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CONFIDENTIAL.

REPORT NO. NSEP - 23.

ORIGINAL

A/S NORSKE SHELL

RESUMÉ OF EXPLORATION WELL

1/6-3

BY

PETROLEUM ENGINEERING

AND

EXPLORATION DEPARTMENTS

MARCH 1975

CONTENTS.

PART A. OPERATIONAL DATA.

A.1. General Summary.

WELL	-	1/6-3
CLASSIFICATION	-	Appraisal
AREA	-	Field 1; Block 6; Production Licence No. 011; Drilling Permit No. 105.
CONTRACTOR	-	Zapata North Sea Inc.
RIG	-	ZAPATA NORDIC Jackup
COORDINATES	-	N 56° 38' 36.375"
		E 02° 55' 49.702"
WATER DEPTH	-	227' below mean sea level.
ROTARY TABLE	-	112' above mean sea level.
OBJECTIVES	-	a) Appraisal of Albuskjell field in Maastrichtian Chalk.
		b) Investigation of Danian Chalk prospect.
		c) Investigation of possible deeper prospects.
PROGNOSIS	-	217' - 9360' Quaternary, Eocene
		9360' - 10010' Palæocene
		10010' - 10600' Danian Chalk
		10600' - 11680' Maastrichtian Chalk
		11680' - 13000' Campanian Chalk
		(All depths below MSL)
RESULTS	-	a) Satisfactory data was gained from the Maastrichtian.
		b) The existence of significant hydrocarbons in the Danian was established. Formation entry and mechanical problems prevented comprehensive testing.
		c) The well was abandoned for mechanical reasons without investigating the deeper prospects.
STATUS	-	Plugged and Abandoned as expendable.
TOTAL DEPTH	-	10910 ft. b.d.f. (earlier sidetrack to 10968 ft.)

+ All depths in this report, unless mentioned otherwise, are in ft. b.d.f.

A.2. DATES OF OPERATIONS.

Start of Shell Contract	-	10th	April 1974	(1500 hours)
Start of Tow: Phillips Norwegian Block Well 2/7-9 - Location 1/6-D	-	10th	April 1974	(2200 hours)
Rig on Location and Jacked up	-	11th	April 1974	(1400 hours)
Spudded 1/6-3	-	12th	April 1974	(0430 hours)
Reached Total Depth	-	22nd	June 1974	(0400 hours)
Start of Production Test No. 1.	-	16th	July 1974	(0200 hours)
Start of Production Test No. 2.	-	3rd	August 1974	(0430 hours)
Abandoned (with seabed clear) and handed over to NAM	-	11th	September 1974	(1800 hours)

A. 3. DRILLING HISTORY.

Location 1/6-D was spudded as 1/6-3 on 12th April 1974 at 0430 hours.

Final coordinates were N 56° 38' 36.375", E 02° 55' 49.702" and the water depth was 227 feet below MSL with the derrick floor elevation 112 feet above MSL, these being the satellite derived values. (Ref. Decca coordinates N 56° 38' 36.2", E 02° 55' 54.2").

36" hole was drilled to 550' with a 26" bit and a 36" hole opener (26" rat-hole to 584'). The 36" x 1" WT conductor was run using CO_2 welding and driven from 408' with a D 44 hammer to 574' with a maximum of 309 blows/ft. Seabed penetration by the 36" conductor was 235'.

Drilling of the 26" hole was resumed with a 17.1/2" bit and a 26" hole-opener to 1300'. A wiper trip was then made and a pill of viscous mud spotted in the open hole. The 20" casing was run but stuck at 923' after making a connection. A diesel/pipelax pill was spotted and the casing worked to 400,000 lb. without success. The mud in the hole was then replaced by seawater but this was also unsuccessful. Concurrently with the above measures, a casing spear was located and the casing was pulled free with this spear using 550,000 lbs. pull.

The hole was reconditioned using a 17.1/2" bit, 26" hole-opener and 26" stabiliser. Some very hard reaming was encountered and, after coming out of the hole, it was found that the lower body of the hole-opener had twisted off, leaving the 17.1/2" bit and lower part of the hole-opener body in the hole.

Three attempts were made to recover the fish but without success. An attempt was also made to drill past the fish but the high torque encountered caused the abandonment of this idea.

The hole was then plugged back to 1030' and successfully sidetracked. A 26" hole was drilled to 1395' using a 17.1/2" bit and 26" hole-opener and the 20" casing successfully run to 1369' and cemented.

The interval 1395' - 4036' was drilled with a 17.1/2" bit and a mud based on Shaletrol (the Milchem gumbo shale inhibitor) without any serious problems, except for a washed out bit body at 3390'. The hole was logged and the 13.3/8" casing was run to 4004' and cemented.

After nippling up, a 12.1/4" hole was drilled to 8045'. Gumbo clays were encountered to ± 6500 bdf and a Shaletrol based mud was used successfully as above. Below this point a high viscosity problem was encountered. This was analysed as bicarbonate and/or carbonate contamination and was successfully treated by "breaking over" to a low lime based mud.

The mud gradient was increased over this interval from 620 to 745 psi/1000 ft. After logging the borehole, the 9.5/8" casing was run to 8024' bdf and cemented.

After nippling up, an 8. 1/2" hole was drilled to 10247' with intermediate correlation logs (BHC, GR) being taken at 9725' and 10200'. Because of very high trip gas (up to 40%) the mud weight was increased over this interval from 745 to 770 psi/1000 ft.

Core No. 1 was cut from 10247' - 10307' bdf (100% recovery).

Drilling continued to 10700' with some mud losses and a mudweight of 760 psi/1000 ft.

At 10700', a further BHC, GR log was taken. This showed that:-

a) A highly porous section of Danian chalk had been drilled below 10307'.

b) The Maastrichtian had already been penetrated by $\pm$ 102'.

A 60' core barrel was run but this became stuck at 10601'. After Shclumberger free-point indicator and back-off runs, the fish was backed off mechanically at 10193'. The fish was recovered with a Bowen jet and bumper sub after 6. 1/2 hours jarring (at 350, 000 lbs.) whilst simultaneously displacing a weighted pipelax pill.

Since a Danian porous zone and 120' of Maastrichtian had not been cored, the hole was plugged back to 9914' bdf and sidetracked. Despite specific instructions regarding depth control and the necessity to core the Danian, a depth discrepancy occurred, which was only discovered by unexpected mud losses occurring at a reported depth of 10280' bdf. A drillpipe measurement showed an error of 95' and an actual depth of 10375' bdf, resulting in the loss of the most desired coring interval in the Danian.

8 Cores (Nos. 2 - 5) were taken from 10375' - 10968' bdf (all having 100% recovery).

During a check trip made at 10968' for intermediate logging, lost circulation occurred and the pipe stuck at 10887' while trying to cure it. Pipelax pills, Schlumberger free point and back-off runs, and continuous jarring freed 6 joints of drillpipe but there remained in the hole 12 drill-collars and 1 joint of pipe. One further attempt, using a Daily jar, parted the 5" dp 5. 2' above the top drillcollars. An attempt to fish this was unsuccessful and the hole was again plugged back (to 9825) and sidetracked.

Core No. 10 was cut 10290' - 10336' (92% recovery) and Core No. 11 10336' - 10380' (86%), with heavy mud losses.

The well was drilled to 10910' and logged, losses again being experienced.

The principal objective of this appraisal well being the comprehensive testing of the known Upper Cretaceous prospects, it was decided that the lost circulation and tight hole problems justified the earlier running of the 7" casing to protect that objective. It was planned to deepen the hole after completing production testing. The 7" casing was run to 10893' with a DV

collar at 10108' and a Lynes EC Packer at 10150'. A two stage cement job was carried out in an attempt to reduce the pressure of the cement column on the porous Danian interval. A Schlumberger CBL showed patchy bonding TD-9850' and very poor bonding to ± 7950' (see page 13 for a critical examination of the cementation).

An attempt was made to obtain a formation water sample by DST No. 1 through perforations at 10820' - 10825'. This produced gas, contrary to the log analysis for the interval, and it was assumed that this came from a higher zone down behind the 7" casing due to an inadequate cement bond. A remedial cement squeeze was performed and a CBL showed a much improved bond over 10700' - 10840'.

A second DST was performed through perforations at 10830' - 10835'. This also produced gas but in very much reduced quantities. (see p. 17 for a description of both DST's). A bridge plug was set at 10780' and 3.5 ft^3 of cement dumped on top of it.

After cementing the 7" casing, pressure had been observed in the 9.5/8" x 7" annulus. This pressure continued throughout the production testing period despite all efforts made to kill it (see p. 8).

In an attempt to control this pressure, and also to ensure separation of the Danian and Maastrichtian reservoirs, two further squeezes were performed by setting cement retainers and squeezing through perforations at 10510' - 10515' and 10120' - 10125'. Each set of perforations was subsequently tested separately by drilling out the retainer and running an RTTS packer on 3.1/2"dp.

In both cases, the perforations held 2500 psi down the 3.1/2" x 7" annulus but leaked very slightly during inflow tests. However, they were considered to be acceptable for production testing to proceed.

A Schlumberger junk catcher was run prior to running the production packer, but this stood up at 6800' (presumably because of metal and rubber junk in the hole).

A trip was made with a scraper and open-ended dp and an attempt made to reverse circulate clean. During this circulation, the pressure was allowed to rise, contrary to orders, to 3000 psi and the perforations at 10120' - 10125' broke down. These were again squeezed off and satisfactorily tested with an RTTS packer.

Two round trips (first with bit and scraper, then with scraper and open-ended dp) were necessary before the Schlumberger junk catcher and FB-1 packer could be run. The packer became stuck on junk at 10206', 229' higher than the intended setting depth, but this was considered to be acceptable as a longer tailpipe could be used. The testing programme was then started. (See production testing report - page 19).

It was only after a break in the casing at 10301' was discovered (see page 33) that the decision was made to abandon the well (and not to drill ahead). The final abandonment was completed after the end of the Danian test.

TOTAL TIME TAKEN TO START OF PRODUCTION TEST NO. 1.

0430 hours 12/4/1974 - 0200 hours 16/7/1974. 94 days 21½ hours.

A.4. 9.5/8" - 7" ANNULUS PRESSURE.

Throughout the period after the cementation of the 7" casing until final abandonment, problems existed with a continuing pressure on the 9.5/8" - 7" annulus. A short chronological outline of the different steps taken to combat this problem is given below:-

23/06	Cementation 7" annulus.
27/06	Two different mud squeezes each of 200 bbls. 0.760 psi/ft. mud down the 9.5/8" - 7" annulus.
29/06	Two temp. surveys, showing a low temperature (gas entry) zone between 10240' - 10385' and a low temperature (mud loss) zone between 8024' - 8315'.
7/07	Pressure bled to zero, 1/2 bbl. of 50:50 mixture of oil and mud recovered; lab. analyses showed this oil to be refined, not crude.
8/07	Same as on 7/07.
9/07	Pressure bled to zero; 2.1/2 bbls. of mud obtained in 4 hours.
10/07	Pressure bled to zero; 5 bbls. of mud obtained in 11 hours
14/07	Pressure bled to zero; 2 bbls. of mud/hydrocarbon gas recovered.
15/07	Cementation down the 9.5/8" - 7" annulus to 7100', with 240 sxs Clean Class "E" cement, slurry weight 16.0 ppg.
19/07	Pressure bled to zero; 2 bbls. of mud with hydrocarbon gas recovered.
20/07 - 28/07	During the testing programme, temperature effects caused the 9.5/8" - 7" annulus pressure to rise and fall regularly. Pressure was not allowed to rise over 2000 psi, and was consequently bled to 1500 psi twice, recovering 1/3 and 1/2 bbl. of mud.
4/09	Pressure bled to zero, 8 bbls. of mud - hydrocarbon gas recovered.
5/09	Cemented with 185 sxs neat Class "B" cement up the 9.5/8" - 7" annulus to 5200', through 6500' - 6505' perforations in 7" csg., slurry weight 15.5 ppg.
7/09	Cemented with 350 sxs neat Class "B" cement up the 9.5/8" - 7" annulus to 1660', through 3945' - 3950' perforations in 7" csg., slurry weight 15.5 ppg.
8/09	As the 9.5/8" - 7" annulus was still leaking (very small amounts) gas, the 7" casing was cut at 650' and a 9.5/8" Johnson bridge plug was set 636'.

A.5. CRITIQUE

1. Stuck 20" Casing.

While running 20" casing in 26" open hole, the string became stuck at 923' after making a connection. A 36 bbl. diesel/pipelax pill was spotted and the casing worked to 400,000 lbs. without success. The mud in the hole was then replaced by seawater but this was also unsuccessful.

Concurrent with the above measures, a casing spear was located and sent to the rig. The casing was pulled free with this spear and 550,000 lbs. pull.

Ready availability of a casing spear would have been a worthwhile insurance (see also 1/6-1 resumé). Although a check trip was made prior to running the casing, no stabiliser was included in the assembly. After freeing the casing, the run with a stabiliser encountered heavy resistance and it is possible that the casing would not have been stuck if a stabiliser had been included in the wiper trip assembly.

2. Broken Hole-opener.

After freeing the 20" casing, the hole was reconditioned using a 17.1/2" bit, 26" hole-opener and 26" stabiliser. Some very hard reaming was encountered and, after coming out of the hole, it was found that the lower body of the hole-opener had twisted off, leaving the 17.1/2" bit and lower part of the hole-opener body in the hole. Three unsuccessful attempts to fish this were made, and the hole had to be plugged back and sidetracked.

The hole-opener used was a SERVCO Drill Master 15000 series with an upper body of 9.1/2" DD with 7.5/8" Reg. box connection, middle section 15" DD and lower body 7.3/4" DD with 6.5/8" Reg. box connection. In 1972, A/S Norske Shell signed a contract with SERVCO for the exclusive use of this type of hole-opener but with a stronger lower body (9.1/2" DD with 7.5/8" Reg. connection). This stronger model had, however, been rented out without Shell's permission and the weaker version had to be utilised in lieu, being the only one available at the time.

3. Sidetracking 26" Hole.

After attempts at fishing the 17.1/2" bit and 26" hole-opener had been abandoned, the 26" hole was plugged back with 1180 sxs cement to 1021'. The top was dressed to 1030' and the hole deviated, using the turbine and bent sub method with a slow angle build-up reaching a maximum of $4.1/4^{o}$ at 1380'.

This new 17.1/2" deviated hole was opened to 26" from 1030' to 1385' and conditioned prior to running 20" casing. This was successfully run and cemented.

Sidetracking such a large-sized hole as 26" is unusual but on this occasion proved completely successful.

4. Mud Viscosity Problems - Base Tertiary.

Whilst drilling through claystone, siltstone and occasional dolomite streaks below the base gumbo clays (6500' - 8000') a mud viscosity problem was encountered. Treatment with caustic and lignosulphonate was not successful, and the change was made to low lime mud on the assumption that the problem was bicarbonate and/or carbonate contamination.

Unfortunately, the problem occurred immediately prior to logging at 9.5/8" casing setting depth and, as is usual with lime muds, considerable time was required to "break over" to a stable system. It took 9 hours circulation prior to running Schlumberger logs and a further 13.1/2 hours circulation before running casing to obtain satisfactory rheological properties.

This problem is apparently not unusual in this part of the North Sea and is usually solved by simple dilution rather than by lime treatment, (e.g. 1/6-1, where the same problem was encountered at 7000' - 9000'). This obviously means costly barite addition.

It is therefore recommended in future drilling below base gumbo to keep a close check on mud alkalinities. If a potentially unstable mud is found, the addition of 1/2 to 1 ppb excess of lime, or perhaps even better for high PH muds, gypsum, could well eliminate the problem.

5. Mud Losses.

Mud was lost to the limestone section of the formation (10200' - TD) and in particular to the porous Danian section of Cores 10 and 11 (18290' - 10380'). This problem was exacerbated by the drilling of the original hole plus two sidetracks in this section and the consequent weakening of the formation appeared to make the losses worse as time went on. Up to the start of testing the losses were:-

Original Hole.

Date	Losses (bbls.)	Remarks
20/05	30	Drilling at 10319'. Spotted 15 ppb LCM pill
	35	" " 10353'. " 30 " " "
	55	" " 10654'. " 30 " " "
21/05	25	" " 10669'. " 30 " " "
25/05	240	Check trip after freeing core barrel. Spotted 15 ppb LCM pill.
Total	385	

Sidetrack No. 1.

Date	Losses (bbls.)	Remarks
30/05	60	Drilling at 10375' (95' too deep due to pipe tally error). Spotted 40 ppb LCM pill.
06/06	220	Check trip for logging. Spotted 32 ppb LCM pill. Pipe stuck while pulling out.
07/06	30	Lost slowly while fishing. Top fish 10456'.
Total	310	

Sidetrack No. 2.

Date		
15/06	100	Coring at 10312'. Spotted LCM pill.
16/06	210	Coring at 01336'. Spotted LCM pill.
19/06	30	Check trip for logging.
20/06	40	Check trip for logging. LCM in circulating mud.
21/06	85	Check trip for logging. LCM in circulating mud.
23/06	100	Running casing and circulating prior to cementing. LCM in circulating mud.
	115	Lost during cementation.
Total	680	

The spotting of LCM pills did, normally, cure the losses though a considerable amount of mud was often lost during the displacement of the pill. Milmica, Milplug and Milfiber were all tried at different times without any obvious difference in effectiveness.

The mudweight used was, for the most part, 760 psi/1000 ft. Although this resulted in considerable mud losses, experience showed that it could not have been safely reduced during drilling operations. It was originally increased from 750 psi/1000 ft. because of very high (+ 40%) trip gas. After the drillpipe was struck at 10887', the mudweight was lowered (to 745 psi) to reduce the differential pressure. The well gave a small kick on the circulation after this (shut in annulus pressure 280 psi).

(N. B. : Estimated cost (mudchem. + LCM) of mudlosses listed above:-

N. Kr. 244, 300)

RECOMMENDATIONS:

i) The mud pit level indicator on the drillfloor should always be working and the driller must pay attention to it.

In some cases, the indicator was either not working or the driller paid no attention to it and drilled ahead at a high circulation rate.

ii) In conjunction with (i), action could sometimes have been taken more quickly. The losses did not often "cure themselves" and switching more quickly to a mud pit pretreated with LCM material, plus the immediate mixing of an LCM pill, could have helped in some cases.

Drilling with mud lightly treated with LCM (see 1/6-1 resumé) was not very practical both because of the danger of fouling bit nozzles and also because the material would be removed by the shale shakers.

iii) The losses in the Danian section were so severe and, by the end of the well, so well known that a remedial cementation might have been worthwhile if it had not been desired to test the interval before stimulation.

5) Stuck Core Barrel/Stuck Drillpipe.

After drilling to 10700' in the original hole, a 60' core barrel was run but stuck running in. Martin Decker charts indicated increasing drag from 10291' down to 10637', suggesting both that the fish was stuck over some 346' and also showed considerable lack of judgement on the part of the driller. The fish was freed after 6. 1/2 hours jarring with a Bowen jar and bumper sub whilst simultaneously displacing a weighted pipelax pill.

While making a check trip for logging in sidetrack hole No. 1, total mud returns were lost. Partial returns were recovered and a 30 bbl. 32 ppb, LCM pill was spotted. The drillpipe was stuck while pulling out of this pill (after pulling 71').

As no jar was available on the rig, the pipe was worked from 150,000 lbs. - 300,000 lbs. while displacing a weighted pipelax pill at 1 bbl./hr. In conjunction with Schlumberger free-point indicator and back-off runs, the fish was successfully backed off 7 joints above the top drill-collars.

A fishing jar had meanwhile been flown to the rig and, in conjunction with pipelax and Schlumberger runs, jarring commenced. The fish was finally backed off 1 joint above the drill-collars. As the previous jar had broken down, a Daily jar was then tried. After a further 4.1/2 hours jarring, the joint of drillpipe above the collars parted. Attempts to latch on to this were unsuccessful and the fishing job was abandoned and the hole plugged back.

RECOMMENDATIONS:

i) The use of spiral drill-collars reduced the chance of sticking. These were used for sidetrack No. 2 without any problems.

ii) The availability on the rig of a good fishing jar and bumper sub may be worthwhile, although rental costs of fishing tools are very high indeed.

iii) The stuck corebarrel could, almost certainly, have been avoided if the driller had shown better judgement when running in and had informed the toolpusher(s) when he encountered tight hole. This should be stressed in future coring operations.

6. 7" Casing Cementation.

After running and cementing the 9.5/8" casing at 8024', the well was drilled to 10910' and logged prior to running the 7" casing. In an attempt to minimise the effect of a heavy cement column on the Danian interval, three special steps were taken:-

a) A two stage cementation job.

b) Use of a Lynes External casing packer below the DV collar.

c) Addition of D-65 (friction reducer) to the cement slurry for reduction of the slurry viscosity and of friction pressure surges.

The first stage was cemented with 200 sx Class "E" + 0.2% HR12 retarder + 0.3% D-65, which was equivalent to 100% excess over the theoretical fill. ± 5% of returns were lost but 50 bbls. of water and light cement were circulated out and dumped after the DV was opened. Therefore it is likely that the first stage was, at that time, successful.

The second stage was cemented with 560 sx Class "E" + o.2% HR12 + 0.3% D-65. From the caliper log the hole was washed out (up to 11"), but the cement used should have given fill to 7400', allowing a 30% excess in open hole.

During the cementation, 95 bbls. ($\pm$ 20%) of returns were lost. A CBL log showed patchy bonding from TD - 9850' and very poor bonding from 9850' - 7950'. Subsequent experience (pressure in the 9.5/8" x 7" annulus - see page 8, unexpected results from the DST's - see page 17), confirmed that the bond was extremely poor.

The Lynes ECP packer was installed to seal off the annulus below the DVC and to allow the second cementation stage to be done before the first stage cement was set. Since no mud loss problems were experienced whilst drilling the formation above the Danian, the losses which occurred in the second stage were probably into the Danian. It is therefore very likely that the packer, for some reason, did not seal properly.

The poor bonding was probably also due to a poor displacement of cement by mud. EP/22 (SIPM) were requested to comment and their advice is included in the recommendations below.

RECOMMENDATIONS:

i) Instead of using a Lynes EC Packer as a sole means of protecting the Danian formation from overpressures, it may be advantageous to wait until the first stage cement has hardened before cementing the second stage, although the DV collar should be opened and mud circulation established to ensure the capability to cement the second stage.

ii) Both lighter mud and cement could have been used. The mud-weight was increased to 760 psi/1000 ft. largely to cope with excessive trip gas. Once the casing was in place, it may have been possible to circulate to a somewhat lighter mud (say 740 psi/1000 ft.). To reduce pressure on the formation, it would be better to use a cement whose density was only slightly higher than that of the mud; the second stage was completed with cement of 850 psi/1000 ft. A suitable cement is being investigated.

iii) The use of D-65 may have been detrimental. The cement slurry should have similar (or slightly higher) viscosity to the mud.

iv) The Schlumberger logs had indicated the presence of a thick mud cake - up to 3/4" thick. Reciprocation is not normally practised when using MLS equipment. However, it is possible, though risky, to reciprocate and land casing after the job. Coupled with scratchers this might have improved the bonding for the first stage.

The poor bonding achieved in this cementation was the cause of

many of the subsequent problems - pressure in the annulus, squeeze jobs and junk in the hole. It is extremely important that possible ways of improving future cementations are critically examined.

7. Junk in Hole.

4 cement retainers were drilled out after squeeze jobs. In addition, a number of runs were made with RTTS packers to test squeeze perforations. After one of these runs, 4.5 lbs. of metal junk were recovered from the tailpipe of the assembly. As the assembly had not been to the bottom of the hole, this junk must have been adhering to the casing well.

This metal junk, and the rubber junk from packer damage, caused considerable hole cleaning problems.

8. Schlumberger Logging.

Up to the completion of logging prior to running the 7" casing, a total of 33.1 hours downtime (19.3% of total logging time) had been lost. The majority of these problems were tool failures which suggested inadequate maintenance on shore. This was taken up with Shclumberger and their later performance - CBL's, perforating, setting of packers - was very much better.

When logging in the chalk, all the calipers showed a considerably under-gauge hole (down to 6" in an 8.1/2" hole). The situation was confused since, concurrent with this, there were problems with the caliper tools. However, it seems reasonable to assume that some at least of the readings were correct, suggesting the presence of a thick mud cake. This necessitated several check trips during logging operations.

The reason for this thick mud cake has not been satisfactorily explained - the mud had a low water loss (less than 5 c.c.) and should not have built a thick cake. This should be further investigated.

9. Parted 7" Casing - See Section A (8) Page 33

10. Snubbing Equipment. - See Section A (8) Page 32

11. FB-1 Packer Milling. - See Section A (8) Page 32

A.6. EVALUATION.

Wireline Operations.

A Summary of Schlumberger Surveys run in the well and the petrophysical evaluation made on them, are enclosed as

Appendix V

Also included is a section diagram showing the positions of the logs in the 3 holes drilled.

Full Hole Coring.

11 cores were taken over the interval 10247' - 10968'.
A full description can be found in

Appendix XI

Also included is a section diagram showing the positions of the cores in the 3 holes drilled.

Testing.

During the drilling phase, 2 DST's were carried out.

These are summarised in

Section A.6.

Two production tests were carried out to investigate flow zones as described in

Section A.7.

The results of the analyses of the hydrocarbons are to be found in the Corelab PVT Analysis Report.

A.7. DRILL STEM TESTING.

OBJECTIVE - To obtain a formation water sample, to aid in petrophysical evaluation of the Maastricthian reservoir.

1. TEST STRING.

Drilling String	:	Size/grade/TD: 3.1/2"/EB 135/2.764"
Tailpipe	:	Size/length : 3.87"/17"
Downhole Equipment	:	
Halliburton Hydrospring Tester	:	
Dual Cip-valve Packer	:	Size/type : 29 lbs/ft/7" RTTS

2. TEST RESULTS.

For detailed information, see Halliburton formation testing service reports on well 1/6-3 from 28.6.74 to 1.7.74.

DST No. 1.

Perforations	:	10820' - 10825', with 4" Hyperjet, 4 SH/ft.
Packer Setting Depth	:	10800'
Water Cusion	:	6000' (Drill Water)
Results	:	After unloading the water cushion, gas followed. For safety reasons, the well was killed immediately, by which time the surface pressure had reached 4250 PSI.
Conclusion	:	Gas from the Hydrocarbon bearing section was able to flow down the 7"/8.1/2" annulus in preference to water from the formation opposite the perforations. To cope with this problem, a cement squeeze was carried out to improve the cement bond in the 7"/8.1/2" annulus, and a second DST was planned.

DST No. 2.

Perforations	:	10835' - 10840', with 4" Hyperjet, 4 SH/ft.
Packer Setting Depth	:	10777'
Water Cushion	:	Full (Drill Water)
Results	:	Only gas cut mud was obtained.
Conclusion	:	The protective cement squeeze above was shown (by CBL) to have very significantly improved the cement bond. Thus probably gas was produced down a natural formation fracture, again in preference to water, which was held by capillary forces in a tight rock section.

A.8. PRODUCTION TESTING

1	Relevant Technical Details.
1.1	Well Completion and Test Assembly.
1.2	Surface Equipment.
2	Summary of Test Results.
2.1	Maastrichtian.
2.2	Danian.
3	Technical Problems.
3.1	Snubbing Equipment.
3.2	FB-1 Packer Milling Attempt (29th July) and Subsequent Fish.
3.3	Casing Damage.

1. RELEVANT TECHNICAL DETAILS.

1.1 WELL COMPLETION AND TEST ASSEMBLY.

Production String

Size/grade	:	7"/P-110
Setting Depth	:	10893' bdf
Weight	:	29 lbs/ft. (Buttress)
Plug Back Depth (Initial)	:	10768' bdf
Packer	:	Baker Model FB-1

Production Tubing String

Maastrichtian Test:

9428 ft.	3.1/2" VAM/C-75	10.3 lbs/ft.
680 ft.	3.1/2" Hydril CS/C-75	10.3 lbs/ft.

Danian Test:

9302 ft.	3.1/2" VAM as above
747 ft.	3.1/2" Hydril as above

String tested to 8000 psi by setting Q-plug in Q-nipple after running tubing.

TAILPIPE ASSEMBLY.

Size/grade	:	2.7/8" Hydril CS/P-105
Weight	:	6.5 lbs/ft.
Seal Assembly	:	Baker Model 'F' (size 80/40) with 6' of seals.
Minimum Restriction	:	2.197" (R-nipple)

Prior to perforation, tubing content was circulated to seawater.

1.2 SURFACE EQUIPMENT.

Cameron 3.1/16" solid block style 'H' X-mas tree.	Flopetrol
Choke manifold, 10,000 psi WP, H_2S service 1 fixed, 1 adjustable choke.	Flopetrol
Separator, 1440 psi WP, max. cap. 60 MMSCFD gas, 13000 BOPD oil.	Flopetrol
Test tank 100 bbl.	Rental
Gas-fired heater, 2 MMBTU/hr, 5000 psi WP	Flopetrol
2 Flopetrol Sea Diving on/4-headed burners	Flopetrol
Cap. 10,000 BOPD at 240 psi.	Flopetrol
Baker Wireline Unit.	Baker
Acidisation Equipment	Halliburton
3 pcs. V-16 Pumping Units	Halliburton
1 CSB 20 Blender	Halliburton
3 pcs. 5000 gal. tanks	originally planned as 2 pcs 5000 gal. tanks
1 pce. 500 bbl. tank	" " " 2 pcs 500 bbl. tanks

2. SUMMARY OF TEST RESULTS.

For detailed information see Flopetrol reports:-

a) Well test on Well 1/6-3 Maastrichtian Zone 27/6/74 - 28/7/74.

b) Well 1/6-3 Albuskjell.
Testing of Danian Interval 5/8/74 - 31/8/74.

c) Albuskjell 1/6-3
Maastrichtian Zone Charts.

2.1 MAASTRICHTIAN TEST.

Preliminary Petrophysical Analysis (Well site calculation by EP/22).

Maastrichtian Chalk 10584' - 10890'

Hydrocarbon-bearing Zone 10584' - 10730'

Gross	146 ft.	
Net	140 ft.	
Average Porosity	19%	(Range 12- 28%)
Average Water Saturation	32%	(Range 17- 50%)

Transition Zone. 10730' - 10792'

Gross	62 ft.	
Average Porosity	20%	(Range 12- 33%)
Average Water Saturation	70%	(Range 52-100%)

Water Zone. 10792' - 10890'

Average Porosity	15%	(Range 12- 20%)

Perforations. 10590' - 10655'
10665' - 10715'

Total 115 ft., 1.9/16" scallop hyperjet gun, 2 shots 2 ft. (3" and 21" spacing), in 7" 29 lbs/ft. P-110 casing.

Testing Results Before Acidisation.

THP rose to 2350 psi after first perforating run.

THP rose to 2850 psi after all 115 ft. perforated.

a) Clean-up Period 0933 - 1045 hrs. July 20th - 72 mins.

Gas Rate - 13.11 MMSCFD on 64/64 choke.

Condensate Rate	- 1675 BOD
GOR	- 7827 SCF/BBL.
FTHP	- 970 psi
FTHT	- 91° F
Gas Gravity	- 0.68
Condensate Gravity	- 48.5° API
CO_2	- 3%
H_2S	- 5 ppm

b) Flow Period No. 1. 1447 - 2300 hrs. July 20th.

	1447 - 1900 hrs.	1900 - 2300 hrs.
Gas Rate	3.52 MMSCFD on 14/64 choke	5.16 MMSCFD on 20/64 choke
Condensate Rate	457 - 221 BOD	914 BOD
GOR	7700 - 6900 (slugging) SCF/BBL	5647 SCF/BBL
FTHP	4770 psig	4314 psig
FTHT	97° F	91° F
Gas Gravity	0.66	0.665
Condensate Gravity	50.5	50.5
CO_2	3%	3%
H_2S	5 ppm	5 ppm

N.B.: No real stablisation was achieved at the 3.52 MMSCFD rate.

c) Build-up Survey No. 1 2300 hrs. 20/7 - 1100 hrs. 21/7

Analysis of pressure bomb at 10495' showed:-

BHFP prior to shut in	6021 psig at 10495'
Reservoir pressure (BHSIP)	7193 psig
Reservoir temperature	279° F
Flow capacity	328 md ft.
Permeability	2.85 md
Skin	11.26
Pressure drop due to skin	1172 psi
Flow efficiency	0.31
Final tubing-head shut in pressure	5400 psig

d) Flow Period No. 2. 1545 hrs. 21/7 - 0200 hrs. 23/7

Gas Rate	12.801 MMSCFD on 40/64 choke
Oil Rate	1655 BOPD
GOR	7735 SCF/BBL
FTHP	1720 psig
FTHT	115° F
Gas Gravity	0.67
Oil Gravity	46.94
CO_2	10%
H_2S	10 - 15 ppm

Water Rate 29 BWPD salinity 30,000 ppm
BHFP 3001 psig at 10526' ←c

e)	Flow Period No. 3.	0845 - 1500 hrs. 23/7
	Gas Rate	9.88 MMSCFD on 24/64 choke
	Oil Rate	1355 BOPD
	GOR	7292 SCF/BBL
	Water Rate	33 BWPD
	FTHP	3185 psig
	FTHT	128° F
	Gas Gravity	0.67
	Oil Gravity	48.07° API
	Water Salinity	22000 ppm
	CO_2	4%
	H_2S	10 ppm
	BHFD	4773 psig at 10501' F D
f)	Flow Period No. 4.	1500 - 2300 hrs. 23/7
	Gas Rate	5.24 MMSCFD on 24/64 choke
	Oil Rate	793 BOPD
	GOR	6608 SCF/BBL
	Water Rate	18 BWPD
	FTHP	4589 psig
	FTHT	112° F
	Gas Gravity	0.67
	Oil Gravity	48.53° API
	Water Salinity	18000 ppm
	CO_2	2.5%
	H_2S	10 ppm
	BHFP	6254 psig at 10501' F E

g) Build-up Survey No. 2 2300 hrs. 23/7 - 1100 hrs. 24/7

Analysis of pressure bomb at 10501'

BHFP prior to shut in	6254 psig at 10501'
Reservoir Pressure	7193 psig
Reservoir Temperature	269° F
Flow Capacity	520 md ft.
Permeability	4.5 md
Skin	+ 16.4
Pressure Drop due to skin	683 psig
Flow Efficiency	0.29
Final Tubing-head shut in pressure	5400 psig

Acid fraced with

a) 150 bbls. seawater preflush containing 2% KCl, 20% methanol, 40 lbs/1000 FR-20 and 0.1% 5N pumped at pressures of 6000 - 4000 psi.

b) 228 bbls. viscous pad containing 40 lbs/1000 WAC-11, 2% KCl and 0.1% 5N pumped at pressure of 4400 - 5000 psi. No real frac pressure could be seen here.

c) 270 bbls. MOD 202 acid (15% HCl) containing 5 galls/1000 HAI 70 + 40 lbs/1000 + 0.1% 5N pumped at an initial pressure of 5000 psi. 20 ball sealers were dropped after 20, 40, 120, 160 and 200 bbls. of acid. The pressure gradually decreased as the acid hit the formation to 3650 psi but built back up to 5100 psi during the ball sealer sequence - good pressure indications were obtained as each batch hit the formation.

d) 150 bbls. seawater containing 2% KCl, 0.1% 5N in the first 70 bbls. pumped at 5100 psi, a slight pressure increase being obtained as the overflush hit the formation.

Testing Results after Acidisation.

a) Clean-up Period. 1915 - 2100 hrs. 24/7

Gas Rate	31.76 MMSCFD on 47/64 choke.
Oil Rate	4277 BOPD
GOR	7427 SCF/BBL
Water Rate	77 BWPD (mainly acid)
FTHP	3140 psig
FTHT	130° F
Gas Gravity	0.682
Oil Gravity	46.71° API
Water Salinity	26000 ppm
CO_2	3%
H_2S	5 ppm

b) Flow Period No. 5 2250 hrs. 24/7 - 0630 hrs 25/7

Gas Rate	5.205 MMSCFD on 13/64 choke
Oil Rate	741 BOPD
GOR	7024 SCF/BBL
Water Rate	6 BWPD
FTHP	5380 psig
FTHT	99° F
Gas Gravity	0.682
Oil Gravity	48.30° API
Water Salinity	26000 ppm
CO_2	2%
H_2S	2 ppm

c) Build-up Survey No. 3 0630 hrs. - 1830 hrs. 25/7

Analysis of pressure bomb at 10495':-

BHFP prior to shut	7104 psig at 10495'
Reservoir pressure	7210 psig
Reservoir temperature	260° F increasing
Flow capacity	990 md ft.
Permeability	8.6 md
Skin	- 3.1
Flow efficiency	1.9
Final tubing-head pressure	5406 psig

d) Flow Period No. 6. 2250 hrs. 25/7 - 0400 hrs. 27/7

	0100 hrs. 25/7	0600 hrs. 26/7		1500 hrs. 26/7	2400 hrs. 26/7	
All readings on	28/64 choke		Closed in			
Gas Rate	19.532	19.107	from 0935 - 0955	19493	19.129	MMSCFD
Oil Rate	3055	2760	to repair	2578	2571	BOPD
GOR	6394	6923	flowline	7561	7440	SCF/BBL
Water Rate	6	6		42 (acid)	42 (acid)	BWPD
FTHP	4750	4758		4769	4748	psig
Gas Gravity	0.67	0.67		0.67	0.67	
Oil Gravity	48.07	48.07		45.6	46.49°	API
Water Salinity	Not measurable due to acid					
CO_2	4	4		4	4°	C
H_2S	10 - 15	10 - 15		10 - 15	10 - 15	
FTHT	136	150		159	153°	F

N.B.: It was intended to flow at 25 MMSCFD but due to excessive heat radiation at the rig legs, this was modified to 19 MMSCFD.

e) Build-up Survey No. 4 0400 hrs. 27/7 - 0400 hrs. 28/7

Analysis of pressure bomb at 10495' :-

Flowing BHP prior to shut in	6805 psig at 10526'
Flow Capacity	710 md ft.
Permeability	6 md
Skin	- 2.9
Flow Efficiency	1.9
Final CIBHP	7162 psig

f) Flow Period No. 7 - Changed separator pressure to allow for Thornton sampling.

	1130 hrs. 1515 hrs. 28/7	1515 hrs. - 1750 hrs. 28/7
Gas Rate	13.565	13.473 MMSCFD
Oil Rate	1985	1805 BOPD
GOR	6834	7285 SCF/BBL
FTHP	5136	5130 psig
FTHT	139	149° F
Gas Gravity	0.67	0.67
Oil Gravity	48.75	46.32° API
CO_2	3%	6%
H_2S	15	15 ppm
FBHP	6980	6965 psig at 10526'

g) Flow Period No. 8 1750 - 1820 hrs. 28/7

Gas Rate on 1" choke	37.718 MMSCFD
Oil Rate	5235 BOPD
GOR	7205 SCF/BBL
FTHP	2590 psig
FTHT	150
Water Rate	48 BWPD (mainly acid)
Gas Gravity	Not measured
Oil Gravity	Not measured
CO_2	5
H_2S	15
BHFP	6424 at 10526'

Well closed in because of excessive heat, killed at 2000 hrs. 28/7.

The above well site data has been presented formally in SIPM (EP/22), The Hague Reservoir Engineering Note No. 74/12 - Europe (Appendix XIII).

2.2 DANIAN TEST.

Preliminary Petrophysical Analysis - (Well site calculation by EP/22)

Danian Chalk	10210 - 10593'	
Hydrocarbon-bearing Zone	10248 - 10584'	
Gross	383 ft.	
Net	300 ft. (tight rock predominantly in lower 50 ft.)	
Average Porosity	30%	Range 23 - 46%
Average Water Saturation	22%	Range 10 - 40%
Perforations.	10255 - 10305'	
	10315 - 10390'	

Total 125 ft., 1.9/16" scallop hyperjet gun, 2 shots/2 ft. (3" and 21" spacing) in 7", 29 lbs/ft., P-110 casing.

Testing Results.

THP rose to 2139 psi after first perforating run.

Final THP after perforating 125 ft. - 2480 psi.

No complete testing results were obtained from the Danian since the tubing was repeatedly plugged with mud and formation. Four separate attempts were made at flowing the well, these may be summarised as follows:-

a) August 5th, 1974.

Immediately after perforating, the well was opened up on a 1" choke.

The well slugged badly and the following values were averages of unstable measurements:-

Gas Rate	11.5 MMSCFD
Oil Rate	2000 BOPD
GOR	5750 SCF/BBL
Oil Gravity	50.7° API at 66° F
H_2S	1 ppm
CO_2	2%

The well killed itself at 2015 hours.

The tubing was cleared with a 1.66" macaroni string and 6" snubbing equipment and a second attempt was made with a smaller choke.

b) August 17th, 1974.

The well was opened on a 16/64 choke at 0446 hours.

The well slugged gas and mud (max. FTHP 1600 psi on 24/64 choke), and killed itself at 0830 hours.

The tubing was again cleaned out using the macaroni string.

c) August 22nd, 1974.

580 bbls. of seawater + 0.1% demulsifier were pumped into the formation and the well opened on a 1" choke at 0615 hours.

The well slugged gas and mud (max. FTHP 300 psi) and killed itself at 1010 hours.

The tubing was again cleaned out using the macaroni string. After cleaning out, the 3.1/2" completion string was pulled and the FB-1 packer at 10080' milled and recovered.

A trip was then made with 5.7/8" bit and 7" casing scraper and an obstruction was found at 10301'. A subsequent trip with a mill passed this obstruction after 5 hours milling.

The mill was significantly undergauge and a GR/CCL tool would not pass 10301'; from these two facts and the presence of formation/cement (in small quantities), it was concluded that the obstruction was due to parted casing.

A cement retainer was set at 10295' and the bottom perforations squeezed off. It was hoped that it was only the lower zone (corresponding to Cores 10 and 11 and the zone of worst mud losses) which was 'producing' mud and formation, and so was causing the plugged tubing.

A new packer was set at 10060' and the completion string run. As an added precaution against plugging, the perforated nipple below the packer was replaced by a slotted pipe. 2 mm x 10 cm slots cut in it (giving a total slot area of twice the tubing cross-sectional area).

An attempt was made to perforate but the Schlumberger dummy gun stood up at 10245'. As the THP was 2560 psi, the old

perforations were clearly at least partly open - and had not been sealed by the cement squeeze. Therefore a blanked-off w-plug was set in the R-nipple (to prevent large pieces of formation entering the tubing) and a further attempt was made to flow the well.

d) August 30th, 1974.

The well was opened at 1135 hours on a 1" choke. It slugged gas, mud and formation and killed itself on several occasions - each time it was brought back by pumping water into the tubing up to a maximum pressure of 5000 psi and then bleeding off. The choke and flow lines were repeatedly plugged with large (3/4") pieces of cement and formation which clearly could only have entered the tubing if the tail pipe assembly had been damaged.

At 1515 hours on 31/8/1974, the well was killed by pumping mud down the tubing and the attempt to test the Danian interval abandoned.

When the tubing was pulled, it was found that several of the slots of the slotted pipe had been washed out (one to a 3/4" diameter).

CONCLUSION.

Log analysis and subsequent testing showed the zone to be hydrocarbon bearing (gas condensate). However, mud and cement contamination and also mechanical problems prevented a proper evaluation being carried out.

3. TECHNICAL PROBLEMS.

3.1 SNUBBING EQUIPMENT.

During the first flow period of the Danian test, the tubing became plugged by mud, formation and cement. Attempts to clear this by rocking (to a maximum pressure of 7500 psi) and by bailing with an Otis sand pump, moved the bridge down the tubing but did not clear it.

Concurrently with these efforts, a macaroni string, snubbing unit and Otis 6" BOP's were located. However, on arrival, the BOP's would hold only 500 psi and a close inspection showed that the bore of the rams were badly corroded and pitted and was declared useless by the Otis operator.

Another set of 6" 5000 psi Cameron BOP's was flown from France and tested satisfactorily.

After washing down with seawater from 6600' - 9654', the well started kicking. While killing the well, a bad leak occurred in the Otis 3.2/26" - 10,000 x 6" - 5,000 double flange adaptor linking the BOP's of the snubbing unit to the X-mas tree.

The well was killed successfully and, on pulling out the string, it was found that the flange had split into two pieces.

A new flange was made locally. This had reinforcing plates between the flanges and gave no problems during the two subsequent clean-outs.

3.2 FB-1 PACKER MILLING ATTEMPT. (29th July) and subsequent fish

After completing production test No. 1 in the Maastrichtian interval and pulling the completion string, a Baker 8OFA47 C-1 milling tool was run on 3.1/2" drillpipe in order to mill out the FB-1 packer slips and retrieve the bottom hole assembly of packer, mill out extension and seal bore extension.

When the tool was retrieved, only the packer mandrel had been recovered leaving the packer guide, mill out extension and seal bore extension in the hole. These were successfully fished with a 4" HE spear and 3.1/8" oil jar (since at that time the option to drill ahead was still required).

An examination of the milling tool assembly showed that it had been wrongly made up, one spacer sub too many being included between the milling head and retrieving dogs. It is therefore likely that, whilst milling the packer, the dogs engaged in the seal bore extension and so provided enough torque to unscrew partially, or even totally, the packer from its guide.

A Baker operator supervised the making up of the tool but in future, a cross-check by Shell personnel is essential.

3.3 CASING DAMAGE.

After the third unsuccessful flow attempt on the Danian interval, an investigation was made below the FB-1 packer.

After pulling the tubing string and milling out the packer, a trip was made with a 5.7/8" bit and 7" casing scraper. An obstruction was found at 10301'. The bit and scraper were pulled and a 5.15/16" milling tool run, which stood up at the same depth. In 5 hours, 2 ft. of penetration were made and then the casing was washed down to 10350' (cuttings of 50% formation + 50% cement).

It was concluded that the casing had parted. The depth of the obstruction on the 7" casing corresponds to a 7" BTS pin casing connection that had been cut locally.

A.9. - PLUGGING AND ABANDONMENT.

a) General.

After the final logging at 10910' (TD), the 7" casing was run to 10893' and cemented.

Cement in the casing was drilled to 10836' and DST 1 carried out through perforations at 10820' - 10825'. This produced gas rather than the expected water sample and was abandoned by squeeze cementation No. 1.

Squeeze Cementation No. 1. (Perforations 10820' - 10825' 4 shots/ft.)

Cement retainer set at 10805'.

100 sx Class "E", slurry weight .845 psi/ft. A CBL showed a much improved bond.

Cement in the casing was drilled to 10870' and DST 2 carried out through perforations at 10830' - 10835'. This was abandoned by bridgeplug No. 1.

Bridgeplug No. 1 - 10780'

A 7" Johnson bridgeplug was set at 10780' and followed by a run of the Schlumberger Dump Bailer which put 3 sx. Class "E" cement, .805 psi/ft, above the plug. The plug was satisfactorily tested to 2500 psi.

Because of the poor bonding from the 7" cementation (as seen on the CBL and as indicated by the pressure in the 9.5/8" x 7" annulus - see below) three further cement squeezes were carried out.

Squeeze Cementation No. 2 (Perforations 10510' - 10515'. 4 shots/ft.)

Cement retainer set 10491'. 50 sx Class "E", slurry weight .830 psi/ft.

Squeeze Cementation No. 3. (Perforations 10120' - 10125'. 4 shots/ft.)

Cement retainer set at 10089'. 70 sx Class "E", slurry weight .845 psi/ft.

Squeeze Cementation No. 4. (Perforations 10120' - 10125'. 4 shots/ft.)

This cementation was performed after the perforations from squeeze No. 3 were inadvertently broken down by a reverse

circulation. Cement retainer set at 10080', bridgeplug No. 2 set at 10150', 100 sx Class "E", slurry weight .830 psi/ft.

Plugs and cement were drilled and the perforations tested satisfactorily with an RTTS packer assembly. (To 2500 psi by pressuring up the 7" casing and by an inflow test).

The Maastrichtian test programme was carried out with perforations at 10590' - 10655', 10665' - 10715' (2 shots/ 2 ft.).

The well was killed with 30 bbls. water and 280 bbls. of .760 psi/ft. mud (including a 55 bbl. LCM pill). A cement retainer was set at 10659' but no satisfactory injection test could be obtained (possibly because of the LCM material used to kill the well) and no cement was squeezed into the lower set of perforations.

Squeeze Cementation No. 5 (Perforations 10590' - 10655', 2 shots/2 ft.)

Cement retainer set at 10580'.

Attempted to squeeze 200 sx. Class "E" cement .840 psi/ft., but max. pressure of 5000 psi after 30 sx squeezed. Set 6 sx cement above retainer and reverse circulated out excess cement.

An attempt was made to test the Danian through perforations at 10255' - 10305', 10315' - 10390' (2 shots/2 ft.). After the tubing became plugged, it was decided to squeeze off the lower set of perforations. However, it was found that the casing had parted at 10301' and therefore a cement retainer was set at 10295'.

Squeeze Cementation No. 6. (Casing parted at 10301')

Cement retainer set at 10295'. 200 sx Class "E" cement, .840 psi/ft.

After a further unsuccessful attempt to test the Danian, the upper perforations were squeezed off.

Squeeze Cementation No. 7. (Perforations 10255' - 10295', 2 shots/2 ft.)

Cement retainer set at 10100'. 200 sx Class "E" cement 0.845 psi/ft.

The well was abandoned by two cementations in the 9.5/8" x 7" annulus (see below) and by setting abandonment plugs 1 - 4.

Abandonment Plug No. 1.

Was set from 9580' to 10100' with 100 sx of Class "E" cement, slurry weight .845 psi/ft.

Abandonment Plug No. 2.

Was set from 7780' (calculated) to 8300' with 100 sx of Class "E" cement, slurry weight .840 psi/ft. This plug was tagged with a bit at 7965' and held 20,000 lbs.

Abandonment Plug No. 3.

Was set from 1100' to 1600' with 70 sx of Class "B" cement, slurry weight .780 psi/ft.

Bridgeplug No. 3 - 636'

After cutting the 7" casing at 650', a 9.5/8" Johnson bridgeplug was set at 636'.

Abandonment Plug No. 4.

Was set from 400' to 636' with 80 sx Class "B" cement + 1% $CaCl_2$ accelerator, slurry weight .800 psi/ft.

Cutting of Casing String.

The casing strings were cut below the seabed using the Hunt Tool mechanical cutter. The 7" was first cut at 820' but could not be pulled with 325,000 lbs. It was recut at 650' and after there, the strings were cut and retrived without problems.

7"	at	650'
9.5/8"	at	370'
13.3/8",	at	358'
20"	at	355'
36"	at	352'

The present status of the well can be seen in Appendix IX.

b) 9.5/8" x 7" Annulus.

90 bbls. 0-760 psi/ft. mud were squeezed into the annulus.

Mud Squeeze No. 2. 30.6.1974

250 bbls. 0.760 psi/ft. mud were squeezed into the annulus.

A mixture of mud and hydrocarbon gas was bled off from the annulus on 14. 7. 1974.

Remedial Cementation No. 1. 15. 7. 1974

240 sx of Class "E" cement, .830 psi/ft., were squeezed down the annulus and displaced to 7100' by .760 psi/ft. mud.

The annulus continued to be monitored but the pressure now appeared to be a temperature effect. The pressure rose during flow periods of the Maastrichtian test but dropped to zero during build-up surveys.

However, the annulus was apparently re-activated during the Danian perforating (4. 8. 74). A third mud squeeze was attempted on 12. 8. 1974 but no injection could be obtained with 3500 psi pressure.

During abandonment, two further remedial cementations were performed by perforating the 7" casing and circulating down the 7" and up the 9.5/8" x 7" annulus.

Remedial Cementation No. 2. 5. 9. 1974

Was performed through perforations at 6500' - 6503' (cement retainer at 6400'). The annulus was circulated to .750 psi/ft. mud and cemented with 185 sx Class "B" cement, .805 psi/ft.

26 hours after this cementation, there was still a small gas flow from the annulus and a second cementation was decided upon.

Remedial Cementation No. 3. 7. 9. 1974

Was performed through perforations at 3945' - 3950' (cement retainer at 3850'). The annulus was circulated to .800 psi/ft. mud and cemented with 350 sx Class "B" cement, slurry weight .805 psi/ft. a back-pressure of 900/1300 psi being maintained while cementing.

After 9 hours, the pressure was bled off and small intermittent gas bubbles were still observed, necessitating the setting of the 9.5/8" bridgeplug at 636'.

PART B. GEOLOGICAL DATA.

B.1. Summary and Conclusions.

Well 1/6-3 was drilled to appraise reservoir development in the western part of the Albuskjell structure. A Danian - Maastrichtian gas condensate field had previously been confirmed by two wells (A/S Norske Shell 1/6-1 and Phillips 2/4-9) drilled farther east along the WNW - ESE trending structure (Enclosure i)). Approximately 50% of the structure lies in A/S Norske Shell block 1/6 and the remainder in Phillips 2/4.

As predicted in the prognosis, hydrocarbon-bearing gases were encountered both in the Danian and Upper Maastrichtian Chalk. The net thicknesses are respectively 300 and 146 ft. (Enclosure ii)). The great thickness of the Danian reservoir, which appears to be confined to A/S Norske Shell acreage, is in contrast to the findings from wells 1/6-1 and 2/4-9, where only a thin hydrocarbon-bearing zone was present in an otherwise tight Danian.

The Maastrichtian reservoir tested 37,718 million scf. gas/day and 5235 BOPD through a 1" choke.

Unfortunately, no successful test was made of the Danian reservoir. This was due to plugging by formation and lost circulation material from the tested interval. In this zone, the Danian consists of very friable, fractured chalk.

The well was spudded on 12. 4. 1974 at final satnav coordinates:-

N 56° 38' 36.375"
E 02° 55' 49.702"

approximately 4 km. WNW of well 1/6-1. Due to several fish jobs, three sidetracks had finally to be drilled, of which the deepest (No. 2), reached 10,968 ft. The well was plugged and abandoned on 11. 9. 1974 as an expendable hole.

B.2. Geology.

2.01 Chronostratigraphy.

No age determination has been carried out on samples from sea bottom to 8070', and thus this part of the Quaternary - Tertiary sequence has not been subdivided. Age determinations on samples from the corresponding interval in well 1/6-1 are presently being carried out and will be issued as a report. Correlation should then be possible between this well and well 1/6-3.

The stratigraphic subdivision outlined below is based on micropalæontology for the Tertiary interval down to the Paleocene/Danian boundary, and calcareous nannoplankton for the Danian and Cretaceous. The latter will be the subject of a separate report. (Report EP-46109).

Interval (depth b.d.f.)				
339' - 8070'		Samples not examined		
8070' - 8340'	Tertiary	Upper Eocene	PT 27/29	zones.
8400' - 9480'		Lower Eocene	PT 22/24	zones.
9540' - 9570'		Lower Eocene	PT 21	zone.
9570' - 10209'		Paleocene	PT 11/15/19	zones.
10209' - 10593'		Danian		
10593' - 10968'	Upper Cretaceous	Maastrichtian		

2.02 Lithostratigraphy.

Detailed descriptions of the lithologies are indicated in the Composite Well Log (Enclosure iv)) and in the Core Descriptions (Appendix XI).

The major lithological subdivisions are listed below:-

Depth in ft. b.d.f.			Lithological Description.
339	-	1395'	No samples.
1395	-	1610'	BOULDER CLAY, very silty and sandy with abundant rock fragments.
1610	-	3315'	Grey green CLAY, slightly calcareous, grading to CLAYSTONE at base.
3315	-	4190'	Interbedded CLAY and CLAYSTONE, green to grey/green, slightly calcareous.
4190	-	5730'	Mainly CLAYSTONE, dark grey/green, soft, slightly micaceous, with minor CLAY as above.
5730	-	6520'	Interbedded CLAY, CLAYSTONE, as above, and SHALE, dark grey/green, calcareous, with traces of DOLOMITE.
6520	-	8024'	Dark grey/green SHALE and SILTSTONE, fissile, friable, calcareous, with minor CLAYSTONE, LIMESTONE and DOLOMITE, fossiliferous.
8024	-	9000'	SHALE light - dark grey, hard, splintery break, with CLAYSTONE and occasional LIMESTONE.
9000	-	9500'	CLAYSTONE light - medium brown/grey with SHALE and occasional LIMESTONE.
9500	-	9700'	SHALE and CLAYSTONE with variable amounts of VOLCANIC TUFF/ASH light grey, soft, dark and light materials, traces of quartz shards.
9700	-	9880'	SHALE light - dark grey/green, hard, with CLAYSTONE and LIMESTONE yellow brown IA.
9880	-	10248'	MARL white - grey, friable - soft calcareous, with white chalky MUDSTONE and dark grey - black SHALE.
10248	-	10315'	Chalky LIME MUDSTONE, slightly porous, white - light brown, conchoidal break.
10315	-	10360'	Chalky LIME MUDSTONE, mixed porosity, isolated rings, crumbly break, soft - moderately hard, occasional argillaceous streaks.
10360	-	10968' (TD)	Mainly LIME MUDSTONE IA, compact light grey - light greyish brown, hard - very hard, conchoidal - angular break, occasionally variegated or banded

Depth in ft. b.d.f.	Lithological Description.
10360 - 10968' (TD) Continued	white/light brown - grey, siliceous; sometimes IIA, light greyish brown - light brown, moderately hard - hard. Stylolites, calcite veins, marcasite and pyrite nodules.

For detailed description of the interval 10247 - 10968', refer to the Core Descriptions (Appendix XI).

2.03 Palæontology and Palynology.

The lower part of the Tertiary sequence has been the subject of micropalæontological studies by EP/12. The stratigraphy is indicated in Section 2.01 and the Composite Log.

More detailed studies of the Tertiary interval for the neighbouring well 1/6-1 is in progress, and a separate report will be issued at a later date.

The Danian/Cretaceous interval is subdivided on the basis of calcareous nannoplankton zonations. These are indicated on the Composite Log, while the study will be the subject of a later report. (EP-46109).

2.04 Hydrocarbons.

Hydrocarbon indications during drilling and test results are shown on the Composite Well Log (Enclosure iv)), while additional details of the gas chromatograph readings may be found in Appendix

2.05 Remarks on Stratigraphy.

As the following tabulation indicates, the stratigraphic succession encountered showed fairly close correlation with that predicted by seismic:-

	Seismic Prognosis	Drilled Depth
Top Paleocene	- 9260 ft. subsea	- 9458 ft. subsea
Top Danian Chalk	- 10010 ft. subsea	- 10097 ft. subsea
Top Maastrichtian	- 10600 ft. subsea	- 10481 ft. subsea

The Tertiary section is very similar to that encountered in well 1/6-1, consisting essentially of soft, slightly calcareous, sticky clay with minor amounts of claystone down to ± 5500'. From this depth down to the top of the Paleocene at 9570', the section consists of shale and siltstone, with interbedded claystone and minor amounts of limestone and dolomite stringers. Volcanic tuff makes its appearance at the base of the Lower Eocene and continues into the upper part of the underlying Paleocene.

The upper part of the Paleocene (9570 - 9670') consists of interbedded claystones and volcanic tuff. This grades downwards into a shaley, marly sequence which continues into the underlying Danian at 10209'. Interbeds of chalky mudstone occur at ± 9900', while reworked Upper Cretaceous Foramifera extends upwards to ± 9720'. The amounts show wide variation. The allochthonous chalk material predicted in the prognosis therefore seems to be present. The total Paleocene thickness (639') is in line with that found in 1/6-1 and Phillips' 2/4-9. (Enclosure 2.).

The top of the Danian Chalk was encountered at 10248'. Down to ± 10315', the formation consists of chalky lime mudstone with effective porosity between 30 - 40% measured on plugs. From 10315' to ± 10350',

the chalk changed to a highly porous, soft and fractured material. Reworked Maastrichtian material was found at 10320' (i.e. 270' above Top Maastrichtian), indicating severe slumping. Slumping within the Danian section is also confirmed by repetitions of the nannoplankton zones (Report EP-46109).

The remainder of the Danian interval consists mainly of chalky lime mudstone. Effective porosities average around 30% down to the base of the upper reservoir at $\pm$ 10540', decreasing to around 20% in a tight zone of hard, lime mudstone at the base of the Danian. The top of the lower reservoir occurred at $\pm$ 10587' and top Maastrichtian at 10593'.

The Maastrichtian chalk consists dominantly of siliceous chalk mudstone IIA with occasional IA. The effective porosity averages around 20% over the hydrocarbon-bearing zone, decreasing to around 10 - 15% in underlying section. (Enclosure ii)). The base of the main reservoir is taken at 10730', i.e. a net pay of 143 ft. as against 111 ft. in 1/6-1 and 152 ft. in 2/4-9. A transition zone zeems to be present between 10730' and the oil - water contact at 10793'.

Return No. 825
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COMPLETED WELL COST STATEMENT

100% figures Rate of exchange £1 = ____

Identification data:

Country: Norway	Company: A/S Norske Shell Group share: %	Field/Concession: Albuskjell	No. of well: 3 representative of: ___ wells
Type of well: ~~Land/swamp~~/Marine ~~Explor./Appraisal~~ ~~Develop.~~	Type installation for drilling: Land/Platform/Mobile Marine Rig type Jack up	Type installation for completion:	
Water depth: 227 / Max. well depth: 10910	Completion depth:	Date moved in: 10/4-74	Date spudded in: 1/4-74 / Date completed/abandoned: 11/9-74
Well drilled by: ~~Comp. rig/comp. personnel~~ Contr. rig/contr. personnel	Name contractor(s): Zapata	Status on completion: Plugged and completed	

Cost data:

Item No.	Description	Total cost: Local currency (no decimals)	Total cost: £ (no decimals)	Expenses per foot (max. depth reached) £ (two decimals)
	0. PREPARATION EXPENSES			
01	Access and drilling site - (land/swamp/marine)	332.353	25.546	-
02	Temporary facilities			-
03	Installing and tearing down Drilling Installation	132.895	10.215	-
04	Drilling Installation: 1.55 days at £ 6.548			-
08	Transportation	57.478	4.418	-
09	Miscellaneous preparation expenses	45.999	3.536	-
07	Sub total Preparation Expenses	568.725	43.715	4.01
	1. DRILLING EXPENSES			
11	Drilling Installation: 37.4 days at £ 6.548	3.186.083	244.895	22.45
12	Mud	1.954.449	150.227	13.77
13	Bits	196.126	15.075	1.38
14	Casing (conductor-, surface-, intermediate-) and cement	2.097.064	161.189	14.77
18	Transportation	1.377.988	105.918	9.71
19	Miscellaneous drilling expenses	803.886	61.790	5.66
10	Sub total Drilling Expenses	9.615.596	739.094	-
	2. EVALUATION EXPENSES			
21	Drilling Installation: 33.0 days at £ 6.548	2.811.250	216.084	-
22	Logging surveys and formation testing	2.197.018	168.871	-
28	Transportation	1.215.872	93.457	-
29	Miscellaneous evaluation expenses	231.132	17.766	-
20	Sub total Evaluation Expenses	6.455.272	496.178	45.48
	3. COMPLETION EXPENSES			
31	Drilling Installation: 73.0 days at £ 6.548	6.218.825	478.003	-
34	Casing (production) and cement	28.119	2.161	-
35	Stimulation, formation consolidation and production testing	2.172.909	167.018	-
38	Transportation	2.689.656	206.738	-
39	Miscellaneous completion expenses	1.437.097	110.461	-
30	Sub total Completion Expenses	12.546.606	964.381	88.39
	4. ABANDONING EXPENSES			
41	Drilling Installation: 9.06 days at £ 6.548	771.816	59.325	-
44	Plugs and cement	20.000	1.537	-
48	Transportation	333.812	25.658	-
49	Miscellaneous abandoning expenses	98.852	7.598	-
40	Sub total Abandoning Expenses	1.224.480	94.118	8.63
50	TOTAL DIRECT EXPENSES OF COMPLETED WELL (total phases 0, 1, 2, 3, 4)	30.410.679	2.337.486	214.25
60	TOTAL DIRECT EXPENSES OF DRY HOLE (total phases 0, 1, 2, 4)			
	MEMORANDUM ITEMS			
70	Well Head Equipment and Subsurface Lifting Equipment (materials expenses only)	-		-
80	Original Value/Replacement Value and age of Company-owned Drilling Installation	-		-
90	Overhead Expenses	-		-

Quantitative drilling data:

Casing scheme: size/length: 36" - 574' / 20" - 1369' / 13-3/8" - 4004' / 9-5/8" - 8024' / 7" - 10893'	Footage drilled: 12839' of which footage cored: 838'	Miles access road: ___ Miles rig move: 21.7 Miles from base: 169	

COMPLETED WELL COST STATEMENT

Dkr figures — Rate of exchange at 12.65

	A/S Norske Shell	Field Concession Albuskjell	3
	Type Installation for drilling: Land Platform Mobile Marine; Rig type Jack-Up		Type Installation for completion
Total depth 10710	Completion depth	Date moved on 10.4.74	Date spudded 14.4.74; Date completed 11.4.74
	Name contractor(s) Zapata		Status: Plugged and completed

Item No.	Description	Total cost: Local currency (no decimals)	Total cost: $ (no decimals)	Expenses per foot (max. depth reached) $ (2 decimals)
	0. PREPARATION EXPENSES			
01	Access and drilling site (land swamp marine)	332.353	26.276	
02	Temporary facilities	-	-	
03	Installing and tearing down Drilling Installation	-	-	
04	Drilling Installation 1.56 days at $ 7.805	94.636	7.481	
05	Transportation	753.767	59.586	
06	Miscellaneous preparation expenses	51.215	4.049	
00	Sub total Preparation Expenses	1.231.971	97.392	8.93
	1. DRILLING EXPENSES			
11	Drilling installation 57.4 days at $ 7.805	5.557.694	439.343	40.27
12	Mud	1.950.338	154.177	14.13
13	Bits	167.748	13.261	1.22
14	Casing (conductor ... intermediate) and cement	2.128.219	168.239	15.42
15	Transportation	3.472.487	274.505	25.16
16	Miscellaneous drilling expenses	835.283	66.030	6.05
10	Sub total Drilling Expenses	14.111.769	1.115.555	102.25
	2. EVALUATION EXPENSES			
21	Drilling installation 33.0 days at $ 7.805	1.791.935	141.665	
22	Logging surveys and formation testing	2.197.018	173.677	
23	Transportation	1.689.536	133.560	
24	Miscellaneous evaluation expenses	226.360	17.894	
20	Sub total Evaluation Expenses	5.904.849	466.786	42.79
	3. COMPLETION EXPENSES			
31	Drilling installation 73.0 days at $ 7.805	6.883.633	544.161	
32	Casing (production) and cement	28.119	2.223	
33	Stimulation, formation consolidation and production testing	2.233.759	176.560	
34	Transportation	24.021	1.899	
35	Miscellaneous completion expenses	1.995.387	157.738	
30	Sub total Completion Expenses	11.164.919	882.603	80.90
	4. ABANDONING EXPENSES			
41	Drilling installation 9.06 days at $ 7.805	878.582	69.453	
42	Plugs and cement	-	-	
43	Transportation	-	-	
44	Miscellaneous abandoning expenses	102.418	8.096	
40	Sub total Abandoning Expenses	981.000	77.549	7.10
	TOTAL DIRECT EXPENSES OF COMPLETED WELL (total phases 0, 1, 2, 3, 4)	33.394.508	2.639.885	241.96
00	TOTAL DIRECT EXPENSES OF DRY HOLE (total phases 0, 1, 2, 4)			
	MEMORANDUM ITEMS			
	Well Head Equipment and Subsurface Lifting Equipment (materials expenses only)			
	Original Value/Replacement Value and age of Company-owned Drilling Installation			
	Overhead Expenses	3.975.302	314.253	

Quantitative drilling data

Casing scheme size/length	36" - 574' 20" - 1369' 13-3/8" - 4004' 9-5/8" - 8024' 7" - 10893'	Footage drilled 12839' of which footage cored 838'	Miles access road: Miles rig move 21.7 Miles from base 162

PART D.

1) List of Appendices.

2) List of Enclosures.

i) Schematic Cross Section - 1/6-3: 1/6-1 and 2/4-9
by C. Louwerens EP/11

ii) Albuskjell Field Composite Log Correlation
by G. C. Severijn EP/22

iii) Well Summary Sheet 1/6-3

iv) Composite Well Log 1/6-3

3) List of References.

i) Location Proposal 1/6-0 - November 1973 by A/S Norske Shell E. & P.

ii) Flopetrol Reports - 1) Well Test on Well 1/6-3 Maastrichtian Zone 27/6/74 - 28/7/74

- 2) Well Test on Well 1/6-3 Danian Zone 5/8/74 - 31/8/74

- 3) Albuskjell 1/6-3 Maastrichtian Zone Charts.

iii) Core Lab PVT Analysis - Reservoir Fluid Study on Flow Penods 1, 2, 5 and 6.

iv) Acidisation Report No. 1 - A/S Norske Shell - 29/7/74

v) Thornton Research Report - Albuskjell 1/6-3 Maastrichtian Zone 19/9/74