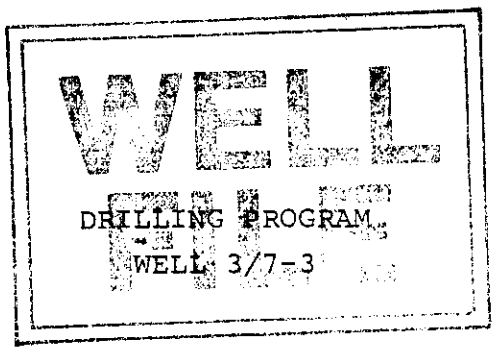
Elf Aquitaine Norge A/S
311E-W 81/059/RS/JLI/GC/es

Stavanger, May 4, 1981



G. COLENO

J.L. IDELOVICI

R. SALES

SUMMARY

A P P E N D I X

A. Well progress prognosis

B. Mud program

C. Cementing and displacement calculations

D. Casing calculations

E. Casing tests/leak off test, procedures

F. Responsibilities

G. Well killing contingency plan

H. Elf Aquitaine Norge A/S - "EMERGENCY TASK FORCE"

1 GENERAL DATA

A) Location

Norwegian Continental Shelf
Block 3/7
Licence 023

B) Position

Required coordinates
04° 10' 59.68" E
56° 24' 54.33" N

C) Levels

RKB-Sea level = 25 m
RKB-Sea bottom = 90 m
Water depth = 65 m

D) Well

Identification: 3/7-3
Class: Exploration
Profil: Vertical

II DRILLING PLATFORMS

A. Platform

Name : DYVI ALPHA
Contractor : DYVI OFFSHORE A/S

B. Rig

Capacity : 20.000 ft drilling depth.

Drawork : NATIONAL 1625 DE

Rotary table : NATIONAL C 495

Pumps : NATIONAL 12-P-160 TRIPLEX

C. BOP stack.

Lower package. 18 3/4. 10.000 PSI WP.

Including from bottom to top :

- VETCO H4 hydraulic connector
- RUCKER SHAFFER studded triple. LWS piperams w/ 3 1/8 (BX 154) outlets. H2S Service.
- RUCKER SHAFFER flanger single. LWS. Blind shear ram w/ 3 1/8 outlets. H2S Service.
- RUCKER SHAFFER mandrel for lower riser package.

Lower Riser package

- RUCKER SHAFFER dual spherical 18 3/4 5000 PSI H2S Service.
- REGAN 24" type CR-I Ball joint.

III GEOLOGICAL DATA

A) Prognosis:

Depth RKB (m)	Geological series	Formation
90 - 650	Quaternary	Sand, gravels, clay
650 - 2630	Tertiary	Clay w/lmst stringers, possible sands
2630 - 2730	Paleocene	Tuff, shale, siltstone/sandstone
2730 - 3140	Upper Cretaceous	Chalk
3140 - 3315	Lower Cretaceous Upper Jurassic	Marl, shale w/lmst stringers
3315 - 3440	Middle Jurassic	Sandstone and shale, coal
3440 - 3500	Upper Permian	Anhydrite and salt

Reference wells:

2/6-1 (Elf Aquitaine Norge operator)
3/7-1 (" " " ")
3/7-2 (" " " ")
Lulu 1 (Chevron operator, Danish waters)

B) Targets

- Danian/Cretaceous Chalk
- Jurassic sandstones

C) Pressures

Pressure build up originated in Tertiary. Data from nearby wells lead to except the following formation pressures:

- Teritary	1.10 to 1.40	equivalent density
- Chalk	1.30 to 1.50	" "
- Lower Cretaceous Jurassic	1.30 - 1.50	" "

POSITION MAP

BLOCK : 3/7

WELL : 3/7-3

OWNER : PETRONORD

x: 04°10'59.68"
y: 56°24'54.33"

Scale: 1/2500 000

Date: May 1981

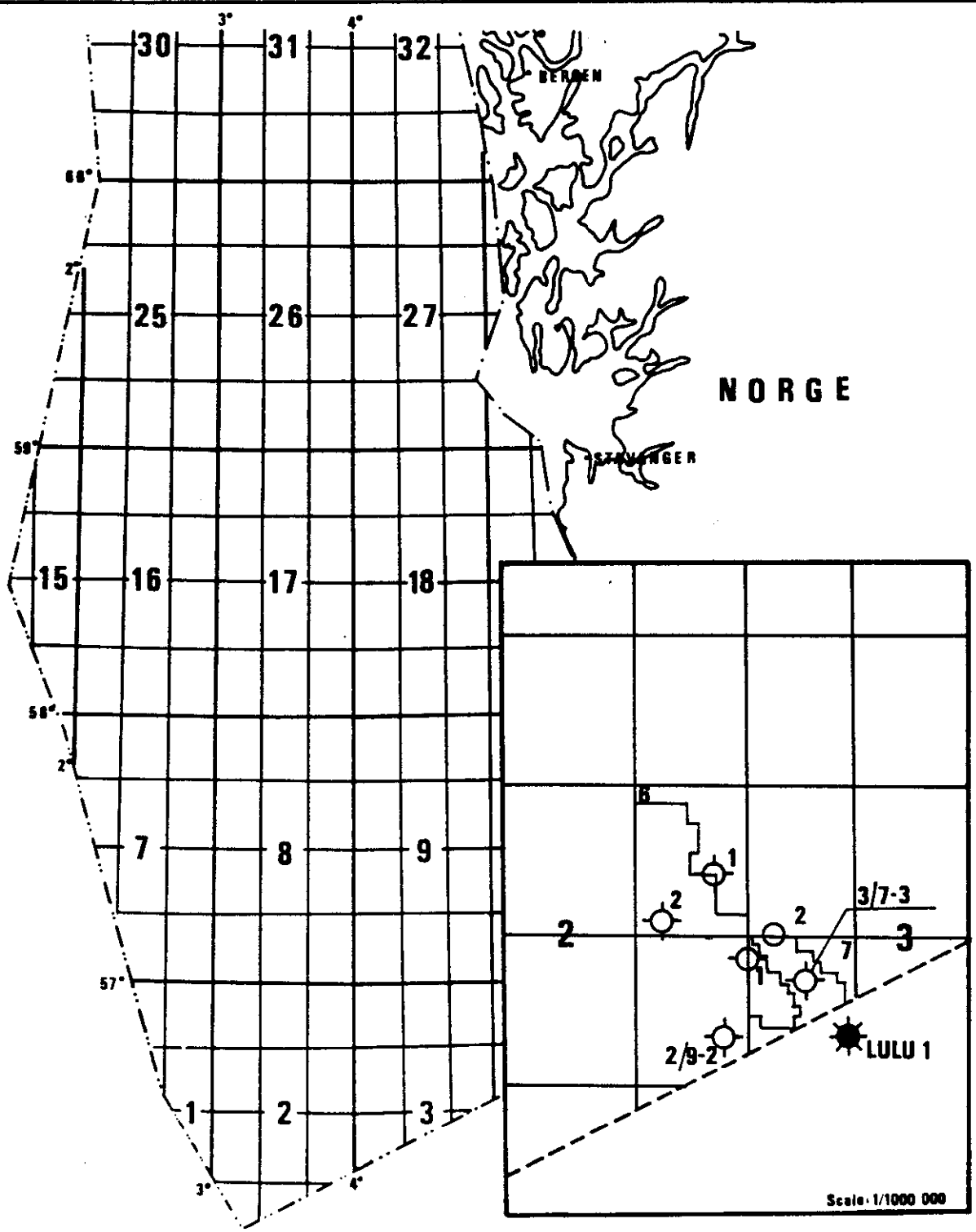


Fig.1

EXPLORATION DIVISION

GEOLOGICAL WELL PROGNOSIS

Well: **3/7-3**

Country: **NORWAY off-shore**

Coord X: 04° 10' 59.68"E Z ground: −66
Y: 56° 24' 54.33"N Z R.K.B: +25
Depth datum: RKB

Seismic location:
Line: 73 80 S.P. 269

Expected date: 15.06.1981
Duration: 80 days
P.T.D. 3500m Fm. ZECHSTEIN
Rig: DYVI ALPHA

Operator: EAN

Licence: 023 Owned by: PETRONORD

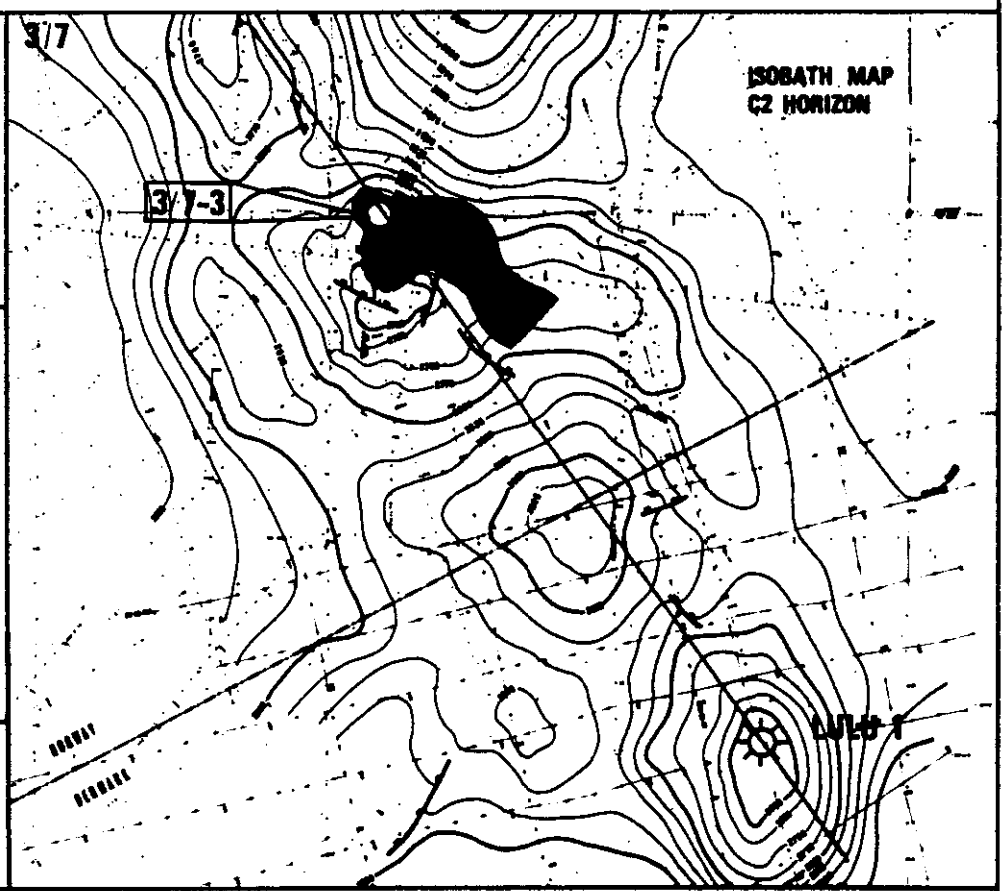
TARGETS:

- DANIAN / CRETACEOUS CHALK
- JURASSIC SANDSTONE

CASINGS:

30" at 150m
20" at 650m
13⅜" at 2000m
9 ⅝" at 2950m

7" liner if needed.



LOGGING:

ISF-SONIC-GR from top to T.D.
FDC-CNL-GR from top to T.D.
HDT below 1500m.
Velocity from top-T.D.
DLL-MSFL-MLL-PL-NGT in reservoir zone.

CORING:

CST below 1500m.
CORES: top of Chalk, Jur.sdst and in case of shows.

TESTING

Any hydrocarbon bearing reservoir

MUD

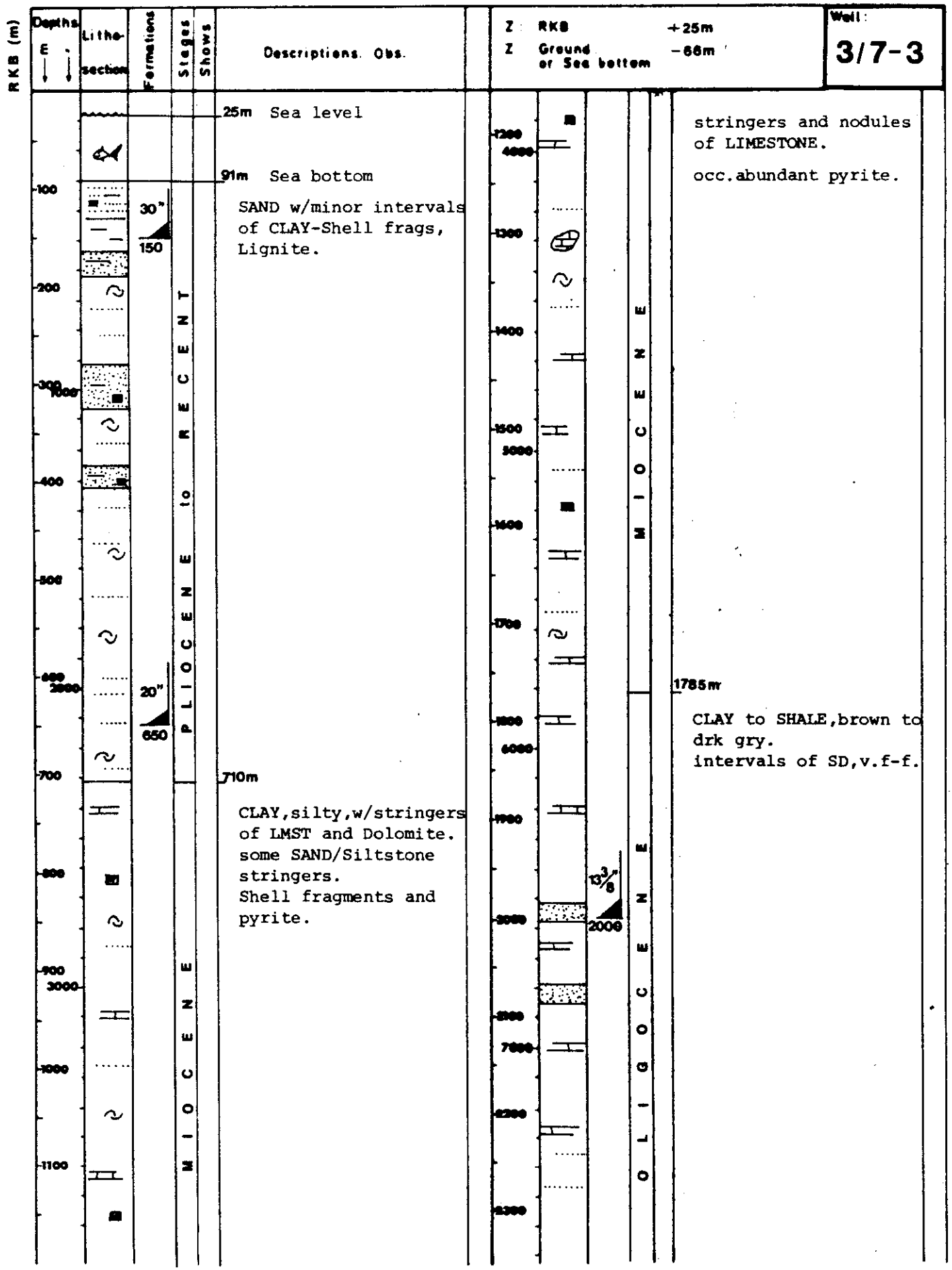
Phase 17½" 1.15-1.30
Phase 12¼" 1.30-1.50
Phase 8 ½" 1.40-1.60

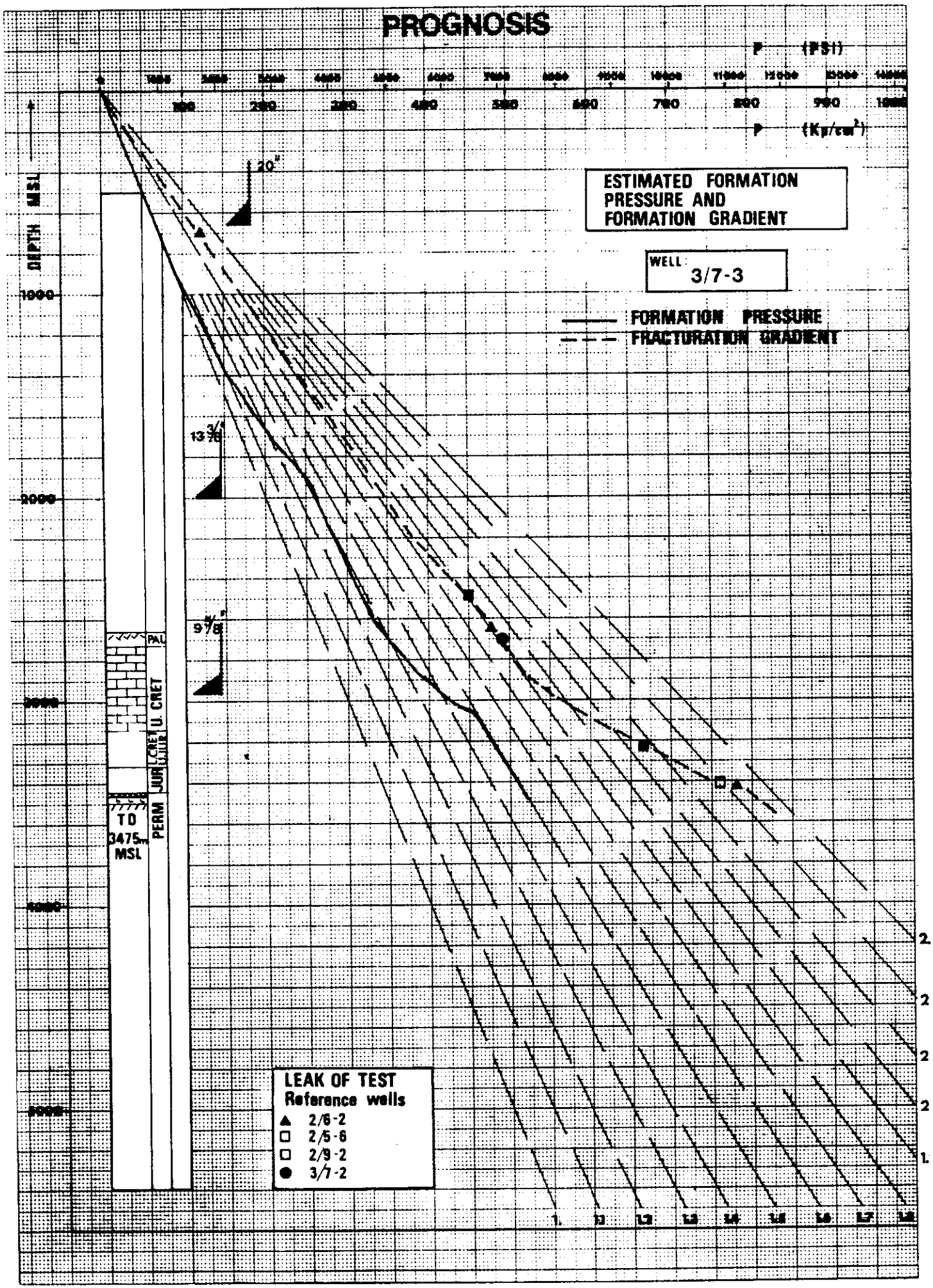
OBSERVATIONS

- All hydrocarbon bearing reservoir will be cored down to the water table.
- Maximum formation pressure expected in Jurassic: No more than 1.50 MED.
- Reference wells: 3/7-1, 3/7-2, 2/6-1 and Lulu 1.

Checked: F.VERROLLES Date: 15.05.81

GEOLOGICAL WELL PROGNOSIS



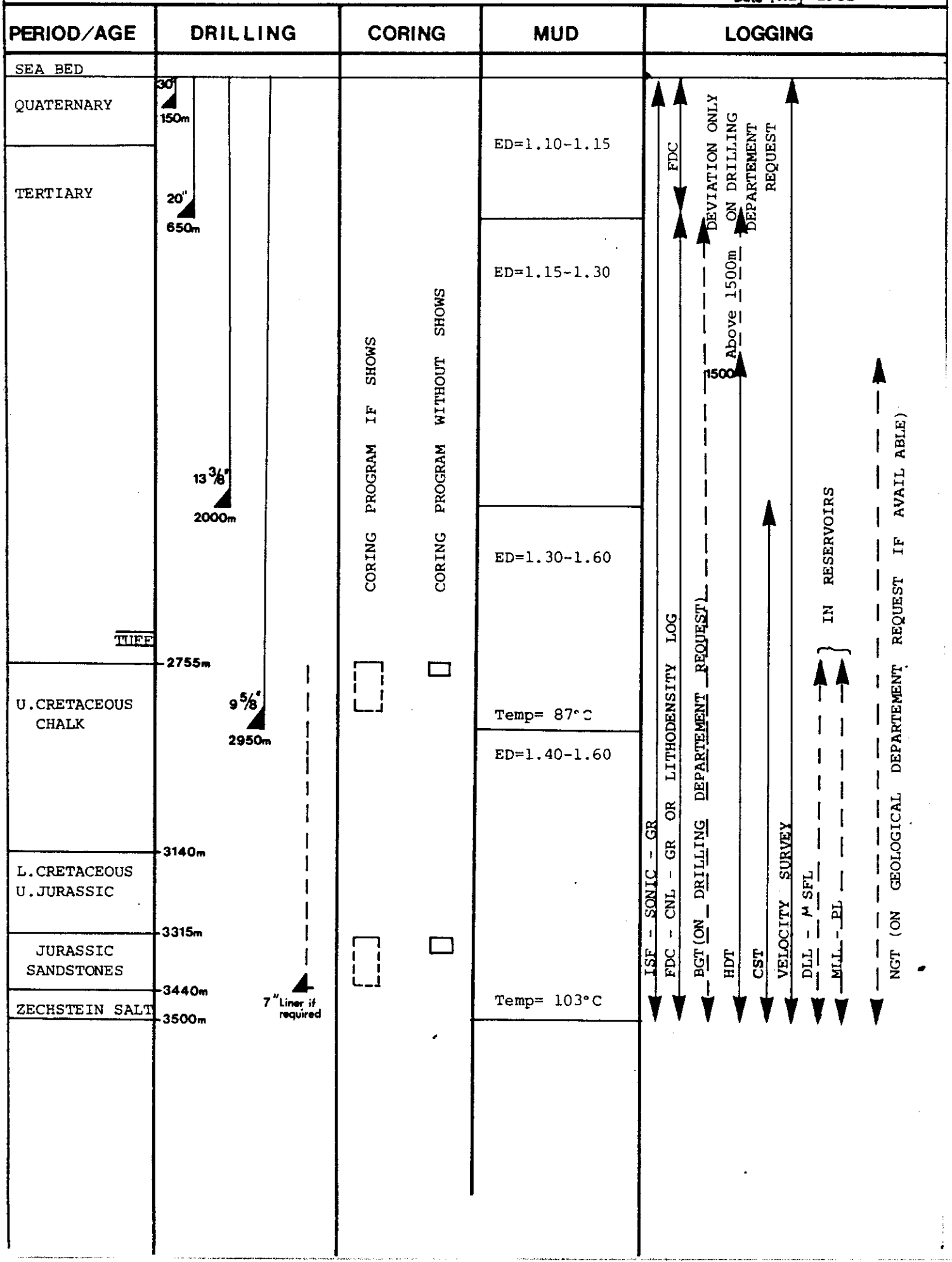

PROGNOSIS
P (PSI)
P (Kg/cm²)
DEPTH MSL
ESTIMATED FORMATION PRESSURE AND FORMATION GRADIENT
WELL 3/7-3
FORMATION PRESSURE
FRACTURATION GRADIENT
20"
13 3/8"
9 5/8"
PAL
U. CRET
L. CRET
JUR
PERM
TD 3475m MSL
LEAK OF TEST
Reference wells
2/6-2
2/5-6
2/9-2
3/7-2

PROPOSED DRILLING PROGRAM

WELL : 3/7-3

Reference Datum : RKB (+25m)

Date : May 1981



IV SOIL SURVEY - RIG POSITIONING

1. SOIL SURVEY

Equipment used to perform the soil survey :

- Echo sounder
- Side scan sonar
- Sub bottom profiler
- Gravity corer

The area surveyed is one square nautical mile and the survey program includes :

- Sparker investigation
- Deep sparker 11 to 15 KJ. program of about 60 km consisting of a seismic grid on a 10 to 15 km^2 area.
- Analog sparker on five or six lines across the well location (approximately 20 km.)
- Soil survey performed by : AQUATRONICS
- Date of survey : October 1980
- Final survey report : will be sent to Norwegian authorities.
- The coordinates of the well as indicated in General data are: X : 4° 10' 59.68" E
  Y : 56° 24' 54.33" N
- Seismic location: - Seismic Line 7380
  - shoot point : 269

2. RIG NAVIGATION AND POSITIONING

- Navigation

  A dual pulse 8 - MK 2 receiver complete with datalogger and printer will be used interfaced to a minicomputer and plotter system for trackguidance.
  This system automatically plots the Rigs current position and prints out the X and Y coordinates, to an accuracy better than 50 meters.

- Positioning

  A microprocessor satellite receiver will be used to determine the Rigs final position on location with an accuracy better than 10 meters.

  Navigation/Positioning will be made by : DECCA

- Accuracy of Drilling platforms position

  Within a 100m radius of intended location.

3. PERMANENT INDICATION OF THE WELL SITE

- A transpinger 48 KH_Z with 2 years life battery, will be run with the permanent base plate.
- The transpinger is set at 3 meters from the base plate.

V ANCHORING - (Characteristics)

Anchoring will be made under the contractors responsibilities. Characteristics are:

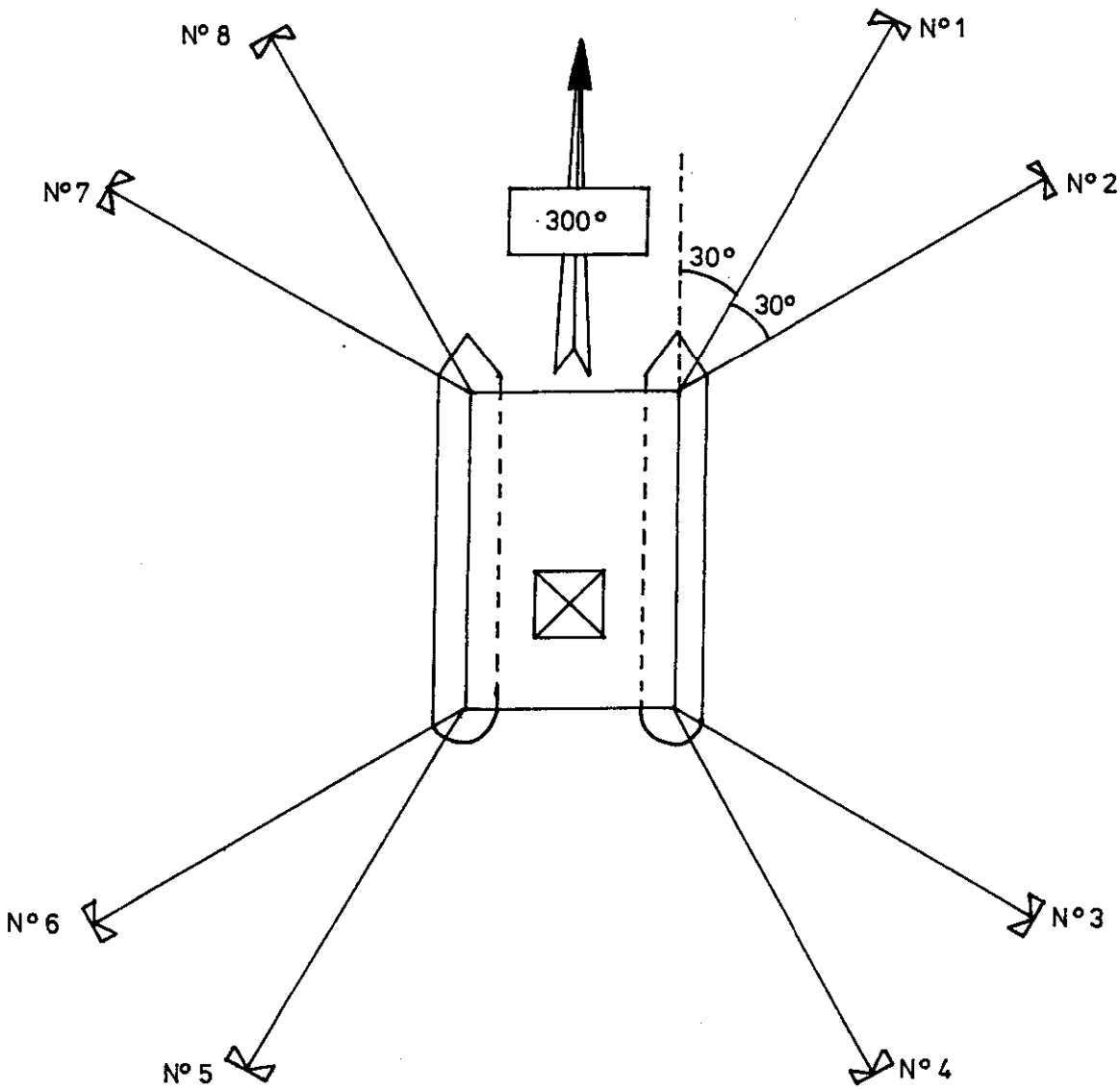
- Heading : 300 to 315°
- Anchor lines : 8 x 3500 ft of 3" chain
- Anchors : 8 x 6500 KG BRUCE
- Test of anchors : 350.00 lbs

Mooring line pattern is given as an indication on next drawing.

MOORING LINE PATTERN

DYVI ALPHA

WELL: 3/7-3



VI CASING PROGRAM - (Summary)

HOLE	CASING				
SIZE	SIZE	WEIGHT	GRADE	THREAD	DEPTH
INCH	INCH	LBS/FT			m (RKB)
26 36 HO	30	310	X52	squnch joint ATD	90 -150
17 1/2 26 UR	20	133	K55	BUTT	90 - 650
17 1/2	13 3/8	72 72	P110 N80	VAM	90 - 700 700 - 2000
12 1/4	9 5/8	53.5	P110	VAM	90 - 2950
8 1/2	7	IF NEEDED			

Estimated total vertical depth 3500 m.

VII CEMENTING PROGRAMME

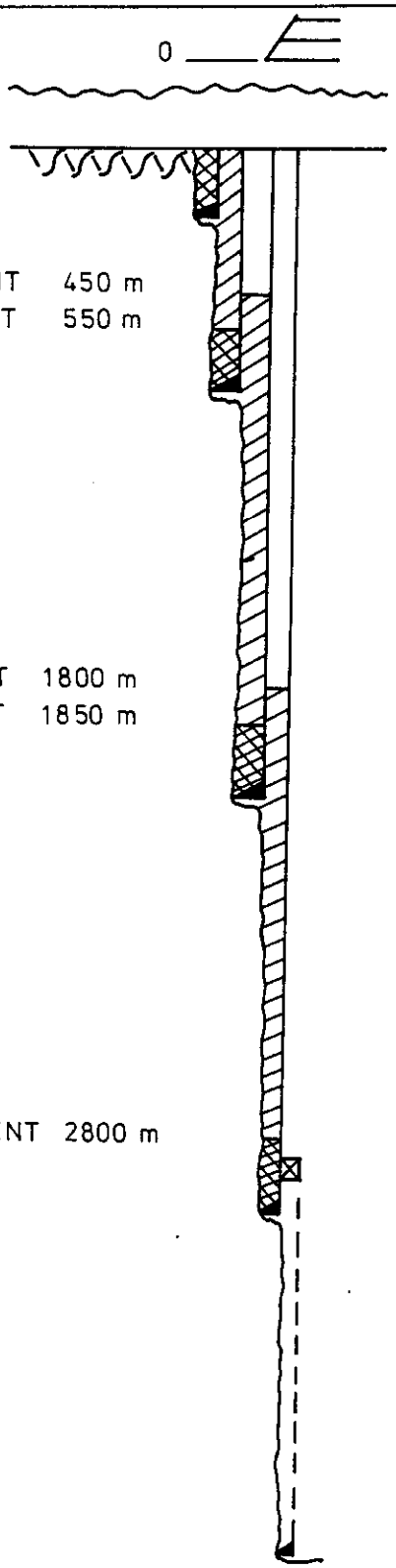
- Summary

HOLE SIZE	CASING	WEIGHT ibs/ft	CLASS CEMENT	SG	INTERVAL m
36"	30"	310	G	1.90	150 - 90
26"	20"	133	G G LIGHT	1.90 1.00	650 - 550 550 - 90
17 1/2	13 3/8	72	G LIGHT	1.90 1.50	2000 - 1850 1850 - 450
12 1/4	9 5/8	53.5	G LIGHT	1.95 1.50	2950 - 2800 2800 - 1800
8 1/2	7		G	1.95	IF NEEDED

CASING AND CEMENTING PROFILE

WELL: 3/7-3

LETT CEMENT G CEMENT CASING SHOE



0 m RKB
25 m MSL
90 m Mud line
150 m 30" CSG Shoe
DRLG 17 1/2" - HO = 26"
650 m 20" CSG Shoe
DRLG 17 1/2"
2000 m 13 3/8" CSG Shoe
DRLG 12 1/4"
2950 m 9 5/8 CSG Shoe
DRLG. 8 1/2"
3500 m T.D. (7" Liner if needed)

VIII MUD PROGRAM

PHASE	MUD TYPE	WEIGHT	FUNNEL VISCOSITY	SOLIDS	FILRATE
36"	BENTONITE	1.04	140		10
90					
155m		1.06	160		15
26"	BENTONITE	1.10	65	7	5
150					
650	LIGNOSULFONATE	1.15	70	9-11	8
17 1/2	GYPSUM SURFACTANT	1.15	55	9-11	4
650	SYSTEM				
2000m		1.30	60	13-18	5
12 1/4	FERROCHROME LIGNOSULFONATE	1.30	50	18-21	3
2000					
2950m	CHROME LIGNITE	1.50	60	20-24	4
8 1/2	FERROCHROME LIGNOSULFONATE	1.50	55	18-21	2
2950					
3500m	CHROME LIGNITE	1.60	60	20-24	3

IX LOGGING PROGRAMME

A) Basic Runs

In 26", 17"1/2, 12"1/4 and 8"1/2 (and eventually 6") open holes before setting each casing, ISF-SL GR and FDC caliper will be performed (GR to be recorded up to the mudline). FDC log is run in order to introduce density parameter in synthetic seismograph computation. ISF-SL-GR-CAL-FDC will have to be available at any time and will have to be permanent on board. Intermediate log could be run if needed on request of Geological/Geophysical Departments.

HDT will be run in open hole below approximately 1500 m.
Deviation logs will be run with HDT in 17 1/2, 12 1/4 and 8 1/2 inch holes before setting casings or liner strings.

Lithodensity log can be run instead of the FDC-CNL-GR at Geological Department request.

B) Reservoir Zones

On request from Reservoir and/or Geological Departments on specific intervals:

DLL - MSFL
ML MLL
FDC CNL GR (or/and Lithodensity log)
DUAL LATERLOG (shallow/deep)

- Spectral Gamma ray or NGT could be run if requested by Exploration (in cooperation with laboratories and central services).
- Velocity survey at TD (or intermediate on request from Geophysical Department).
- Cement bond logs will be recorded behind all casing strings. From 20" casing.
- Temperature log will be run in order to check the cement tops in annulus when fluid losses are noticed during cementing operations.

- All logs will be recorded at scales 1/500 and 1/200 while ML MLL will be in scale 1/200 - 1/40.
- CST (see sampling) technical advice from the well site geologist will have to be considered concerning choise of charges, kind of bullets to be used and so on. In any case, all necessary material will have to be available on-board before surveys in order to obtain the best results considering recovery of S.W.C.

NOTE: The 3/7-3 well being an exploratory well, the Geological Department is fully responsible for the operations. In the reservoir zones, decisions about logging will be taken both by the resident geologist and reservoir engineer.

X SAMPLING AND CORING

A) Cuttings/Sampling

Cuttings will be taken every 10 - 5 - 3 m regarding the drilling rate and continuously observed under the microscope and fluoroscope. Sampling intervals can be reduced if the well site geolgist decides so. A set of dried and wet samples (according to dispatching list in annexes) will be made at location.

Samples for source rock analysis will be performed on sample with a spacing defined by well site geologist. A carbide test will be used to check lag time computation (and degasser) at least once a day in normal drilling conditions. Especially during drilling of the objectives, we have to get a very good quality of samples. Therefore drilling parameters and choice of bit will have to be discussed between well site geologist and drilling supervisor. In particular, use of diamonds bits will have to get the approval of the well site geologist.

B) Coring Programme

In case of hydrocarbon shows, reservoir zones or if additional lithological information are needed, cores should be cut on demand of Geological or Reservoir Departments. In any case the top of the following reservoirs will be cored: Danian Cretaceous Chalk and Jurassic sandstones.

In reservoirs, the coring will continue to the watertable.

Pictures of cores will be taken on the rig if possible.

Sidewall cores will be shot before each casing setting (or on request at any time if needed) for checking an accurate information:

micropaleontology, palynology, sedimentology, log character etc...

The program is made by the on-site geologist together with the Exploration Division and Laboratory of Reservoir Department if necessary.

XI TESTING PROGRAMME

A) FIT and/or RFT will be run in front of reservoirs as soon as possible in order to get a representative value of the formation pressures whatever the nature of formation fluids. In any case, at the top of the first Cretaceous and Jurassic reservoirs FIT will be performed in order to adjust mud weight.

B) DST

Conventional DST through casing might be performed if warranted by log analysis.

Special test procedure will be made in case of testing operrations (see appendix).

XII DEVIATION SURVEY PROGRAM

A. 36" PHASE

Totco survey dropped prior to pull the bit giving a drift angle indication.

B. 17 1/2 x 26" PHASE

Totco survey at least every 100m or prior to pull the 17 1/2 bits.

C. 17 1/2" PHASE

Survey every 100m angle and orientation.

D. 13 3/8 CASING

Gyroscopic multishot survey in casing before 12 1/4" phase, from shoe to mud line, only if the Deviation log taken with HDT is not available. (see § 9.A. page 22).

E. 12 1/4 PHASE

Survey every 100m at least (angle and orientation).

F. 9 5/8 CASING

Gyroscopic multishot survey in casing from shoe to 13 3/8 casing shoe before 8 1/2 phase, if the deviation log taken with HDT is not available. (see § 9.A. page 22)

G. 8 1/2 PHASE

Survey every 100m at least (angle and orientation).

Note

For single shot surveys in all drilling phases, in case of rapid change of angle, the intervals between surveys will be reduced and the drilling parameters changed in order to reduce the dog legs to a maximum of 1^{o}/100m.

XIII LEAK OFF TEST AND FORMATION TEST PROGRAM

A. 20" casing - 17 1/2" hole.

- The desired formation integrity at 20 inch casing shoe is 1.40 gr/cc sp.gr. test must be made after heaving drilled 5 m in new formation.

20" casing shoe set at	:	650	m
17 1/2" hole drilled to	:	2000	m
Maximum mud weight expected at that depth	:	1.30	sp.gr.
Mud weight in 20" casing during test	:	1.15	
Minimum surface pressure to reach for L.O.T.	:	19.5	kg/cm^2
Equivalent mud weight at 20" shoe	:	1.45	

B. 13 3/8" casing - 12 1/4" hole.

- A leak off test will be performed at 13 3/8" casing shoe to check the formation integrity, after having drilled 5 m in new formation.
- The minimum equivalent density required must be 1.70 sp.gr.

13 3/8" casing shoe at	:	2000	m
12 1/4" hole will be drilled to	:	2950	m
Maximum mud weight expected at that depth	:	1.45	sp.gr.
Mud weight in 13 3/8" casing during test	:	1.30	
Minimum surface pressure to reach for L.O.T.	:	80	kg/cm^2
Equivalent minimum mud weight at 13 3/8" casing shoe	:	1.70	

C. 9 5/8" casing - 8 1/2" hole.

- A leak off test will be performed at 9 5/8" casing shoe to check the formation integrity after having drilled 5 m in new formation.
- The minimum equivalent density required must be 1.85 sp.gr.

9 5/8" casing shoe at	:	2950	m
8 1/2" hole will be drilled to	:	3500	m
Maximum mud weight expected at that depth	:	1.60	sp.gr.
Mud weight in 9 5/8" casing during test	:	1.45	
Minimum surface pressure to reach for L.O.T.	:	118	kg/cm^2
Equivalent minimum mud weight at 9 5/8" casing shoe	:	1.85	

D. Procedure

For the leak-off test procedures refer to the appendix "E" "Pressure Testing after setting Intermediate Casing".
If any of the above leak-off tests give lower value than expected, a cement squeeze must be performed.

XIV DRILLING OPERATIONS

A. 36" Phase (90m to 150m approx)

1. Drilling procedure

   The open hole depth will be calculated in order to have the 30" housing 2m above mudline when 30" shoe is set on bottom.

2. Drilling string

   26" bit
   36" hole opener
   3 - 9 1/2" OD. DC.
   6 TO9 - 8" DC
   X - HWDP
   5" - DP

3. Parameters

   RPM: 60 - 80
   Weight: 10.000 - 20.000 lbs.
   Flow rate: 1.000 - 1.200 l/min. during the first 15 m.
   Beyond that depth, maximum pump output.

   Note: Spot 5 m^3 gelly mud before each connection.

4. Drilling fluid

   See mud programme.

5. Deviation

   One survey at end of phase.

6. Logging

   No logging.

B. 30" Casing (shoe at 140m approx.)

1. Casing set up

1 - Shoe joint 30" x 1" - 40 FT w/ATD Pin up x Baker Float Shoe.

3 - 30" x 1" - 40 FT long - Intermediate joints w/ATD connectors.

1 - 30" VETCO Housing w/40 FT long extension - 30" x 1½" wall w/ADT Box connector down.

1 - 1 VETCO permanent guide base w/4 guide posts 10 FT long.

Note: Attach the 3m long extension arm w/basket to permanent guide base and set transpinger before running in hole.

2. Landing string

- Tail pipe 5" DP at about 10m from shoe.
- 30" Cam actuated running tool.
- 5" HWDP (or DC) to surface.
- 4 1/2 IF Pin cementing head.

3. Cementing job

- 30" casing will be cemented in its full length. Returns will be checked with TV.
- See appendix "C" for cement and displacement calculations.
- Slurry volume gives 200% excess in open hole.
- Displace cement to about 5m above shoe.
- Bleed off pressure and check for return before to unlatch 30 Inch Running tool.

C. 26" PHASE (150 m to 660 m approx.)

1. Drilling procedure

- Install 22" marine riser with diverter system on 30" casing.
- Drill out 30" shoe with 17 1/2" bit and 26" underreamer. Drill 4m of formation. Pull and lay down 26" underreamer.
- Drill 17 1/2" rat hole to approximately 660 m.
- Deviation surveys as per deviation program (XII-B).
- Run logs.
- Run 17 1/2" pilot bit with underreamer 26" and underream hole to bottom. (Check 26" underreamer function and diameter in open position on surface before running in hole).
- Fill up hole to mud line with mud of specific gravity calculated to balance the hydrostatic pressures as follows:
  a) Open hole + riser to surface w/drilling mud, equal to
  b) Hole to mud line w/adjusted mud weight + sea water to MSL + 100 psi
- Pull to mud line. Displace riser with sea water. Observe well. If well steady, pull out and disconnect riser.
- Run 26" bit for wiper trip. Any reaming operation must be performed using mud weight of sp.gr. as calculated on b) above.

2. Drilling string

a) . 17 1/2" bit
   . Drill pipe float valve
   . 3 x 9 1/2" DC
   . 9 x 8" DC
   . 17 1/2" stabilizers at 9m and 27m from bit
   . 15 x HWDP 5" (w/drop in pressure valve sub on top 1st HWDP)
   . 5" DP

b) . 17 1/2" pilot bit
   . 26" underreamer
   . 3 x 9 1/2" DC
   . 9 x 8" DC
   . 17 1/2" stabilizers at 9m and 27m from bit
   . 15 x HWDP 5"
   . 5" DP

3. Parameters

RPM : 60 - 100
WOB : 10.000 - 20.000 lbs
Flow : Max pump output

4. Drilling fluid

See mud programme

5. Deviation

As per deviation programme (XII-B)

6. Logging

See logging programme

D. 20" CASING (shoe at 650 m approx.)

1. Casing set up

From bottom to top

- 1 float shoe 133 lbs/ft. Buttress thread
- 1 joint casing 20" 133 lbs/ft. K55. Buttress thread
- 1 float collar " " " "
- X joints casing 20" " " " "
- 1 cross over joint 20" OD. 0.625 wall with LX Box connector up x Buttress pin down.
- 1 VETCO 18 3/4" - 10000 housing w/20" OD x 0.625 wall extension and LX VETCO Pin connector down.

2. Landing string

- VETCO 18 3/4 - 10.000 running tool with subsea cementing system.
- 5" HWPD (or 6 1/2 DC)
- Subsea cementing head

3. Cementing job

- 20" casing will be cemented in its full length
- Returns will be checked by TV
- See appendix "C" for cement and displacement calculations
- Slurry volume gives 125% for cement and displacement calculations
- Bump down plug with 1000psi (15 mn)
- Bleed off and check flow return

E. 17 1/2" PHASE (660 to 2000 m approx.)

1. Drilling procedure

- Pressure test BOP stack on test stump (to be done during preceeding phases).
  - Rams, kill and choke valves to 10.000psi
  - bag preventers to 3500psi
- Install BOP stack and lower marine riser package on cellar deck beams.
- Test all BOP functions using both koomey pods.
- Run BOP. Pressure test kill and choke lines, while running in, every second riser joint.
- With slip joint rigged up, run and latch BOP on 18 3/4" wellhead housing.
- Check H4 connector indicator rod position with TV.
- Pick up test, 10 to 15 tons approximately.
- Retrieve 18 3/4" bore protector.
- Pressure test stack on bottom.
  - pipe rams + K/CH valves + lower H4 connector to 5000psi,
  - bag preventer and lower marine package connector to 3000psi.
- Run 18 3/4". Bore protector.
- Run 17 1/2" bit. Pressure test 20" casing to 1000psi (if not done at the end of cementing operation).
- Drill out float collar - cement - float shoe.
- Drill 5m of new formation.
- Perform a leak off test as per L.O.T. programme (XIII) and L.O.T. procedure appendix "E".
- Drill 17 1/2" hole to 2000m approximately.
- Wiper trip before logs.
- Control trip after logs.
- Retrieve 18 3/4" bore protector to run 13 3/8" casing.

2. Drilling string

-17 1/2" bit

- 17 1/2" bit stabilizer (Bored for Float w/Baker float valve in.)
- 1 - 9 1/2" short DC
- 17 1/2" string stabilizer, (w/totco ring set on top).
- 1 - 9 1/2" monel DC
- 1 - 9 1/2" DC
- 17 1/2" string stabilizer
- cross over sub - 9 1/2 x 8"

- 15 to 18 x 8" DC
- 1 - 7 3/4" drilling jar
- 15 Heavyweight drill pipes 5", (w/drop in pressure valve sub on top of 1st HWDP).
- Drill pipes 5".

3. Parameters

RPM	: 80 - 150
Weight	: 30.000 - 60.000 lbs (according to penetration rate)
Flow rate	: Maximum pump output.

4. Drilling fluid

See mud programme

5. Deviation

See deviation survey programme (XII-B)

6. Logging

See logging programme (IX).

F. 13 3/8 CASING (Shoe at 2000 m approx.)

1. Casing set up

From bottom to top.

1 - float shoe 72 lbs/ft
2 - joints N80 - 72 lbs/ft - VAM
1 - float collar - 72 lbs/ft - VAM Pin x Box (with seal off plate)
X - joints N80 - 72 lbs/ft - VAM - Up to 700 m approx.
Y - joints P110 - 72 lbs/ft - VAM - Up to mud line

1 - 18 3/4" - 13 3/8" - SG-5 casing hanger w/6 ft long extension 13 3/8" - 72 lbs/ft P110 - VAM - Pin down.
Note: Lock ring must be removed from 13 3/8" casing hanger

Notes: Casing hanger/extension and casing hanger running tool could be made up after electrical logs and before the wiper trip for casing operation.

- The 18 3/4" x 13 3/8" casing hanger running tool must have the pack off torque keys removed before being made up with casing hanger and pack off.
- All 13 3/8" casing joints must be properly calibrated to 12 1/4" ID before running into hole (13 3/8" - 72 lbs/ft, special drift = 311.38mm or 12 1/4").
- Recommended make up torque for 13 3/8" VAM thread without correction factor for thread compound:

minimum :	1700 m.kg	(12.300 ft/lbs)
optimum :	1800 m.kg	(13.000 ft/lbs)
maximum :	2000 m.kg	(14.500 ft/lbs)

2. Landing string

- From casing hanger to surface
- VETCO 18 3/4" - 13 3/8" full bore running tool w/13 3/8" B uttress box up.
- Cross over joint 13 3/8" - N80 - 72 lbs/ft - Butt. Pin x VAM Box, (already made up on running tool).
- X joints 13 3/8" - N80 - 72 lbs/ft - VAM
- Double stage cementing head.

Note: Landing string must be made up with the maximum recommended torque on VAM threads.

3. Cementing job

- Quantities given in Appendix "C" - Cementing and displacement calculations" will be adjusted accurately according to 17 1/2" hole caliper log.
- Casing will be cemented with:
  - . Class "G" neat cement - S.G. 1.90 - from 2000 to 1850 m.
  - . lett cement - S.G. 1.50 - from 1850 m to 450 m.
  - . displacement with drilling mud and bump plug with 2500psi pressure during 15 minutes
  - . if the plug can not be bumped down, the total displacement volume must not exceed the total inside volume of the casing down to the shoe calculated with a 98% efficiency of the displacement pumps
  - . bleed off pressure and check return volume
- Unlatch casing hanger running tool (4 to 5 turns to the right).
- Pick up R/T 2 to 3 feet above casing hanger.
- Circulate few minutes to clean up pack off area.
- Pull out and lay down casing running string.
- Run in hole with pack off running/retrieving tool with 5" HWDP or 6 1/2" DC. (Bumper sub if needed according to weather conditions.)
- Tighten the pack off (5 to 6 turns to the right), to the required torque 16.000 to maximum 18.000 lbs/ft on surface.
- Close pipe rams. Pressure test pack off to 7500psi check carefully volume pumped to avoid the collapse of 13 3/8" casing, in case of pack off leaks.
- Retrieve pack off running tool.
- Run in with test tool.

G. 12 1/4" PHASE (from 2000m to 2950m approx.)

1. Drilling procedure

- Pressure test casing hanger pack off - pipe rams, kill and choke valves up to 7500 psi
- Pressure test bag preventers to 3500psi.
- Check carefully volumes pumped to avoid 13 3/8" casing collapse if the pack off is leaking.
- Run 18 3/4" x 13 3/8" wear bushing.
- Pressure test casing at 2500 psi, 15 mn if not done at the end of cementing job.
- Drill out float collar, cement and shoe, wash to bottom of 17 1/2" hole.
- Drill 5m of new formation.
- Perform a leak off test as per L.O.T. programme (XIII) and L.O.T. procedure (appendix "E").
- Run gyroscopic multishot survey all along the 13 3/8" casing after first trip out for bit change, only if deviation log taken in 17 1/2" hole is not available (see XII-D).
- Drill 12 1/4" hole to 2350 m approx.
- Short trips according to hole problems.
- Check drilling jar and stabilizer sizes on every trip.
- If turbodrilling method has to be used, a turbodrilling programme will be issued giving new drilling string and parameters.
- Wiper trip before logs.
- Run logs.
- Make up 9 5/8" casing hanger running tool w/casing hanger.
- Control trip after logs.
- Retrieve 18 3/4 - 13 5/8 wear bushing before running the 9 5/8" casing.

2. Drilling string

- 12 1/4" bit
- 12 1/4" bit stabilizer (bored for float w/Baker float valve in)
- 1 - 9 1/2" short DC
- 12 1/4" string stabilizer, (w/totco ring set on top)
- 1 - 9 1/2" monel DC
- 1 - 12 1/4 - string stabilizer
- 1 - 9 1/2" DC
- 12 1/4 string stabilizer
- cross over sub.

- 12 to 15 drill collars 8" OD
- 1 drilling jar - 7 3/4" OD
- 15 Heavyweight drill pipes 5"
  (Drop in pressure valve sub on top of 1st HWDP)
- Drill pipes 5" OD
- 1 rubber protector each stand in casing

3. Parameters

RPM	:	100 - 140
Weight	:	20.000 - 50.000 lbs
Flowrate	:	Depending on rheological parameters. The flowrate will be fixed every day in connection with use of computerized programmes by EAN Mud Section.

4. Drilling fluid

See mud programme

5. Deviation

- See deviation survey programme (XII-E).

6. Logging

See logging programme (IX) including CBL - VDL in 13 3/8" casing.

H. 9 5/8" CASING (Shoe at 2950m approx.)

1. Casing set up

From bottom to top

- 1 float shoe 53.5 lbs/ft VAM
- 2 joints P110 53.5 lbs/ft VAM
- 1 float collar 53.5 lbs/ft VAM
- X joints P110 53.5 lbs/ft VAM
- 18 3/4 x 9 5/8" casing hanger w/6 ft extension - P110 53.5 w/VAM thread down. (Extension to be drifted 8 1/2)
- 9 5/8" - 53.5 lbs/ft P110 casing has special drift 8 1/2".
- Check for free circulation through float equipment after making up one joint of casing above float collar.
- Fill up every joint while running in hole.
- Centralizers: Programme will be decided according to hole angle and caliper.
- Run casing very slowly when centralizers pass through the 18 3/4" x 13 3/8" casing hanger.
- Recommended make up torque for 9 5/8" vAM regular type coupling (without correction factor for thread compound.)

Minimum	Optimum	Maximum
1.700 m/kg	1.800 m/kg	2.000 m/kg
12.300 ft/lb	13.000 ft/lb	14.500 ft/lb

2. Landing string

- From casing hanger to surface
  - 18 3/4" - 9 5/8" - VETCO SG 5 Full bore running tool with 9 5/8" Buttress box up.
  - The pack off torque keys must be removed from running tool
  - Cross over joint 9 5/8" - P110 - 47 lb/ft Butt. pin x VAM box, (already made up on running tool).
  - X-joints 9 5/8" - P110 - 47 lbs/ft - VAM
  - Cementing head (Double plug type).
- Landing string must be made up with the maximum recommended torque.

Note: Upon request from main office the lock ring could be removed from the VETCO 18 3/4 - 9 5/8" casing hanger.

3. Cementing job

- Quantities given in Apendix "C" cementing and displacement calculations will be ajusted accurately according to 12"1/4 hole caliper log.
- Casing will be cemented with :
  - Neat slurry class "G" cement sp.gr. 1.95 from 2950 to 2800 m approximately.
  - Lett slurry sp.gr. 1.50 from 2800 to 1800 m (or approximately 200 m above 13" 3/8 shoe).
- Displace cement with mud and bump down plug with 3500 psi (15mn)
- Maximum displacement volume will be calculated as for the 13" 3/8 cementing job.
- Bleed off and check return volume.
- Unlatch 9" 5/8 casing hanger running tool (4 to 5 turns to the right).
- Pick up R/T 2 to 3 feet above casing hanger.
- Circulate few minutes to clean up pack off area.
- Pull and lay down casing running string.
- Run in hole w/pack off R/R tool using 5" HWDP or 6"½ DC (w/bumper sub if needed).
- Tight the pack off to the required torque 16 to 18.000 lbs/ft.
- Pull out with pack off/R/R tool, run in with test tool.
- Pressure test pack off and BOP's.

I. 8 1/2" PHASE (from 2950 to 3500 m approx.)

1. Drilling procedure

- Pressure test casing hanger pack off. Pipe rams. Kill and choke valves up to 7500 psi.
- Pressure test bag preventers to 3500 psi.
- Check carefully volumes pumped to avoid 9 5/8" casing collapse if pack off is leaking.
- Run 18 3/4" x 9 5/8" wear bushing.
- Run 8 1/2" bit to float collar.
- Pressure test 9 5/8" casing to 3500 psi if not already done at end of 9 5/8" cementing operation.
- Drill out float collar, cement and shoe.
- Drill 5m of new formation.
- Perform a leak off test as per L.O.T. program (XIII) and L.O.T. procedure (appendix "E").
- Run gyroscopic multishot survey on 9 5/8" casing from 9 5/8" shoe up to 200m above 13 3/8" shoe, after first trip out for bit change if deviation log in 12 1/4" hole not available.
- Drill 8 1/2" hole to 4000m approx.
- Short trips according to hole problems.
- Check drilling jar and stabilizer sizes on every trip.
- Wiper trip before any logging operation.

2. Drilling string

- 8 1/2" bit
- 8 1/2" near bit stabilizer, (bored for float w/Baker float valve in).
- 1 - 6 1/2" short DC.
- 1 - 8 1/2" string stabilizer, (w/Totco ring set on top).
- 1 - 6 1/2" monel DC
- 1 - 8 1/2 string stabilizer
- 1 - 6 1/2" DC
- 1 - 8 1/2" string stabilizer
- 21 drill collar 6 1/2" OD
- Drop in pressure valve sub
- Drilling jar 6 1/4" OD, (check if valve sub could pass through)
- 14 Heavyweight drill pipes 5"
- Drill pipes 5"

3. Parameters

RPM : 100 - 140 (80 with insert bits)

Weight : 20.000 - 35.000 lbs

Flowrate : same remarks as for 12 1/4" phase

4. Drilling fluid

See mud programme

5. Deviation

See deviation survey programme (XII-G)

Gyroscopic multishot survey in 9 5/8" csg to be made after first trip out for bit change.

6. Logging

See logging programme + CBL - VDL in 9 5/8" casing.

7. Safety precautions during drilling operations

- Any down hole equipment must be accurately measured (length OD - ID - threads - condition...) before entering the hole.
- A drilling Jar "DAILEY" type will be kept permanently in any drilling or wiper string.
- Conditions for surface equipment (slips, rig tongs, table bushings) will be carefully checked before each trip.
- Displace periodically the drill pipe joint set above the drill collars (or HWPD) to avoid any abnormal fatique.
- On each trip, pull out the string in order to alternate the D.P. Tool joints unscrewed.

J. Liner 7"

In case of favourable formation a test through 7" liner will be performed.

A special programme will be made in time giving all characteristics and detailed instructions to run and cement the 7" liner.

K. Abandonment of well

In case of abandonment of well a special programme approved by authorities will be issued and sent to the rig.

L. Cleaning the well site

It is the responsibility of ELF AQUITAINE NORGE to clean the well site before removing the drilling platform.

So it must be reminded that any drop of equipment, or material to the sea must be avoided and in case of such a drop the fact must be pointed out to the company's representative on board in order to take proper actions to retrieve the lost equipment.

After the wellhead has been cut and retrieved, a sea bottom survey must be performed around the wellhead by divers, and they must report by writing the status of the sea bed. This report must be signed by Chief Diver, EAN Drilling Supervisor and Drilling Superintendent.

A special sea bottom survey will be issued and sent to authorities for approval.

A P P E N D I X

A. Well progress prognosis

B. Mud program

C. Cementing and displacement calculations

D. Casing calculations

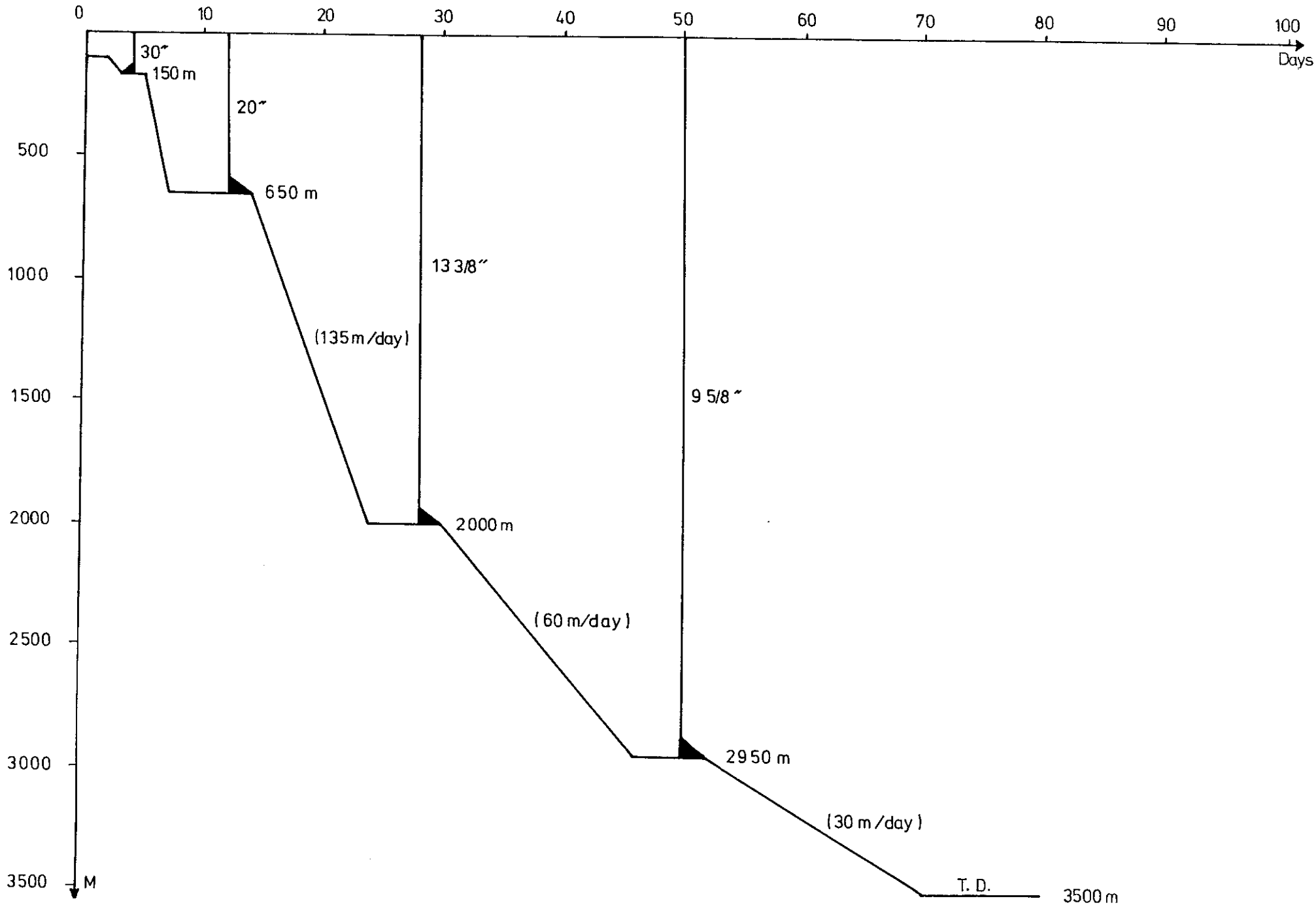
E. Casing tests/leak off test, procedures

F. Responsibilities

G. Well killing contingency plan

H. Elf Aquitaine Norge A/S - "EMERGENCY TASK FORCE"

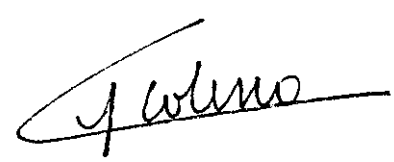
TOTAL DURATION (ESTIM.) 80 Days. Including : anchoring - drilling - abandon - desanchoring



APPENDIX B

FLUIDS PROGRAM
3/7-3

FLUIDS AND CEMENT



G. COLENO

1. 36" PHASE interval sea bed 90 to 155 m. 30" casing at ± 150 m.

1.1. Drill with sea water, allowing returns to go to the sea Displace sea water with 6-8 m^3 gelly slugs of mud before each connection. When the 36" hole is drilled, pump to fill up well with thick mud before making a wiper trip.

Circulation with viscous mud into the hole for cleaning before pulling out to run 30" casing.

To avoid any incident, fill the hole and circulate. It is necessary to get permanently in reserve a volume of thick mud corresponding to the hole volume.

1.2. Composition of high viscosity mud for starting up

Sea water	: 1000	
CMC extra HV	: 2 - 5	Kg to adjust rheology and reduce filtrate
Caustic soda	: 3 - 6	Kg
Wyoming bentonite	: 80 - 120	Kg if possible prehydrated in 300 l FW

1.3. Characteristics of mud

Weight	: 1.04 - 1.06
f.viscosity	: 140 - 160
filtrate	: 10 - 15
pH	: 8.5 - 9

1.4. Provide mud 250 m^3

2. 26" PHASE interval 155 to 650 m. 20" casing at ± 640 m.

2.1. Drill out cement and shoe with sea water and returns to the sea. After drilling the shoe, displace sea water by mud and continue drilling 17 1/2 hole to 650 m. After logging opening 26" hole.

Before running in the 20"casing, the hole control with 26" bit with no mud return, requires an important volume of mud. To avoid any incident, fill the hole and circulate. It is imperative to get permanently in reserve, a volume of mud corresponding.

2.2. Composition of bentonite and lignosulfonate mud

Sea water	:	1000 l
CMC HV or LV	:	4 - 6 Kg to adjust rheology reduce filtrate
FCL	:	6 - 8 Kg
Caustic soda	:	5 - 7 Kg
w.bentonite	:	50 - 70Kg
d.detergent	:	1 - 2 l if "bit balling" or torque

2.3. Characteristics of mud

Weight	:	1.10 - 1.15
Solids	:	7 - 11
Funnel viscosity	:	65 - 70
Plastic viscosity or "N"	:	15 - 20 / 0.55 - 0.60
yield point or "K"	:	10 - 15 / 1.30 - 1.60
gel 10 sec	:	2 - 5
gel 10 min	:	10 - 15
filtrate 30 min	:	5 - 8
pH	:	9 - 9.5
alkalinity Pf	:	0.1 - 0.3

4.

2.4. Provide mud 1000 m^3

3. 17 1/2 PHASE interval 650 to 2000 m. 13 3/8 casing at ± 1990m.

3.1. Drilling out with SW the cement inside 20" casing, or pretreat the system with sodium bicarbonate to avoid cement contamination and the products to adjust the following composition.

3.2. Composition of gypsum surfactant system

Sea water	: 1000	l	
CMC extra. HVouLV	: 5 - 10	Kg	to adjust rheology reduce filtrate
FCL	: 15 - 20	Kg	
Surfactant	: 10 - 15	Kg	control the normal tendency of shales to ball up
Caustic soda	: 8 - 12	Kg	
Gypsum	: 10 - 15	Kg	to adjust ca ++
W.bentonite	: 40 - 60	Kg	cake and filtrate
barite	: for weight adjustment		

3.3. Characteristics of mud

Weight	: 1.15 grading to 1.30	
Solids	: 9 - 11	13-18
funnel viscosity	: 55 - 60	
plastic viscosity or "N"	: 30 - 35 / 0.60 - 0.65	
yield point or "K"	: 25 - 22 / 0.80 - 0.85	
gel 10 see	: 2 - 4	
gel 10 min	: 10 - 15	
filtrate 30 min	: 4 - 5	
pH	:9.5 - 10	
alkalinity Pf	: 1 - 1.5	
Ga^{++} (filtrate)	: 1 - 1.5	

3.4. Provide mud 1100 m^3

4. GENERAL DISCUSSION

It is during this stage that the "SHALES" are to be drilled. These shales are reputed as being difficult due to problems arising during penetration. They hydrate easily and eventually come apart and, if the mud is not perfectly suited to this type of formation, this may give rise to redrilling and caving.

The mud weight will be progressively increased:

20" shoe	:	1.10 - 1.15
1000 m	:	1.16
1200	:	1.18
1400	:	1.20
1600	:	1.30

The mud used in this stage must therefore respond to the following essential criteria:

- have a specific gravity at such a level as to contain the slight tendency to creep in the shales. The specific gravity will be obtained in successive from a level of 1.15 at the start of this phase to 1.30 towards 1600m.
- possess normal rheological properties to have a good dispersed system, to ensure proper cleaning and to avoid a too high equivalent circulating density.
- have a very low filtrate.
- The solids will be eliminated on the shales shakers, desilters, desanders, mud cleaners and dilution. Run the smallest screens possible on all shakers and mud cleaners. The shakers will be constantly watched. If there is a decrease of cuttings volume, one short trip to shoe will be made immediately and circulation established.
- be in good electrochemical equilibrium with the shales to avoid hydratation phenomena. pH 9.5 - 10.
- In order to maintain this mud in a dispersed state and in good electrochemical equilibrium with the formation, constant supervision is required, together with continuous treatment with lignosulfonate, surfactant and gypsum, as well as applying all mechanical means for eliminating solids.

5. 12 1/4 PHASE interval 2000 to 2950 m. 9 5/8 casing at ± 2940m.

5.1. Before drilling out the cement inside 13 3/8 casing, mud weight will be increased to 1.50 and pretreat the system with sodium bicarbonate to avoid cement contamination and the products to adjust the following composition.

5.2. Composition of ferro chrome lignosulfonate and chrome lignite mud

Sea water	:	1000 l	
CMC pure HV or LV	:	4 - 8	to adjust rheology and reduce filtrate
FCL	:	25 - 35 Kg	maintain concentration
CL	:	25 - 35 Kg	
caustic soda	:	8 - 12 Kg	
w.bentonite	:	30 - 50 Kg	necessary to have a good cake
d.detergent	:	1 - 2 l	more if "bit balling" or torque
barite	:	for weight adjustment	

5.3. Characteristics to mud

Weight	:	1.50 grading to 1.60
Solids	:	18 - 21 20-24
funnel viscosity	:	50 - 60
plastic viscosity or "N"	:	27 - 34 / 0.65 - 0.70
yield point or "K"	:	10 - 13 / 0.70 - 0.80
gel 10 sec.	:	1 - 2
gel 10 min	:	10 - 15
filtrate 30 min	:	3 - 5
filtrate HT/HP	:	10 - 12
pH	:	9.5 - 10
alkalinity Pf	:	0.3 - 0.5

5.4. Provide mud : 700 m^3

5.5. The mud weight will be progressively increased:

13 3/8 shoe	1.50
2800	1.55
2900	1.60

6. 8 1/2 PHASE interval 2950 to 3500 m. 7"liner if needed.

6.1. Before drilling out the cement inside 9 5/8 casing dump and clean the (setting tank) and pretreat mud if necessary, this mud with sodium bicarboate to avoid cement contamination.

6.2. Composition of Ferrochrome Lignosulfonate and Lignite mud

Seawater	:	1000 L
CMC Pure HVorLV	:	3-6 Kg
FCL	:	30-45 Kg
CL	:	30 40 Kg
Caustic Soda	:	4-8 Kg
Baryte	:	for weight adjustment
W. Bentonite	:	25-30 Kg

6.3. Characteristics of mud

Weight	:	1.50 grading to 1.60
Solids	:	18-21 20-24
funnel viscosity	:	55 - 60
plastic viscosity or "N"	:	45 - 50 / 0.70 - 0.80
yield point or "K"	:	18 - 22 / 0.80 - 0.90
gel 10 sec.	:	2 - 4
gel 10 min.	:	10 - 15
filtrate 30 min	:	2 - 3
filtrate HT/HP	:	10 - 12
pH	:	9.5 - 10
alkalinity Pf	:	0.3 0.5

6.4. Provide mud : 500 m^3

6.5. The mud weight will be progressively increased:

9 5/8 shoe	1.50
3100	1.55
3400	1.60

7. PERMANENT INSTRUCTIONS

7.1. To avoid any incident, it is imperative to get permanently a volume of mud, that is to say :

ONE TANK OF MUD W/A S.G. OF 2.10 FOR THE 12 1/4 and 8 1/2" PHASES

and necessary products needed to make this volume quickly, ready to be used immediately to control any income or blow out.

- For an immediate action, take care to test as soon as possible all the installations and facilities enabling a quick control of any income.
- Further in the sequence of the precautions to take care, be sure to be able to make and circulate quickly a barite plug and a cement plug.
- Permanent survey of the pit level, volume and of the characteristics of the fluid in circulation, and mainly, if a velocity break occurs, the mud ditch fluid, gas content, temperature, chloride variation, should be under survey, in order to detect any show in case of abnormal pressure.
- Let a homogenous and a steady fluid in well before every pulling out of hole.
- Control the permanent filling of the well, particularly during the trips (possum belly tank).
- Calibrate the densimeter often, mainly for the abnormal pressured formation.
- A pressurized mud balance will be used throughout the 12 1/4 and 8 1/2" phases to ensure accurate mud weight determination.
- For the purpose of making the electrical logging, the running in casings and to assume their best cementing jobs easier, it is necessary to be very careful to have the best rheological fluid characteristics during the circulation preceding these operations.
- Mud tanks for mixing water with additives will be thouroughly cleaned to prevent pollution by mud.

HYDRAULIC RECOMMENDATIONS

DEPTH	CUTTING THICK X Ø	VELOCITY m/min	SG MUD	B or P	PV or "K"	YP or "N"	HOLE DIAMETER MINUS D.C. DIAMETER	CRITICAL FLOW RATE	LARGEST ANNULUS CASING MINUS D. PIPE	MINIMAL FLOW RATE PULLING CUTTING	FLOW RATE FOR N Re 1300	OPTIMUM FLOW RATE
150			1.04				36 9.50					maxi
400	5	10	1.10	P	1.90	0.55	17.50 9.50	12313	28 5	5430	7406	maxi
700	3 x 5	5	1.19	P	1.56	0.57	26 9.50	21599	28 5	3446	12966	maxi
900	3 x 5	15	1.15	P	0.54	0.66	17.50	6380	18.7	3463	3839	3600
1580	3 x 5	18	1.22	P	0.65	0.65	9.50	6809	5	3838	4097	3900
2044	3 x 5	20	1.33	P	1.79	0.58		11262		3841	6773	3900
2300	3 x 5	20	1.40	P	1.08	0.64		8845		3871	5322	3900
2486	3 x 5	20	1.40	P	0.61	0.70		6639		3991	3999	4000
2510	3 x 5	25	1.40	P	0.46	0.70	12.25	2676	12.34	1919	1612	2000
2610	3 x 5	25	1.42	P	0.89	0.66	9.50	3727	5	1821	2242	2200
2792	3 x 5	25	1.45	B	37	17		3014		1778	2178	2100
2892	3 x 5	25	1.47	P	1.02	0.64		3754		1789	2259	2200
3000	3 x 4	25	1.19	P	1.18	0.66	8.50	3010	8.53	738	1811	1200
3300	2 x 3	25	1.20	P	0.76	0.67	6.50	2242	5	720	1350	1200
3500	2 x 4	25	1.20	P	0.48	0.73		2057		742	1240	1100

7.2. Permanent Safety Material in Stock

- barite on the rig	200 T
- barite on each supply	100 T
- w. bentonite	20 T
- cement	40 T
- attapulgite clay (sack)	5 T
- calcium chloride	1 m^3
- L.C.M. fiber	0.5 T
granular (coarse and fine)	1 T
flake	0.5 T
- pipe free	2000 l
- sodium bicarbonate	2 T
- soda ash	1 T
- sodium tetraphosphate pH10	0.5 T
- H2S scavenger	1 T

BARITE IN STOCK THE 01.05.81

Companies	Bulk Dusavik	Bulk Tananger	Sacks Storage	Total
Anchor Dril. Fluid	338	835	22	1195
Milchem	475	100	1200	1775
Ceca	804	2130		2934
Dresser	298	382		680
Baroid	481	289	20	790
TOTAL m/tons	2396	3736	1242	7374

MATERIALS QUANTITIES ESTIMATION

PHASE	MATERIALS	QUANTITIES (Kg or l)
36"	CMC extra HV	1500
$\pm$ 250 m^3	caustic soda	1500
	W. bentonite	30000
	attapulgite clay (sack)	5000
	defoamer	250
	barite	50000
	lost circulation material	2000
	sodium bicarbonate	1000
	soda ash	1000
	pipe free	2000

PHASE	MATERIALS	QUANTITIES (Kg or l)
26"	CMC extra HV	3500
$\pm$ 1000 m^3	CMC LV	3500
	FCL	9000
	caustic soda	8000
	W. bentonite	70000
	defoamer	500
	drilling detergent	1000
	barite	100000

PHASE	MATERIALS	QUANTITIES (Kg or l)
17 1/2 ± 1100 m^3	CMC extra HV	8000
	CMC LV	8000
	FCL	35000
	surfactant	23000
	caustic soda	18000
	gypsum	23000
	defoamer	1200
	barite	300000
	sodium tetraphospate	500
	H2s scavenger	1000
	drilling detergent	800
	W. Bentonite	80000

PHASE	MATERIALS	QANTITIES (Kg or l)
12 1/4 ± 700 m^3	CMC pure HV	1000
	CMC pure LV	3000
	FCL	18000
	CL	18000
	caustic soda	6000
	w. bentonite	25000
	drilling mud detergent	600
	defoamer	400
	barite	550000
	sodium bicarbonate	500

PHASE	MATERIALS	QANTITIES (Kg or l)
8 1/2 ± 500 m^3		
	caustic soda	2000
	defoamer	600
	barite	700000
	CMC pure LV or HV	8000
	FCL	22000
	CL	22000
	W. Bentonite	22000

APPENDIX C

CEMENTING PROGRAM 3/7-3

FLUIDS AND CEMENT

G. COLENO

C E M E N T I N G P R O G R A M

HOLE SIZE CASING LINER	WEIGHT lbs/ft	DV SHOE	CLASS CEMENT	SG	INTERVAL m	MUD SG	MAXIMUM EXPECTED PRESSURE DURING DISPLACEMENT KG/cm2	MAXIMUM ESTIMATED EQUIVALENT DENSITY DURING DISPLACEMENT
36" 30"	310	150	G	1.90	150 to 90	1.05	17	1.46
26" 20"	133	650	LIGHT G G	1.50 1.90	550 - 90 650 - 550	1.15	104	1.54
17 1/2 13 3/8	72	2000	LIGHT G G	1.50 1.90	1850 - 450 2000 - 1850	1.30	300.50	1.50
12 1/4 9 5/8	53,5	2950	LIGHT G G	1.50 1.98	2800 - 1800 2950 - 2800	1.70	460	1.56
8 3/8 7	35	3500	E	2.10	If needed	1.60		

DEPTH RECALL

WATER DEPTH	65 m
RKB SEA LEVEL	25 m
RKB SEA BOTTOM	90 m

ADDITIVES FOR CEMENT SLURRIES

- PREHYDRATED BENTONITE

  Contact time with fresh water must be sifficient to let Wyoming bentonite to be hydrated. It is generally know that this one is complete after an important mixing of about one hour.

- CALCIUM CHLORIDE

  The effect of the calcium chloride on the viscosities of slurries is without influence. The calcium chloride must be added into prehydrated bentonite just before to mixt the cement slurry.

ADDITIVES FOR CEMENT WITH LIQUID ADDITIVES SYSTEM

Extender is incompatible with $CaCl_2$, the extender mixing in water with $CaCl_2$ causes massive precipitation of a white insoluble residue.

FLUID LOSS REDUCER MUST BE COMPULSORY ADDED AND MIXED WITH WATER BEFORE ADDING DISPERSANT AND RETARDER.

30" CASING shoe at about 150

Hole gage 36" 656,80
Casing gage 30" (310lb) 455,80/28" 407.80
Top cement up to sea bed 90
Open hole interval 60
Excess in open hole 200% (hole size ± 46")

SLURRY VOLUME

Annular	36" x 30"	201.00 x 60 (3)	=	36180
Inside	30"	407.80 x 5	=	2039
Total volume G cement			=	38219

TIMING OF OPERATION

Mix and pump G cement 38219:700 =	54
Drop plug	20
Displacement 5" DP ± 9.27 x (150-5) = 1344	
Flow rate 700 l/min	2
Total	76
Safety factor 50%	38
GRAND TOTAL min	114

30" SLURRY

Composition	Weight-Kg/100	Volume-l/100	By m^3 FW	For each 10 bbls
Fresh water	42	42		
Defoamer	0.050	0.050	1.19 l	0.50 gal
Accelerator D77	6.081	4.439	105.69 l	44.37 "
G cement	100	31.75		
SG ± 1.89		78.239		

RESULTS (± 140m BHST 5°C - mud weight 1.05)

T.T. requested: 2^H00
T.T. recorded : 6^H00
24 hours compressive strenght: 94 b
rheology and gels: 175 - 138 - 121 - 102/49-114
Maximum expected pressure during displacement: 16.80 b
Maximum estimated equivalent density : 1.46

REQUIREMENTS

Fresh water $\frac{42 \times 48848}{100} =$ 20516 l

Defoamer $\frac{0.050 \times 48848}{100} =$ 24.5 l

Accelerator D77 $\frac{4.439 \times 48848}{100} =$ 2168.3 l

G cement $\frac{100 \times 38219}{78.24} =$ 4884.8 Kg

20" CASING shoe at about		650
Casing gage 30" (310 lb)	455,80/407.80	150
Hoel gage 26"	342,50	
Casing gage 20" (133 lb)	202,96/ 18.72" 177,76	
Top cement up to sea bed		90
Open hole interval		500
Casing interval		60
Excess in open hole 125% (hole size ± 32")		

SLURRIES VOLUMES

Lead-light 30" x 20"	204,84 x 60	=	12904
Lead-light	139,54 x 400(2.25)	=	125586
TOTAL VOLUME LIGHT		=	138490
Tail - G	139,54 x 100(2.25)	=	31.396
Inside 20"	177.76 x 12	=	2.133
TOTAL VOLUME G		=	33.529

TIMING OF OPERATION

Mix and pump light		138490	: 900	=	154	
Mix and pump G		33529	: 700	=	49	49
Drop top plug					20	20
Displacement 20"	177,76	x 560	= 95545			
HW	4,61	x 90	= 415			
Total displacement ±			95960			
Flow rate 2000 l/min					48	48
Total					271	117
Safety factor 50%					135	58
GRAND TOTAL (min.)					406	175

20 " LEAD SLURRY

Composition	Weight-Kg/100	Volume-l/100	By m^3 SW	For each 100 bbls
Sea water	109.60	107		
Defoamer	0.05	0.05	0.47 l	0.20 gal
Extender D75	6.30	4.50	42.05 l	17.65 gal
G cement	100	31.75		
SG $\pm$ 1.50		143.30		

RESULTS ($\pm$ 650 m BHST 25°C - mud weight 1.15)

T.T. requested: $\geqslant$ 8^h00
T.T. recorded : 8^h30
24 hours compressive strength: 35 b
Rheology and gels: 50-39-35-30/18-39

REQUIREMENTS

Sea water $\frac{107 \times 96643}{100} = 103408$ l

Defoamer $\frac{0,05 \times 96643}{100} = 50$ l

Extender D75 $\frac{4,50 \times 96643}{100} = 4349$ l

G cement $\frac{100 \times 138490}{143,30} = 96643$ Kg

20" TAIL SLURRY

Composition	Weight-Kg/100	Volume-l/100	By m^3 FW	For each 10 bbls
Fresh water	44	40		
Defoamer	0.05	0.05	1.14 l	0.47 gal
G cement	100	31.75		
SG $\pm$ 1.90		75.80		

RESULTS ($\pm$ 750 BHST 25°C - mud weight 1.15)

T.T. requested: $\geqslant$ 3^h15
T.T. recorded : 7^h00
24 hrs. compressive strenght: 122 b
Rheology and gels: 133-92-79-60/14-21
Maximum expected pressure during displacement: 104 b
Maximum estimated equivalent density : 1.54

REQUIREMENTS

Fresh water $\frac{44 \times 44233}{100} = 19462$ l

Defoamer $\frac{0.05 \times 44233}{100} = 22$ l

G cement $\frac{100 \times 33529}{75.80} = 44233$ Kg

13 3/8 CASING Shoe at about	2000
Casing gage 20" (133 lb) 202,96/18,72" 177,76	650
Hole gage 17 1/2 155.20	
Casing gage 13 3/8 (72 lb) 90.80/12.34" 77,24	
Top cement	450
Open hole interval	1350
Casing interval	200

The cement volumes are calculated according to:

- the theoretical volume increased by 58% (hole size ± 19 1/2") for the preliminary calculations.
- and the volume given by the caliper increased by 10% for the final calculations.

SLURRIES VOLUMES

Lead Light 20"	x 13 3/8	86,96 x 200	17392
Lead Light 17 1/2	x 13 3/8	64,40 x 1200(1,58)	122102
Total Lead			139494
Tail G 17 1/2	x 13 3/8	64,40 x 150(1,58)	15262
Inside casing	13 3/8	77,24 x 24	1854
Total G			17116

TIMING OF OPERATION

Pump the spacer (at least 100 m of annulus) SG.
Rheological and gels slightly greater than the mud one.

Mix and pump light	139494	:	900	=	155	
Mix and pump G	17116	:	700	=	25	25
Drop top plug					20	20
Displacement 13 3/8 ±	77,24 x 1976 = 152625					
Flow rate 1600 l/min				152625	95	95
TOTAL					295	140
Safety factor 50%					147	70
GRAND TOTAL					442	210

13 3/8 LEAD SLURRY

Composition	Weight Kg/100	Volume l/100	By m^3 FW	for each 10 bbls
Fresh water	102	102		
Defoamer	0.05	0.05	0.49 l	0.20 gal
Extender D75	7	5	49 l	20.58 gal
Retarder D 81	0,223	0,117	1,75 L	0.74 L
G cement	100	31.75		
SG ± 1.50		138.80		

RESULTS (± 2000 m BHST 60°C - mud weight 1.30)

T.T. requested: $\geqslant 7^h30$
T.T. recorded : 8^h
24 hrs. compressive strenght: 31 b
Rheology and gels: 56-36-29-20/10-29

REQUIREMENTS

Spacer $\pm 5 \times 6500 = 33$ Kg
Fresh water $\frac{102 \times 100500}{100} = 102510$ l

Defoamer $\frac{0.05 \times 100500}{100} = 50$ l

Extender D75 $\frac{5 \times 100500}{100} = 5025$ l

Retarder D 81 $\frac{0,117 \times 100500}{100} = 118$ l

G cement $\frac{100 \times 139494}{138.8} = 100500$ kg

13 3/8 TAIL SLURRY

Composition	Weight-Kg/100	Volume-l/100	By m^3 FW	For each 10 bbls
Fresh water	42	42		
Defoamer	0.05	0.05	1.19 l	0.5 gal
F.loss reduce D73	1.398	1.331	31.69 l	13.3 gal
Dispersant D80	0.546	0.444	10.57 l	4.4 gal
Retarder D81	0.500	0.355	8.45 l	3.5 gal
G cement	100	31.75		
SG± 1.90		75.93		

RESULTS (± 2000 m BHST 60°C - Mud weight 1.30

T.T. requested: $\geqslant 3^h50$
T.T. recorded : 4^h00
24 hrs. compressive strength: 262 b
Fluid loss: 92
Rheology and gels: 62-31-20-10/2-12
Maximum expected pressure during displacement: 386.50
Maximum estimated equivalent density : 1.43

REQUIREMENTS

Fresh water $\frac{42 \times 22542}{100} = 9468$ l

Defoamer $\frac{0.05 \times 22542}{100} = 12$ l

F.loss reduce D73 $\frac{1.331 \times 22542}{100} = 300$ l

Dispersant D80 $\frac{0.444 \times 22542}{100} = 100$ l

Retarder D81 $\frac{0.355 \times 22542}{100} = 80$ l

G. cement $\frac{100 \times 17116}{75.93} = 22542$ Kg

9 5/8 CASING Shoe at about 2950

Casing gage 13 3/8	72 lbs	90.80/12.34"	77.24	2000
Hole gage 12 1/4		76.04		
Casing gage 9 5/8	53.5 "	47.10/ 8.53"	37.92	
Top cement 100 m above the 13 3/8 shoe				1900
Open hole interval				950
Casing interval				100

The cement volumes are calculated according to:

- The theoretical volume increased by 56% (hole size ± 13 1/2) for the preliminary calculations.
- And the volume given by the caliper increased by 10% for the final calculations.

SLURRIES VOLUMES

Lead-light 13 3/8 x 9 5/8	30.14	x	100		=	3014
Lead-light 12 1/4 x 9 5/8	27.94	x	800	(1.56)	=	34869
TOTAL VOLUME LIGHT					=	37883
Tail G	28.94	x	150	(1.56)	=	6772
Inside 9 5/8	37.92	x	36		=	1365
TOTAL VOLUME G					=	8137

TIMING OF OPERATION

Pump the spacer (at least 200 m of annulus) SG, rheology and gels slightly greater than the mud one.

Mix and pump light cement	37883	: 900	42	
Mix and pump G "	8137	: 700	13	13
Drop top plug			20	20
Displacement ± 37.92 x 2914 =	110498			
Flow rate 1800 l/min		64000	36	36
700 l/min maxi		46498	66	66
Total			177	135
Safety factor 50%			88	67
GRAND TOTAL (min.)			265	202

9 5/8 LEAD SLURRY

Composition	Weight-Kg/100	Volume-l/100	By m^3 FW	For each 10 bbls
Fresh water	101	101		
Defoamer	0.05	0.05	0.50 l	0.20 gal
Extender D75	7	5	49.50 l	20.78 gal
F.loss reduce D73	1.398	1.331	13.18 l	5.53 gal
Dispersant D80	0.546	0.444	4.40 l	1.85 gal
Retarder D81	0.223	0.177	1.75 l	0.74 gal
G cement	100	31.75		
SG ± 1.50		139.75		

RESULTS (± 2950 m BHST 90°C - Mud weight 1.60)

T.T. requested: ⩾ 4^h40
T.T. recorded : 5^h30
24 hrs. compressive strength: 50 b
Fluid loss: 520
Rheology and gels: 37-26-22-18/17-24

REQUIREMENTS

Spacer $\frac{\pm 5 \times 5800}{1000} = 29$ Kg

Fresh water $\frac{101 \times 27107}{100} = 27378$

Defoamer $\frac{0.05 \times 27107}{100} = 15$ l

Extender D75 $\frac{5 \times 27107}{100} = 1355$

F.loss reduce D73 $\frac{1.331 \times 27107}{100} = 361$ l

Dispersant D80 $\frac{0.444 \times 27107}{100} = 120$ l

Retarder D81 $\frac{0.177 \times 27107}{100} = 48$ l

G cement $\frac{100 \times 37883}{139,75} = 27107$ Kg

9 5/8 TAIL SLURRY

Composition	Weight-Kg/100	Volume-l/100	By m^3 FW	For each 10 bbls
Fresh water	41	41		
Defoamer	0.05	0.05	1.220 l	0.51 gal
F.loss reduce D73	1.864	1.775	43.293 l	18.17 gal
Dispersant D80	1.095	0.887	21.634 l	9 gal
Retarder D81	0.671	0.532	12.976 l	5.45 gal
G cement	100	31.75		
SG ± 1.90		75.99		

RESULTS (± 2950 m BHST 90° C - Mud weight 1.60)

T.T. requested: 3^h30
T.T. recorded : 4^h00
24 hrs. compressive strength: 250 b
Fluid loss: 19
Rheology and gels: 70-32-22-11/2-38
Maximum expected pressure during displacement: 561 b
Maximum estimated equivalent density : 1.67

REQUIREMENTS

Fresh water $\frac{41 \times 10707}{100} = 4390$ l

Defoamer $\frac{0.05 \times 10707}{100} = 6$ l

F.loss reduce D73 $\frac{1.775 \times 10707}{100} = 190$ l

Dispersant D80 $\frac{0.887 \times 10707}{100} = 95$ l

Retarder D81 $\frac{0.532 \times 10707}{100} = 57$ l

G cement $\frac{100 \times 8137}{76} = 10707$ Kg

7" LINER (if required) shoe at about 3500

Landing collar					3440
Casing gage	9 5/8	(53.5 lb)	47.10/ 8.53"	37.92	2950
Hole gage	8 3/8		36.61		
Liner gage	7"	(35 lb)	24.88/ 6 "	18.27	
Drill pipe	5"	(19.5 lb)	13.16/ 4.27"	9.16	
Top liner					2850
Open hole interval					550
Between casing-liner					100

The cement volumes are calculated according to:

- The theoretical volume increased by 78% (hole size ± 9 1/2) plus a 50% wash out factor for the preliminary calculations.
- Practically the final volumes calculations shall be based on the caliper log increased by 10% plus a 50% wash out factor (slurry SG 1.95).

SLURRY VOLUME

Annular 9 5/8 x 7	13.04	x	100	=	1304
Annular 8 1/2 x 7	10.66	x	550(1.78)	=	10436
Wash out volume 50%					5218
Left in 7"	18.27	x	60	=	1095
Total volume E cement					18053

TIMING OF OPERATION

Circulating the necessary time to obtain a homogeneous system and the best rheological and thixotropic characteristics of the mud. Pump the lead spacer (at least 200 m of annulus) SG, rheological and gels slightly greater than the mud one.

Mix and pump E cement	18053 : 600 =		30
Drop pump down plug			20

In order to avoid contact between the mud inside the drill pipe and the cement above the stinger during the displacement, it will be preferable to pump behind the plug a volume of tail spacer which will fill the liner at least 200 m above the running tool extension.

First bumping pressure	5" 9.16 x 2850 =	26106	
Final bumping pressure	7" 18.27 x 590 =	10780	
Total displacement ±		36886	
Flow rate 1000 l/min		18000	18
300 l/min maxi		10000	33
500 l/min		8886	18
Energizing work			30
Inverse circulating $\frac{9.16 \times 2850}{1000} \times 2$			52
Total			201
Safety factor 50%			100,5
GRAND TOTAL 5h			301,5

30" CASING shoe at about 150

Hole gage 36" 656,80
Casing gage 30" (310lb) 455,80/28" 407.80
Top cement up to sea bed 90
Open hole interval 60
Excess in open hole 200% (hole size ± 46")

SLURRY VOLUME

Annular	36" x 30"	201.00 x 60 (3)	=	36180
Inside	30"	407.80 x 5	=	2039
Total volume G cement			=	38219

APPENDIX D

CASING CALCULATIONS

Maximal pressure at the weak point (casing shoe) Ps max is reached when gas comes to this point. To have Ps max lower than P frac, we need:

$$P\ pore + s \leqslant P\ frac + \frac{\Delta z - hs}{10}\ d + \frac{hs}{10}\ fm \qquad (1)$$

Considering gas is perfect ($\frac{PV}{ZT}$ = constant)

$$(P\ pore + S)\ h_b\ rk = P\ frac \times hs \qquad (2)$$

(1) + (2) give:

$$hb \leqslant \frac{10 \times P\ frac}{(d-fm)(P\ pore+S)} \left[P\ frac + \frac{\Delta z}{10} d - P\ pore - S \right] \frac{1}{rk}$$

Symbols:

S : safety factor over pressure when circulating bubble
Z : height between bottom and casing shoe
hs : height of gas bubble at shoe
hb : height of gas bubble at bottom
d : mud specific gravity
fm : average gas density
r : ratio linear volum at bottom/linear volum at shoe

k : $\frac{Zs \times Ts}{Zb \times Tb}$ with T = absolute temperature, Z = compressibility gas factor

	A	B	C
Casing set	20"	13 3/8"	9 5/8"
Drilling in	17 1/2"	12 1/4"	8 1/2"
P fracturation	at 650 m : 107 kg/cm²	at 2000 m : 350 kg/cm²	at 2950 m : 531 kg/cm²
d (mud)	at 2000 m : 1.30	at 2950 m : 1.450	at 3500 m : 1.60
f (gas)	at 2000 m : 0.25	at 2950 m : 0.25	at 3500 m : 0.30
P pore	at 2000 m : 260 kg/cm²	at 2950 m : 428 kg/cm²	at 3500 m : 560 kg/cm²
S	10 kg/cm²	10 kg/cm²	10 kg/cm²
Z	1350 m	950 m	550 m
K	0.95	1.0	1.0
r	0.766	0.683	0.625

Nota: - P frac is higher than p max used for leak off test.

- While circulating, we keep an overpressure on bottom around 10 kg/cm^2. (safety factor S)
- K = 1. We admit that T and Z remain constant between bottom and shoe except for case A where we come near the surface.

Calculation of r:

- case A: At bottom 17 1/2" hole, 9 1/2" DC
  at shoe 17 1/2" hole, 5" drill pipes

$$r = \frac{109.\ 1/m}{142.5\ 1/m} = 0.766$$

- case B: at bottom 12 1/4" hole, 8" DC
  at shoe 12 1/4" hole, 5" drill pipes

$$r = \frac{43\ 1/m}{63\ 1/m} = 0.683$$

- case C: at bottom 8 1/2" hole, 6 1/2" DC
  at bottom 8 1/2" hole, 5" drill pipes

$$r = \frac{15\ 1/m}{24\ 1/m} = 0.625$$

MAXIMUM BUBBLE ALLOWABLE VOLUM:

CASE A: hb = 64 m, we can have a maximum influx of gas around 7 m^3.

CASE B: hb = 485 m. It exceeds height of 8" DC. By considering an average r including string upper 8" DC., we have hb = 360 m with an average linear volum of 51 l/m. The maximum influx of gas is then 18 m^3.

CASE C: hb = 561 m. Same considerations give a maximum gas influx of 8 m^3 without control problems.

20"	K55	133 lbs	BUTT	at	650 m	i.e.	560 m string
13 3/8"	N80/P110	72 lbs	VAM	at	2000 m	i.e.	1910 m string
9 5/8"	P110	53.5 lbs	VAM	at	2950 m	i.e.	2860 m string

	BURST 1.1		COLLAPSE		TENSION 1.5		WEIGHT IN AIR
	STANDART	SAFETY FACTOR	STANDART	SAFETY FACTOR	STANDART	SAFETY FACTOR	
20"	211	190	103	95	945	630	110
13 3/8 N80	371	337	184	143	738	492	201
13 3/8 P110	510	464	199	164	970	647	201
9 5/8 P110	752	684	547	427	759	506	225
	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	10^3 da N	10^3 da N	10^3 da N

NB: For collapse, safety factor depends on the weight of the string in mud.
But we considered weight in air, which is a greater safety factor.

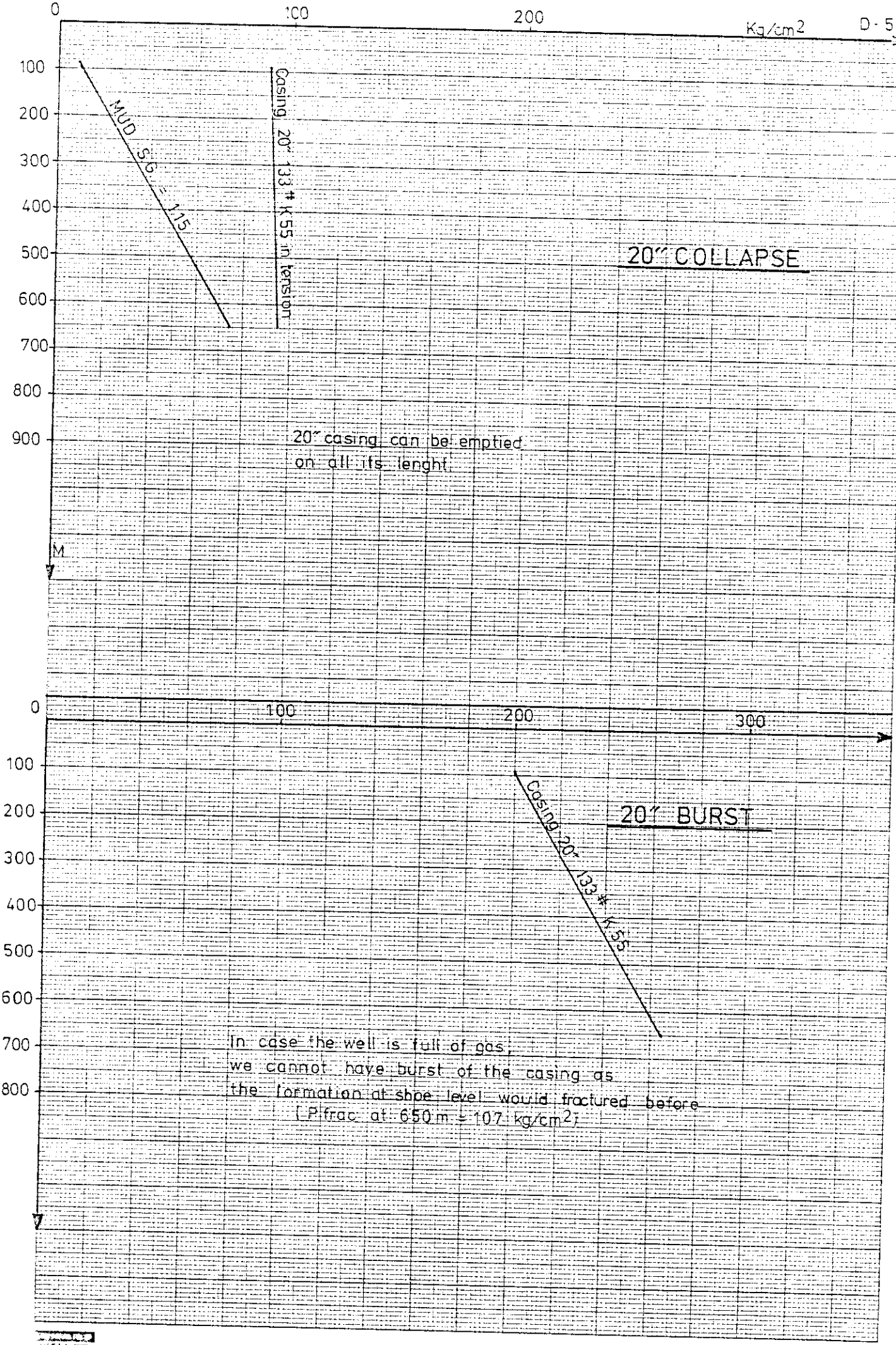
For burst, we admit that fluid behind casing is 1.0 specific gravity.
For collapse, we admit that fluid behind casing has the maximum specific gravity of the mud used during the corresponding phase.

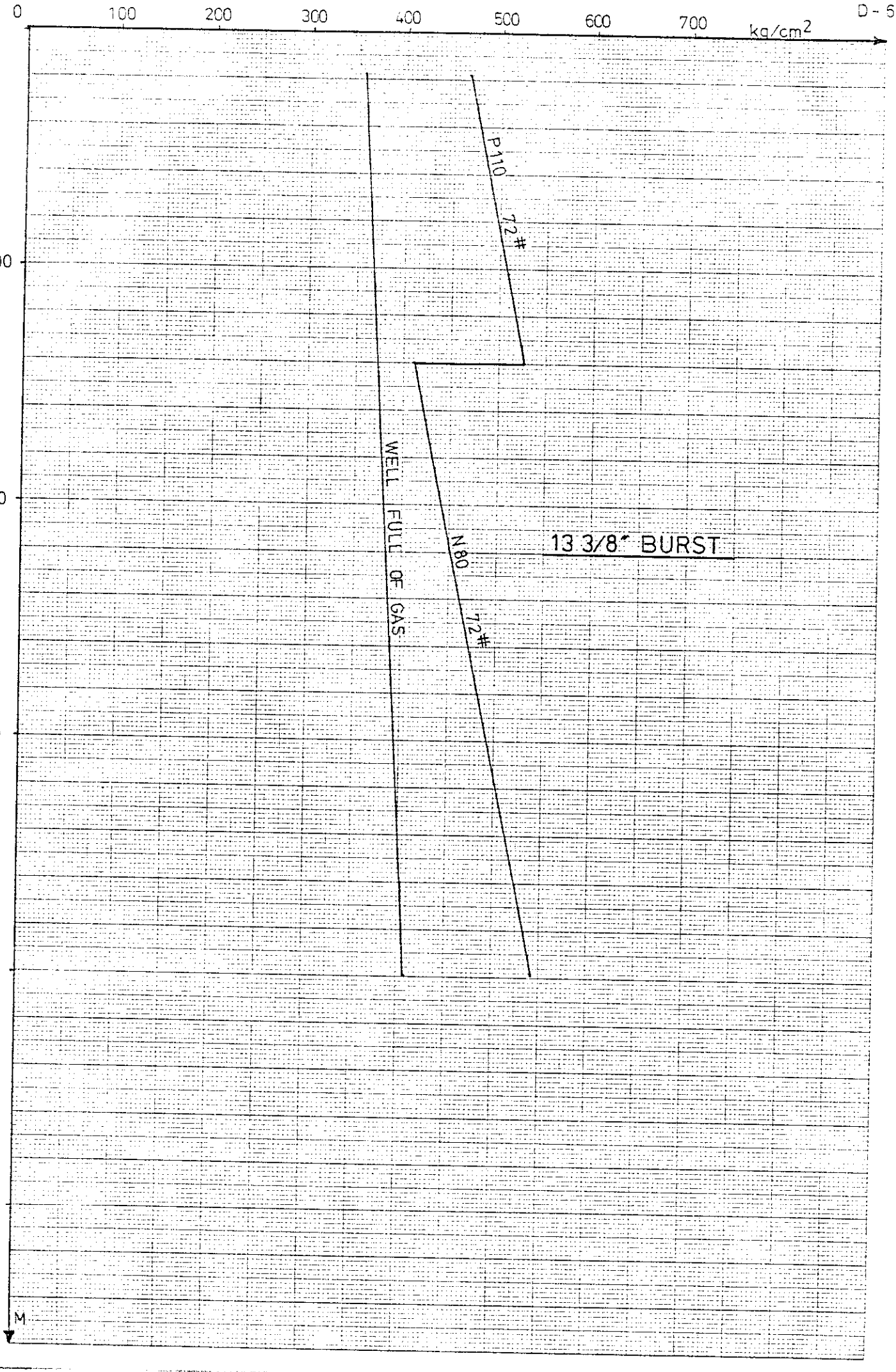
CONCLUSIONS:

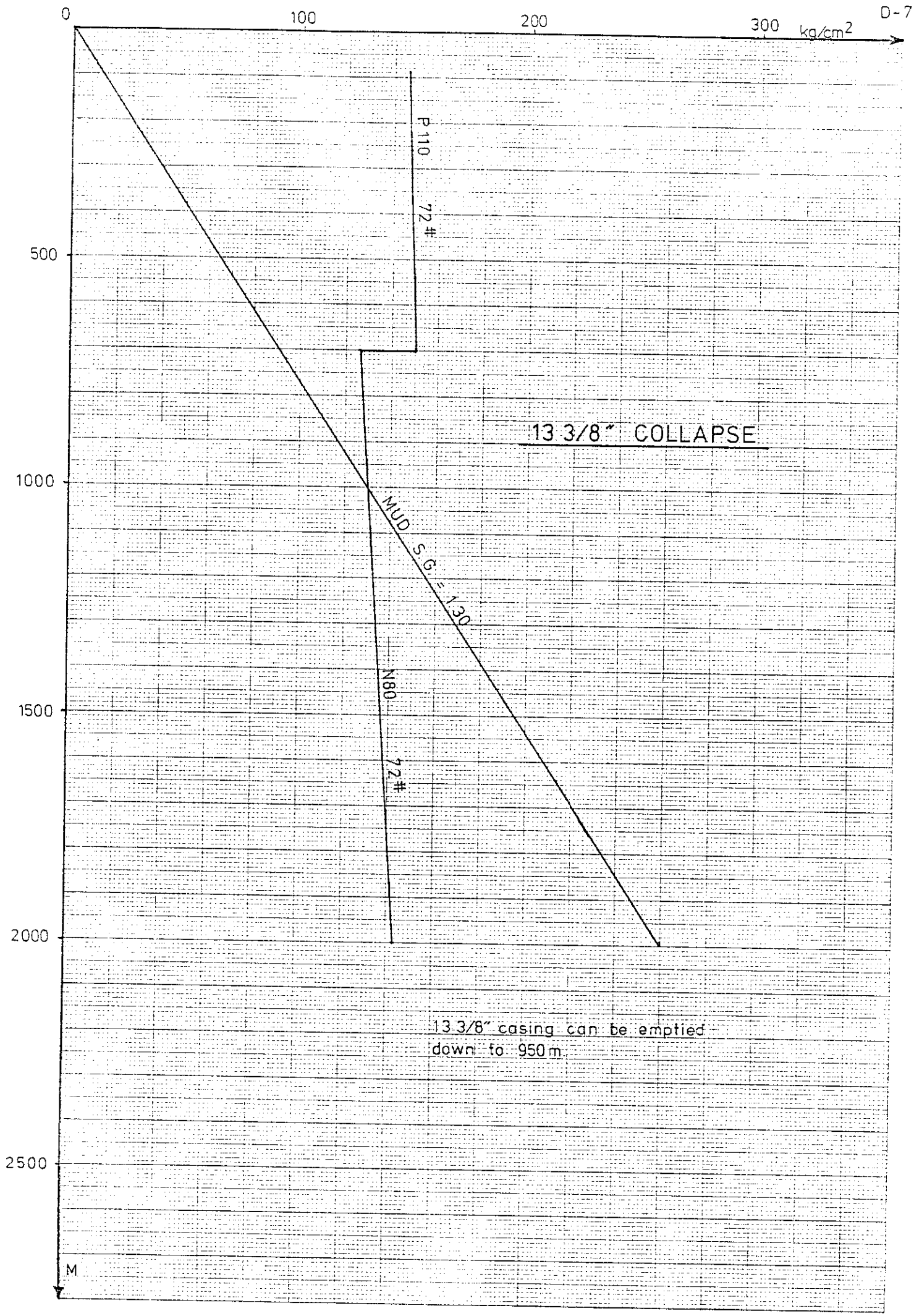
20" casing can be emptied in its full length.
During 17 1/2" drilling, a 7 m^3 gas bubble can be admitted without fracturing at shoe when circulating it out. In any case, there will not be a burst from 20" casing but only possible fracturation at shoe.

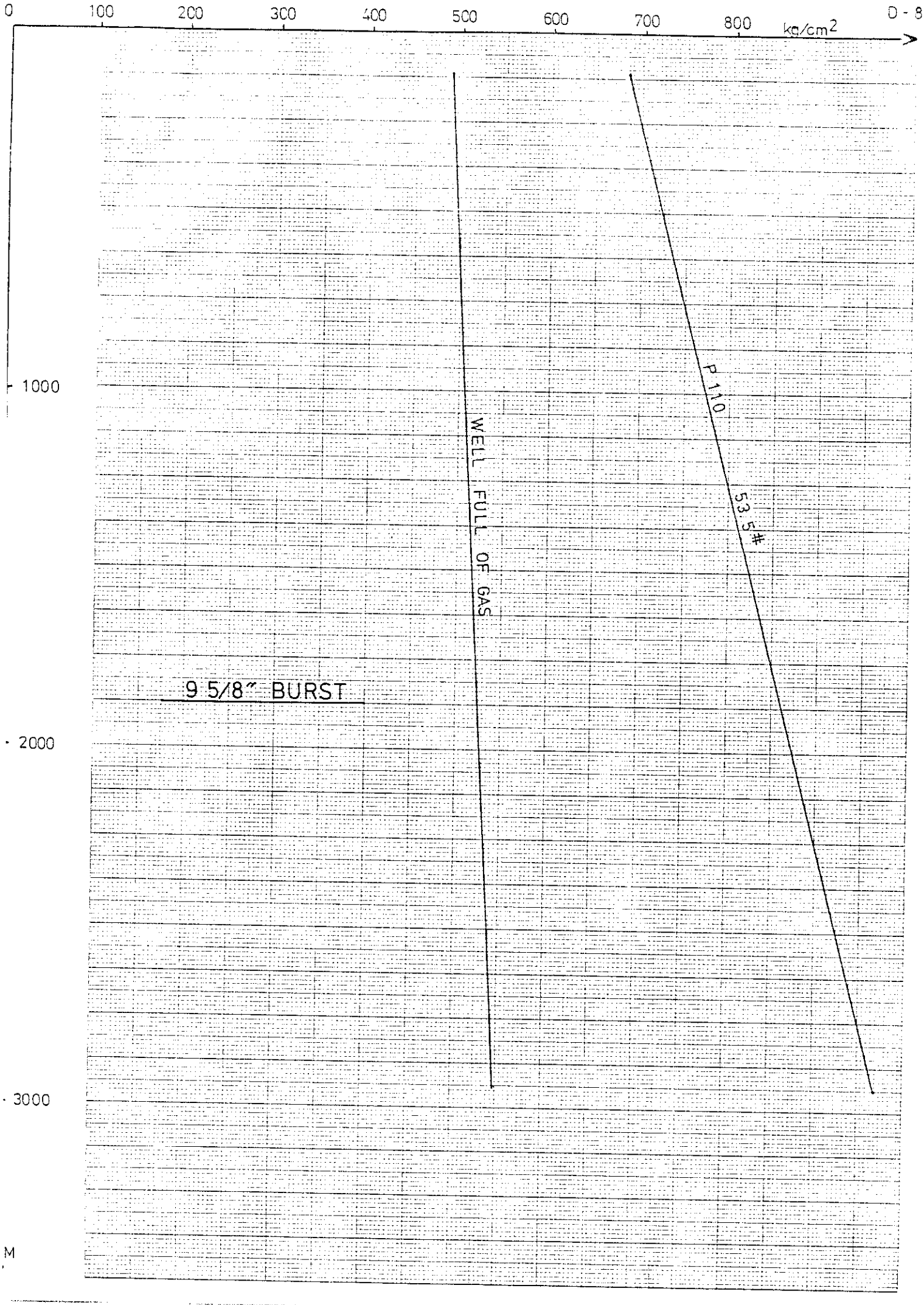
13 3/8" casing can be emptied down to 940 m.
During 12 1/4" drilling a 18 m^3 gas bubble can be admitted without fracturing at shoe when circulating it out. The well can be full of gas without burst of casing.
In that case, pressure at shoe will be around 405 kg/cm^2 (compared to an estimated P frac = 350 kg/cm^2) and thus fracturation at shoe would occur.

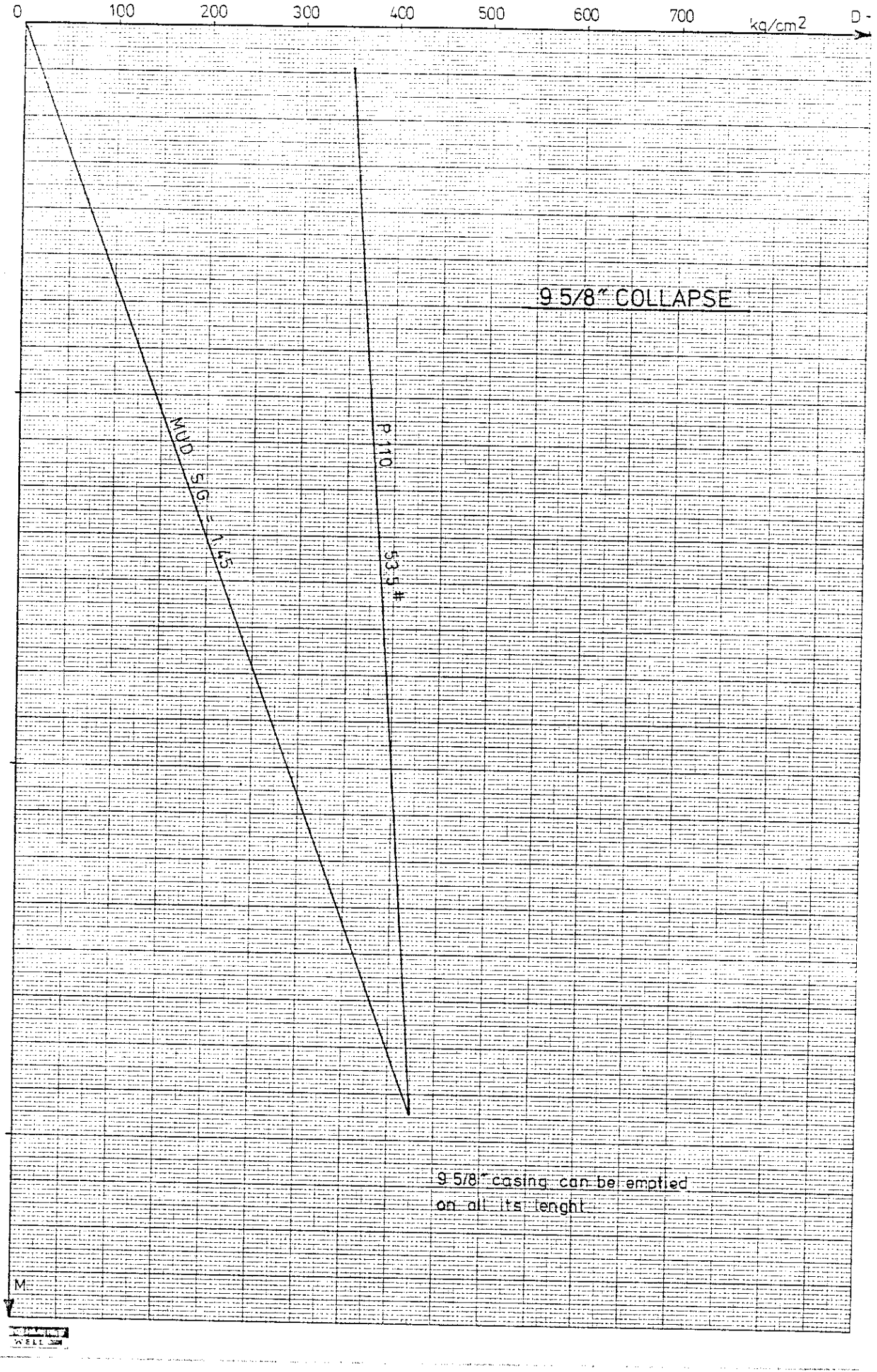
9 5/8" casing can be emptied in its full length.
During 8 1/2" drilling a 8 m^3 gas bubble can be admitted without fracturing at shoe when circulating it out. The well can be full of gas without burst of casing.
In that case, pressure at shoe will be around 543 kg/cm^2 (compared to an estimated P frac = 531 kg/cm^2) and thus fracturation at shoe would occur.


0
100
200
Kg/cm2
100
200
300
400
500
600
700
800
900
MUD S.G. = 1.15
Casing 20" 133 # K 55 in tension
20" COLLAPSE
20" casing can be emptied
on all its lenght
M
0
100
200
300
100
200
300
400
500
600
700
800
Casing 20" 133 # K 55
20" BURST
In case the well is full of gas,
we cannot have burst of the casing as
the formation at shoe level would fractured before
(P frac at 650 m = 107 kg/cm2)


0
100
200
300
400
500
600
700
kg/cm2
500
1000
1500
2000
2500
M
P110
72#
N80
72#
WELL FULL OF GAS
13 3/8" BURST


0
100
200
300
kg/cm2
P 110
72 #
500
13 3/8" COLLAPSE
1000
MUD S.G. = 1.30
N80
72#
1500
2000
13 3/8" casing can be emptied
down to 950 m.
2500
M


0
100
200
300
400
500
600
700
800
kg/cm2
D - 8
1000
2000
3000
M
WELL FULL OF GAS
P 110
53.5#
9 5/8" BURST


0
100
200
300
400
500
600
700
kg/cm2
9 5/8" COLLAPSE
1000
2000
3000
MUD S.G. = 1.45
P 110
53.5 #
9 5/8" casing can be emptied
on all its lenght
M

APPENDIX - E

CASING TESTS / LEAK OFF TEST PROCEDURES

CASING TESTS / LEAK OFF TESTS PROCEDURES

PRESSURE TESTING AFTER SETTING INTERMEDIATE CASING

I - Casing test

11 - Casing testing requires a high pressure pumping unit with measuring tanks. Casing is tested prior to drilling out cement, first with drill string out of hole (to test total shut-in) and then with bit on cementing collar (to test shut-in around the pipe if the casing has not been already tested at end of cementing operation).

12 - Pressure should be increased gradually (50 to 200 l/min). The pressure-volume relationship should be plotted. (Record one point every 50 to 200 l depending upon the total volume to be pumped, and at least 5 points.) If there is no leakoff, the relationship is linear. See Example on Fig. 1 attached.

13 - Under no circumstances should the maximum pressure exceed:

- The working pressure of the wellhead.
- Ninety percent of the internal yield pressure of the most exposed casing pipe, which is not necessarily the top pipe, (mud weight in string and annulus are to be considered).

The test pressure less than the two preceeding measures may be set if justified by the maximum operating pressure anticipated at the wellhead during the subsequent drilling phase.

14 - Pressure should be maintained for 15 minutes. The pressure test is considered positive, when the pressure drops less than 10 percent during this time. The pressure test should be recorded.

15 - Release pressure and measure the mud returns in the measuring tank. Compare with the theoretical volume required, taking into account size and length of casing (see Chart 1).

2 - Casing seat testing.

The purpose of this testing procedure is to test the resistance of the formations immediately beneath the casing shoe and the quality of the cement sheath around the shoe, if the latter is set in a relatively imperious zone (clay, shale etc.).

21 - Drill out cement and drill:

- 3 to 10 - m new hole, if the formation is impervious, when testing the quality of the cement sheath;
- not more than 50 - m new hole, if a permeable zone is expected in this interval.

22 - If necessary, circulate until mud weight is constant.

23 - Pull the bit up to the shoe, close the B.O.P. and pump mud into the drill pipe at a speed between 50 and 100 l/min. Plot the pressure-volume relationship on a graph (one point every 50 or 100 l).

24 - Stop the pump when one of the three following preset requirements is fulfilled:

Class A test: When the pressure attains a preset level, considered sufficient to cope with the problems anticipated during the subsequent drilling phase.

Class B test: When two consecutive points are distinctly out of the normal trend set by the linear relationship of the previous points (see reference line recorded during casing test). The point of deviations from the linear relationship marks the beginning of fluid leakoff into the formation. The corresponding bottom-hole pressure is the initial squeeze pressure by the depth at which fluid leakoff takes place. See Fig. 2.

Class C test: When after passing through a maximum, the pressure drops rapidly, the bottom-hole pressure corresponding to the maximum is the fracturing pressure "FP". The equivalent fracturing density "FD" is calculated by dividing the fracturing pressure by the depth at which fracturing takes place. See Fig. 3 and 4. In the case of Fig. 4, it has not been possible to detect the leakoff point due to excessive pump speed. This is to be avoided.

25 - After shut down of the pump, maintain pressure of 10 minutes and record the pressure drop every minute.

26 - Release pressure and measure the mud returns. Compare to the returns after casing test.

3 - Open hole pressure test.

An open hole pressure test while drilling may be justified in the following cases:

- After drilling through a permeable zone.
- Before entering into transition zone.
- Before entering into a doubtful zone.
- Before increasing mud weight significantly.

The higher the open hole, the greater the number of anomalies while increasing pressure and therefore the difficulties encountered for determining the actual leakoff point.

31 - While pulling out, stop the bit at the shoe and proceed as set forth in para 23.

32 - If due to leakoff, it appears that the pressure rise will last more than half-an-hour, stop the pump, release pressure, and resume operation with a higher pump speed (200 to 300 l/min.).

33 - Stop the pump:

- either when the preset pressure has been attained (this pressure being for instance calculated so that the bottom-hole pressure at the shoes does not exceed the squeeze pressure determined during the first test);

- or when 3 or 4 successive points deviate from the average linear relationship in the neighbourhood of the normally expected pressure drop (see Fig. 5).

34 - Complete the test as set forth in para. 25 and 26.

4 - Important note.

Watch annulus between strings while carrying out pressure tests and bleed pressure off if required.

When the access to this annulus is impossible carefully observe the volumes pumped during the casing test (prior to drilling out cement) and ascertain that they are in accordance within 10 percent with the theoretical volumes shown in Chart No 1, since monitoring the mud volumes consitutes the only means available to check if a strin is leak-proof and if the pressure is not taken by preceding string. I should be noted that pressuring the annulus between two strings may burst the outer string if the annulus between the two strings is shut-o (cement top above shoe).

When pressure testing below the shoe, mud volume monitoring becomes inefficient due to fluid leakoff into the formation, such leakoff increasing with the height of the open hole (see Fig. 5). However, if the casing has been shown to be leak-proof during the casing test, it will be sufficient, during the subsequent tests in the open hole, to stay below the casing test pressure to avoid any risk of "wild" leak through the annulus.

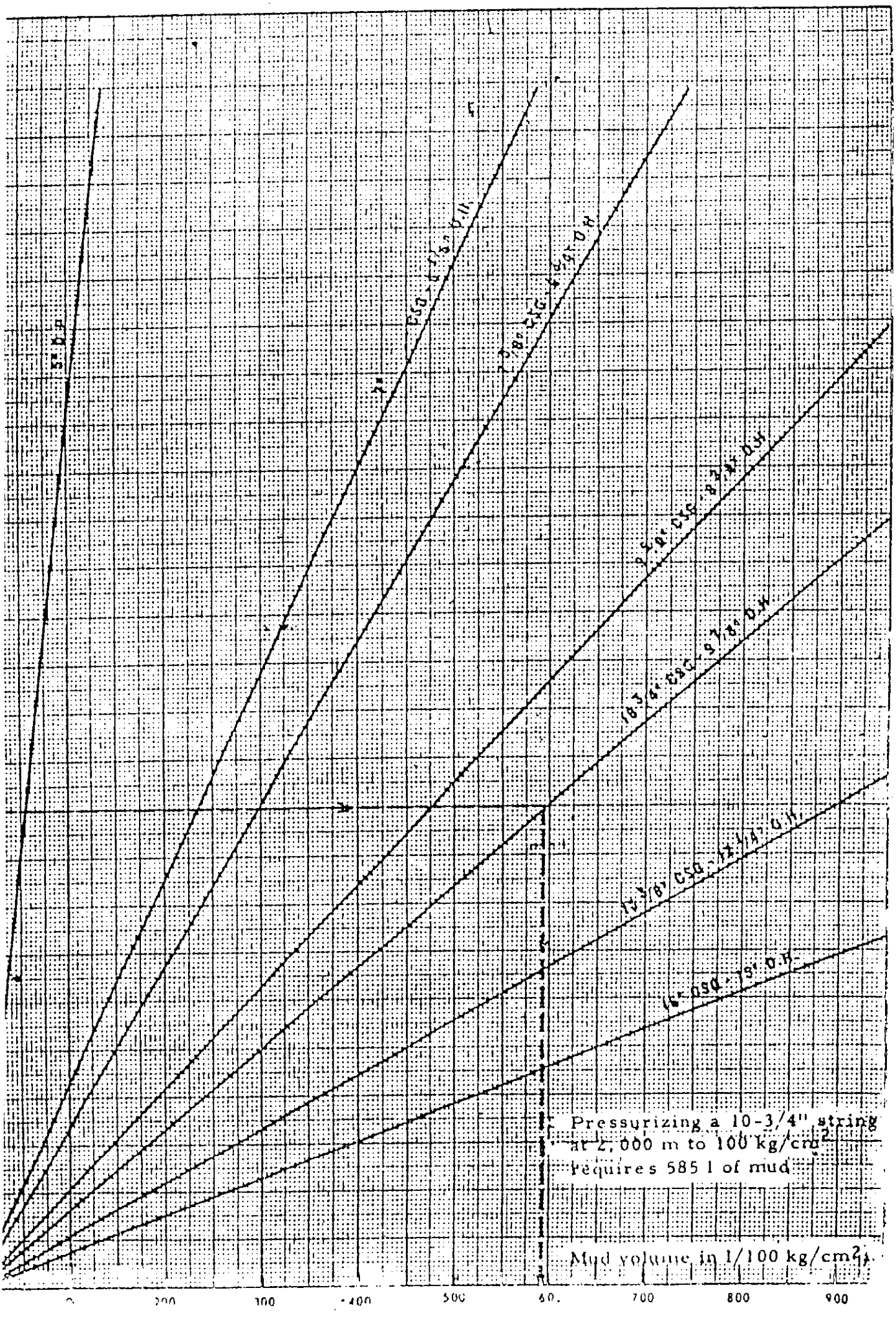
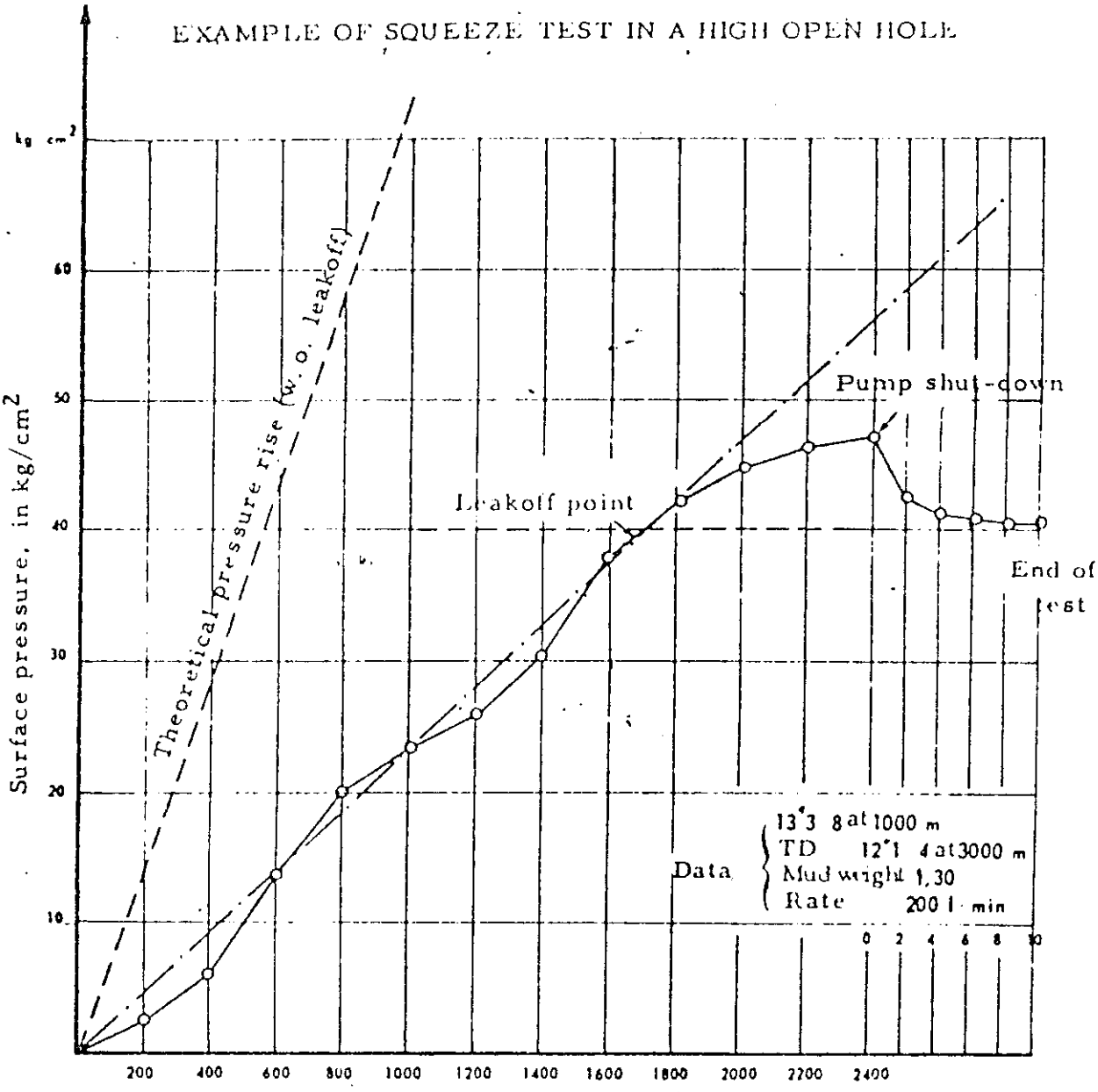

5" O.D.
7" O.D. CSG - 4" O.H.
9 5/8" CSG - 8 1/2" O.H.
13 3/8" CSG - 12 1/4" O.H.
18" OSG - 15" O.H.
Pressurizing a 10-3/4" string at 2,000 m to 100 kg/cm² requires 585 l of mud
Mud volume in l/100 kg/cm²
0
200
300
400
500
600
700
800
900

Fig. 5

EXAMPLE OF SQUEEZE TEST IN A HIGH OPEN HOLE



Resistance

at shoe

$SQP \geqslant 40 \cdot \frac{1000}{10} \cdot 1,30 \quad 170 \text{ kg/cm}^2$

$sqd \geqslant \frac{170 \cdot 10}{1000} \cdot 1,70$

at bottom

$SQP \geqslant 40 \cdot \frac{3000}{10} \cdot 1,30 \cdot 430 \text{ kg/cm}^2$

$sqd \geqslant \frac{430 \cdot 10}{3000} \cdot 1,43$

Fig. 1

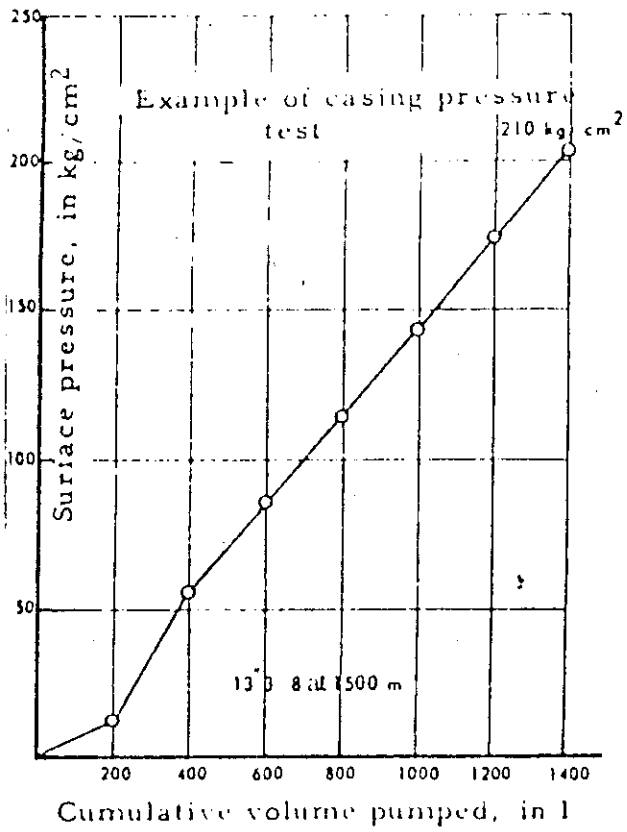


Fig. 2

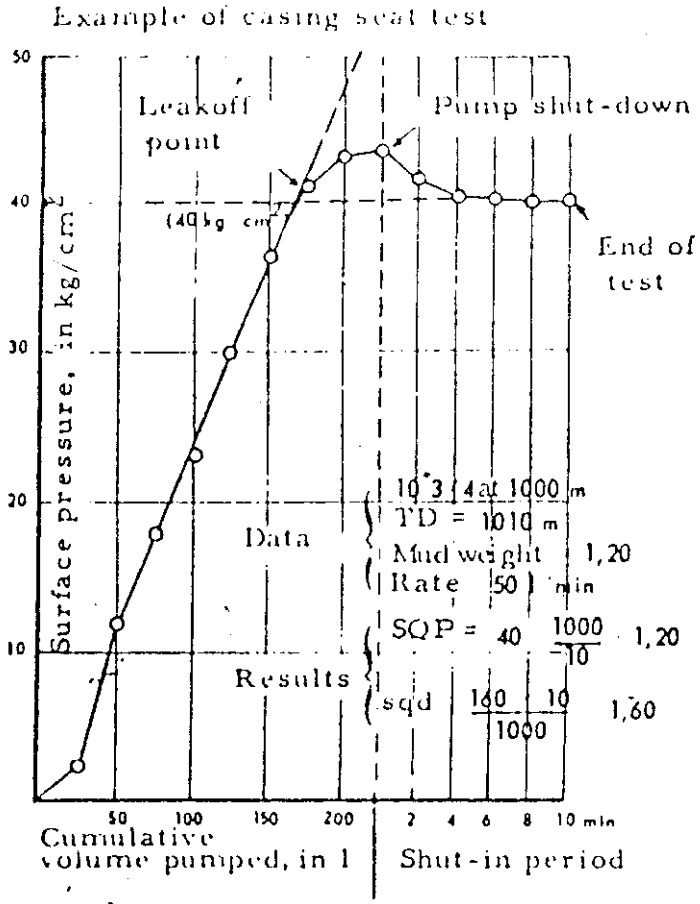


Fig. 3

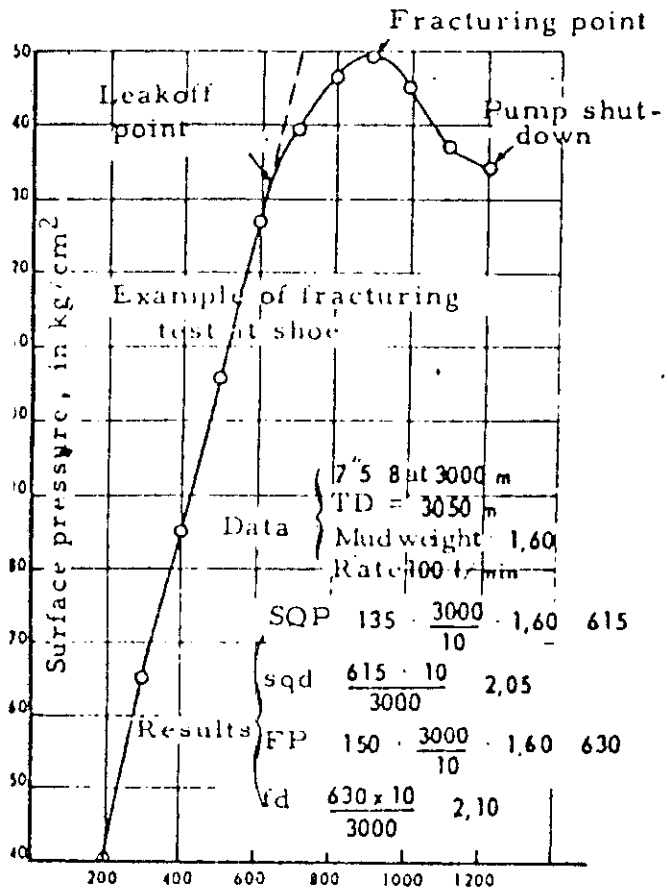
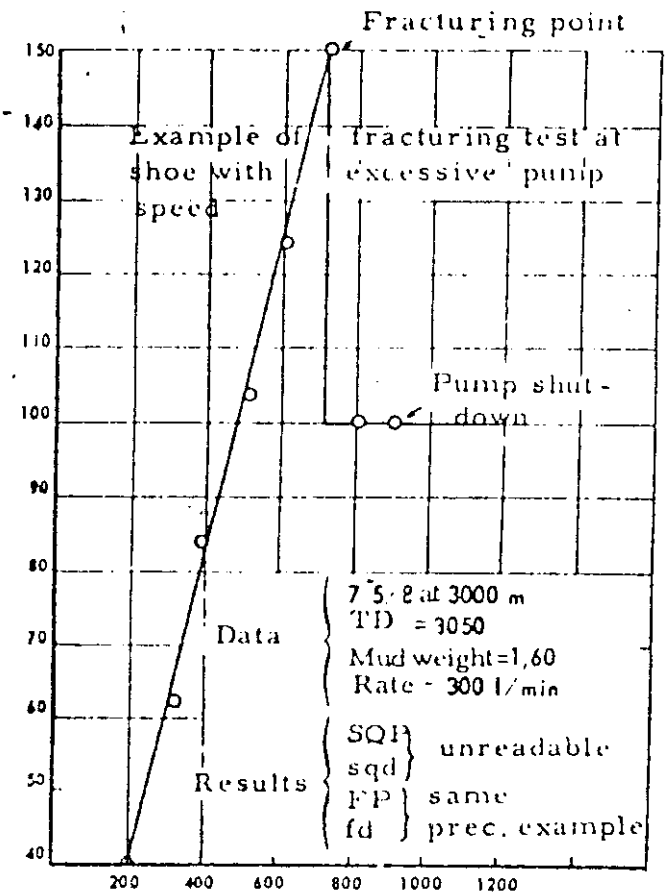


Fig. 4



ELF NORGE A/S
STAVANGER

From : DRILLING SUPERINTENDANT

To : ELF NORGE A/S - SUPERVISORS

RESPONSIBILITIES

1. Elf Norge A/S toolpusher on a Contractor rig is the Company representative on that rig.

2. No visitors are allowed when not announced by Drilling head office.

3. It is always the Elf Norge A/S responsibility when supervising contractor-operated rigs, regardless of the type of contract, to see that drilling operations are conducted in such manner that adequate well control is maintained at all times.

   Well control starts with the planning of the well prognosis and includes an alert drilling crew having knowledge of possible hazards, mud control techniques and the mechanical facilities to detect at the earliest possible moment indications of trouble. It requires proper training of contractor personnel and continuous surveillance of the drilling operations by all concerned.

4. Elf Norge A/S is responsible for rig safety at all times ; apart from being in charge during normal drilling operations, he will have the responsibility for well completion and well abandonment in connection with Drilling Department.

Drilling Superintendant
(R.Sales)

Elf Norge A/S Stavanger,

WELL KILLING CONTINGENCY PLAN WHEN DRILLING EXPLORATION WELL

1. INTRODUCTION

The only method to kill a flowing well is to drill relief wells. This contingency plan is established for exploration well in case of blow-out occurence after the 13"3/8 casing or 9 5/8 casing have been set.

II. GENERAL PROGRAM

II.I. Number of Relief Wells

The general method consists in drilling two relief wells.

- The first one to intercept the flowing well around the shoe of the last casing string set.
- The second one to intercept the well in the flowing formation (generally the bottom of the hole).

This figure permits to pump heavy mud at two different levels in the flowing well and have best results for killing wells particularly in case of blow-out.

II.2. Positionning Drilling Platform

II.2.I. Distance between flowing well and relief well.

The spud location depends on depth reached and design of the rig drilling the relief well.

II.2.2. Position of the rig

The rigs must be located following the winds and currents.

II.3. Objectives

Around the shoe of the last casing string set and the flowin formation. The objective will be chosen according to available geological data and electrical logs in order to have the best facilities to establish communication between the wells, and deviation surveys (single shot surveys during drilling and Multishot Gyro surveys in casing strings) obtained during drilling operations.

II.4. Well Profiles

II.4.1. Direction and inclination will be determined exactly according to the objectives.

II.4.2. The target should be within 30/50m from bloming well. Such accuracies should be obtained by using good survey equipment, and is sufficient to obtain communication between the wells.

II.5. Casing Program

Setting depth of casing will be determined according to the objectives and geological results encountered during drilling.

III. KILLING PROCEDURE

- 7" liner will be set approx. 100m above the target
- Drill to approx. 50m below liner shoe
- For fracturing and heavy mud injection a 3"½ DP will be run to the top of the liner (owing to high pressure loss it is not recommended to run the drill string inside the 7" liner)
- Pump heavy mud until blow out stop
- When the blow-out is controlled, squeeze cement to plug the well and the bore hole.

IV. PARAMETERS DURING KILLING OPERATION

IV.1. Mud Weight

Mud weight will be adjusted according to knowledges obtained during drilling.

IV.2. Volume of mud

The experience shows that it is necessary to have an important volume of heavy mud to succeed in a blow-out control. About three ot four times the volume of the flowing well may be required after pumping sea water in high quantities.
In this case we need :

- For blow-out when drilling 12 1/4 hole : 750m^3.
- For blow-out when drilling 8 ½ hole : 500m^3.

This volume must be ready before drilling out 9"5/8 shoe in the relief well(s).

IV.3. Pumping rate

Heavy mud must be pumped at a high rate in the flowing well as soon as the communication is established. (Pumping rate could be estimated at about $6m^3$/Min.).

V . EQUIPMENT AND MATERIALS

Drilling Platforms

No problem is foreseen in making drilling platforms available to drill relief wells, as NSOC has pledged to maintain a current list of equipment available in an emergency situation.

Well Heads and Casing

Sufficient well head equipment and casing is available from own stock and partners' stocks.

Mud Chemicals and Baryte

Baryte needed is available at Tananger and Dusavik bases on a permanent basis.

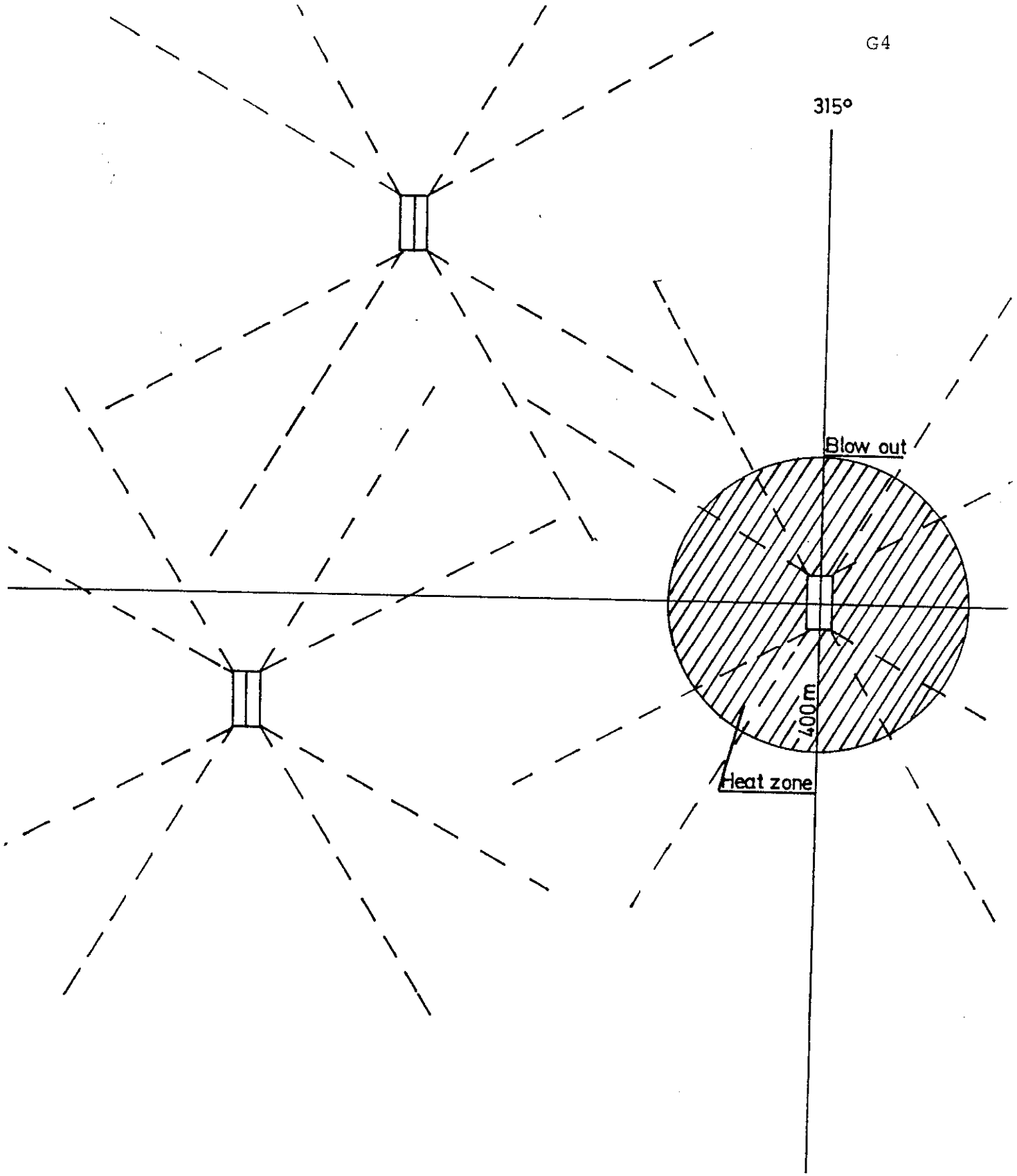
Pumps

Generally the North Sea drilling platforms are equipped with a pumping power of 4000 - 4800 mech.HP. The addition of three or four more pumping skids will bring the total mechanical HP up to approx. 7300 HP.

Calculations shows that the mechanical HP required on each rig when pumping at 6000 l/min. is the range of 6800 HP. So, by installing some additional pumping unit we will have sufficient power to perform the operation.

VI . ORGANISATION

Emergency task force is shown in table No.2.
Technical and personnel assistance will be given by ELF Aquitaine hea office and ELF Aquitaine subsidiaries when necessary.



ANCHOR PATTERN (SCHEMATIC)

APPENDIX - H

ELF AQUITAINE NORGE A/S
EMERGENCY TASK FORCE