009/01/09D

SCOTTON
BP.

Operational Drill Stem Testing Programme

for Well 29/6-1

NAME DATE

otton

. Hares

Operational Drill Stem Testing Programme

for Well 29/6-1

Prepared by: G. Scotton

Approved by: T.N.D. Hares

CONTENTS

Detailed Testing Procedures Well 29/6-1

1.1 General Comments

1.1.1 The programme has been compiled in preparation for the production testing of NOCS Well 29/6-1. The programme is tailored to testing the Brent formation inside the 7" liner. A separate programme will be issued if any testing of the secondary target is required in the 5" liner.

1.1.2 Test pressures are based on known parameters from the Brent formation (11,150 psig at 4206 mBRT). Revision of the test pressures may be required for a test of the secondary target.

1.2 Test Procedures

1.2.1 Pressures in well 29/6-1 are expected to exceed the normal working range of 10,000 psi equipment. The test equipment is where necessary rated to 15,000 psi. Safety will be of prime importance during all aspects of the test.

1.2.2 The BP Drilling Supervisor will be in overall charge throughout the test. The Drilling Supervisor will be advised and assisted by a BP Petroleum Engineer who will directly supervise the conduct of the test and contract personnel involved.

1.2.3 The testing and perforating procedures laid down in Section 9 and 11 of the BP Norway Operations Manual will be observed throughout the test.

2. General Preparations - Wellbore

2.1 Run casing scraper and bit over 9 5/8" casing. Run casing scraper and bit over 7" liner and circulate and condition mud to 1.99 S.G. Operate pipe rams to ensure all cuttings are removed.

2.2 Run CBL/VDL/CCL/GR over the 7" liner. (This must be done before the liner is pressure tested). A separate cement squeeze programme will be issued in the event that the cement bond and zone isolation proves unsatisfactory.

2.3 Pressure test 7" liner and 9 5/8" casing overlap to 3000 psi. Run a dry test on the liner overlap (see separate programme).

2.4 Pull 9 5/8" wear bushing.

2.5 Conduct B.O.P. tests to 10,000 psi.

2.6 Pick up swage and run through Hydril. This will ensure the Hydril rubber is fully retracted and the Flopetrol Subsea Test Tree will not hang up.

2.7 A space-out trip of the Subsea Test Tree will be carried out prior to commencement of testing. (see Fig. 3).

2.8 Pick up and stand back the tubing as outlined in Section 4.1 of this programme.

2.9 Rig up Schlumberger and perforate the test interval with 4" casing guns, in accordance with Section 9 of the BP Operations Manual.

Run junk basket/gauge ring across the perforations.

When the preparations outlined in this section, and in Section 3, are completed, the test string can be run into the well, as detailed in Section 4.

3. General Preparations - Surface Testing Equipment

This section outlines the hook-up and pressure testing programme to be carried out prior to running the test string.

3.1 Flowlines and Choke Manifold

3.1.1 Pressure test the data header and choke manifold against the inlet valves and downstream valves to 10,500 psi.

3.1.2 Connect the high pressure chiksans to be used for the flow and kill lines together and pressure test to 10,500 psi.

3.2 Production Equipment and Pipework

3.2.1 Install and connect heater, separator, flowtank, transfer pump and associated pipework as detailed in Fig. 1. Purge all lines with water. Wash out and drain separator and tank to ensure no fluids or solids from previous test remain.

3.2.2 Pressure test the rig test line from the rig floor and chiksans upstream of the heater to 10,000 psi against the heater inlet valves. Repeat the test against the heater choke blank plug.

3.2.3 Pressure test the lines between the heater and separator against the separator inlet valves to 1500 psig.

3.2.4 Pressure up the separator slowly against the separator outlet block valves to 1440 psig to ensure the relief valve operates. Retest to 1400 psig to ensure the relief valve is reseated.

3.2.5 With the heater and separator by-passed, pressure up the rig test line, the chiksan pipework and the oil manifold against the outlet valves on the burner divertor manifold - firstly against the oil outlet and afterwards against the gas outlet valves - to 1500 psi.

3.2.6 Ensure the flow tank and separator vent/relief lines are clear.

3.2.7 Hook up the steam supply to the heat exchanger and ensure the steam feed and return lines are clear. Test operation of rig steam generator to ensure it can provide an adequate supply to maintain a suitable operating temperature.

3.2.8 Check calibration of all oil and water turbine meters by pumping water through the meter runs into the flowtank. Check the gas line orifice meter differential pressure cell using a manometer, and the Dead Weight Tester. Foxboro - calibrated in town

With water

3.3 Burners

3.3.1 Purge all burner lines with water to remove debris and ensure no blockages exist. Check water supply to burners and ensure no water spray nozzles are blocked.

3.3.2 Connect up and function test the propane ignition pilot system for the burners.

3.3.3 Check air supply to burners.

VAM X-overs

3.3.4 Pump a few barrels of diesel to each burner in turn and check for complete combustion.

3.4 Subsea Test Tree

3.4.1 Make up the slick joint to the Flopetrol 15M E-Z tree. Pressure test the tree internally below the ball/flapper valve assembly to 10,500 psig.

With ball/flapper valves open, pressure test the entire body of the tree to 10,500 psig.

3.4.2 Pressure test the control lines (for the ball/flapper valve and the unlatch mechanism) to 5000 psig.

3.4.3 Pressure test the chemical injection line to 10,500 psig.

3.4.4 Hook up the chemical injection line to SSTT. Ensure the pump can maintain injection with a subsea test tree internal pressure of 10,500 psig.

3.5 Flow Control Head

3.5.1 Function test the hydraulic valve on the flowhead flowline side arm.

3.5.2 Pressure test the body of the flowhead to 10,500 psig under the following conditions;

- with the master valve open against the swab valve, and flow and kill sidearm valves
- below the master valve
- above the master valve.

3.6 Chemical Injection Equipment

3.6.1 Ensure all chemical injection pumps (to SSTT, data header and separator gas outlet line) function correctly and all fittings make up correctly.

3.6.2 Pressure test the surface chemical injection line using the chemical injection pump against the isolating valve. Ensure satisfactory injection can be maintained against a line pressure of 10,500 psi.

3.7 Emergency Shutdown System

3.7.1 Calibrate all of the P-pilots using an air supply and the dead weight tester to the trip settings as follows;

a) lo pilot (flowline) - 500 psi falling

b) hi/lo pilot (d/s choke manifold, u/s heater) - 9000 psi rising
500 psi falling

c) hi/lo pilot (d/s heater, u/s separator) - 1400 psi rising
100 psi falling

3.7.2 Connect up the ESD console, all pilots and control hoses to the hydraulically operated valve on the flowhead.

Function test each pilot in turn, ensuring that the hydraulic failsafe valve closes fully.

4. Running the DST string

4.1 Picking up the tubing

4.1.1 The 3 1/2" VAM tubing will be laid out on deck on arrival on board and be measured. The tubing inspector will remove the thread protectors and clean and inspect the pins and boxes. The pin thread protectors will be replaced for running the tubing.

4.1.2 Prior to perforating the well and running downhole tools, the tubing will be made up and run in the hole. This will be carried out by the casing crew, checking the make-up of each joint with the torque gauge.

Each joint will be drifted before running, and the threads will be doped with the supplied casing dope. (Jet-lube API modified - friction factor = 1).

The recommended make-up torque is as follows;

	3 1/2" L-80 15.8 lb.ft^{-1}	3 1/2" N-80 12.7 lb.ft^{-1}
Minimum	6100 ft.lb	5100
Optimum	6500 ft.lb	5600
Maximum	7200 ft.lb	6900

4.1.3 Run the entire tubing string into the hole. Pick up the circulating head and circulate and condition the mud as appropriate.

4.1.4 Pull out of the hole, racking the tubing in stands. Unbroken connections should be externally pressure tested using the Gatormator external leak detector using a test pressure of 5000 psi. This should be carried out with the pipe under tension but with the slips in place.

4.2 Running the Downhole Tools (for 7" liner) - see Fig. 2

Successful running of the string relies on the correct make-up and handling of the tool joints. It is emphasised that extreme care should be taken handling the Halliburton tools, and that sufficient time should be taken to ensure that they are holding pressure correctly prior to being run.

4.2.1 Pick up tailpipe, inserting the Halliburton, Sperry Sun and Flopetrol gauges.

4.2.2 Pick up the remaining Halliburton test tools. Fill the string above the APR-N valve with 10 bbl of a pre-mixed viscous gel to ensure solids from the tubing do not settle out on top of the valve. Pressure test to 5000 psi on top of the tools after the first two slip joints.

4.2.3 Run the drill collars filling with seawater cushion every stand.

4.2.4 Pick up the 3 Halliburton slip joints, the 3 1/2 IF x 3 1/2" VAM crossover and the first stand of VAM tubing. Pressure test the string internally to 5000 psi. Note that the slip joints must be handled with extreme care.

4.2.5 Run the VAM tubing stands, making up each connection with the tubing tong to the torque valves as given in 4.1.2. The rig floor stab-in valve and a 3 1/2" IF x 4 1/2" IF crossover should be available on the rig floor at all times. To prevent any damage to the pressure gauges the test string should be set in the slips carefully to minimise any jarring of the string.

IT IS ESSENTIAL THAT THE BACK-UP TONG IS TIGHT BEFORE A CONNECTION IS MADE UP, PARTICULARLY INSIDE THE LINER. IF TORQUE IS GIVEN TO THE STRING, THE RTTS REVERSING VALVE MAY OPEN RESULTING IN A STRONG BACKFLOW OF THE WATER CUSHION.

4.2.6 Test each newly-made connection with the Gatormator external leak detector with the pipe under full tension but with the slips in place. Maximum test pressure will be 5000 psi.

4.2.7 Fill the pipe with seawater cushion on every connection. Ensure that complete filling is achieved with each stand run to eliminate all of the air.

4.2.8 The VAM tubing should be run slowly, not faster than 15 sec/stand.

4.2.9 Internally pressure test the string after running approximately half of the tubing (1890m) to 6000 psi, and before picking up the Subsea Test Tree to 9500 psi.

4.2.10 Space out the string so that with the packer set ± 10m above the top perforation (and at least 2m from a casing collar). 2 slip joints will be open.

4.3 Running the Landing String

See Fig. 4.

4.3.1 Pick up the Flopetrol EZ tree and make up to the string. Function test the latch mechanism. Internally pressure test the string to 9500 psi above the SSTT. The SSTT should be run with the valves in the open position.

4.3.2 Continue running the remaining tubing as detailed in section 4.2. Care should be taken to ensure that the SSTT control hoses and chemical injection lines are not damaged.

4.3.3 Space out the landing string so that the flowhead master valve is around 5m above the rig floor. Pick up the Flopetrol flowhead and make up to the string. Pressure test the string to 10,500 psi.

4.4 Landing the String

4.4.1 Set the packer under the direction of the Halliburton tool operator. Space out the string so that with the packer set and the subsea test tree landed 2 slip joints are open. Maintain tension with the compensator to support the weight of the landing string.

4.4.2 Connect up the flow and kill lines as described in Fig. 1. With the master valve closed, pressure test the flow and kill lines against the choke manifold inlet valves to 10,500 psi, against the choke manifold outlet valves to 10,500 psi, and the rig permanent DST line to 10,000 psi against the heater inlet valves.

4.4.3 With the flowhead master valve closed, pressure test the flowline sidearm valve to 10,500 psi. If no leaks are detected, close the kill line wing valve and bleed off to 1000 psi at the cement pump. Observe for a pressure increase which will be indicative of a leaking kill-line wing valve. Repressure kill line to equalise the flowhead kill valve before opening and bleeding off.

4.4.4 Close the middle 3 1/2" pipe rams and the lower 5" pipe rams on the SSTT slick joint, ensuring that the Koomey system operating volume is indicating the rams are fully closed.

4.5 Operation of Down Hole Test Tools

4.5.1 Flopetrol Subsea Test Tree contains one ball valve and one flapper valve. The valve assembly is opened by applying prssure down the control hose, and fails to the closed position, ie. if the control line pressure is bled off at surface (or the control line is accidentally damaged, releasing the pressure), the valve closes. In the event of bad weather the tree can be unlatched above the valves and the string above the sea floor recovered. The shear rams can then be closed above the disconnect point. The tree can be unlatched hydraulically, or mechanically by approximately 10 turns to the right.

4.5.2 Halliburton APR-N Tester Valve is opened by applying approximately 1500 psi annulus pressure. The valve will close again if annulus pressure is released, and can be cycled repeatedly during a test.

4.5.3 Halliburton APR-M Safety/Reversing Valve will be run with one ball valve. The valve is normally open, but moves to the closed position and opening reverse circulating ports at the same time, when the annulus pressure is increased to around 2500 psi. Once closed, the valve cannot be reopened and the string contents must be reversed out. For this reason it is essential that any increase in annulus pressure due to thermal effects during the flow period is bled off.

4.5.4 Halliburton RTTS Circulating Sub is included in the test string as a back-up reversing device to allow the contents of the test string to be reversed out if annulus pressure is lost (eg. if a leak develops in the casing or liner overlap and it is not possible to operate the APR-M valve). The tool has a J-slot configuration and can be operated by picking up the string and applying right hand rotation. (Approximately 4 to 5 turns at surface may be required).

4.6 Annulus pressure system

4.6.1 The rig mud pumps will be used during testing to pressure the annulus through the 15M choke line, to activate the Halliburton APR tools.

4.6.2 As indicated in section 4.5 it is important that any increase in annulus pressure resulting from thermal effects during the flow period be bled off through the rig choke manifold as necessary.

4.6.3 An emergency bleed off line will be installed from the annulus pressure system to a point remote from the rig floor (at the 10M cement pump), to allow the annulus pressure to be vented to close the test tools if an accident renders the rig floor inaccessible.

5. Start-up Procedure

Testing may commence at the discretion of the BP Drilling Supervisor (see BP Operations Manual Section 9) once the string has been run and the surface equipment hooked-up and tested, as outlined in Sections 3 and 4.

5.1 Burners

5.1.1 Align valves to flow to leeward burner; open outboard valves on both burners, open air, water, oil and gas valves to leeward burner at rig test manifold, and close valves to windward burner.

5.1.2 Start compressed air, cooling sprays and light pilot on leeward burner.

5.2 Heater and Separator

5.2.1 Align valves to flow direct to the gas line while unloading water cushion, bypassing heater and separator.

5.2.2 Ensure the heater choke is fully opened. Align separator valves so that condensate and water are directed to burner oil line when flow is later directed to the separator.

5.2.3 Raise the steam heater to its operating temperature.

5.3 SSTT

Ensure SSTT valves are in open position.

5.4 Choke Manifold

Align the valves on the choke manifold so that flow will be through the adjustable choke. Close the adjustable side inlet valve.

5.5 Mud and Cement Pumps

Line up the mud pumps to the annulus to operate the APR tools. Direct the 15M cement pump to the flowhead kill line.

5.6 Flowhead

Close swab valve and non-active (kill) sidearm valve on flowhead. Open manually operated master valve and the hydraulic active (flowline) sidearm valve.

5.7 Emergency Shutdown System

Ensure the ESD system pilots are isolated prior to opening the well. The control system panel should be set so that the failsafe valve can be operated manually.

5.8 Opening Well

5.8.1 Reduce the underbalance differential across the APR-N valve in the following manner;

a) The inlet valve on the choke manifold should remain closed.
b) Open the non-active (kill) sidearm valve.
c) The Flopetrol EZ tree valves should remain in the open position.
d) Pressure up the string to ca. 3000 psi with the cement pump.
e) Close non-active sidearm valve.

5.8.2 RECHECK THE ENTIRE SYSTEM STATUS PRIOR TO OPENING THE WELL, THEN:

a) Pressure up the annulus to approximately 1500 psi using the mud pumps to open the APR-N tester valve.

b) The Halliburton tool operator should monitor the annulus pressure continuously during the test and ensure it does not approach the APR-M activating pressure.

6. Flowing Procedures

6.1.1 Open the choke manifold inlet valve on the adjustable side of the choke manifold. Commence chemical injection of glycol at the SSTT and data header at a high rate. The adjustable choke should be set initially at its lowest setting, and slowly opened up to 28/64" once the inlet valve is fully open. Monitor pressures upstream and downstream of choke manifold as water cushion flows overboard.

6.1.2 Once the surface flow is mainly gas direct the flow via the heater.

a) Open heater inlet and outlet valves.
b) Close heater by-pass valve.

6.1.3 Slowly close heater choke until upstream pressure reaches 2000-4000 psi.

6.1.4 Adjust the chokes so that the WHFP is between 4000 and 5000 psig. (This step, and 6.1.3 will depend on the flowing pressures obtained at surface).

6.1.5 Steps 6.1.3 to 6.1.5 should be completed as quickly as possible in order to minimise hydrate formation.

6.1.6 Once relatively stable flowing conditions have been achieved, the flow may be directed via the separator;

a) Inject methanol at maximum rate upstream of the back-pressure control valve.
b) Open gas line valves.

6.1.7 Flow may then be directed via the fixed side of the choke manifold. Open up the fixed choke inlet and outlet block valves, close the adjustable choke inlet and outlet block valves.

6.1.8 Once stable, the Emergency Shutdown System should be brought on line by opening the respective isolating valves on the pilots. The well will then by automatically shut-in if the pilots are tripped for any reason during the flow period.

6.1.9 Continue flowing to achieve test objectives (defined separately). Closely monitor flowing pressure and temperatures throughout the system at all times. If possible, shut down glycol and methanol injection. Separator sampling as outlined in section 9 should start at the earliest time when stable rates have been achieved.

6.1.10 The calibration of the condensate meters should be checked during the flow period by flowing the condensate to the gauge tank.

7. Shutdown Procedures

7.1 Normal Shutdown (completion of the flowtest)

7.1.1 On completion of flowtest isolate Emergency Shutdown System

a) isolate choke manifold lo-pilot
b) isolate downstream choke manifold hi-lo pilot
c) isolate downstream heater hi-lo pilot

7.1.2 Commence injecting glycol at maximum rate to subsea test tree and choke manifold.

7.1.3 By-pass separator;

a) Open by-pass valve.
b) Close separator gas line valves.

7.1.4 By-pass heater

a) Open heater by-pass valve.
b) Close heater inlet valve.

7.1.5 With the well flowing through the adjustable side of the choke manifold, slowly close the adjustable choke until WHFP is approximately 7000 psig.

7.1.6 Increase annulus pressure to 2500 psig to activate APR-M reversing valve.

7.1.7 Reverse out the string contents by bleeding the gas off slowly through a 16/64" choke. The annulus pressure should not exceed 800 psi while reversing out.

7.1.8 When mud reaches surface, stop reverse circulating and close in well at choke manifold inlet valve.

7.1.9 Observe pressure build-up period.

7.2 Automatic or Emergency Shutdown

7.2.1 In the event of any of the Emergency Shutdown System pilots being tripped, or the remote block and bleed valve on the ESD control console being activated, the flowline sidearm valve will close.

7.2.2 The APR-N tester valve should be closed immediately by bleeding off the annulus pressure. At the same time close the choke manifold inlet valve.

7.2.3 COMPLETELY CHECK SYSTEM STATUS.

7.2.4 If the fault is rectified, re-initiate the start-up procedure detailed in Section 5. Ensure that the flowline between the choke manifold and the flowline failsafe valve is pressured up to reduce the differential across the flowline valve on re-opening. This can be accomplished by using the glycol injection pump. The pressure should be increased to wellhead closed-in pressure and the flowline valve can then be opened.

7.2.5 If it is necessary to terminate the test, reverse out the gas column as soon as possible following the procedures outlined in Section 7.1.

8. Contingency Measures

8.1 Surface Leak

8.1.1 In the event of a leak developing in the surface system, or relief valve lifting during the flowtest, the well should be closed-in at the flowhead flowline hydraulic valve. If shutdown has not been initiated by the Emergency Shutdown System, the valve should be shut manually.

8.1.2 Immediately following shutdown, the APR-N tester valve should be closed by bleeding off annulus pressure via the drilling choke manifold or at the remove bleed off point at the 10M cement pump. The testing choke manifold inlet valve should be closed.

8.1.3 If the test may be safely continued after the plugging or leak has been rectified, repressure test the system as necessary.

CHECK COMPLETE SYSTEM STATUS PRIOR TO RECOMMENCING TEST .

8.1.4 Open the hydraulic valve as described in 7.2.4. Follow test start-up procedure from Section 5.

8.1.5 If the test is to be terminated, rectify plugging or leak to extent necessary to allow gas to be bled off by-passing heater and separator while reversing out. Re-pressure test as necessary.

8.1.6 Follow reversing out procedures from Step 7.1.

8.2 Downhole Leak

8.2.1 A leak in the test string itself will become apparent either from an increase or decrease in annulus pressure or gas flowing through the riser mud.

8.2.2 If a minor leak is indicated, isolate the Emergency Shutdown System pilots and choke back the well at the choke manifold until WHFP approaches 7000 psi. Close-in the well simultaneously at the APR-N tester valve and at the choke manifold inlet valve. If the leak is confirmed the test should be terminated following the normal procedures from Step 8.1.

8.2.3 If a more significant leak occurs close-in the well immediately at surface. Maintain the annulus full and activate the APR-M safety/ reversing valve as quickly as possible (this may have already occurred). Once the annulus is full commence reversing-out procedures as from step 7.1. Ensure that all mud in the tubing is fully conditioned prior to pulling the test tools. Care should be exercised when pulling the tools since the leak may have washed out the pipe body or a connection thus weakening the string.

8.3 Hydrogen Sulphide

8.3.1 Air breathing apparatus will be available at the rig floor and separator area. Essential personnel are required to be familiar with this equipment prior to start of testing.

8.3.2 The presence of H_2S may be indicated in the mud or RFT recoveries prior to the test. During the test itself, samples will be taken and checked for H_2S using detector tubes as soon as possible following gas to surface, and subsequently throughout the flow period. (see section 9).

8.2.3 If H_2S levels in excess of 20 ppm are detected in the produced gas, the BP Drilling Supervisor and Rig Manager should be warned. Reference should be made to Section 7 of the BP Norway Safety Regulations.

8.3.4 Rig personnel should be directed to keep clear of areas downwind of the test equipment and pipework.

8.3.5 If H_2S is detected around the rig, the BP Drilling Supervisor and Rig Manager should be informed and the level checked immediately using detector tubes. If the presence of H_2S is confirmed, the well should be closed in immediately at surface any leaks in the system traced and remedied. Air breathing apparatus should be worn while checking H_2S levels around the rig, locating leaks etc. if H_2S levels in the produced gas exceed 20 ppm.

8.3.6 If the level of H_2S on the rig should persist, then the test should be terminated, and if necessary the test fluids bullheaded back into the formation.

8.4 Deteriorating Weather

8.4.1 The test string will only be run once acceptable weather has been forecast for the expected duration of the test. Once the tools have been run, rapidly deteriorating weather may necessitate delay or termination of the test.

8.4.2 If the weather deteriorates while running the test string, the hang-off tool should be made up, and, if necessary, the string hung-off.

8.4.3 Should it prove necessary to unlatch the string at the SSTT during testing, every effort should be made to first reverse out the contents of the tubing, following the procedures from Step 7.1. If time permits after reversing-out, the SSTT should be pulled and the hang-off tool run.

8.5 Emergencies

In general, an emergency shutdown will follow procedures described above. Should circumstances dictate that other methods of closing-in are necessary, the following alternatives exist:

8.5.1 Surface Valves

a) Manually close one of the surface valves.

b) Flopetrol Flowhead
Manually initiate closure of the hydraulically-operated flow-line wing valve using the Emergency Shutdown System panel or the pilots.

8.5.2 Flopetrol Subsea Test Tree

The ball and flapper valve assembly can be closed by bleeding off control line pressure.

8.5.3 Halliburton Tools

a) APR-N Tester Valve
Bleed-off annulus pressure from standpipe manifold or remote bleed-off.

b) APR Safety/Reversing Valve

Increase annulus pressure to approximately 2500 psi (this will close safety valve, and open integral reverse circulating ports) reverse circulate string contents.

c) RTTS Safety/Reversing Valve

Lift string to extend upper 3 slip joints and lower slip joint and rotate pipe 4-5 turns to right (this will open reverse circulating ports). Reverse circulate string contents.

8.5.4 Bullheading

Pressure up the kill line to WHCIP against the flowhead kill line wing valve. When the pressure has equalized, open the kill line wing valve. Pressure up the annulus to ca. 1500 psi to open the APR-N valve. Bullhead the string volume back to the formation with the 15M cement pump.

9. Sampling Requirements

Table 1 outlines the sampling requirements.

9.1 Pressurised Surface Samples

At least six (6) sets of separator condensate and gas recombination samples should be taken per test. The condensate will be taken in 630 c.c. sample bottles, and the gas in 20 litre Gerzhat-type bottles. Procedures shall be in accordance with API recommended practice. This sampling should commence as soon as stable flowing conditions and rates have been established. A BP Environmental Hygienist will monitor the service company personnel appointed to carry out the sampling, and will be particularly concerned with the use of mercury. Operations regarding mercury will be carried out in accordance with the BP Code of Practice (Appendix 2).

9.2 Atmospheric Condensate Samples

The following samples will be taken at the separator condensate outlet line during the flow period.

i) One 1 litre sample every 15 minutes for 2 hours, with one sample every 30 minutes taken thereafter.

ii) Six 10 litre jerry cans.

iii)Four 45 gallon drums of condensate.

9.3 Water cushion samples

Water cushion samples will be taken at the data header every 5 minutes until sump mud reaches surface. The samples will be taken in 1 litre plastic containers. After sump mud has reached surface, no further sampling will be required at the data header. If formation water is produced, these samples will be taken both at the data header and separator at 15 min intervals. Condensed water out of the hydrocarbon streams will be sampled at the separator water outlet line.

9.5 Gas

When the well is stable and flowing through the separator, gas analyses will be required.

1) By Exlog chromatograph
A sample is required to be taken by the Exlog representative every 30 minutes. Analysis should be carried out using the mud logging unit chromatograph, and will include H_2S CO_2 measurements as well as hydrocarbon concentration.

2) By Draeger and Gastech detector tubes (By service company and BP)
The presence of hydrogen sulphide (H_2S), carbon dioxide (CO_2) and mercaptans (CH_3SH) may be detected in the mud or RFT samples prior to the test. During the test itself, samples will be taken as soon as possible at the following locations and analysed using detector tubes.

i) data header, simultaneously with sampling of the water cushion.

ii) separator gas outlet line, every 15 minutes for the first 2 hours, every 30 minutes throughout test thereafter.

iii) the atmosphere around the separator area and rig floor will be checked using H_2S 'sniffer' detectors as soon as gas comes to surface and at regular intervals thereafter depending on the H_2S content of the gas.

iv) Note also that mercury vapour measurements will be taken around the separator area while the recombination samples are being taken.

29/6-1 SEDCO 707

SCHEMATIC OF PRODUCTION TESTING EQUIPMENT

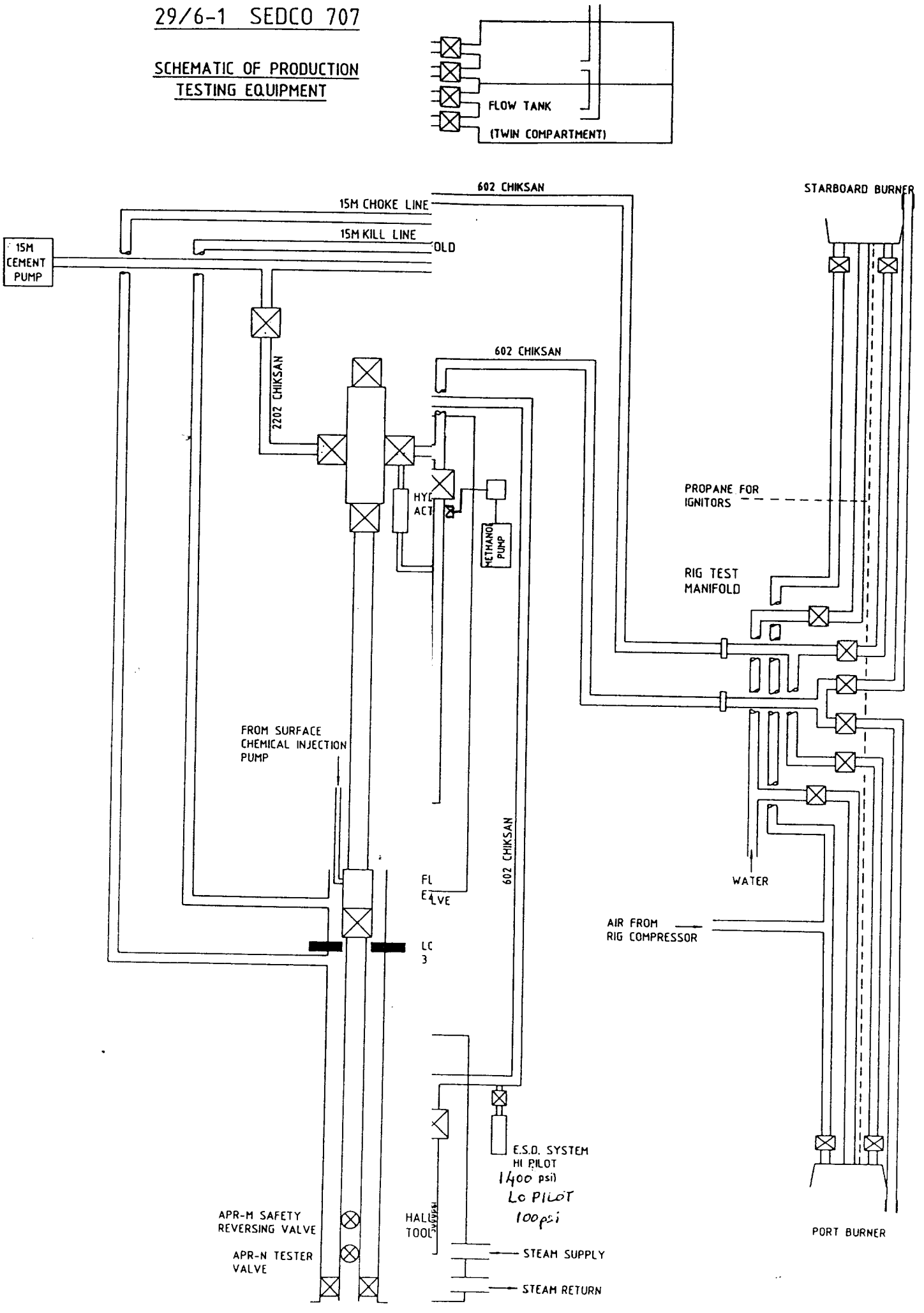
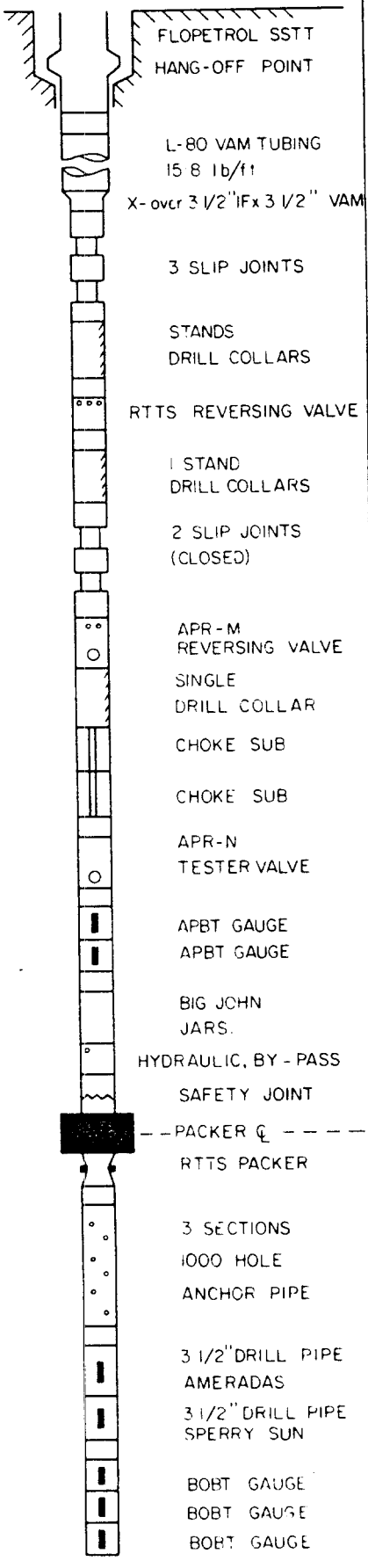


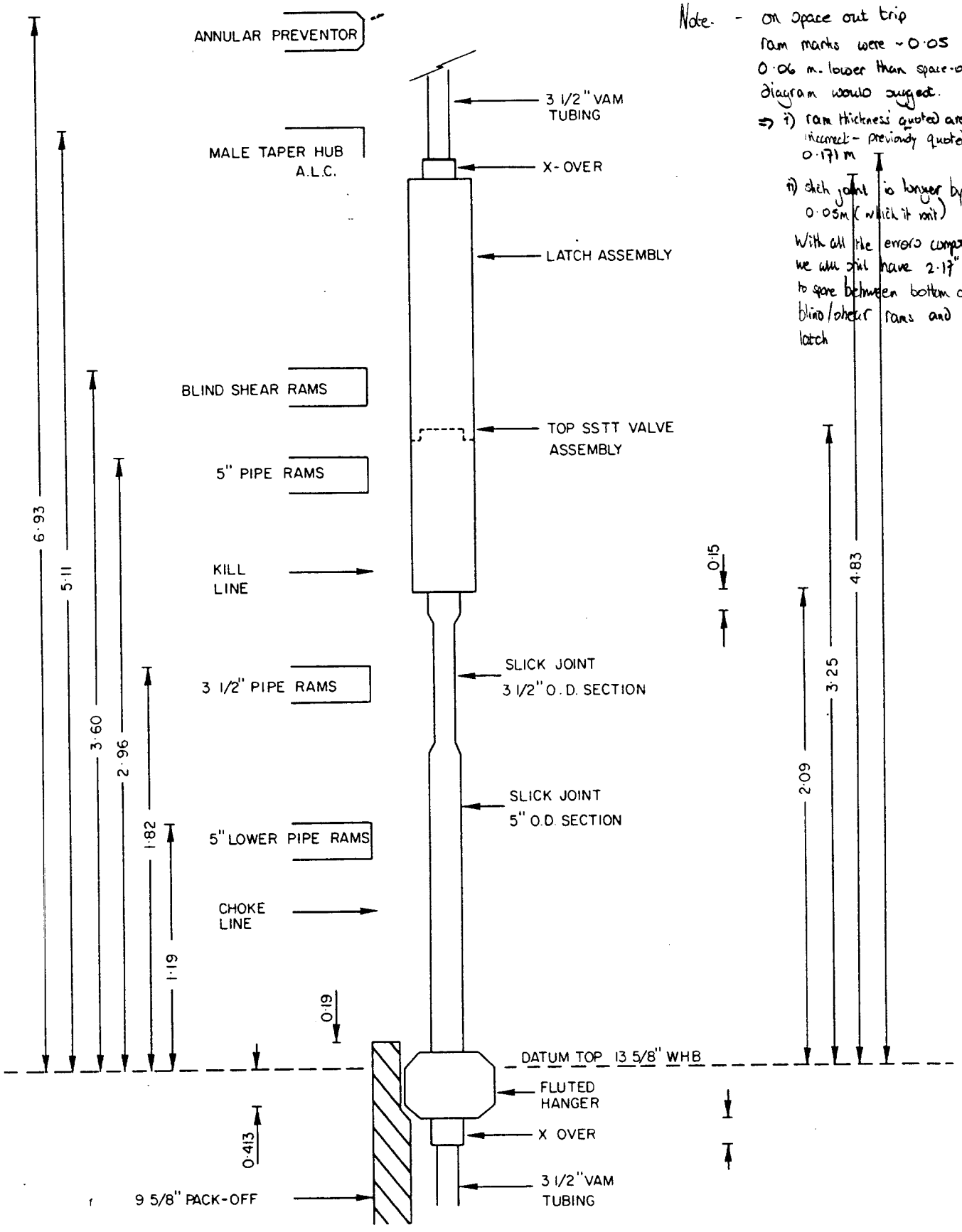
Fig. 1

WELL 29/6-1. HALLIBURTON 4 5/8" APR TOOL STRING FOR USE INSIDE 7" LINER.



	BOX	PIN	MAX O.D.	MIN I.D.	LENGTH	DEPTH MBRT
DATUM TOP 13 5/8" WHB						
FLOPETROL SSTT HANG-OFF POINT						
L-80 VAM TUBING 15.8 lb/ft						
X-over 3 1/2" IF x 3 1/2" VAM						
3 SLIP JOINTS						
STANDS DRILL COLLARS						
RTTS REVERSING VALVE						
1 STAND DRILL COLLARS						
2 SLIP JOINTS (CLOSED)						
APR-M REVERSING VALVE						
SINGLE DRILL COLLAR						
CHOKE SUB						
CHOKE SUB						
APR-N TESTER VALVE						
APBT GAUGE						
APBT GAUGE						
BIG JOHN JARS.						
HYDRAULIC, BY-PASS						
SAFETY JOINT						
PACKER ℄						
RTTS PACKER						
3 SECTIONS 1000 HOLE ANCHOR PIPE						
3 1/2" DRILL PIPE AMERADAS						
3 1/2" DRILL PIPE SPERRY SUN						
BOBT GAUGE						
BOBT GAUGE						
BOBT GAUGE						

Fig 2



Note. - on space out trip ram marks were ~0·05 0·06 m. lower than space-out diagram would suggest.

⇒ i) ram thickness quoted are incorrect - previously quoted 0·171 m

ii) stick joint is longer by 0·05m (which it was)

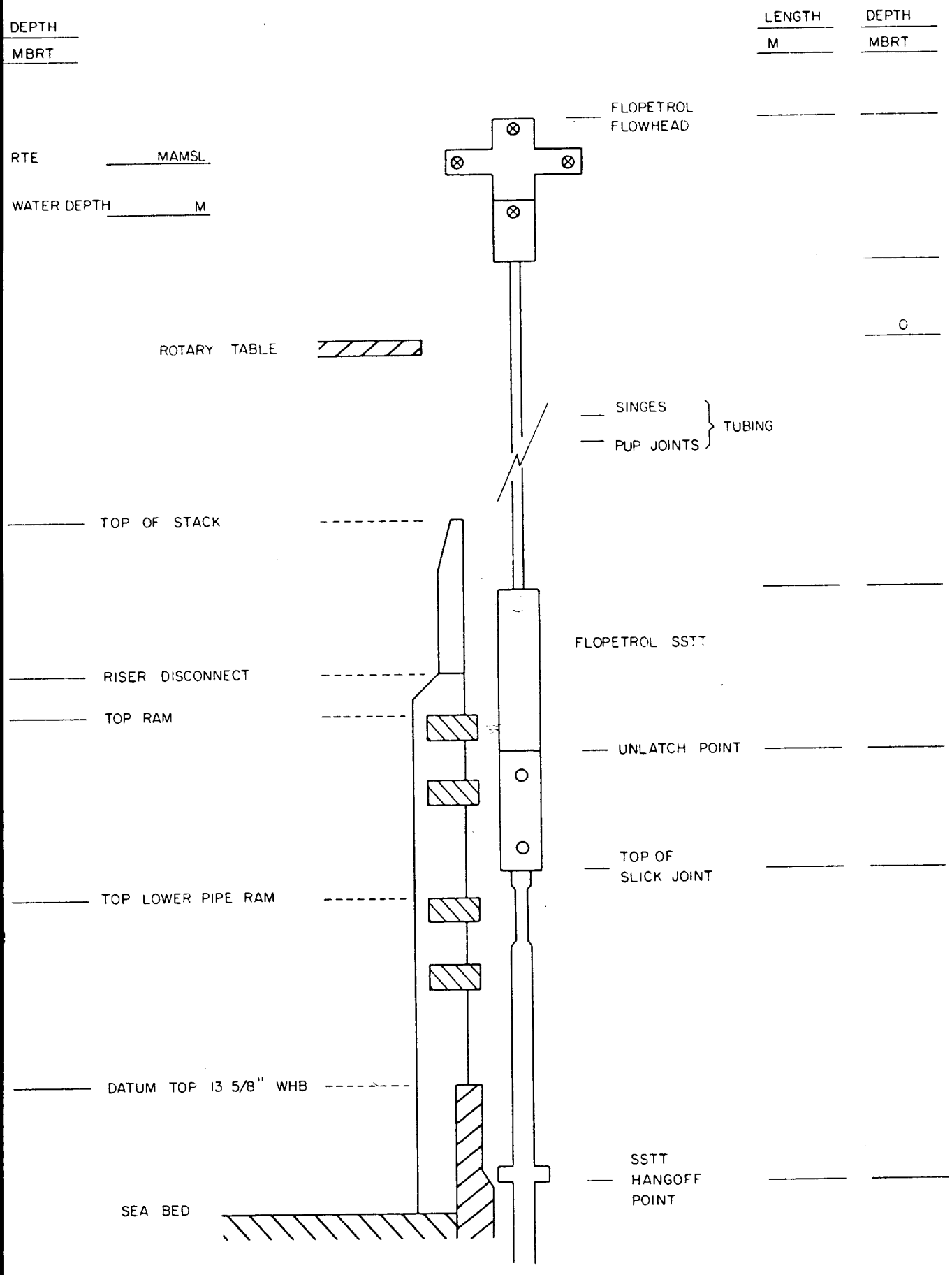
With all the errors compounded we will still have 2·17" to spare between bottom of blind/shear rams and latch

DIMENSIONS IN METRES

RAM HEIGHT 0·235 M (0·171m?)

WELL 29/6-1 SEDCO 707. CONFIGURATION OF FLOPETROL 15M SUBSEA TEST TREE IN 15M BOP STACK TREE LANDED INSIDE 9 5/8" PACKOFF.

Fig. 3



WELL 29/6-1 SEDCO 707
SURFACE/SUBSEA SPACE-OUT WHILE TESTING

Fig. 4.

Appendix 1

Handling of Chemicals

CHEMICAL PROPERTIES

C.1 The chemicals to be used for hydrate inhibition are somewhat dangerous. Attached are outline chemical properties, along with advice on safe handling, and instructions for storage from BP stores manual.

Methanol

C.1.1.1 METHYL ALCOHOL - General Information

Synonym: methanol.
Clear colorless very mobile liquid.
Formula: CH_3OH.
Mol wt: 32.04 bp: 64.8°C, lel = 7.3%, uel = 36. %, fp: -97.8°C, flash p.: 52°F, d: 0.7913 at 20°/4°C, autoign. temp.: 867°F, vap. press.: 100 mm at 21.2°C, vap. d.: 1.11.

Hazard Analysis
Toxic Hazard Rating:

Acute Local:	Irritant 1:	Inhalation 1	
Acute Systemic:	Ingestion 3;	Inhalation 2;	Skin Absorption 2.
Chronic Local:	Irritant: 1;	Inhalation 1;	
Chronic Systemic:	Ingestion 2;	Inhalation 2;	Skin Absorption 2.

Toxicology:

Methyl alcohol possesses distinct narcotic properties. It is also a slight irritant to the mucous membranes. Its main toxic effect is exerted upon the nervous system, particularly the optic nerves and possibly the retinae. The effect upon the eyes has been attributed to optic neuritis, which subsides but is followed by atrophy of the optic nerve. Once absorbed, methyl alcohol is only very slowly eliminated. Coma resulting from massive exposures may last as long as 2 to 4 days. In the body the products formed by its oxidation are formaldehyde and formic acid, both of which are toxic. Because of the slowness with which it is eliminated, methyl alcohol should be regarded as a cumulative poison. Though single exposures to fumes may cause no harmul effect, daily exposure may result in the accumulation of sufficient methyl alcohol in the body to cause illness.

Severe exposures may cause dizziness, unconsciousness, sighing respiration, cardiac depression, and eventually death. Where the exposure is less severe, the first symptoms may be blurring of vision, photophobia and conjunctivitis, followed by the development of definite eye lesions. There may be headache, gastrointestinal disturbances, dizziness and a feeling of intoxication. The visual symptoms may clear temporarily, only to occur later and progress to actual blindness. Irritation of the mucous membranes of the throat and respiratory tract, peripheral neuritis, and occasionally, symptoms referable to other lesions of the nervous system have been reported. The skin may become dry and cracked due to the solvent action of methyl alcohol.

Methyl alcohol is a common air contaminant. It is used as a food additive permitted in foods for human consumption.

Fire Hazard:	Dangerous, when exposed to heat or flame.
Spontaneous Heating:	No.
Explosion Hazard:	Moderate, when exposed to flame.
Disaster Hazard:	Dangerous, upon exposure to heat or flame; can react vigorously with oxidizing materials.
Storage:	Segregation in separate store away from naked lights and any source of heat.

Emergency Action:

Spillage:	Stop engines, no naked lights, use only explosion-proof electrical equipment. Shut off leak if possible, drench with water, warn of explosion hazard.
Fire:	If exposed to fire keep containers cool by spraying with water. Extinguish with water spray, dry chemical, alcohol, CO_2 or carbon tetrochloride spray.
First Aid:	If the substance has got into the eyes, immediately wash out with plenty of water for several minutes. Remove soaked clothing immediately. Obtain medical treatment for anyone with symptoms of swallowing or contact with eyes.

C.1.1.2 METHANOL - extract from BP Chemical Hazards Directory

OTHER NAME - (Methyl alcolhol)

Colourless, volatile liquid miscible with water.

TLV 200 ppm - Boiling Point 65°C

Inhalation of high concentrations of vapour may cause dizziness, stupor, cramps and digestive disturbance. Lower concentrations may cause headache, nausea, vomiting and irritation of the mucous membranes. Dangerous to the eyes. Ingestion damages the central nervous system particularly the optic nerve (causing temporary or permanent blindness) and injures the kidneys, liver, heart and other organs. Unconsciousness may develop after some hours and this may be followed by death. Skin contact may cause dermatitis.

1. Remove the casualty out of the danger area after first ensuring your own safety.
2. Loosen clothing. Administer oxygen.
3. If the casualty is unconscious, place in a face down position and watch to see if breathing stops.
4. If breathing has stopped, apply artificial respiration by the mouth to mouth method.
5. If the emergency warrants it, remove the patient to hospital and provide information on the gas responsible with brief details of the first aid treatment given.

1. If Methanol has been confined to the mouth, give large quantities of water as a mouth wash. Ensure the mouthwash is not swallowed.
2. If Methanol has been swallowed, give copious drinks of water or milk to dilute it in the stomach.
3. Do not induce vomiting.
4. Arrange for transport to hospital. Provide information to accompany the casualty on the Methanol swallowed with brief details of the treatment given and if possible, an estimate of the quantity and concentration of the chemical consumed.

1. Flood the eye thoroughly with large quantities of gently running water either from a tap or from one of the eye wash bottles provided and continue for at least ten minutes.
2. Ensure the water bathes the eyeball by gently prising open the eyelids and keeping them apart until treatment is completed.
3. All eye injuries from chemicals require medical advice. Arrange transport to hospital and supply information to accompany the casualty on the chemical responsible and brief details of the treatment already given.

1. Flood the splashed surface thoroughly with large quantities of running water and continue for at least ten minutes or until satisfied that no chemical remains in contact with the skin. Removal of splashes with solvents, solutions and chemicals known to be unsoluble in water will be facilitated by the use of soap.
2. Remove all contaminated clothing, taking care not to contaminate yourself in the process.
3. If the situation warrants it arrange for transport to hospital or refer for medical advice to the nearest doctor. Provide information to accompany the casualty on the Methanol and brief details of first aid treatment given.

Highly flammable liquid - Forms explosive mixtures 7.3 36.5%

464°C

Water spray, dry powder, CO2 + Halon.

Monoethylene Glycol

ETHYLENE GLYCOL - General information

C.1.2 Synonyms: 1.2 ethanediol, glycol, ethylene alcohol, glycol alcohol.
Colorless, sweet-tasting liquid. Hygroscopic.
Formula: $CH_2OH\ CH_2OH$
Mol wt: 62.1 bp: 197.5°C, lel = 3.2%, fp: -13°C, flash p: 232°F (C.C.)
d: 1.113 at 25°/25°C, autoign, temp.: 775°F, vap. press.: 0.05 mm at 20°C, vap. d.: 2.14.

Hazard Analysis
Toxic Hazard Rating:

Acute Local:	Low
Acute Systemic:	Ingestion 3
Chronic Local:	Irritant 1
Chronic Systemic:	Ingestion 2

(Lethal dose for man reported to be 100ml)

Toxicology:

If ingested it causes initial CNS stimulation followed by depression. Later it causes kidney damage which can terminate fatally. Very toxic in particulate form.

Fire Hazard:	Slight, when exposed to heat or flame can react with oxidizing materials.
Spontaneous Heating:	No
Explosion Hazard:	Moderate, when exposed to flame.

Countermeasures:

Personal Hygiene:	Section 2.
To Fight Fire:	Alcohol foam, water, foam, carbon dioxide, dry chemical or carbon tetrachloride (Section 7).
Storage:	No special instructions in BP Manual.

Toxic Hazard Rating Code:

NONE: (a) No harm under any conditions;
(b) Harmful only under unusual conditions or overwhelming dosage.

SLIGHT: Causes readily reversible changes which disappear after end of exposure.

MODERATE: May involve both irreversible and reversible changes not severe enough to cause death or permanent injury.

HIGH: May cause death or permanent injury after very short exposure to small quantities.

UNKNOWN: No information on humans considered valid by authors.

Appendix 2

Mercury Control

BP Petroleum Development Ltd., Norway (U.A.)

Code of Practice for the Control of Mercury during Hydrocarbon Sampling

1. Objectives

The aim of the Code of Practice is to protect the health of all rig personnel, and particularly well testing personnel, by controlling their exposure to mercury during welltest sampling and sample transfer operations, and monitoring the absorption of mercury by the individual so that he may be removed from work which exposes him to mercury before his health has been affected.

2. Operations Having A High Risk Of Mercury Exposure

The Code applies to all work which exposes persons to mercury in any form such that it may be ingested, inhaled or otherwise absorbed. The rigsite operations considered to be high risk are;

A) Transfer of samples from bottom hole samplers.

B) Transfer of samples from the test separator.

C) General mercury handling operations.

3. Code Of Practice

1. The Norwegian Petroleum Directorate (Seksjon for Arbeidervern og Arbeids Miljø) will be informed of the commencement and termination of any well test operations which involves the use of mercury for hydrocarbon sampling.

2. Sampling and sample transfer operations will be undertaken by at least two members of the service company test team throughout the test operations. The individual will provide a certificate proving that he has had a urine sample screening test not more than one month prior to the start of sampling operations, and that the mercury content within his body does not exceed the required limits.

3. All service company personnel will have been given adequate information and training in the handling of mercury. Service company personnel will use the equipment and facilities provided by their own company and the Operator, and will co-operate at all times with the Operator in restricting contamination of any areas by mercury.

4. The sampling and transfer operations will be supervised by the BP Wellsite Petroleum Engineer, who will be fully conversant with the procedures involved, and will carry the BP Safety Kit (see Attachment) for use in dealing with large mercury spills. He will have the authority to terminate any operation involving the use of mercury in the event of unsafe practice.

5. Shipping containers holding sample transfer equipment and mercury will be correctly stowed and will only be accessible by authorised service company and Operator personnel.

6. Protective clothing, and clothing storage should be provided by the service company along with suitable disposal bags for the clothing following the operation. Changing facilities will be provided by the Operator. Emergency protective clothing will be provided by the Operator.

7. Air monitoring will be carried out on a regular basis by service company and Operator personnel to check that the mercury in air standard is not exceeded. The mercury vapour concentration in air should not normally exceed 0.5 mg/m^3.

8. Food and drink are not to be consumed in any place liable to be contaminated by mercury.

9. Personal hygiene will be maintained, and the use will be made of the washing facilities provided.

10. The transfer of samples will be undertaken using an adequate, purpose-built sample transfer bench. This unit will be sited in a well ventilated area of the installation.

11. All unauthorised persons will be kept clear of sampling or sample transfer operations at all times.

12. Sufficient time will be allowed for the rigging-up, dismantling and cleaning of equipment using or containing mercury.

13. Regular biological testing will be carried out to detect any absorption of mercury before clinical effects become evident.

Urine samples will be taken from the person designated to undertake sample transfer operations at the following times;

i) When the person arrives on board the rig.

ii) Each morning throughout the test period.

iii) A final test before departure from the installation.

14. Following the test operations the Operator will forward a report to the NPD as soon as possible and not more than 3 weeks after sampling has been completed. The report will give the following details;

i) Name of involved personnel, address and date of birth.

ii) Name of installation, block and well number.

iii) Description of the work which has involved the use of mercury, duration, reports of spillage, risk of exposure etc.

iv) Name of appointed BP representative.

v) Urine specimen check list.

vi) Urine analysis from Yrkeshygienisk Institutt Lab.

Urine specimens, check list, and a copy of the service company report form should be forwarded by the Operator to;

Yrkeshygienisk Institutt Lab
P.O. Box 8149
Oslo 1

Tel. (02) 46 68 50

Attachment

Contents of BP Safety Kit for Mercury Spillage

This kit will be held by the BP representative responsible for witnessing sampling and sample transfer operations.

The safety kit will contain the following equipment items;

i)	Dust mask for mercury	- 12
ii)	Gas mask	- 1
iii)	Gas mask filters	- 3
iv)	Draeger Multi Gas Detector Pump CH304	- 1
v)	H_2S detector tubes 50-600 ppm CH29801	- 20
vi)	Mercury vapour detector tubes CH23101	- 20
vii)	Rubber gloves (prs)	- 3
viii)	Protective coveralls	- 3
ix)	Urine sample bottles	- 30
x)	Sheet containing details of mercury toxicity	- 1
xi)	BP Mercury Exposure Control Form	- 10 copies
xii)	Copy of Code of Practice for Control of Mercury during Hydrocarbon Sampling	- 1