

Denne rapport  
tilhører



# L&U DOK. SENTER

L. NR. 12382290073

KODE Well 31/2-9 nr.10

Returneres etter bruk

## DRILLING PROGRAMME

LOCATION 31/2-K

31/2-9

L. NR. 1238229-0073		Statoil			
Avd. FLT		Sentralarkiv			
Spes. KJT		Avd. arkiv			
Dato. 22 JULI 1982		Spes. arkiv		DOI	
Tittel					
Oppg.					
Utgitt					
	Dato	Sign.		Dato	Sign.
LET/BER		KjH	int	KH	
BoR		PR			
		PAL	T		
		OKG			BRG
Emneord:					
Arkiv PS-10					

↓ Sikk rasht

July 1982

~~OK~~  
LKE 78  
RN  
LR

A/S NORSKE SHELL  
LICENCE 054

DRILLING PROGRAMME

LOCATION 31/2-K

31/2-9

L. No. <b>238229-0073</b>		Statoil	
Avd. <b>FLT</b>		Sentralarkiv	
S. No. <b>RJT</b>		Avd. arkiv	
Dato. <b>22 JULI 1982</b>		Spes. arkiv	
		<b>DOI</b>	
Bredde			
Lengde			
Høyde			
Dato			
Sign.			
	Dato	Sign.	
<b>LET/BER</b>		<b>KJH</b>	<b>KH</b>
<b>BoR</b>		<b>PR</b>	
		<b>PAL</b>	
		<b>OKB</b>	<b>OKB</b>
Emneord:			
<b>Arkiv PS-10</b>			

↓ Siste raskt  
~~OK~~  
 OK 78  
 RN  
 LR

July 1982

A/S NORSKE SHELL  
 LICENCE 054

DRILLING PROGRAMME

AMMENDMENT NUMBER 1

LOCATION 31/2-K

August 1982

A/S Norske Shell

Licence 054.

A/S NORSKE SHELL

Drilling Programme Amendment No. 1 Location 31/2-K

1. SUMMARY

On receipt of the site survey for location 31/2-K, it was noted that a potential shallow gas pocket exists at ca. 475 m BDF. The 30" conductor pipe was initially planned to be set at 460 m with 36 inch hole being drilled to 470 m. Therefore the setting depth of 30" conductor pipe is revised to c. 450 m BDF, with 36" hole being drilled to 460 m BDF.

2. SITE SURVEY

The site survey results are attached as appendix I.

The critical points of interest to drilling operations are the possible presence of shallow gas at 475 - 495 m BDF and at 695 m BDF.

3. 30" CASING DEPTH REVISION

Originally, eight joints of 30" casing had been planned, to be set at +/- 96 m penetration into the sea bed ie at 460 m BDF. For this casing 36" hole would be drilled to 470 m.

It is now evident that the 36" hole should stop short of the potential shallow gas zone at 475 m BDF. Thus, seven joints will now be run to be set at +/- 84 m penetration into sea bed i.e. 450 m BDF with 36 inch hole being drilled to 460 m BDF.

4. PRECAUTIONS IN 26" HOLE

In view of the identified potential gas zone c. 695 m BDF, the standard procedure of drilling a 14 3/4" pilot hole with a constant vigilance for any flow will be adopted as proposed in the original programme.

AMK. 12/8

Operations Superintendent

Chief Petroleum Engineer

APPENDIX I

SITE SURVEY 31/2-K

The seabed in the area is generally flat, with a gentle dip down towards the N.N.W. The water depths increase from 337.5 metres in the south east to 343 metres in the north west. At the centre of the site the depth is 340 metres.

The most significant seabed features are the numerous pockmarks in the area. These are evenly distributed and vary between 1 m to 3 m in depth. No outcrops, wrecks or debris were found, although the presence of a wreck outside the survey site should be noted.

The top layer of seabed consists of soft silty clay, of 25 m - 30 m thickness. This overlies a unit of thicker consolidated clay of 30 m thickness.

Beneath this is a 50 m thick unit of overconsolidated morainic clay which may contain some boulders in its upper part.

A series of erosional surfaces immediately underlie the morainic clay over an interval of ca. 450 m to 470 m BMSL. It is likely that these sediments are sands and gravels, and could contain trapped gas.

Further, a strong undulating and faulted reflector exists at 670 m BMSL, probably marking the base of the Tertiary sediments. Reflection amplitudes vary in some areas and it is possible that gas might exist at this surface.

NORSKE SHELL E & P, FORUS.

DRILLING PROGRAMME

CONFIDENTIAL

LOCATION: 31/2-K  
WELL: 31/2-9  
RIG: Borgny Dolphin

PRODUCTION LICENCE No.: 054

ESTIMATED DAYS: 51 (incl. Prod. test)

CO-ORDINATES OF LOCATION


60 deg 52' 54.6" N  
03 deg 28' 03.1" E

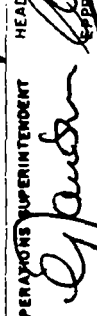
HOLE SIZE (INS)	HOLE DEPTH / CASING DEPTH (metres)	CASING SIZE / WT / GRAD / CPLG	CEMENT		REMARKS	S.G. (PSI/1000')	MUD		LOGGING	DERRICK FLOOR ELEVATION.	M. ABOVE MSL	M. ABOVE SEA BED	m T.V B.D.F.
			Type / Mixer	Req'd on Board (Tons)			REMARKS	REMARKS					
36"	470 / 460	30" / 1" WT / 310 / X-52 ATD-RB Squanch	Class "G" S'water	150	See Enclosure 2A	1.03 (445)	Seawater + Viscous pills (+/- 100 MF)	None	(In 14-3/4" pilot hole) ISF/SONIC/SP/GR FDC/CNL/CAL/GR	366	FORMATION TOP	366+/-2	
26" See note 3	820 / 810	20" / 133 / X-52 Hunting SWIFT DW - LH	Class "G" S'water	220	See Enclosure 2B	1.03 (445)	Gelled seawater + viscous pills		ISF/SONIC/SP/GR FDC/CNL/CAL/GR SWS (as required)		Seabed (Quaternary-Miocene) Oligocene Eocene Balder formation Palaeocene Cretaceous	765+/-5 1035+/-10 1120+/-5 1315+/-5 1350+/-5 1505+/-10	
17-1/2" 1500	1510 / 1500	13-3/8" / 72 / L80 / BTC / 68 / X55 / BTC	Class "G" F'water	150	See Enclosure 2C	1.26 (545) to 1.31 (567)	KCL/Polymer system KCL: +/- 35 ppb MF: 50-60 secs PV/YP 20-25/15-20 WL: Less than 10 ccs		ISF/SONIC/SP/GR FDC/CNL/CAL/GR LDT/NGT MSFL/DLL/CAL/SP/GR HOT		Upper Jurassic Sandstone Top reservoir Zone 1a U.J.S.* Zone 1b U.J.S.	1530+/-5 1530+/-5 1565+/-10 1610+/-10 1680+/-10	
12-1/4" See note 8	1725 / 1715	9-5/8" / 43.5 / M80 / BTC	Class "G" F'water	100	See Enclosure 2D	1.14 (494)	KCL/Polymer system from 17-1/2" section dispersed with Lignosulphonates. MF: 50-60 PV/YP: 20-25/15-20 WL: Less than 5 ccs		ISF/SONIC/SP/GR FDC/CNL/CAL/GR LDT/NGT MSFL/DLL/CAL/SP/GR HOT RFT's (as required) SWS (as required) CBL (on 13-3/8" and 9-5/8" casing) Velocity Survey		*Primary Target	1725	

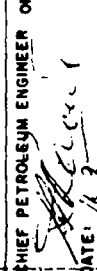
NOTES:

- All mud weights are to be adjusted in the light of hole problems (i.e. sloughing shales, high mud gas readings etc.)
- Formation leak off tests are required below 20" and 13-3/8" casing shoes.
- 14-3/4" pilot hole is to be drilled to 20" casing depth and logged for shallow gas prior to pulling the MR and opening the hole to 26".
- Cutting Collection: Every 10m below the 30" casing shoe. Every 3m below 1270m BDF.
- Estimate pore pressure is +/- 2280 psi at 1530m BDF.

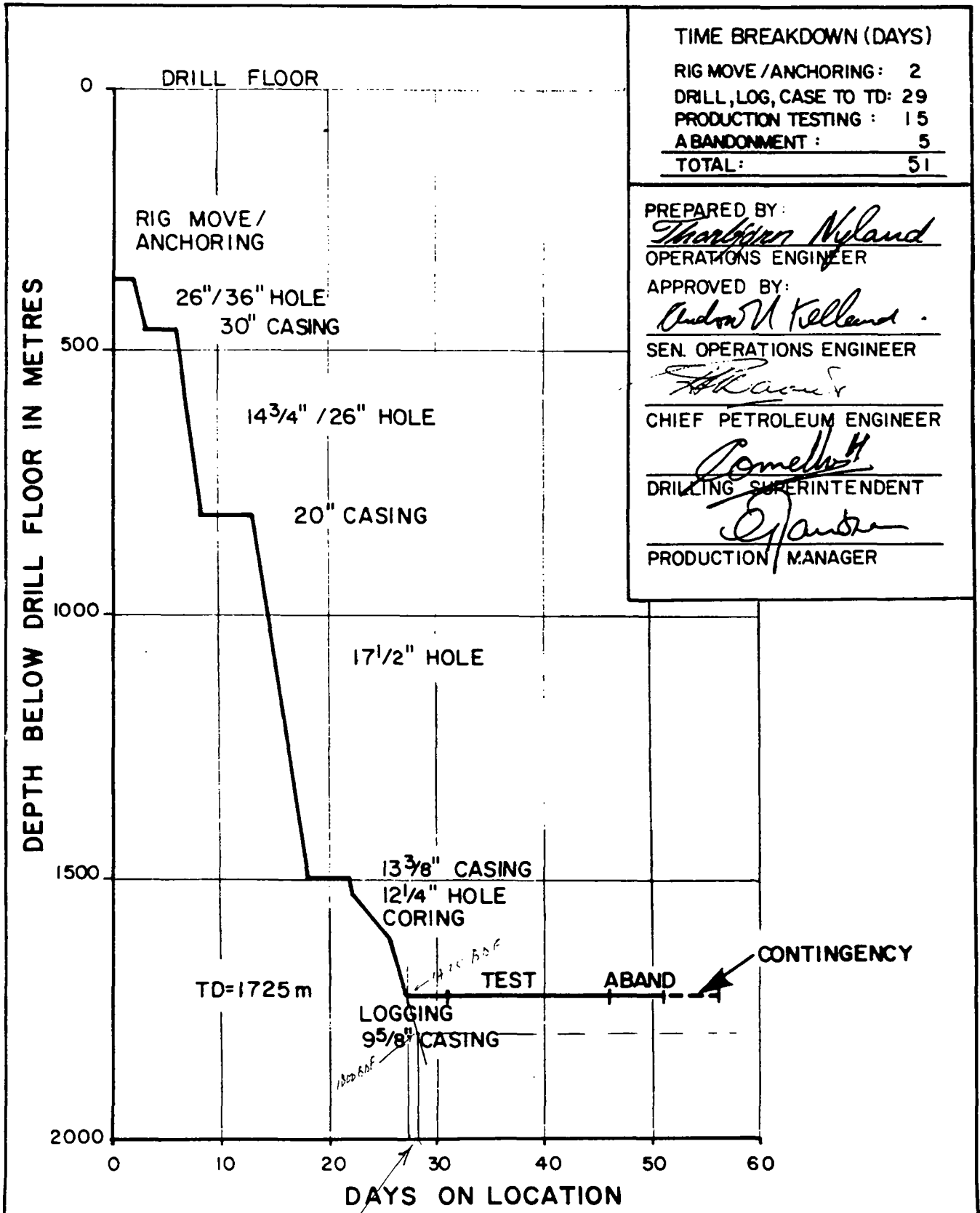
- Coring is to commence from top of the reservoir in the Upper Jurassic sandstone, and is to continue through the complete hydrocarbon-bearing sequence until just below top of zone 2 in the U.J.S. Approximate interval to be cored is 1530 - 1610 m BDF.
- Testing is subject to confirmation upon receipt of logs.
- 9 5/8" casing will be set only if testing is required.

SIGNED:   
PRODUCTION MANAGER

CHIEF PETROLEUM ENGINEER OPERATIONS SUPERINTENDENT:   
DATE: 12/3

HEAD OF DRILLING: 

# DRILLING PROGRESS CURVE 31/2-K



*only one day  
 additional drilling  
 to include for 2002-03  
 120000 m of field.*

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A/S NORSKE SHELL

DRILLING PROGRAMME - LOCATION 31/2-K

A. GENERAL

1. Location

- a) A/S Norske Shell - Block 31/2 - Production Licence 054
- b) Preliminary surface co-ordinates (centre of location)  
corresponding to SP 435 on seismic line 79.403

GEOGRAPHICAL

UTM (ZONE 31)

60 deg. 52' 54.6" N

NORTHINGS 6749875 M

03 deg. 28' 03.1" E

EASTINGS 525382 M

Tolerance: 25 meter radius from proposed location.

2. Base

Tananger Shore Base to Location 270 kms

Bergen Shore Base to Location 130 kms

3. Depth References

- a) All depths are given with respect to the rotary table (derrick floor) of the drilling vessel at the specified drilling draught.
- b) The drilling draught will be ca. 21.0 m.
- c) Expected water depth at location is +/- 341 m (MSL-seabed)
- d) Distance from rotary table to MSL is taken as +/- 25 m for this programme but will be measured on site. Distance from rotary table to seabed is taken as +/- 366 m for this programme but will be measured on site.

4. Type of well

Appraisal well.

5. Total Depth

*Nothing mentioned about being sure to hit top zone 3!*

TD in Upper Jurassic Sandstones is anticipated to be +/- 1700 m SS or +/- 1725 m BDF.

6. Drilling Installation

"Borgny Dolphin" - Aker H-3 semi-submersible.

7. Objectives

- I) Establish the northerly extent of the 27.5 m oil column province i.e. the area in which the GOC is at 1541 m SS.

The structural position is selected such that fluid contacts are encountered in Zone 1 with the OWC at least 10 m above top Zone 2.

- II) Test a deep completion interval in the oil leg close to the OWC, so that development of water - coning could be observed.

Testing however, will be dependent on logs revealing if this well is part of the same oil province as seen in well no. 7, i.e. in excess of 20 m oil column, or not. In the event that the well is proven to be part of the gas province with a small oil leg, i.e. ca. 12 m as seen in well no. 4, the well is then not considered to be in the oil prospective area and therefore abandonment will be implemented.

- III) *Establish with confidence thickness of zone 2.*

8. Prognosis

<u>Formation Tops</u>	<u>Lithology</u>	<u>Depth</u> <u>TVBDF (m)</u>	<u>Seismic</u> <u>Tolerance (m)</u>
Seabed (Quaternary- Pliocene-Miocene)	Clay, Claystones, Sandstones.	366	+/- 2
Oligocene	Claystones	765	+/- 5
Fault plane		1035	+/- 10
Eocene	Tuffaceous clay- stones.	1120	+/- 5
Balder formations	Claystones	1315	+/- 5
Palaeocene	Claystones, silty claystones. Marls.	1350	+/- 5
Cretaceous	Mudstone, silty, mudstone. Limestones.	1505	+/- 10
Top reservoir		1530	+/- 5
Upper Jurassic Sandstones			
Zone 1a	Fine to coarse unconsolidated sandstone. Micaceous sandstone. Occasional car- bonate cemented bends.		
Zone 1b	Medium uncon- solidated sand- stones.	1565	+/- 10

GOC	1572 ?	+/- ?
OWC	1584 ?	+/- ?
Zone 2	Fine, consolidated, 1610 micaceous sand- stones.	+/- 10
Zone 3	Fine, consolidated, 1680 Micaceous sand- stones.	+/- 10
TD +/- 1725 m BDF		

9. Pressure Regime

Data gained from drilling, electric logging, RFT pressure measurements and production tests show that the wells drilled to-date in block 31/2 are hydrostatically pressured. (See enclosure 3)

The proposed location 31/2-K is some 3.0 km NNE of 31/2-7 and is considered to be in the same hydrostatically pressured regime.

10. Mud Resumé

The 36" hole section is to be drilled with a seawater and viscous pill combination.

The 14-3/4" pilot hole for the 26" hole section is to be drilled with an unweighted gelled seawater mud combined with the frequent spotting of viscous pills. The 14-3/4" pilot hole will be opened up to 26" using seawater and viscous pills, with the riser removed and returns to seabed.

Note:

Prior to pulling out of the 14-3/4" pilot hole and 26" hole for logging and the running of 20" casing respectively, mud of 1.35 SG is to be spotted in the open hole section, to ensure hole stability.

The 17½" hole section will be drilled with a KCL/Polymer mud system with a mud weight of 1.26 - 1.31 SG (.545 - .567 psi/ft)

Note:

From experience gained on other wells drilled in the block a mud weight of 1.31 SG was required to stabilize this hole section.

For the 12-1/4" hole section the addition of KCL will be stopped in the KCL/Polymer mud. A mud weight of 1.14 SG (.494 psi/ft) will be used in this section. The fluid loss is to be brought down to the lowest practical value but certainly below 5cc. The hydraulics programme and ROP in the reservoir section should be such as to minimize the chances of washing out the hole prior to a MCURGP if required. (See page 25)

Note:

- 1) Mud weights mentioned are a guide only and are liable to change if hole conditions dictate.
- 2) The mud weight used in the 12-1/4" hole will exert +/- 130 psi overbalance on top of the reservoir in the event of the riser being disconnected.

11. Well Control

A diverter will be hooked up to the riser during the drilling of the 14-3/4" pilot hole for 20" casing. In addition, 1.4 SG mud (.606 psi/ft) should be available during this diverter drilling in case flows are encountered. Cement will also be available on the rig for use in an emergency. Pressure control will be maintained from the 20" casing point to TD in accordance with the well control policy manual EP 40806.

12. Deviation Control

Totcos are to be taken while drilling the 36" and 26" hole sections. Magnetic single shot (MSS) surveys will be taken at the 20" casing point and thereafter every 90 meters, to coincide with bit trips where possible. The well path is to be calculated using the "Minimum Radius of Curvature" Method.

13. Casing Summary

<u>Size</u>	<u>Grade</u>	<u>Weight</u>	<u>Coupling</u>	<u>Interval BDF</u>
30"	X-52, 1" WT	310 lbs/ft	ATD-RB squinch	Seabed - 460 m
20"	X-52	133 lbs/ft	H.Swift DW-LH	Seabed - 810 m
13-3/8"	K-55	68 lbs/ft	BTC	Seabed - 900 m
	L-80	72 lbs/ft	BTC	900 - 1500 m
9-5/8"	N-80	43.5 lbs/ft	BTC	Seabed - 1700 m

Note:

- 1) The 9-5/8" casing will only be set if the well is to be tested.
- 2) The 13-3/8", L-80, 72 lbs/ft, BTC casing has been specially drifted at the mill (during manufacturing) and will again be drifted on the pipe rack of the rig (before running) to ensure it will pass a 12-1/4" bit.

14. Wellhead Equipment

Vetco SG-5 18-3/4", 10,000 psi wellhead equipment will be used.

15. Formation Leak-off Tests

Leak off tests will be made after drilling 5 metres of new hole below 20" and 13-3/8" casing shoes.

16. Casing Accessories

- 30" Float shoe.
- 20" Float shoe (automatic fill up). Two spring centralizers on the shoejoint and 3 on the next 6 joints (one per two joints). Two spring centralizers equally spaced inside 30" conductor.
- 13-3/8" Float shoe + float collar one joint above shoe. 10 spring centralizers - 2 on shoe joint, 6 on the next 12 joints (one every second joint) and 2 inside 20" shoe, spaced 1 joint apart.



9-5/8" Float shoe + float collar 3 joints above the shoe. Three spring centralizers on the shoe track, 1 centralizer per joint up to the base of the OWC, no centralizers across the oil zone, 1 centralizer per joint up to the 13-3/8" shoe and 1 centralizer per 3 joints over the first 100 m of 9-5/8" inside the 13-3/8" casing.

Casing test pressures will be as follows:

20"	1000 psi for 15 mins
13-3/8"	2500 psi for 15 mins
9-5/8"	3000 psi for 15 mins

Pressure tests on the 13-3/8" and 9-5/8" casings to be done immediately after bumping the top plug. The casing may be retested using an RTTS packer set below the top of cement around the particular casing if there is concern over the casing being worn.

Cement calculations: See enclosure 2.

17. Contingency Plans - Stand-by vessel

The current A/S Norske Shell Exploration & Production Emergency Contingency Plan dated 4th of January 1982 is valid for this drilling operation.

The name of the stand-by vessel which will be used is M/V "Nautik".

B. SUMMARY OF OPERATION

1. Pre-Spud Phase

Site Survey

A site survey for the 31/2-K location was carried out by A/S Geoteam during mid July 1982.

The Site Survey report was not available at the time of issue of the programme, and will be issued as a separate report before start of drilling.

2. Rig Positioning

The rig will be brought on to location utilizing Decca Pulse-8 and/or Siledis with HP minicomputer. All anchors will be run out plus/minus 1450 m. The rig will be positioned with a heading of 315 deg true north. After anchors have been set, each anchor will be tested to plus/minus 400,000 lbs for 1 hour. After a satisfactory mooring test, approximately 250,000 lbs tension will be maintained on all anchor chains.

If the Siledis system is available at the time of the rigmove, Siledis will be used to determine the final coordinates of the location. If it is not available, Satnav. will be used and a minimum of 40 satellite passes are required.

3. Spudding in, drilling 36" hole and running 30" Casing

1. Check the seabed condition by lowering underwater TV on the guide lines prior to setting the TGB on seabed.
2. Set TGB (with 5 m skirt). A Regan slope indicator is to be run on the TGB running tool to give an indication of the TGB angle. The TGB guide lines are to be marked at the spider deck level so that any subsequent sinking or tilting will be detected.

Note:

Calculate the DF - seabed distance and Mean Sea Level (MSL) after landing the TGB, taking into account the drilling draught and tidal variation.

3. Make up a 36" hole opener and 26" pilot bit assembly. Drill down to 30" casing setting depth, taking a survey (Totco) after the first kelly down. Additional surveys will be carried out as necessary, depending on hole angle. If hole angle is greater than  $1\frac{1}{2}$  degree then contact Base.

Before POH to run 30" casing circulate high viscosity mud (60 MF) in the hole, using 200% excess.

4. Run 30" casing plus PGB equipped with a Regan slope indicator (to be installed in the middle of a side beam, as close to the beam as possible). Install a second Regan slope indicator on the 30" running tool. Ensure that the slope indicators are properly level and zeroed and will be visible on the subsea TV.
5. When the 30" casing is landed observe the angle with the subsea TV camera. If the angle is 1 degree or less, cement the casing using 200% excess cement. (For cement calculations see enclosure 2A.)

6. WOC. Divers to check around the guide bases with an observation dive, if thought necessary.
7. If excessive cratering is observed, re-cementing around the guide base or seabed may be considered prior to drilling out of the 30" casing. Or if this problem is anticipated, consider using 300% excess cement instead of 200%.

Note:

- a) For the single stack system the angle of the PGB and the BOP stack, and the base being level, are of utmost importance and good support is required to carry the heavy load of the stack.
- b) Observe operations such as placing of the TGB and PGB, spudding in, stabbing in, drilling with returns to seabed, cementing of the 30" and 20" casings, with the rig's underwater TV camera.
- c) Maintain a tension in the anchor chains at the upper limits until the 30" casing is cemented, in order to minimize rig offset. Otherwise, the stack and conductor could be set under an angle which could lead to serious damage to the underwater equipment.
- d) Ensure that the tension of the guide lines is optimum so that the TGB will not be lifted on one side or be tilted by excessive uneven guide line tension.

4. Drilling 26" hole and running 20" casing

1. Drill out cement in 30" casing and 36" pocket with 26" hole opener and 14-3/4" pilot bit with a stabilizer at 20 m and start 14-3/4" pilot hole. POH and lay down 26" hole opener and stabilizer.
2. Run 30" hydraulic latch and dump valve complete with ball joint on 21" riser. Use minimum required tension on ruckers. Fill up riser with seawater and observe fluid level.
3. Make up 14-3/4" pilot hole drilling assembly. Use a float sub, with the float installed, and run in hole.
4. Close diverter around drill pipe, and circulate through both diverter lines to check the diverter equipment, gradually building up to maximum circulating rate. Open diverter packing.
5. Drill 14-3/4" pilot hole to the 20" casing setting depth, allowing for a 10 m pocket taking Totco surveys as required.

Note:

This section is to be drilled using an unweighted gelled mud and the weight of annular returns is to be continuously monitored. If the weight of annular returns causes losses or exceeds 1.15 SG (498 psi/1000 ft) stop drilling and circulate the hole clean. ROP must be controlled whilst drilling this section.

6. Perform a check trip to the 30" shoe and back to bottom, clean out any fill and spot viscous mud of 1.35 SG (585 psi/1000 ft) in the open hole section prior to pulling out of hole for logging.

7. Rig up Schlumberger and log as programmed.

Note:

Inspect the logs for indications of shallow gas prior to continuing with the programme. If any indications of shallow gas are observed then call Base and a revised programme will be issued.

8. Rig down Schlumberger and run in hole to TD. Circulate the hole volume to seawater and open the dump valve (close kelly cock). Observe well static for  $\frac{1}{2}$  hour and then spot viscous mud of 1.35 SG in the open hole section. If flow occurs, the 14-3/4" pilot hole will be under-reamed as described under "Notes on Diverter Drilling" point d.

Note:

The 1.35 SG mud should be circulated out in steps and dumped via the dumpvalve to prevent losses to the formation due to the heavy mud entering the marine riser.

9. Pull out of hole and retrieve the 30" hydraulic latch on riser.

10. Pick up a 14-3/4" pilot bit and 26" hole opener with a 26" stabilizer at 20 m above the bit. Open the hole up to 26" using seawater and viscous pills as required.

11. Perform a check trip to the 30" shoe and back to bottom, clean out any fill and spot viscous mud of 1.35 SG (585 psi/1000 ft) in the open hole section prior to pulling out of hole for running casing.

12. Run and cement 20" casing as per programme.

Note:

1 subsea plug (top plug) will be used for cement displacement.

13. Unlatch the running tool and POH.
14. RIH with a jetting sub and wash in and around the 18-3/4" wellhead housing. POH and lay down the jetting sub.
15. Install the 18-3/4" BOP stack and 21" Marine Riser. Test BOP stack, complete with casing. For stack test procedure see "Stack Testing" item C. Make up drill pipe hang off assembly and circulating head assembly. Install wearbushing.

Notes on Diverter Drilling/ Shallow gas drilling

- a) A diverter system is fitted on the "Borgny Dolphin" to provide a means of controlling the flow should shallow pressures be encountered whilst drilling for the first casing string (20" surface casing).
- b) The diverter system is not a blowout preventer. It is not designed to hold pressure, but instead, to direct the flow overboard. The controls of the flowline valves are manifolded in such a way that it is impossible to hold any pressure in the diverter. The downwind blow-off line must always be open.

c) Severe Losses

If severe losses are encountered while drilling with returns to surface pull out and drill a 8½" pilot hole instead of 14-3/4" and restrict penetration rates to obtain the lightest possible annular returns. If severe losses are continuing, open the dumpvalve and drill a 8½" pilot hole with returns to seabed.

If gas is encountered whilst drilling 8½" pilot hole with seawater and returns to seabed, spot heavy mud and inform Base.

d) Gas Flow (No Losses)

If there are any signs of gas having been encountered whilst drilling the 14-3/4" pilot hole carry out the following programme: -

- i) Drill to 20" casing setting depth with mud weight required.



- ii) Circulate the hole clean and make a wiper trip to the 30" shoe and back to bottom. Circulate bottoms up and spot weighted viscous mud as required. POH.
  - iii) Run logs as programmed.
  - iv) RIH with 14-3/4" bit and displace hole to mud with required weight for under-reaming. Dump heavy mud via dump valve. POH.
  - v) RIH with 26" hydraulic under-reamer with a 14-3/4" pilot bit and 17½" stabilizer.
  - vi) Under-ream the 14-3/4" hole to 26". Check hole size with a BGT log.
  - vii) RIH and circulate the hole clean.
  - viii) Increase the weight of the mud in the interval TD - seabed, to give an overbalance to any potential gas zones and thus compensate for removing the riser.
  - ix) POH to seabed. Circulate the drillpipe and marine riser to seawater and close kelly cock. Open the dump valve and observe the well static for 30 mins. Unlatch the 30" hydraulic latch and pull the marine riser.
  - x) Run a BGT to check hole size.
  - xi) Rig up and run 20" casing.
- Note:  
If the casing has to be circulated down and when circulating prior to cementing, weighted mud as used in step viii) above is to be used.

e) Gas Flow and Severe Losses

If any flow of gas is encountered whilst drilling the 14-3/4" pilot hole with returns to surface, and the required increased mud weight to counteract the gas flow causes severe losses, then inform Base and the various options will be considered.

Note:

There should be sufficient barytes and SAPP (1500) kg onboard the rig to allow for the setting of baryte plugs. Further programme will be advised in this case.

5. Drilling 17½" hole and running 13-3/8" casing

1. Drill out shoe track and shoe with a 17½" bit. Drill 5 m of new hole, and carry out a formation leak off test.
2. Drill 17½" hole to programmed depth.
3. Log as per programme. Make up 13-3/8" casing hanger with subsea cementing assembly (use two plugs) and stand back in derrick.
4. Make checktrip, pull wearbushing and run 13-3/8" casing to landing point, leaving 10 m pocket below the 13-3/8" shoe.
5. Cement 13-3/8" casing as per programme. Clean out the stack area prior to pulling out with the running string.
6. Carry out stack and casing tests as per "Stack Testing" Item C. Install wearbushing. Make up drillpipe hang-off assembly and circulating head assembly. Carry out a kickdrill.

6. Drilling 12-1/4" hole and running 9-5/8" casing

1. Drill out float collar, cement and shoe. Drill 5 m of new hole, and carry out a formation leak off test.

2. Drill 12-1/4" hole to programmed depth. Bit weight, RPM, bit selection and bottom hole assembly to be determined on site for optimum penetration rate.

Note: Coring will commence, using fibreglass inner corebarrel, from the top of the reservoir in the Upper Jurassic sandstone with a 8-1/2" core head and will continue through the complete oil bearing sequence. Approximate interval to be cored is 1530 - 1610 m BDF. The cored interval will be opened up to 12-1/4" prior to logging.

3. Carry out logging programme, including wire line tests if necessary.

Note: Dependent upon the results of the logs the well will either be abandoned or 9-5/8" casing will be run to allow for testing. If the well is to be tested, then proceed with step 4 below.

4. Make up 9-5/8" casing hanger with seal assembly and subsea cementing assembly (using two plugs) and stand back in derrick.

5. Make check trip, pull wearbushing and run 9-5/8" casing to landing point, leaving a 10 m pocket below the 9-5/8" shoe.

6. Cement the 9-5/8" casing as per programme. Clean out the stack area prior to pulling out the running tool. Whilst displacing, (in turbulent flow at 250 ft/min or higher), returns are to be monitored closely. If losses are observed adjust pump rates until full returns are obtained.

7. Carry out stack and casing tests as per "Stack Testing" Item C. Install wearbushing. Make up drillpipe hang-off and circulating head assembly. Carry out a kickdrill.

Note: At this point the testing phase will commence and a separate testing programme will be advised.

7. Abandonment

A specific abandonment/suspension programme will be prepared and issued when the well reaches total depth, but the general points below will apply:

1. If there is open hole below the last casing then all porous zones in the open hole interval will be isolated with cement plugs extending 50 m above and below each zone. In addition a cement plug, extending 50 m above and below the casing shoe, shall be set. The top of the cement plug shall be located and load tested. A mechanical bridge plug may be set in the lower part of the casing but not more than 50 m above the shoe. A 20 m cement plug must be placed on top of the bridge plug. The plugs at the last casing shoe shall be tested to 1000 psi (70 bar) differential pressure.
2. Perforations shall be isolated by means of a mechanical bridge plug and squeeze cemented, or a cement plug shall be placed across the perforations extending 50 metres above and below the perforated interval or down to a casing plug whichever is less.
3. Cement plugs of at least 50 metres shall be placed in the smallest casing string extending to seabed. These plugs shall be placed at the level of the 13-3/8" casing shoe and the 20" casing shoe.
4. A cement plug of at least 200 metres, with the top of the plug not more than 50 metres below the sea floor, shall be placed in the smallest string of casing extending to the sea floor.
5. Casing strings and other installations extending above the sea floor will be removed to a depth of at least 5 metres below the ocean floor.
6. The sea floor in the vicinity of the borehole will be inspected by underwater TV/observation dive to ensure that no obstructions remain on the sea bed which may cause danger or impediment to fishing or shipping.

C. STACK TESTING

The regular tests of the BOP stack in service have to be limited to the following pressures, unless differently advised by the base.

18-3/4", 10.000 psi BOP Stack

1. Pipe Rams : 4000 psi
  2. Blind Rams : Casing test pressure, as specified in Item A-16
  3. Kill/choke lines and valves : 4000 psi
  4. Annular preventers : 2000 psi around 5" DP  
1500 psi around 3-1/2" DP
- a) Test 1,3 and 4 to be carried out with a boll weevil tester run on DP and landed in the wellhead.
  - b) Test 2 to be carried out only when the cement of the last casing is not yet drilled out.
  - c) The 13-3/8" and 9-5/8" seal assemblies are to be tested to 4250 psi.

Accumulator Tests

The accumulators must have sufficient capacity to be able to close, open and close all preventer with both air and electric charge pumps off, and then still have enough pressure left to provide working fluid for 25% of one closing function. Minimum recharge time from above condition with both air and electric pumps running should be in accordance with manufacturer's specifications. A note that this test has been carried out (and results) must be made in the Drilling Report and on weekly BOP test checklist. For frequency see item 10 of this section.

Notes on Testing

1. The BOP stack has to be tested on all functions and all rams tested to the full rated WP at surface prior to running the Stack. However, the blind/shear rams will be tested only on orders of Base, but at least once per month during a routine stack test. After the surface tests all Cameron clamp connections and all studded connections must be checked for tightness.
2. All pressure tests to be carried out with water, unless differently advised by Base.
3. All surface equipment has to be satisfactorily pressure tested prior to testing the BOP stack underwater.
4. When running the Marine Riser with integral kill-and choke lines, the kill-and choke lines can be tested while running in at various stages. This should be done at least twice, firstly as soon as the stack is below sea level, and secondly, just before landing the stack.
5. When testing the BOP stack underwater with a boll weevil test tool in the wellhead, use the vented red-painted test single.
6. All pressure tests should be done in 500 psi stages up to the required test pressure.
7. The test pressure should be kept on for 15 minutes, and the acceptable pressure drop over this 15 minutes period is 10% of the initial test pressure, provided that the pressure remains constant for the next 5 to 10 minutes.
8. All pressure tests to be recorded on pressure recorder charts. A record is to be kept of the volumes required to obtain the test pressure, and of the volumes returned when bleeding off.

9. For all pressure tests either the Shell TP or WSPE will be present at the pumping unit to monitor volumes/pumped and pressures.
10. The opening/closing times and the volumes of hydraulic operating fluid required for the operation of the various underwater stack components (such as: rams, kill and choke valves, annular preventers, hydraulic connectors, etc.) should be recorded during testing of the stack underwater. These results should be compared with the normal opening/closing times and volumes required of the hydraulic system. Any major differences are an indication that the system is not operating "normally" and may require further investigations and/ or repairs.
11. The testing of 10,000 psi BOP stack will be done to 4000 psi only, at the weekly routine BOP test underwater. If higher test pressures are required then, depending on the well programme, the test pressure will be increased to the value required and carried out with a boll weevil test tool, e.g. subjecting the seals of the seal assembly to the same pressure as the BOP stack, or by means of a weight set tester, subjecting only the stack to the required test pressure. Run 2 stands drill collars below the weight set tester to assist in shearing the pins with set down weight.  
  
See item 1 on blind/shear rams.
12. Accumulator tests (as described previously) should be done either on request of Base, or after repair have been done to the accumulator system, i.e. bottles, bladders, pumps, etc.



D. EVALUATION REQUIREMENTS

1. Cutting Samples

Ditch cuttings to be collected every 10 m below 30" casing down to 1270 m BDF, and every 3 m thereafter. The following samples will be required for partners/ government bodies:

- a) 5 x full large bags (2 kg each) of wet cuttings.
- b) 1 x medium large bag (1 kg) of wet cuttings for biostratigraphy.

1 x 2 kilogram large bag of wet samples from each interval should be kept on board until the well has reached TD when the complete set should be sent in. 4 wet (large bags) samples should be sent ashore ASAP by boat, marked for attention of EPXV/1, Tananger. Biostratigraphy samples should be in cardboard box and sent in by first available helicopter.

2. Coring

Coring is to commence from top of the reservoir in the Upper Jurassic sandstone, and is to continue through the complete hydrocarbon-bearing sequence until just below top of zone 2 in the Upper Jurassic sandstone. Approximate interval to be cored is 1530 - 1610 m BDF.

8-1/2" core-head and fiberglass innerbarrels are to be used.

Note: A 150 grams sand sample will be taken of each 90 cm length of core taken across the oil bearing sand and properly labelled. This sample will be used in sieve analysis to optimize sand size for the gravelpack completion.

3. Logging Programme

At 20" casing depth	ISF/SONIC/SP/GR (GR to seabed) FDC/CNL/CAL/GR
At 13-3/8" casing depth	ISF/SONIC/SP/GR FDC/CNL/CAL/GR SWS (as required)
At 9-5/8" casing depth (TD logging)	ISF/SONIC/SP/GR FDC/CNL/CAL/GR LDT/NGT MSFL/DLL/CAL/SP/GR HDT RFT's (as required) SWS (as required) CBL (on 13-3/8" casing and 9-5/8" casing). Velocity Survey

4. Testing Programme

Testing of the well is subject to confirmation upon receipt of logs.

The intention is to production test the oil zone with sufficient thickness of oil column present by means of a milled casing under-reamed gravel pack (MCURGP) completion. Specific test programmes will be advised later.

E. CASING DESIGN

Casing design are presented for the 20", 13-3/8" and 9-5/8" casings (See Encl. 1.0.)

The following assumptions apply:

1. For tension, a design safety factor of 1.6 is used, neglecting buoyancy in the drilling fluid.
2. Bi-axial effects have been neglected except in the case of the lowering of collapse resistance caused by tension. No allowance is given for the increase of burst resistance caused by tension.
3. For burst, a design safety factor of 1.1 is employed. The pressure distribution for the burst loading assumes a 40% evacuation of mud from the well by a kick. (This is equivalent to a kick volume in excess of 100 bbls).
4. For collapse, a design safety factor of 1.0 is employed. For the 20" and 9-5/8" casings total evacuation has been assumed for the design. For the 13-3/8" casing, evacuation of 85 % has been assumed for the design.
5. In the production test design for casing burst, a tubing leak is assumed putting full THP on the tubing/casing annulus, filled with 1.15 S.G. fluid.

F. GLOSSARY OF ABBREVIATIONS

BDF	:	below derrick floor
BGT	:	borehole geometry tool
BOP	:	blow out preventer
FS	:	fail safe (as in FS valve)
FWL	:	free water level
GOC	:	gas oil contact
ID	:	internal diameter
MCURGP	:	milled casing under-reaming gravel pack
MF	:	Marsh funnel (mud viscosity)
MR	:	Marine riser
MSL	:	mean sea level
MSS	:	magnetic single shot
OD	:	outside diameter
OWC	:	oil water contact
PGB	:	permanent guide base
PPG	:	pounds per US gallon
PV	:	plastic viscosity
ROP	:	rate of penetration
SS	:	sub sea
TD	:	total depth
TGB	:	temporary guide base
THP	:	tubing head pressure
TMCM	:	Transverse Mercator, Central Meridien
UGF	:	universal guide frame
YP	:	yield point
WHP	:	wellhead pressure
WP	:	working pressure
WOC	:	wait on cement
UTM	:	Universal Transverse Mercator

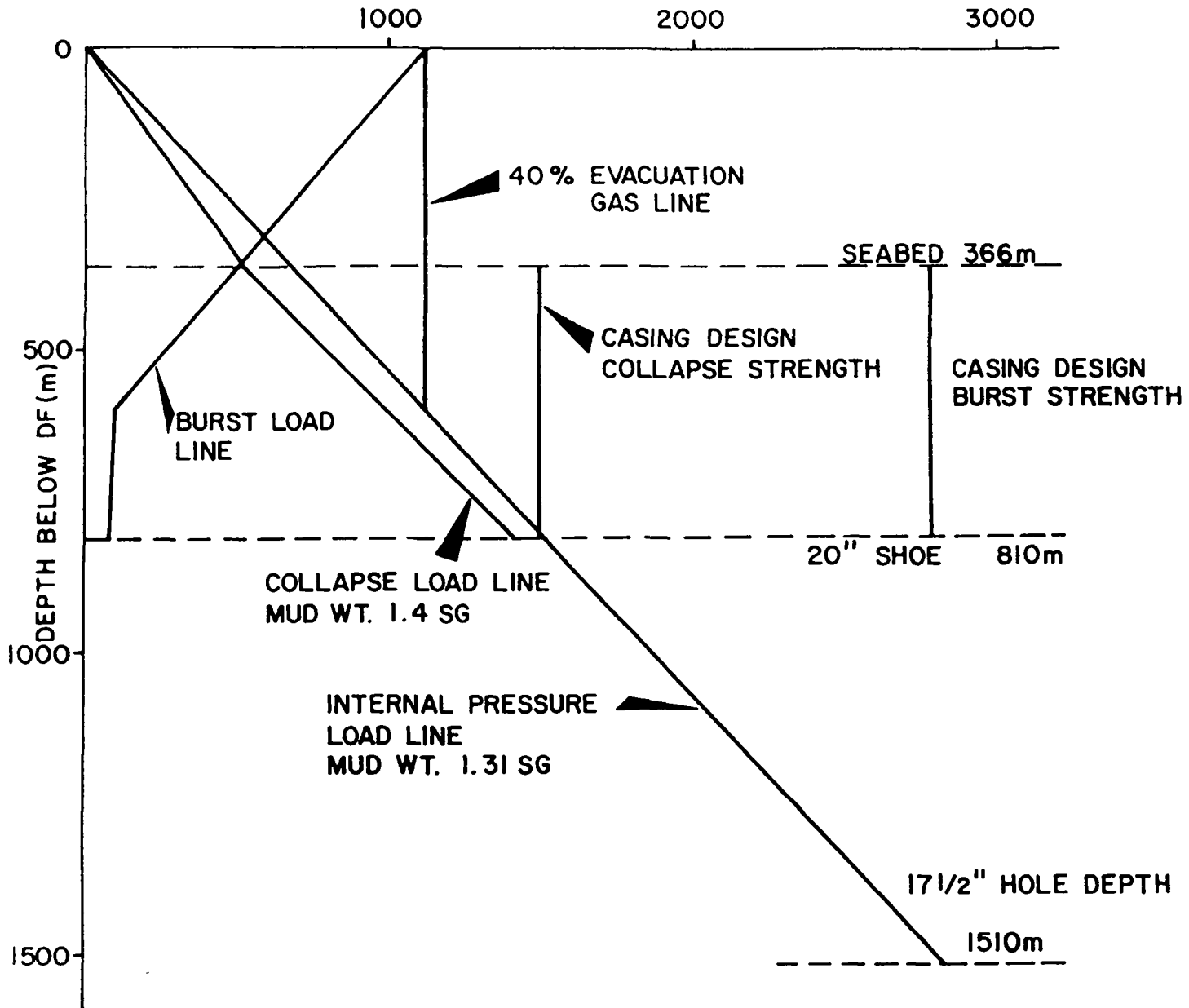
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BDF	:	below derrick floor
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OWC	:	oil water contact
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PPG	:	pounds per US gallon
PV	:	plastic viscosity
ROP	:	rate of penetration
SS	:	sub sea
TD	:	total depth
TGB	:	temporary guide base
THP	:	tubing head pressure
TMCM	:	Transverse Mercator, Central Meridien
UGF	:	universal guide frame
YP	:	yield point
WHP	:	wellhead pressure
WP	:	working pressure
WOC	:	wait on cement
UTM	:	Universal Transverse Mercator

# 20" CASING DESIGN 31/2-K

Encl. IA

PRESSURE PSI



FOR 20", 133 LB/FT, X-52, HUNTING SWIFT DW-LH CASING

	<u>COLLAPSE</u>	<u>BURST</u>	<u>TENSION</u>
API RATING	1500	3060	2,123,000
SAFETY FACTOR	1.0	1.1	1.6
DESIGN STRENGTH	1500	2782	1,326,875

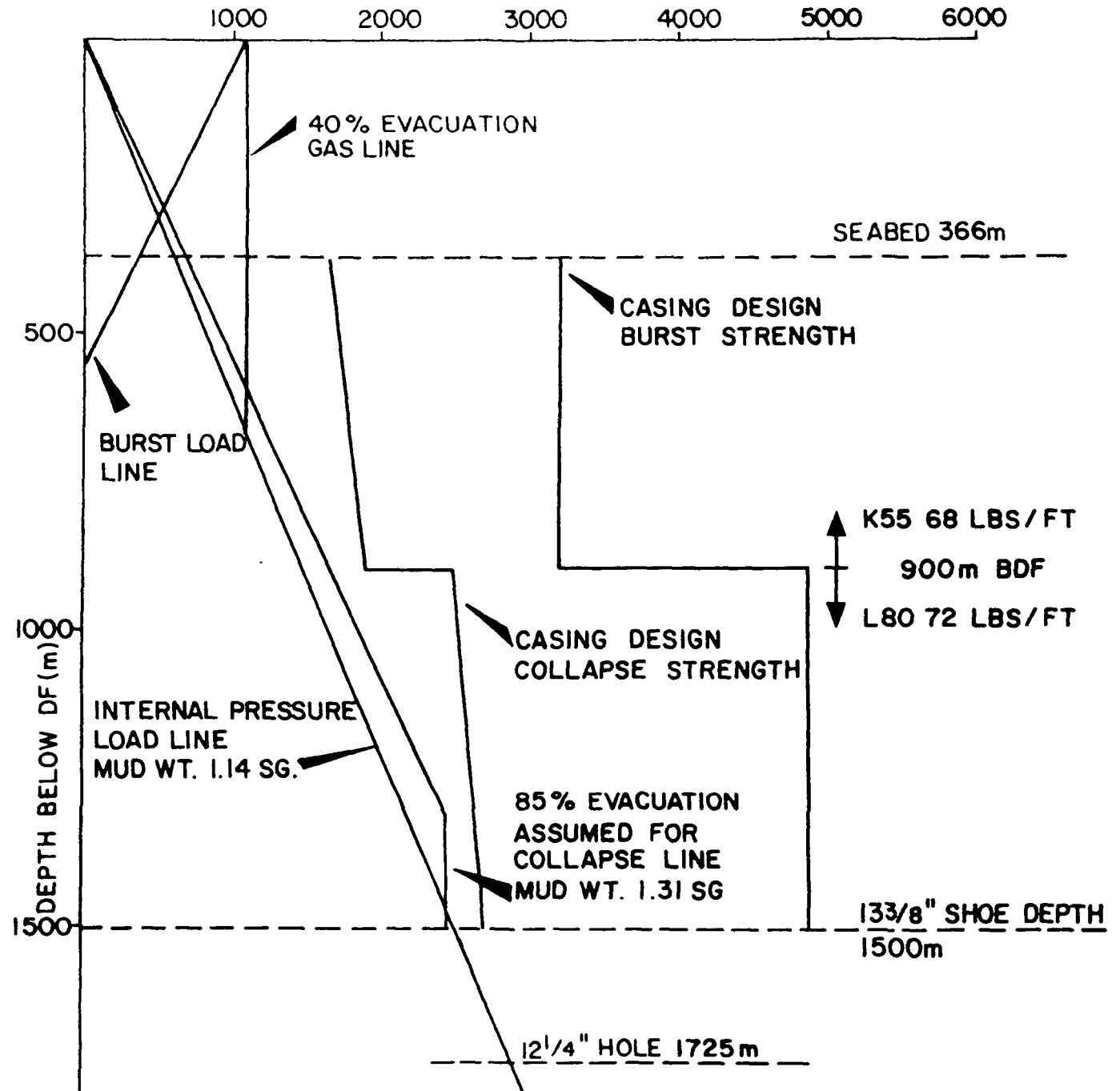
MAXIMUM TENSILE LOAD =  $133 \times 3.281 (810 - 366)$   
 = 193,750 LBS

20" 133 LB/FT, X-52, HUNTING SWIFT DW-LH IS THEREFORE SATISFACTORY  
 IN BURST, COLLAPSE AND TENSION FOR THIS WELL.

# 13 3/8" CASING DESIGN 31/2-K

ENCL 18

PRESSURE PSI



FOR 13 3/8", 68/72 LBS/FT, K55/L80, BTC CASING THE FOLLOWING APPLY

	COLLAPSE		BURST		TENSION	
WT LBS/FT	(68)	(72)	(68)	(72)	(68)	(72)
API RATING	1950	2670	3450	5380	1.069.000	1.661.000
SAFETY FACTOR	1.0	1.0	1.1	1.1	1.6	1.6
DESIGN STRENGTH	1950	2670	3136	4891	668.130	1.038.125

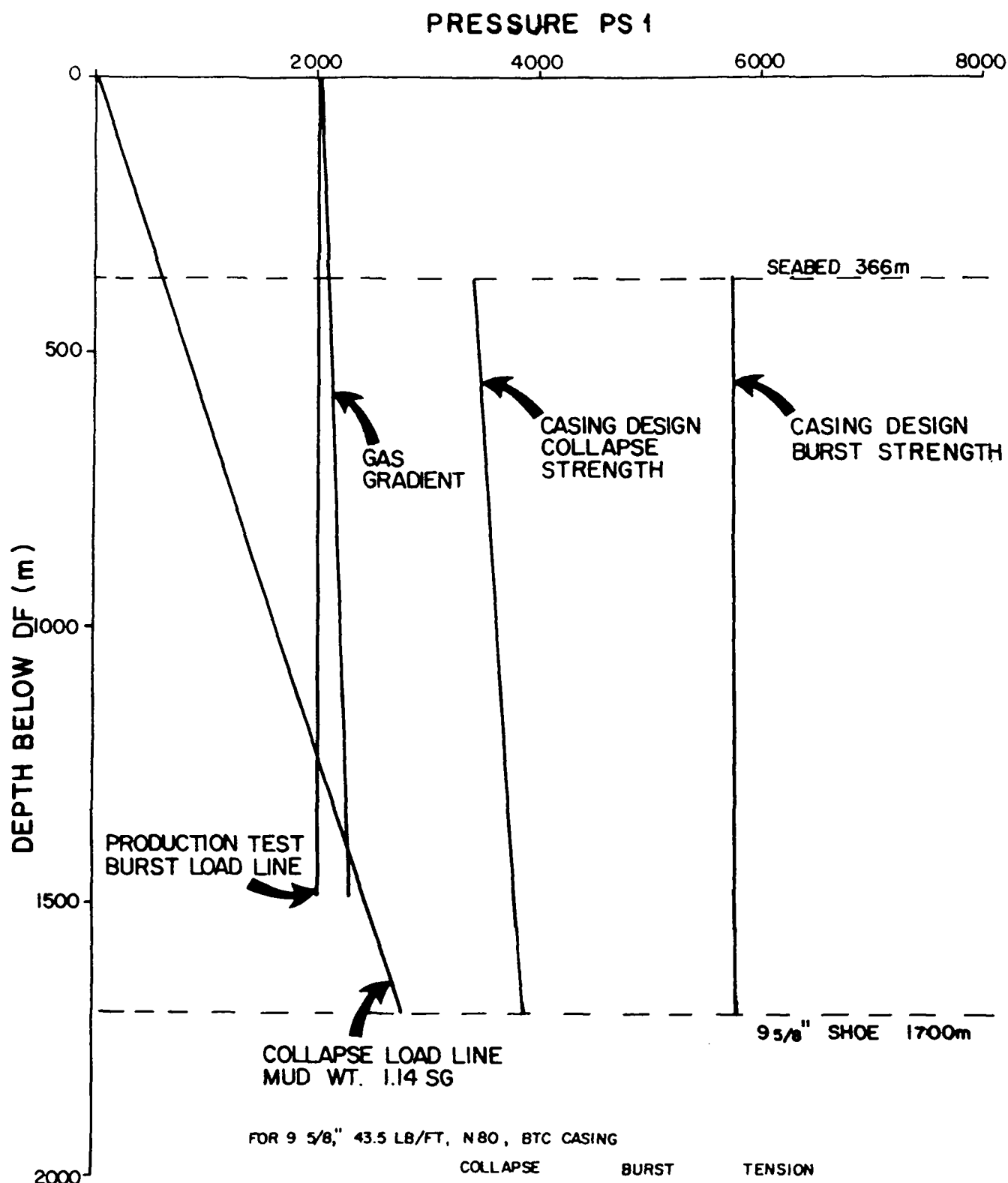
MAXIMUM TENSILE LOAD (68 LBS/FT) =  $72 \times 3.28 \times 600 + 68 \times 3.281 \times 534$   
 = 260,836 LBS

13 3/8", 68/72 LBS/FT, K55/L80 BTC IS THEREFORE SATISFACTORY IN BURST, COLLAPSE AND TENSION FOR THIS WELL.

2000  
2500

# 9 5/8" CASING DESIGN 3 1/2-K

Encl. 1c



FOR 9 5/8," 43.5 LB/FT, N80, BTC CASING

	COLLAPSE	BURST	TENSION
API RATING	3810	6330	1005000
SAFETY FACTOR	1.0	1.1	1.6
DESIGN STRENGTH	3810	5754	628125

MAXIMUM TENSILE LOAD  $43.5 \times 3.281 (1700 - 366)$   
= 190400LBS

9 5/8" 43.5 LB/FT, N80, BTC CASING IS THEREFORE SATISFACTORY  
IN BURST, COLLAPSE AND TENSION FOR THIS WELL.

THE DESIGN SHOWS THAT THE CASING CAN WITHSTAND A  
PRODUCTION TEST ON THE MAIN GAS RESERVOIR.



CEMENT CALCULATIONS30" Cementation

Extended Norcem Class "G" cement of lead slurry weight 13.2 ppg(1.58 SG) and 10 m of 15.8 ppg(1.90 SG) tail slurry above the shoe are to be used. The casing is to be cemented back to seabed, and an excess of 200% is to be used over open hole intervals. Cement displaced to 10 m above shoe.

Data: Casing 30" 1" WT/VETCO "ATD-RB"  
 30" shoe 460 m BDF  
 36" hole 470 m BDF

13.2 ppg Lead Slurry Volumes

i) 36" x 30" annulus	= (450-366)x3.281x2.1598x3	= 1785.7 cu.ft.
Cement required	= 1785.7/1.89	= 944.8 sxs
		= 40.3 m/t
Seawater required	= 944.8 x 10/42	= 225.0 bbls
Econolite required	= 944.8 x 0.36	= 340.1 gals.

15.8 ppg Tail Slurry Volume

i) 36" x 30" annulus	= (460-450)x3.281x2.1598x3	= 212.6 cu.ft.
ii) 36" pocket	= (470-460)x3.281x7.0686x3	= 695.8 cu.ft.
iii) 30" casing fill	= 10 x 3.281 x 4.2761	= <u>140.3 cu.ft</u>
	Total slurry	= 1048.7 cu.ft.
Cement required	= 1048.7/1.17	= 896.3 sxs
		= 38.2 m/t
Seawater required	= 896.3 x 5.15/42	= 109.9 bbls
CaCl <sub>2</sub> required (BWO)	= 896.3 x 94 x 0.03/2205	= 1.15 m/t

20" Cementation

Extended Norcem Class "G" cement of lead slurry weight 13.2 ppg(1.58 SG), and 60 m of tail slurry above the shoe, of weight 15.8 ppg(1.90 SG) are to be used. The casing is to be cemented back to seabed and an excess of 100% is to be used over open hole intervals. Cement to be displaced to 12 m above the float shoe using 1 subsea cement plug.

Data: Casing 20"/133 lbs/ft/X-52/Hunting SWIFT DW - LH  
 30" shoe at 460 m BDF  
 36" hole at 470 m BDF  
 20" shoe at 810 m BDF  
 26" hole at 820 m BDF

13.2 ppg Lead Slurry Volumes

i) 30" x 20" annulus	= (460-366)x3.281x2.0944	=	645.9 cu.ft.
ii) 36" x 20" annulus	= (470-460)x3.281x4.8869x2	=	320.7 cu.ft.
iii) 26" x 20" annulus	= (750-470)x3.281x1.5053x2	=	<u>2765.8 cu.ft.</u>
	Total slurry volume	=	3732.1 cu.ft.

Cement required	= 3732.1/1.89	=	1974.7 sxs
		=	84.2 mt
Seawater required	= 1974.7 x 10/42	=	470.2 bbls
Econolite required	= 1974.7 x 0.36	=	710.9 gals

15.8 ppg Tail Slurry Volumes

i) 26" x 20" annulus	= (810-750)x3.281x1.5053x2	=	592.7 cu.ft.
ii) 26" pocket	= 10 x 3.281 x 3.6870 x 2	=	241.9 cu.ft.
iii) 20" casing fill	= 10 x 3.281 x 1.9133	=	<u>62.8 cu.ft.</u>
	Total slurry volume	=	897.4 cu.ft.

Cement required	= 897.4/1.17	=	767.0 sxs
		=	32.7 mt
Seawater required	= 767.0 x 5.15/42	=	94.0 bbls
CaCl <sub>2</sub> required (BWOc)	= 767.0 x 94 x 0.02/2205	=	0.65 mt

13-3/8" Cementation

Extended Norcem Class "G" cement of lead slurry weight 13.2 ppg(1.58 SG), and 100 m of tail slurry above the shoe, of weight 15.8 ppg(1.90 SG) to be used. The casing is to be cemented back to 150 m inside the 20" casing using 30% excess on open hole volumes. Cement will be displaced to a float collar c. 13 m above the shoe.

Data: Casing 13-3/8"/72 lb/ft/N80/BTC  
 20" shoe at 810 m BDF  
 26" hole at 820 m BDF  
 13-3/8" shoe at 1500 m BDF  
 17-1/2" hole at 1510 m BDF

13.2 ppg Lead Slurry Volumes

i)	20" x 13-3/8" annulus	= (810-660)x3.281x0.9377	=	461.5 cu.ft
ii)	26" x 13-3/8" annulus	= (820-810)x3.281x2.7113x1.3=		115.6 cu.ft
iii)	17½"x 13-3/8" annulus	= (1400-820)x3.281x0.6946x1.3=		<u>1718.4 cu.ft</u>
	Total slurry volume		=	2295.5 cu.ft

Cement required	= 2295.5/1.79	=	1282.4 sxs
		=	54.7 mt

Mixwater required	= 1282.4 x 9.47/42	=	289.2 bbls
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Additives to be advised.

15.8 ppgTail Slurry Volumes

i)	17½"x 13-3/8" annulus	= (1500-1400)x3.281x0.6946x1.3=		296.3 cu.ft.
ii)	17½" pocket	= 10 x 3.281 x 1.6703 x 1.3 =		71.2 cu.ft.
iii)	13-3/8" shoe track	= 13 x 3.281 x .8314	=	<u>35.5 cu.ft.</u>
	Total slurry volume		=	403.0 cu.ft

Cement required	= 403.0/1.17	=	344.4 sxs
		=	14.7 mt

Mixwater required	= 344.4 x 5.15/42	=	42.2 bbls
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Additives to be advised.

9 5/8" Cementation

Norcem Class "G" cement at 15.4 ppg(1.85 SG) slurry weight will be used as the main slurry up to 1325 m BDF. 50 bbls (262 m) of 13.5 ppg(1.62 SG) scavenger slurry (Class "G") is to be pumped ahead of the main 15.4 ppg slurry. A 20% excess is to be used over open hole intervals, and cement is to be displaced to a float collar c.25 m above the shoe.

Data: Casing 9-5/8"/47 lb/ft/L80/VAM  
 13-3/8" shoe at 1500m BDF  
 17-1/2" hole at 1510m BDF  
 9-5/8" shoe at 1715m BDF  
 12-1/4" hole at 1725m BDF

15.4 ppg Slurry Volume

i) 13-3/8"x9-5/8" annulus (1500-1325)3.281x.3262	=	187.3 cu.ft.
ii) 17-1/2"x9-5/8" annulus (1510-1500)3.281x1.1651x1.2	=	45.9 cu.ft.
iii) 12-1/4"x9-5/8" annulus (1715-1510)3.281x.3132x1.2	=	252.8 cu.ft.
iv) 12-1/4" pocket 25x3.281x0.8185x1.2	=	80.6 cu.ft.
v) 9-5/8" shoe track 36 x 3.281 x 0.4180	=	<u>49.4 cu.ft.</u>
Total slurry volume	=	616.0 cu.ft.

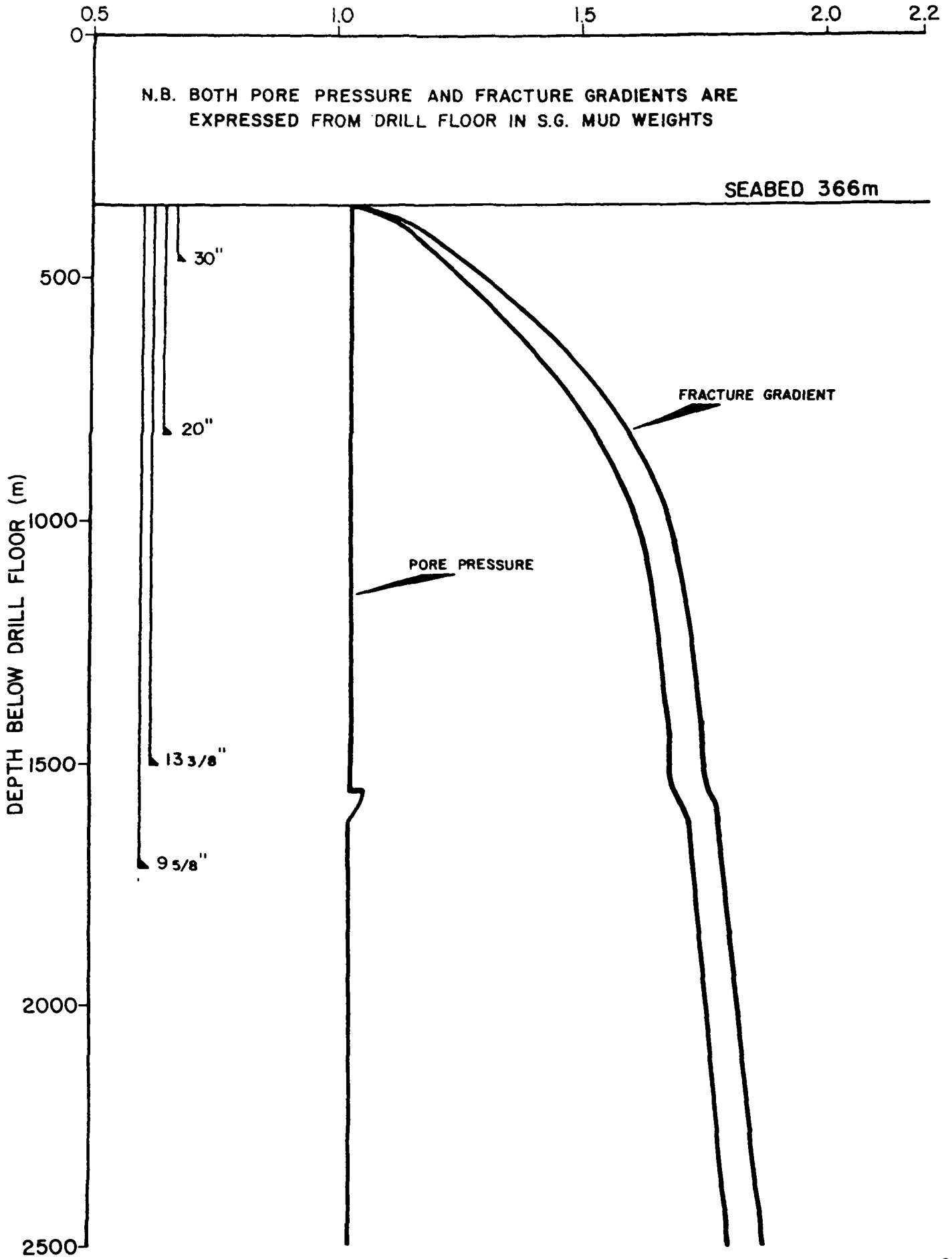
Cement required	= 616.0/1.23	=	501 sxs
		=	21.4 mt
Mixwater required	= 501 x 5.67/42	=	67.6 bbls
Additives to be advised.			

13.5 ppg Scavenger Slurry Volumes

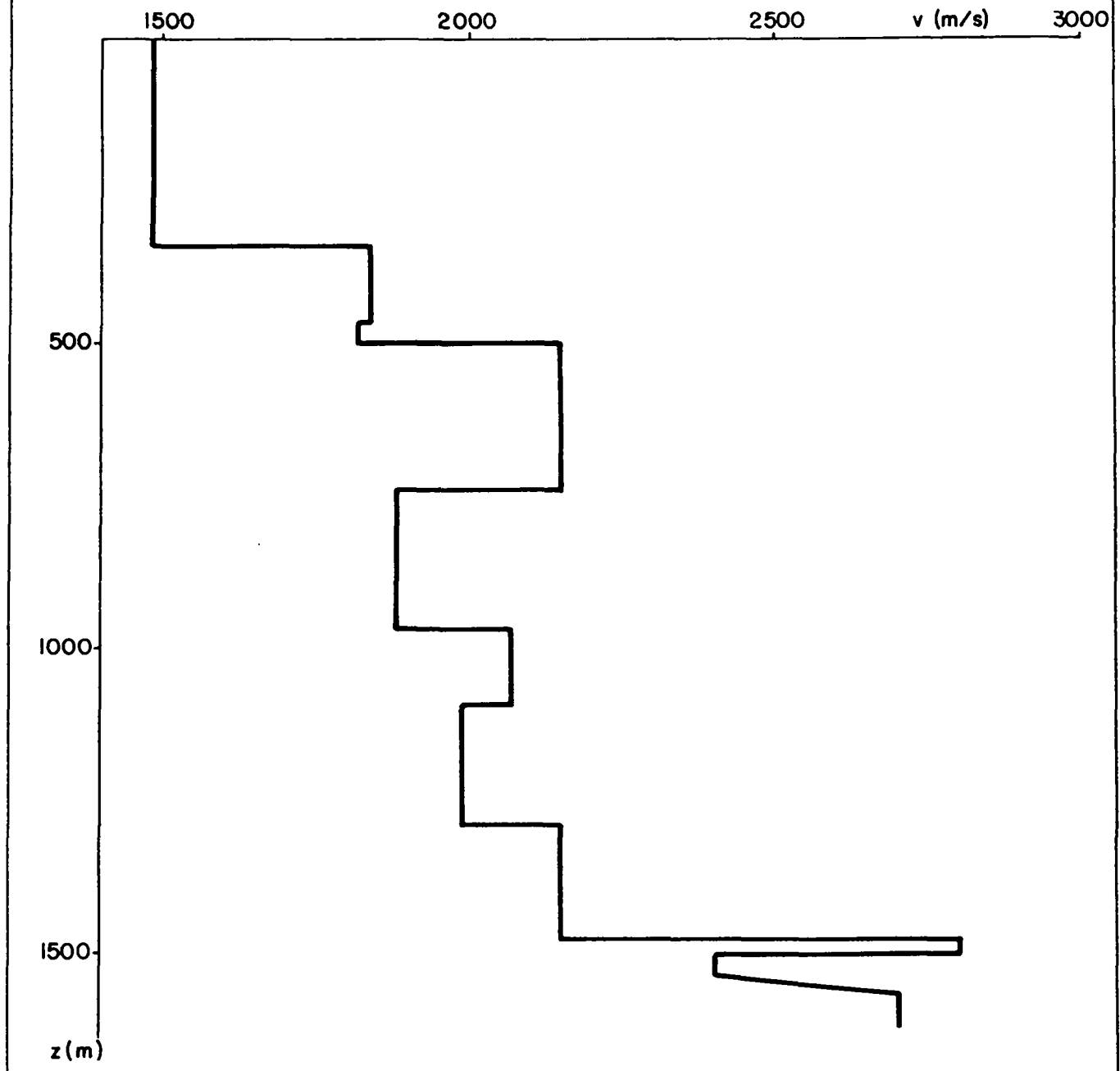
i) 13-3/8" x 9-5/8" annulus (1325-1063)3.281x.3262	=	280.4 cu.ft.	
Cement required	= 280.4/1.71	=	164.0 sxs
		=	7.0 mt
Mixwater required	= 164.0 x 9.27/42	=	36.2 bbls
Additives to be advised.			


# WELL 31/2 - K

## ESTIMATED PORE PRESSURE AND FRACTURE GRADIENTS SHOWING THE DEGREE OF UNCERTAINTY



# INTERVAL VELOCITY VS. DEPTH



**a-s Norske Shell**  
EXPLORATION & PRODUCTION FORUS 

**DRILLING PROGRAMME**  
**LOCATION 31/2-K**

AUTHOR <b>EPPP/30</b>	ENCL. <b>5</b>	DATE <b>JUNE '82</b>
REPORT NO.		DRAW NO <b>G 1157/2</b>