A/S NORSKE SHELL E&P

TANANGER

PRODUCTION TEST PROGRAMME

INTERNAL GRAVEL PACK COMPLETION

WELL 31/2-11

RIG: BORGNY DOLPHIN

14 APRIL 1983

Thorbjørn Nyland
OPERATIONS ENG.

Audun N Kelland
SENIOR OPERATIONS ENG.

CHIEF PETR. ENGINEER

Cornelio H.
DRILLING SUPT.

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1. OBJECTIVES AND GENERAL TEST OUTLINE

NOTE: Depth Control
All depths quoted in this programme for packer setting and perforating refer to the LDT/CNL log, No. 3 of 13.04.83 made from the "Borgny Dolphin".

1.1 Ojectives

This short production test (4-5 days) in the oil zone will record performance and provide another calibration point for simulation studies.

The test is designed to:

a) Determine well deliverability.

b) Provide samples of water and oil to investigate emulsion forming characteristics, scale forming tendency, and to further investigate waxing criteria.

c) Investigate if high induced skins caused by gravel packing can be reduced by improved IGP methods viz perforation using tubing conveyed guns, backsurging, cleaner fluids, cleaner tubulars and smaller diameter drill pipe enabling higher gravel concentrations to be used without risk of screen out.

1.2 General Test Outline

The oil bearing reservoir section will be tested in the interval 1576 - 1582 m BDF in loosely consolidated, highly porous sands. Accordingly, the zone will be perforated, backsurged and flowed at low rate (less then 500 bbl/day) to establish the well's P.I. before gravel packing. Following this short flow test a wire wrapped inner liner will be gravel packed across the interval, the production string installed, and the well flow tested.

NOTE: On completion of the flow testing if sufficient formation water samples have not been collected, the water zone below the Gravel Pack may be perforated if spacing allows and the well again produced to lift the water. Following collection of adequate water samples, the well will be killed and a fracture test will be carried out and the production string finally pulled and the well abandoned.

2. PREPARATION

General

The success of this gravel pack installation is totally dependant on the cleanliness of all the fluids pumped in the hole, and the cleanliness of all the equipment run in the hole. Great care should be taken to achieve the maximum cleanliness possible. Two specific items of concern are as follows:

i) Ensure ALL relevant circulating lines are cleaned of mud, using seawater. This includes choke and kill lines, and all lines which may be used in the brine circulation system. This should be carried out whilst circulating the well clean and before perforation.

ii) DO NOT USE EXCESSIVE D.P. DOPE. - Dope pins only using a small paint brush and wipe off excess dope squeezed out of the connection.

2.1 Run 8½" bit (no nozzles), 9-5/8" casing scraper (for 47 lbs/ft), 9 x 6-1/4" DC's, 4 stands of 5" heviwate DP, and 3½" plastic coated DP, picking up the 3½" DP whilst RIH. Scrape the packer setting interval 1500 - 1600 m. Continue down to bottom and tag the 9-5/8" float collar at +/- 1692 m.

NOTE: 3½" DP is required to improve flow characteristics during the actual gravel packing operation, and the pipe is therefore being picked up at this stage to be cleaned during the circulation in step 2.3.

The 5" DP will be used in the abandonment programme, therefore sufficient 5" DP (1500 m) should be racked.

The 9 DC's and the 4 stands of HWDP are run in this trip to be cleaned in step 2.3, as they will be used later in the gravel packing operation.

2.2 With bit on bottom, circulate the well to clean seawater at maximum rate.

Having displaced to clean seawater pump the following fluids.

a) 20 bbl pill of seawater gelled with 2 lb/bbl J-164 (HEC) and 1/2 gal/bbl F40 (surfactant), containing 2 lb/gal D30 silica sand.

b) 20 bbl pill of gelled seawater as in (a), but without the sand.

Circulate these pills around with seawater introducing a second viscous pill as in (b) after approximately 1/2 hole volume. Circulate out and discard the sand and gell pills.

Following this abrasive treatment, pump acid as follows:-

2000 gal 7-1/2% HCL containing 10 gals A200 inhibitor. (Inhibitor already included in the acid as delivered to the rig). Circulate round the acid at maximum rate - and discard spent acid returns. Continue

circulating seawater as fast as possible until the solids level has reached an irreducible minimum as measured by the Coulter Counter. Repeat hivis pills as necessary. N.B. Rotate and reciprocate string intermittently to assist in hole cleaning.

2.3 Circulate out seawater with 20 bbls gelled seawater (as in 2.2a) followed by filtered (3-micron) 1.12 SG (485 psi/1000 ft) inhibited $CaCl_2$ brine. Dump seawater returns and gelled pill until brine returns are observed. Ensure filtering continues throughout to maintain minimum solid concentration in the $CaCl_2$ brine, monitoring with the Coulter Counter.

2.4 POH with 8½" bit and 9-5/8" casing scraper.

2.5 Rig up Schlumberger and run CBL/VDL/CCL/GR log (with maximum thermometer) from the top of the 9-5/8" float collar at +/- 1692 m to 1000 m or 100 m above top of cement which ever is lower. POH.

2.6 Run gauge ring/ junk basket and tag top of the float collar at +/- 1692 m. POH. Set Baker Model "DB" size 194-47 packer at 1586 m (top packer 4 m below lowermost perforations according to reference log). POH and rig down Schlumberger.

2.7 Make up 1 stand of 5" drill pipe, fluted hanger, slick joint, SSTT. At this stage connect hydraulic hoses and test unlatching/latching feature. Blank off injection and control line ports and run 4½", 19.2 lbs/ft, C-75, PH-6 tubing riser including lubricator valve (+/- 30 m BDF) with blanked off control line ports (Note: 4½" tubing has been blasted clean). Run in and land fluted hanger on wearbushing. Space out so that top of tubing riser is +/- 4 meters above rig floor. Close/open 5" pipe rams. Pull out and stand 4½" riser back in derrick, including SSTT. Check for ram-impressions on slick joint. See fig. 3 for SSTT space out.

2.8 Make up the flowhead on one single of 4½" PH-6 tubing joint and lay down same on piperack.

3. PERFORATION AND BACKSURGING USING VANN TUBING CONVEYED GUNS

Perforation interval 1576 - 1582 m BDF.

Depth reference: LDT/CNL run No. 3 date 13.04.83.

3.1 Make up Vann guns and associated equipment as below and also shown in fig. 7:

a) Vannguns, 6" Super Hole Scalloped (Gun lenght 6 m).
b) Tubing joint 2 3/8" EUE 8RD
c) Bar Actuated vent
d) Pup joint 2 3/8" EUE 8RD
e) PDRS. (Break plug)
f) Mechanical Tubing Release
g) X-over 2 7/8" HCS Box x 2 7/8" EUE 8RD (P)
h) Pup joint 2 7/8" HCS
i) "XN" no-go nipple 2 7/8" HCS
j) Pup joint 2 7/8" HCS
k) X-over 3½" EUE 8RD box x 2 7/8" HCS pin
l) Baker "FHL" hydraulic packer w/x-overs to 3½" EUE
m) Tubing joint 3½" EUE
n) X-over 2 7/8" HCS box x 3½" EUE 8RD pin
o) Pup joint 2 7/8" HCS
p) "XA" SSD 2 7/8" HCS, 2.313" seal Bore
q) Pup joint 2 7/8" HCS
r) X-over 3½" HCS box x 2 7/8" HCS
s) Pup joint 3½" HCS
t) "Q" Nipple 3½" HCS
u) X-over 3½" VAM box x 3½" HCS pin
v) Tubing joint 3½" VAM w/radioactive clamp-on.

NOTE: Item m to v will be pressure tested to 3000 psi/15 min before being made up to the packer.

3.2 With the tubing joint hanging in the table, rig up wireline and open the "XA" SSD. Install the mandrel/junk catcher in the "XN" nipple. Rig down W/L.

3.3 RIH gun assembly on 3 1/2" tubing, picking up tubing whilst RIH. (Note, the 3½" tubing has been blasted clean). Install fluted hanger on the top of the 3 1/2" tubing, such that when landed in the wellhead, the gun will be at required perforating depth 1576 - 1582 m BDF (according to theoretical pipe measurements). Run in the 3 1/2" tubing and fluted hanger on 3 1/2" DP and land the hanger.

NOTE: While running the string in the hole it will fill with brine automatically due to the open SSD (sliding side door).

3.4 Rig up Schlumberger and run a "slim hole" GNT/CCL(1 11/16") correlation log inside the 3 1/2" tubing. Locate the radioactive clamp installed on the first 3½" tubing joint above the "Q" nipple, and correlate for correct positioning of the gun. Correlate the log with the LDT/CNL reference log. POH with Schlumberger and rig down.

3.5 POH with the 3 1/2" DP to the fluted hanger. If the guns are out of position space out below fluted hanger with required 3 1/2" tubing pup joints to put the shots exactly on depth.

3.6 When the guns are correctly spaced out, RIH with the guns and fluted hanger on the pre made up 4 1/2" tubing riser with the slick joint and SSTT and lubricator valve installed and land the fluted hanger into the wearbushing. Top of the tubing riser should be +/-4 m above rig floor as spaced out in step 2.7.

3.7 Rig up Schlumberger and run the GNT/CCL correlation log for a final depth check.

3.8 Pull back one joint and hang off string in rotary table. Pick up flowhead and 4 1/2" tubing joint. Install 40 ft x 2 1/2" wire slings between bails and flowhead elevators. Install chicksan lines to flow and kill sides on flowhead. Connect assembly to upfacing tubing connection in rotary table. Land fluted hanger into wearbushing. Connect the kill line to the Dowell unit.

3.9 Rig up wireline lubricator and test same to 3000 psi. Install a 3½" wireline retained test tool in the "Q" nipple above the SSD. Pressure test the tubing string to 3000 psi/15 min. Retrieve the test tool. Close the 2 7/8" "XA" SSD and POH.

3.10 Set the Baker FHL hydraulic packer by pressuring up slowly on the tubing with brine in 500 psi increments, holding each increment for 1 minute. The "FHL" packer will set at approximately 1000 psi. Continue pressuring up to 3000 psi and hold pressure for 15 minutes to pressure test the tubing string. Release pressure. Pull 10,000 lbs only over string weight to check that the packer has set. (Note packer will release with 50,000 lbs pull).

3.11 Connect flowline chicksans to the sandfilter and then to the 6" flowline, flush lines above closed automatic mastergate and pressure test to 3000 psi/15 min. against choke manifold.

3.12 RIH with shifting tool and open the 2 7/8" XA-SSD. POH and close the swab valve on the flowhead.

3.13 Displace the brine in the tubing with diesel to within 2 bbls of the 2 7/8" XA-SSD. Close kill line valve.

3.14 RIH with shifting tool and mandrel retrieving tool and close the 2 7/8" XA-SSD. Bleed off the pressure on the tubing through the separator to ensure that the SSD is closed. Retrieve the mandrel/junk catcher and POH and close the swab valve.

3.15 Close middle 5" pipe rams around slick joint and pressure test annulus to 500 psi/10 min down kill line. Bleed pressure down to 100 psi (just to give a gauge reading). Keep the middle 5" pipe rams closed throughout the perforating and subsequent clean up of the well and observe the annulus pressure via the kill line.

3.16 Place detonating bar on top of the closed hydraulic wireline BOP. Connect lubricator to the BOP. Open swab valve.

NOTE: At this stage the kill valve must be closed, the SSTT,

lubricator valve, master valve, swab valve, flow valve and the flow line to the gauge tank, must be open.

3.17 Open the wireline BOP letting the bar fall to fire the guns. Close swab valve.

NOTE: A listening devise provided by Geo Vann will be installed to confirm firing of the guns.

3.18 Backsurge well through open choke flowing to the gauge tank. Allow 10 bbls of unchoked flow.

3.19 After the 10 bbls flow, switch flow through a 4/64" choke and bypass the separator to the burner to clean the well.

3.20 When flowing clean oil at surface measure sand content, and when sand free (less than 10 lbs/1000 bbls), RIH with pressure gauges with surface read-out to the 2 7/8" XN nipple.

3.21 Flow the well on 4/64" choke, through the separator. Flow rate should not exceed 500 bbls/day or the rate when sand is produced.

3.22 Flow well until a steady bottom hole flowing pressure and flow rate are observed.

NOTE: If stabilized flow is established, take 7 x 700 cc oil samples and 6 x 20 liters gas samples for later recombination.

3.23 Close in well and record build up. Retrieve wireline pressure gauges. RIH with shifting tool and open the XA-SSD. POH with shifting tool.

3.24 Reverse circulate the well dead with 1,12 SG brine. Spot viscous pills as necessary to control losses (For recipe see Appendix 5 item C). RIH with wireline and close the XA-SSD. Rig down wireline.

3.25 Unseat the packer with 50,000 lbs overpull and circulate normally and condition well with 1.12 SG brine. Observe well dead. Spot a 20 bbls viscous brine pill across the perforations.

NOTE: 50000 lbs is required to shear the shear ring. The yield strength of the 2 7/8" tubing above the packer is 105.000 lbs.

3.26 Rig down surface equipment and pull the tubing string. Stand back the 4 1/2" tubing riser and the 3 1/2" tubing.

4. INSTALLATION OF GRAVEL PACK ASSEMBLY (See Fig. 1)

4.1 Rig up Schlumberger and run GR/CCL (3-3/8" OD) through the DB packer to ensure it is open and tag possible fill on top of the float collar at +/- 1692 m. Record hold up depth. POH and rig down Schlumberger.

NOTE: Exercise extreme care while running the tool through the DB packer.

4.2 Make up 3 joints of 5½" LTC blank pipe in the rotary table. Pick up and run through the 3 joints of 5½" blank pipe the following wash pipe, from bottom up: -

a) Wash pipe - as required 2-3/8" VAM
b) Cross-over 2-3/8" VAM pin x 2-3/8" EU 8RD box
c) Indicating collet 2-3/8" EU 8RD pin x box
d) Pup joint 2-3/8" EU 8RD pin x box
e) Indicating collet 2-3/8" EU 8RD pin x box
f) Indicating collet 2-3/8" EU 8RD pin x box
g) Spacer pup 2-3/8" EU 8RD pin x box

Item b, c, d, e and f are allready preassembled. Clamp off the 2-3/8" 8 RD spacer pup onto the top joint of blank pipe.

4.3 Pick up the 3 joints of 5½" blank pipe with the 2-3/8" tubing clamped to the top joint of blank pipe and stand back this assembly in the derrick.

4.4 Pick up the pre-made (a, b, c) Gravel Pack (GP) screen assembly and hang off in the rotary table. The assembly consists of, from bottom up: -

a) 5½", LTC box Model G-22 locator seal assembly size 192-47
b) Bakerweld screen 5½" LTC pin x box 1.88 m long (tell-tale) (with centralizers)
c) GP seal bore receptacle 5½" LTC pin x box 2-3/8" bore with "O" ring.
d) Bakerweld screen 5½" LTC pin x box 9.18 m long.

4.5 Install the "slick" wash pipe assembly into the GP assembly and locate it into the seal bore.

NOTE: The slick stinger will consist of from bottom up:-

a) Polished stinger 2-3/8" OD with turned down locator and 2 3/8" Vam box.
b) Wash pipe 2-3/8" VAM pin x box where the collar is tapered to ensure easy passage through the flapper valve.
c) Wash pipe pup joint 2-3/8" VAM pin x box.

4.6 With the wash pipe protruding from the screen take the 5½" Reverse Flapper valve LTC pin x box and stab it over the wash pipe. Make up the flapper valve onto the top of the screen.

NOTE: The flapper valve and its seal are made from "MICARTA" a special material designed to shatter on impact. Therefore the utmost care should be exersised when making pipe movements of the 2-3/8" wash pipe through this valve so as not to prematurely shatter the flapper valve or its seat and thus make it redundant.

4.7 Pick up the three joints of blank pipe with indicating collets and wash pipe made up and stood back in step 4.2 above and position just above GP assembly. Make up the 2-3/8" VAM wash pipe pin protruding from the blank pipe onto the 2-3/8" VAM wash pipe box inside the GP assembly.

4.8 Whilst holding the blank pipe in the elevator lift up the 2-3/8" wash pipe, with an air winch, so that the 2-3/8" EU 8RD spacer pup can be removed. With the pup joint removed clamp the 2-3/8" EU 8RD wash pipe to the top joint of blank pipe.

4.9 Lower the 3 joints of 5½" blank pipe, together with the 2-3/8" wash pipe, and make up the blank pipe onto the top of the GP assembly. Lower the complete assembly and set the 5½" blank pipe with slips in the rotary table.

NOTE: Ensure that the polished stinger is correctly spaced in the GP seal bore receptacle above the tell tale screen.

4.10 Pick up the following preassembled Baker GP assembly:

a) Model "SC-1" gravel pack packer
b) Model "S" gravel pack extension with sliding sleeve
c) Crossover sub - 6-5/8" box x 5½" pin
d) Model GP shear-out safety joint
e) Indicating coupling

Preassembled and connected also will be:

a) Model "SC" crossover/ model "B-1" setting tool (4½" IF box up)
b) Model "S-1" shifting tool
c) Pup joints 2-3/8" EU 8RD

4.11 Connect the 2-3/8" EU 8RD box wash pipe sticking out from the 5½" blank pipe to the 2-3/8" EU 8RD pin protruding from the "SC-1" packer assembly and remove the clamp from the 2-3/8" wash pipe. Connect the "SC-1" packer assembly to the top joint of blank pipe.

NOTE: a) See Note to steps 4.6 and 4.9 above.

b) Check and note the free hanging weight of the entire assembly.

c) See fig. 1 for schematic of the complete GP assembly.

4.12 RIH with the complete GP assembly, using 9 x 6-1/4" DC's, 4 stands of HWDP and 3½" DP as the running string.

NOTE: a) All DP, HWDP, and DC's must be rabbitted to ensure they are

clear. The same collars, HWDP and DP should be used which were cleaned during the preparation phase.

b) Running speed - 60 seconds per stand.

c) Set slips slowly and avoid jarring the assembly to prevent shearing of the shear out safety joint.

d) DO NOT USE EXCESSIVE DP DOPE! - dope pins only using a small paint brush and wipe off excess dope squeezed out of the connection. This is of the utmost importance in ensuring a successful gravel pack.

4.13 Complete RIH with gravel pack assembly and set down gently in the sump packer at 1586 m - c. 5,000 lbs wt. should be adequate: control with heave compensator. Space out drill pipe to place top at +/- 4 m above derrick floor. After spacing out and gently landing in the packer at 1586 m again, install circulating valve on top of drill pipe. Hook up Dowell lines and pressure test same to 3000 psi. Circulate (with brine) drill pipe volume + 20% and then drop the 1-7/16" kirksite packer setting ball.

4.14 When packer setting ball is estimated to have landed pressure up on drill pipe slowly with brine in 500 psi increments, holding each increment for 1 minute. The "SC-1", GP packer will set at approximately 1500 psi. Continue pressuring up to shear ball seat and blow ball out at approximately 2500 psi.

4.15 Pull 20,000 lbs over whole string weight to check packer set (use heave compensator). With drill pipe circulating valve on top of the 3½" DP open, and upper annular closed, pressurise annulus to 500 psi down kill line to check packer element sealing. Open upper annular.

4.16 Using heave compensator, slack down to neutral point at packer. Rotate DP 10-12 turns to the right at the packer to back out with the crossover tool.

4.17 When the crossover tool comes free, set back down on packer with 30,000 lbs weight to ensure location of squeeze position, with the left hand running thread of the setting tool located on the top of the packer. Mark the pipe - this mark will be referred to as mark (1) for the squeeze position.

4.18 Pick up approximately 1 m at the packer and set back down with the upper indicator collet on the indicating coupling, using sufficient weight (10,000 lbs) to ensure definite location of the coupling. Mark the pipe - this mark will be referred to as mark (2) for circulating through the tell tale screen.

4.19 Pick up a further 1 m at the packer and set down with the middle indicator collet on the indicating coupling using sufficient weight (10,000 lbs) to ensure definite location of the coupling. Mark the pipe - this mark will be referred to as mark (3) for circulating through production screen.

4.20 Pick up a further +/- 3 m at the packer and set back down with the lower indicator collet on the indicating coupling using sufficient weight (10,000 lbs) to ensure definite location of the coupling. Mark the pipe - this mark will be referred to as mark (4) for reverse circulating above the packer.

NOTE: The above pipe manipulations should be carried out as smoothly as possible so as not to prematurely shatter the reverse flapper valve assembly by the 2-3/8" wash pipe hanging up or jarring it. When locating the reverse circulating position do not pull up so far as to pull the polished stinger out of the reverse flapper.

4.21 Slack off weight to push upper, middle and lower indicator collets through the indicating coupling (approximately 15,000 to 20,000 lbs will be required) and re-stab work string stinger into GP lower seal bore. When mark (1) has been definitely re-located, pick up and locate mark (2). Set 10,000 lbs weight on indicating coupling/ indicator collet to ensure definite location of the position for circulating through the tell tail screen.

At this stage the string is in position to commence the preacidization and gravel packing operations and the following points are to be noted: -

a) Following four work string positions have been established:

Position (1): Squeeze to formation.
Position (2): Circulating through tell tale screen, Gravel Pack position.
Position (3): Circulating through main screen.
Position (4): Reverse circulating above packer.

b) It is essential that marks (1), (2), (3) and (4) are unambiguous, hence they should be painted on the DP at mid heave with simultaneous reading of the derrick floor tide indicator recorded.

c) When relocating marks (2), (3) and (4) it must be remembered that the particular indicator collet has to be pulled up past the indicating coupling to meet it going down.

d) All lines must be arranged so that all operations can be performed via the Dowell manifold without shutting down for repositioning.

e) Sufficient chicksans must be available to the drill pipe circulating valve to accommodate the necessary pipe movements.

f) All piping, chicksans, hoses, tanks, pumps etc. assosiated with the GP operation must be clean.

5. GRAVEL PACKING (SLURRY PACK)

5.1 With the work string in position (2), establish circulation through the tell tale screen and the 2-3/8" wash pipe, to a maximum of 2 BPM, or a maximum of 950 psi, whichever occurs first. Monitor returns closely for losses and plot surface pressures versus pump rates.

5.2 Mix acid as follows: -

50 bbls of 15 % HCL containing

0.5 bbl A200 inhibitor (1 % by volume already in the acid)
5.0 bbl U66 mutual solvent (10 % by volume)
150 lbs L41 iron sequestering agent (3 lb per bbl of acid).

5.3 Mix breaker and gravel into previously gelled fluid as follows - (see Figs. 2.0 and 2.1 for fluid formulations and specifications).

a) 20 bbls "water pack" 1.12 SG (485 psi/ 1000 ft).

b) 14.84 bbls "water pack" slurry containing 15 lbs/gallon fluid of Baker "Low Fines", 12-20 mesh gravel. The slurry density will be 1.74 SG (753 psi/1000 ft).

5.4 Carry out the pre-gravel pack 50 bbl acidisation. Circulate the acid mixed in step 5.2 through the work string and to the lower tell tale screen (+/- 35 bbls). Continue pumping at maximum rate (max surface pressure 950 psi) until +/- 10 bbls of acid have been circulated past the perforations. At this point, stop pumping, change to position 1 (squeeze position) and soak the acid for 15 minutes. Squeeze (inject) +/- 5 bbls of acid at low rate (maximum pressure 1050 psi). Pull back to position 2 (gravel packing position) and having finnished pumping the acid, continue immediately with gravel pack (step 5.5).

NOTE: If losses are observed when the acid reaches the perforations prior to the programmed squeeze, then do not squeeze any further acid, but proceede directly to the gravel pack (step 5.5).

5.5 Carry out gravel pack, pumping the following fluids as a continuous operation (note manifolding to be arranged to permit quick change over from acid to spacer to prepad etc.).

- 10 bbls 1.12 SG $cacl_2$ brine spacer
- 15 bbls "water pack" prepad (item 5.3 a).
- 14.84 bbls "water pack" slurry (item 5.3 b).
- 5 bbls "water pack" after pad (item 5.3 a).

These slurries will lead to an imbalance between the heavy contents in the drill pipe and the lighter annulus fluids of +/- 610 psi while the fluids are in the drillpipe. Therefore, during the first 3 bbls of displacement with brine until the 15 bbl "water pack" pre-pad arrives at the crossover tool, a maximum surface pressure of 340 psi may be used. Close annular preventer and apply 100 - 200 psi backpressure.

NOTE: The HCl acid, brine spacer and the "water pack" fluids should be pumped in a continuous phase, therefore arrange the mixing of fluids storage, manifolds etc. accordingly.

5.6 Displace "water pack" with brine at maximum allowable rate (max surface pressure 340 psi) until pre-pad reaches crossover tool - approximately after 3 bbls of brine. Reduce pump rate to give maximum surface pressure of 200 psi. After pumping a further +/- 21 bbls the gravel slurry should completely cover the screen and a pressure rise should be noted at surface - however, do not exceed 950 psi.

5.7 Slack off work string down to mark (1), the squeezing position. Reduce pump rate to maintain surface pressure below 950 psi as long as possible but ultimately let pump pressure increase to 1100 psi for the final squeeze. Pull back to circulating through tell tale ie. position (2), and repressure to check the pack, but do not exceed 1100 psi.

NOTE: If no screen-out is obtained then overdisplace with 10 bbls of completion fluid to clear the packer. Mix and prepare additional "water-pack" pads and slurry volumes (50% of original job size) and re-pack. The string should be in position (2), circulation through tell tail until a pressure increase is observed and then slacked off to the squeeze position.

5.8 After achieving satisfactory screen out, allow the pressure to bleed off. Pressurise the annulus to 500 psi. Pick up to mark (4), the reverse circulation position, and reverse out excess gravel/fines from above packer.

NOTE: The amount of gravel/fines returned should be measured as accurately as possible therefore returns should be switched to a holding tank (i.e. sand trap) when gravel/fines reach surface. Add breaker to the returned slurry to allow for quick setting out of gravel/fines and quantify the amount returned.

5.9 Having finished the pack and reverse circulated all sand out, wait with the work string still in the hole, until the breaker has broken down the gel supporting the sand slurry. When the slurry is broken, position the string in position (3) and attempt to circulate clean brine through the main screen to check the pack, up to a maximum pressure of 950 psi. If free circulation is possible, a Low Density gravel pack top up will be carried out as outlined in Appendix 12.

When circulation is not possible, a successful pack will have been accomplished, in this case procede to step 5.10.

5.10 Open annular preventer, then POH with SC crossover/setting tool and 2-3/8" wash pipe.

NOTE: Exercise extreme care when pulling back so as to not cause the 2-3/8" wash pipe to prematurely shatter the reverse flapper valve assembly. When the wash pipe is above the valve and it is judged to have closed and sealed monitor the hole static for 30 mins. If continual severe losses are observed, indicating that the flapper valve has malfunctioned, spot 50 bbls of viscous brine (200 sec MF) made using brine and HEC to stabilize the well and advise Base where upon a revised programme will be issued. (This spotting fluid should be mixed up prior to gravel packing).

5.11 With the well observed static and the reverse flapper valve functioning pull back until the crossover port in the crossover tool is +/- 50 m above the SC-1 packer. Circulate well clean and spot a 20 bbls viscous brine pill.

NOTE: The surface pumping pressure when circulating clean and spotting the 20 bbls viscous pill is to be such that the differential pressure across the reverse flapper valve is kept below 750 psi, to prevent its premature rupturing.

5.12 Continue out of the hole and lay down the GP assembly running tools.

NOTE: From this period until the complete test string is run and landed the well SHALL BE CONTINUOUSLY observed for losses. The hole is to be kept full with brine and a record is to be made of the amount and rate of losses, if any. If losses are observed inform Base immediately.

LOW DENSITY GRAVEL PACK TOP UP

With the work string in position (3) proceed as follows:

1. Establish circulation through the main screen increasing circulation up to 4 BPM. Continue circulating brine for a complete drill pipe volume (+/- 40 bbls). If losses are observed reduce circulation rate until full returns are regained.

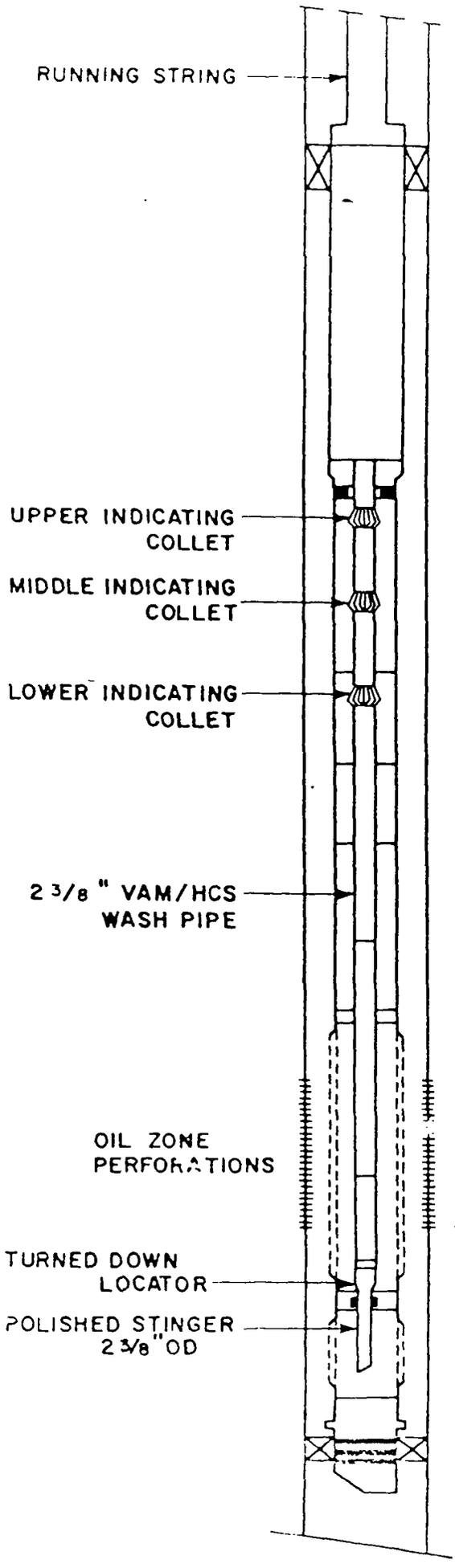
2. While circulating at 2 BPM, mix gravel sand at 1/4 lb/gal concentration and pump down hole. After pumping 40 bbls, and no obstruction or bridging of the gravel has occured, increase gravel concentration gradually to 1 lb/gal at 2 BPM pumping rate.

3. Continue circulating sand until the pressure starts increasing. Reduce sand concentration to a minimum and slow down pumping rate. Stop pumping at a maximum surface pressure of 950 psi.

   NOTE: If losses are observed, during the gravel placement, stop gravel injection and regain full returns by circulating brine alone. Once loss of fluid is stopped, continue gravel packing with a reduced gravel concentration.

4. Pick up work string to position (4) and reverse out excess gravel in the drillpipe.

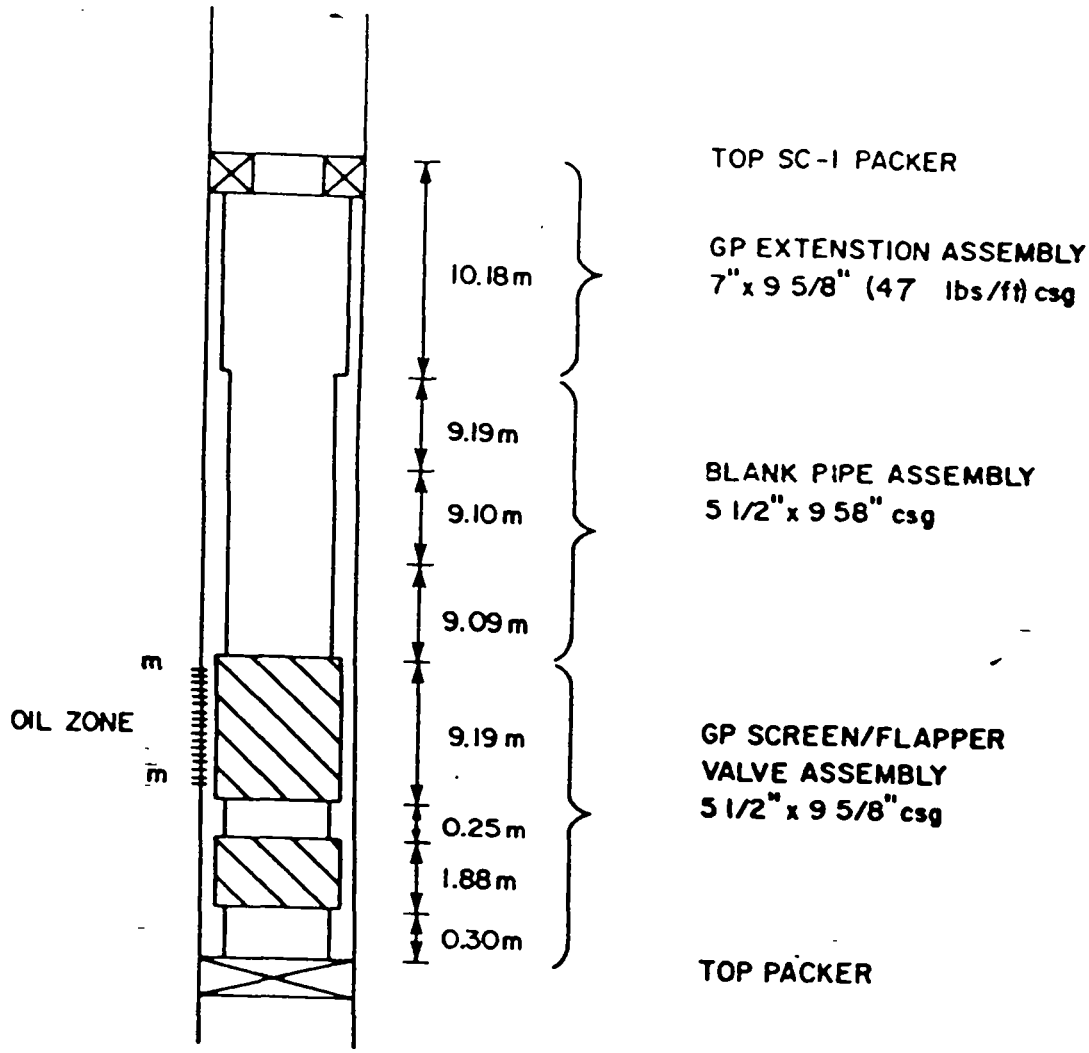
   NOTE: Pressurise the annulus to 500 psi before picking up to position (4).



10.18 m	G.P. EXTENSION
	INDICATING COLLAR
9.19 m	BLANK PIPE
9.10 m	BLANK PIPE
9.09 m	BLANK PIPE
0.38 m	FLAPPER VALVE
9.19 m	G.P. SCREEN
0.25 m	SEAL BORE 2 3/8"/O-RING
1.88 m	TELL-TALE SCREEN
0.30 m	LOCATOR SEAL ASSY 9 5/8" BAKER SUMP PACKER MODEL "DB"

GP VOLUMES - OIL ZONE B1/2-11

(NB. ALL CALCULATION TO BE CHECKED ON WELLSITE)



GRAVEL TO FILL ANNULUS

GP Extension x CSG	:	10.18 m x 3.281 x 0.1438 cuft/ft	=	4.80 cuft
Blank Pipe x CSG	:	27.38 m x 3.281 x 0.2460 cuft/ft	=	22.10 cuft
GP Screen x CSG	:	12.00 m x 3.281 x 0.2147 cuft/ft	=	8.45 cuft
		Total	=	35.35 cuft
Sand requirement	:	35.35 cuft x 105 lbs/cuft	=	3712 lbs
With 50 % excess			=	5568 lbs

Fig. 2.1.

GRAVEL PACK FLUID FORMULATION

(NOTE: All calculations to be checked on site).

1. "Pre-Pad" gelled brine: 15 bbls, 1.12 S.G.

15 bbls	-	1.12 SG $CaCl_2$ brine
50.4 lbs	-	J164 gelling agent (80 lbs/1000 galls)
5.1 oz	-	J218 breaker (8.1oz/1000 galls)

2. "Water Pack" slurry: 14.84 bbls, 1.74 SG

8.84 bbls	-	1.12 SG $CaCl_2$ brine
29.70 lbs	-	J164 gelling agent
3.01 oz	-	J218 breaker
5568 lbs	-	12-20 mesh gravel (at 15 ppg concentration), 50% excess.

3. "Post Pad" gelled brine: 5 bbls, 1.15 SG

5 bbls	-	1.12 SG $CaCl_2$ brine
16.8 lbs	-	J164 gelling agent
1.70 oz	-	J218 breaker

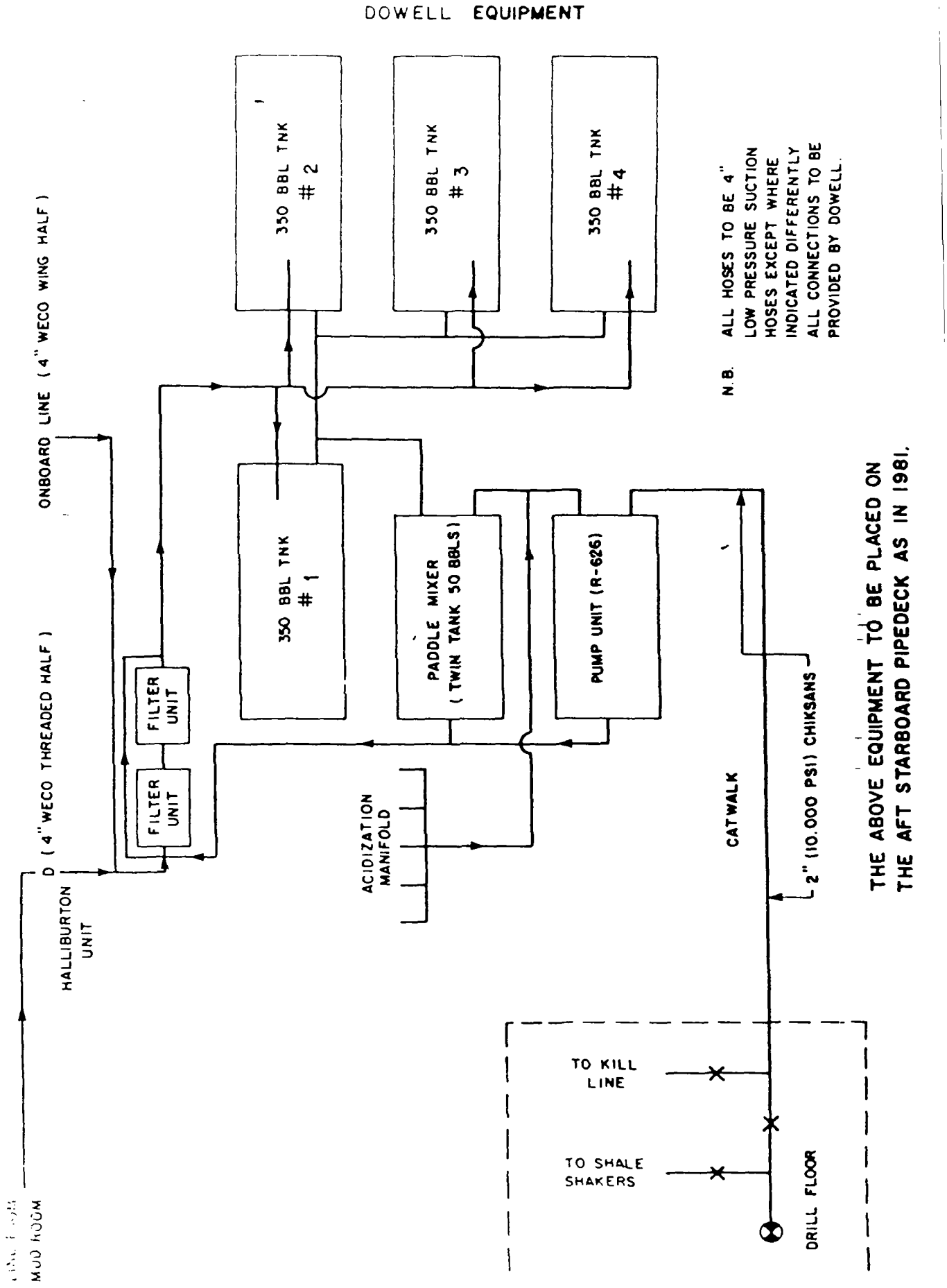
NOTE: a) Check the pH of the brine. Adjust to pH of 4-5. Add the required amount of J164. The J164 is to be added in small amounts and in a continous manner - do not dump into tank. Allow a few minutes for the gell to disperse. Adjust the pH to 8-8.8 with a solution of caustic (observe all safety procedures). Add this in small amounts so as not to bring up the "local" pH too much. The viscosity should start to build up after 15 - 30 mins. (actual time is dependent on ambiant temperature and brine pH).

b) Add the gravel with the paddles turning. The J218 breaker is to be added 5-10 mins prior to pumping the fluids downhole. Breakdown time for this job is designed to be +/- 3 hrs.

c) Use D47 antifoam as required to remove entrapped air from the slurry.

FIG. 6

LAYOUT OF DOWELL / SCHLUMB. SUPPLIED EQUIPMENT FOR BRINE STORAGE, GRAVEL PACKING AND ASSOCIATED STIMULATIONS ON BORGNY DOLPHIN.



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6. INSTALLATION OF PRODUCTION TESTSTRING

6.1 Run the test string sub assemblies G to A as shown in fig. 4, with a "lock-open" sleeve (ID = 1.950") installed through Halliburton's APR-N tester valve. Rig up wireline and install a 2-3/8" "PX" plug in the "X" nipple above the perforated pipe. Install 3 1/2" VAM testsub and pressure test to 3000 psi/ 15 min. Retrieve the "PX" plug and install a W/L retrievable straddle to blank off the perforated joint in order to allow for circulation through the mule shoe to clean up fill, if any, from above the GP reverse flapper valve.

6.2 Run 3 1/2", 10.2 lbs/ft, VAM C-75 tubing in the interval between the top of the sub assemblies and the wellhead. 5" DP is to be run from the BOP stack to surface with a white painted DP single across the BOP's at the depth where by the space out seal assembly stabs into the seal bore of the baker SC-1 GP packer.

6.3 While circulating slowly, stab into the SC-1 packer with the lower set of 190-47 space out seals.

6.4 Check the depth of the Baker SC-1 packer by:

i) Noting entry of mule shoe into packer.

ii) Noting pressure increase when space out seals enter packer seal bore while pumping slowly through tubing string. Do not exceed a surface pressure that will create a 750 psi differential pressure across the reverse flapper valve.

6.5 With lower space out seal assembly stabbed into seal bore, close middle 5" pipe rams around painted single for spacing purposes. Open pipe rams (N.B. Check 5" DP collar positions before closing rams).

6.6 Pull back to white painted single, identify ram-impression, calculate spacing requirements so that when fluted hanger lands in the wellhead, the top of the main upper locator seal assembly will be 2.5 - 3.0 m above the top of the SC-1 packer.

6.7 Space out the 3 1/2 VAM" tubing, install the fluted hanger, 5" slick joint and SSTT. Run 4½", PH-6 tubing riser, with the Flopetrol lubricator valve installed at +/- 30 m (one stand) BDF, spaced out so that the top of the tubing riser is +/- 4 m above rig floor.

6.8 Pick up flowhead and 4½" tubing joint. Install 40' x 2½" wire slings between bails and flowhead elevators. Install chicksan lines to flow and kill sides of flowhead. Connect assembly to upfacing tubing connection in rotary table. Test kill line to 3000 psi.

6.9 While pumping very slowly note when the lower set of "space out" seals enters the packer bore by observing a pressure increase. Pick up 1 to 2 m (minimum possible) and circulate slowly +/- 20 bbls. Lower the string again and continue to lower a further +/- 1.4 m when circulation should again be possible as the lower "space out" seals pass through the packer bore enabling circulation around the tubing pup joint between the upper and lower sets of seals.

NOTE: The moment that circulation is re-established the mule shoe

of the tail pipe will be +/- 1.5 m above the reverse flapper valve.

6.10 While circulating continue to lower the production string and shatter the reverse flapper valve assembly. A pressure increase should be noticed immediately after the valve has shattered as the upper set of seals then first start to enter the SC-1 packer bore.

6.11 Land fluted hanger into wearbushing and fully engage the upper set of seals in the packer bore in the calculated spaced out position.

NOTE: The success of the above sequence of operations depends on accurate depth control. Therefore exercise great care while measuring tubing, sub assemblies, calculating space out requirements, making pipe tallies etc.

6.12 Connect flowline chicksans to dual sandfilter and to fixed 6" flowline, flush lines above closed automatic mastergate and pressure test to 3000 psi/ 15 min. against choke manifold.

6.13 Close middle 5" pipe rams around slick joint and pressure test annulus to 500 psi/15 minutes down kill line. Bleed off pressure and open rams.

6.14 Rig up wireline lubricator (test same to 3000 psi) and retrieve straddle out of perforated pipe. Run 1.800" OD drift through mule shoe. RIH with wireline retained model "N" test tool (with extended fishing neck) and set same in 3½" XN nipple. Pressure test tubing and tubing riser to 3000 psi/15 min. Bleed off pressure slowly to zero and shear off so that plug and extended fishing neck stays behind. POH. RIH and open 3½" XA-SSD. POH.

6.15 Displace the tubing to diesel to within 2 bbls of the 3½" XA-SSD. Close 5" pipe rams. RIH with positioning tool and 2½" SB-pulling tool. Close the 3½" XA-SSD. Pressure test annulus to 500 psi. latch on to test plug, equalize pressure across the plug and POH.

6.16 Pressure up annulus to 500 psi/15 minutes. Bleed pressure down to 100 psi (just to give a gauge reading). Keep the middle 5" pipe rams closed throughout the production testing programme and observe the annulus pressure via the kill line.

6.17 RIH with 2" nominal (1.62" max. OD) wireline sandbailer and tag bottom on top of the float shoe. Record hold-up depth and retrieve sample of sand (if any).

NOTE: Exercise extreme care while running the sandbailer through the lower GP seal bore (2-3/8" ID).

7. TEST PROGRAMME

NOTE: This outline programme is a guide only. Specific items e.g. rates and durations, lengths of build ups etc. may be varied in the light of onsite information gained during the test.

7.1 Open the well up and unload slowly, flow through the separator at the earliest opportunity. Stabilize the flow at +/- 500 bbl/d for 6 hours to stabilize the gravel pack.

NOTE: If the well dies after flowing for a while, the well will be brought live again by setting the "N" test tool in the "XN" nipple, opening the XA-SSD, reversing out the tubing contents, displacing the tubing to diesel, closing the XA-SSD, retrieving the test plug and opening up the well again.

7.2 Flow the well at the following rates and durations:

Rate (bbl/d)	Duration (hrs)
1000	6
1500	6

NOTE: a) Bean up gradually at each rate.
b) Recombination Samples if not already taken in 3.22.
c) If the well does not flow satisfactorily, an acidisation may be made at this stage and will be advised.

7.3 Close in the well. Run 2 Flopetrol SSDR gauges (144 hr clock) and 1 x Amerada (5000 psi element, 144 hr clock). Make gradient stops in the lubricator and at 200 m and 100 m above the mule shoe while RIH. Set gauges in the 2-3/8" 'XN' profile.

7.4 RIH with 3" GS pulling tool with brass shear pin. Latch on to "lock-open" sleeve. Pull 100 lbs overpull to confirm tool is latched. Slack off weight on wire. Pressure annulus to 500 psi over the opening pressure (1000 psi) of the APR-N tester valve. Retrieve the "lock-open" sleeve. Sufficient pressure (1000 psi) should be kept on the annulus throughout the complete flow period to keep the APR-N valve open.

NOTE: No jarring is required as the sleeve is free standing inside the APR-N as soon as the opening pressure has been applied. In case the sleeve does not come free increase the annulus pressure and pull again on sleeve. Do not at any time try to free the sleeve by jarring as the opening/closing mechanism of the valve might have failed. In this case the test will continue without a down hole close in facility.

7.5 Open up the well and flow at the following rates and durations:

Rate (bbl/d)	Duration (hrs)
1000	2
1500	2
2000	6
3000	6
4000	12
Max rate	12 hrs

NOTE: a) 20 x 1 bbl drums of produced oil sample should be collected during the 1000 or 1500 bbl/day flow rate periods and before any demulsifiers are added to the flow.

b) A slow and continuous build up in flow rate (bean size) are required to stabilize the performance of the gravel pack.

7.6 Upon completion of the 12 hrs flow period close in for a 2 hr build up period by closing the APR-N tester valve immediately followed by closing in at surface.

7.7 Open up the well and flow for 60 hrs at maximum rate, and collect produced water samples.

7.8 Upon completion of the 60 hrs flow test close in for a 2 hr build up period by closing the APR-N tester valve immediately followed by closing in at surface.

NOTE: If the down hole closed-in fails, i.e. the APR-N valve leaks, the well will be re-opened and after reaching maximum flow rate, flowed for an additional 6 hrs before the well will be closed in at surface again.

7.9 After completion of the closed-in period, pressure up the annulus to open the APR-N valve. RIH with wireline and set the "lock-open" sleeve in the APR-N valve. Bleed annulus pressure down to 200 psi (just to give a gauge reading).

7.10 Retrieve pressure gauges making gradient stops as in step 7.3 above and conclude the test.

NOTE: a) In all wireline work where the lubricator valve is closed, the lubricator is to be filled with water for an oil test and a 50/50 water/glycol for a gas tests. Prior to opening, the lubricator is to be re-pressurized to equalize across the valve.

b) Before re-opening the APR-N valve in steps 7.6 and 7.9 above, the pressure should be equalized across the valve.

c) Monitor for sand production via the sand filter after each bean-up and when ever signs of sand production are evident.

7.11 RIH with wireline sand bailer and record Hold Up Depth (HUD) on top of the float shoe. Recover a sample if any. POH.

NOTE: During this period inspect gauges and ensure that they have worked and the results are acceptable prior to continue with programme.

NOTE: Obtaining of a Water Sample.

It is required to collect a representative sample of formation water from the formation. It is anticipated that this may be achieved during the oilflow test, however, if insufficient water is collected a further programme will be issued to cover perforating in the sump below the gravel pack.

8. ABANDONMENT - TEST INTERVAL

8.1 Bullhead tubing contents down to test interval with brine of 1.12 SG (485 psi/1000 ft), using a 50 bbl, HIVIS brine pill ahead (see Appendix 5 for formulations). Observe tubing dead.

NOTE: Take care not to fracture formation. Expected fracture gradient is 1.64 SG (710 psi/1000 ft), giving a maximum allowable down hole pressure of +/- 3672 psi at 1576 m (top perforations) or 3472 psi with 200 psi safety margin. Maximum allowable surface pressure with 1.12 SG brine in the tubing is thus +/- 950 psi.

8.2 Bleed off pressure on annulus. Open the 5" pipe rams. RIH with wireline and open the 3½" XA-SSD. POH. Reverse circulate well dead with 1.12 SG brine. RIH with wireline and close the XA-SSD. Rig down wireline.

8.3 Pick up lower "space out" seals out of packer and circulate normally and condition well with 1.12 SG brine. Observe well dead.

NOTE: Further abandonment programme, including fracture test, will be advised.

APPENDIX 1

PREPARATION OF TUBING

1. Offload and rack tubing, separating each layer with at least three evenly spaced wooden strips.

2. Number and measure each joint. WSPE and Production Test Supervisor to make separate tubing tallies.

3. Remove pin and box protectors, inspect threads for damage, clean with solvent, and if possible, with steam.

4. Brush each joint to remove scale and loose solids: if any joint has excessive scale it should be rejected.

5. Drift each joint with appropriate 42" long tubing drift. All drifts should be fitted with a fishing neck.

6. Reclean pins and boxes and replace protectors. (N.B. Protectors should also be clean and only lightly doped).

7. Check that there are a reasonable number of pup joints for spacing.

8. Inform shore of any further tubing requirements.

9. Return any unsatisfactory joints.

PREPARATION OF TUBING SUB-ASSEMBLIES/GP EQUIPMENT

1. Physically check all tubing and GP accessories and inspect and clean threads with solvent.

2. Ensure that spares of each item available on the rig.

3. Function test all equipment (sliding sleeves, nipples, etc.)

4. Make up tubing sub-assemblies.

5. Run wireline drift through each sub-assembly paying particular attention to polished sections as these can easily be squeezed in make up. N.B. Separate drift runs should be made down to and through No-Go nipples.

6. Carry out API pressure test on each sub-assembly to 5,000 psi (to be witnessed by WSPE, TP and Production Test Supervisor).
   NOTE: Items 2 through 6 only when not carried out on-shore and witnessed by PTS.

7. Accurately measure each tubing sub-assembly and GP equipment item and note the position of all accessories.

8. Replace protectors on each end of the tubing sub-assemblies and GP items.

9. Examine sub-assemblies for tong damage. If excessive, a new sub-assembly should be made up as above.

10. TP and WSPE to carry out final dimensions check.

PRESSURE TESTING SURFACE LINES AND EQUIPMENT

See fig. 5 for schematic of the layout of the test equipment.

Before the well is flow tested (preferably prior to installation of the string) the following equipment will have been function/pressure tested on the deck as follows:

Flowhead

Install a single joint of 4-1/2" PH-6 tubing on the lower end of the flowhead. All inlet/outlet connections are to be blanked off with testsubs. Pressure test body with all valves open.

Close wingvalves and swabvalve. Open downstream of the valves to atmosphere. Pressure test. Close the mastergate and pressure test the valve from below. Close the swabvalve and pressure test from above. Drift the vertical bore of the tree/joint with a 2.797" OD drift. All the pressure tests to be 5000 psi/15 mins.

EZ Tree

Install a 4-1/2" PH-6 pupjoint on the upper end and the slick joint, fluted hanger, X-over and a 3-1/2" VAM pupjoint on the lower end of the tree. With testsubs installed pressure test the body to 5000 psi.

Check the non-return valve in the chemical injection line as follows: Bleed off the body pressure from 5000 to 4500 psi and re-pressure to 5000 psi through the chemical injection hose. Bleed-off the injection line and observe for returns. Close the ball valve and pressurize from below with the upper tree section open to atmosphere.

Test latching/unlatching with the E/Z tree assembly in the rotary table prior to running in for space out. Drift assembly with a 2.797" OD drift.

Lubricator valve

Install a 4-1/2" pupjoint above and below the valve and test the body and the ball valve from both sides to 5000 psi. Drift assembly with a 2.797" OD drift.

Production Test Equipment

The following tests should be carried out before the installation of the test string in order to save rig time. Connect the cement discharge line to the permanent 6" rig test line and pressure test as follows:

Lines to burners	:	1000 psi/15 min
Lines to T-manifold against bulk head	:	1000 psi/15 min
Separator	:	1350 psi/15 min
Relief valve(s) on separator	:	+/- 1450 psi (only if not recently done onshore and witnessed by Shell representative).

Flush the valves clean by pumping +/- 1 bbl of water and close the valve by bleeding the pressure to zero.

Lines to upstream inlet of separator and
By-pass valve : 1350 psi/15 min
Check "P" pilot trips at +/- 1350 psi
Lines downstream of steam heat exchanger: 3000 psi/15 min
Lines upstream of steam heat exchanger : 3000 psi/15 min

With 3000 psi through the choke manifold close all valves on same and bleed off the pressure between the upstream and downstream valves. Observe for leakages.

Calibrate the oil and water meters while hooked-up to the pump line.

TESTS TO BE CARRIED OUT AFTER THE INSTALLATION OF THE PRODUCTION EQUIPMENT

With the flowhead mastergate closed and the kill line/flowline chicksan loops installed pressure test against the closed choke manifold to 5000 psi/15 mins.

Check the automatic flow wing shut off valve is operational from the following area:

1. Separator
2. Dog house
3. "P" pilot

Checks should be carried out to ensure the following auxiliaries are operational:

1. Steam supply to the steam heat exchanger, the condensate feed back line to the rig system, and the steam degasser system.

2. Rig air supply to the burners.

3. Water sprays to burnerheads. Cooling water to the rig's hull/cranes etc readily available and at sufficient pressure.

NOTE: After pressure testing the burner boom oil and gas lines all valves downstream of the T-manifold must be kept open to allow for quick change-over of burners.

APPENDIX 3

SAFETY PROCEDURE FOR HANDLING EXPLOSIVES

Safety during loading and firing

Before gun/setting tool is armed all transmitters, cranes, welding machines, radar etc. must be switched off and remain switched off until the gun/packer is fired/set. After firing/setting, transmission can be resumed until the gun/packer setting tool has been pulled to about 100 m below the seabed, but must then cease until the gun/packer setting tool has been laid down and checked.

Portable transmitters should be placed in one room to prevent accidental transmission.

Helicopters should not be permitted to land on the platform during perforations, or to approach closer than 150 m.
Supply and standby boats must also stand off from the rig at this time.

Work involving explosives

Work involving the use of explosives should be carried out only by specialist personnel and should never be done during an electrical storm.

During any job involving the use of explosives, the number of personnel employed should be kept to a minimum. All other persons should be excluded from the danger area (e.g. walkway and derrick floor) throughout the operation.

Warning signs should be placed on access routes to the danger area to prevent access by unauthorised persons.

The Platform Manager (Captain) is to inspect equipment and check safety procedures.

Two hours before each perforating/packer setting run the Petroleum Engineer will telex Base with an estimate of when the radio beacon, VHF transmitter, etc. will be closed down and for how long. Actual times will be advised by the Radio Operator.

This is particulary important if a helicopter flight is scheduled for the rig concerned.

The first perforation must be carried out in daylight but later runs and packer settings may be carried out at night. However, if in the course of the production test a well is killed due to unforeseen circumstances, the first of any subsequent perforations must also be carried out in daylight.

A constant check must be made to ensure that no voltage is measured between the riser and the rig at surface. In the event that voltage is measured, all sources of electrical energy must be switched off. (N.B. This may preclude perforating/packer setting at night).

FLOWING THE WELL

Opening up a well to bleed off, or initial start up of a separator, must be carried out in daylight;- production testing may then continue into the night.

Blowing off operations may be carried out under the following conditions:

a) Weather suitable for rescue operations.

b) Wind force sufficient to carry gases away from the platform.

c) Shipping and aircraft warned to stand clear during blowing off.

d) Standby boat and supply boat(s) advised that this operation is to take place and to take the action and precautions necessary for this operations.

HYDRATE PREVENTION

To prevent hydrate formation during the flow testing, pump facilities should be hooked up to the following injection points:

a) E/Z Tree
b) Flowhead
c) Data Header
d) Gasline downstream of the separator

c) and d) may be fed by one pump with a T-manifold to allow for changeover.

In order to safeguard against hydrate formation during shut-in periods it is recommended to continuously inject glycol in the vertical run of the flowhead as well as at the E/Z tree.

NOTE: Triethylene Glycol to be used for hydrate prevention.
Methanol to be used when hydrates have been formed.

HANDLING AND MIXING OF CALCIUM CHLORIDE BRINE

A) Handling of CaCl2 brine.

$CaCl_2$, both as brine and powder can cause unpleasant skin irritation and even blistering if allowed to remain in contact with the skin. It is therefore important that personnel involved in work where they may be exposed to the brine or powder should be protected as follows:

a) Rubber gloves (gauntlet type to cover wrists).

b) Waterproof slicker suits with hoods.

c) Rubber boots (leather boots are shrivelled by the brine).

d) Full face masks for use when mixing powdered $CaCl_2$.

e) Barrier cream (e.g. "Vaseline") for use on exposed skin, particularly face, neck and wrists, to prevent direct skin contact with the brine.

Additionally, whenever brine/powder is inadvertently splashed onto clothing then the affected clothes should be changed and washed forthwith. Never allow brine to dry on the skin or clothes. If brine is splashed into the eye, wash the eye at once with copious amount of fresh water.

B) Mixing of a CaCl2 brine pill (1.12 SG) using CaCl2 powder:

The following instructions are for the mixing of 50 bbls of Calcium Chloride brine in the slug pit, the formulation is to be verified by a pilot check performed at the wellsite.

1. Thoroughly clean the slug pit and flush all the mixing lines and hoppers that are to be used for mixing with water. Also flush clean with water the transfer lines from the slug pit to the Halliburton unit.

2. Add 46 bbls of drillwater to the slug pit.

3. Add +/- 2600 lbs of Calcium Chloride (Peladow) (54.5 lbs/bbl) to the drill water while circulating through the mixing hopper.

NOTE: a) Fluid in the slug pit is to be thoroughly agitated during mixing or the Calcium Chloride flakes will drop out and settle on the bottom of the tank.

b) This mixing process is a exothermic reaction therefore as the brine is quite hot while being mixed it will weigh less when initially mixed than when cooled down.

C. To viscosify the above pre-mixed (50 bbls) Calcium Chloride brine.

1. Reduce the pH of the brine to below 7.8 by the addition of J286 powder or HCl acid.

2. Add +/- 50 lbs (25 lbs/1000 gal) of J164 (HEC) to the brine.

   NOTE: The J164 is to be added SLOWLY to the brine while circulating through the mixing hopper. If not added SLOWLY "fish eyes" will form which could possibly cause formation damage later.

   Agitate for 30 mins to ensure the J164 (HEC) is fully dispersed and hydrated. The viscosity should start to build after 15 - 30 mins dependent upon pH and ambiant temperature.

3. Add caustic soda (while taking the standard precautions for handling) to the brine and increase the pH to around 8.5.

   NOTE: Ensure that the caustic soda is fully dispersed in the gelled brine before adding more as precipitates will form if the pH increases above 10.

   The Wellsite Petroleum Engineer is to conduct and monitor the above brine mixing and gelling procedures to ensure correct formulation etc.

D) Formulation Calcium Chloride brine containing sized Calcium Carbonate

The formulation for 1 bbl of 1.12 brine containing 40 ppb sized Calcium Carbonate is: -

0.32 bbls 1.00 SG fresh water
0.64 bbls 1.12 SG Calcium Chloride brine
(To give 0.96 bbl of 1.04 SG brine)
1 ppb HEC and 1 ppb XC-Polymer
20 ppb Norcal N 40 Calcium Carbonate
20 ppb Norcal N 15 Calcium Carbonate

The mixing procedure for 1 bbl of brine containing 40 ppb sized Calcium Carbonate is: -

1. Dilute the 1.12 SG brine in the above ratio with freshwater to give the desired volume.

2. Add J286 to the 1.04 SG brine and adjust its pH to +/- 5.

3. Add (slowly) the required amount of HEC and XC-Polymer and mix throughly. Increase the pH to 8 - 9 using caustic soda (while taking standard precautions for handling).

   NOTE: Ensure that the caustic soda is fully dispersed in the gelled brine before adding more as precipitates will form if the pH increases above 10.

4. Add the required amount of sized Calcium Carbonate and agitate well to ensure it is fully dispersed through out the brine.

NOTE: a) For ease of shipping/handling the base Calcium Chloride brine will be sent to the rig at 1.12 SG and diluted back to 1.04 SG with freshwater.

CONTINGENCY MEASURES

A. Surface Leaks/Malfunctions

1. Minor surface leak/malfunction:

   a) Close the well in at surface by activating the automatic and manual gate valves on the flowhead.

   b) Bleed off the pressure trapped in the surface test lines and equipment.

   c) Repair the minor leak/malfunction and re-pressure test the relevant surface equipment as required.

   d) Open up the well and resume testing.

2. Major surface leak/malfunction (assuming the automatic shut down system has activated).

   a) Close in the well manually at the flowhead and bleed off pressure trapped in surface lines and equipment.

   b) Rig up the wireline lubricator and BOP's pressure test same:

   c) Close the APR-N valve.

   d) RIH and open the SSD. POH with wireline. Reverse circulate the tubing contents to brine and observe tubing dead.

   e) RIH and close SSD, pressure test annulus to 500 psi:

   f) Complete repairs and re-pressure test the relevant surface equipment.

Re open the well as follows:

   a) RIH and open the SSD. POH.

   b) Circulate diesel into the tubing string to within 2 bbls of the SSD.

   c) RIH and close the SSD. Pressure test annulus to 500 psi/15 mins.

   d) Pressure up annulus to open the APR-N valve.

   e) Carry on and complete the testing programme.

B. Subsurface Tubing Leaks

1. If a tubing leak is suspected the following procedure is to be carried out:

   a) Close in the well at the production wing valve and observe tubing and annulus pressures.

   b) Bleed off annulus pressure to close the APR-N valve.

   c) RIH and open the SSD. POH.

   d) Reverse circulate the tubing contents to brine and observe tubing dead. RIH and close the SSD. Pressure annulus to 500 psi/15 mins.

   e) Attempt to pressure test the tubing to 3000 psi. If this test is OK then proceed with the test programme, if not carry out step g) below.

   f) If either of the tubing or annular pressure tests fail then pull the test string and inspect the tubing and sub assemblies closely for leaks.

   g) The further test programme will be advised and will obviously be dependent on what is found to be the cause of the leak.

C. HYDROGEN SULPHIDE (H2S)

1. If H2S is monitored in the hydrocarbons produced while testing (H2S is to be checked for immediately hydrocarbons reach surface) the following will apply.

   a) Inform Shell Drilling Supt. and Platform Manager.

   b) Air breathing apparatus is to be readily available on the rig floor and rig personnel are to be directed to keep clear of areas down wind of the test equipment and pipework.

   c) A constant check is to be kept around the rig for H2S, if detected advise the Shell Drilling Supt. and Platform Manager immediately. If the presence of H2S is confirmed (in whatever quantities) the well is to be immediately closed in at the flow head and any leaks in the system traced and remedied.

      NOTE: Breathing apparatus to be worn while checking for leaks.

   d) If the H2S persists the test will be terminated by bull heading the tubing contents into the formation.

D. Deteriorating Weather

1. The test string will only be run once an acceptable weather window has been forecast for the duration of the test. If the weather begins to deteriorate rapidly once the string has started to be run a hang off tool will be picked up and the string hung off.

   If deteriorating weather is expected once the flow testing has commenced the test will be suspended. The well will be secured as outlined below:

   a) Close in well at the flowhead and bleed off pressure trapped in the surface lines.

   b) Bullhead the tubing contents back into the formation with brine, using a 50 bbl slightly viscous brine pill ahead of the brine. See Appendix 5 for formulation. Observe the tubing dead.

   c) Close the EZ tree, bleed off any pressure in the annulus and monitor tubing pressure via the glycol injection line. Be prepared to unlatch the EZ tree.

APPENDIX 7

WELL STATUS 31/2-11

1. The well has been drilled vertically to a TD of +/- 1735 m.

2. Casing Data

Size	Weight	Grade	Coupling	Depth (m BDF)	Collapse Strength	Internal Yield	Capacity BBL/FT
30"	310	X-52	Vetco ATD-RB	460	-	-	-
20"	129	X-52	LW-LH	799	1410	2930	-
13-3/8"	72	L-80	BTC	1525	2670	5380	-
9-5/8"	47	L-80	BTC/VAM	+/- 1725	4750	6870	0.0732

3. Tubing Data

				Make up			
3-1/2"	10.2	C-75	VAM	4700ft/lbs	11360	10480	0.0083
3-1/2"	9.3	C-75	Hydril CS	3000ft/lbs	10040	9520	0.0087
4-1/2"	19.3	C-75	Hydril PH6	7500ft/lbs	12960	12540	0.0126
5-1/2"	15.5	J-55	LTC	2170ft/lbs	4040	4810	0.0238
2-7/8"	6.5	C-75	Hydril CS	2100ft/lbs	10470	9910	0.0058
5"	15.0	L-80	VAM	6500ft/lbs	7250	8290	0.0188
2-3/8"	4.7	P-105	Hydril CS	1500ft/lbs	15460	14700	0.00387

NOTE: No safety factors included in the pressure ratings.

4. Drill Pipe Data

3½"	15.5	-	3½" IF	-		-	0.00658

MEASUREMENTS REQUIRED

A. During flow periods

The following data should be recorded during flowing periods every 15 mins, or whenever a change occurs:

WHP, WHT, choke size flowline pressure
Separator pressure, separator temperature
Flowrate (liquid) and GOR
Sand concentration (see Appendix 10)
Annulus pressure (via kill line)

In addition, all produced fluids should be measured for density. Gas should be analysed via the mud logging unit's gas chromatograph, with H2S measured with Draeger tubes. Produced water should be measured for salinity.

B. During BHP surveys

During all BHP surveys the following deadweight THP measurements are required:

a) Every 5 minutes during initial lubricator calibration stop.

b) Every 15 minutes during flow period.

c) After closing in for build up, every 5 minutes for the first hour, thereafter every ½ hour.

d) Every 5 minutes during the gradient stops at 100 m and 200 m above XN nipple and at seabed.

e) Every 5 minutes during the final lubricator calibration stop.

SAMPLING REQUIREMENTS

No bottom hole samples are required for the oil zone test. 7 set of separator recombination samples will be taken. 20 x 1 bbls drums of produced oil sample should be collected during the 1000 or 1500 bbl/day flow rate periods and before any demulsifiers are added to the flow. The drums are to be clearly marked with the well number, test interval, date, and time.

APPENDIX 9

SAND DETECTION DURING OIL TEST

A. Materials required (to be supplied by Flopetrol).

1. Acetone, toluene and paraffin
2. 10 x 63 sieves
3. 1 gallon cans
4. Electrically driven centrifuge and 50 centrifuge tubes
5. Watch glasses
6. Glass funnel

B. Procedure

1. Collect one imperial gallon crude oil from choke manifold as fast as possible in a clean container.

2. Shake the sample vigorously and slowly pour the contents over the sieve.

3. Wash the residue on top of the sieve with paraffin, toluene and acetone in that order and allow acetone to evaporate.

4. With a fine brush transfer the residue from the top of the sieve into a graduated conical centrifuge tube, wash the glass funnel and brush with toluene so that particles are flushed into the tube. (It is unsafe to centrifuge with acetone).

5. Centrifuge for about 3 minutes and determine the volume in cubic centimetres of solids collected at the bottom of the tube. The tube should be clearly marked with sample number, date, zone on test, production rate, concentration of sand, well number.

6. Estimated sand concentration in lbs/1000 lbs: Sand content = 102 x No. of cc volume of solids centrifuged out. (For more accuracy, multiples of imp. gallons could be processed and the concentration divided appropriately).

7. To establish whether the sediment is partially wax, pour off excess toluene and add acetone, shake and pour off sediment free acetone. Drain sediment onto a watch glass, allow it to dry and heat to above 100 degs C. Observe for melting. This can also be verified under a microscope.

8. Carefully store samples and send ashore for analysis.

9. If wax is found to be a large percentage in item (d) the screen contents can be flushed with water so that the wax will lie above the sand and can be easily distinguished.

PROCEDURE FOR RECOMBINATION SAMPLES

A. Gas Sample

1. The bottles should be properly evacuated with a vacuum pump.
2. The Wellsite Petroleum Engineer ensures that bottles are filled up slowly and are at separator pressure prior to being closed.
3. Check container and valves for leaks.
4. Mark bottles with sample number.
5. Fill in surface PVT sampling forms.

B. Oil/Condensate

1. Oil/Condensate sample container to be filled with mercury.
2. Slowly displace 500 cc mercury from 600 cc container with oil/condensate from separator.
3. The Shell Petroleum Engineer ensures that bottles are at separator pressure prior to being closed.
4. Draw off 50 cc of mercury to create gas cap.
5. Check containers and valves for leaks.
6. Mark bottles with sample number, date, time and well no.
7. Fill in surface PVT sampling forms.

Sample Bottle Working Pressure

Capacity	W.P.
20 litres (gas)	2,800 psi
0.7 litres (oil)	10,000 psi

SAND CONCENTRATION - CRITERIA

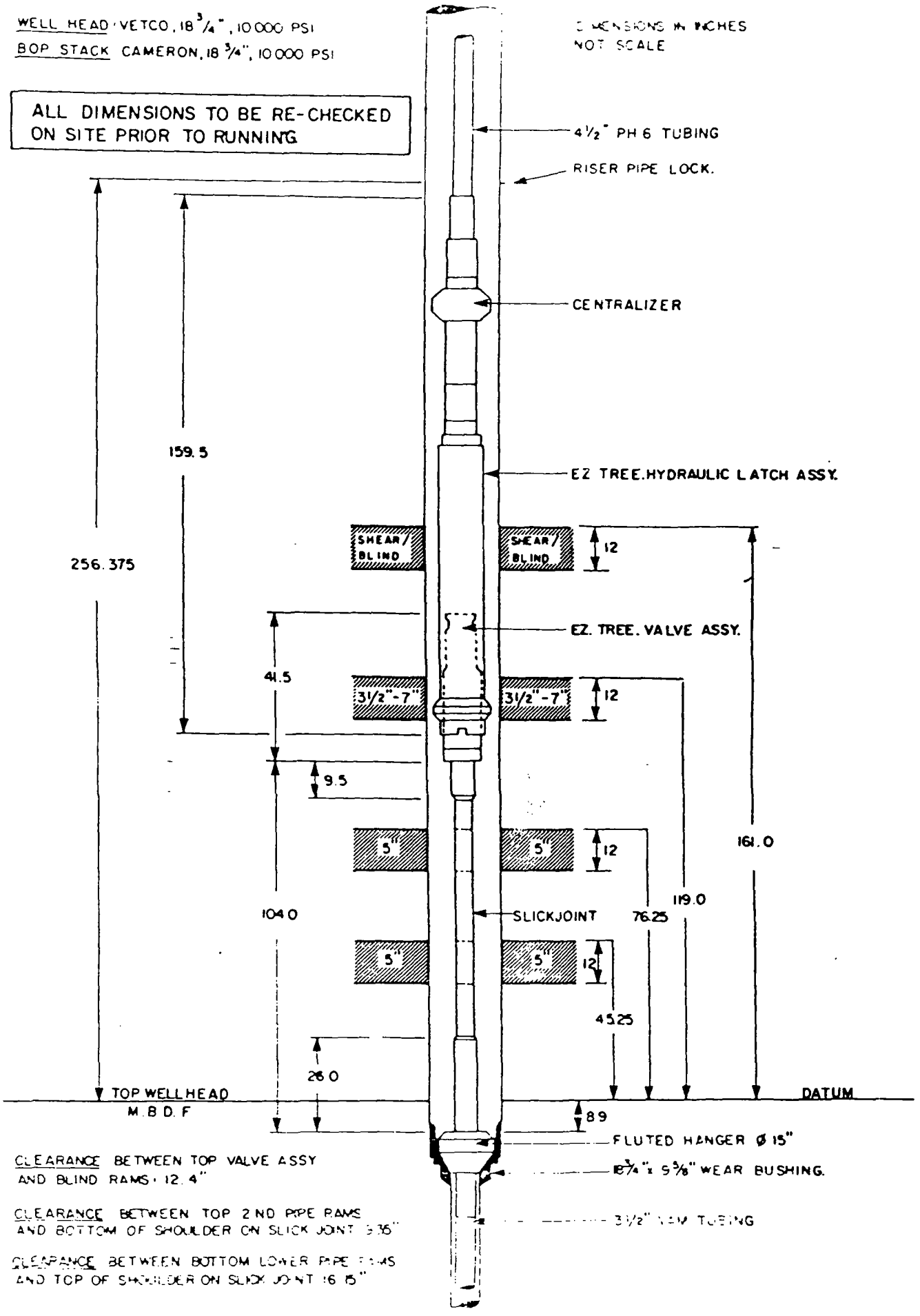
The maximum allowable sustained concentration is 50 lbs/1000 bbls for all tests, including maximum rate tests. If the concentration exceeds this, the well should be beaned back and a further sample taken after 1½ tubing volumes. In the case of a maximum rate test, the test can be terminated once sustained sand production has been established. N.B. Some sand can always occurs after bean change.

In general:

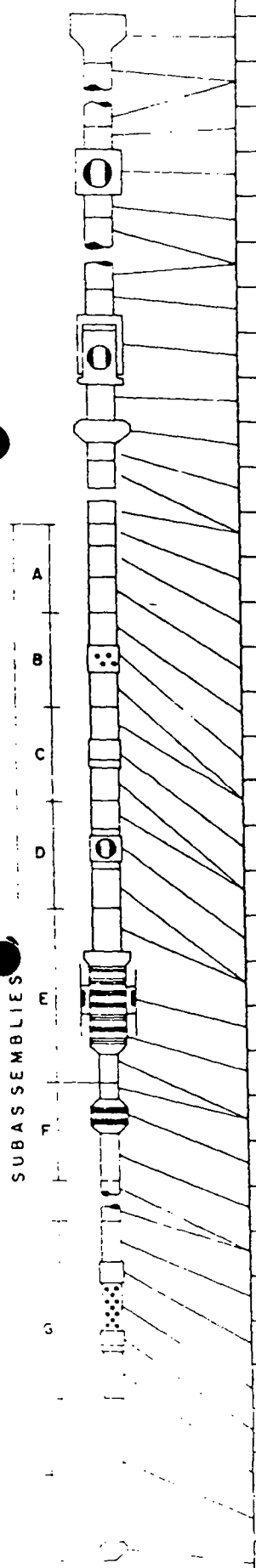
25 lbs/1000 bbls	-	continue with programme
25 - 50 lbs/1000 bbls	-	maintain the rate steady.
50 lbs/1000 bbls	-	bean back rate by half and repeat beaning back until concentration declines.

It is expected that, during clean up, bursts of high sand concentration may be detected. These should not cause undue concern if they are not sustained.

EZ TREE SPACE OUT WELL 31/2-11 RIG BORGNY DOLPHIN



9⅝" CASING BY 3½" PRODUCTION TEST STRING, WELL 31/2-11

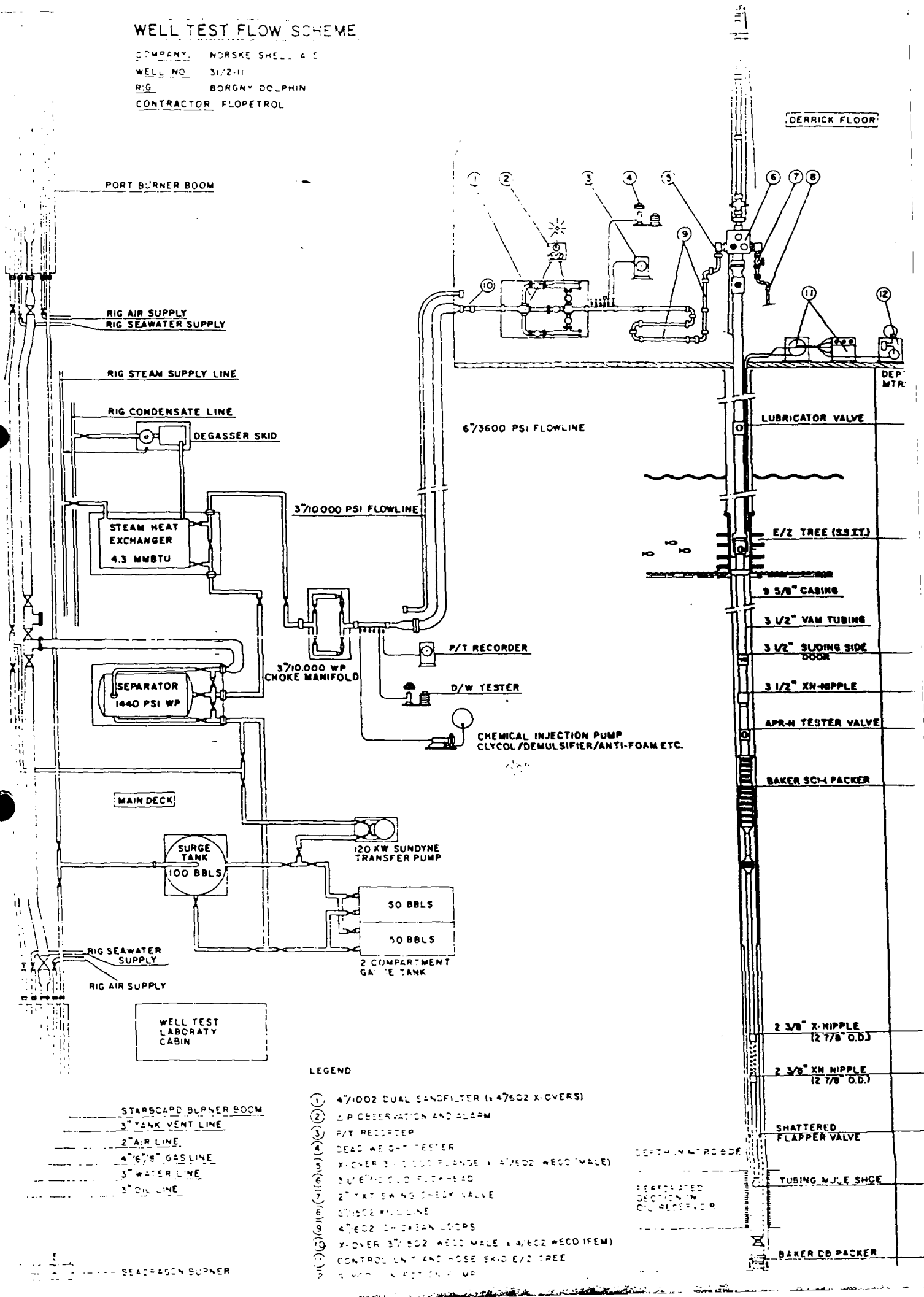


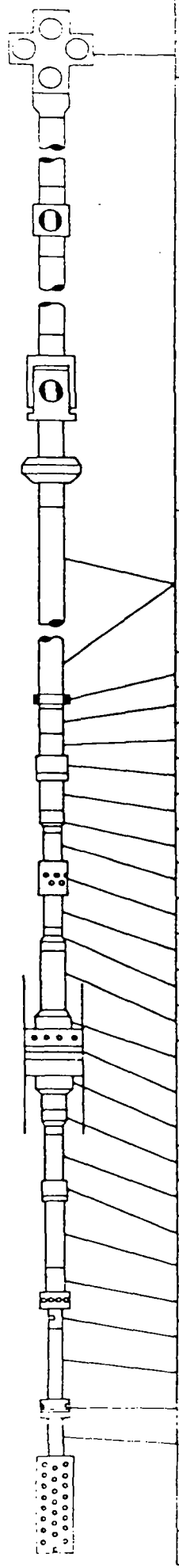
ITEM	DESCRIPTION	MIN. I.D.	MAX. O.D
	X-OVER, 6½" ACME (B) x 4½" PH-6 (P), C-75	3.515	
	TUBING, 4½", 19.2 LBS/FT, PH-6, C-75	3.515	5.313
	X-OVER, 4½", PH-6 (B) x 4½", ACME (P), C-75	3.515	5.313
	FLOPETROL LUBRICATOR VALVE, H2S SERVICE, 10000 PSI. W.P. 4½" ACMC (B) x (B)	3.000	10.750
	X-OVER, 4½", ACME (P) x 4½", PH-6 (P), C-75	3.515	5.313
	TUBING, 4½", 19.2 LBS/FT, PH-6, C-75	3.515	5.313
	X-OVER, 4½", PH-6 (B) x 4½" ACME (P), C-75	3.515	5.313
	FLOPETROL EZ TREE, H2S SERVICE, 10.000 PSI W.P. WITH GLYCOL INJECTION SYSTEM, 4½" ACME (B) x (B)	3.000	10.750
	SLICK JOINT, 4½", ACME (P) x (P), C-75	3.000	5.000
	FLUTED TUBING HANGER, 4½", ACME (B) x (B), C-75	3.000	15.000
	X-OVER 4½", ACME (P) x 3½" VAM (P), C-75	2.797	5.000
	TUBING, 3½", 10.2 LBS/FT, VAM, C-75	2.797	3.917
	PUPJOINT (5'), 3½", 10.2 LBS/FT. VAM, C-75	2.797	3.917
	X-OVER, 3½" VAM (B) x 3½" CS (P), C-75	2.867	3.917
	PUPJOINT (10'), 3½", 9.3 LBS/FT, CS, L-80	2.867	3.905
	OTIS, 3½" "XA" SSD, 2.75" SEAL BORE, CS (B) x (P), C-75	2.750	4.280
	PUPJOINT (10'), 3½", 9.3 LBS/FT, CS, L-80	2.867	3.905
	OTIS 3½" "XN" NIPPLE, NO-GO, 2.635, SEAL BORE: 2.750", CS (B) x (P) C-75	2.635	4.280
	PUPJOINT (10'), 3½", 9.3 LBS/FT, CS, L-80	2.867	3.905
	APR-N TESTER VALVE, ASSY, NO. 615.2272, 3½" I.F. (B) x (P) C/W. X-OVERS EITHER SIDE TO 3½" CS (B) x (P)	2.250	5.000
	PUPJOINTS (10'), 3½", 9.3 LBS/FT, CS, L-80	2.867	3.905
	BAKER SC-GP PACKER, SIZE 96 A4-47 4.750" SEAL BORE	4.750	8.440
	BAKER G-22 LOCATOR SEAL ASSY, 20' LONG, SIZE 190-47 3½" CS (B) x 2⅞" CS (P)	3.000	4.900 4.750
	PUPJOINTS (5' + 3'), 2⅞", 6.5 LBS/FT, CS, L-80	2.347	3.220
	BAKER G-22 SEAL ASSEMBLY, 2' LONG, SIZE 190-47 2⅞" CS (B) x 2⅞" CS (P)	3.000	4.750
	PUPJOINT (10'), 2⅞", 6.5 LBS/FT, CS, L-80	2.347	3.220
	TUBING AND PUPJOINTS FOR SPACE OUT INSIDE G.P. ASSEMBLY, 2⅞" 6.5 LBS/FT, CS, L-80	2.347	3.220
	PUPJOINT (5'), 2⅞", 6.5 LBS/FT, CS, L-80	2.347	3.220
	OTIS, 2⅞" "X" NIPPLE, SEAL BORE 1.875, CS (B) x (P), 9 CR-1 MO.	1.875	3.250
	PERFORATED PIPE (10'), 2⅞", CS (B) x (P), P-105	2.347	3.220
	OTIS, 2⅞" "XN" NIPPLE, SEAL BORE 1.875 NO-GO 1.825, CS (B) x (P), 9 CR-1 MO	1.875	3.250
	PUPJOINT (10'), 2⅞", 6.5 LBS/FT, CS, L-80	2.347	3.220
	TUBING JOINT, 2⅞", 6.5 LBS/FT, CS, P-105	2.347	3.220
	HALF MULE SHOE, 2⅞" CS (B)	2.347	3.850

N.B. ALL DIMENSIONS TO BE CHECKED PRIOR TO RUNNING

WELL TEST FLOW SCHEME

COMPANY NORSKE SHELL A.S
WELL NO 31/2-11
RIG BORGNY DOLPHIN
CONTRACTOR FLOPETROL





GEO - [illegible] PERFORATING [illegible] GAUGE/
PRODUCTION TEST STRING.

		MIN O.D.	MAX.O.D.
3 1/8" x 10 000 PSI FLOWHEAD			
AS FOR PRODUCTION TESTSTRING, FIG. 4			
3 1/2" VAM TUBING, 10.2 # C. 75		2.797	3.917
RADIOACTIVE COLLAR			
3 1/2" VAM PUPJOINT		2.797	3.917
X - OVER, 3 1/2" VAM (B) x 3 1/2" CS (P)		2.797	3.917
3 1/2" "Q" NIPPLE, 3 3/2" HCS (P) x (B)		2.625	4.280
3 1/2" HCS PUPJOINT, 9.3 LBS/FT, L-80		2.867	3.905
X - OVER, 3 1/2" HCS (B) x 2 7/8" HCS (P)		2.347	3.905
2 7/8" HCS PUPJOINT, 6.5 LBS/FT, L-80		2.347	3.220
2 7/8" "XA" SSD, 2.313 SEAL BORE, CS (B) x (P), C-75		2.317	3.750
2 7/8" HCS PUPJOINT, 6.5 LBS/FT L-80		2.347	3.905
X - OVER, 2 7/8" HCS (B) x 3 1/2" EUE (P)		2.347	4.500
3 1/2" EUE TUBING JOINT		2.867	4.500
BAKER RENTED	X - OVER, 3 1/2" EUE (B) x 4 1/2", 8 RD		
	BAKER FHL PACKER		
	X - OVER, 4 1/2", 8 RD x 3 1/2" EUE (P)		
X - OVER 3 1/2" EUE (B) x 2 7/8" HCS (P)		2.347	4.500
2 7/8" HCS PUPJONT, 6,5 LBS/FT. L-80		2.347	3.905
2 7/8" "XN" NIPPLE, HCS (B) x (P)		2.205	3.250
2 7/8" HCS PUPJOINT, 6,5 LBS/FT.		2.347	3.220
X - OVER, 2 7/8" HCS (B) x 2 7/8" EUE (P)		2.347	3.668
GEOVANN PROVIDED	MECHANICAL RELEASE		
	PDRS (BREAK PLUG	2.250	
	PUPJOINT		
	BAR ACTUATED VENT	1.410 1.870	3.38
	2 3/8" TUBING JOINT		
	6" SUPERCHARGE GUNS		

N.B ALL DIMENSIONS TO BE CHECKED PRIOR TO RUNNING.