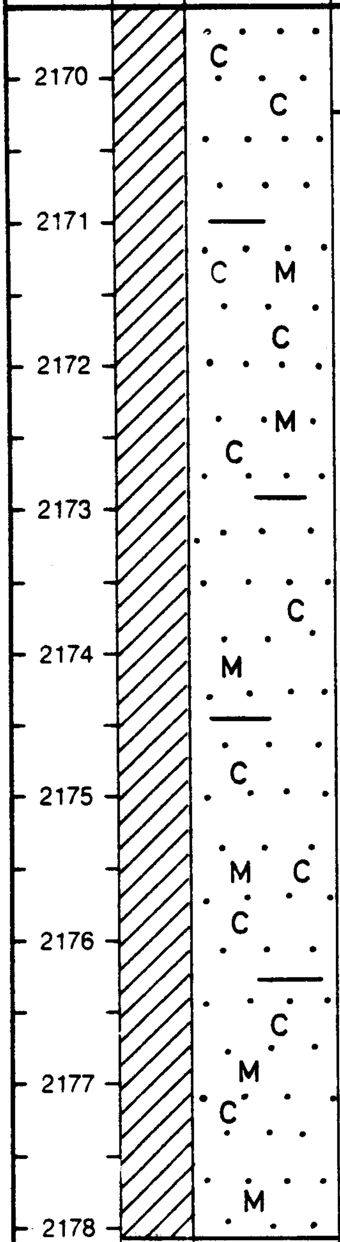
Norsk Hydro a.s

Oslo – Norway

Well no.		Core nos
31/4-6	Core report	3

Interval	Area	Cut	Date
2169.5 - 2178.1 m	Norwegian North Sea	2159.5 - 2178.1 m	29.3.82

Scale	Well R.K.B.	Recovery	Geologist
1:50	25 m	2159.5 - 2178.1 m. 100%	Lærkerod/Johnsen

Depth scale / Re-covery / Lithological column	Depths	Lithological descriptions	Shows
	2170.3 m 2178.1 m	**Sst:** as for 2163.15 - 2169.5 m. incr carb and mic. **Sst:** olv gy - m gy. vf - f. mod hd - hd. carb. v carb in lam. mic. occ v mic. arg. pred cly mtx. calc cmtd in pts. pr vis por. Carb and mica conc in dk lams. 1 - 2 mm thick. occ 3 - 4 mm. horizontal lam. no struct dip seen.	Show as for 2163.15 - 2169.5 m. Flu bcmg patchy (10%). No show below 2170.5 m.

Well	Core report	Core nos
31/4 - 6	2 of 2	3

Norsk Hydro a.s

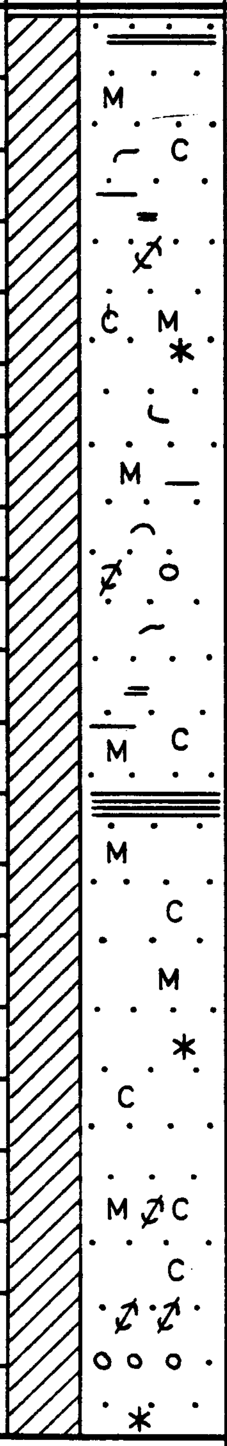
Oslo – Norway

Well no.		Core no's
31/4-6	Core report	4

Interval	Area	Cut	Date
2178.1 - 2188 m	Norwegian North Sea	2178.1 - 2196.1 m	30.3.82
Scale	**Well R.K.B.**	**Recovery**	**Geologist**
1:50	25 m	2178.1 - 2196.1 m. 100%	Lærkerød/Johnsen

Depth scale: 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188

Re-covery / Lithological column:



Depths	Lithological descriptions	Shows
2178.4 m	**Sst:** dk gy - gy blk, vf - f, mod hd, pred subang, mic, occ v mic w lam of mica, carb, occ glau, lt gy arg mtx, well srtd, fair vis por, occ fair - gd when less mic and carb.	No shows.
	Sst pred bioturb, occ horizontal lam, occ low angle x - lam. Abn foss frags, brachs and belemnites, scat coal frags.	
2182.1 m	Calc nod 2 cm dia.	
2183.6 m	Horizontal lam.	
2187.5 m	Calc nods	

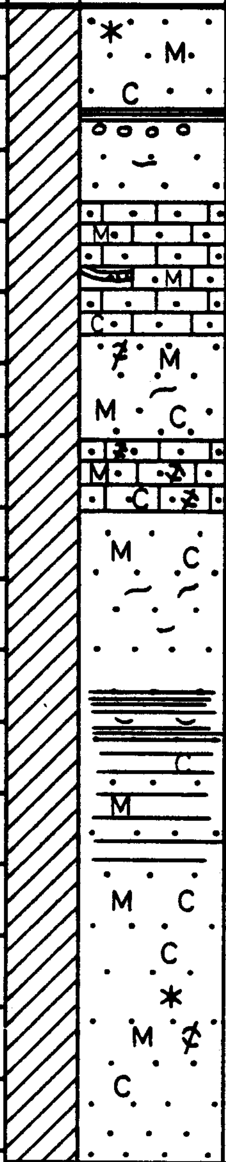
Norsk Hydro a.s

Oslo – Norway

Well no.		Core no's
31/4-6	Core report	4

Interval	Area	Cut	Date
2188 - 2196.1 m	Norwegian North Sea	2178.1 - 2196.1 m	30.3.82.
Scale	**Well R.K.B.**	**Recovery**	**Geologist**
1:50	25 m	2178.1 - 2196.1 m. 100%	Lærkerød/Johnsen

Depth scale	Re-covery	Lithological column	Depths	Lithological descriptions	Shows
2188				**Sst:** as for 2178.1 - 2188 m.	No Shows.
			2188.75 m		
			2188.86 m		
2189			2188.05 m	**Sst:** olv gy. vf. gen a/a but less mic and carb. fair - gd vis por.	
			2189.4 m	**Sst:** gy blk. vf - f. v hd. subang. mic. sl carb. well calc cmtd. pr vis por.	
2190			2190.3 m	**Sst:** as for above calc **Sst**. v mic. v carb. foss frags. pr - fair vis por.	
2191			2191.1 m	**Sst:** as for 2189.4 - 2190.3 m. v foss (bracs).	
			2191.57 m	**Sst:** gen as for 2178.1 - 2188 m. pred bioturb. occ horizontal lam. gen more por and fri when less carb and mic.	
2192				At 2189.91 m 10 cm long belemnite.	
2193					
2194					
2195					
2196			2196.1 m		



Well	Core report	Core no's
31/4 - 6	2 of 2	4

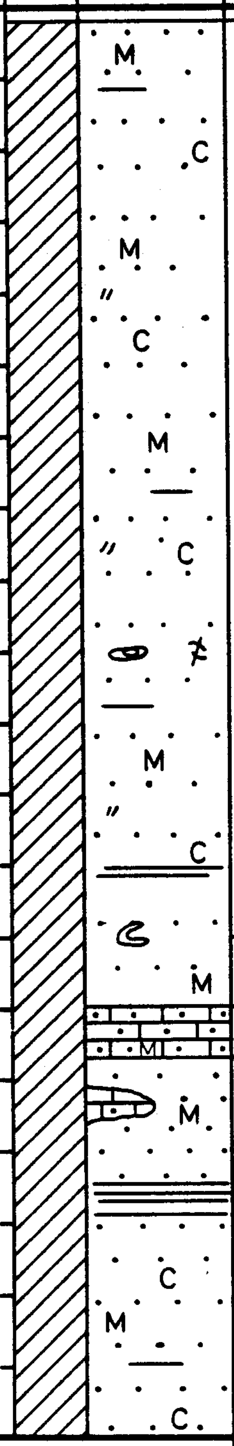
Norsk Hydro a.s

Oslo – Norway

Well no.		Core no's
31/4-6	Core report	5

Interval	Area	Cut	Date
2196.1 - 2206 m	Norwegian North Sea	2196.1 - 2214.5 m	31.3.82.
Scale	**Well R.K.B.**	**Recovery**	**Geologist**
1:50	25 m	2196.1 - 2214.5 m, 100%	Lærkerød/Johnsen

Depth scale	Re-covery	Lithological column	Depths	Lithological descriptions	Shows
			2196.1 m	**Sst:** brnsh gy - m dk gy, pred vf, occ f, occ slty, mod hd, subang, occ ang, mic, carb, abn carb mat in lam, horizontal and contorted, lt gy cly mtx, mod well srtd, pr - fair vis por.	No shows.
2197					
2198					
2199				Occ patches w **Sst:** a/a but less mic and carb.	
2200				**Sst** gen prly lam, occ well dev horizonal lam, w carb and mica enriched dk lam. Occ low angle cross lam, foss in pts. Calc nods loc abn.	
2201					
2202			2202.5 m		
2203			2203 m	Struct dip 0 - 1°. **Sst**, m dk gy a/a, hd, well calc cmtd, pr vis por.	
			2203.4 m		
2204					
2205					
2206					



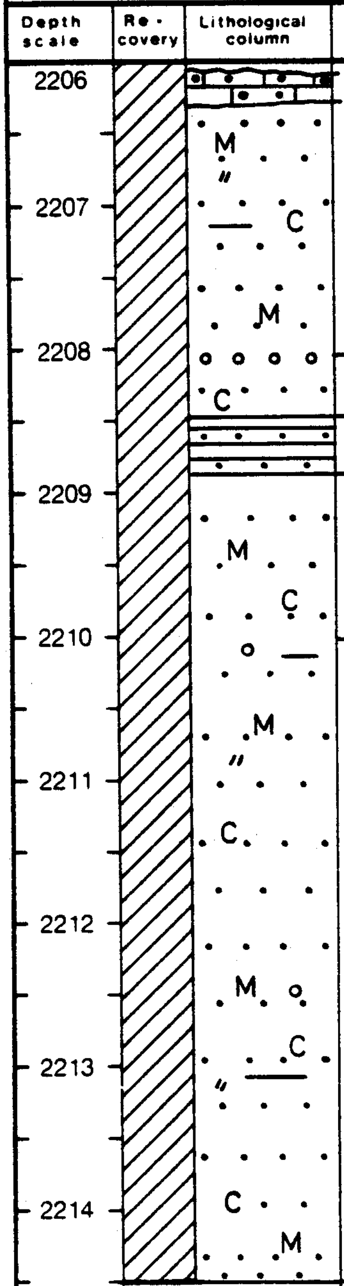
Norsk Hydro a.s

Oslo – Norway

Well no.		Core nos
31/4-6	Core report	5

Interval	Area	Cut	Date
2206 - 2214.5 m	Norwegian North Sea	2196.1 - 2214.5 m	31.3.82.

Scale	Well R.K.B	Recovery	Geologist
1:50	25 m	2196.1 - 2214.5 m. 100%	Lærkerod/Johnsen



Depths	Lithological descriptions	Shows
2206.05 m 2206.35 m	**Sst:** as for 2196.1 - 2206 m. except for 2206.05 - 2206.35 m where **Sst** is well calc cmtd w pr por.	No shows.
2208.1 m		
2208.5 m 2208.9 m	Occ calc nods. Well lam. horizonal	
2210 m	From 2210.25 m. tr red brn. flaky gs. f - crs. as infill in pores. Poss fe - mineral.	
2214.5 m		

APPENDIX 2

SIDE WALL CORE DESCRIPTIONS

RUNS 1-3

Norsk Hydro

SIDE WALL CORES DESCRIPTION

WELL: 31/4-6	RUN Nº: 1	SERVICE COMPANY: Schlumb	
LICENCE: 055	PAGE Nº: 1 of 2	ASKED: 30	SHOT: 30
	DATE: March 18. 1982	LOST: 0	EMPTY: 3
		SAMPLES RECOVERED: 27	
		GEOLOGIST: P.A. Midtkandal	

tr : trace - **M** : medium - **G** : good

Nº	DEPTHS m	REC cm	LITHOLOGY	Fluorescence	CUT
1	1850	0	Empty		
2	1830	3	**Clyst,** olv gy. firm. occ subfis. vrr micro mic. v rr glau. non calc. no show.		
3	1820	3	**Clyst,** olv gy - olv blk. firm. sl stky. v rr micro mic. loc sl calc. no show.		
4	1810	4	**Clyst,** olv blk. sft - hd. micro pyr. non calc. no show.		
5	1787	5	**Clyst,** mod brn - gy brn. sft - firm. stky. rr micro mic. v rr dk spec. non calc. no show.		
6	1785	4	**Clyst,** dusky yel brn intlam pl yel brn. mod hd. micro mic. abn dk glassy spec. v calc. no show.		
7	1780	5	**Clyst,** gy brn - dusky brn. mod hd. micro mic. tr glau. loc incl dk grn **Clyst,** grn blk. sl slty. tr glassy shards. non calc.		
8	1760	3	**Clyst,** dusky brn - gy brn. firm - sft. sl stky. tr micro mic. loc incl dk grn **Cly,** rr glau. non calc. no show.		
9	1610	0	Empty.		
10	1597	4	**Clyst,** dk grn. firm - sft. stky. rr micro mic. non calc. no show.		
11	1592	4.5	**Clyst,** dk grn - grn blk. firm. - mod hd. rr micro mic. rr micro pyr. non calc. non show.		
12	1586.5	3.5	**Clyst,** grn blk. mod hd. sl stky. rr micro mic. non calc. no show.		
13	1584	5	**Clyst,** dk grn gy - grn blk. mod hd. sl stky. rr micro mic. rr micro pyr. non calc. no show.		
14	1570	4.5	**Clyst,** dk grn gy. mod hd. sl stky. tr micro mic. rr glau. non calc. no show.		
15	1550	5	**Clyst,** dk grn gy. firm - sft. stky. tr micro mic. rr glau. non calc. no show.		
16	1540	5	**Clyst,** dk grn gy. firm - sft. stky. tr micro pyr. rr micro mic. rr glau. non calc. no show.		
17	1525	4	**Clyst,** dk grn gy. firm. sl stky. rr micro mic. non calc. no show.		
18	1510	4.5	**Clyst,** dk grn gy. firm - sft. stky. rr micro mic. non calc. no show.		

Norsk Hydro

SIDE WALL CORES DESCRIPTION

WELL: 31/4-6	RUN N°: 1
LICENCE: 055	PAGE N°: 2 of 2
	DATE: March 18, 1982

SERVICE COMPANY:	Schlumb
ASKED:	30
SHOT	30
LOST	0
EMPTY	3
SAMPLES RECOVERED	27
GEOLOGIST:	P.A. Midtkandal

tr : trace - M : medium - G : good

N°	DEPTHS m	REC cm	LITHOLOGY	Fluorescence tr	M	G	CUT
19	1490	3	**Clyst,** dusky yel brn, mod hd - firm, sl stky, tr micro mic, rr glau, non calc, no show.				
20	1400	3	**Clyst,** dusky yel brn, mod hd - firm, sl slty, sl stky, micro mic, non calc, no show.				
21	1330	0	Empty.				
22	1230	3.5	**Clyst,** olv gy, firm, tr micro mic, rr glau, calc, no show.				
23	1205	4.5	**Clyst,** olv gy, firm - mod hd, tr micro mic, sl calc, no show.				
24	1200	3	**Clyst,** olv gy, firm - mod hd, sl stky, tr micro mic, non calc, no show.				
25	1190	4	**Clyst,** olv gy, firm - mod hd, tr micro mic, rr glau, non calc, no show.				
26	1185	4	**Clyst,** olv gy - olv blk, firm, slty, micro mic, tr glau, calc, no show.				
27	1180	4	**Clyst,** olv gy - dusky yel brn, firm, tr micro mic, tr glau, calc, no show.				
28	1175	5	**Clyst,** dusky yel brn, firm, sl slty, tr mic, tr micro pyr, calc, no show.				
29	1100	5	**Clyst,** olv gy, firm, tr micro mic, calc, no show.				
30	1020	4.5	**Slst,** olv blk, sft - firm, micro mic, glau, calc, no show.				

Norsk Hydro

SIDE WALL CORES DESCRIPTION

WELL: 31/4-6	RUN N°: 2	SERVICE COMPANY: Schlumb	
LICENCE: 055	PAGE N°: 1 of 2	ASKED:	30
	DATE: April 5, 1982	SHOT	30
		LOST	0
		EMPTY	1
		SAMPLES RECOVERED	29
		GEOLOGIST: Lærkerød/Henderson	

tr : trace - M : medium - G : good

N°	DEPTHS m	REC cm	LITHOLOGY	Fluorescence tr	M	G	CUT
31	2310	3	**Sst,** olv gy, sft - firm, vf - slt, subang, mic, carb, v arg, non calc, well srtd, 3 mm dia calc foss, low vis por, no show.				
32	2295	4	**Sst,** m dk gy, firm, vf - slt, subang, mic, carb, v arg, slty, well srtd, low vis por, no show.				
33	2280	2.5	**Sst,** as 2295 m, v arg and slty, grdg to **Slst,** no show.				
34	2268	3.5	**Sst,** brn gy, other wise as 2295 m, no show.				
35	2255	3.5	**Sst,** brn gy, firm, vf - slt, occ grdg to **Slst,** carb, v faintly lam, well srtd, low vis por, no show.				
36	2242	3.5	**Sst,** m dk gy, firm, vf - slt, v arg, v mic, carb, non calc, low vis por, no show.				
37	2225	4	**Sst,** olv gy, vf - slt, sft - firm, v arg, mic, low vis por, no show.				
38	2130	4	**Clyst,** olv blk, firm, micro-mic, sl slty, carb, non calc, no show.				
39	2128	5	**Clyst,** blk, sft, sl micro-mic, sl pyr, sl slty, carb, non calc, no show.				
40	2125	5.5	**Clyst,** as 21 28 m but v sl calc.				
41	2123.5	5	**Clyst,** as 2125 m.				
42	2121	5.5	**Clyst,** dk grnsh gy, sft, micro-mic, v calc, no show.				
43	2120	3	**Clyst,** grnsh gy, sft - firm, micro-mic, v calc, no show.				
44	2115	2.5	**Mrl,** lt gy, firm, sl slty, sl micro-mic, occ lenses w mica, carb mat and pyr w assoc calc veins, no show.				
45	2111.5	2	**Lst,** pink gy, firm, arg, chky, no show.				
46	2109	4	**Clyst,** olv gy, sft - firm, sl micro - mic, v calc, no show.				

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Norsk Hydro

SIDE WALL CORES DESCRIPTION

WELL: 31/4-6	RUN Nº: 2	SERVICE COMPANY:	Schlum
LICENCE: 055	PAGE Nº: 2 of 2	ASKED:	30
	DATE: April 5, 1982	SHOT:	30
		LOST:	0
		EMPTY:	1
		SAMPLES RECOVERED	29
		GEOLOGIST:	Lærkerod/Henderson

tr : trace - **M** : medium - **G** : good

Nº	DEPTHS m	REC cm	LITHOLOGY	Fluorescence tr	M	G	CUT
47	2106	4	**Clyst,** olv gy, sft - firm, sl micro-mic, sl micro - pyr, v calc grdg to **Mrl,** no show				
48	2100	4	**Clyst,** as 2106 m.				
49	2094	2	**Clyst,** olv blk - dk grn gy, sft - firm, sl micro-mic, sl micro - pyr, v calc grdg to **Mrl,** no show.				
50	2090	4	**Clyst,** as 2094 m.				
51	2084	4	**Clyst,** as 2094 m.				
52	2079	3	**Lst,** v lt gy, firm - mod hd, glau, sl arg, chky, no show.				
53	2065	0	Empty.				
54	2062.5	2	**Lst,** v lt gy, mod hd, glau, sl micro - mic, sl arg, chky, no show.				
55	2060	2	**Mrl,** olv gy, firm, micro-mic, grdg to calc **Clyst,** no show.				
56	2057	5	**Clyst,** olv blk, firm, sl micro-mic, v calc, no show.				
57	2052	5	**Clyst,** olv blk - dk grnsh gy, firm, sl micro-mic, v calc grdg to **Mrl.**				
58	2043	4.5	**Clyst,** olv blk, mod hd, sl micro-mic, non calc, no show.				
59	2037	5	**Clyst,** as 2043 m.				
60	2035	3	**Clyst,** as 2043 m.				

Norsk Hydro

SERVICE COMPANY:	Schlum
ASKED:	30
SHOT	30
LOST	3
EMPTY	0
SAMPLES RECOVERED	27

SIDE WALL CORES DESCRIPTION

WELL:	31/4-6	RUN N°:	3
LICENCE:	055	PAGE N°:	1 of 3
		DATE:	April 5, 1982

GEOLOGIST: Henderson/Leskerod

tr : trace - **M** : medium - **G** : good

N	DEPTHS m	REC cm	LITHOLOGY	Fluorescence tr	Fluorescence M	Fluorescence G	CUT tr	CUT M	CUT G
61	2448	3	**Clyst,** olv gy - olv blk, mod hd, v slty, micro-mic, tr carb, tr sdy, vf - slt, non calc, **tr v slow weak yel flu crush cut, tr weak yel flu resd.**						
62	2455	0	Lost in hole.						
63	2440	0	Lost in hole.						
64	2435	$2^1/_2$	**Clyst,** olv gy - olv blk, mod hd, v slty, micro-mic, tr carb, loc sdy vf - slt, non calc, loc int lam of **Sst.**						
			Sst, v lt gy, clr Qtz, vf - slt, fri - lse, subang - subrnd, slty, pr srt, fair vis por, **tr v slow weak yel flu crush cut, tr weak yel flu resd.**						
65	2425	$2^1/_2$	**Clyst,** olv gy, mod hd, v slty, v sdy vf - slt, v mica, carb, tr pyr, non calc, grdg **Sst, tr v slo weak yel flu crush cut, tr weak yel flu resd.**						
66	2420	3	**Clyst,** olv blk - olv gy, mod hd, v slty, sdy vf - slt, micro - mic, carb, non calc.						
67	2414	$2^1/_2$	**Sst,** olv gy - olv blk, clr Qtz, vf - slt, sft - mod hd, fri, subang - subrnd, v slty, v arg, v micro-mic, carb, sl calc, pr srt, no vis por, grdg to **Clyst,** no show.						
68	2410	4	**Clyst,** olv blk, spec grn blk and dk yel brn, mod hd, slty, loc sdy, vf - slt, mica, tr carb, mod calc.						
69	2405	$2^1/_2$	**Sst,** olv gy - olv blk, vf - slt, mod hd, fri, subang, subrnd, tr calc cmt, v arg mtx, v mica, pr srt, no vis por, grdg to **Clyst.**						
70	2395	3	**Clyst,** olv blk - olv gy, mod hd, v slty, sdy vf - slt, micro-mic, tr carb, non calc.						
71	2387	$2^1/_2$	**Clyst,** olv gy, mod hd - firm, v sdy,vf - slt, v slty, micro-mic, tr carb, non calc, grdg to **Sst.**						
72	2383	$2^1/_2$	**Sst,** olv gy, clr Qtz, vf - slt, mod hd, fri, subang - subrnd, non calc, v arg, micra - mic, tr carb, loc lam, v pr srt, no vis por, grdg to **Clyst,** no show.						

Norsk Hydro

SIDE WALL CORES DESCRIPTION

WELL: 31/4-6	RUN N°: 3
LICENCE: 055	PAGE N°: 2 of 3
	DATE: April 5, 1982

SERVICE COMPANY:	Schlum
ASKED:	30
SHOT:	30
LOST:	3
EMPTY:	0
SAMPLES RECOVERED	27
GEOLOGIST:	Henderson/Lærkerød

tr : trace - M : medium - G : good

N°	DEPTHS m	REC cm	LITHOLOGY	Fluorescence tr	Fluorescence M	Fluorescence G	CUT tr	CUT M	CUT G
73	2380	3	**Sst,** lt olv, clr Qtz vf - crs, pred m - f, v fri - lse, subang - rnd, non calc, loc tr wh slty arg mtx, tr mica, tr pyr, tr glau, mod - pr srt, fair - gd vis por, no show						
74	2354	$3^1/_3$	**Sst,** yel gy - v lt gy, f - vf, firm - mod hd, fri, subang - subrnd, non calc, tr wh slty arg mtx, occ arg lam, mod srt, fair vis por, no show						
75	2345	$4^1/_2$	**Clyst,** m gy - olv gy, mod hd, sl slty, micro-mic, carb, non calc, **tr v weak yel flu resd.**						
76	2341	0	Lost in hole.						
77	2337	$3^1/_2$	**Cly/Clyst,** olv gy - lt olv gy, sft, slty, and mod hd, brit, non calc.						
78	2335	3	**Clyst,** olv gy - lt olv gy, mod hd - firm, slty, tr micro-mic, non calc, **tr v weak yel flu resd.**						
79	2330	3	**Sst,** lt olv gy, clr Qtz, vf - crs, firm, fri, subang - subrnd, pr calc cmt, pr slty arg mtx, micro-mic, pr srt, no vis por, **tr v slow weak yel flu crush cut, tr v weak yel flu resd.**						
80	2321	$3^1/_2$	**Clyst,** olv gy, firm, v slty, micro-mic, loc tr **Lig,** brn blk, slty, fibrous, **tr v weak yel flu resd.**						
81	2303	2	**Slst,** lt olv gy - m lt gy, mod hd, brit, v calc, arg, tr micro-mic.						
82	2287	$3^1/_2$	**Sst,** olv gy, vf - slt, firm - mod hd, subang - subrnd, calc, slty arg mtx, micro-mic, loc lam, pr srt, pr vis por, no show.						
83	2274	3	**Sst,** olv gy, vf - slt, firm - mod hd, subang - subrnd, v calc, v slty grdg **Slst,** arg mtx, micro-mic, pr srt, no vis por, **tr weak yel flu resd.**						
84	2262	3	**Sst,** olv blk, vf - slt, mod hd - firm, subang - subrnd, calc, v slty, v arg grdg to **Clyst,** micro-mic, carb, v pr srt, no vis por **tr slow weak yel flu crush cut, tr weak yel flu resd.**						
85	2247	$2^1/_2$	**Sst,** olv blk - olv gy, vf - slt, occ f, mod hd, subang - subrnd, v calc, v slty, v arg, micro-mic, carb, v pr srt, no vis por, no show.						

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Norsk Hydro

SIDE WALL CORES DESCRIPTION

WELL:	31/4-6	RUN N°:	3
LICENCE:	055	PAGE N°:	3 of 3
		DATE:	April 5, 1982

SERVICE COMPANY:	Schlum
ASKED:	30
SHOT	30
LOST	3
EMPTY	0
SAMPLES RECOVERED	27
GEOLOGIST:	Henderson/Lærkerød

tr : trace - M : medium - G : good

N°	DEPTHS m	REC cm	LITHOLOGY	Fluorescence tr	Fluorescence M	Fluorescence G	CUT
86	2237	3 1/2	**Sst,** m gy - olv gy, vf - slt, firm, subang - subrnd, non calc, slty, arg, carb, tr micro-mic, pr srt, no vis por, no show.				
87	2231	3	**Sst,** olv gy - lt olv gy, lam lt gy, vf - slt, firm - mod hd, subang - subrnd, mod calc, slty, loc arg, carb, micro-mic, loc lam, pr srt, loc pr vis por, no show.				
88	2220	4	**Sst,** lt olv gy - m gy, vf - slt, firm - lse, fri, subang - subrnd, non calc, sl slty, arg, tr carb, tr micro-mic, mod srt, fair - pr vis por, no show.				
89	2215	3	**Sst,** olv gy, vf - slt, mod hd - firm, subang - subrnd, v sl calc, slty, v arg, carb, micro-mic, pr srt, no vis por, **tr weak yel flu resd.**				
90	2066	1 1/2	**Lst,** pl red, minor v lt gy, mod hd, sft, loc chky, loc mrly, micro xln, tr arg, glau				

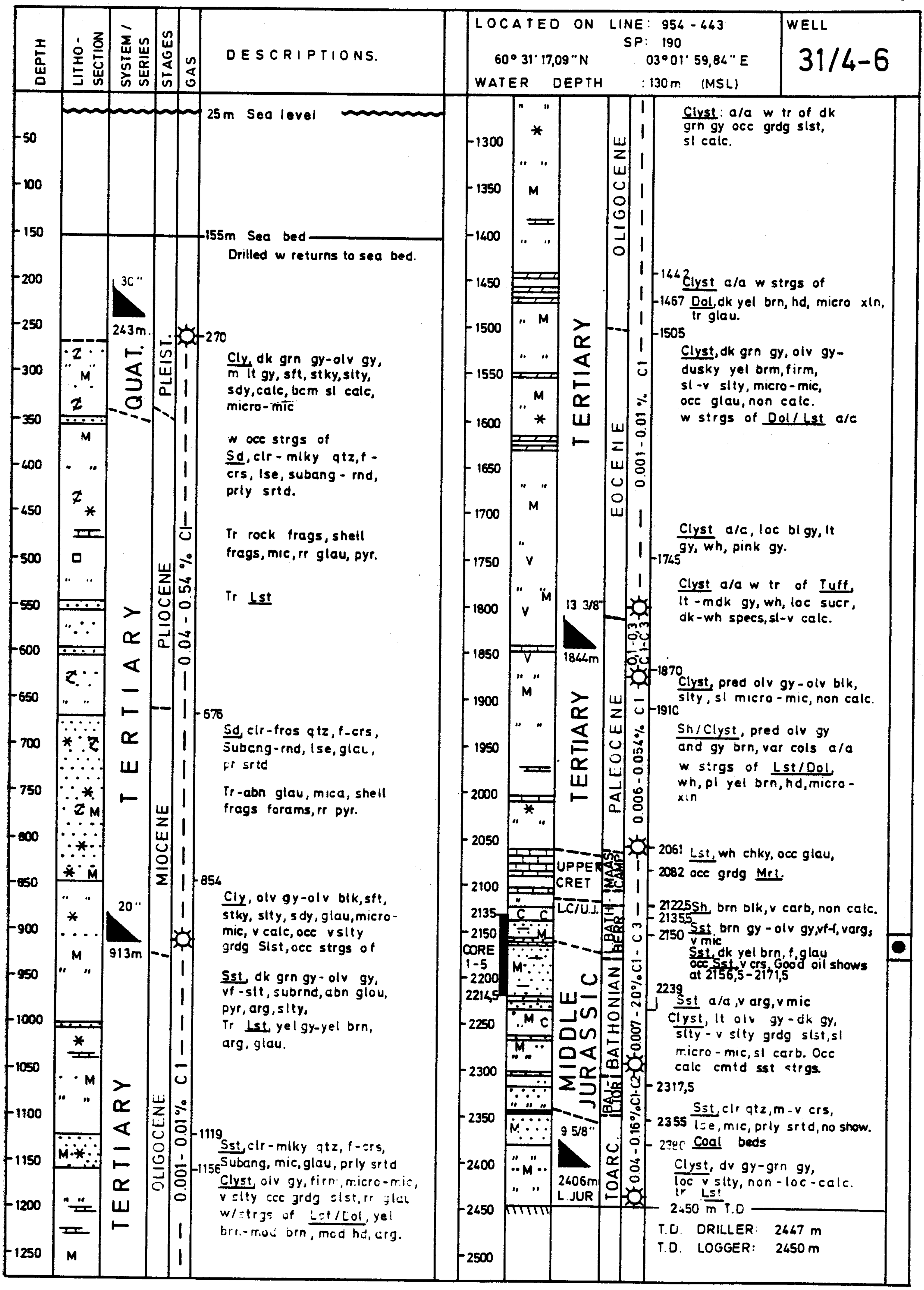
APPENDIX 3

WELL SUMMARY

GEOLOGICAL WELL SUMMARY

RFT/DST RESULTS

GEOLOGICAL WELL SUMMARY



WELL SUMMARY

Coord : N 60° 31'17,09" E : 03°01' 59,84"
Line : 954 443, SP 190
Depths datum: R.K.B.
Rig : Nordtrym
Water depth : 130 m (MSL) RKB elev: 25m.
Stopped in : Early Jurassic, shales (Dunlin Fm.)

Spudded : FEBRUARY 28,1982
At T.D. : APRIL 3, 1982
Completed : APRIL 22. 1982

T.D Driller : 2447 m. T.D. Logger: 2450 m.

WELL 31/4-6

COUNTRY NORWAY

OPERATOR NORSK HYDRO PRODUKSJON A/S

LICENCE 055

OWNED BY NORSK HYDRO/STATOIL/ESSO/BP/ARCO

TARGETS "INTRA HEATHER SAND II" OF UPPER JURASSIC AGE

RESULTS
Hydrocarbons were produced from one interval in the Upper Jurassic. „Intra Heather Sand II" (2150 - 2239m)
All other reservoir intervals were water bearing.
DST I : 2159,5 - 2168m .
2841 STBO/D, 1352 MSCF/D, 476 GOR, 36/64" choke,
Oil gravity 34.4° API, Gas gravity 0.727 gm/cc,
WHP 864 psi, WHT 110°F, B,S+W - tr, CO_2 - tr, k_0 - 400 md.
Hydrocarbon interval : 2156.5 - 2171.5 m, Net pay : 14.5 m.
AV Ø : 25%, AV Sw : 46%

CASING

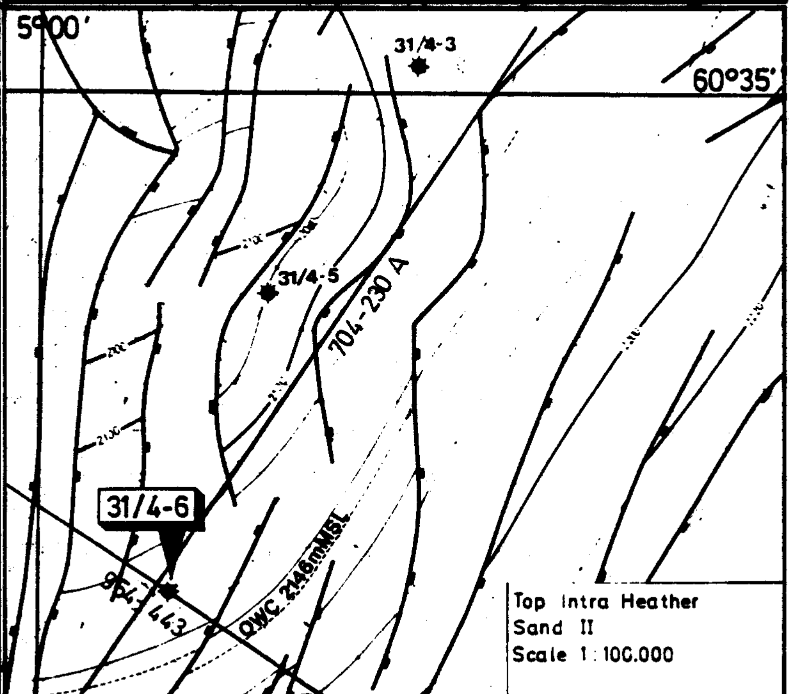
30" at 243 m.
20" at 913 m.
13 3/8" at 1844 m.
9 5/8" at 2406m.

CORES

CORE #1	Cut : 2132-2149 m. Rec : 2132-2148,3 m. 96 %
CORE #2	Cut : 2149-2159,5 m. Rec : 2149-2159,5 m. 100 %
CORE #3	Cut : 2159,5-2178,1 m. Rec : 2159,5-2178,1 m. 100 %
CORE #4	Cut : 2178,1-2196,1 m. Rec : 2178,1 2196,1 m 100 %
CORE #5	Cut : 2196,1-2214,5m. Rec : 2196,1 2214,5m. 100 %

GAS RECORD

243- 920m : 0.04 - 0.54 % C1
920-1800m : 0.001-0.01 % C1
1800-2070m : 0.006-0.34 % C1
2070-2302m : 0.007 - 2 % C1 - C3
2302-2450 m : 0.04 - 1.6 % C1, occ C2



Top Intra Heather Sand II
Scale 1 : 100.000

LOGS

ISF/SONIC/GR	155-913 m	1	RFT	2166,5 Segr, sample	2
	913-1861m	2			
	1845-2214 m	3	CST	1020-1850 m	1
	2115-2448 m	4	"	2035-2310 m	2
FDC/GR	913 - 1662 m	1	"	2065-2448 m	3
FDC/CNL	1845 - 2215 m	2			
LDT/CNL EPT	2215-2450 m.	1			
DLL/MSFL	2035-2212m	1			
HDT	1845 - 2449m	1			
VELOC SURVEY	360-2444 m	1			
CBL/VDL	700- 1840 m	1			
RFT	2138,5 - 2377m Segr. sample at 2160,5m	1			

OIL SHOWS

In core I : Sh + Slst : (2132 - 2137m) No flu, uniform, v wk, wn - yel wn crush cut

In core 1-3: Sst (2148- 2170.5) Strong hydrocarbon odour, occ lt brn bleeding oil, loc patchy-uniform, wk - strong, dull yel - yel wh flu, mod fast - instant, yel wh - blwh, strmg and flood cut, occ lt brn vis cut and resd.

In SWC's : Occ tr wk, slow yel flu crush cut, tr wk yel flu resd.

In Sst : 2115m, 2262m, 2274m, 2321m, 2330m.

In Clyst : 2335m, 2345m, 2425m, 2435m, 2448m.

Checked: A. Davies
Date : 9.8.82

RFT RESULTS 31/4-6

RUN 1

DEPTH M.(KB)		PHI	PF	PHA	PERM.
1/1	2138.5	4005	0	4006	TIGHT
2/1	2145.5	4018	0	4018	TIGHT
3/1	2149.5	4024	0	4026	TIGHT
4/1	2153.5	4030	0	4033	TIGHT
5/1	2157.5	4038	3121	4040	LOW
6/1	2160.0	4043	3120	4045	VERY GOOD
7/1	2161.5	4046	3121	4047	VERY GOOD
8/1	2163.0	4052	3126	4054	GOOD
9/1	2165.2	4056	3128	4058	VERY GOOD
10/1	2166.5	4059	3129	4060	VERY GOOD
11/1	2168.0	4060	3130	4062	VERY GOOD
12/1	2169.5	4063	3132	4063	LOW
13/1	2171.5	4065	3133	4066	GOOD
14/1	2173.0	4068	3137	4070	LOW
15/1	2175.0	4073	3143	4074	LOW
16/1	2183.0	4088	3168	4088	LOW
17/1	2190.0	4101	3168	4102	POOR
18/1	2194.0	4109	3176	4110	POOR
19/1	2220.5	4162	3204	4156	GOOD

RUN 1

DEPTH M.(KB)		PHI	PF	PHA	PERM.
20/1	2351.0	4400	0	4397	TIGHT
21/1	2350.0	4398	3392	4398	VERY GOOD
22/1	2358.0	4413	3403	4414	EXCELLENT
23/1	2364.0	4423	3412	4425	EXCELLENT
24/1	2372.5	4439	3423	4440	VERY GOOD
25/1	2377.0	4447	3430	4448	EXCELLENT

SAMPLING RUN 1.

26/1	2160.0	4043	3123	0	PLUGGED
27/1	2160.5	4044	3126	4043	SAMPLE

Took segregated sample at 2160.5 m. Recovered 200.8 cuft of gas, 8 litres of 36.7° API oil and 14 litres of water/filtrate.

SAMPLING RUN 2

1/2	2166.5	4059	3129	4056	SAMPLE

Took segregated sample at 2166.5 m. Recovered 210 cu ft at gas, 9 litres of 35.6° API oil, and 11 litres of water/filtrate.

DST RESULTS

DST No. 1

Perforated interval: 2159.5 - 2163.5 m and 2165.0 - 2168.0 m.
Oil rate: 2841 STB/D
Oil gravity: 34.4° API
Gas rate: 1352 MSCF/D
Gas gravity: 0.727
G.O.R.: 476 SCF/STB.
Choke: 36/64"
WHP: 864 psig
WHT: 110° F
B.S.+W.: Tr
Co_2: Tr

SECTION B

OPERATIONS

LIST OF CONTENTS

TABLES

FIGURES

1. LOCATION SURVEY

During the period from 19th of October to 3rd November 1981 and from 29th of December to 15th of January 1982 Fairfield Aquatronics Limited performed a site survey for the planned well location 31/4-6.

The coordinates for the well were given as:
Lat. $60^{o}31'16,3"N$
Long. $03^{o}01'58,6"E$
which was the centre of the survey area of approx 3,5 x 4,5 km.

The survey was a combined sea floor investigation, bathrymetric survey and high resolution survey. Seafloor image profiles vere run in order to map the sea floor topography and to locate any possible debris or obstructions that might cause problems for the drilling operations. The interpretations of these surveys indicated a possible wreck and associated area of seabed disturbance on the edge of the site, 2600 m NW of the proposed well location. A further seabed disturbance occured 2020 m west of the well location. No obstructions were seen within a 1500 m radius of the well.

The hole site area was covered with sand ribbons trending NNW-SSE and having an amplitude of less than 0.5 m.

The seabed was found to consist of fine to medium sands.

For mapping the uppermost zone of sediments, profiles were run with deep towed boomer. Fairflex sleeve exploder, single trace, 1/4 ms sampling rate, was run to map the upper 200 m of sediments. To map the geological horizon to a depth of 1500 m below seabed, Fairflex sleeve exploder with multichannel digital recording was utilized. The interpretation indicated flat laying layers of sands and clays. At 175 m below seabed, a major unconformity-base of quarternary, was seen. The interpretation showed no sign of trapped gas.

2. POSITIONING AND ANCHORING OF THE RIG

The location for the well 31/4-6 was defined as shot point 190 on seismic line 954-443. The well was to be spudded within a sector of radius 50 m between the azimuts of 200° and 360° from the planned location. Between the azimuts of 0° and 200° the spud in tolerance was within a sector with radius of 100m. For the positioning of the rig into the location, the Pulse - 8 navigation system was used.

Final position of the well 31/4-6 was:
Lat. 60°31'16,6"N
Long. 03°01'57,7"E

The rig heading was 310° and the deviation from the intended location was 17m in NE direction.

Prior to spudding on February the 28th the anchors were set without any problem. All anchors were pretensioned to 1112 KN. The mooring line pattern is showed in fig. B-1.

3. OPERATION SUMMARY

3.1. Summary

Nortrym left the 15/2-1 location at 15.00 hrs on February the 25th and reached the 31/4-6 location at 16.00 hrs on February the 27th. The well was spudded at 14.00 hrs on February 28 after anchor handling for 9 hrs.

A 36" hole was drilled to 243,5 m and the 30" casing was landed and cemented with the shoe at 243 m. After having run the riser, a 17 1/2" pilot hole was drilled down to 927 m. ISF/SONIC/GR logs were run before the pilot hole was underreamed to 26". The hole was conditioned before the riser was displaced to sea water. After observing the well to be stable, the riser was pulled and a 26" bit wiper trip was made before running the 20" casing to 913 m and cementing same back to seabed.

After the BOP was tested to full working pressure, the 20" casing shoe was drilled out and a leak off test was performed, resulting in a leak off at an equivalent mud weight of 1,68 r.d.

Prior to drilling the 17 1/2" hole, the mud was displaced with the Promud shale trol-polymer system. The mud weight was increased from 1.10 r.d. at 927 m to 1.35 r.d. at 1865 m. The 17 1/2" hole was drilled down to 1865 m where ISF/SONIC/FDC/CNL/CST logs were run prior to running the 13 3/8" casing string. The casing was cemented and the top of cement was placed 100 m above the 20" casing shoe.

The BOP was tested prior to drilling out of the 13 3/8" shoe. The leak off test performed below the 13 3/8" shoe resulted in a leak-off at an equivalent mud weight of 1.72 r.d.

The 12 1/4" hole was drilled down to 2447 m which was the total depth of this well. The following cores were cut in the 12 1/4" hole section:

Core no. 1 2132 m - 2149 m
Core no. 2 2149 m - 2159,5 m
Core no. 3 2159,5 m - 2177,5 m
Core no. 4 2177,5 m - 2195,5 m
Core no. 5 2195,5 m - 2213,5 m

At 2213,5 m the following intermediate logs were run:

Log no. 1 ISF/SONIC/GR
Log. no. 2 FDC/CNL/GR
Log. no. 3 DLL/MSFL/GR
Log. no. 4 CBL/VDL

At the total depth of the well the following logs were run:

Log no. 1 ISF/SONIC/NGT
Log no. 2 LDT/CNT/SGT/EPT
Log no. 3 HDT, 2 runs
Log no. 4 RFT, 2 runs
Log no. 5 CST, 2 runs
Velocity survey

A wipertrip was made before running the 9 5/8" casing. The casing was landed at 2406 m and cemented. After cementing, the BOP was pulled to change all rams to 3 1/2". After reinstalling the BOP, a CBL/VDL/GR log was run prior to running the production test tubing.

The well was production tested for 53 hrs until April 16 (see production test summary) before being abandoned as shown in fig. . Last anchor was pulled on April 20, 1982.

3.2 Production testing summary

On April 13, the 9 5/8" casing was perforated from 2159,5 m to 2163,5 m and from 2165 m to 2168 m. The test string was run and pressure tested against the tester valve to 220 bar after 1 stand, 37 stands and 74 stands. The "Positrieve" packer was set at 2140 m and the well was opened up for initial flow for 10 min. and shut in for initial build up for 1 hrs. 9 min. The well was opened up for final flow for 9 hrs. 45 min. and shut in for final build up for 24 hrs. Thereafter, rigged up wire line equipment for bottom hole sampling. After retrieving the first two samples, two additional samples were taken. The well was killed and observed before pulling the test string on April the 17th.

Test results

Choke:	Initial flow:	18/64"
	Final flow:	36/64"
	Oil rate:	2841 BBLS/D
	Gas rate:	1352 MSCF/D
	GOR:	476 SCF/STDBL
	Oil gravity:	34.4 deg API
	Gas gravity:	0.727
	Separator pressure:	12.1 bar
	Separator temperature:	32.2°C
	B.S. and W:	Trace of solids
	H_2S:	-
	CO_2:	Trace

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Area	Well	Rig
North Sea	31/4-6	Nortrym

Casing							
	Size						
	Setting depth (m)						

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
25.02				Nortrym left the 15/2-1 location at 15.00 hrs. In transit for well 31/4-6.
26.02				In transit for the 31/4-6 location. Turned the rig upwind 6NM from location and ballasted. Waited on weather.
27.02				Waited on weather to make a new approach for the location. Arrived the 31/4-6 location at 16.00 hrs. Ran the achors and started ballasting the rig at 23.15 hrs.
28.02	187		1.04	Picked up the 30" casing and hung off the same in the Moonpool. Ran in hole with the 36" hole opener and tagged the sea bed at 155.2 m RKB. Deballasted the rig from 68 ft draft to 55 ft and drilled from 155 m to 172 m. Ballasted the rig from 55 ft draft to 70 ft. Rapaired burst air hose on heave compensator. Drilled the 36" hole from 172 m to 187 m. Spotted 5.6 m^3 mud on each connection.

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Weekly drilling report

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Area	Well	Rig
North Sea	31/4-6	Nortrym

Casing							
	Size	30"					
	Setting depth (m)	243					

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
01.03	243.5		1.04	Drilled 36" hole from 187 m to 243.5 m. Ran a survey, circulated and spotted 63 m^3 gel mud. Problems with retrieving the survey. Ran subsea TV and checked bull eye - showing 3/4 degree. Ran the 30" casing, circulated and cemented. Pulled out of the hole with the running tool and laid down the same. Continued working on the broken compensator hose. While doing this, the position on the funnel on the guide frame was changed. Made up the 2 3/8" stinger and ran down on a 4 arm guide frame. Stabbed in between the guide frame structure and string 20 m down outside the 30" casing.
02.03	243.5		1.04	Cemented outside the 30" casing and pulled stinger out of hole. Rigged up and ran the pin connector and riser, while waiting on the slip joint. Latched the pin connector to the 30" wellhead and tested the same to 222 KN. Installed the diverter and found crack in flow line weld while testing. Repaired the same and retested. Found the balljoint leaking. Replaced the seals on the balljoint. Changed the shale shaker valve which was blocking the flowline sensor. Carried out a succesful test on the diverter system. Ran in the hole with the 17 1/2" pilot hole assembly and drilled cement from 238 m to 240 m.
03.03	865		1.11	Drilled cement and 30" casing shoe to 243 m. Drilled the 17 1/2" pilot hole from 243 m to 711 m. Pumped 6 m^3 high viscosity mud. Circulated and conditioned the mud. Drilled the 17 1/2" pilot hole to 865 m.

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Weekly drilling report

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Area	Well	Rig
North Sea	31/4-6	Nortrym

Casing							
Size	30"						
Setting depth (m)	243						

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
04.03.	920		1.07	Drilled the 17 1/" pilot hole from 865 m to 920 m and circulated. Dropped a survey and pulled out of the hole to 240 m and retrieved the survey. Ran in the hole and spotted 64 m^3 high viscosity mud in the hole. Dropped the multishot survey and pulled out of the hole to 240 m and retrieved the multi shot survey. Pulled out of the hole and ran the ISF/SONIC/GR logs from 243 m to 920 m. Made up 26" underreamer on bit nr. 3 and ran in hole. Underreamed from 238 m to 378 m and spotted 7 m^3 high viscosity mud on every third connection.
05.03	920		1.12	Underreamed the hole from 378 m to 770 m. Pulled out of the hole due to excessive torque and no pentration. Picked on a new underreamer and ran in the hole with bit no. 4. Underreamed from 770 m to 784 m. Problems with tight hole from 775 m to 780 m. Pumped 8 m^3 high viscosity mud.
06.03	920		1.12	Rotary table broke down while underreaming at 789 m. Floating shaft was worn out in the gear end. Pulled out of hole up to shoe. Stripped down floating shaft. Repaired rotary table with dummy shaft while waiting on spare parts. Finished repair on rotary table.
07.03	920		1.10	Replaced arms on the 26" underreamer and underreamed from 660 m to 758 m. While underreaming at 758 m, the pump pressure dropped 28 bars and 90 KN string weight was lost. Pulled out of the hole and found string parted. Made two fishing runs (first unsuccesful) and engaged fish at 819 m. Made up new bit and new underreamer arms and ran in hole.

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Weekly drilling report

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Area	Well	Rig
North Sea	31/4-6	Nortrym

Casing							
Size	30"	20"					
Setting depth (m)	243	913					

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
08.03	927		1.11	Underreamed the 26" hole from 743 m to 927 m. Pumped 16 m^3 high viscosity mud. Pulled out of the hole to the wellhead and displaced the riser with seawater. Observed the well for 1 hrs. Pulled out of the hole. Unlatched the pin connector and pulled the riser.
09.03	927		1.10	Rigged down the riser handling equipment after pulling the riser to surface. Made up the cement head and picked up the 18 3/4" housing. Ran in the hole with a 26" bit. Hooked up the guide frame and the TV and ram the same into the water. Spotted 165 m^3 high viscosity mud into the hole and pulled out to the wellhead. Slipped and cut 35 m drilling line. Continnued to pull out of the hole and prepared to run the 20" casing. Waited on the weather.
10.03	927		1.03	Waited on the weather. Ran in the hole with the 26" bottom hole assembly down to 927 m. Spotted 63.6 m^3 high viscosity mud in the hole and pulled out of the hole.
11.03	927		1.03	Finished pulling out of the hole. Ran the 20" casing and landed at 913 m. Circulated with seawater. Rigged up the cement lines, tested the same and cemented the casing string. Backed out the landing string, washed the wellhead and pulled out of the hole. Prepared to run the B.O.P. and the riser.
12.03	927		1.03	Tested the kill and the choke line and hoses to 345 bar. The TV lamp failed after running the TV. Changed the lamp and reran the TV. Repositioned the rig. Landed the BOP and pull tested to 222 KN. Made up the diverter and cleared the rig floor.

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Weekly drilling report

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Area	Well	Rig
North Sea	31/4-6	Nortrym

Casing							
Size	30"	20"					
Setting depth (m)	243	913					

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
				Ran in the hole with the jet tool and combination tool. Washed the wellhead and filled the pipe with water. Tested the surface lines. Attempted to test the BOP. Checked the choke manifold. Pulled out of the hole with the test tool and changed the "O" rings. Made a new negative test. Pulled out of the hole with the test tool and tested casing against the shear rams to 69 bar. Made a new negative BOP test. Pulled out the testing tool and changed the "O" rings. Washed the wellhead and spotted 2.4 m^3 mud.
				Landed the test plug. Spotted a soluble oil inside the wellhead and retested. Observed the collet connector with the TV for possible leak. Got a positive test and continued to test the BOP.
13.03	1221	1.10		Continued to test the BOP. Pulled out the testing tool. Installed the wear bushing. Tested the surface equipment. Ran in the hole and tagged the cement at 889 m. Drilled the cement from 889 to 913 m. Reamed and washed to 927 m. Drilled formation to 937 m. Pulled out to the shoe, hung off and performed a leak off test. Result: 1.68 r.d. equivalent mud density. Drilled the 17 1/2" hole from 937 m to 1221 m.
14.03	1516		1.25	Drilled the 17 1/2"hole from 1221 m to 1401 m. Ran a survey and pulled out of the hole. Tight hole from 1375 m to 1168 m. Ran in the hole and drilled from 1401 m to 1510 m. Opened the plugged flowline. Drilled down to 1516 m. Opened the plugged flow line. Circulated the riser volume through the kill and the choke line to clean.

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Weekly drilling report

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Area	Well	Rig
North Sea	31/4-6	Nortrym

Casing								
	Size	30"	20"					
	Setting depth (m)	243	913					

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
15.03	1741		1.35	Drilled the 17 1/2" hole from 1516 m to 1562 m. Had problems with flowline plugging. Controlled the rate of penetration due to gumbo problems. Drilled to 1647 m. Made a wiper trip to 1403 m. Drilled from 1647 m to 1741 m.
16.03	1779		1.34	Drilled the 17 1/2" hole from 1741 m to 1765 m. Found the wear bushing in the diverter assembly. Circulated through the kill and choke line. Pulled out of the hole and washed the wellhead area and BOP. Attempted to set the wear bushing with the jet sub. Pulled out of the hole with the wear bushing. Made up the jetting tool and jetted down to the wellhead. Displaced the riser with seawater through the choke and the kill time. Ran in the hole and set the wear bushing. Made up bit no. 8 and ran in the hole. Drilled the 17 1/2" hole from 1779 m to 1793 m.
17.03	1865		1.35	Drilled from 1779 m to 1793 m. Pumped 16 m^3 high viscosity mud. Drilled from 1793 m to 1865 m. Circulated and pulled out of the hole to the casing shoe. Ran in the hole, circulated and conditioned the mud. Dropped a multi-shot survey. Pulled out of the hole and retrieved the survey. Rigged up Schlumberger and ran in the hole. Did not come further down than 86 m. Washed and circulated for several times. Ran in the hole. The tool would not go below 924 m. Pulled out of the hole and installed a rubber extension.
18.03	1865		1.34	Ran the logs. Could not pass 935 m. Pulled out and rigged down. Ran in the hole and circulated. Pulled out of the hole, maximum overpull 222 KN at 935 m. The wear bushing was pulled out with the stabilizer. Washed the wellhead, changed the "O"-rings on the wear bushing and set the same. Ran the ISF/Sonic/FDC/CNL/CST logs. Rigged down.

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Weekly drilling report

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Area	Well	Rig
North Sea	31/4-6	Nortrym

Casing							
	Size	30"	20"				
	Setting depth (m)	243	913				

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
19.03	1865		1.35	Made up the casing hanger, cement head and loaded the cement plug. Ran in the hole to the 20" shoe. Slipped and cut the drill line. Ran in the hole to 1862 m, had 3 m fill. Circulated and conditioned the hole, pulled out of the hole. Ran the 13 3/8casing string. Made up the hanger joint and landed the casing in the wellhead. Circulated, tested the cement lines and cemented the string.
20.03	1865		1.32	Dropped the dart. Had partial returns after 5200 strokes. The plug did not bump. Rigged down the surface lines and released the running tool. Pulled out of the hole. Ran in the hole with the jetting tool, washed and circulated. Ran in the hole with the seal assembly. Was not able to set the seal assembly. Pulled out of the hole to check the assembly. Ran in the hole again and set the seal assembly. Was unable to test the assembly. Washed the wellhead. Made a dummy run through the annulars. Pulled out of the hole and made up new seal assembly.
21.03	1865		1.32	Ran in the hole and set the seal assembly. Tested the seal assembly and the BOP. Attempted to test the casing against the pipe rams the pressure bleed of. Set the 13 3/8" wear bushing. Ran in the hole with the RTTS packer, the tool stopped at 287 m. Attempted to circulate. Pulled the RTTS packer out of the hole and ran in the hole with open ended drill pipe. Tagged the top plug at 1819 m, no cement. Circulated and conditioned the mud. Spottet 4.1 m3 cement. Squeezed 10 bbl cement with 103 bars. Pulled out of the hole and tested th surface equipment. Picked up the 12 1/4" bottom hole assembly.

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Weekly drilling report

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Area	Well	Rig
North Sea	31/4-6	Nortrym

Casing							
	Size	30"	20"	13 3/8"			
	Setting depth (m)	243	913	1844			

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
22.03	1902		1.31	Ran in the hole with the 12 1/4" bottom hole assembly. Flushed the diverter system. Tagged the cement at 1785 m and drilled down to 1870 m. Performed a leak of test which showed an equivalent mud weight of 1.72 r.d. Drilled the 12 1/4" hole from 1870 to 1902 m and pulled out of the hole. Picked up the 12 1/4" stabilizer and ran in the hole.
23.03	2068		1.27	Reamed and worked the stabilizers through the shoe. Washed and reamed to 1902 m. Worked a junk sub and drilled from 1902 m to 1975 m. Circulated and ran a survey. Drilled from 1975 m to 2068 m.
24.03	2123		1.26	Drilled from 2068 m to 2076 m. Ran a survey and pulled out of the hole. Worked the junk sub and drilled from 2076 m to 2113 m.
25.03	2132		1.25	Drilled the 12 1/4" hole from 2113 m to 2132 m. Flow checked a drilling brake at 2128 m. Circulated for samples and pulled out of the hole. Made up a core barrel and ran in the hole. Ran the elevator into the upper racking arm. The drill pipe was sheared by the racking arm head and fell into the hole. Repaired the upper racking arm. Made up the fishing string and ran in the hole. Tagged the top of the fish at 989 m. Milled over the top of the fish and latched onto it. Retrieved the fish with max overpull 378 KN.
26.03	2132		1.26	Pulled out of the hole with the fish. Laid down the fishing string and the retrieved string. Ran in the hole with bit no. 11 for a wiper trip. Circulated and conditioned the mud.

Weekly drilling report

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Area	Well	Rig
North Sea	31/4-6	Nortrym

Casing	Size	30"	20"	13 3/8"			
	Setting depth (m)	243	913	1844			

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
27.03	2149		1.27	Circulated and conditioned mud. Pulled out of the hole. Made up the 12 1/4" corebit and the corebarrel and ran in the hole. Tagged the bottom at 2128 m, 5 m fill. Reamed and washed to the total depth. Circulated and conditioned the mud. Dropped the ball and recorded the slow circulation rates. Cut core no. 1 form 2132 to 2149 m. Pulled out of the hole with the core barrel. Got 96% recovery with core run no. 1. Serviced the corebarrel and ran in the hole.
28.03	215		1.28	Ran in the hole with the corebarrel. Tagged the bottom at 2144 m, 5 m fill. Reamed and washed to the total depth. Dropped the ball and cut core no. 2 from 2149 m to 2159 m. Pulled out of the hole. Got 100% recovery with core run no.2. Serviced the corebarrel and set it back in the derrick. Ran in the hole with the combination tool and washed from 125 m to the wellhead. Retrieved the wear bushing and pulled out of the hole. Tested the BOP. Washed the wellhead area and pulled out of the hole.

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Weekly drilling report

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Area	Well	Rig
North Sea	31/4-6	Nortrym

Casing							
	Size	30"	20"	13 3/8"			
	Setting depth (m)	243	913	1844			

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
29.03	2177.5		1.28	Ran in the hole and set the wear bushing. Tested the kelly, the kelly valves and the inside BOP valve to 345 bar. Made up the bit and the corebarrel and ram in the hole. Had 6.5 m fill. Dropped the ball and cut core no. 3 from 2159.5 m to 2177.5 m. Got 100% recovery with core no. 3. Serviced the corebarrel and set the same back in the derrick. Worked on the drill string compensator.
30.03	2213.5		1.29	Made up the corebarrel and the corebit and ran in the hole. Washed and reamed from 2174.5 m to 2177.5 m. Dropped the ball and cut core no. 4 from 2177.5 m to 2195.5 m. Recovered 100% of core no. 4. Serviced the corebarrel and ran in the hole to 2194.5 m. Had 1 m fill. Dropped the ball and cut core no. 5 from 2195.5 m to 2213.5 m. Pumped 14.3 m^3 high viscosity mud and circulated for logging.
31.03	2213.5		1.29	Circulated bottoms up for logging and pulled out of the hole. Got 100% recovery with core no. 5. Rigged up and ran log no. 1, the ISF/SONIC/GR log. Log no. 2, the FDC/CNL/GR log. Log no. 3 the DLL/MSFL/GR log. Log no. 4, the CBL/VDL log. Rigged down Schlumberger. Made up bit no. 12 and ran in the hole.
01.04	2320		1.29	Continued to run in the hole. Reamed from 2195 m to 2213 m due to tight hole. Drilled the 12 1/4" hole from 2213 to 2228 m. Circulated and ran a survey. Drilled from 2228 m to 2290 m. Circulated while checking out a high temperature on the rotary motor. Drilled from 2290 m to 2320 m.

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Weekly drilling report

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Area	Well	Rig
North Sea	31/4-6	Nortrym

Casing							
Size	30"	20"	13 3/8"				
Setting depth (m)	243	913	1844				

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
02.04	2395		1.30	Drilled the 12 1/4" hole from 2320 m to 2322 m. Dropped a survey and pulled out of the hole. Made up bit no. 13 and ran in the hole. Had to ream through a bridge at 2202 m. Drilled the 12 1/4" hole from 2322 m to 2395 m. Had reduced weight on bit from 2359 m to 2376 m due to excessive torque.
03.04	2447		1.30	Drilled the 12 1/4" hole from 2395 m to 2447 m. Circulateed and made a wiper trip to the 13 3/8" casing shoe. Ran back to the bottom and dropped a survey. Pulled out of the hole. Rigged up and ran log no. 1, the ISF/SONIC/NGT log.
04.04	2447		1.30	Ran log no. 2, the LDT/CNT/SGT/EPT log. Malfunction on the EPT tool. Ran log no. 3, the HDT log. Misrun due to panelfailure. Ran log no. 4, the RFT no. 1. Ran the RFT no. 2. Rigged down the RFT tool.

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Weekly drilling report

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Area	Well	Rig
North Sea	31/4-6	Nortrym

Casing							
	Size	30"	20"	13 3/8"	9 5/8"		
	Setting depth (m)	243	913	1844	2406		

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
05.04	2447		1.30	Ran the HDT log for the second time. Rigged down the HDT and ram a SSL velocity survey. Ran the CST no. 1. Ran the CST no. 2. Rigged down Schlumberger. Made up the cement head and the 9 5/8" casing hanger and set same back in the derrick. Ran in the hole to 1800 m. Slipped and cut the drilling line. Ran in the hole to 2445 m. Washed down to the total depth and circulated bottoms up. Pulled out of the hole to run the casing.
06.04	2447		1.30	Continued to pull out of the hole. Retrieved the wearbushing. Rigged up and ran 190 joints of 9 5/8" casing. Rigged down the casing equipment. Landed the casing with the shoe at 2406 m. Circulated and conditioned the hole. Attempted to test the surface equipment to 413 bar. Found a leak on the lower cement head valve and the cement stand pipe. Rigged up the chicksan line and changed the seal in the low torque valve. Retested, positive test. Cemented the 9 5/8" casing. Displaced the cement by use of the rig pumps. Pressure tested the casing to 379 bar and pulled out the running tool. Ran in the hole with the seal assembly. Was not able to energize it. Pulled out of the hole with the seal assembly running tool to inspect the same. Found the lead indicator still intact.
07.04	2447		1.30	Ran in the hole again with the seal assembly running tool and attempted to energize the seal - negative. Washed the wellhead area. Attempted to back out the seal assembly, but were not able to pull it out. Ran in the hole again and made a new attempt of releasing the seal assembly. Pulled out ot the hole and found the seal assembly still in the wellhead.

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Weekly drilling report

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Area	Well	Rig
North Sea	31/4-6	Nortrym

Casing							
	Size	30"	20"	13 3/8"	9 5/8"		
	Setting depth (m)	243	913	1844	2406		

Date	Depth (m) Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
				Ran in the hole with a jet tool and washed the wellhead while displacing the riser with sea water. Made up the Norsk Hydro seal assembly running tool and ran in the hole. Energized the seal assembly and made a positive test on the same to 345 bar. Pulled the BOP. Changed all the pipe rams to 3 1/2". Changed "O"-rings in the ball joint.
08.04	2447		1.31	Continued to change the rams in the BOP. Tested the BOP on stump. Nippeled up the balljoint. Continued to test the BOP.
09.04	2447		1.31	Continued to test the BOP. Changed the lipseals on the kill/choke stab subs on lower marine riser package. Nippled up and ran the BOP. Nippled up the kill/choke line goosenecks. Ran in the hole with the test tool and made a positive test on the BOP. Pulled out the test string.
10.04	2447		1.28	Ran in the hole with the wear bushing and set the same. Displaced the riser with mud. Ran in the hole to 2236 m with a bit and a casing scraper. Circulated and conditioned the mud. Pulled out of the hole. Rigged up Schlumberger.
11.04	2447		1.28	Ran the CBL/VDL/GR log. Rigged down Schlumberger. Ran in the hole, circulated and conditioned the mud. Pulled out of the hole. Picked up 15 joints of 3.5" tubing and stood back in the derrick.

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Weekly drilling report

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Area	Well	Rig
North SEa	31/4-6	Nortrym

Casing							
	Size	30"	20"	13 3/8"	9 5/8"		
	Setting depth (m)	243	913	1844	2406		

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
12.04	2447		1.28	Waited on the weather. Made a dummy run with the sub sea test tree. Laid down the sub sea test tree and lubricated the valve. Made up the surface test tree with 1 joint vam tubing. Rigged up Schlumberger and ran in the hole with the perforating gun.
13.04	2447		1.28	Fired the lower section and perforated from 2168 m to 2165 m and from 2163.5 m to 2161.5 m. Pulled out of the hole due to failure in the upper section. Rapaired the upper section and ran in the hole again. Fired the upper section and perforated from 2161.5 m to 2159.5 m. Pulled out the perforating gun. Ran in the hole with the gaugering/junk basket to 2158 m. Pulled out and rigged down Schlumberger. Made up the drill stem test string, ran in the hole and tested the string. Installed the sub sea test tree, function tested the same and pressure tested after changing an "O"-ring. Made up the landing string with the lubricator valve and the surface test tree. Landed the sub sea test tree in the wellhead and installed the surface lines.
14.04	2447		1.28	Tested the surface test tree and the surface lines. Set the packer. Prepared to open the well for initial flow. Started to pressure up on the annulus. The pressure controlled tester valve opened with 1200 psi. Opened the choke for initial flow and flowed 6 bbl to the stock tank. Shut the well in. Opened the well for second flow. Flowed to burner and started flow throught separator. Shut the well in for pressure build up.
15.04	2447		1.28	Shut the well in for final build up. Prepared to run the bottom hole samples on wire line. Ran in the hole with the bottom hole samplers. Opened the well and flowed through burners and flowed to stock tank. Shut the well in and retrieved the bottom hole samples.

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Norsk Hydro

Weekly drilling report

Week	Weeks Progress	Report no.	Page	of
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Area	Well	Rig
North Sea	31/4-6	Nortrym

Casing							
Size	30"	20"	13 3/8"	9 5/8"		
Setting depth (m)	243	913	1844	2406		

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
16.04	2447		1.28	Checked the bubble point and transferred samples. Redressed the bottom hole samples and ran in the hole. Opened well and flowed to the burners. Shut in the well and pulled the bottom hole samples out of the hole. Checked the bubble point and transfered samples. Prepared to kill the well. Bullheaded the well. Reversed the tubing volume twice. Released the packer and laid down the surface test tree. Circulated through the choke. Pulled out of the hole and laid down the tubing.
17.04	2447		1.28	Continued to pull out the test string. Rigged up Schlumberger and ran in the hole with the squeeze packer. Made up the cement stinger and ran in the hole on 3 1/2" drill pipe. Squeezed 1.92 m^3 slurry through the packer and dumped 1.23 m^3 slurry on top of the packer. Pulled out to 2040 m and reversed out. Tested the cement to 138 bar and pulled out of the hole. Prepared to perforate the 9 5/8" casing.
18.04	2447			Rigged up Schlumberger with 1 11/16" casing puncher and ran in the hole. Perforated the 9 5/8" casing at 165 m and pulled out of the hole. Made up the casing cutter assembly and cut the 9 5/8" casing at 300 m. Pulled out of the hole with he cutter assembly. Retrieved the wear bushing. Ran in the hole with the casing spear. Pulled out 15 joints of 9 5/8" casing. Perforated the 13 3/8" at m casing and pulled out the casing puncher assembly. Ran in the hole and cut the 13 3/8" casing at 27[illegible] m. Retrieved 117 m 13 3/8" casing. Ran in the hole with the cement string to 400 m, tested the surface lines and set a balanced plug from 400 m to 200 m. Pulled out to 180 m and reversed out. Flushed the BOP, riser, choke/kill lines and the diverter lines with sea water.

1920 HK [illegible]

Norsk Hydro

Weekly drilling report

Week	Weeks Progress	Report no.	Page	of
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Area	Well	Rig
North Sea	31/4-6	Nortrym

Casing							
	Size	30"	20"	13 3/8"	9 5/8"		
	Setting depth (m)	243	913	1844	2406		

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
19.04	2447			Pulled out of hole and laid down drill pipe. Rigged up to pull the BOP stack. Disconnected the BOP and pulled the same on riser. Made up casing cutter assembly and ran in hole to cut the 30" and 20" casing. Rigged up the guide frame and the sub sea TV to observe cutting the 20" and the 30" casings. Pulled out of hole with the cutter. Ran in hole with the spear and retrieved the wellhead, max. overpull was 1800 kN. Laid down the permanent guide base and the well head. Inspected the ocean floor with the sub sea TV.
20.04				Pulled the anchors. The rig under way to Framnes Mek. Verksted, Sandefjord.

1920 HF H 6 82 4000

3.4 Time distribution

The total time spent to move the rig to the location, drill, test and to permanently plug and abondon the well 31/4-6 was 53,8 days (1291 hrs.). The time distribution is shown in table B-1 and fig. B-2.

The operations can be divided as follows.

1.	Drilling of the well to T.D.	25.3 days
2.	Formation evaluation	16.3 days
3.	Lost time	9.5 days
4.	Plugging and abandonment	2.7 days

TABLE B-1

TIME BREAK DOWN

		Hrs.	%
1.	Rig move	17	1.32
2.	Positioning	20	1.55
3.	Drilling	191.5	14.84
4.	Tripping	101	7.83
5.	Surveying	6	0.47
6.	Conditioning mud	13.5	1.05
7.	Reaming	24.5	1.90
8.	Slipping and cutting	4.5	0.35
9.	Sub sea equipment handling	26.5	2.05
10.	Testing equipment	32	2.48
12.	Formation evaluation	392	30.38
13.	Drills	0.5	0.04
14.	Lost time: Drlg. equipment	41.5	3.22
15.	Lost time: Sub sea equipment	3.5	0.27
16.	Lost time: Fishing	62.5	4.84
17.	Lost time: Hole problem	37.5	2.91
18.	Lost time: Mooring system	-	-
19.	Lost time: Wo weather	82	6.36
20.	Lost time: Wo equipment	1	0.008
21.	Lost time: Wo orders	-	-
22.	Plugging and abandonment	65	5.04
23.	Mics.	23	1.78
		1291	100

= 53 days 19 hrs.

TABLE B-2

HOLE DEVIATION

Depth	Inclination (Degrees)	Direction (Degrees)
243	0.5	89
920	0.5	60
1401	1.25	235
1975	0.5	262
2076	0.5	240
2132	0.5	295
2228	0.25	275
2320	0.5	29
2447	0.5	350

4. PERMANENT ABANDONMENT OF THE WELL

The abondonment program is shown in fig. B 3 and was carried out as follows.

4.1 Plug 1:

Set a cement plug from 2440 m to 2380 m.

4.2 Plug 2:

An EZ squeeze packer was set at 2155 m and cement was squeezed into the test interval perforations at 2159.5 m - 2163.5 m and 2165 m - 2167 m.

4.3 Plug 3

Set a balanced plug from 400 m to 200 m.

4.4. Casing/Wellhead removal

Cut the 9 5/8" casing at 300 m, the 13 3/8" casing at 270 m and cut the 20" and 30" casings at 158 m.

The seabed was inspected by sub sea TV after pulling the PGB. According to the rig's deck log of 3/3-82, 1 joint of 20" casing was lost overboard during offloading from "Olav Viking". This item could not be seen during the sea bed inspection.

5. PORE PRESSURE AND FORMATION INTEGRITY

5.1 Pore pressure

Pore pressure results from the RFT-test are given in the following table (Ref. Fig. B-4).

Depth (m)	RFT (r.d.)
2157.5	1.017
2161.5	1.015
2165.2	1.016
2168	1.015
2171.5	1.014
2175	1.016
2183	1.020
2190	1.017
2220.5	1.014
2350	1.015
2358	1.015
2364	1.015
2372.5	1.014
2377	1.014

5.2 FORMATION INTEGRITY TEST (REF. FIG. B-4)

The following table shows the formation integrity tests results.

Casing depth (m)	Open hole depth (m)	Leak off (r.d. equiv. mud grad.)
20" - 913 m	927	1.68
13 3/8" - 1844 m	1865	1.72

6. MATERIALS REPORT

6.1 Casing and well head

A Cameron 18 3/4" housing wellhead system was used, and the 30", 20", 13 3/8" and 9 5/8" casing strings were set as shown in Table. B-3.

TABLE B-3

CASING COMPOSITION

Size	Grade	Weight lbs/	Lenght m	Threads	Setting Depth m
30"	B	1 1/2" WT	12	ATDRB	243
	B	1" WT	72	ATDRB	
20"	N55	133	526	BUTT	913
	X52	133	205	LS	
13 3/8"	N80	72	1691	BUTT	1844
9 5/8"	N80	47	2253	BUTT	2406

BIT RECORD

WELL NO.: 31/4-6

BIT NO.	SIZE	MAKE	TYPE	SERIAL NO.	JETS 32 ND.	DEPTH OUT M	M DRLG.	HRS. DRLG.	M/HR	ACC. DRLG. HRS.	WEIGHT KN	RPM	PRESS. BAR	OUTP. G/MIN	SPM 1	SPM 2	BIT COND T	BIT COND B	BIT COND G	BIT COND OTHER	REMARKS
CBLRR3	121/4"	DB	CB403	-	708155R	2145.5	18	3 ½	5.1	184.5	115	120	120		-	82	10	%	worn		Sandstone
CBLRR4	121/4"	DB	CB403	-	7081558	2213.5	18	4	4.5	189	115	120	120		82	-	15	%			"
12	12 1/4"	HTC	J4	3X13	AJ820	2322	108.5	20.5	5.3	209.5	220	100	240		65	65	7	8	I		Clayst./s.st.
13	12 1/4"	Reed	S21G	3X13	NCF775	2447	125	29	4.3	238.5	220	100	240		65	65	5	4	1/16		" "
14	12 1/4"	Reed	S21G	-	Scraper run												1	1	I		

BIT RECORD

WELL NO.: 31/4-6

BIT NO.	SIZE	MAKE	TYPE	SERIAL NO.	JETS 32 ND.	DEPTH OUT M	M DRLG.	HRS. DRLG.	M/HR	ACC. DRLG. HRS.	WEIGHT KN	RPM	PRESS. BAR	OUTP. G/MIN	SPM 1	SPM 2	BIT COND T	B	G	OTHER	REMARKS
1	26"	HTC	OSC3A	3X22	-	243.5	88.5	14.5	6.1	14.5	22/45	50	62		80	80	1	1	I		
	36"	SERVCO	H.O.																		
2	17½"	HTC	X3A	3X22	ND060	920	677	24.5	27.6	39	67	140	193		100	100	2	3	I		Clay/sand
3	17½"	Reed	Y11J	3X28	-												1	7	I		" "
	26"	Servco	UR-1	-		770	527	22.5	23.4	61.5	22/44	130	138		100	100	4	8	I		
4	17½"	Reed	Y11J	3X28	-	789	19	1.5	12.6	63	22/44	130	170		100	100	1	4	I		Pulled due to torque problem
	26"	Servco	UR-2	-													1	7	I		
RR4	17½"	Reed	Y11J	3X28	_	Lost in hole while reaming at 758 m.											1	5	I		
	26"	Servco	UR-3	-		Total fish recovered.											1	5	I		
5	17½"	Smith	DSJ	3X28	XA6346												1	2	I		
	26"	Servco	UR-4	-		927	210	10	21	73	15/67	130	173		100	100	1	7	-		Reamed from 717 m to 789 m
6	26"	TSK	3S	3X22	10484-T	Wiper trip															
7	17½"	HTC	X3A	3X22	MN799	1765	838	37.5	22.6	110.5	45/156	100 160	220		80	80	2	7	I		Drlg. 24 m cmt.
8	17½"	Smith	SDS	3X24	AX5325	1865	100	8.5	11.8	119	90/156	120 140	220		85	85	2	5	I		Bit used before
9	12 1/4"	HTC	XV	3X14	332VF	1902	37	3.5	10.6	122.5	45	50	138		50	50	3	2	I		
10	12 1/4"	HTC	XV	3X13	330VF	2076	174	27.5	6.3	150	200	90	240		65	65	4	5	1/16" BT		Shale limestone
11	12 1/4"	HTC	XV	3X13	247VF	2132	58	13	4.5	163	220	100	240		65	65	2	2	I		LST/SHALE
CB1	12 1/4"	DG	CB403	-	4100713	lost in hole. Fish recovered															-
CB2	12 1/4"	DB	CB403	-	7081558	2149	17	8	2.1	171	60/140	65 120	117		80	-	5	½ worn			Siltst/sands
CBLRR1	12 1/4"	DB	CB403	-	7081558	2159.5	10.5	3	3.5	174	140	120	124			82	5	½ worn			" "
CBLRR2	12 1/4"	DB	CB403	-	7081558	2177.5	18	7	2.6	181	140	125	110		-	82	5	½ worn			" "

PROMUD a/s

DRILLING MUD RECAP

Contractor: Golar Nor
OPERATOR: Norsk Hydro
LEGAL DESCRIPTION:

Rig No.: Nortrym
Well Name And No.: 31/4-6
Field:
COUNTRY: Norway

Promud a/s Warehouse: TANANGER
Spud Date: 28/2
No. Drilling Days To T.D.:
DATE T.D. REACHED:
TOTAL DEPTH:
TOTAL COST $:

DATE (19 82)	TIME	DEPTH meters	WT (PPG)	FV APIψ	PV cp ψ	YIELD POINT (lb/100ft²)	GELS (lb/100ft²) 0/10	pH	FILTRATE (ml/30 min) API	HT-HP	°F	Cake (32nd in)	Alkalinity P_m	P_f/M_f	Chloride (ppm)	Calcium (ppm)	Sand (% by Vol.)	Solids (% by Vol.)	Oil (% by Vol.)	Water (% by Vol.)	Methy. Blue (me/ml mud)		Circ. Volume (bbl)	REMARKS
28/2	2400	187	1.04	91		23	14/31	8.8	N/C						800	240								
1/3	2400					NO MUD CHECK																		
			END OF 30" HOLE SECTION												2800	90	TR	4	0	96				
2/3	2400	243	1.04	146	15	69	45/52	10.8	N/C															
3/3	2400	880	1.11	32	2	6	2/5	7.6	N/C						18200	2400	.25	6	0	94				
4/3	2400	400	1.07	37	2	3	2/2	8.0	N/C						20000	1960	.25	4	0	96				
5/3	2400	790	1.12	35	5	9	9/13	7.5	N/C						19000	2200	TR	5	0	95				
6/3	2400	790	1.12	35	5	9	9/13	7.5	N/C						19000	2200	TR	5	0	95				
7/3	2400	790	1.10	34	4	7	8/9	7.5	N/C						19000	1600	TR	5	0	95				
8/3	2400	927	1.11	38	5	16	12/18	7.5	N/C						18000	1400	.25	5	0	95				
9/3	2400	927	1.10	38	5	16	13/18	7.5	N/C								.25	5	0	95				End of 26" hole.
10/3	2400	927	1.03	42	11	3	1/2	10.5	12.0			2	1.4	15/12	22000	600	0	TR	0	99+				
11/3	2400	927																						Mixing SST mud.
12/3	2300	927	1.03	41	9	2	2/2	10.8	14.0			2	1.8	.7/1.7	19000	400	0	TR	0	99				
13/3	2400	1238	1.10	42	8	2	5/8	10.8	14			2	.75	.25/.9	19000	360	1/4	4	0	96			1874	
14/3	2200	1510	1.25	50	20	12	2/11	10.5	9.8			2	.7	.6/1.5	19000	240	1/4	9	0	91	4.0		2288	
15/3	2200	1716	1.35	56	20	21	7/27	10.7	10.0			2	.9	.8/2.1	19000	320	1/4	12	0	88	8		2286	
16/3	0600	1765	1.24	63	21	23	11/30	11	8.8			2	1.0	.95/2.4	19000	320	1/4	12	0	88	8		2408	
17/3	1500	1865	1.25	81	30	37	21/56	11	9.2			2	1	.95/2.3	19000	290	1	12	0	87	8.5		2561	
18/3	2230	1865	1.24	107	31	42	19/47	10.7	9.1			2	1.1	.8/2.0	19000	290	1	12	0	87	8.6		2451	
19/3	2200	1865	1.25	110	32	40	17/49	10.8	9.1			2	1.1	.8/2.0	19000	290	1	12	0	87	8.5		2451	
20/3	2100	1844	1.32	70	26	31	7/21	10.3	11			2	.9	.45/1.3	19000	480	1	12	0	87	9		1450	
21/3	2100	1844	1.32	70	25	32	8/25	10.3	10.3			1	1	.45/1.3	19000	360	1	9	0	90	8.5		1480	
22/3	1400	1872	1.31	77	21	29	7/22	10.4	9.7			2	1	.4/1.25	19000	300	1	9	0	90	8		1465	
23/3	2400	2068	1.27	64	25	26	10/31	10.3	7.7			1	1.3	.5/1.7	18600	230	1	9	0	90	9.5		1580	
24/3	2300	2109	1.26	59	24	28	10/29	10.2	7.5			1	1.1	.5/1.5	19000	210	TR	9	0	91	9.5		1583	
25/3	2400	2132	1.25	58	24	27	9/28	10.1	7.6			1	1	.5/1.6	19000	210	TR	9	0	91	9.5		1587	
26/3	2300	2132	1.26	63	24	36	10/30	10.0	8.9			1	1	.55/1.4	19000	330	TR	9	0	91	9.5		1587	

Date ______ Promud a/s Technical Representative ______ District ______ Region ______ PAGE ____ OF ____

PHENTA/S SANDNES

DRILLING MUD RECAP

PROMUD

Contractor: Golar Nor
OPERATOR: NORSK HYDRO
LEGAL DESCRIPTION:
Rig No.: NORTRYM
Well Name And No.: 31/4-6
Field:
COUNTRY: NORWAY
Promud a/s Warehouse: Tananger
Spud Date: 28/2-82
No. Drilling Days To T.D.:
DATE T.D. REACHED:
TOTAL DEPTH:
TOTAL COST $:

DATE (1982)	TIME	DEPTH meters	WT (ppg)	FV APIw	PV cp	YIELD POINT (lb/100ft²)	GELS (lb/100ft²) 0/10	pH	FILTRATE (ml/30 min) API	HT-HP	°F	Cake (32nd in)	Alkalinity Pm	Pf/Mf	Chloride (ppm)	Calcium (ppm)	Sand (% by Vol.)	Solids (% by Vol.)	Oil (% by Vol.)	Water (% by Vol.)	Methy. Blue (me/ml mud)		Circ. Volume (bbl)	REMARKS
27/3	2400	2148	1.27	56	25	20	4/23	9.8	8			1	.89	.4/1.2	18500	350	.35	10	TR	90	12.5		1648	
28/3	2400	2159	1.28	57	27	19	4/21	10.1	7.8			1	1.21	.6/1.6	18500	350	.50	10.5	TR	89.5	12.5		1622	
29/3	2400	2177	1.28	54	24	17	3/14	10.6	7.6			1	1.47	.8/2.0	19000	320	.35	10	TR	90	10		1655	
30/3	2400	2213	1.29	56	24	16	3/13	10.5	7.4			1	1.32	.8/2.0	19000	330	.25	11	0	89	15		1816	
31/3	2400	2213	1.29	57	25	15	4/14	10.7	7.8			1	1.51	.9/2.1	18500	340	.50	10.5	TR	89.5	12.5		1816	
1/4	2400	2321	1.29	54	21	16	4/18	10.5	7.4			1	1.23	.7/2.1	17500	350	.25	10	0	90	12.5		1870	
2/4	2400	2396	1.30	55	23	14	5/22	10.4	7.2			1	1.08	.7/1.8	16500	340	.15	11.5	TR	88.5	20		1897	
3/4	2400	2447	1.31	54	24	15	5/19	10.7	7.0			1	1.37	.8/2.1	16000	350	.15	12	TR	88	32.5		1872	
4/4	2400	2447	1.30	57	24	19	5/22	10.7	7.2			1	1.34	.8/2.1	16000	340	.15	11.5	TR	88.5	32.5		1852	
5/4	2400	2447	1.30	73	29	24	5/26	10.5	7.8			2	1.21	.6/1.9	15500	340	.25	12	TR	88	37.5		1852	
6/4	2400	2447	1.31	61	27	18	5/22	10.5	8.2			2	1.18	.6/1.9	16000	350	.35	11.5	TR	88.5	37.5		1852	
7/4	2400	2406	1.31	71	28	25	5/20	10.3	8.4			2	1.07	.6/1.7	15500	360	.25	12.5	TR	87.5	40		1252	
8/4	2400	2406	1.31	76	30	29	5/21	10.3	8.8			2	1.04	.5/1.7	14500	350	.25	12	TR	88	40		1282	
9/4	2400	2406	1.31	80	31	25	5/20	10.2	9.0			2	1.0	0.5/1.7	14500	360	TR	12	TR	88	40		1091	
10/4	2400	2447	1.28	65	24	22	7/28	10.5	8.5			1	1.0	0.5/1.8	12000	360	TR	12	TR	88	33		1100	
11/4	2400	2447	1.28	70	29	22	5/25	10.5	8.3			1	1.0	0.5/1.8	12000	360	TR	12	TR	88	33		1100	
12/4	2400	2447	1.28	65	27	21	5/25	10.2	7.5			1	0.9	0.4/1.7	12000	200	TR	12	TR	88	33		1100	
13/4	2400	2447	1.28	70	29	22	5/25	10.4	7.5			1	1.0	0.5/1.7	12000	200	TR	12	TR	88	33		1110	
14/4	2400	2447	1.28	70	30	20	5/25	10.4	7.6			1	1.0	0.5/1.7	12000	200	TR	12	TR	88	33		1075	
15/4	2400	2447	1.28	70	30	20	5/25	10.4	7.6			1	1.0	0.5/1.7	12000	200	TR	12	TR	88	33		1075	
16/4	2400	2447	1.28	70	29	20	7/30	10.5	7.6			1	1.3	0.6/2.2	12000	120	TR	12	TR	88	30		1200	
17/4	2400	2447	1.28	65	28	19	6/27	10.5	7.6			1	1.3	0.6/2.2	12000	120	TR	12	TR	88	30		1140	
18/4	——																						——	

Date ______ Promud a/s Technical Representative ______ District ______ Region ______ PAGE ___ OF ___

6.2 BOTTOM HOLE ASSEMBLIES

Bit no	Bit size	Bottom hole assembly
1	26"	Bit-H.O.-Stab.-Monel-Stab-5x91/2" DC-X/O-3x8" DC-X/O-15 HWDP
2	17 1/2"	Bit -Sub w/float-Monel-9 1/2" DC-Stab-4X9 1/2" DC-X/O-3X8" DC-X/O-15 HWDP
3	17 1/2"	Bit-U.Ream-Sub-Monel-9 1/2" DC-Stab-4x9 1/2" DC-X/O-3x8" DC-X/O-15 HWDP
4	17 1/2"	Same as for bit run no. 3.
RR4	17 1/2"	Same as for bit run no. 3.
5	17 1/2"	Bit-U.Ream-Sub-3x9 1/2" DC-X/O-6x8" DC-X/O-15 HWDP
6	26"	Bit-Sub-3x9 1/2" DC-X/O-6x8"DC-X/O 12 HWDP.
RR6	26"	Same as for bit run no. 6.
7	17 1/2"	Bit-Sub w/float-Monel-9 1/2" DC-Stab-4x9 1/2" DC-X/O-9x8" DC-X/O-12 HWDP
8	17 1/2"	Bit-Sub w/float-Monel-9 1/2" DC-Stab-4x9 1/2" DC-X/O-6x8" DC-X/O-9HWDP
RR8	17 1/2"	Same as for bit run no. 8
9	12 1/4"	Bit-Junk basket-Stab w/float-Monel-17x82 DC-Jars-3x8" DC-X/O-15HWDP
10	12 1/4"	Bit-Junk basket-N.B. Stab-Monel-Stab-8" DC-Stab-2x8" DC-Stab-14x8" DC-Jars-3x8" DC-X/O-15 HWDP

11	12 1/4"	Same as for bit run nr. 10
Core no 1	12 1/4"	Corehead -core barrel - 2x8" DC-Jar-3x8" DC-X/O-6 HWDP
RR11	12 1/4"	Bit-Junk sub-N.B. Stab-Monel-Stab 5x8" DC -X/O-6 HWDP
RR Core no. 1	12 1/4"	Core head-Core barrel-8" DC-Stab-14x8" DC-X/O-15 HWDP
Core no.2	12 1/4"	Same as for core no. 1RR
Core no. 3	12 1/4"	Core head-Core barrel-8" DC-Stab-15x8" DC-Jars-3x8" DP-X/O-15 HWDP
Core no. 4	12 1/4"	Same as for core run no. 3.
Core no. 5	12 1/4"	Same as for core run no. 3.
12	12 1/4"	Bit-N.B. Stab-Monel-Stab-8" DC-Stab-15x8" DC-Jars-3x8" DC-X/O-15 HWDP
13	12 1/4"	Same as for bit run no. 12
RR13	12 1/4"	Same as for bit run no. 12.
14	8 3/8"	Bit-Sub-Casing scraper-15x6 1/2" DC-X/O-X/O

MUD REPORT

36" Hole Section

The 36" hole was drilled down to 243 m using seawater/high viscouse pills with return to seabed. The casing was run and cemented without any problems.

26" Hole Section

17 1/2" pilot hole was drilled down to 920 m using spud mud. High viscous mud was spotted on each 3rd connection. Some problems appeared with sand plugging the shaker screens. Before the logs were run, a total of 600 bbls high viscous mud was spotted. The hole was then underreamed to 26". However, after underreaming the 26" hole, the riser was pulled and a 26" bit was run in the hole to TD. A 150 bbls high viscous pill was spotted together with 600 bbls mud before the 20" casing was run and cemented.

17 1/2" Hole Section

This section was drilled using the non-dispersed Shale Trol system. Mud from the previous section was diluted and converted to a Shale Trol system.

Down to 1400 m the mud weight was increased to 1,25 to combat sloughing shales in the top part of the section. At approx. 1500 m the flowline and bell nipple became completely plugged with gumbo. The ROP had to be controlled around 1550 m because of bad hole cleaning.

Down to 1750 m the bell nipple was plugged again three times with gumbo. At 1740 m the mudweight was raised to 1,35 because of heavy gumbo accumulation.

Overpull was noticed at 1527 m and 952 m when POOH.

The hole was drilled to 1865 m and logged. The first log stood up at 927 m. Hence, the log was pulled out and a bit wiper trip to TD was performed. The hole was circulated clean before POOH. The rest of the logging could then be successfully completed before the casing was run and cemented without problems.

12 1/4" Hole Section

The mud system was then converted to a fully dispersed mud system by adding Unical and Ligcon. The 12 1/4" hole was drilled to 2132 m where cores were cut down to 2214 m and intermediate logs were run without any problems.

The hole was then drilled to 2447 m. After final logging, casing was successfully run and cemented.

6.4 CEMENT REPORT

30" casing

The 30" casing was set at 243.5 m and cemented to seabed.

Slurry	Composition	Total used
Lead slurry		
Class "G" cement		27.34 ton
Yield	1.10 m^3/ton	
Seawater	0.63 m^3/ton	17.33 m^3
Caustic	9.47 kg/ton	254 kg
Econolite	0.16 m^3/ton	4.32 m^3
Density	1.68 r.d.	
Thickening time	4:30 hrs at 13 °C (55°F)	
Spacer slurry		
Class "G" cement		6.40 ton
Yield	0.80	
Seawater	0.48 m^3/ton	3.07 m^3
Caustic	0.72 kg/ton	4.60 kg
Density	1.87 r.d.	
Thickening time	4:30 hrs at 13°C (55°F)	
Tail in slurry no. 1 (4% $CaCl_2$)		
Class "G" cement		17.40 ton
Yield	0.84 m^3/ton	
$CaCl_2$	0.096 m^3/ton	1.67 m^3
Seawater	0.42 m^3/ton	7.27 m^3
Density	1.87 r.d.	
Thickening time	2:00 hrs at 13°C (55°F)	

<u>Tail slurry no. 2 (6% CaCl2)</u>

Class "G" cement		6.00 ton
Yield	0.85 m^3/ton	
Seawater	0.39 m^3/ton	2.32 m^3
$CaCl_2$	0.143 m^3/ton	0.86 m^3
Density	1.87 r.d.	
Thickening time	1:30 hrs at 13°C (55°F)	

<u>Grouting slurry</u>

Class "G" cement		11.94 ton
Yield	0.85 m^3/ton	
$CaCl_2$	0.144 m^3/ton	1.72 m^3
Seawater	0.39 m^3/ton	4.64 m^3
Density	1.87 r.d.	
Thickening time	1:30 hrs at 13°C (55°F)	

<u>20" Casing</u>

The 20" casing was set at 913 m and cemented to seabed.

Slurry	Composition	Total used
Lead slurry		
Class "G" cement		155.0 ton
Yield	1.45 m^3/ton	
Seawater	1.09 m^3/ton	168.2 m^3
Econolite	0.05 m^3/ton	8.3 m^3
Density	1.5 r.d.	
Thickening time	6:40 hrs at 27°C (30°F)	

<u>Tail slurry</u>

Class "G" cement		12.8 ton
Yield	0.80 m^3/ton	
Seawater	0.41 m^3/ton	5.3 m^3
$CaCl_2$	0.07 m^3/ton	0.9 m^3
Density	1.90 r.d.	
Thickening time	3:52 hrs at 27°C (80°F)	

13 3/8" casing

The 13 3/8" casing was set at 1844 m and cemented 100 m back in the 20" casing

Slurry	Composition	Total used
Lead slurry		
Class "G" cement		53.47 ton
Yield	1.20 m^3/ton	
Fresh water	0.85 m^3/ton	45.28 m^3
Econolite	0.032 m^3/ton	1.708 m^3
Density	1.58 r.d.	
Thickening time:	4:46 at 43°C (110°F)	
Tail slurry		
Class "G" cement		20.64 ton
Yield	0.77 m^3/ton	
Fresh water	0.43 m^3/ton	8.87 m^3
CFR-2L	0.026 m^3/ton	0.530 m^3
Density	1.90 r.d.	
Thickening time:	4:22 at 43°C (110°F)	

9 5/8" Casing

The 9 5/8" casing was set at 2406 m.

Slurry	Composition	Total used
Class "G" cement		38.60 ton
Yield	0.77 m^3/ton	
Fresh water	0.39 m^3/ton	14.96 m^3
CFR-2L	0.026 m^3/ton	0.99 m^3
H-10	0.044 m^3/ton	1.71 m^3
Density	1.90 r.d.	
Thickening time		

Abandonment plugs

Plug no. 1

Slurry	Composition	Total used
Class "G" cement		3.0 ton
Yield	0.77 m^3/ton	
Fresh water	0.39 m^3/ton	1.17 m^3
CFR-2L	0.026 m^3/ton	0.078 m^3
H-10	0.044 m^3/ton	0.132 m^3
Density	1.90 r.d.	

Plug no. 2

An EZ-drill squeeze packer was at 2155 m. Squeezed cement into perforations from 2159,5 m kr. 2168 m and left a 33 m cement plugs on to of the packer.

Slurry	Composition	Total used
Class "G" cement		4.23 ton
Yield	0.75 m^3/ton	
Water	0.466 m^3/ton	1.97 m^3
CFR-2L	0.027 m^3/ton	0.114 m^3
Halad-10L	0.026 m^3/ton	0.110 m^3
Density	1.90 r.d.	

Plug no. 3

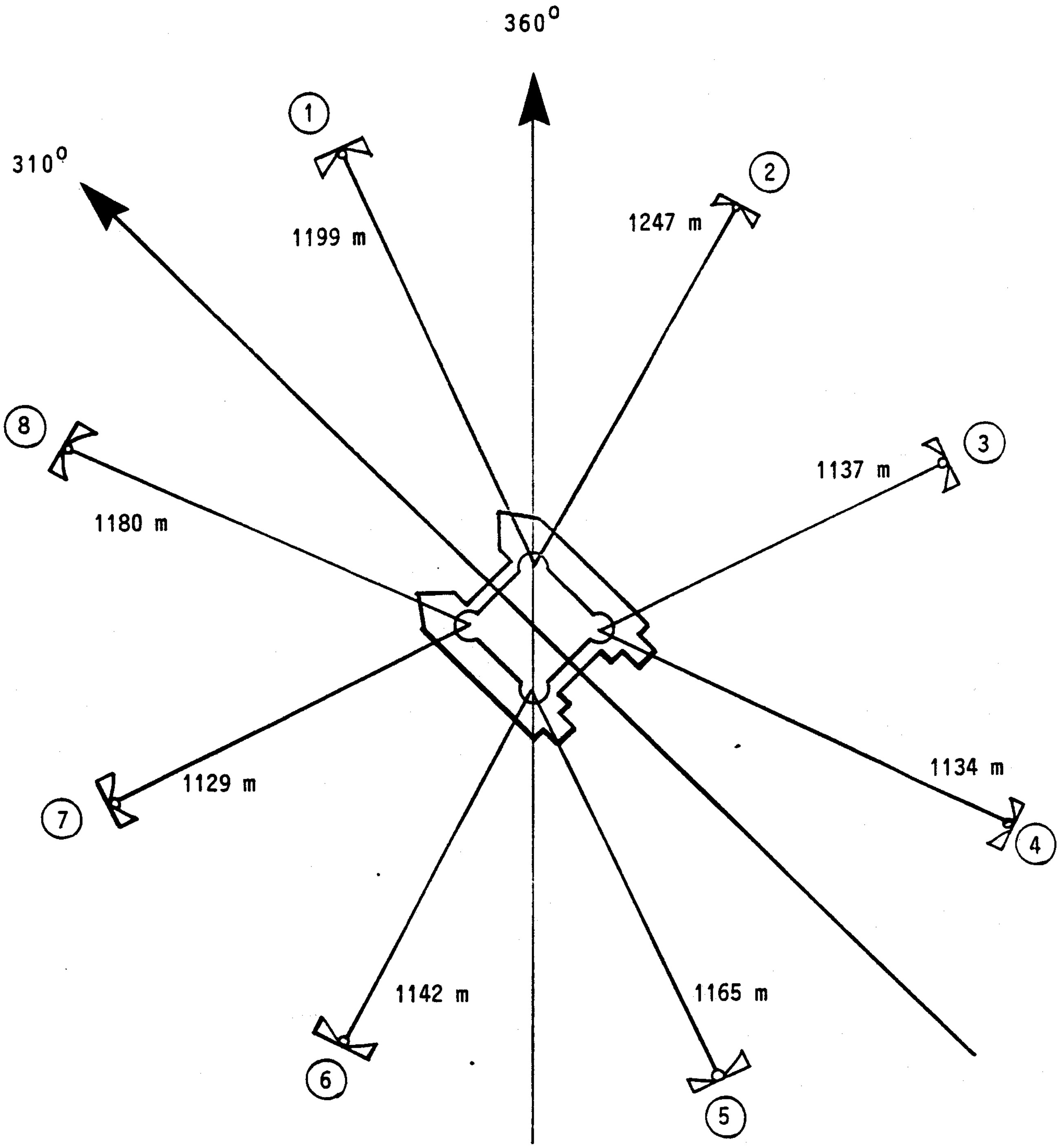
A balanced plug was set from 400 m to 200 m.

Lead slurry

Class "G" cement		19.67 ton
Yield	0.82 m^3/ton	
Water	0.47 m^3/ton	9.31 m^3
Density	1.89 r.d.	

Tail slurry

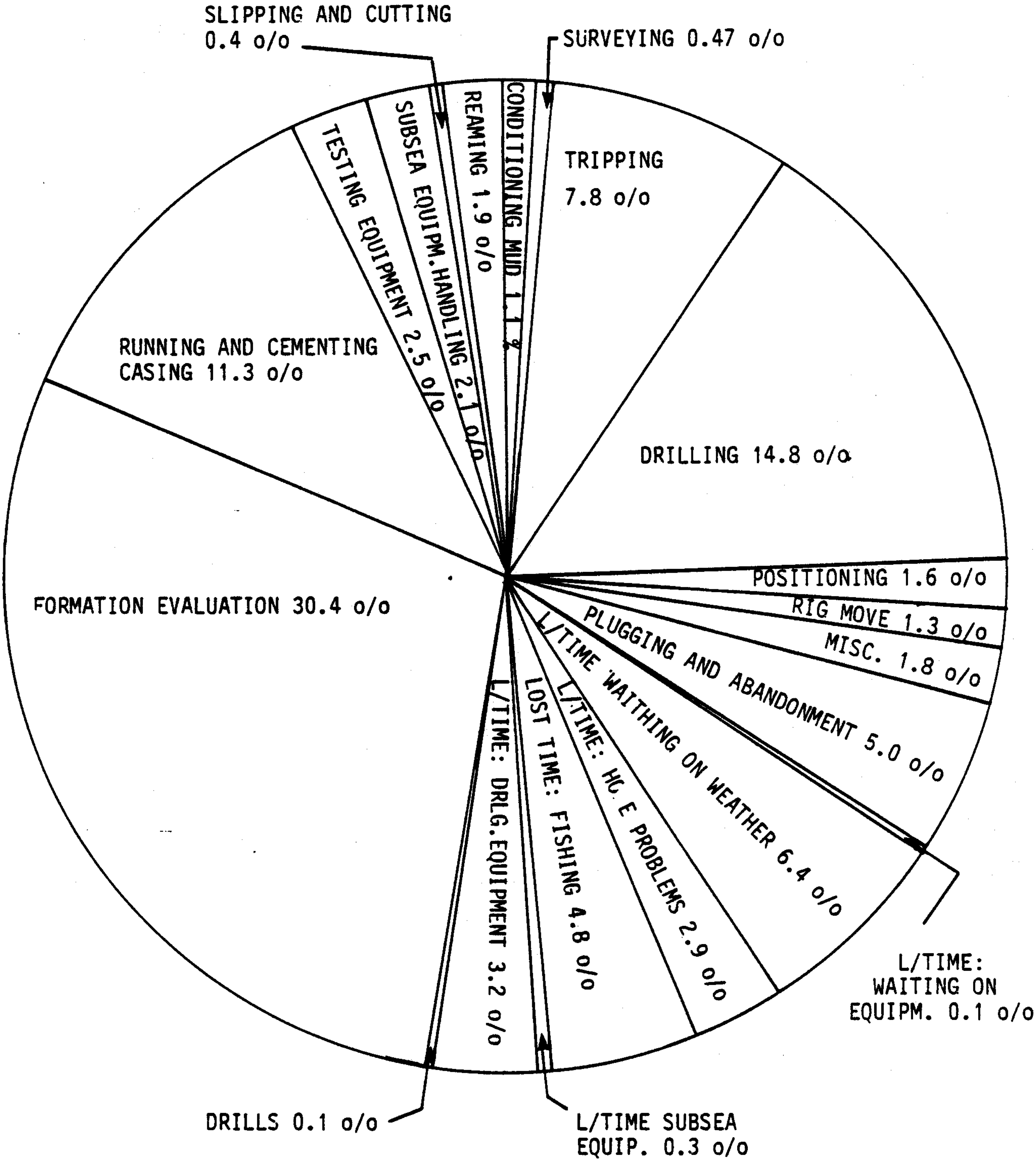
Class "G" cement		3.24 ton
Yield	0.78 m^3/ton	
Water	0.50 m^3/ton	1.61 m^3
$CaCl_2$	0.096 m^3/ton	0.31 m^3
Density	1.89 r.d.	



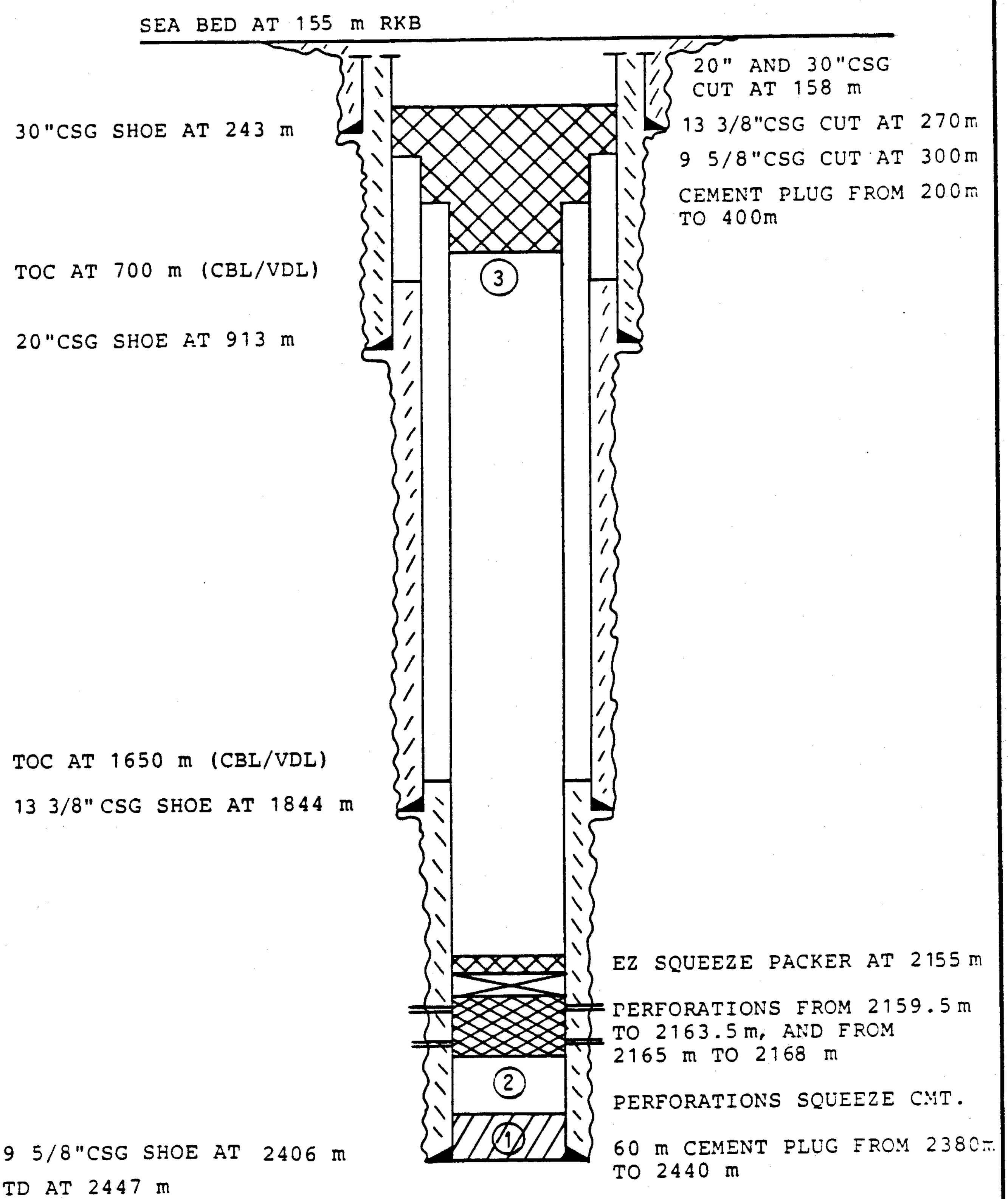
HEADING 310°

WELL COORDINATES: 60°31' 16.6"N
03°01' 57.7"E

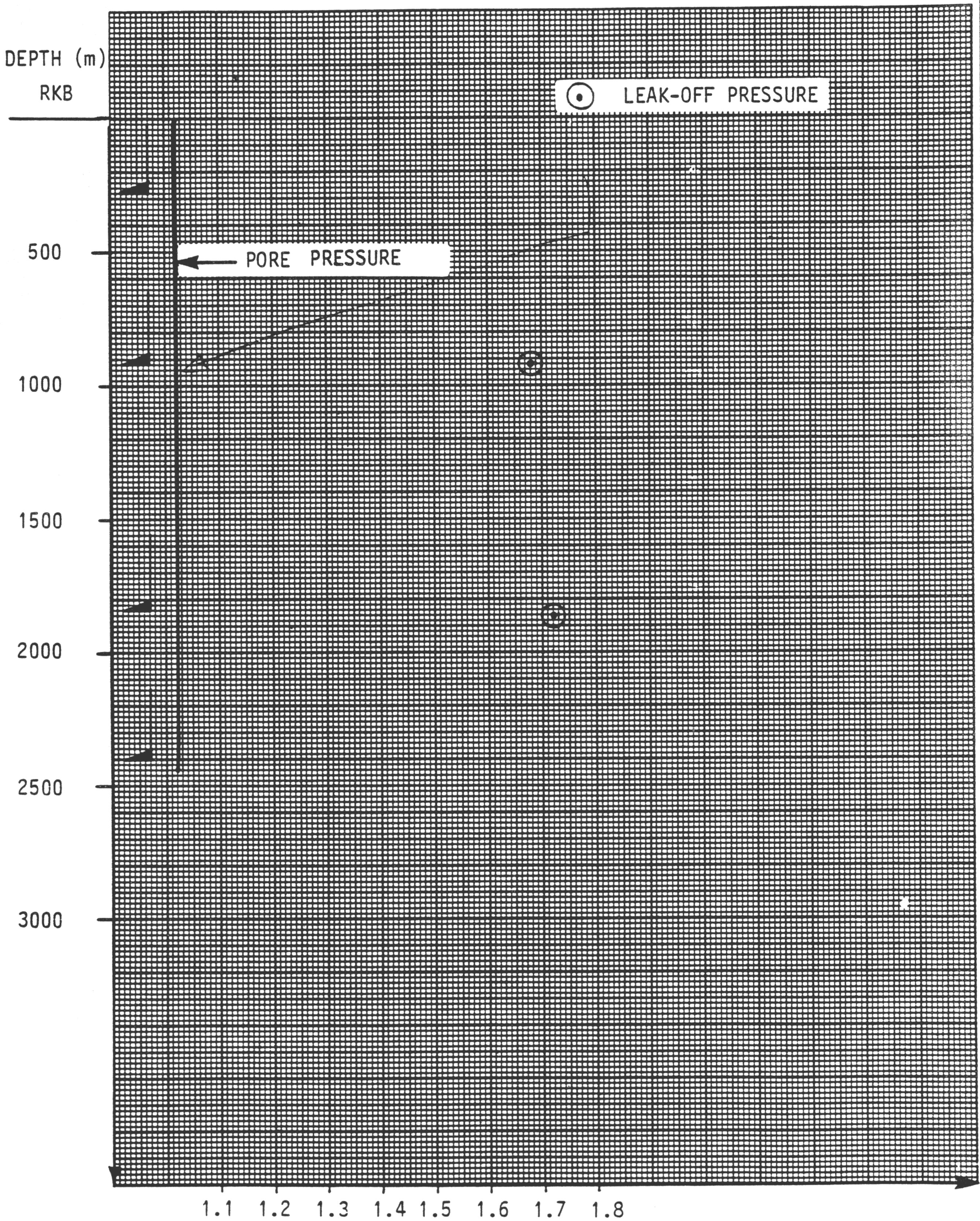
Norsk Hydro Drilling Department	MOORING LINE PATTERN NORTRYM WELL 31/4-6	Gr. no.: 3	Fig.: B - 1
		Date: 14/9 - 1982 Sign: Sho / Hes	Dwg. no.: 40



Norsk Hydro Drilling Department	TOTAL TIME DISTRIBUTION WELL 31/4-6	Gr. no.: 3	Fig.: B - 2
		Date: 14/9 - 1982 Sign: Sho / Hes	Dwg. no.: 40



Norsk Hydro Drilling Department	ABANDONMENT WELL 31/4-6	Gr. no.: 3	Fig.: B-3
		Date: 10/9 - 1982 Sign: Sho / Hes	Dwg. no.: 35



Norsk Hydro Drilling Department	PORE PRESSURE AND LEAK-OFF PRESSURE RESULT WELL 31/4-6	Gr. no.: 3	Fig.: B-4
		Date: 14/9 - 1982 Sign: Sho / Hes	Dwg. no.: 41

NH.DD.28.2.80

cc. [illegible], Jacobsen

Norsk Hydro

ESTIMATED FINAL Cost Report

Period from	to	Total operation days	Sign.	Date
25.2.82 15.00 hrs.	20.04.82 11.00 hrs.	43,167	TSt	13.5.82

Well no.	Acc.no.	Rig name	
31/4-6 (+ test)	71680 (71650)	Nortrym	

Orig.budg.dated	M.Nkr.	Based on	Oper.days
4.2.82	50	45	

Sub. no.	Item	Cost in period 1000 Nkr.	Cumulative costs 1000 Nkr.	Budget revision 1000 Nkr.	Costs in % of budget	Remarks
	LOCATION EXPENSES:					
105	Site-survey		1.280	300		
106	Resurvey		-	200		
120	Locationing		200	200		
125	Location Clean-up		-	300		
130	Miscellaneous		-	-		
	RIG:					
210	Rig Contract		21.350	22.500		
212	Reimbursables		200	200		
	SUPPLIES:					
310	Bits		400	400		
311	Coring Equipment		400	500		
312	Drilling Tools		500	600		
313	Fishing Tools		-	-		
320	Casing		3.600	3.900		
321	Casing Equipment		250	250		
322	Test Tubing & Equipment		-	-		
330	Mud Products		2.000	2.000		
332	Cement		1.200	1.200		
340	Wellheads		1.200	1.200		
395	Fuel and Greases		2.300	2.300		
398	Miscellaneous		300	300		
	SERVICES:					
405	Helicopter		600	500		
410	Supply and Standby Ships		2.800	3.100		
415	Mud Engineering		130	130		
420	Mud Logging		420	425		
425	Cementing		300	300		
430	Logging		3.300	3.300		
431	Velocity Services		100	100		
435	Fishing		-	-		
440	Fishing Tool Rentals		-	-		
444	Casing Services		250	200		
445	Casing Cutting		120	175		
446	Tubular Inspection		50	50		
450	Coring		60	60		
455	Testing		10.000	-		*
460	Test Tool Rentals		115	115		
470	Diving		210	230		
475	Radioservice		100	100		
480	Meteorological Service		15	15		
485	Catering		135	135		
490	Miscellaneous		100	100		
	OPERATORS COSTS:					
510	Mobilization Costs		335	335		
519	Rig Insp. N.T. Febr. 1981		815	815		
515	Repair Costs		-	-		
520	Insurance		-	-		
530	Base		765	765		
540	Laboratory Studies		600	600		
550	Onshore Drilling Supervision		500	500		
555	Onshore Geological Supervision		150	150		
560	Offshore Drilling Supervision		600	600		
570	Offshore Geological Supervision		250	250		
580	Exploration Assistance		500	500		
595	Miscellaneous		100	100		
	Total		$\boxed{58.000}$	50.000		

* Test 31/4-6 in period 7.4.82 at 07.00 hrs. - 17.4.82 at 23.00 hrs. = 10,666 days

1925 [illegible] 12. 5 1000

Norsk Hydro

Norway

DRILLING PROGRESS, WELL 31/4 - 6

OPERATOR : NORSK HYDRO a.s

COORDINATES : 60°31' 16.6" N

: 03°01' 57.7" E

SPUD IN : 28/02-1982

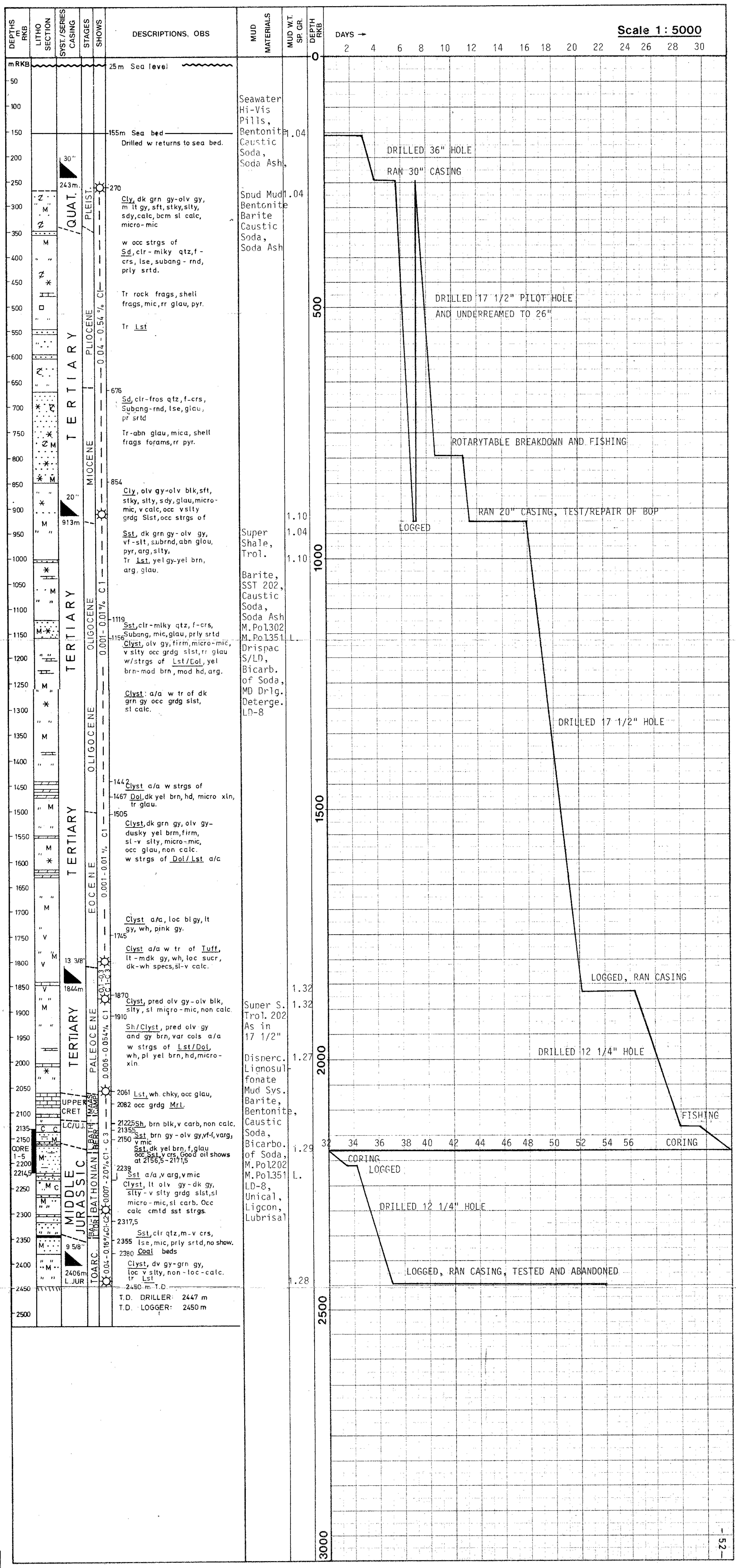
WELL COMPL. : 20/04-1982

RIG : NORTRYM

WATER DEPTH : 130.2 m

RKB to MSL : 25 m

RKB to SEABED : 155.2 m



SECTION C

FORMATION EVALUATION

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SECTION C

FIGURES

1 INTRODUCTION

Computerized log interpretation was performed on the intervals 2135 m - 2240 m and 2317 m - 2390 m.

The first 20 m of interval one is a micaceous sandstone starting at the base of the hot shale at 2135 m and going down to 2156.5 m. Below is the Intra Heather sandstone, with top of sandstone at 2156.5 m and the base at 2239.5 m. Interval 2 is the Brent Group going from 2317.5 m - 2380 m.

LDT/CNL and ISF/SONIC were run in both intervals. In addition DLL/MSFL was run in interval 1. All the logs were of a good quality. In addition to the regular log runs an EPT log was run. Schlumberger provided an EPT porosity playback.

Five cores were cut in the Intra Heather sandstone II, and conventional core analyses were performed. (Three plugs per meter were cut from all cores).

2 INTRA HEATHER SANDSTONE II 2156.5 M - 2239.5 M RKB

2.1 Lithology

The Intra Heather sandstone is relatively clean, and has good porosities and permeabilities down to 2171.5 m. The sandstone is fine grained and moderate - to occasionally well sorted. A tight calcite stringer is present at 2163 - 2164.5 m. At 2159.5 m there is a 6 cm thick stringer of coarse sand. Below 2171.5 m the sandstone is very fine, poorly sorted, more silty, more argilaceous and more micaceous.

The change in lithology at 2171.5 m is assumed to affect the cementation factor.

2.2 Calculation of V_{cl}

Due to mica problems GR could not be used as a clay indicator, and also FDC/CNL calculated a too high V_{cl} in the shaly intervals. To have the best estimate of clay content and porosity, log derived porosities were correlated with core-derived porosities, using the core porosity as a maximum porosity. This way the FDC/BHC clay indicator was found to give best results.

Interval	ρ_{bclay}	ϕ_{Nclay}	Δt_{clay}	GR_{min}	GR_{max}	R_{clay}	R_w	m	a
2156.5-2171.5	2.52	0.38	96	52	85	3	0.08	2	1
2171.5-2239.5	2.50	0.38	94	52	85	3	0.08	2.15	1

2.3 Saturation

Movable hydrocarbons are found in the interval 2156.5 m - 2170.5 m. The oil water contact is at 2171.5 m. Pressure gradients from RFT and shows from cores confirm the oil water contact found from the logs.

2.4 Cores

Five cores were cut in the Intra Heather sandstone II.

Core no.	Core depth	Log depth
1	2132 - 2149	2131 - 2148
2	2149 - 2159.5	2148.8 - 2160.7
3	2159.5 - 2178.1	2160.7 - 2179.3
4	2178.1 - 2196.1	2179.6 - 2197.6
5	2196.1 - 2214.5	2199.9 - 2218.3

Core porosity matches very well with the log porosity in the clear section. In the more shaly intervals core porosities are expected to be too high. (Fig. 1).

Interval m	Average horizontal core permeability md	Average core porosity	Average log porosity
2156.5-2173	164.7	26.1	24.0
2133-2214	77.2	19.6	13.4

Special core analyses have been ordered on several plugs in the interval 2155.32 m - 2170.99 m. Porosity and permeability under overburden, formation factors, capillary pressures, relative permeabilities and cation exchange capacity will be measured.

2.5 Results

Top of sand, m RKB	2156.5
Base of sand, m RKB	2239.5
Gross sand, m	83
Net sand, m	25
Oil water contact, m	2171.5
Gross pay, m	15
Net pay, m	12.5
Average porosity in	
net sand:	0.226
net pay	0.264
Average water saturation in	
net sand	0.651
net pay	0.438
Net/gross sand	0.30
Net/gross pay	0.83

Cut offs defining net pay

$S_w < 70\%$ $V_{cl} < 50\%$ $\phi > 15\%$

Net sand has no cut off on S_w.

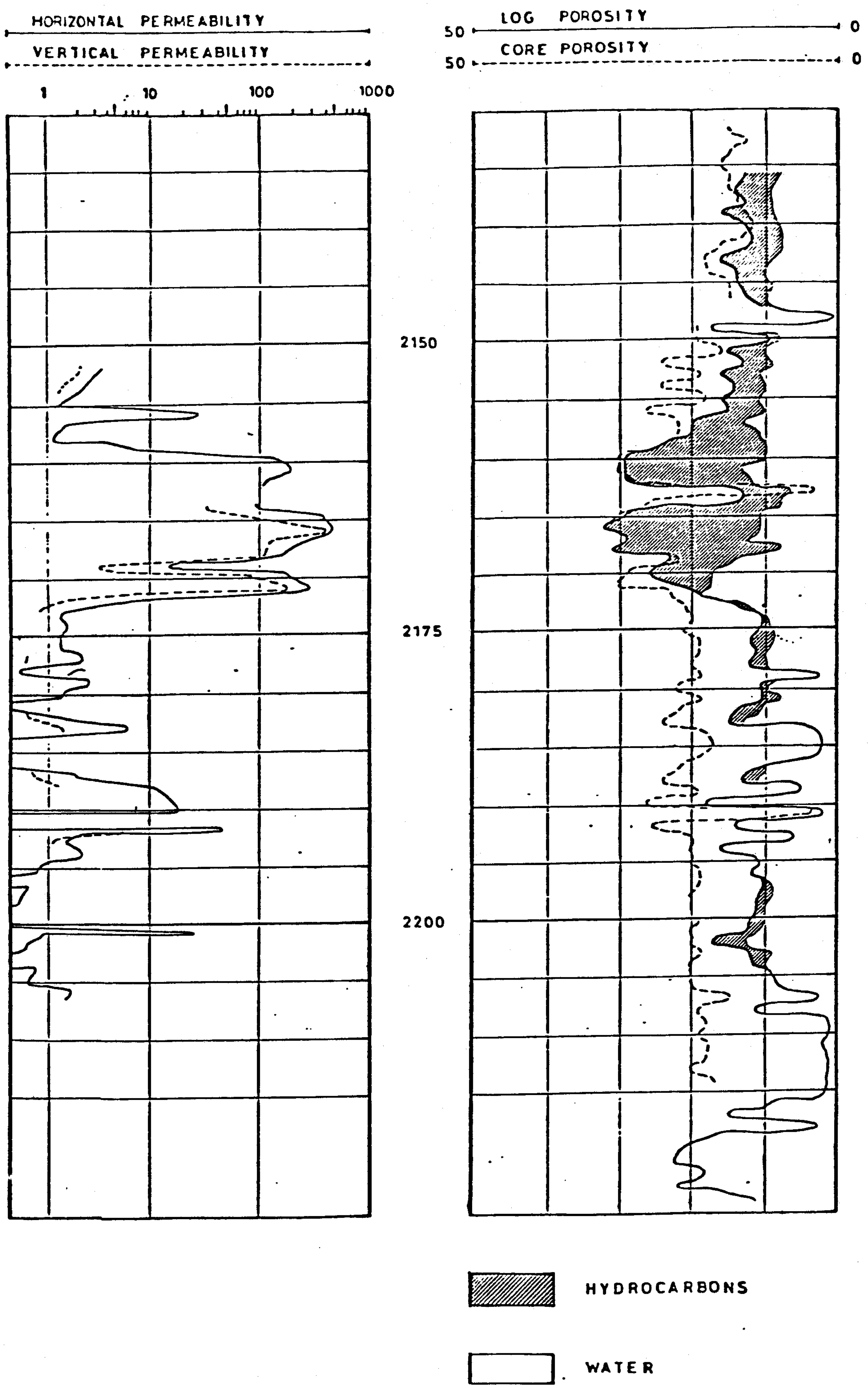
3. BRENT GROUP 2317.5 M - 2380 M RKB

The Brent Group is water saturated with a good sandstone interval in the lower part.

Gross sand, m RKB	62.5
Net sand, m RKB	31
Average porosity in net sand	0.234
net/gross	0.50

Cut offs defining net sand: $V_{cl} < 40\%$ $\phi > 10\%$

WELL 31/4-6


HORIZONTAL PERMEABILITY
VERTICAL PERMEABILITY
1
10
100
1000
LOG POROSITY
CORE POROSITY
50
0
50
0
2150
2175
2200
HYDROCARBONS
WATER

SECTION D

WELL TESTING

LIST OF CONTENTS

SECTION D

FIGURES

1 REPEAT FORMATION TESTING (RFT)

1.1 Summary of events

Two runs were made in the well, covering the Intra-Heather Sand II and the Brent Formation:

Run no. 1, 4/4-82, 12 1/4" hole:
27 tool settings/pressure tests attempted from 2138.5 m to 2377.0 m, plus segregated sampling at 2160.5 m (6 Gal + 2 3/4 Gal. chambers).

Run no. 2, 4/4-82, 12 1/4" hole:
Additional sampling run, to verify fluid below tight stringer dividing the pay zone. Segregated sampling performed at 2166.5 m (6 Gal. + 2 3/4 Gal. chambers).

The pressure recordings are tabulated in table 1.1.

Plots of formation pressure vs. depth are found in:

fig. 1.1 for total survey and
fig. 1.2 for I.H.2-formation.

1.2 Comments on pressure survey

Pre-test pressures were obtained in the two main Jurassic sands, namely the Intra-Heather Sand II and the Brent Group Sand. Both sands experience the normal pressure regime as seen in the other wells on the structure. A good definition of the OWC can be established from this well, by the intersect of the oil gradient in I.H.2-sand and the water gradient common to both I.H.2-sand and Brent aquifers (see enclosure 1). This OWC is then at 2172 mRKB +- 1 m (see fig. 3.2). The first four pre-tests of the survey show the formation just below the hot-shale to be tight. The first pre-test pressure is recorded at 2157.5 m showing low permeability. Below this depth down to OWC, the permeabilities are generally very good.

Below the OWC the permeabilities are rapidly decreasing to poor. One exception is the good sand layer at approx. 2220 m. Here the pre-test showed good permeability and a good formation pressure was obtained. This good sand in the water zone helps in defining the common water gradient below OWC. The oil gradient of 0.32 psi/ft agrees with the density and GOR of the 31/4 reservoir oil.

The fact that the zone above the good oil bearing sand is tight and likewise that the sand below approx. 2173 m generally is of poor reservoir quality, agrees with log and core results, and confirms them.

1.3 Comments on sampling

Two segregated samples were taken in the oil zone. One sample set was taken above the tight layer (2163 - 2164.5 m) and one below this layer. This was to verify the oil properties in the pay zone. Resumé of sampling is found in appendix 1.1.

According to experience from 31/4-5, 2 3/4 Gal + 6 Gal chambers were used for segregated sampling. This time the recovery was good in both 6 Gal. chambers (81 and 91), compared to 31/4-5 where only small amounts were recovered in the 6 Gal chamber. This might indicate that this well has a better permeability in the pay zone. However, there is no doubt that filtrate invasion is less than in the 31/4-5 well.

1.4 NOTES ON PRESSURE REGIMES, B-STRUCTURE

All three wells drilled on the structure were tested with the RFT and subsequently production tested. Hence a lot of pressure data is available. Figure 1.3, contains all of this data and a good agreement is observed between RFT and DST pressures.

Some conclusions:

- All DST-pressures are 10 - 20 psi higher than RFT pressures, this discrepancy is generally within the tolerance of the RFT-gauge.

- All water zones show normal pressures and gradients, according to water salinity, reservoir pressure and reservoir temperature.

  Using data from 31/4-3, we see that Upper Jurassic, Dunlin, Brent, Statfjord and Triassic reservoirs are all normal pressured.

- All wells can now be tied in showing an OWC at 2172 mRKB +- 1 m in Intra Heather Sand II.

  Furthermore, an OWC at 2051 mRKB is indicated in the Intra Heather Sand I.

Appendix 1.1
Sampling resumé

Segregated sample no 1 at 2160.5 m:

6 gal:	drained on rig floor	
2-3/4 gal:	sample sent to Core-Lab, Aberdeen	
2-3/4 gal:	sample pressure checked on rig floor with Haskel pump: 1400 psig	
6 gal:	Opening pressure	1150 psi
	Gas meter	200.8 cuft
	Oil ca. 8 l	36.7^{o} API
	Water/filtrate ca. 14 l	
	Resistivity	.384 at 56^{o}

Segregated sample no. 2 at 2166.5 m:

6 gal:	drained on rig floor	
2-3/4 gal:	sample sent to Core-Lab, Aberdeen	
2-3/4 gal:	sample pressure checked on rig floor with Haskel pump: 1400 psig.	
6 gal:	Opening pressure	1375 psig
	Gas meter	210 cuft
	Oil ca. 9 l	35.6^{o} API
	Water/filtrate ca. 11 l	
	Resistivity	.391 at 56^{o} F

TABLE 1.1

WELL 31/4-6 ,RFT RUNS 1&2, JURASSIC FM'S.

RUN 1

TEST NO	DEPTH MRKB	PHI PSIG	PF PSIG	PHA PSIG	REMARKS
1	-2138.5	4005	0	4006	TIGHT
2	-2145.5	4018	0	4018	TIGHT
3	-2149.5	4024	0	4026	TIGHT
4	-2153.5	4030	0	4033	TIGHT
5	-2157.5	4038	3121	4040	LOW PERMEABILITY
6	-2160.0	4043	3120	4045	VERY GOOD PERMEABILITY
7	-2161.5	4046	3121	4047	VERY GOOD PERMEABILITY
8	-2163.0	4052	3126	4054	GOOD PERMEABILITY
9	-2165.2	4056	3128	4058	VERY GOOD PERMEABILITY
10	-2166.5	4059	3129	4060	VERY GOOD PERMEABILITY
11	-2168.0	4060	3130	4062	VERY GOOD PERMEABILITY
12	-2169.5	4063	3132	4063	LOW PERMEABILITY
13	-2171.5	4065	3133	4066	GOOD PERMEABILITY
14	-2173.0	4068	3137	4070	LOW PERMEABILITY
15	-2175.0	4073	3143	4074	LOW PERMEABILITY
16	-2183.0	4088	3168	4088	LOW PERMEABILITY
17	-2190.0	4101	3168	4102	POOR PERMEABILITY
18	-2194.5	4109	3176	4110	POOR PERMEABILITY
19	-2220.5	4162	3204	4156	GOOD PERMEABILITY
20	-2351.0	4400	0	4397	TIGHT
21	-2350.0	4398	3392	4398	VERY GOOD PERMEABILITY
22	-2358.0	4413	3403	4414	EXCELLENT PERMEABILITY
23	-2364.0	4423	3412	4425	EXCELLENT PERMEABILITY
24	-2372.5	4439	3423	4440	VERY GOOD PERMEABILITY
25	-2377.0	4447	3430	4448	EXCELLENT PERMEABILITY
26	-2160.0	4043	3123	0	1ST SAMPLING ATTEMPT ABORTED DUE TO PLUGGING
27	-2160.5	4044	3126	4043	SEGREGATED SAMPLING (6 GAL+ 2 3/4 GAL CHAMBERS)

RUN 2

TEST NO	DEPTH MRKB	PHI PSIG	PF PSIG	PHA PSIG	REMARKS
28	-2166.5	4059	3129	4056	SEGREGATED SAMPLING (6 GAL. + 2 3/4 GAL.)

ALL PRESSURES TEMPERATURE CORRECTED
MAX RECORDED TEMP. = 71.1 DC

PHI = INITIAL HYDROSTATIC PRESSURE
PF = FORMATION PRESSURE
PHA = HYDROSTATIC PRESSURE AFTER TEST

31-4-6, RFT form. press. vs. depth
JURASSIC FORMATIONS

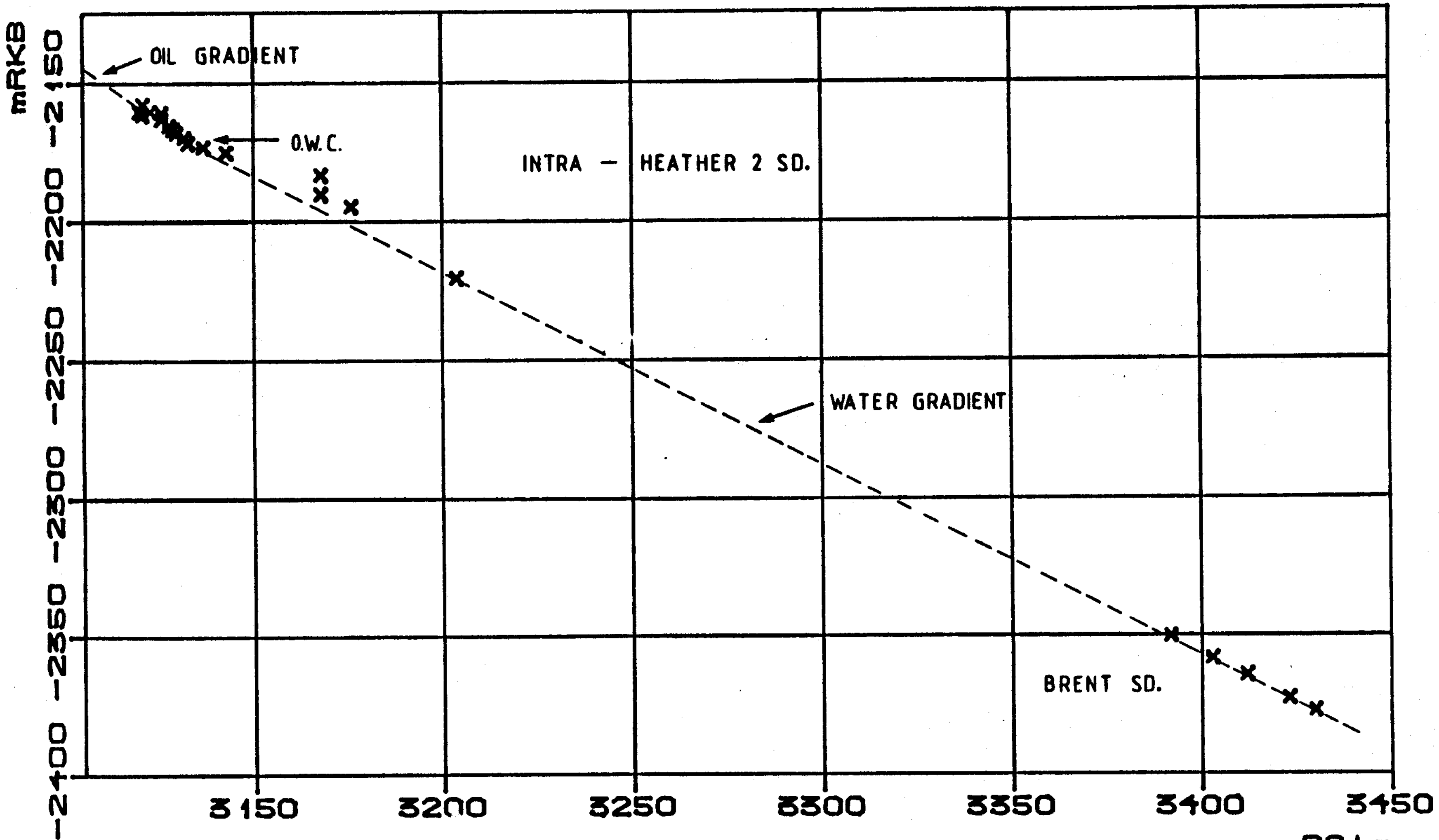
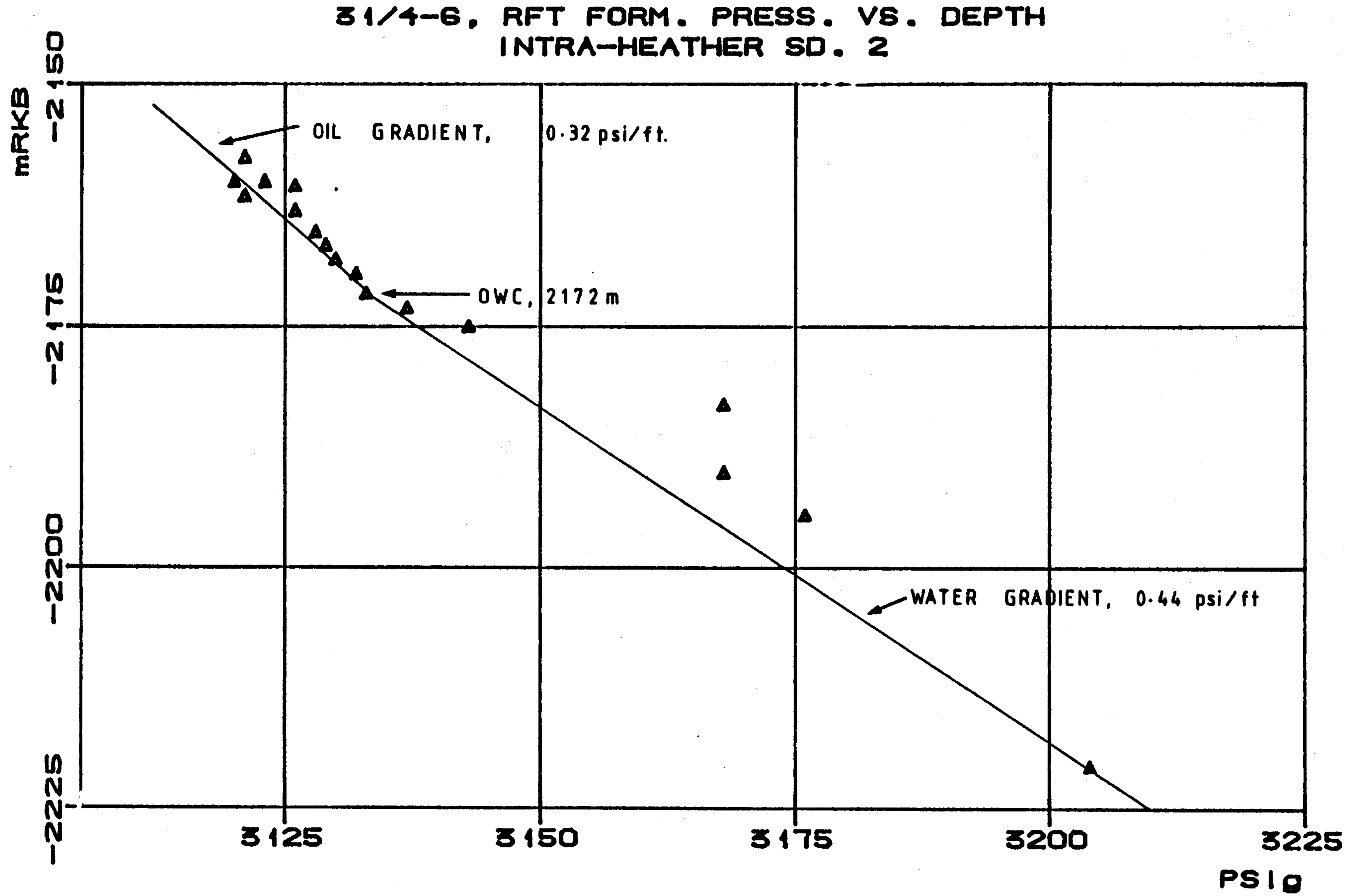
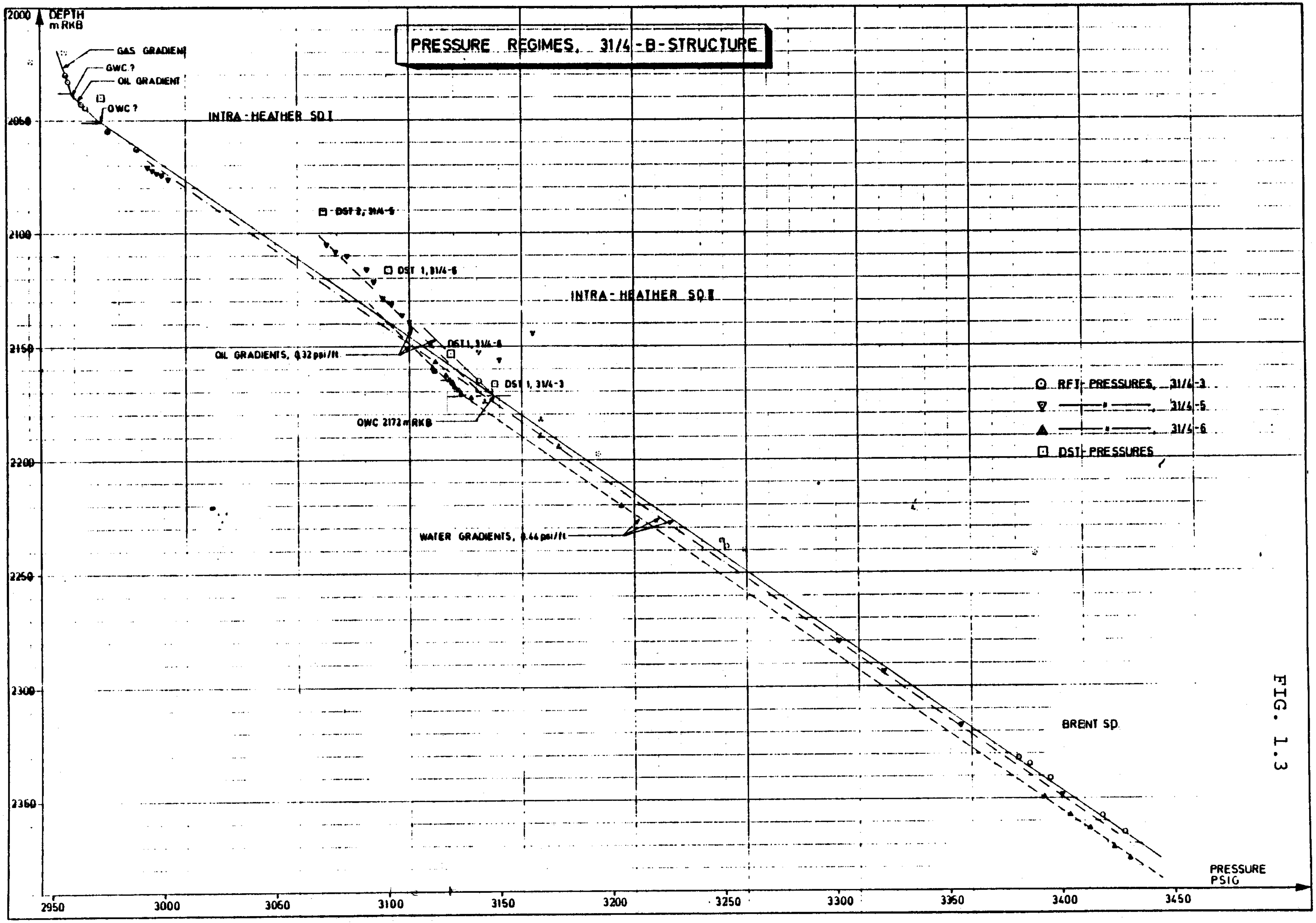


fig. 1.1



31/4-6, RFT FORM. PRESS. VS. DEPTH
INTRA-HEATHER SD. 2
mRKB
-2150
-2175
-2200
-2225
OIL GRADIENT, 0.32 psi/ft.
OWC, 2172 m
WATER GRADIENT, 0.44 psi/ft
3125
3150
3175
3200
3225
PSIg

fig. 1.2



PRESSURE REGIMES, 31/4-B-STRUCTURE
DEPTH m RKB
PRESSURE PSIG
GAS GRADIENT
GWC ?
OIL GRADIENT
OWC ?
INTRA-HEATHER SD I
DST 2, 31/4-5
DST 1, 31/4-5
INTRA-HEATHER SD II
DST 1, 31/4-6
OIL GRADIENTS, 0.32 psi/ft.
DST 1, 31/4-3
OWC 2172 m RKB
WATER GRADIENTS, 0.44 psi/ft.
BRENT SD
RFT-PRESSURES, 31/4-3
31/4-5
31/4-6
DST-PRESSURES
2000
2050
2100
2150
2200
2250
2300
2350
2950
3000
3050
3100
3150
3200
3250
3300
3350
3400
3450

FIG. 1.3

2 PRODUCTION TESTING

2.1 Introduction

17 April 1982 one sandstone zone was production tested with the following objectives:

- Determine reservoir productivity
- Verify reservoir properties
- Obtain representative reservoir fluid samples

This report summarizes the data gathered during the test and presents the results from the analysis of the data.

All depths are with reference to the Schlumberger DLL/MSFL Logs, and are measured from RKB.

2.2 Summary

Test interval:	2159,5 - 2163,5 m
	2165 - 2168 m

The downhole test string is shown schematically in Fig. 2.2.4, and the test operations are summarized in appendix 2.B.

Main flow period: 12.5 hours
Main shut in period: 24 hours

Average test data recorded during main flow period:

Oil rate	STB/D	2841
Gas rate	MSCF/D	1352
Gas-oil ratio (separator)	SCF/STB	476
Well head pressure	PSIA	864
Well head temperature	^{o}F	110
Choke size	1/64"	36
Oil gravity	^{o}API	34.4
Gas gravity	AIR=1	0.727
Separator pressure	PSIG	176
Separator temperature	^{o}F	90
B.S. & W.	%	TRACES
CO_2	%	TRACES

The recorded data vs time is plotted in Figs. 2.2.1, 2.2.2 and 2.2.3.

2.3 Results and conclusions

Analysis of the test data has given the following results:

kh	md x ft	16404
K_o	md	400.0
SKIN	dimensionless	4.8
PI - ACTUAL	STB/D/PSI	12.3
PI - IDEAL	"	19.3
Flow efficiency	dimensionless	0.64
P*	PSIG	3129
T.max. (B.H.)	^{o}F	195
Ref. depth (P*)	m	2153.5

In addition to the results presented above, the test might also indicate that a reservoir heterogeneity is located approx. 400 - 450 m from the well.

The high test permeability of 400 mD, compared to the core permeability for the total pay zone: K_H, arithmetic average = 180 mD, could be explained by the obviously highly permeable 6 cm thick sand-layer at 2059.5, (no permeability measurement possible due to loose sand). However, the high test permeability could also be explained by more, and/or higher permeable pay within the radius of investigation of the test.

The parameters used in the above calculations are listed in appendix 2A, and the build-up curves are plotted in Figs. 2.3.1, 2.3.2 and 2.3.3.

2.4 Pressure analysis technique

The primary method used to analyse the test results was conventional Horner-analysis.

Because of a sudden increase in the well-flowing pressure (approx. 50 psig after 4.5 hrs flow), which was probably due to separator having been by-passed, analysis based on superposition was also used.

The results of the two methods of analysis were practically the same.

2.5 Sampling

During main flow 2 sets of separator recombination samples and 5 x 25 ltr stock-tank fluid samples were taken.

Bottom-hole sampling was performed after the final shut-in period. 4 bottom-hole samples were sampled in two runs. Two of these samples were chosen for further laboratory studies.

The bottom-hole samples were taken under the following conditions:

Oil rate	STB/D	286.5
Bottom-hole pressure	PSIG	3107.5
Bottom-hole temperature	^{o}F	193.3
Well-head pressure	PSIA	969
Well-head temperature	^{o}F	48
Choke size	1/64"	12

The samplers were positioned approx. 5 ft above the PCT-tester valve.

APPENDIX 2.A

Parameters used in pressure build-up calculations.

H_{net}	m	12.5
tp	hrs	12.5
μ_o	cP	0.56
B_o	BBL/STB	1.3
P_{1hr}	PSIG	3105
P_{wf}	PSIG	2897
C	PSI^{-1}	12×10^{-6}
m	PSI/cycle	20.5

Parameters used in superposition analysis:

Oil rate 1	STB/D	3280
Oil rate 2	"	2841
Time 0	hrs	0
Time 1	"	4.5
Time 3	"	12.5

APPENDIX 2.B

SEQUENCE OF EVENTS

DST 1, Well 31/4-6

DATE	TIME	EVENT
13.04.82	04:00	DST-interval perforated
	06:55	Start to run in hole with test string
14.04.82	02:00	Finished pressure testing all DST-Equipment
	02:23	Set packer
	03:11	Open PCT-tester valve
	03:13	Open choke manifold on 8/64" adj. choke
	03:14	Change choke to 18/64" adj. choke
	03:23	Shut in choke-manifold
	03:25	Shut in PCT-tester valve
	04:31	Open PCT-tester valve
	04:32	Open choke manifold on 18/64" adj. choke
	04:36	Change to 24/64" adj. choke
	04:47	Change to 28/64" adj. choke
	04:50	Change to 32/64" adj. choke
	04:52	Change to 36/64" fixed choke
	05:13	Oil and gas cut mud to surface
	06:55	Change from fixed choke to adj. choke and back again to check that choke is ok.
	07:15	Start flowing through separator
	16:55	Bypass separator
	17:00	Shut in choke manifold and PCT-tester valve
15.04.82	17:00	Build-up ended, start rigging up wireline for bottom-hole sampling
	19:14	Open PCT-tester valve
	19:15	Open choke manifold on 12/60" fixed choke for sampling flow
	21:58	Shut in choke manifold
	22:05	Shut in PCT-tester valve

16.04.82	05:37	Open PCT-tester valve
	05:38	Open choke manifold on 12/64" fixed choke for additional sampling
	08:28	Shut in choke manifold
	08:32	Shut in PCT-tester valve
	11:30	Proceed to kill well

NORSK HYDRO A/S
31/4-6
N.D.A.
OFF BERGEN

NL Sperry-Sun, Inc.
PRESSURE/TEMP. Vs TIME PLOT

17 APRIL 1982
MRPG-1211-NOR
1942
D04320

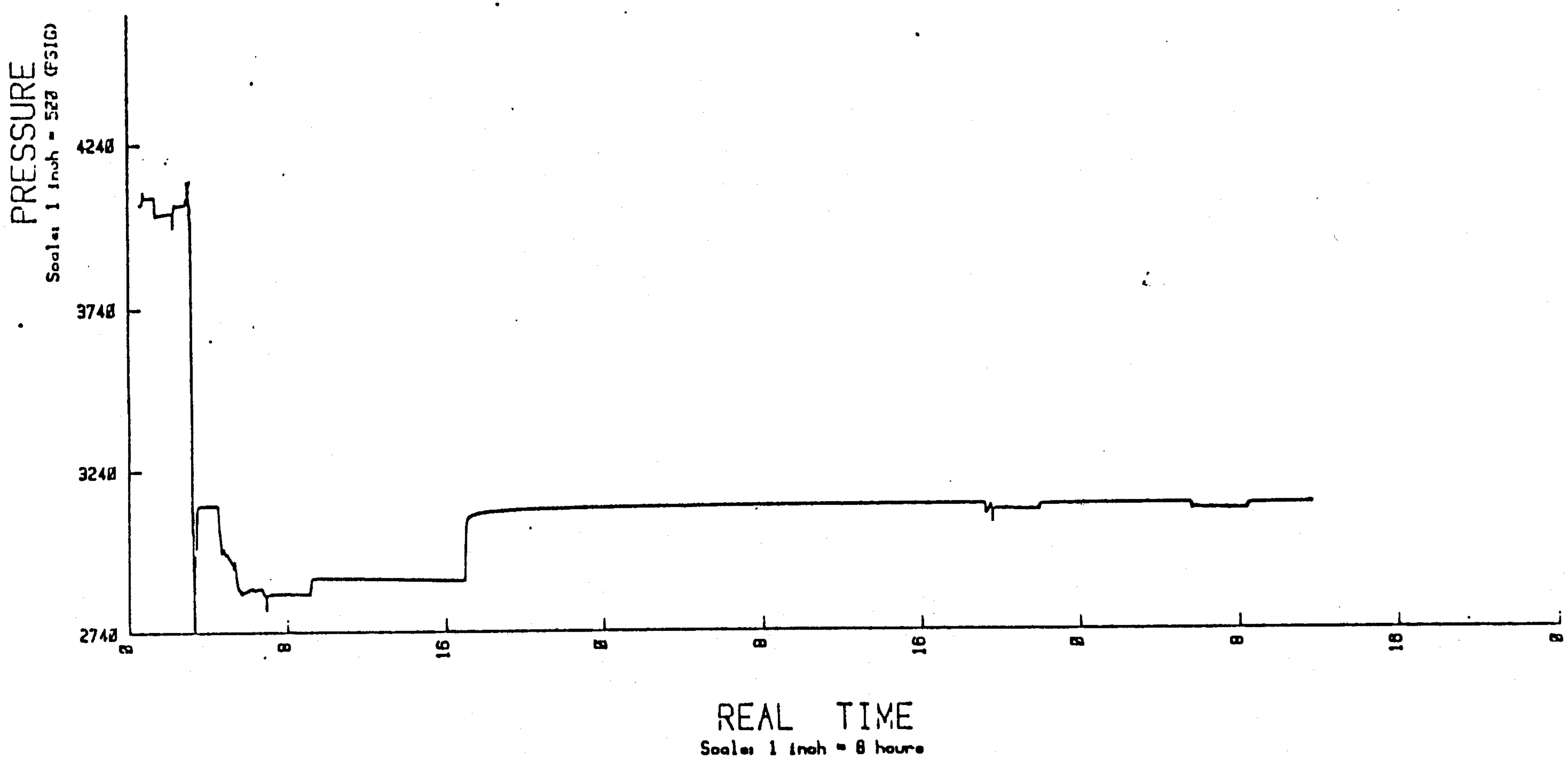


FIG. 2.2.1

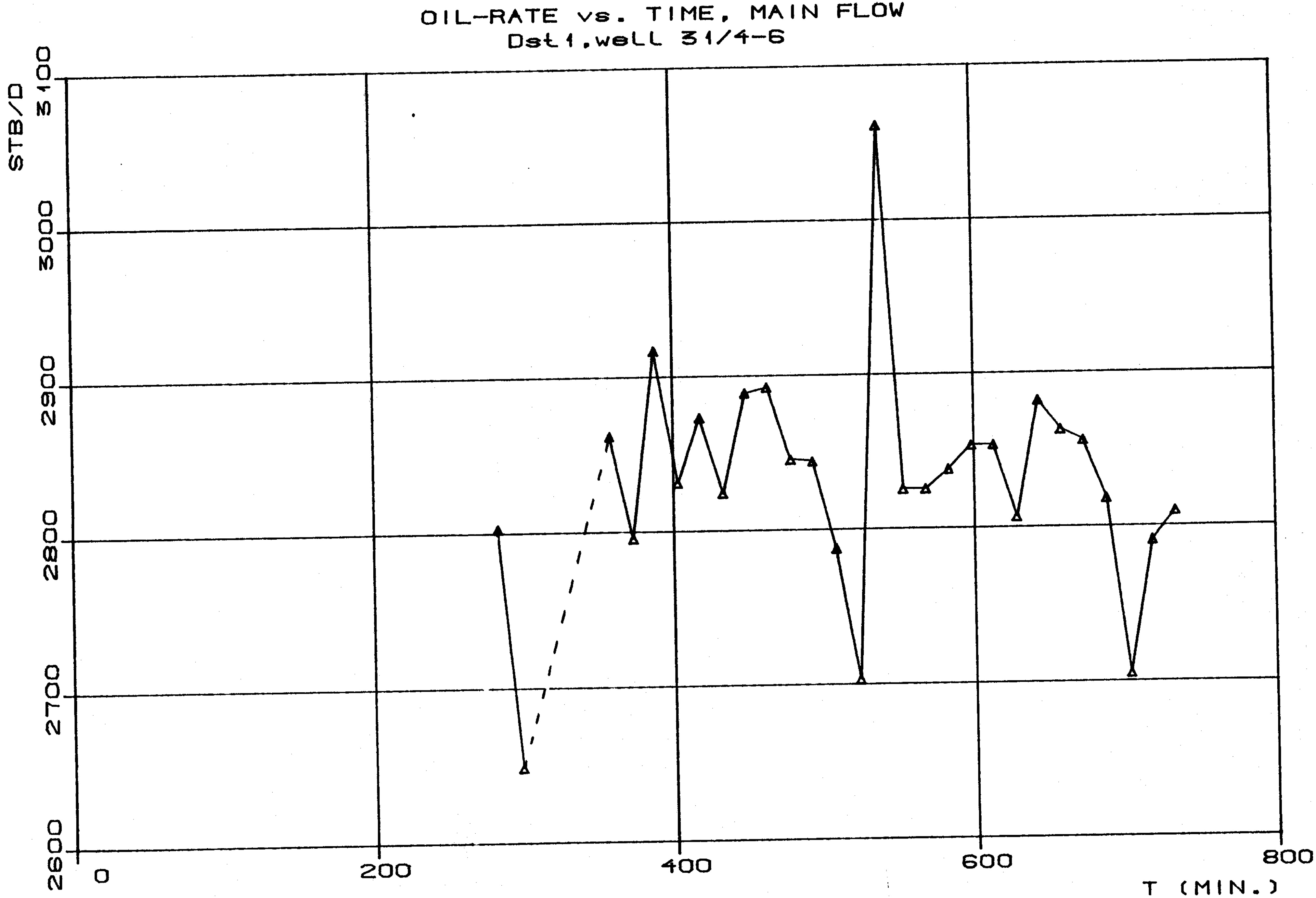

OIL-RATE vs. TIME, MAIN FLOW
Dst1,well 31/4-6
STB/D
3100
3000
2900
2800
2700
2600
0
200
400
600
800
T (MIN.)

FIG. 2.2.2

GAS-RATE vs. TIME, MAIN FLOW
Dst.1, well 31/4-6

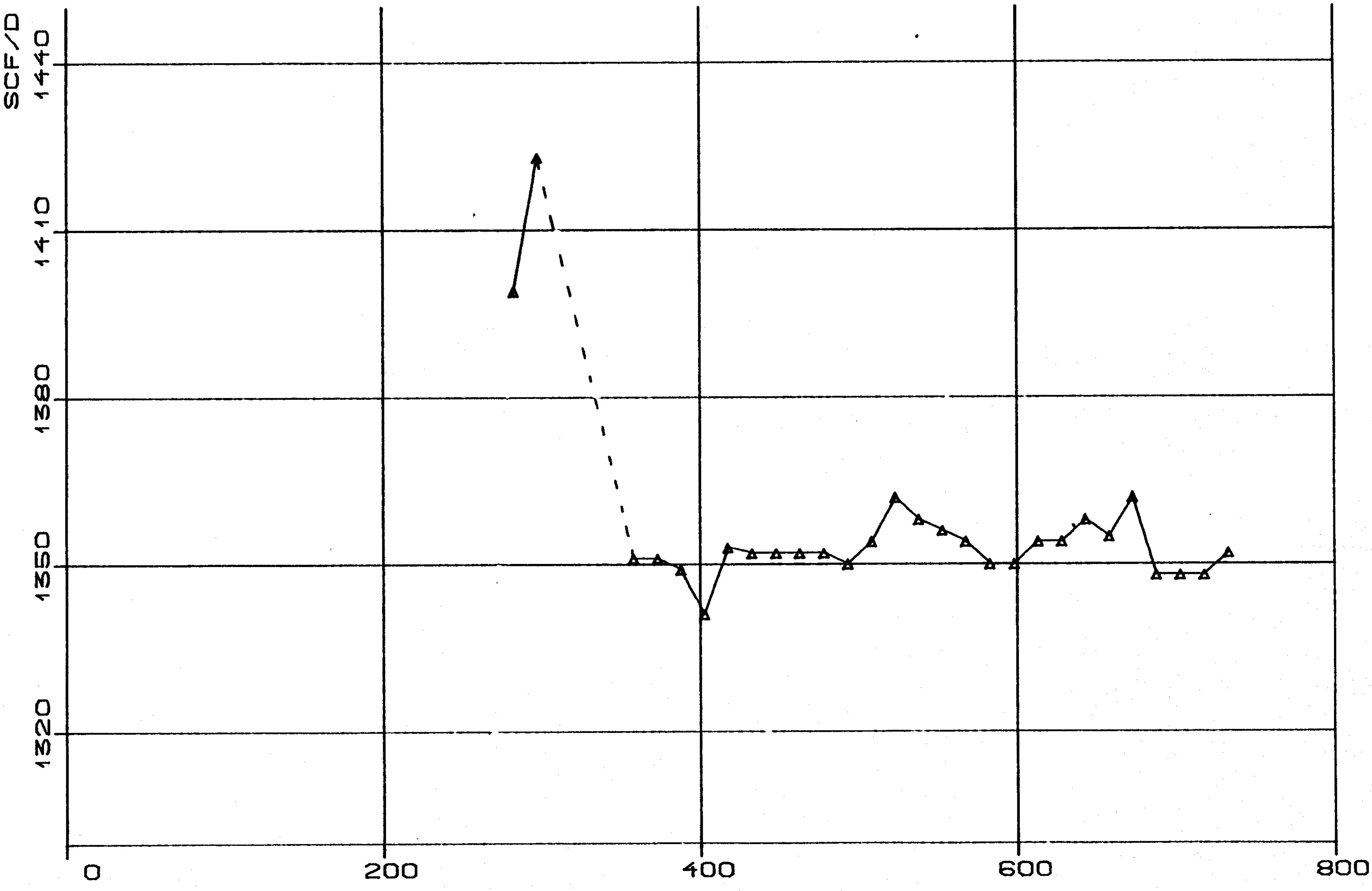
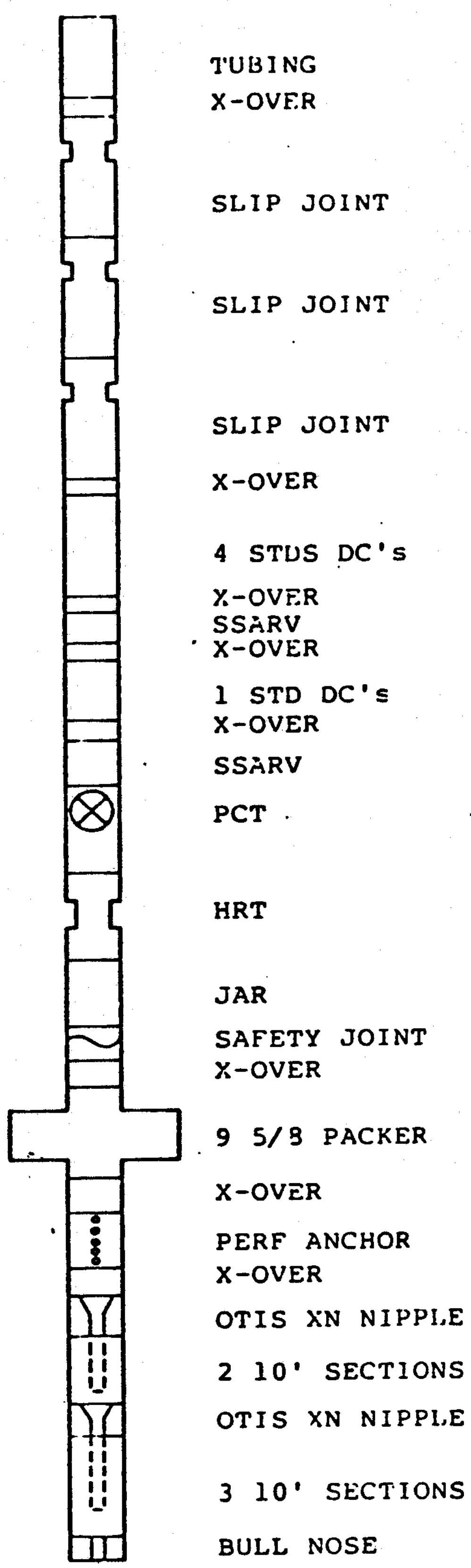
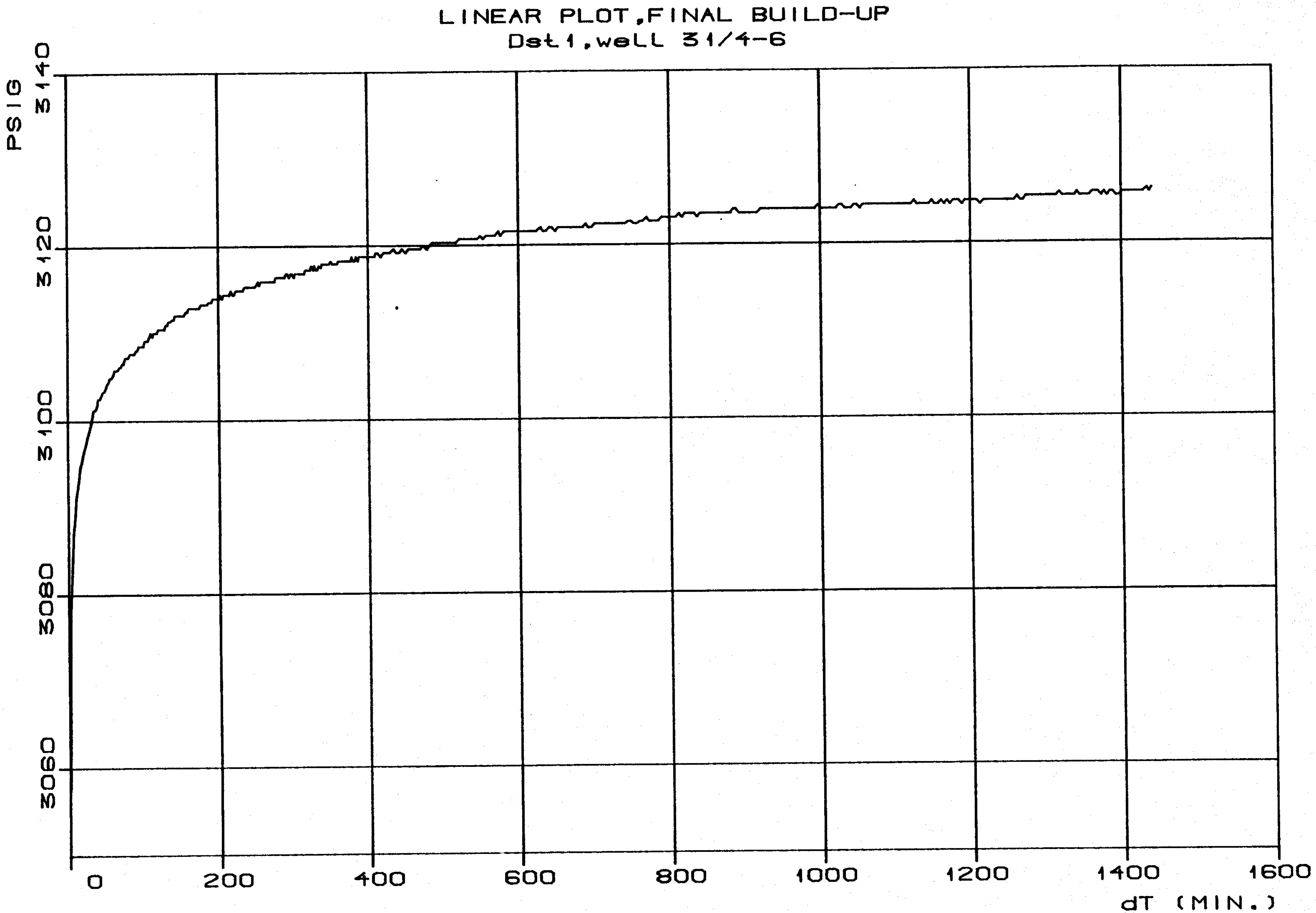


FIG. 2.2.3



DOWNHOLE TEST STRING

FIG. 2.2.4



LINEAR PLOT,FINAL BUILD-UP
Dst.1,well 31/4-6
PSIG
3140
3120
3100
3080
3060
0
200
400
600
800
1000
1200
1400
1600
dT (MIN.)

FIG. 2.3.1

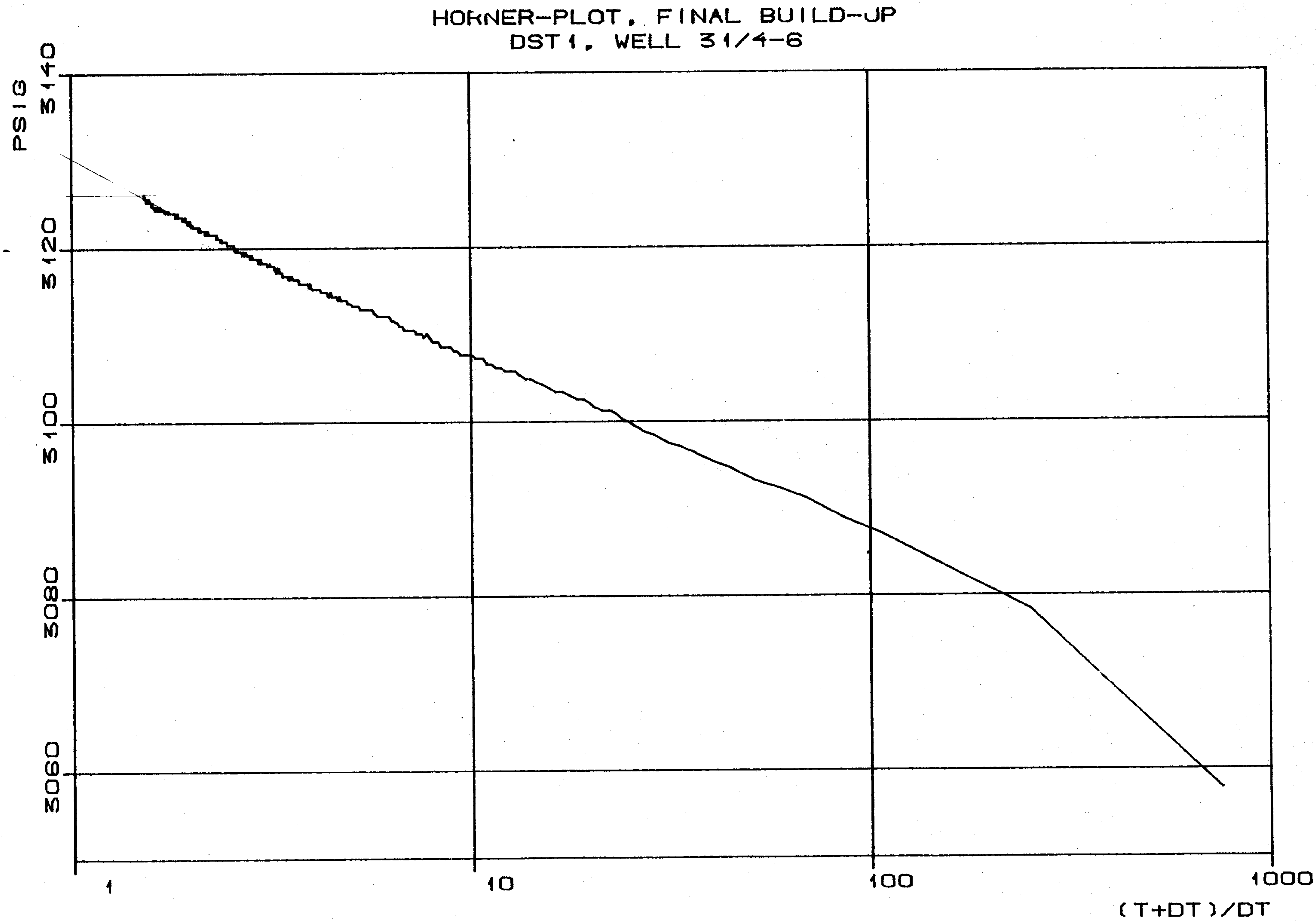
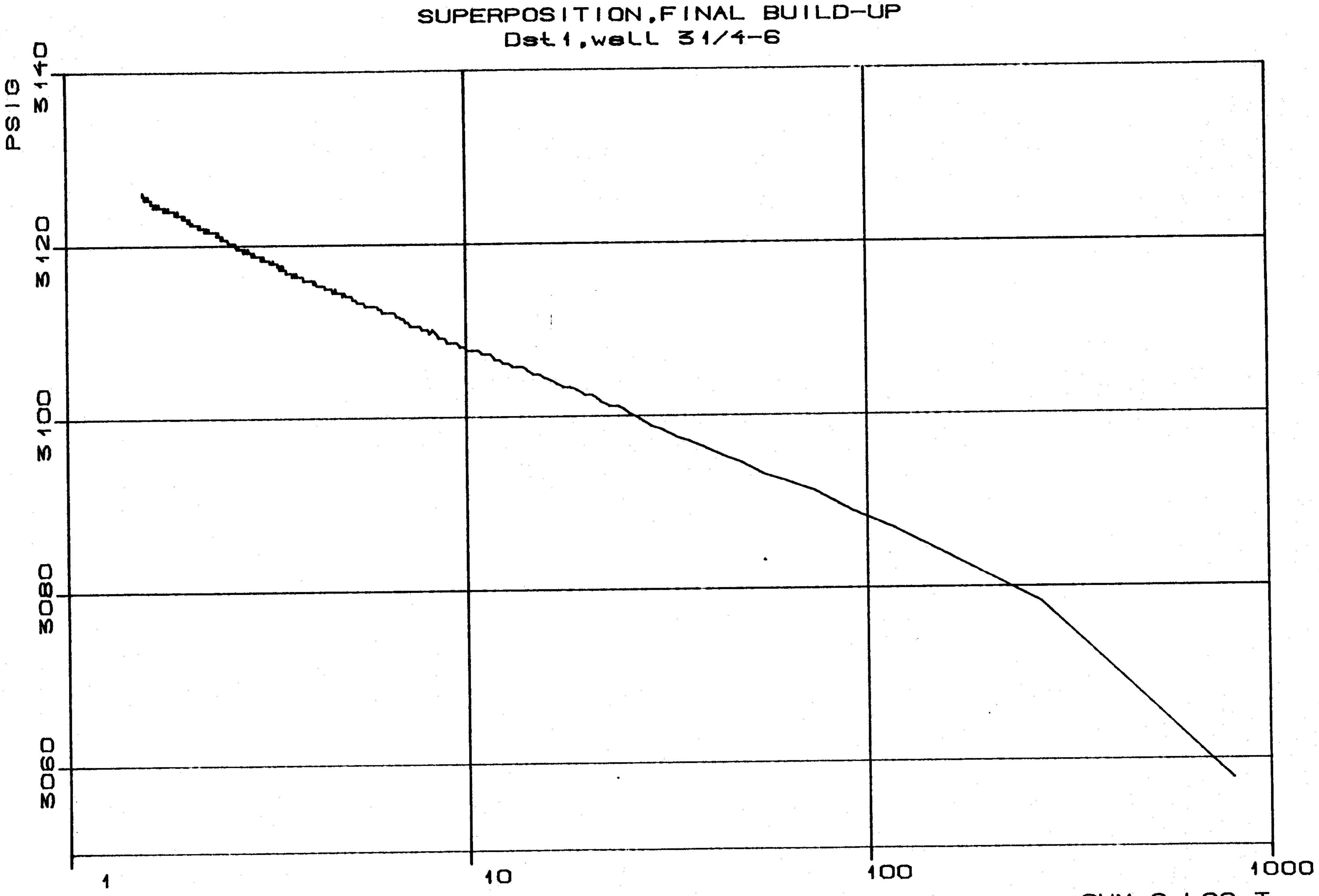

HORNER-PLOT, FINAL BUILD-UP
DST 1, WELL 31/4-6
PSIG
3140
3120
3100
3080
3060
1
10
100
1000
(T+DT)/DT

FIG. 2.3.2


SUPERPOSITION,FINAL BUILD-UP
Dst.1,well 31/4-6
PSIG
3140
3120
3100
3080
3060
1
10
100
1000
SUM-Q-LOG-T
FIG. 2.3.3

II/NOR 31/4-6
B-1

12605

Norsk Hydro
Oslo - Norway

Completion log
Scale 1:500

Well: 31/4-6

Location map

Scale: 1 : 1.000.000

Country:	Norway.
Licence:	055
Owners:	Norsk Hydro, Statoil, BP, ARCO, Esso.
Field:	-
Date Spudded:	February 28, 1982
Reached Total Depth:	April 3, 1982
Completed:	April 22, 1982
Well Status:	Plugged and abandoned with Upper Jurassic hydrocarbon bearing Sandstones.
Rig:	Nortrym.
Contractor:	Golar Nor.
Mudlogging Company:	Gearhart Geodata Services Ltd.
Geologists:	J.H. Skogen, K.L. Kalgraff, M. Henderson, P.A. Midtkandal.
Prepared by:	A. Davies.
Date:	Oct. 1, 1982

Coordinates:	60°31'17.09" N 03°01'59.84" E
Elevation K B:	25m
Water Depth:	130m
Total Depth (Driller):	2447m
Total Depth (Logger):	2450m
Formation at Total Depth:	Early Jurassic Drake Fm.

Casing Records:

30"	at	243m
20"	at	913m
13 3/8"	at	1844m
9 5/8"	at	2406m

Comments:

Logs Run

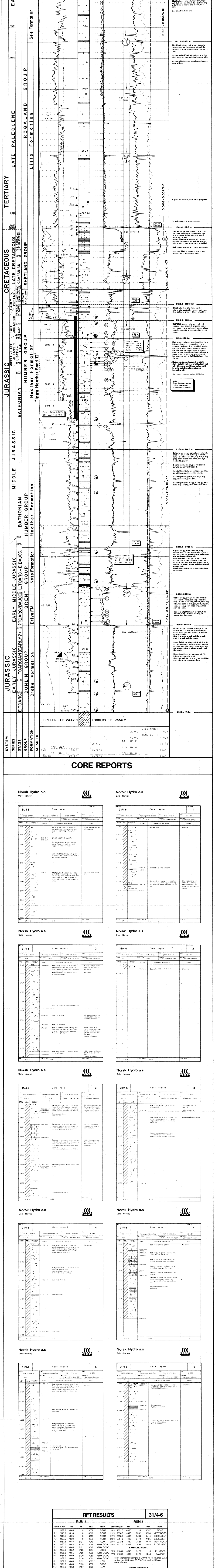
ISF/SONIC	FDC/CNL	HDT	RFT	CST	CBL/VDL
1. 155 - 913 m 2. 913 - 1861 m 3. 1845 - 2214 m 4. 2115 - 2448m (NGT)	1. 913 - 1862m (FDC/GR) 2. 1845 - 2215 m	1. 1845 - 2446 m	1. 2138.5 - 2377 m 1. 2160.5 (sample) 2. 2166.5 (sample)	1. 1020 - 1850 m 2. 2035 - 2310 m 3. 2065 - 2448 m	1. 700 - 1840 m
	LDT/CNL/EPT	VELOCITY SURV.			
	1. 2215 - 2450m	1. 360 - 2444 m			
	DLL/MSFL				
	1. 2035 - 2212 m				

Legend

CONGLOMERATE, SHALE, CHALK, ANHYDRITE, SANDY VERY / SANDY / SANDY SLIGHTLY, C Carbonaceous mat
SAND/SANDSTONE, LIMESTONE, MARL/MARLSTONE, SALT, SILTY VERY / SILTY / SILTY SLIGHTLY, Chert
SILT/SILTSTONE, DOLOMITE, COAL/LIGNITE, GYPSUM, ARGILLACEOUS, Glauconite
CLAY, DOLOMITIC LIMESTONE, TUFF, M Mica
CLAYSTONE, CALCAREOUS DOLOMITE, IGNEOUS EXTR./INTR., Pyrite, Macrofossils, Macrofossils frag, Microfossils

Hydrocarbon Shows: Stain, Fluorescence, Cut, Gas Shows
Casing Shoe, Deviation, Dipmeter results, One way time from Velocity log (depth m K B) e.g. 3603 m 1.450 s
Core Interval (No recovery), Side Wall Core (No recovery)
Perforated Interval, Cement Plug Interval
DST: Through casing, Open hole, Re - Run, RFT/FIT

CORE REPORTS



RFT RESULTS — 31/4-6

RUN 1						RUN 1					
DEPTH M.(KB)		PHI	PF	PHA	PERM.	DEPTH M.(KB)		PHI	PF	PHA	PERM.
1/1	2138.5	4005	0	4006	TIGHT	20/1	2351.0	4400	0	4397	TIGHT
2/1	2145.5	4018	0	4018	TIGHT	21/1	2350.0	4398	3392	4398	VERY GOOD
3/1	2149.5	4024	0	4026	TIGHT	22/1	2358.0	4413	3403	4414	EXCELLENT
4/1	2153.5	4030	0	4033	TIGHT	23/1	2364.0	4423	3412	4425	EXCELLENT
5/1	2157.5	4038	3121	4040	LOW	24/1	2372.5	4439	3423	4440	VERY GOOD
6/1	2160.0	4043	3120	4045	VERY GOOD	25/1	2377.0	4447	3430	4448	EXCELLENT
7/1	2161.5	4046	3121	4047	VERY GOOD	SAMPLING RUN 1.					
8/1	2163.0	4052	3126	4054	GOOD	26/1	2160.0	4043	3123	0	PLUGGED
9/1	2165.2	4056	3128	4058	VERY GOOD	27/1	2160.5	4044	3126	4043	SAMPLE
10/1	2166.5	4059	3129	4060	VERY GOOD	Took segregated sample at 2160.5 m. Recovered 200.8 cuft of gas, 8 litres of 36.7° API oil and 14 litres of water/filtrate.					
11/1	2168.0	4060	3130	4062	VERY GOOD						
12/1	2169.5	4063	3132	4063	LOW						
13/1	2171.5	4065	3133	4066	GOOD						
14/1	2173.0	4068	3137	4070	LOW	SAMPLING RUN 2					
15/1	2175.0	4073	3143	4074	LOW	1/2	2166.5	4059	3129	4056	SAMPLE
16/1	2183.0	4088	3168	4088	LOW	Took segregated sample at 2166.5 m. Recovered 210 cu ft at gas, 9 litres of 35.6° API oil, and 11 litres of water/filtrate.					
17/1	2190.0	4101	3168	4102	POOR						
18/1	2194.0	4109	3176	4110	POOR						
19/1	2220.5	4162	3204	4156	GOOD						

DST RESULTS

DST No. 1

Perforated interval:	2159.5 - 2163.5 m and 2165.0 - 2168.0 m.
Oil rate:	2841 STB/D
Oil gravity:	34.4° API
Gas rate:	1352 MSCF/D
Gas gravity:	0.727
G.O.R.:	476 SCF/STB.
Choke:	36/64"
WHP:	864 psig
WHT:	110° F
B.S. + W.:	Tr
CO_2:	Tr