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NORWEGIAN SOCIETY OF CHARTERED ENGINEERS

NORWEGIAN SOCIETY FOR OIL AND GAS MEASUREMENT

NORTH SEA FLOW MEASUREMENT WORKSHOP 1993
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Remote Sampling

by

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BACKGROUND:

Embla is the last field development by Phillips Petroleum Company Norway in Norwegian sector of the North Sea. It is situated south of Ekofisk, near Eldfisk, on block 2/7. The reservoir is found appr. 5000 m below seabed in Jurassic sand. It is a high temperature, high pressure field. Production started April this year.

Embla is a relative small field. Consequently it was decided to use available facilities on nearby platforms, Eldfisk A/FTP, for separation and processing, with only one small unmanned and remote operated platform located on Embla. 8 producing wells were originally planned for in phase 1 of the development.

During normal operation, production from the wells are combined, and transported to Eldfisk A without any processing on Embla. For allocation and reservoir evaluation purposes, a test seperator is installed. Each well was intended to be tested at least once every month for allocation purposes. Samples of oil and gas should be collected manually during testing. Consequently it would be necessary for qualified sampling personnel to travel to the platform by helicopter 8 times every month to collect samples. In addition to sampling personnel, a minimum safety crew of 7 persons, also would have to go to the platform at the same time.

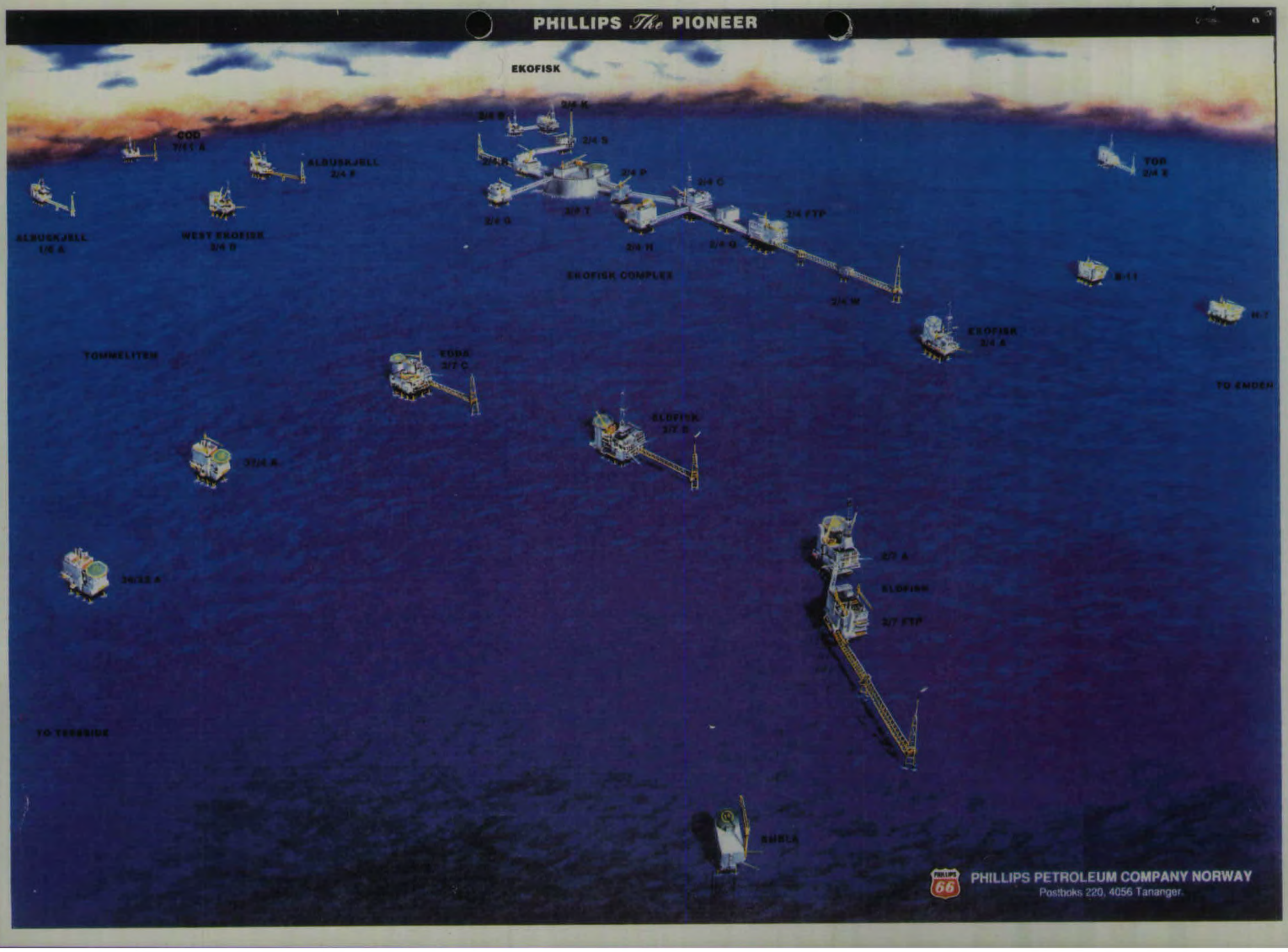
Based solely on economics, good reasons to look into some way of remote sampling were obvious.

DEVELOPMENT OF "RAS":

Mid 1990 personnel from PPCoN were invited to Proserv for a demo of their new sampling system, PRO-SAMP. It consisted of a Titanium sample cylinder with piston and mixing device. The piston position was detected from outside by means magnetic field action on a non contact lance position detector, MAGPOS. A LCD display showed the sampled volume at any time. Later the system was developed to show the piston location graphically on a monitor.

Late 1991 PPCoN decided to go for remote sampling on Embla. Potential vendors of equipment were contacted, but none were able to deliver "turn key" equipment to PPCoN specifications. In the mean time Proserv had further developed their PRO-SAMP system, and discussions initiated on even further development of this to a 10 cylinder remote operated sampling system. Fall 1992 a development contract was signed.

The original system was designed to fill each of 8 cylinders once, to a predetermined volume. Prior to this, the bypass loop should be flushed at a preset time and flow. No options for emptying and refilling was planned at this stage. The cylinders should be changed once every month.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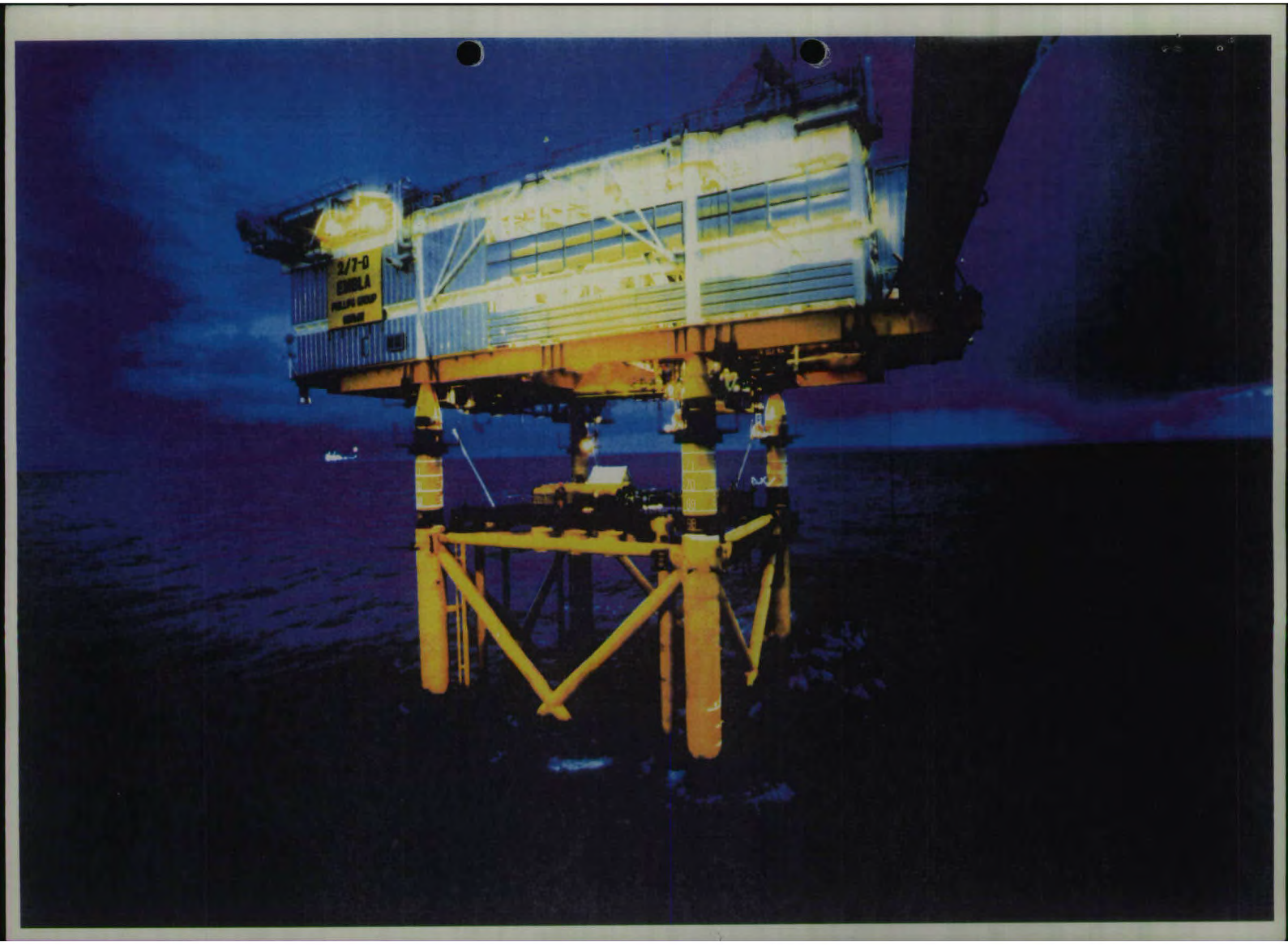
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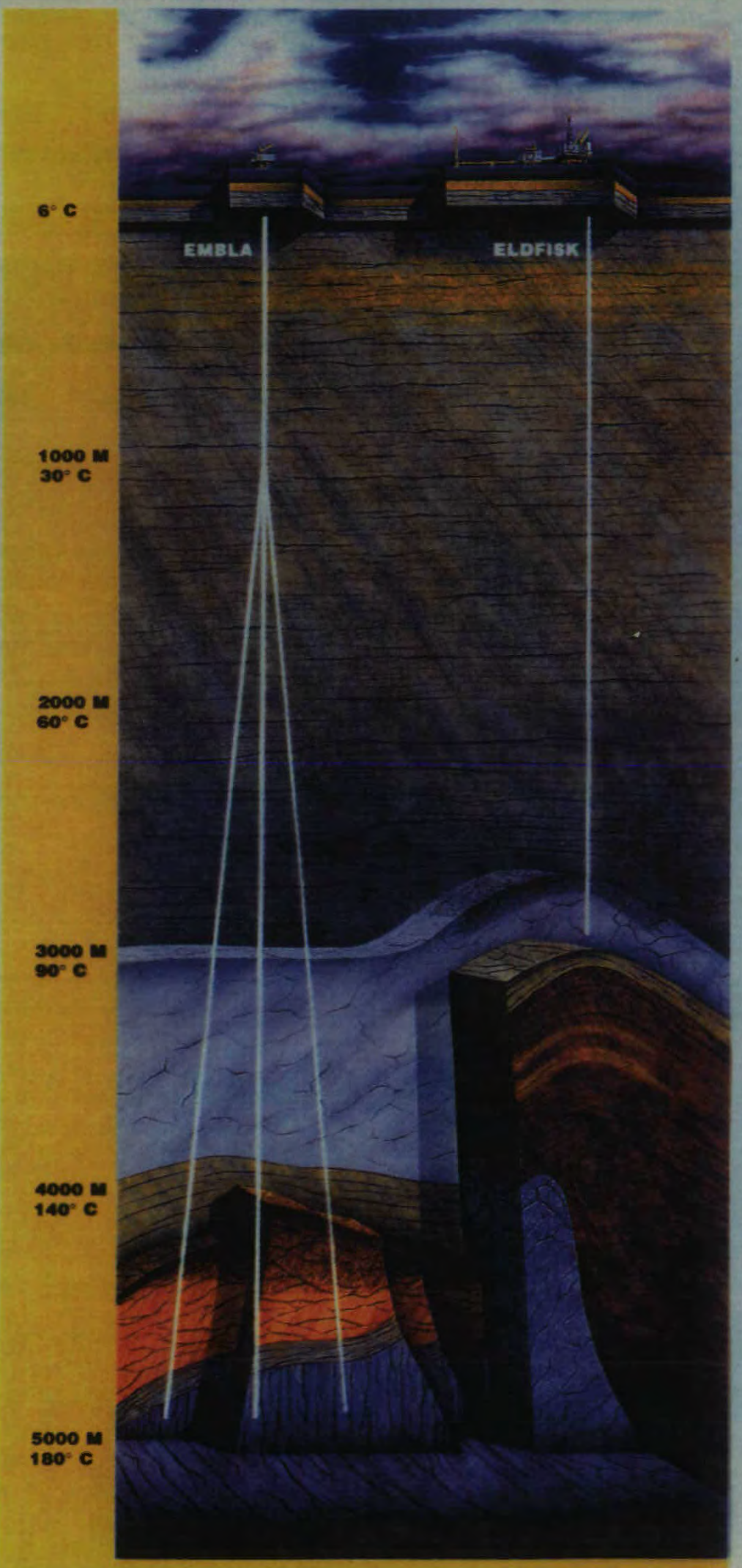
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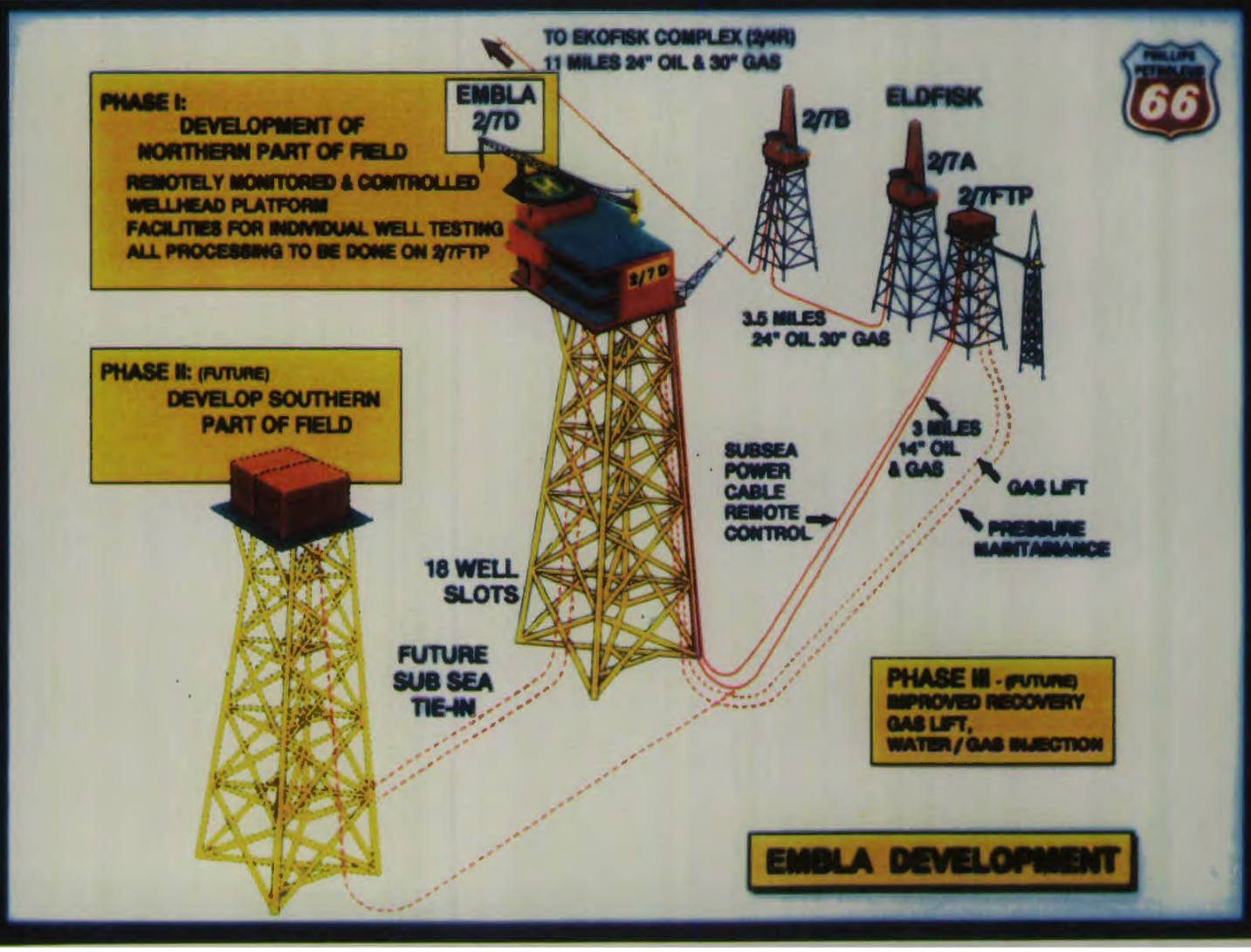
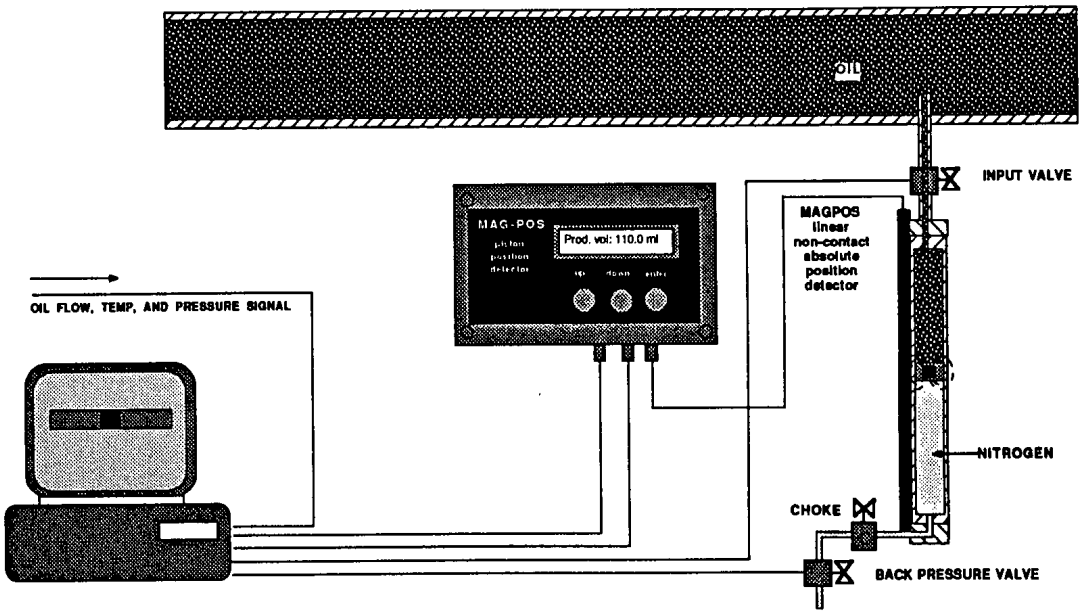


BASIC PRINCIPLE PROSERV / INFOTRONICS
REMOTE AUTOMATIC SAMPLING



The project progressed smoothly until April 1993. An unacceptable leak on the magnetic operated solenoid valves resulted in a "snow ball" effect on the design. The computer program, sampling and report options, have been modified and improved continiously. Future modifications can be performed from any place, also onshore, via modem.

A final functional test was performed June 24. Prior to this, the equipment was throughly tested, using pressurized crude oil and real flow data. Shipment to Embla was delayed to late August due to specification based hardware modifcations. Offshore equipment installation and computer communication was completed mid September.

First sampling from onshore via modem was performed Sept. 23.

ADVANTAGES USING "RAS":

Improved sample quality:
Good, and reproduceable quality is a requirement for samples used for allocation purposes. Through an automatic system, human errors and individual variations are eliminated.

Reduce operational costs:
Helicopter rental and labor time expences related to manual sampling are eliminated.

Safety improvement:
High pressure, high temperature sampling of this nature might involve safety hazards, especially when performed by personnel with limited experience. This is eliminated.

Helicopter shuttling to unmanned platforms is in general reduced to a minimum for safety reasons.

Tools and spare parts on an unmanned platforms are normally limited. Unforeseen problems might in certain cases lead to procedural hazardous short cuts in manual sampling.

Sampling time flexibility:
Sampling can be performed at any time, preset or manually initiated from remote location.

Reduce training costs:
A high number of personnel is involved in sampling on different platforms. To ensure proper sampling, training time has been a considerable "expense". The intention is to reduce number of people involved to a minimum.

SYSTEM DESCRIPTION:

1) Sampling Probe:
Standard probe, collecting sample from center of pipe. Sampling point is located on vertical pipe section upstream metering. Probe is fitted with shut off valve, and T-piece for manual spot sampling.

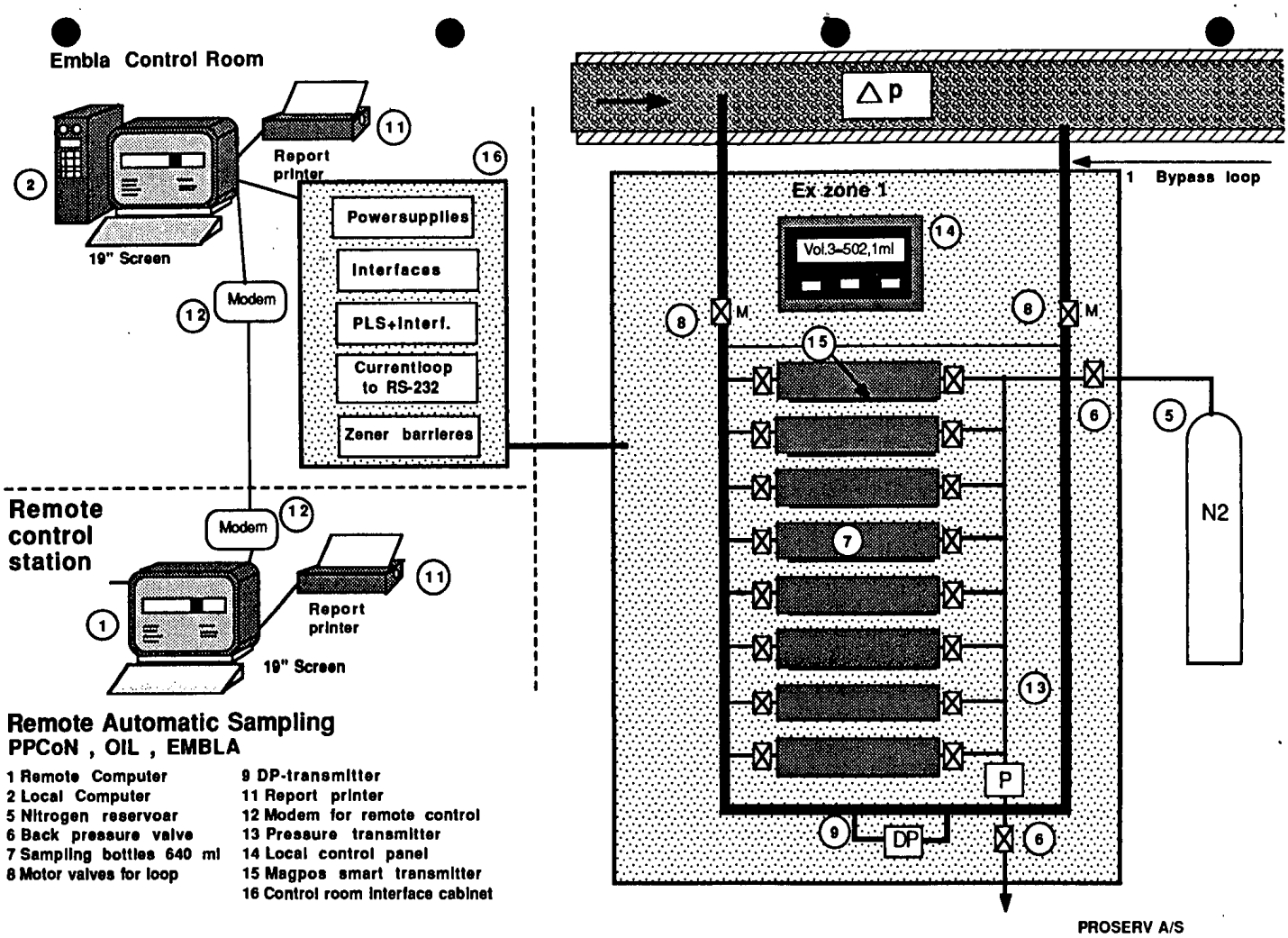
2) Bypass Loop:
A 3/8" Monel 400 tubing connected to the sampling probe. This tube transfer liquid through sampling cabinet, and terminates on low pressure side of production regulating valve. Choke valve is located at the outlet from the sampling cabinet. Shut off valve is in addition located on return point.

3) Sampling Cabinet:
A 316 SS cabinet sized 2250mm*1500*600mm (H*W*D) equipped with full open doors in front and removeable walls. The lower and largest part of the cabinet is occupied by sampling hardware. The seperated top section is reserved for signal processing units and connection boxes. The lower section contains:

Sample Cylinders:
In this version, eight 640 cc floating piston sample cylinders are located horisontally above each other. The cylinders are standard design PROSERV mod. S1-690-64 made of Titanium, with magnetic core pistons. Each cylinder is equipped with gauges, manual valves, rupture disc and quick connectors. On location the cylinders rest on a "tray", and are secured by a quick locking metal strap. The counterparts to the quick connectors on the sample side of the cylinders are permanently mounted. This ensures that the cylinders are installed in same position after change out, thus eliminating repositioning of piston indicator lances.

Piston Detectors:
For continious detection of piston, INFOTRONC MAGPOS Linear non-contact position detector mod. 444 has been used. These are mounted on the tray walls behind the cylinders. When calibrated, the volume on the sample side is determined with an accuracy of 0.1 cc. Small deviations in sample cylinder location (after change out) are easily corrected for.

Cylinder Valves:
Two magnetic operated solenoid valves with metal seats located downstream each end of all cylinders. The valve on the inlet side is located close to the cylinder, on a 1/4" SS tubing. The preload gas discharge valve is located downstream a h.p. flexible tubing. Magnetic operated valves were selected due to requirement of fast response.
Each cylinder is also equipped with manually operated valves. These are normally open when the cylinders are installed in the cabinet.

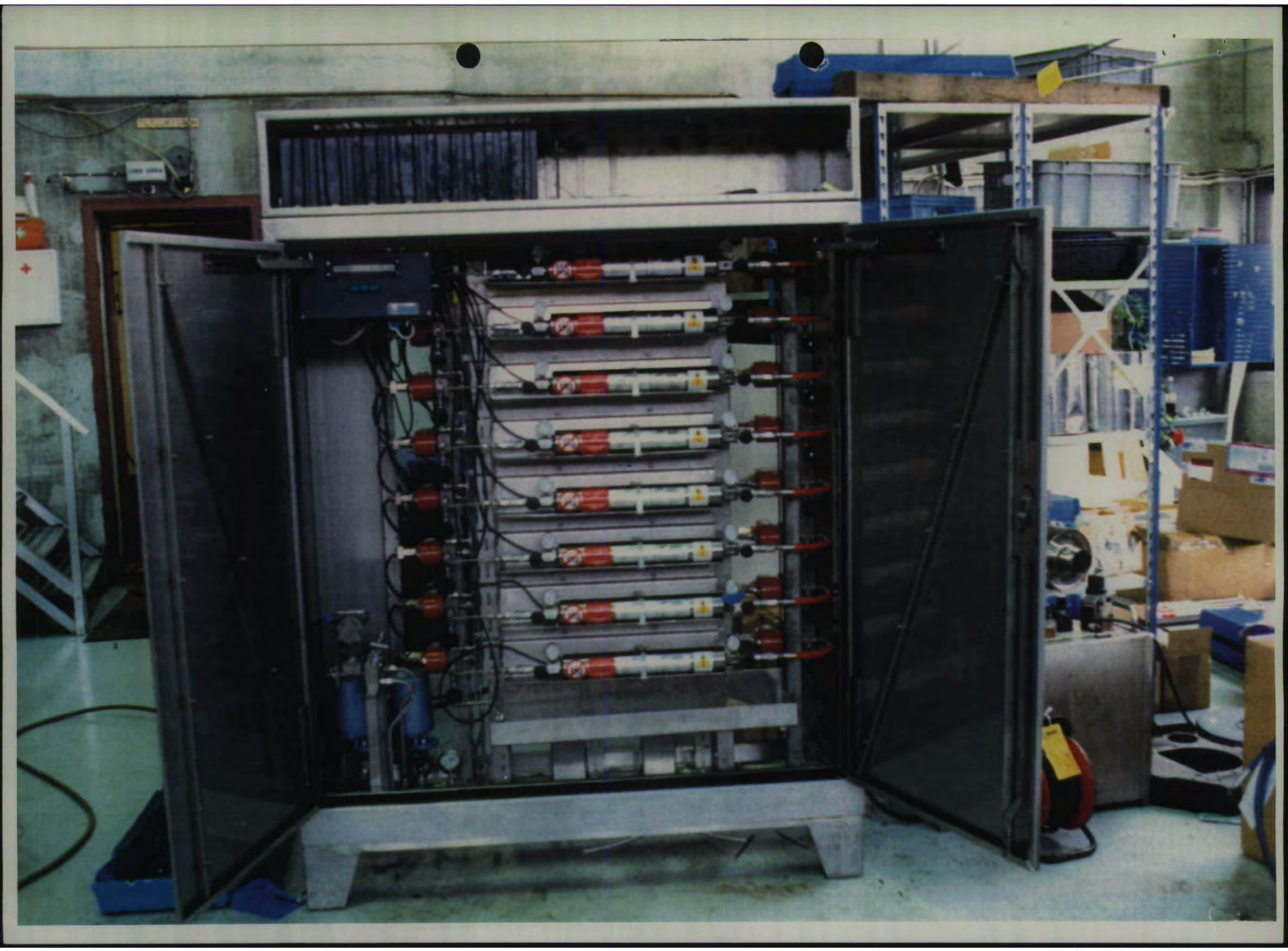


Remote Automatic Sampling

PPCoN , OIL , EMBLA

1 Remote Computer
2 Local Computer
5 Nitrogen reservoar
6 Back pressure valve
7 Sampling bottles 640 ml
8 Motor valves for loop
9 DP-transmitter
11 Report printer
12 Modem for remote control
13 Pressure transmitter
14 Local control panel
15 Magpos smart transmitter
16 Control room interface cabinet

PROSERV A/S
INFOTRONICS A/S



Bypass Loop Valves:
Two electrically motor actuated ball valves are installed on inlet and outlet of the bypass loop, inside the cabinet. These will open and close for flow through the bypass prior to and during sampling.

Differential Pressure Transmitter:
A DP-transmitter measures the pressure drop between inlet and otlet of the bypass loop in the cabinet. This is used as a indirect measure of the flow rate in the bypass loop.

Total Pressure Transmitter:
Purpose of this transmitter is to measure the the pressure on the nitrogen side of each cylinder, and monitor backpressure when sampling. A secondary function is to detect abnormal friction between piston and cylinder. (High dp sampling side vs. preload side.)

Sampling Valve:
This magnetic operated fast response valve is continiously operating during sampling. It bleeds off nitrogen in small portions, thus creating a smooth piston movement during sampling.

Local Control Panel:
From this push buttom box, all operations normally executed from the PCs can be performed locally. It is normally not used for sampling.

4) Nitrogen Reservoir:
Two 40 l cylinders with pressure reduction valves. Through a seperate magnetic operated valve, nitrogen at preset pressure is delivered to the sampling cylinders.

5) Interface Cabinet:
This is located on Embla, in the control room. It has connections to the sampling cabinet and the local computer. It contains power supplies, PLS, Zener barriers, relay switches, over voltage protection and communication interfaces.

6) Local Computer:
This is located in Embla control room, and is the main computer for the system. It contains a communication modem and the traditional three hardware parts, PC, screen and printer.

At power on, the system boots automatically. The PC executes the config.sys and autoexec.bat and starts up Window with Norton Desktop automatically. Norton Desktop has a program called "Automatic Start-up". The driver routines and sampling program is located in this window.

There are four programs which starts up automatically:

- Net-DDE - for remote communication by modem.
- Omrom Modbus Driver - for communication with PLS and MagPos.
- MC-Link - for receiving data from measurement computer.
- Sampling Program - Intouch (eye Icon)

The system is then ready to receive commands.

7) Remote Computer:

This will normally be located in Ekofisk Center Laboratory, but any location with modem connection to telephone lines is possible. The remote computer station consists of same hardware parts as the local computer.

The remote PC also starts automatically at Pover On. There are only two programs in the automatic start up program group, the Net - DDE and the Sampling Program. The Net - DDE program automatically calls up the sampling computer (local). If connection is not made, the program retries every minute to establish connection. Changing the telephone number and the settings is done by starting up this program seperately and enter the wanted numbers.

All parts of the system are constructed according to regulations for offshore application. In addition the strict specifications for installation on Embla have been followed.

OPERATION:

1) Changing Cylinders:

This has to be done manually. Any, or all cylinders can be removed, or changed out whenever convenient.

The position where a cylinder is not present will automatically be indicated on the PC screen by a missing cylinder symbol. At same time valves and other functions related to this position will be inactivated in safe positions, but sampling can still be performed in other cylinders.

Prior to removing a cylinder, the manual valves on the cylinder must be closed, and pressure in the quick connector bled off. The two quick connector parts are then easily disconnected, and the cylinder removed. The replacement cylinder is connected, and the manual cylinder valves opened. Replacement cylinders should be precharged with nitrogen, but this can also be checked and performed after installation in the cabinet.

2) Sampling Conditions:

Sampling parameters can be entered or changed at any time, from any of the work stations. The only limitation on changing conditions is the authority level of the operator. Lowest levels are not permitted to perform any changes. The values most frequently changed are shown at any time on the screen. Changes are made by pointing at relevant figure and enter new value. Sample volume may also be changed by moving the vertival line crossing the cylinders. Before any sampling is initiated, pistons should be in start position, and the MagPos set to zero (unless a special sampling procedure is wanted). Sampling conditions are printed on the report for documentation purposes.

3) Sampling:

The system permits use of three different sampling procedures:

- **Automatic Sampling initiated by operator.**
- **Automatic Sampling initiated by timer.**
- **Manual Sampling.**

Before any sampling is initiated, the valves on the bypass loop must be opened manually from the computer.

The cylinder which is to be filled, is marked by clicking in the bottle-symbol on the screen. This cylinder is then marked with a white frame. Only the chosen bottle is live and gets updated values on volume and temperature.

Sampling is initiated by a "click" on "Start Sample" button on the screen.
First back pressure is bled down to match inlet pressure. Then smooth sampling according to preset conditions is regulated by the sampling valve.
When selected sample volume is reached, sampling stops, and all valves close.

Sampling may be terminated any time during sampling. Sample volume may also be changed during sampling.

If "Sampling Initiated by Timer" is selected, the predefined time is set by double-clicking on the sample trend window and enter selected date and time. The function is activated by pressing the "Start on Timer" button in the command window.

If "Manual Sampling" is selected, the operator can manipulate all valves directly. The valves are operated by clicking on their symbols, which causes them to toggle on and off. The motor operated bypass loop valves must not be toggled more often than every 30 sec., as this is the time necessary to completely open and close the valves.

If for some reason a sample is rejected, and the cylinder wanted to be reused, the sample can be injected back into the production line. This is done manually from the PC by opening the bypass loop and cylinder valves, and apply nitrogen pressure from the reservoir. The pressure forces the piston to move towards zero position and dump the rejected sample back into the production line. The cylinder is now ready to collect another sample.

The Procedure Manual for Ekofisk Laboratory will be updated with a detailed sampling procedure. This will also include a subroutine for flushing of the transfer lines between the cylinders and the bypass loop.

4) Reports:

The sampling report can be shown on screen by pressing the report window button, and will be printed out on the attached printer.

The alarm messages during sampling may also be printed on this report.

The graph showing the progress of sampled volume, printed on remote location, will normally show a stepwise development. This is a result of communication between the local and remote PCs. In reality the sampling progress is smooth, as can be seen an a report printout from the local printer.

CONCLUSION:

A user friendly system for remote operated oil sampling has been constructed.

It can easily be modified for similar sampling of gas.

Sampling can be performed by personnel without any experience in manual sampling procedures.

The system can be installed on any location with access to telephone lines.

Remote sampling from any location, also onshore, is possible.

Software can be modified or expanded to include other or more options.

Several safety related properties are included in the system.

Oil sampling report

PPCON Embla

Date:	23.09.93
Time:	15:34:29

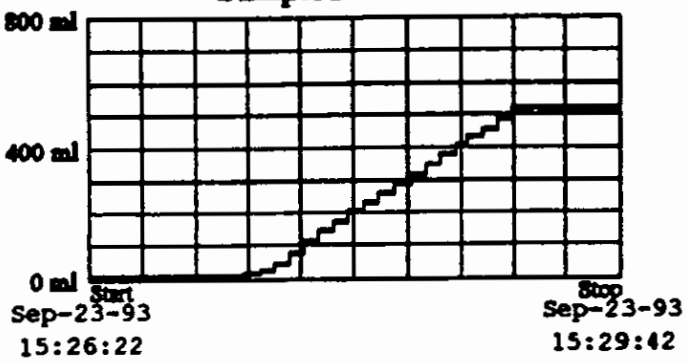
Bottle nr.	8
Serial nr.	TS49-08

Operator entries

Operator: B.Å. BJØRNSEN

Well number: D-20

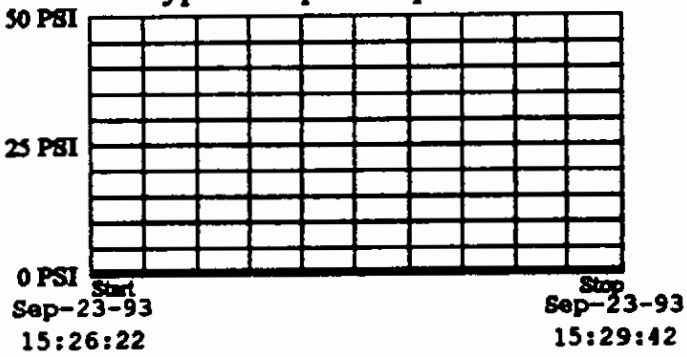
Sampled volume



Process status

Meter pressure:	830	PSI
Meter temperature:	144	°F
Production rate:	11.9	kBPD

Bypass loop delta pressure



Sampling parameters

Sample flow:	5.0	ml/sec
Max. volume:	520.0	ml
Max. time:	200	sec
Grab. size:	10.0	ml

Auto shut off alarm limits

Max. reverse flow:	5.0	ml
Max. loop delta pressure:	50.0	PSI
Min. loop delta pressure:	-5.0	PSI
Min. drain pressure:	10.0	PSI

NOTE: REMOTE SAMPLING FROM INFOTRONICS OFFICE IN SANDNES.

References

[1] Paper presented at the North Sea Flow Measurement Workshop, a workshop arranged by NFOGM & TUV-NEL

Note that this reference was not part of the original paper, but has been added subsequently to make the paper searchable in Google Scholar.