

L&U DOK. SENTER	
L. NR. 20084450006	
Nr.:	KODE Well 31/2-5 nr 37
Returneres etter bruk	

DRILLING PROGRAMME

LOCATION 31/2-5

**31/2-5**

Lnr. 1080-0024	Statell				
Ans.	Operativ				
Opp.					
1. OKT 1980					
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A/S NORSKE SHELL

LICENCE 054



NORSKE SHELL E & P, FORUS.  
**DRILLING PROGRAMME**  
 CONFIDENTIAL

LOCATION: 31/2-F  
 WELL: 31/2-5  
 RIG: "West Venture"

PRODUCTION LICENCE No: C54  
 ESTIMATED DAYS (including Prod. Testing) 100 days

TOLERANCE: 75 m all round  
 CO-ORDINATES OF LOCATION  
 N 6738478  
 E 414584

HOLE SIZE (mm)	HOLE DEPTH (metres)	CASING SIZE/WT/GRAD/PLG	CEMENT		REMARKS	S.G. (PSI/1000)	MUD		LOGGING	DEBRICK FLOOR ELEVATION.	32 M ABOVE MSL 362 M ABOVE SEA BED
			Remarks	Remains			REMARKS	REMARKS			
36"	450	30"/11"WT/310 ATD-RB Squinch	Class G S'water	See Enclosure (2A)	1.03 (445)	1.03 (445)	Seawater + Viscous pills (+/- 100secs HF)	None			
26" see note 3	810	20"/133/K55 Vetco LS-LH	Class G S'water	See Enclosure (2B)	1.03 (445)	1.03 (445)	Gelled seawater + Viscous pills	(In 17 1/2" pilot hole) ISF/SONIC/SP/GR FDC/CNL/CAL/GR			
17 1/2"	1480	13 3/8"/72/L80/BTC	Class G F'water	See Enclosure (2C)	1.26 (545) to 1.31 (567)	1.26 (545) to 1.31 (567)	KCL/Polymer system KCL: +/- 35 ppb MF: 50-60 secs PV/YP: 20-25/15-20 ML: Less than 10 CCS	ISF/SONIC/SP/GR FDC/CNL/CAL/GR SMS as required			362
12 1/4"	1760	9 5/8"/47/L80/VAM	Class G F'water	See Enclosure (2D)	1.15 (500)	1.15 (500)	KCL/Polymer system from 17 1/2" section dispersed with Lignosulphonates. MF: 50-60 PV/YP: 20-25/15-20 ML: Less than 5 CCS	ISF/SONIC/SP/GR FDC/CNL/CAL/GR HDT RFT's as required SMS's as required CBL on 13 3/8" casing			1312 +/- 20 1382 +/- 20 1507 +/- 20
8 1/2"	2532	7"/29/H80/BTC Liner if required	Class G F'water	To be advised	1.15 (500)	1.15 (500)	As for 12 1/4" section See note 7	ISF/SONIC/SP/GR FDC/CNL/CAL/GR HDT RFT's as required SMS's as required CBL on 9 5/8" casing Velocity Survey			1527 +/- 20 1580 1602 +/- 30 1787 +/- 20 2042 +/- 30 2212 +/- 30 2472 +/- 50 2532

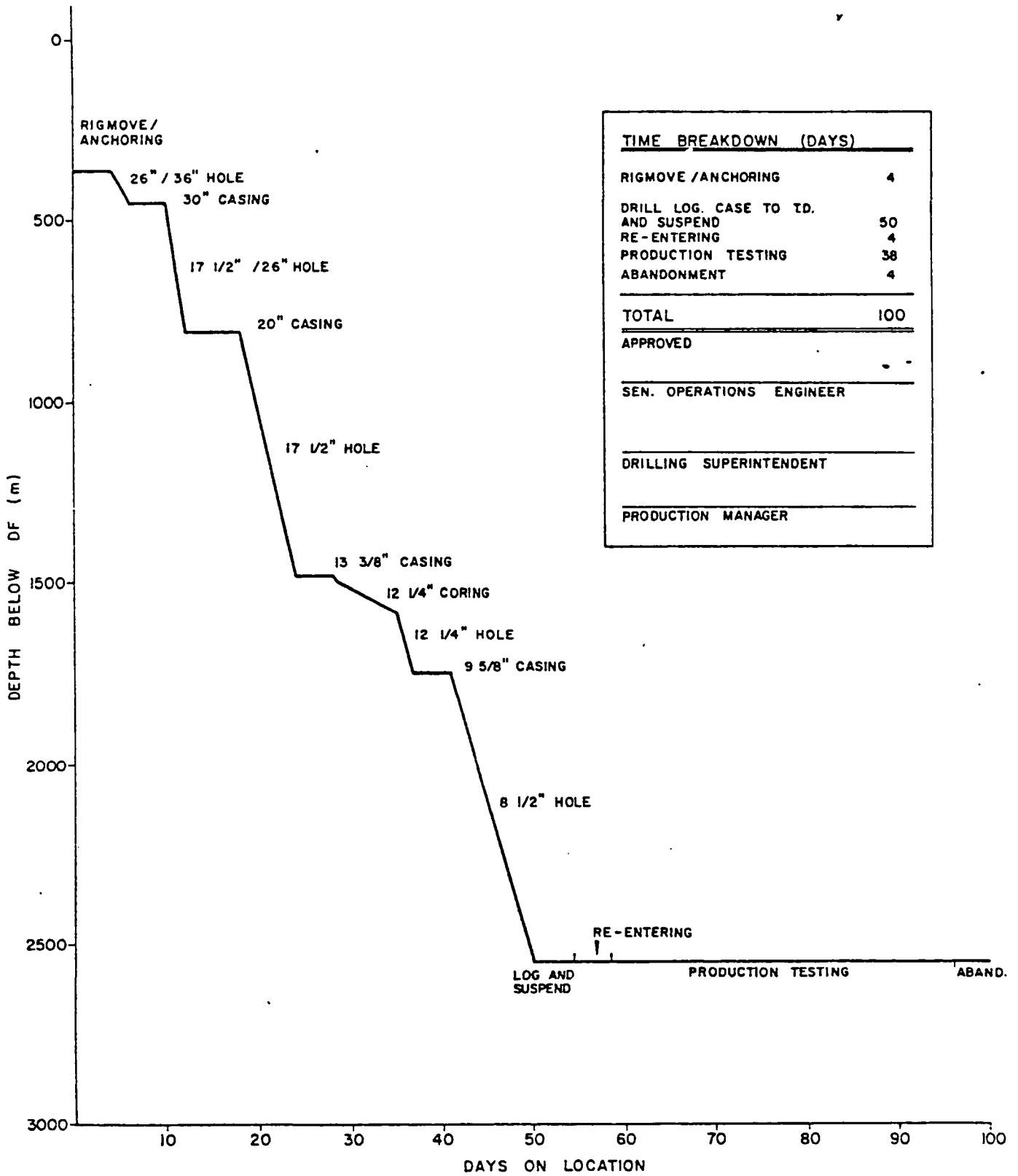
NOTES:

- All mud weights are to be adjusted in the light of hole problems (i.e. sloughing shale, tight hole, high mud gas readings etc.)
- Formation leak off tests are required below 20".
- 13 3/8" and 9 5/8" casing shoes.
- 17 1/2" pilot hole is to be drilled to 20" casing depth and logged for shallow gas prior to pulling the MR and opening the hole up to 26".
- Cutting Collection: Every 10 m below the 30 casing. Every 3 m below 1250 m.
- Coring will commence in the L. Cretaceous to ensure coring the clay/sand interface and will continue until at least one core is taken in the waterzone. Coring will resume if hydrocarbons are encountered below the main reservoir and continue until at least one core is taken in the waterzone.

- Estimated pore pressure is +/- 2283 psi at 1527 m BDF.
- If hydratable clays are encountered the mud will be "broken over" to a Gypsum/Ligno-sulphonates system.

SIGNED BY  
 [Signature]  
 CHIEF PETROLEUM ENGINEER  
 [Signature]  
 PRODUCTION MANAGER  
 [Signature]  
 EXPLOREMENT MANAGER  
 [Signature]  
 HEAD OF DRILLING  
 [Signature]  
 DATE: 17.09.80

# 3 1/2 - F DRILLING PROGRESS CURVE



## TIME BREAKDOWN (DAYS)

RIGMOVE / ANCHORING	4
DRILL LOG. CASE TO TD. AND SUSPEND	50
RE-ENTERING	4
PRODUCTION TESTING	38
ABANDONMENT	4

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TOTAL 100

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APPROVED

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SEN. OPERATIONS ENGINEER

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DRILLING SUPERINTENDENT

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PRODUCTION MANAGER

A/S NORSKE SHELL

DRILLING PROGRAMME - LOCATION 31/2-F

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 274 on seismic line 79-421 and SP 838 on seismic line 79-410)

Geographical

TMCM 5 deg. E

60 deg 46' 16.2" N 6738478 N  
03 deg 25' 55.1" E 414584 E

Tolerance: 75 metres all round.

2. Base

Tananger Shore Base to Location 258 kms  
Bergen Shore Base to Location 119 kms

3. Depth References

- a) All depths are given with respect to the rotary table of the drilling vessel at the specified drilling draught.
- b) Expected water depth at location is +/- 330 m (MSL-seabed).
- c) For drilling, the barge draught will be c.25 m.
- d) Distance from rotary table to MSL is taken as +/- 32 metres for this programme but will be measured on site.  
Distance from rotary table to seabed is taken as +/- 362 metres for this programme but will be measured on site.

4. Type of Well

Exploration well.

5. Total Depth

TD is anticipated to be 2500 m SS, in Triassic Red Beds.

6. Drilling Installation

"West Venture" - a Norrig-5 design semisubmersible.

7. Objectives

- i) To test for the presence and nature of hydrocarbons in a structure west of the main gas reservoir.
- ii) To evaluate the lateral variation in reservoir parameters.
- iii) To get reliable geological tie to the seismic reflectors to allow for accurate lateral extrapolation of well data.
- iv) To investigate possible causes for the difference in flatspot appearance in this fault block.

See attached seismic section, structure map and pronosis sheet.

8. Prognosis

<u>Formation Tops</u>	<u>Lithology</u>	<u>Depth</u> <u>TVBDF</u>	<u>Seismic</u> <u>Tolerance</u>
Seabed (Quarter- nary Eocene)	Clay, clay- stones	362	+/- 5
Eocene	Tuffaceous claystones	1312	+/- 20
Palaeocene	Calystones and marls	1382	+/- 20
Cretaceous	Marls and limestones	1507	+/- 20
Jurassic Sandstone Group			
Interval 4	Medium-coarse unconsolidated sandstones	1527	+/- 20
Seismic Flatspot		1580	
Interval 3	Fine micaceous sandstones	1602	+/- 30
Interval 2 and 1	Sandstones, claystones, coals and marls	1787	+/- 20
Dunlin Unit Equivalent	Silty/sandy claystones	2042	+/- 30
Statfjord Formation	Fine - medium sandstones with coals at base	2212	+/- 30
Triassic Red Beds	Claystone and sandstones	2472	+/- 50
TD 2532 m BDF			

9. Pressures

From data gained in the drilling, the subsequent electric logging and RFT pressure measurements made in 31/2-1, and from the production tests performed on 31/2-2 and 31/2-3 it was found that these wells are hydrostatically pressured.

The proposed location 31/2-F is located in a separate fault block some 11 kms and 11.5 kms SW of 31/2-2 and 31/2-3 respectively. Various seismic events can be traced across the faults indicating that the faults are non-sealing. Therefore, the location 31/2-F is considered to be in the same hydrostatically pressured regime.

(See Encl. 3)

10. Mud resume

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

The 17½" pilot hole for the 26" hole section is to be drilled with an unweighted gelled water mud combined with the frequent spotting of viscous pills. The 17½" 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 17½" pilot hole and 26" hole for logging and the running of 20" casing respectively, mud of 1.40 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 wells 31/2-1, 2 and 3 a mud weight of 1.31 SG was required to stabilize this hole section.

For the 12-1/4" hole section the KCL/Polymer mud will be dispersed by the use of Lignosulphonates. A mud weight of 1.15 SG (.500 psi/ft) will be used in this section.

Note:

This mud weight will exert +/- 100 psi overbalance on top of the main reservoir in the event of the riser being disconnected.

The 8½" hole section will be drilled with a dispersed Lignosulphonate mud system with a mud weight of 1.15 SG (.500 psi/ft).

Note:

- 1) Mud weights mentioned are a guide only and are liable to change if hole conditions dictate.
- 2) If hydratable clays are encountered in the 12-1/4" or 8½" hole sections, the mud will be "broken over" to a Gypsum/Lignosulphonate mud system.

Detailed mud properties and parameters will be specified in a separate mud programme.

11. Well Control

A diverter will be hooked up to the riser during the drilling of the 17½" pilot hole for 20" casing. In addition, 1.4 SG mud (.600 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.

12. Deviation Control

Magnetic single shot surveys will be taken every 90 metres, 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 Squnch	Seabed - 440 m
20"	K-55	133 lbs/ft	Vetco LS-LH	Seabed - 800 m
13-3/8"	L-80	72 lbs/ft	BTC	Seabed -1470 m
9-5/8"	L-80	47 lbs/ft	VAM	Seabed -1750 m

N.B. The 13-3/8", L-80, 72 lbs/ft, BTC casing will be specially drifted at the mill (during manufacture) and again at the rig (before running) to ensure it will pass a 12-1/4" bit.

14. Wellhead Equipment

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

15. Formation Gradient Tests

Leak off tests will be made after drilling 5 metres of new hole below the 20", 13-3/8" and the 9-5/8" casing shoes.

16. Casing Accessories

The 30", 20", 13-3/8", 9-5/8" casing scheme will be used. Casing attachments will be as follows:

30" Float shoe.

20" Float shoe + float collar one joint above shoe.  
Two rigid 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 2 joints above the shoe. Two spring centralizers on the shoe track, 1 centralizer per 3 joints up to the base of the reservoir, 1 centralizer per joint across the reservoir, 1 centralizer per 3 joints up to the 13-3/8" shoe and 1 rigid 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"	3000 psi for 15 mins
9-5/8"	4000 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.

B. SUMMARY OF OPERATIONS

1. Pre-Spud Phase

Site survey.

A seabottom/shallow gas survey has been carried out over the well location by A/S Geoteam (See Site Survey Report no. 6744). Analog sparker, deep tow boomer, echo sounder and side scan sonar surveys were made with in a 4 x 4 kms grid centred on the location. Digital sparker profiles were also shot in a star pattern (6 x 3 kms lines) centred on the well location.

2. Rig Positioning

The rig will be brought on to location utilizing Decca Pulse-8 with HP minicomputer. All anchors will be run out plus/minus 1450 m. The rig will be positioned with a heading of 315 deg (T). 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 will be held on all anchor chains.

The final coordinates will be determined with an accuracy of 10 m (RMS) using Satnav.

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

1. Check the seabed condition by an observation dive.
2. Set TGB (with 5 m skirt) at slack tide. 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 ( a monel collar to be included for MSS). Drill down to 30" casing setting depth, taking a MSS 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, where the various options will be considered.

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

4. Run 30" casing plus MGB 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 to the TV.
5. When the 30" casing is landed observe the angle with the TV camera. If the angle is 1 degree or less, cement the casing using 200% excess cement.

6. WOC. Divers to check cratering around the guide bases with an observation dive. Run a check-totco in 30" running tool. (Install a totco ring in a sub below the running tool.)
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 MGB and BOP stack, and the base being level, are of utmost importance and good support is required to carry the very heavy load of the stack.
- b) Observe operations such as the penetration test, placing of TGB and MGB, spudding in, stabbing in, drilling with returns to seabed, cementing of 30" and 20" casing, 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 U.W. equipment.
- d) Ensure that the tension of the guide lines is optimum so that the TGB not be lifted on one side or be tilted by excessive uneven guide line tension.
- e) It is evident that the weather conditions should be moderate for most of these above operations.

4. Drilling 26" hole and running 20" casing

1. Drill out cement in 30" casing and 36" pocket with 26" hole opener and 17½" pilot bit with a stabilizer at 20 m and start 17½" pilot hole. POH and lay down 26" hole opener.
2. Run 30" pin connector and dump valve complete with flex joint on 21" riser. Use minimum required tension on ruckers. Fill up riser with seawater and observe fluid level.
3. Make up 17½" pilot hole drilling assembly. Use a float sub, with the float installed, and run in the hole.
4. Close diverter around drill pipe, and circulate through diverter lines to check the diverter equipment, gradually building up to maximum circulating rate. Open diverter packing.
5. Drill 17½" pilot hole to the 20" casing setting depth, allowing for a 10 m pocket.

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 1.10 SG (475 psi/1000 ft) stop drilling and circulate the hole clean.

6. Perform a check trip to the 30" shoe and back to bottom, clean out any fill and spot viscous mud of 1.4 SG (606 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. Observe well static for  $\frac{1}{2}$  hour and then spot high viscosity mud in the open hole section.
9. Pull out of hole and retrieve the 30" pin connector.
10. Pick up a 17 $\frac{1}{2}$ " pilot bit and 26" hole opener with a 26" stabilizer at 10 m and 30 m above the bit. Open the hole up to 26" using seawater and viscous pills.
11. Run and cement 20" casing as per programme.

Note:

Use a long drillpipe stinger (+/- 60 m above the float collar) inside the casing.

12. Unlatch the running tool, pick up until the bottom of the stinger is just below the 18-3/4" housing. Wash in and around the housing with seawater prior to retrieving the running tool.
13. 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:

- a) Diverter systems are fitted on offshore rigs to provide a means of controlling the flow should shallow pressures be encountered whilst drilling for the first casing string (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 12-1/4" pilot hole instead of 17½" and restrict penetration rates to obtain the lightest possible annular returns. If severe losses are continuing, open the dumpvalve and drill a 12-1/4" pilot hole with returns to seabed.

If gas is encountered whilst drilling 12-1/4" pilot hole with seawater and returns to seabed, spot heavy mud and inform Base. Have a cementer on board for this eventuality as long as diverter is in use.

d) Gas Flow (No Losses)

If any flow of gas is encountered whilst drilling the 17½" pilot hole, drill to 20" casing point with required mud weight. Circulate hole clean and make check trip. Circulate, drop Totco and pull out of hole. Run logs as required. Make up 26" hydraulic under-reamer with 17½" stabilizer 60 ft above under-reamer.

Under-ream 17½" hole to 26". Circulate and increase mud weight on bottom to compensate for the loss in hydrostatic head as a result of the removal of the Marine Riser later on. Check trip to shoe. Run back to bottom. POH. Run BGT to check holesize. RIH with bit and under-reamer. Circulate, if required. Observe well. Open dump valve. Fill up Marine Riser with seawater to give a column equal to the water depth. After level in Marine Riser is equalised to sea level, observe well in Marine Riser and check flow on open dump valve with TV. Close dump valve. Make another check trip, circulate and pull back to pin connector, circulate to seawater. POH. Retrieve Marine Riser. Stand back 18-3/4" housing in derrick. Make additional check trip prior to running 20" casing.

e) Gas Flow and Severe Losses

If any flow of gas is encountered whilst drilling the 17½" pilot hole with returns to surface, and the required increased mud weight to counteract the gas flow causes severe losses, then inform Base.

Note:

There should be sufficient barytes onboard 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 17½" hole to programmed depth. Use maximum annular velocities. Design the drilling assembly for maximum penetration rate. NB: Leak off test to be performed after drilling 5 m new hole below 20" shoe.
2. Log as per programme. Make up 13-3/8" hanger with subsea cementing assembly and top plug only, and stand back in derrick.
3. Make checktrip, pull wearbushing and run 13-3/8" casing to landing point, leaving 10 m pocket at below the 13-3/8" shoe.
4. Cement 13-3/8" casing. Subsea plug system to be used (top plug only), unless otherwise advised by Base. Clean out the stack area prior to pulling out the running string.
5. 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 in the L.Cretaceous limestones and marls and will continue until at least one core has been taken in the water zone.

3. Carry out logging programme, including wire line tests if necessary. Make up 9-5/8" hanger with subsea cementing assembly and top plug only, and stand back in derrick.
4. 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.
5. Cement the 9-5/8" casing using a subsea plug system (top plug only). 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 accordingly.
6. 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.
7. Drilling 8½" hole
  1. Drill out float collar, shoetrack and float shoe. Drill 5 m of new hole and carry out a formation leak off test.

Note:  
An RTTS will be set inside the 9-5/8" casing to avoid damaging the cement bond across the reservoir.
  2. Drill 8½" hole to T.D. with a mud weight as dictated by hole conditions.

Note:  
Coring will commence on the occurrence of good hydrocarbon shows and will continue until at least one core is taken in the water zone.
  3. Rig up Schlumberger and carry out the logging programme, including wireline tests if necessary.
  4. Dependent upon the results of the logs and wireline tests the hole will either be plugged back to allow for testing of the upper reservoir or a 7" liner will be set to allow testing of a lower reservoir.

8. Abandonment

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 30 m above and below each zone. In addition a cement plug, extending 30 m above and below the casing shoe, shall be set. A mechanical bridge plug may be set in the lower part of the casing but not more than 50 m above the shoe. A 15 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 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 30 metres above and below the perforated interval or down to a casing plug whichever is less.
3. Cement plugs of at least 30 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 50 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 must 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 TV/observation dive to ensure that no obstructions remain on the sea bed which may cause danger or impediment to fishing or shipping.
7. A specific abandonment/suspension program will be prepared and issued when the well reaches total depth.

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                   | : | 5000 psi   |
| 2. | Blind Rams                  | : | Casing test pressure, as specified in Item A-16    |
| 3. | Kill/choke lines and valves | : | 5000 psi   |
| 4. | Annular preventers          | : | 2000 psi around 5" DP<br>1500 psi around 3-1/2" DP |
- a) Tests 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.

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 (this Section) item 10.

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 studed 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. 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.
7. 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.
8. 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 in indication that the system is not operating "normally" and may require further investigations and/or repairs.

9. The testing of 10,000 psi BOP stack will be done to 5000 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.

10. 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 1250 m, and every 3 m thereafter.

The following samples will be required for partners/government bodies:

- a) 6 x small cuttings bags of washed dried samples.
- b) 4 x 2 kilograms bags of wet samples.

1 x 2 kilogram 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. Otherwise, samples should be sent ashore ASAP, marked for attention of EPXV/1, Tananger.

2. Coring

a) Jurassic Sandstone Group

Interval 4 :

Coring is to commence immediately above the reservoir, i.e. in the L.Cretaceous limestones and marls, and is to continue until at least one core is taken in the water zone. Approximate interval is 1512 - 1601 m BDF.

b) Deeper Reservoir Intervals

Coring is to commence on occurrence of good hydrocarbon shows in sands and is to continue until at least one core is taken in the water zone.

3. Logging Programme

At 20" casing depth	ISF/SONIC/SP/GR 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	ISF/SONIC/SP/GR FDC/CNL/CAL/GR MSFL/DLL/CAL/GR HDT RFT's (as required) SWS (as required) CBL ( on 13-3/8" casing)
At T.D.	ISF/SONIC/SP/GR FDC/CNL/CAL/GR HDT RFT's (as required) CBL (on 9-5/8" casing) SWS (as required) Velocity Survey

Note: Intermediate logs may be required to be run in the 12-1/4" hole section.

4. Testing Programme

Production tests as required. Specific programmes will be advised.

E. CASING DESIGN

Casing designs 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.
4. For collapse, a design safety factor of 1.0 is employed. Total evacuation of the casing is 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.

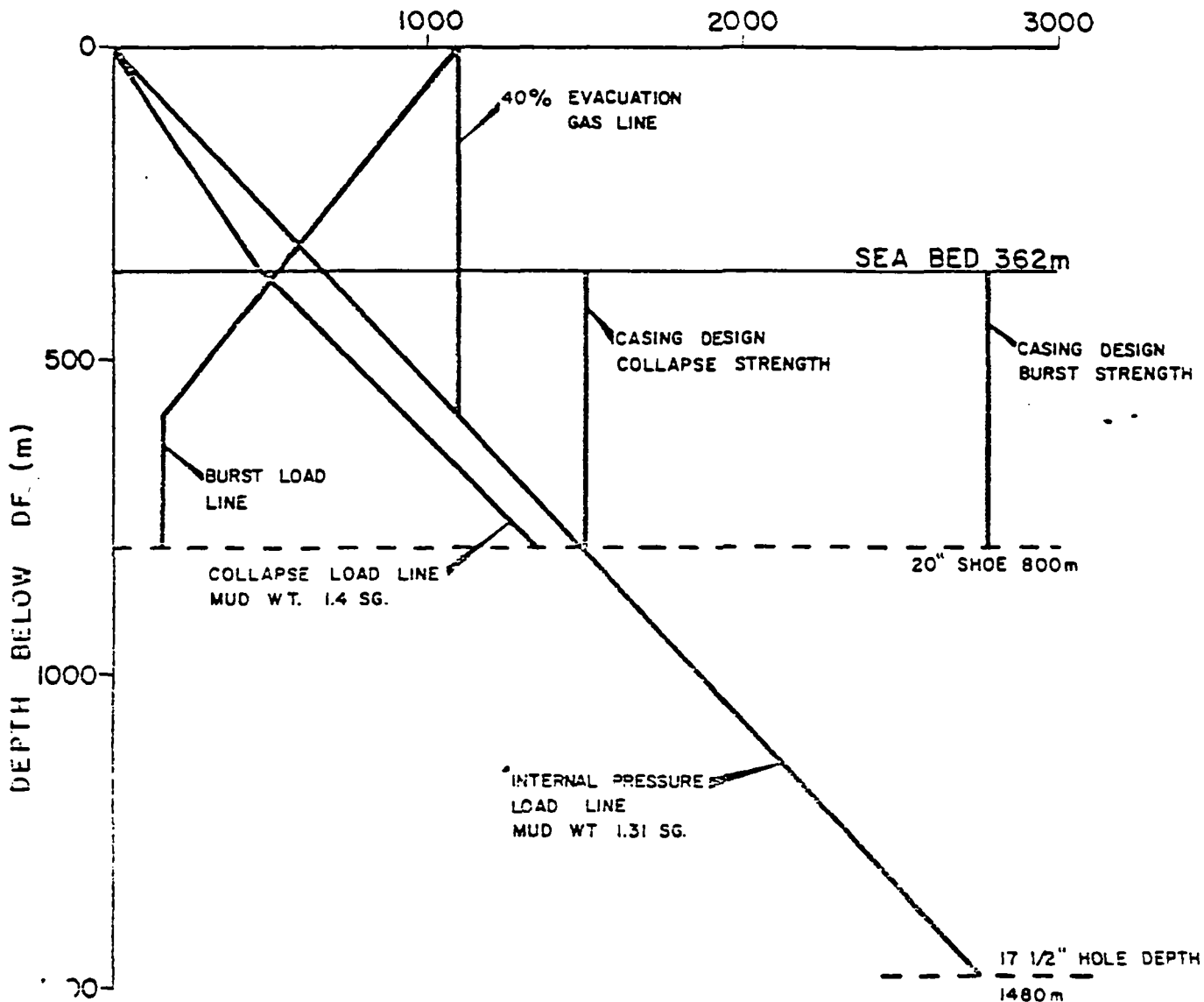
F. GLOSSARY OF ABBREVIATIONS

BDF	:	below derrick floor
BGT	:	borehole geometry tool
BOP	:	blow out preventer
FS	:	fail safe (as in FS valve)
ID	:	internal diameter
MF	:	Marsh funnel (mud viscosity)
MGB	:	main guide base
MSL	:	mean sea level
MSS	:	magnetic single shot
OD	:	outside diameter
PPG	:	pounds per US gallon
PV	:	plastic viscosity
SS	:	sub sea
TGB	:	temporary guide base
TMCM	:	Transverse Mercator, Central Meridien
UGF	:	universal guide frame
WHP	:	wellhead pressure
YP	:	yield point

# 20" CASING DESIGN 3 1/2-F

ENCL. 1A

PRESSURE PSI



FOR 20", 133 LB/FT, K 55, VETCO LS-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

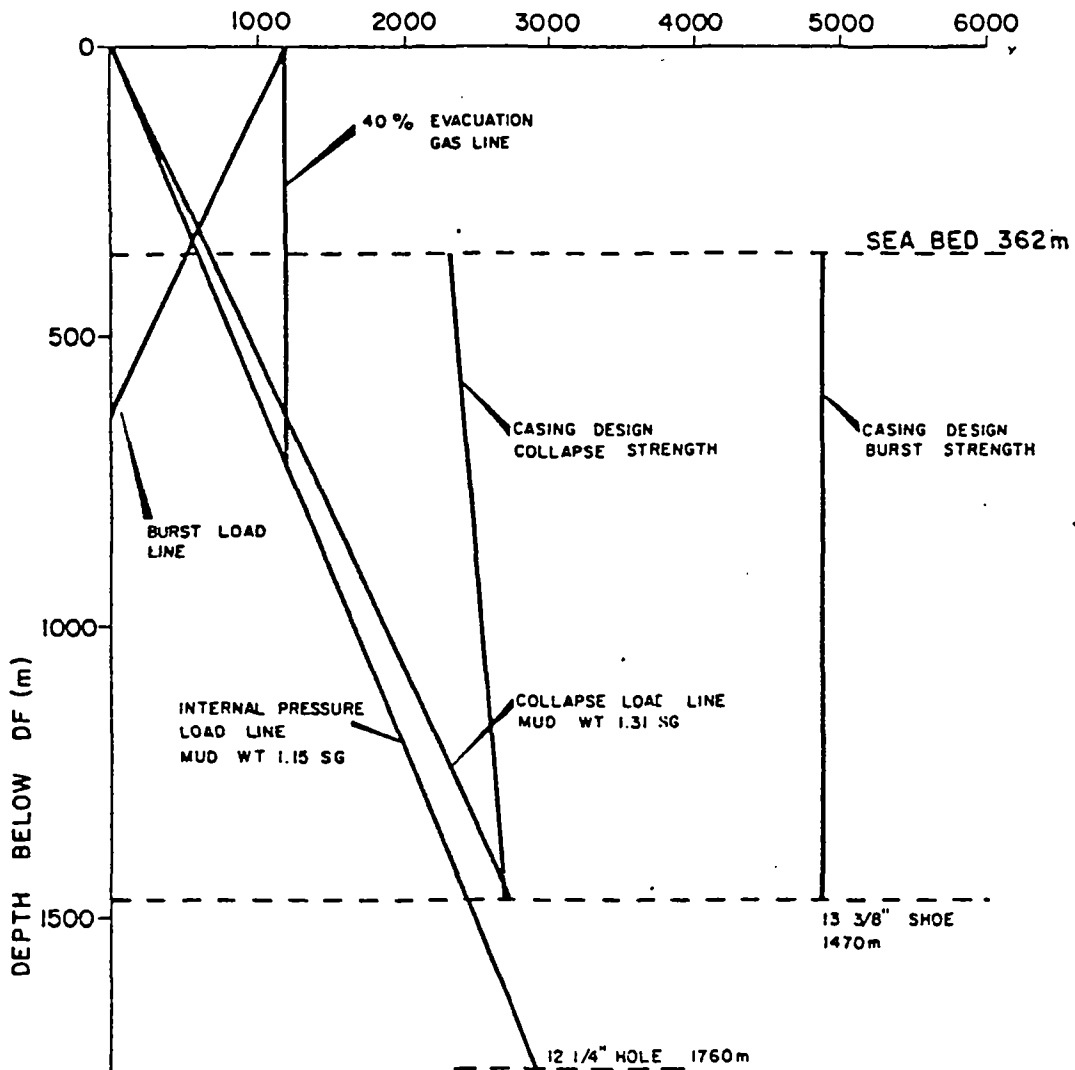
$$\begin{aligned} \text{MAXIMUM TENSILE LOAD} &= 133 \times 3.281 (800 - 362) \\ &= 191131 \text{ lbs} \end{aligned}$$

20" 133 LB/FT, K 55, VETCO LS-LH IS THEREFORE SATISFACTORY IN BURST, COLLAPSE AND TENSION FOR THIS WELL.

# 13 3/8" CASING DESIGN 3 1/2-F

ENCL 1B

PRESSURE PSI



FOR 13 3/8", 72 LB/FT, L80, BTC CASING

	<u>COLLAPSE</u>	<u>BURST</u>	<u>TENSION</u>
API RATING	2670	5380	166 1000
SAFETY FACTOR	1.0	1.1	1.6
DESIGN STRENGTH	2670	4891	1038125

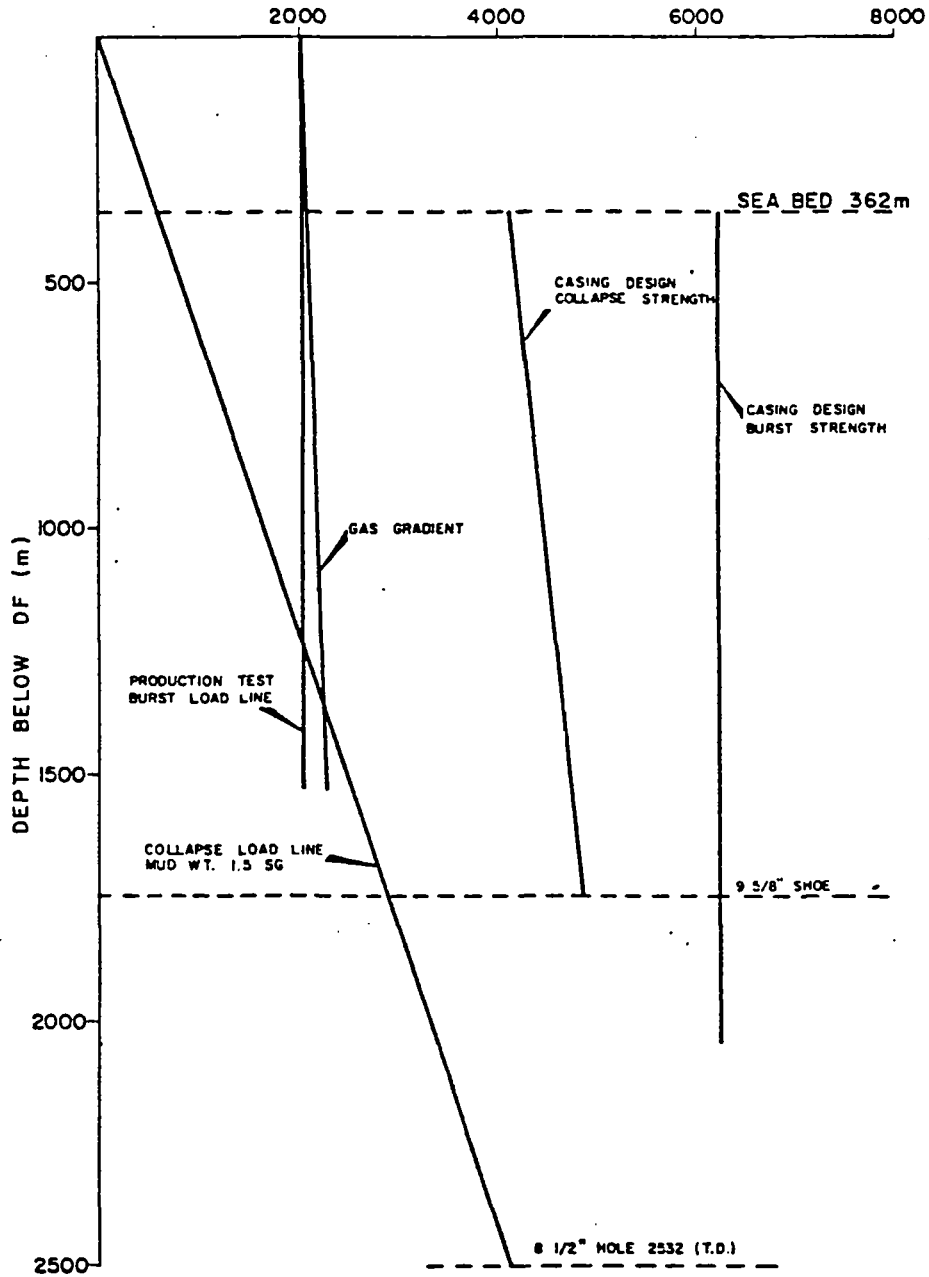
$$\text{MAXIMUM TENSILE LOAD} = 72 \times 3.281 (1470 - 362)$$

$$= 261745 \text{ lbs}$$

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

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

## PRESSURE PSI



FOR 9 5/8", 47 LB/FT, L80, VAM CASING

	<u>COLLAPSE</u>	<u>BURST</u>	<u>TENSION</u>
API RATING	4750	6870	1086000
SAFETY FACTOR	1.0	1.1	1.6
DESIGN STRENGTH	4750	6245	678750

MAXIMUM TENSILE LOAD =  $47 \times 3.281 (1750 - 362)$   
 = 214039 LBS

9 5/8" 47 LB/FT, L80, VAM CASING IS THEREFORE SATISFACTORY  
 IN BURST, COLLAPSE AND TENSION FOR THIS WELL.

THE DESIGN SHOW 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 and 10 m of 15.8 ppg 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 440 m BDF  
 36" hole 450 m BDF

Lead Slurry Volumes

i) 36" x 30" annulus =  $(430 - 362) \times 3.281 \times 2.1598 \times 3 = 1445.6$  cu.ft.  
 Cement required =  $1445.6 / 1.89 = 764.9$  sxs  
 = 32.6 m/t  
 Mixwater required =  $764.9 \times 10 / 42 = 182.1$  bbls  
 D-75 required =  $764.9 \times .36 = 275.4$  gallons

Tail Slurry Volume

i) 36" x 30" annulus =  $(440 - 430) \times 3.281 \times 2.1598 \times 3 = 212.6$  cu.ft.  
 ii) 36" pocket =  $(450 - 440) \times 3.281 \times 7.0686 \times 3 = 695.8$  cu.ft.  
 iii) 30" casing fill =  $10 \times 3.281 \times 4.2761 = 140.3$  cu.ft.  
 Total slurry 1048.7 cu.ft

Cement required =  $1048.7 / 1.17 = 896.3$  sxs  
 = 38.2 m/t  
 Mixwater required =  $896.3 \times 5.15 / 42 = 109.9$  bbls  
 $\text{CaCl}_2$  required =  $896.3 \times 94 \times 0.03 / 2205 = 1.15$  m/t



20" Cementation

Extended Norcem Class "G" cement of lead slurry weight 13.2 ppg, and 60 m of tail slurry above the shoe, of weight 15.8 ppg 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 10 m above the float collar.

## Data

Casing 20"/133 lbs/ft/K55/VETCO LS-LH

30" shoe at 440 m BDF

36" hole at 450 m BDF

20" shoe at 800 m BDF

26" hole at 810 m BDF

Lead Slurry Volumes

i)	30" x 20" annulus	= (440-362)x3.281x2.0944	= 536.0 cu.ft.
ii)	36" x 20" annulus	= (450-440)x3.281x4.8869x2	= 320.7 cu.ft.
iii)	26" x 20" annulus	= (740-450)x3.281x1.5053x2	= <u>2864.6 cu.ft.</u>
	Total slurry volume		= 3721.3 cu.ft.

Cement required	= 3721.3/1.89	= 1968.9 sxs
		= 83.9 mt
Mixwater required	= 1968.9 x 10/42	= 468.8 bbls
D-75 required	= 1968.9 x .36	= 708.4 gallons

Tail Slurry Volumes

i)	26" x 20" annulus	= (800-740)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
Mixwater required	= 767.0 x 5.15/42	= 94.0 bbls
CaCl <sub>2</sub> required	= 767.0 x 94 x 0.02/2205	= 0.65 mt

Extended Norcem Class "G" cement of lead slurry weight 13.2 ppg, and 75 m of tail slurry above the shoe, of weight 15.8 ppg to be used. The casing is to be cemented back to 150 m inside the 20" casing using 20% 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 800 m BDF

26" hole at 810 m BDF

13-3/8" shoe at 1470 m BDF

17½" hole at 1480 m BDF

Lead Slurry Volumes

i) 20" x 13-3/8" annulus =  $(800-650) \times 3.281 \times 0.9377$  = 461.5 cu.ft.  
 ii) 26" x 13-3/8" annulus =  $(810-800) \times 3.281 \times 2.7113 \times 1.2$  = 106.7 cu.ft.  
 iii) 17½" x 13-3/8" annulus =  $(1395-810) \times 3.281 \times 0.6946 \times 1.2$  = 1599.9 cu.ft.  
 Total slurry volume = 2168.1 cu.ft.

Cement required =  $2168.1/1.89$  = 1147.1 sxs  
 = 48.9 mt  
 Mixwater required =  $1147.1 \times 10/42$  = 273.1 bbls  
 D-75 required =  $1147.1 \times .36$  = 413.0 gallons

Tail Slurry Volumes

i) 17½" x 13-3/8" annulus =  $(1470-1395) \times 3.281 \times 0.6946 \times 1.2$  = 205.1 cu.ft.  
 ii) 17½" pocket =  $10 \times 3.281 \times 1.6703 \times 1.2$  = 65.8 cu.ft.  
 iii) 13-3/8" shoe track =  $13 \times 3.281 \times .8314$  = 35.5 cu.ft.  
 Total slurry volume = 306.4 cu.ft.

Cement required =  $306.4/1.17$  = 261.8 sxs  
 = 11.2 mt  
 Mixwater required =  $261.8 \times 5.15/42$  = 32.1 bbls

Additives to be advised.

Norcem Class "G" cement at 15.4 ppg slurry weight will be used at the main slurry up to 1320 m 50 bbls (262 m) of 13.5 ppg 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 1470 m BDF
- 17½" hole at 1480 m BDF
- 9-5/8" shoe at 1750 m BDF
- 12-1/4" hole at 1760 m BDF

15.4 ppg Slurry Volume

- i) 13-3/8" x 9-5/8" annulus (1470-1320)3.281x.3262 = 160.5 cu.ft.
- ii) 17½" x 9-5/8" annulus (1480-1470)3.281x1.1651x1.2 = 45.9 cu.ft.
- iii) 12-1/4" x 9-5/8" annulus (1750-1480)3.281x.3132x1.2 = 332.9 cu.ft.
- iv) 12-1/4" pocket 10x3.281x0.8185x1.2 = 32.2 cu.ft.
- v) 9-5/8" shoe track 25 x 3.281 x 0.4110 = 33.7 cu.ft.
- Total slurry volume = 605.2 cu.ft.

Cement required = 605.2/1.24 = 488.1 sxs  
= 20.8 mt

Mixwater required = 488.1 x 5.24/42 = 60.9 bbls

Additives to be advised.

13.5 ppg Scavenger Slurry Volumes

i) 13-3/8" x 9-5/8" annulus (1320-1058)  $3.281 \times 3.262 = 280.4$  cu.ft.

Cement required	= 280.4/1.68	= 166.9 sxs
		= 7.12 mt
Mixwater required	= 166.9 x 8.29/42	= 32.9 bbls

Additives to be advised.

# WELL 31/2-F

ENCL. 3

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

0.5                      1.0                      1.5                      2.0                      2.2

N.B. BOTH PORE PRESSURE AND FRACTURE GRADIENTS ARE EXPRESSED FROM DRILL FLOOR IN S.G. MUD WEIGHTS

SEABED 362m

