Den norske stats oljeselskap a.s

A report for
DEBRIS SURVEY, Block 6407/1-2
1983

OCEANEERING NORWAY A/S

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REPORT OF DEBRIS

SITE 6407/1-2

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Stavanger 04.09.83
Oceaneering Norway A/S

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ABSTRACT

Oceaneering Norway A/S were contracted by Den norske stats oljeselskap A/S to undertake a debris survey in block 6407/1-2.

The Survey crew mobilised on board M.V. Skandi Ocean in Stavanger on July 19 1983. On completion of the fitting of Syledis and Argo Positioning Systems at 2345, the ship sailed for location arriving at 0030 July 21 1983.

The Sidescan Sonar and Bathymetry Survey of block 6407/1-2 was carried out between 0306 July 26 1983 and 2210 July 29 1983. This showed very clear indications of scaring (possible anchor scars). There was also a sonar contact in the area that could possibly be a lost anchor.

REQUIREMENTS

The requirements for this survey were to carry out a debris Survey, 3Km x 3Km 6407/1-2, the area to be covered with Side Scan Sonar and Echo Sounder. Line spacing generally to be around 175m with 100m near location. Tie lines to be run with 500m spacing. Two extra lines were run to the North, South and East of this area plus three to the West to assist in location of lost anchor.

2.0 SURVEY CONTROL AND COMPUTATIONS

2.1 CALIBRATIONS

No fixed calibration can be applied to the Argo DM54 until it is mobilised upon the vessel and therefore calibrations are undertaken by either baseline crossing or transit fix.

Upon arrival in the survey area the Drilling Rig "Treasure Saga" was contacted and permission was granted to undertake a transit fix.

The co-ordinates given by A/S Geoteam of Norway and confirmed by the Captain of the Treasure Saga were:

Latitude 64 deg 59 min 39.64 sec
Longitude 07 deg 31 min 53.08 sec
Eastings 430733
Northings 7208809

Upon completion of the transit, the 'as found' position of Treasure Saga was : 430 336E 7 208 401N.

From both the co-ordinates of the 'Treasure Saga' and the centre of the transit a lane count was calculated, the difference being applied to give lane corrections and a C-O figure (Delta value) for final correction.

Calculations of Transit Fixes are appended.

A single range from a Syledis Station on the 'Treasure Saga' gave proof of Lane Count and calibrations.

2.2 SHORE STATIONS

All geographical positions are based on International Spheroid (Hayford 1909) European Datum 1950.

All grid positions are based on U.T.M. Grid Zone 32, Central Meridian 9^{o} East.

2.2.1 ARGO STATIONS

a) SKOMVAER

Latitude	67^{o} 24' 35.29" N
Longitude	11^{o} 52' 32.39" E
Eastings	623242
Northings	7480114
Height	16m

b) TRAENA

Latitude	66^{o} 25' 51.72" N
Longitude	11^{o} 58' 09.45" E
Eastings	632454
Northings	7371290
Height	14m

c) SKLINNA (MASTER)

Latitude	65^{o} 12' 07.99" N
Longitude	10^{o} 59' 51.83" E
Eastings	7232653
Northings	593486
Height	32m

d) SLETTRINGEN

Latitude	63^{o} 40' 00.46" N
Longitude	08^{o} 15' 52.54" E
Eastings	7060268
Northings	463601
Height	4m

2.2.1 (Continuation)

Lane width	92.478395m
Frequency	1620.0khz
Propagation Speed	299630km/s

2.2.2 SYLEDIS STATIONS (CALIBRATION STATION)

a) TREASURE SAGA

Latitude	64^{o} 59' 39.64" N
Longitude	07^{o} 31' 53.08" E
Eastings	430733
Northings	7208809
Height	100m

2.3 LOCATION

The co-ordinates of the centre of the area were supplied by Statoil as:

International (Hayfords 1909) Spheroid,
European Datum 1950

64^{o} 47' 50.61" N
07^{o} 02' 23.76" E

U.T.M. Grid, Zone 32, Central Meridian 9^{o} East

406877 E
7187495 N

2.4 GEODETIC PARAMETERS

International (Hayfords 1909) Spheroid, European Datum 1950

$a = 6378388$
$e^{2} = 0.006722670$

2.4 (Continuation)

U.T.M. Grid, Zone 32, Central Meridian 9^{o} East
False Eastings = 500000
False Northings = 0
Scale Factor on Central Meridian = 0.9996
Latitude of Origin = 0
Longitude of Origin = 9^{o} East

EQUIPMENT

3.1 TOWED SENSORS

The Towed Sensors for both Side Scan Sonar and Sub Bottom Profiler were mounted in the O.R.E. Model 136P Tow Fish. This design accommodates four Acoustic Transducers in the forward part of the Fish, and a saddle for Side Scan Transducers plus adjustable cylindrical tail in the rear. The Fish is free flooding with a glass reinforced polyester housing for Hydrodynamic Fairing. Fish connection to the tranceiver is via tow cable, winch and deck cable.

For sub-bottom profiling the model 310 tranceiver has been used, giving both accurate and versatile profile capabilities. Frequencies available are 3.5kHz, 5kHz and 14kHz.

For Side Scan Sonar operation model 160 and 162 tranceivers have been used operating at 100kHz. This provides a topographic picture of the sea floor thus enabling both geological sea floor studies and object locations to be undertaken. The module 160 provides D.C. power and key pulse to the Sub Surface Electronics (Model 162), this Sub Surface Unit drives the transducers and receives the return echoes which are returned, via the Tow Cable, to the surface unit for display on a model 3200/S E.P.C. Recorder.

3.2 ECHO SOUNDER

The Echo Sounder used throughout this survey was a Simrad EA 200 Hydrographic Echo Sounder. The recorder can be either single or multifrequency with sound velocity, draft and heave compensation. Depth readout, direct tracing of scale lines and supplementary information on the recording paper are among the main features of this sounder.

Digital external outputs are available plus facilities for external computer control. A variety of transducers are available, either two single beam or one dual beam transducer can be connected to the LF. tranceiver and for this survey a 38kHz dual beam LF. transducer and 210kHz HF transducer were used.

3.3 POSITION FIXING SYSTEMS

Prior to sailing, A/S Geoteam of Norway installed an ARGO DM54 Positioning System, this consists of four units and an antenna.

The R.P.U.(Range Processing Unit) has two main functions, firstly to tune the antenna via the Antenna Loading Unit (A.L.U.), secondly to search for the chains timing pulse and 'slot-in' it's own transmission within a two second cycle. The R.P.U. also has the task of monitoring the system performance.

The A.L.U. (Antenna Loading Unit) provides the tuning circuitry for antenna matching.

3.3 (Continuation)

The C.D.U. (Control and Display Unit) provides count and update of lanes from each station for on pass to the host computer for computation of position. In addition, display of time, test facilities, smoothing of raw data and secondary options are controlled from this unit.

The Chart Recorder provides a hard copy print of the increment/decrement of lanes, thereby showing the track of ship in relation to the fixed stations. This gives a definite display of any lane loss enabling quick correction.

3.4 POSITION FIXING COMPUTER

Navigation Suite-System description

The navigation system employed onboard the Skandi Ocean for the duration of contract was the Marinav 'SYSTEM 45'.

This software system written for the Hewlett Packard 9845B was interfaced to the following peripherals, for both computation and data acquisition.

ARGO DM54 Long Range Positioning System
SIMRAD EA200 Hydrographic Echo Sounder
SIMRAD HPR 309 Acoustic Reference System
ROBERTSON SKR82 Gyrocompass
HEWLETT PACKARD 7580B A1 Size Plotter
HEWLETT PACKARD Real Time Clock
MARINAV Fix Box, for remote marking

3.5 SIMRAD 309T

The Simrad HPR309 Acoustic Reference System employs a tracking transducer extended beneath the hull of the vessel to locate the position relative to ship and depth of any selected transponder.

A control unit mounted in the bridge selects the transponder or transponders to be interrogated and displays their positions relative to either the vessel or each other. Again data output is interfaced to the host HP9845B for real time positioning of any remote vehicle or fixed beacon.

3.6 The Robertson SKR82 Gyrocompass, accurate to 0.7 of a degree, is installed in the control room, and this unit proves vessel heading, essential for the accuracy of offset positions. Digital data output is fed to the HP9845B.

The Hewlett Packard 7580B Plotter provides a permanent record of the track of either the vessel, a remote vehicle, or both on A1 paper or film.

A Real Time Clock installed in the rear of the HP9845B provides time on hard copy printout of fixes and against logged data.

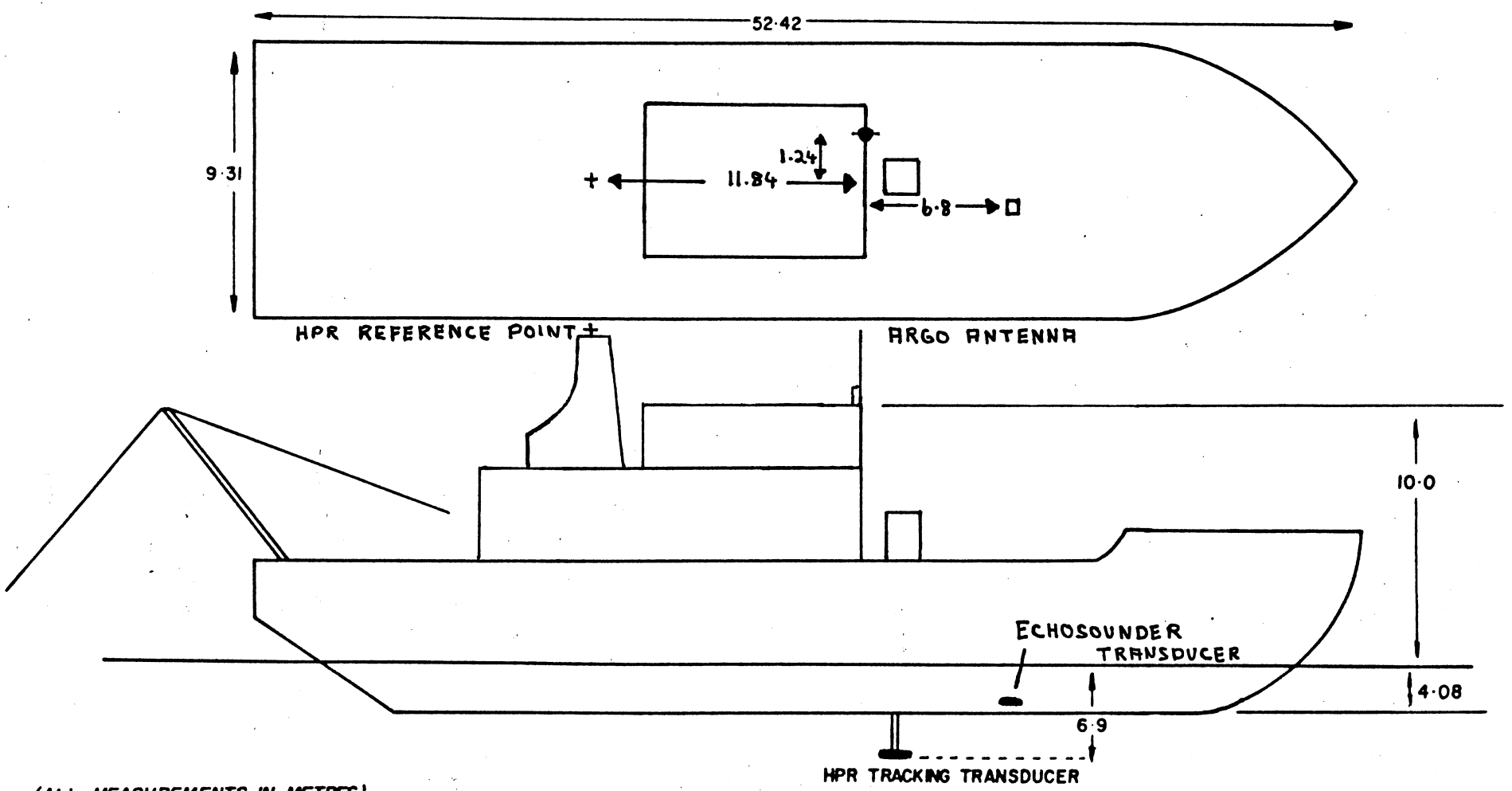
The Marinav Fix Box passes, upon pulse from the host computer, an output to all recorders, giving synchronisation of fixes.

3.7 ROV System

SCORPIO has proved to be the most reliable and widely accepted of the medium sized ROV's. Its power, payload and open frame construction make it readily adaptable for a wide variety of tasks, including accurate site surveys, pipeline inspection and as an aid to sub-sea production and drilling systems. Fitted with Oceaneering's exlusive five function manipulator it can perform intricate manipulative tasks on BOP stacks and wellheads etc. Other optional equipment that has successfully been used with SCORPIO includes, Obstacle Avoidance Sonar, Scanning Trench Profiler, Innovatum Pipe Tracker, Water Jet Cleaning, a complete range Video and Stills cameras and bottles for seabed gas sampling.

Fig.1

M.V. SKANDI OCEAN.



(ALL MEASUREMENTS IN METRES)

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EQUIPMENT SPECIFICATION

HP 9845 COMPUTER SYSTEM

Introduction

An advanced class of desk top computers designed for ease of operation with increased performance. The 9845 system enables the display of graphics, storage of data on tape, hard copy thermal printer, plus the ability to plug in peripheral data loggers, plotters, printers, data tape stores, etc.

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FEATURES

*16K, optional 32K or 64K memory stores

*Basic language format, for simplicity of field operation and software modification and update.

*System capable of enabling the surveyor to select any or all of the following parameters:

On line plotting (using incremental of X-Y plotter)
Left-Right indicator
Navigational aids
Data logging facilities
Fully automated fixing, logging and printing/plotting routine
Offline programmes for chart preparation
Co-ordinate conversions
C-D-Computers
Pipeline geometry and special barge conning routines
Ability to compare offsets
Data replay and replot facility
Dual tape cartridges for storage of up to 217K bytes of data

*CRT display for Graphics/Tabular data display

*Capablity of being used as a controller with easy I/O interconnects (BCD, bit parallel, bit serial, HPIB) enabling interfacing to input sources, positioning systems, tide gauges, etc., plus peripherals outputs.

SPECIFICATIONS

Typical system:

Height: 48cm (19in)
Width : 46cm (18in)
Depth : 66cm (26.25in)
Weight: 48kg (106lbs)
Power : 110 or 220V AC 48-66Hz
Read/write memory standard 29882.
46266 or 62650 bytes

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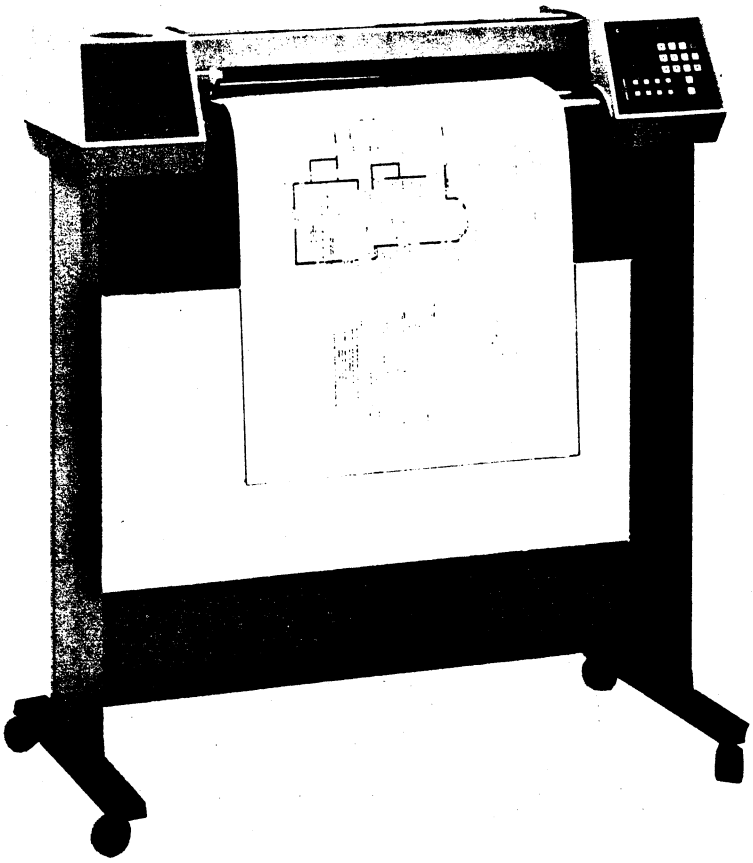
EQUIPMENT SPECIFICATION

HP 7580A PLOTTER

The HP 7580A Plotter is designed to produce high quality graphics on individual sheets made of paper or double matte polyester film. Plots can be drawn on media sizes ranging from ISO A4 through A1 with a choice of roller ball, fibre tip ot liquid ink drafting pens of various colours and line widths.

Both pen and medium movements are controlled by D.C. Servos for a mechanical resolution of 0.003mm (0.00012in.) and a repeatability of better than 0.05mm (0.002in.).



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SPECIFICATIONS

SPEED	
Pen down:	60cm/s independent of vector direction
Pen up:	60cm/s independent of vector direction
ACCELERATION	
Maximum:	39m/sec
Programmable:	9.75 to 39m/sec
PENS	
Number:	8/ Carousel
Type:	Fibre tip, liquid ink, roller ball
POWER REQUIREMENTS	
Source:	100, 120, 220, 240V -10% to +5%
Frequency:	48-66Hz single phase
Consumption:	170 Watts maximum
ENVIRONMENTAL	
Temperature:	$0^{o}C$ to $+55^{o}C$
Relative Humidity:	5 to 95% (below $40^{o}C$)
SIZE AND WEIGHT	
Height:	1188mm (46.8in.)
Width:	1087mm (42.8in.)
Depth:	557mm (21.9in.)
Weight:	59.1kg (130lbs) Net.
	114kg (250lbs) Shipping

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EQUIPMENT SPECIFICATION

SKR 80 GYRO COMPASS

GENERAL INFORMATION

The compass is a self-contained True North electronic gyrocompass.

The vessel's True Heading can be read directly from the 165mm diameter compass card or from the 4-digit electronic display on the control unit without recourse to a graph or a chart.

There is a manual control for automatic compensation of speed and latitude.

The analog signals from a 3-wire synchro and the digital electrical signals that correspond to heading information are available as system outputs for an autopilot and compass repeater system.

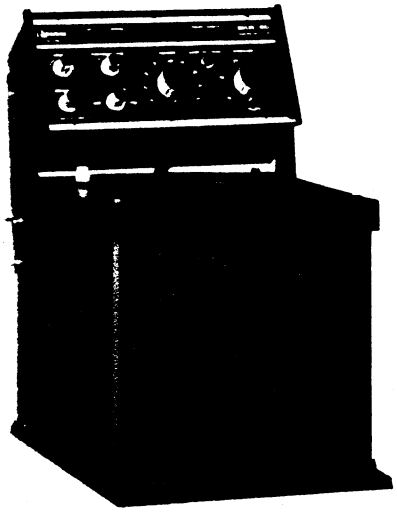
The control unit provides the interface between the operator and the gyrocompass unit. A Directional Gyro (DG) mode is also provided.

A repeater distribution unit provides for output signals to the gyrocompass repeaters.

The SKR 80 is based on the MAREX gyro. This is a two-degree of-freedom, dry, flexure-joint-suspended, free rotor gyro. This gyro is mounted in the inner gimbal of a two gimbal assembly, which has a $\pm 55^{o}$ of freedom about the horizontal axis.

The outer gimbal has unlimited rotation in azimuth and has the compass card mounted on the top.

The gyrocompass electronics are contained on one curcuit card. This card performs the general functions of power conditioning, energizing the gyro and level sensors, provide control loops for gimbal stabilization, leveling and gyrocompassing. The gimbal assembly is temperature stabilized.



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SPECIFICATIONS

Accuracy	Static	+/- 0.3^{o}
	Dynamic (at sea)	+/- 0.75^{o}
Compensation	Latitude	0 - 80^{o}
	Speed	0 - 40 knots
Settling time	Normal	54 min
Mains voltage	110 or 220 VAC	+10%/-15% 50/60Hz 1 Ø
	or	
	24 VDC	+/- 20%
Power requirement	Start-up	approx 150W
	Normal operation	less than 60W
Ambient temperature	Normal	+ 5^{o}C to + 45^{o}C can operate in 0^{o}C to + 55^{o}C
	Storage	- 25^{o}C to + 80^{o}C
System outputs	Analog	To RRE autopilot: 2 V L-L synchro signals with 13V/400 hz reference.
		Optional: 11.8 V L-L synchro signals with 26 V/400Hz reference. Minimum load impedance 5K.ohms.
	Digital	20 mA current loop (9600 Baud). Standard UART format, 8 bit (4bit data and 4 bit address) odd parity.

Conection for external alarm.

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EQUIPMENT SPECIFICATION

SYLEDIS

SYSTEM:

Syledis is a short to medium range radiopositioning system with the ability to operate in either range/range mode or hyperbolic mode, with power outputs of 100 mW, 20W or 320W, working ranges from 10m up to 400 Km are possible, with an accuracy of 1 metre within the line of sight to 5×10^{-5} X distance (CEP) beyond the line of sight.

APPLICATIONS:

All offshore positioning problems including:-

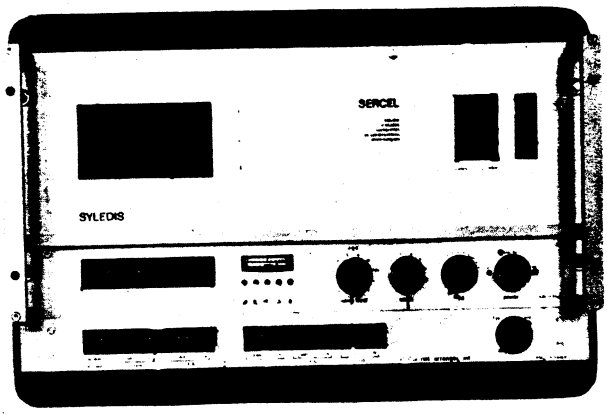
Hydrographic Survey

Pipelaying

Geophysical Survey Positioning

Drilling

Dynamic Positioning



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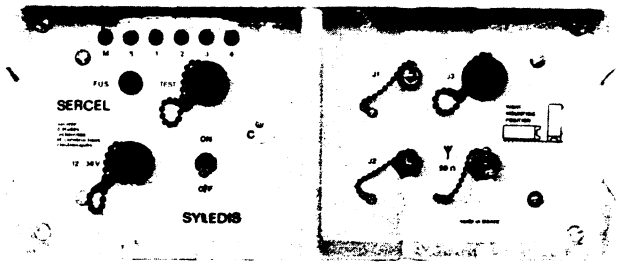
SYLEDIS



SPECIFICATIONS:

Frequency:

Tuneable frequency band:	420 to 450 MHz
Nb of frequency assignment required:	1
Bandwidth occupancy:	99% of total energy in FO ± 1.25 MHz (CCIR - advice 328.3)

Signal:

Type of modulation:	PSK
Type of code:	Pseudo random 127 elements
Duration of each element:	0.52 µs
Code repetition period:	66.666 µs (equivalent to 10 Km)
Pulse Length:	80 codes (40 or 160 in special cases)
Adopted propagation velocity:	299695.1 Km/s at refractive index 1.000325

		INTERROGATOR	BEACON
Weight		25 Kg (23 Kg without SNA)	16 Kg
Size W		505 mm	380 mm
D		415 mm	460 mm
H		267 mm (223 without SNA)	170 mm
Power supply		22 to 30 volts	11-14 or 22-30 V (automatic internal adaptation)
Mean consumption		5 amps	3 or 1.8 amps
Peak consumption		10amps	10 amps
Temperature	Operating:	0^{o} to 55^{o} C	- 20^{o}C to + 55^{o} C
	Storage :	-30^{o} to + 70^{o} C	- 30^{o} to + 70^{o} C
Humidity		drip proof	waterproof

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EQUIPMENT SPECIFICATION

ARGO DM-54

The Cubic Western Argo DM-54 is a precision radiolocation system designed to provide accurate long range positioning. The mobile station uses two, three or four fixed location stations to provide position information. The system operates in the medium frequency band (1600 to 2000kHz) utilizing the ground wave component of the radiated signal. Depending on atmospheric conditions, ranges up to 400 nautical miles can be obtained.

The system consists of:

a) Range Processing Unit (RPU) - generates, transmits, receives and processes all signals for range measurement.

b) Control and Display Unit (CDU) - performs all operational control, range displays and interface functions between it and the RPU.

c) Antenna Loading Unit (ALU) - matches the RPU transmitter output to the antenna.

Peripherals such as digital printers and strip chart recorders are also available.

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SPECIFICATIONS

MAXIMUM RANGE TO:	
Day	400 nautical miles (740 kilometers)
Night	125 to 300 nautical miles (232 to 556 kilometers)
RANGE ACCURACY:	0.02 lanes, instrumental; 0.05 lanes, achievable field accuracy.
LANE WIDTH:	75 to 94 metres, depending on the frequency in use.
FREQUENCY:	A single frequency between 1,600 and 2,000kHz is required for range measurements. Lane identification (when used) requires a second frequency from 9 to 10.5% higher than the primary range frequency.
TRANSMITTER OUTPUT POWER:	100W peak
TRANSMIT BANDWIDTH:	80 Hz
RANGE DATA RATE:	Updated once every 2 seconds
RANGE DATA DISPLAY:	0.00 to 9999.99 lanes (six digit capability) for each range.
PACKAGING:	All units are housed in splash-proof aluminium cases.
SIZE AND APPROX. WEIGHT:	
Control & Display Unit:	19 x 19 x 7 inches. 27 lbs.
Range Processing Unit:	19 x 19 x 7 inches. 38 lbs.
Antenna Loading Unit:	19 x 23 x 7 inches. 32 lbs.
INPUT POWER:	22 to 32 Vdc for all stations.
OPERATING TEMPERATURE RANGE:	-20^{o} to $+55^{o}C$

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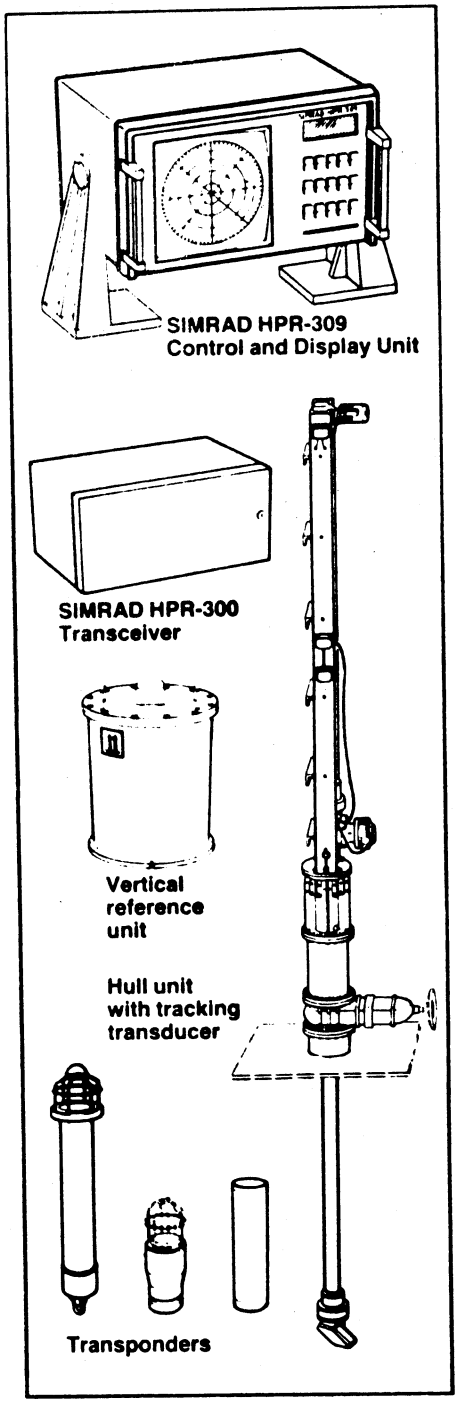
EQUIPMENT SPECIFICATION

SIMRAD HPR-309

HYDROACOUSTIC POSITION REFERENCE SYSTEM



THIRD GENERATION HPR

General

The Simrad HPR-309 Hydroacoustic Position Reference system is designed to provide a reliable and precise means of establishing position relative to an underwater structure on the ocean floor, or to a submersible.

The system can be used as a stand-alone navigation system, or it can be integrated with surface navigation systems to establish absolute position.

The HPR-309 system is based on the super-short baseline (SSBL) principle with the acoustic transmit/receive elements housed in one single transducer unit, providing a simple and compact installation.

The position calculation is based on range and direction measurements giving the relative position between the transducer and the transponder. The system can measure relative position to sixteen different transponders.

Basic System

* Display and control unit
* Transceiver Unit
* Standard fixed 60/160 Transducer
* Standard Transponder
* Vertical reference Unit
* Standard Gyroscope interface

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Features

* Super Short Baseline (SSBL)
* 16 channel capability
* Interactive operator communication
* Display of polar and cartesian co-ordinates
* DP Interface
* Versatility in choice of operating frequencies and pulse lengths
* Flexible installation
* Online/offline test facilities
* Hardware signal conditioning has to a large degree been substituted by software processing for increased control and flexibility.
* Prepared for expansion to long baseline navigation.

Hardware Options (Software included)

* Tracking Transducer System featuring automatic steered narrow beam tracking for increased range and accuracy.
* Choice of Vertical reference unit
* Remote Display Unit
* Sturdy transducer hull unit with remote raise/lower control
* Transducer with 30/160 beam width
* Additional standard transponders
* Miniature responder
* Miniature transponder
* Sub miniature transponder
* Course Gyro
* Video output of precision data
* Expandable for operation in the Simrad HPR-309A Acoustic Control and Navigation system.

Software Options

* Inclinometer Transponder operation
* Emergency transponder operation
* Transponder priority
* Transponder command and release
* Teletype printout of CRT/position information
* External control from custom computer
* Plotting of position data

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EQUIPMENT SPECIFICATION

SIMRAD EA 200 MULTIFREQUENCY HYDROGRAPHIC ECHO SOUNDER

Frequencies:

12,18,27,38,49,120,200 and 710kHz

Available for single and multifrequency.

Features:

Sound Velocity, Draught and Tide Compensation. Digital Output.

Indication of Recording Scale and other Parameters.

Power Supply:

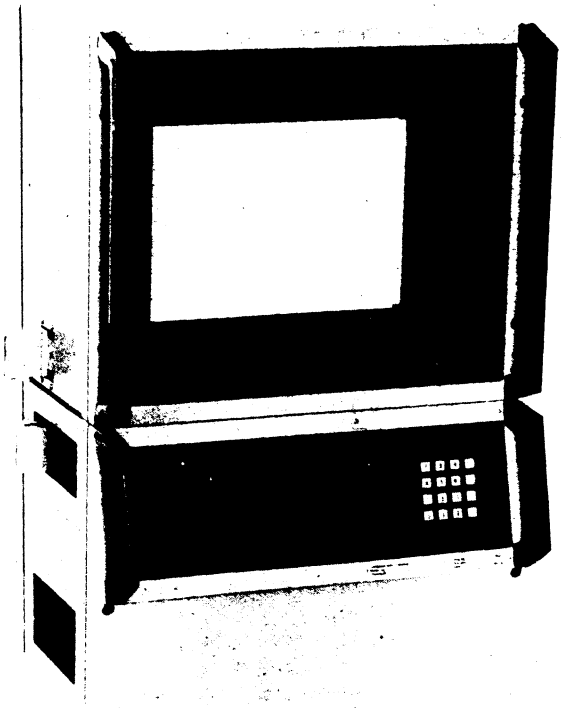
230V A.C.
110V A.C.
24V A.C.

Transceivers:

Two internal and up to two external

Power Output:

750 Watts (710kHz, 25W)



Recorder

The recorder stylus is driven at a linear speed dependent on the Sound Velocity setting. The graph has timing marks for ease of analysis plus the capability for user defined numerical data to be input.

The recorder has two versions
1) 50-100m in 9 ranges
2) 250-5000m in 9 ranges

Control Unit

The Echo Sounder is controlled through a microcomputer via 4 x 4 Matrix keyboard. Commands are given from a menu and display prompt. The following functions are controlled from here:

1) Depth Alarm	2) Gain	3) Recorder mode
4) Sub bottom gain	5) Min. depth	6) Sound Velocity
7) Draft	8) Main Range	9) Phased range
10)Hi-Res Range	11) Scale divisions	12) Preset by number
13)Hi-Res Phasing	14) Transducer No.	15) Pulse Duration
16)Hi-Res Depth	17) Transceivers	18) Hi-Res Range

Transceivers

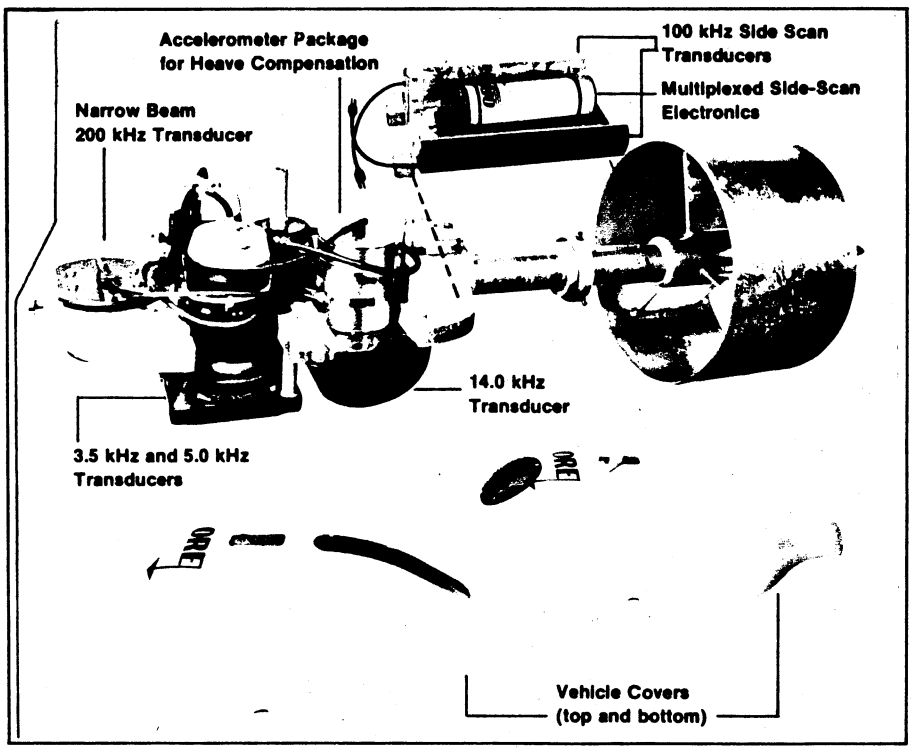
Internally the EA200 has two transceivers. The following frequencies and combination of frequencies can be used: 38kHz, 49kHz, 120kHz, 200kHz and 710kHz. The output power of all units is 750 Watts except for 710kHz which is 25 Watts. External transceivers may be operated simultaneously with the internal ones and are controlled from the front panel.

ORE MODEL 3000 PIPELINER

The system consists of Model 310 Transceiver and Model 136P Tow fish and optional E.P.C. 3200S, 1600 or 320 recorder.

Description and Application

The ORE Pipeliner gives simultaneous depth of burial and trench delineation. Using the four selectable frequencies this can be conducted on a wide range of pipe sizes and Geologic conditions. The pipeliner is heave compensated enabling work to be carried out in adverse weather conditions. Official calibration tests have shown a 5cm depth of burial accuracy and a schedule of 40 line Km per day.



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SPECIFICATIONS

MODEL 136P PIPELINER TOWED TRANSDUCER ARRAY

Low frequency components

* Operating Frequency	3.5 and 5 kHz
* Beam pattern	Eliptical pattern, narrow beam athwartships, wide beam fore/aft.

MODEL 310 PIPELINER TRANSCEIVER

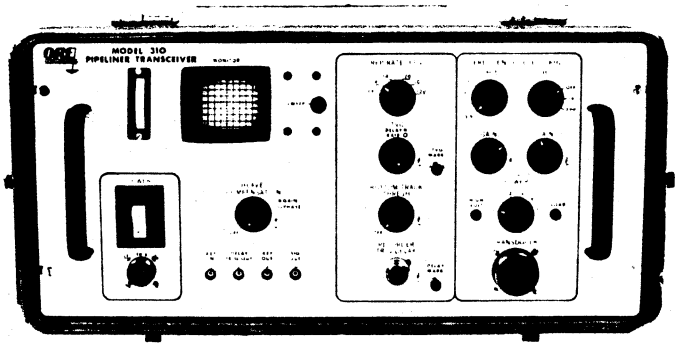
Transmitter section

* 3.5 and 5.0 kHz for maximum sediment penetration
* 14 kHz for higher resolution of shallow buried smaller diameter pipes
* Output power to 5kW
* Heave compensation permits surveying under extreme weather conditions.
* TVG "Finder" to mark beginning of ramp on record
* Rugged protective environmental container
* 200 kHz for trench delineation
* Any two frequencies displayed in dual channel mode on single channel recorder
* Scope aids operator by monitoring TVG, trigger pulse and signal levels
* Adjustable TVG delay and rate

* Operating frequencies single trace or dual trace	3.5, 5, 14 or 200 kHz 3.5 or 5 combined with 14 or 200kHz
* Power output	10kW rms during key pulse 1% duty cycle max. Adjustable 0-10kW
* Output Impedance	Matched to Transducer array 100 ohms nominal

SPECIAL CONTROLS AND FEATURES

* Rep rate control	Selects rep rates of 4, 10, 20, 50 or 100 pps for use with fibre optics recorder
* Heave Compensation	Corrects record for transducer array heave by varying transmit key timing.



OCEANEERING NORWAY A/S

EQUIPMENT SPECIFICATION

EPC MODEL 3200 S GRAPHIC RECORDER

SYSTEM:

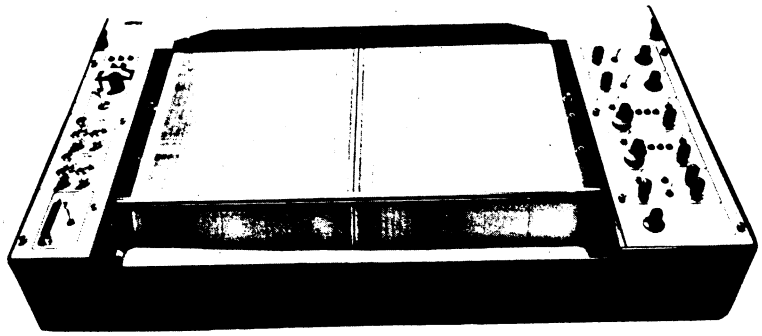
A multi-purpose dry paper graphic recorder with complete capabilities for use with sidescan sonar and shallow and deep seismic profiling systems. The 3200 contains two independent channels with independent time bases.

SPECIFICATIONS:

Display Modes:	1. Single Channel across 19.2 in. 2. Dual Channel, each channel 9.6 in. 3. Channel A delayed by Channel B.
Display Rates:	1/64, 1/32, 1/16, 1/8, 1/4, 1/2, 1,2,4 and 8 seconds/scan which correspond respectively to depths of 37, 75, 150, 300, 600, 1200, 2400, 4800, 9600 and 19200 feet.
Time Base:	Each channel has independent time bases and in dual channel mode, different display rates can be used.
Chart Advance:	75, 100, 150, and 200 lines/inch
Synchronization:	Recorder may be externally synchronized to display rates up to 1/64th second.

Internal

Analogue Signal:	Ein $\geq$ 0.1 V for maximum black DC to 100 KHz
Digital Signal:	Resolution - 4 bits, 16 shades Input coding - straight binary, TTL levels Amplifier shall write black for all "ones" input and white for all "zero" inputs. Separate inputs for each channel.



SPECIFICATIONS (cont'd)...

Digital Key Pulse:	One for each channel per sweep; 5V, TTL, 1.0 msec duration
Digital Outputs:	Signal:-
	Resolution - 4 bits, 16 shades
	Output Coding - straight binary, TTL Levels
Ditigal Outputs:	Key Pulse - one for each channel, corresponding to display speed: 5V, TTL, 1.0 msec duration.
	Clock Pulse - 4096 pulses/sweep from either channel or 2048 each from two channels depending upon mode of operation; the clock pulse is 950 msec wide.
	Zero Pulse - corresponds to zero position of sylus once-a-sweep, 5V, TTL, 50μ sec width.

POWER REQUIREMENTS:

A-C Power required is:	100 - 130V, 50 - 60 Hz, 150W
DIMENSIONS:	30" x 19" x 5"
WEIGHT:	65 lbs

ROV System Specification

VEHICLE: Scorpio Serial No 19

TYPE: Tethered, unmanned, work and survey underwater vehicle. Open frame construction with syntactic foam and pressure resistant electronics tank providing buoyancy within a tubular aluminium frame.

DIMENSIONS: (LxWxH) 88"x48"x64"

WEIGTH IN AIR: 2000lbs

WATER DEPTH RATING: 3000FSW

POWER UNIT: 25 HP electrically driven hydraulic power unit providing power for thrusters, manipulators and all hydraulic actuated functions.

PROPULSION: Four hydraulic motors driving five blade propellers within Kortz nozzles; two fore/aft, one lateral, one vertical; HP - five per thruster, approximately 275lbs thrust each.

BOLLARD PULL IN ZERO CURRENT (vehicle static trust): Forwards - 750lbs; backwards - 600lbs, lateral right 375lbs; lateral left 300lbs:

OPERATING FOOTPRINT IN CURRENT: Dynamic thrust fall off as follows:

Speed of vehicle (Kts)	Reduction
0	100
1	92
2	83
3	75

ROV System Specification (cont)

To arrive at dynamic thrust, take speed of vehicle, multiply static thrust by reduction percent. Maximum speed of vehicle is where dynamic thrust equals vehicle drag (with no umbilical drag). This is at - forward 3.25KT; lateral right 1.85KT.

INSTRUMENTATION SCANNING SONAR: For obstacle avoidance and search - Ametek 250A CTFM^{0} sweep, 2000ft to 4ft range, 90^{0} tilt unit to scan seabed. Selectable acoustic marker beacon/receiver mode.

COMPASS: Flux-gate gyro compass (also used for automatic heading control).

DEPTH: Pressure sensitive depth gauge and acoustic altimeter allowing wither automatic depth control or automatic height (above seabed) control.

VEHICLE FUNCTION MONITORS: Pitch, ascent/descent rate, hydraulic temperature, pump motor temperature, water intrusions alarms, hydraulic pressure alarms.

MANIPULATOR: Perry five function hydraulically powered rate manipulator.

BUOYANCY: Up to 60lbs normally trimmed to 15lbs positive or as required.

PAYLOAD: Up to 250lbs lift without additional buoyancy; 60lbs (in water) payload of instrumentation.

TV CAMERAS: One Photosea 1000 remotely operated 25mm x 28mm format colour stills camera and strobe plus one Osprey combined SIT camera and colour stills TVP camera system (Plus E6 photographic processing system).

ROV System Specification (cont)

LIGHTS: Two remote Ocean Systems 28 volt/80 watt or 250 watt wide beam lights, independently switchable.

PAN AND TILT: Combination of TV and stills cameras, lights and strobe(s) can be mounted on the hydraulically actuated pan and tilt unit.

CABLE CUTTER: Hydraulic blade cutter with 1/18" capacity for wire ropes, polypropylene etc.

VEHICLE EMERGENCY: Helle acoustic beacon (27KHZ) and flashing strobe with pressure switch activated only when on surface.

CONTROL CABIN: Offshore rated A60 container; (LxWxH) 12'x8'x8½'; weight 9000lbs. Fully fitted with power transformers, safety cut-outs, switch and distribution panel, connectors, control console, video and sonar displays, instrument racking for recorders, tracking and navigation equipment. Store space and positions for pilot, observer and client's representative. Video recorders are three JVC 6600 VCR's with remote control. Video monitors are 12" screen size to reduce operator fatigue for long operations. Video distribution amplifiers allow additional remote TV monitors as required. Inter-com system between pilot, observer, survey suite, bridge and CP engineers.

ROV System Specification (cont)

WORKSHOP/STORES CONTAINER: Fully equipped with electronics work bench, test equipment and tools, electronics and vehicle spares and stores, mechanical workshop with bench, vice, grinder, drills etc and a full range of tools to allow full maintenance and repair of the sytem in the field as well as making specialised tooling or modifications of the system in situ to carry out new tasks underwater. Cabin is (LxWxH) 12'x8'x8½' and weighs 6000lbs.

4.0 BATHYMETRY SURVEY

4.1 RESULTS

The seabed was found to slope gently from south-east to north-west at a gradient of 0.05%. Maximum depth of 266m was found in the north with a minimum depth of 254m in the south. The depth at the centre of the area was 260m. All depths are reduced to M.S.L. using the reference port of Trondheim. (See chart 3 of 4).

4.2 VELOCITY OF SOUND IN WATER

Prior to the survey commencing, a temperature, depth and salinity probe was lowered to a depth of 200 metres and readings were taken at 10 metre in levels.

By applying Wilsons formula simplified by Medwin

$$V = 1449.2 + 4.6T - 0.055T^2 + 0.00029T^3 + (1.34 - 0.01T) \times (S - 35) + 0.016D$$

Where:- V = Velocity of sound in metres/seconds
T = Temperature ^{o}C
S = Salinity in parts per thousand
D = Depth in metres

Taking the mean of these results, the velocity of sound in water was derived.

The velocity of sound in water for this survey was calculated to be

1484 metres per second

This figure was used for both the echo sounder and H.P.R. system.

4.3 BAR CHECK

To ensure accurate correction for the ship's draft to the echo sounder, a steel bar was lowered horizontally under the keel of the vessel. By accurate measurement on the rope holding the bar the exact depth was known and correction could be made for the depth of the transducers under the waterline.

This was undertaken in 10 metre steps to a depth of 30 metres and draft correction was calculated to be 4.08 metres.

4.4 TIDAL INFORMATION

Using tide gauge information, supplied by the Norwegian Oceanographic Institute in Trondheim the Mean Spring Range and delay relative to Trondheim has been used to correct all depth readings to Mean Sea Level.

At each fix point on the North/South lines corrections were applied to the echo sounder results.

These depths were reduced to Mean Sea Level to remove the effects of tidal variations using predicted tidal curves for Narvik, modified for range to Trondheim and again modified for time and height at the survey location.

5

5.0 SIDE SCAN SONAR SURVEYS

5.1 RESULTS

BLOCK 6407/1-2 GEOPHYSICAL INTERPRETATION

The survey procedure, with a general line spacing of 150 metres, decreasing to 100m spacing in the central rig location area, provided good cover over the site, using a $1/4$ sec scan speed (a range of 185m per channel on the side scan speed, based on a velocity of sound in water of 1485m/sec).

The features identified from the Side Scan Sonar records were plotted to a scale of 1:10000.

GENERAL MORPHOLOGY

The survey area consisted of a relatively flat lying region with a local topographic relief varying by up to 4m in height, the sea bed material being mainly of sands and finer deposits.

The low relief found on the sea bed is probably a reflection of the subsurface topography, which would seem to be current deposited sands, forming large-scale ripple features which have been probably buried by finer deposits to a depth of up to 2 metres. Where these sand deposits are not totally buried by the fines, i.e. the crests of the ripple features, the exposed sands offer high reflectivity to the side scan sonar, and a general overall pattern of the crests is seen in the records, taking the form of localised low ridges, trending in general NW/SE.

5.1 (Continuation)

There also exists, within the area, some large linear features that continue across the area, also trending NW/SE. These features consist of a single trough and ridge, the trough being unfilled with finer material and the ridge being the exposed sands as before. The origin of these extensive liner features is not certain, but may be evidence of an earlier drainage system that existed after the sands were deposited.

Throughout the area there exist isolated boulders, in general about 1-2m in diameter, but these boulders tend to be more concentrated in zone in the central and southern parts of the survey area.

There is no evidence of recent current activity, as seen from the sonar records, but the possibility of continuing current activity should not be discounted.

DEBRIS SURVEY

On the enclosed chart, (see chart 4 of 4) only man made features were plotted, the results being the main purpose of the survey.

The most outstanding features on the site were the anchor scars, being numerous and readily identifiable. When plotted, the scars formed a pattern that trended towards the rig site, the scars being the results of the rig-anchoring system.

Most of the scars, which were up to 2m in depth, are linear and continuous, and there was no evidence of residual debris associated with the mooring system (i.e. chain, wire etc.).

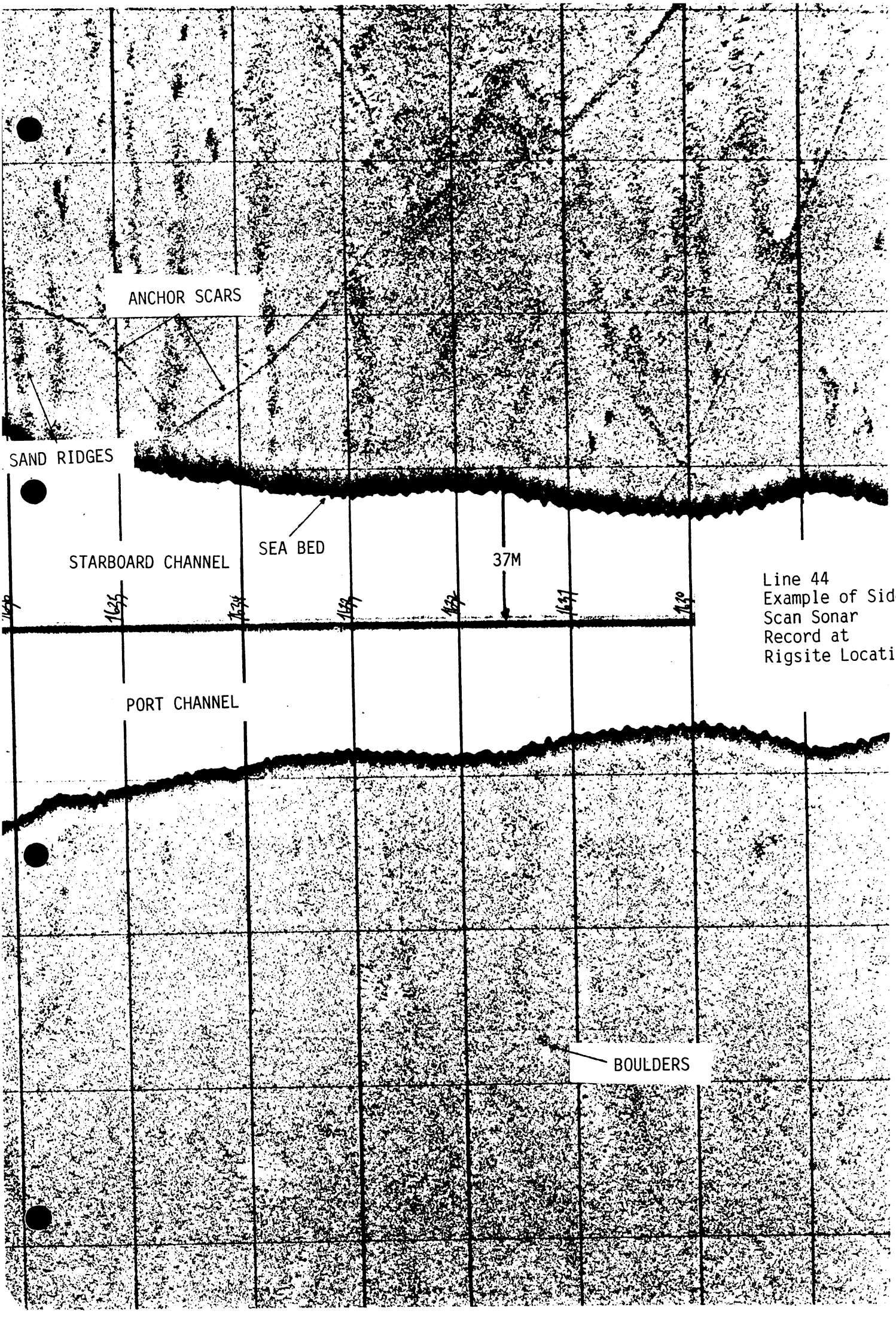
5.1 (Continuation)

Specific survey routes were taken to locate a possible lost anchor to the west of the rig site, but no evidence of its location was seen. It is likely that such debris would be buried in the superficial soft materials on the sea bed.

The rig site was also clear of debris; the only features of note on the site being small scars and isolated boulders(found also elsewhere in the area). There is the possibility that some of the "boulders" might be man deposited debris, but the reflectivity contrast and small size of these contacts does not provide specific evidence that their origins are from the drilling operations, and it was concluded that they are of natural origin.

The sonar contact mentioned in the preliminary report has been interpreted as a shoal of fish, due to its size, structure and reflectivity.

Figure 2 shows an example of the Sidescan Sonar records, close to the rig site location.



Line 44
Example of Side
Scan Sonar
Record at
Rigsite Location

6.0 CONCLUSIONS AND RECOMMENDATIONS

The rig site located on Block 6407/1-2 is considered to be relatively free of major debris resulting from previous drilling operations.

The apparently soft nature of the seabed sediments and the overall morphology of the sea floor i.e. the ridges and troughs, would tend to cover all but the largest obstructions and in this context, from the environmental aspect, there would seem to be no hazard to future sea bed operations in particular fishing trawls etc. Sonar contacts in the area that could possibly be considered as man derived are in the same order of magnitude as the natural features on the sea bed, and are therefore considered of little significance.

Although it was reported that drill string and an anchor has been lost on the site, no sonar contacts were observed that could be related to these losses. Should the recovery of such items be considered as priority it is suggested that a magnometer survey be instigated, which would readily locate buried debris.

DIARY OF EVENTS

DATE	TIME	EVENTS
18-7-83	0800-0900	Complete bunkering 45,000 Litres Fuel Oil
	1100-2300	Return to Stavanger to fit Argo and Syledis equipment
	2345	Sail from Stavanger
19-7-83	001-2359	On passage to work area
2-7-83	0001-2359	On passage to 6407/2-2 location of 'Treasure Saga' to Carry Out transit fix for navigation confidence check
21-7-83	0030-0600	Arrive Treasure Saga Location await suitable weather for transit fix
	0700	Start transit fix Argo fails
	0700-1900	Down due to Argo
	2300	Complete transit fix proceed to 6507/11-1 work area
22-7-83	0015-0045	Launch and recover R.O.V.
	0430-1145	Run survey lines of Area 6507/11-1
	1250-1550	Return Treasure Saga carry out Argo confidence check. Deploy transponder in 6507/11-1 location
	1730-2359	Run survey lines 6507/11-1
	0019-1000	Complete survey lines 6507/11-1. Transit to 6507/11-2 carry out T.D.S. Probe (Sound Vel:- 1484mo) and start Side Scan Survey

DIARY OF EVENTS

DATE	TIME	EVENTS
23-7-83	1005-1145	Return to 6507/11-1 for ROV dive. Further problems, dive completed
	1230-2359	Return 6507/11-2 Location & run survey lines
24-7-83	0001-0820	Run S/S, E/S and Profiler Lines 6507/11-2
	0825-0920	Retrieve gear and transfer ROV personnel to M.V. Sjovarden for demobilisation
	0930-2359	Continue running survey lines 6507/11-2
25-7-83	0001-1045	Continue and complete 6507/11-2 Survey
	0500	retrieve fish fit new HPR Mini Beacon
	1242-2300	Run Survey Lines 6507/11-1 and Complete
	2320-2359	Go to transponder site and check Nav prior to transit to 6407/1-2
26-7-83	0001-0225	Transit to 6407/1-2
	0306-2247	Run survey lines 6407/1-2
	2253-2359	Electrical storm affecting all signals on Argo. Range 4, Slettringen, off the air
27-7-83	0001-0325	Transit to reference transponder correct Argo lane count
	0330-0720	Relocate reference transponder at 418 000E 7 197 000N

DIARY OF EVENTS

DATE	TIME	EVENTS
27-7-83	0735-1020	Return to 6407/1-2 Box Statoil Transponders. No reply from Code Y
	1059-2310	Run Survey Lines 6407/1-2
	2316-2359	Proceed to reference buoy. Further problems with Station 4 Argo
28-7-83	0001-0200	At reference trisponder check Argo lane count
	0200-0755	Run survey lines 6407/1-2
	0755-2359	Down to Argo. No transmission Station 4 (Slettringem)
29-7-83	0015	Argo back on air
	0220-0350	At reference transponder setting Argo lane count
	0457-2220	Run survey 6407/1-2 and complete
	2220-2359	On standby at 'Treasure Saga' Location
30-7-83	0001-2359	Standby await "Treasure Saga" departure
	1225-1235	"Standby Pioneer" delivers 2 transponders and flotation collars
31-7-83	0001-2030	Standby for departure of Treasure Saga from survey location
	1600-1640	Argo Station 4, Slettringem, off the air
	2030-2330	Transit to reference transponder carry out Argo lane count
	2300-2359	Re-Deploy transponder adjacent to survey area after 'Treasure Saga' departure

DIARY OF EVENTS

DATE	TIME	EVENTS
1-8-83	0001-0100	Complete deployment of transponder in 6407/2-2 area
	0215-1700	Run survey lines 6407/2-2
	1730-2230	Leif Profiler arrives for Argo lane count & calibration
	2330-2359	Resume Survey Block 6407/2-2
2-8-83	0001-2359	Complete 6407/2-2 Survey
3-8-83	0235-0355	Recover Oceaneering transponder
	0400-0630	Steam to reference transponders Argo lane check
	0630-1040	Stream transponders at 64^{o} 52' 24.86N 07'2" 52E
	1120-2359	Transit to Stavanger for demobilisation
4-8-83	0001-	Continue transit to Stavanger
	1000	Demobilisation Port now Fitjar
		arrive Fitjar

PERSONNEL

The following Oceaneering Personnel were involved in this survey:-

K. Izatt	Engineer/Party Chief
A. Murphy	Senior Surveyor
C. Sellers	Surveyor/Geophysicist
B. Cooley	Geophysicist
D. Turner	Survey Engineer
N. Beaman	Survey Engineer

9.0 CHARTING

The results of the Debris Clearance Survey in the area of Block 6507/1-2 are presented on a total of four charts at a scale of 1:10000.

Chart 1 of 4 - Ship's Track (Antenna positions)
Chart 2 of 4 - Fish Track (Fish positions)
Chart 3 of 4 - Bathymetry
Chart 4 of 4 - Seabed Features

APPENDIX

LINE LISTINGS

DATE	LINE NO.	SOL FIX	EOL FIX	SOL TIME	EOL TIME
26/7	14	1	34	0306	0342
26/7	06	35	69	0417	0454
26/7	12	70	106	0523	0602
26/7	18	107	137	0629	0702
26/7	22	138	175	0725	0805
26/7	08	176	207	0833	0905
26/7	02	208	242	0933	1009
26/7	10	243	276	1147	1222
26/7	04	277	310	1248	1324
26/7	16	311	341	1436	1510
26/7	20	342	374	1545	1620
26/7	13	375	408	1651	1728
26/7	05	409	443	1806	1843
26/7	01	444	475	1919	1953
26/7	07	476	509	2028	2103
26/7	17	510	539	2135	2207
26/7	23	540	567	2247	2316
27/7	11	603	635	1059	1134
27/7	19	636	669	1213	1249
27/7	09	670	704	1324	1402
27/7	03	705	738	1440	1517
27/7	15	740	774	1613	1709
27/7	23R	775	810	1753	1832
27/7	21	814	847	1917	1953
27/7	25	848	886	2058	2139
27/7	30	887	916	2220	2252
28/7	27	918	944	0206	0235
28/7	29	945	981	0328	0407
28/7	26	982	1010	0443	0514
28/7	24	1011	1041	0555	0626
28/7	35	1042	1080	0719	0800
29/7	34	1097	1134	0457	0537
29/7	28	1135	1164	0628	0701

DATE	LINE NO.	SOL FIX	EOL FIX	SOL TIME	EOL TIME
29/7	31	1165	1203	0732	0813
29/7	42	1204	1240	0837	0915
29/7	27R	1241	1285	1002	1048
29/7	32	1286	1318	1122	1156
29/7	41	1319	1371	1306	1401
29/7	33	1373	1414	1450	1534
29/7	39	1415	1446	1641	1715
29/7	40	1447	1495	1811	1902
29/7	36	1496	1531	2006	2045
29/7	37	1532	1573	2134	2219
29/7	43	1575	1611	2352	0025
30/7	44	1612	1636	6131	0156
30/7	45	1637	1684	0242	0334

APPENDIX

THREE WAY FIX COMPUTATION

THREE WAY FIX COMPUTATION

The system computes the geodetic co-ordinate (E, N) of the ships antenna from the input of three Argo ranges used in a matrix least squares computation of observation algorithms based on U.T.M. grid solutions (The standard deriation of the fix being derived from the residuals of the matrix solution). The calculation for standard error of the fix i.e. the error ellipse, is also incorporated in the programme.

APPENDIX

SPHEROIDAL DISTANCES AND ARGO LANE COUNTS

SPHEROIDAL DISTANCES AND ARGO LANE COUNTS TO TREASURE SAGA

SKOMVAER - TREASURE SAGA

Grid Distance	332666 metres
Scale Factor	0.999645
Spheroidal Distance	332783 metres
Lane Count	3598.49 lanes

TRAENA - TREASURE SAGA

Grid Distance	259020 metres
Scale Factor	0.999653
Spheroidal Distance	259110 metres
Lane Count	2801.84 lanes

SLINNA - TREASURE SAGA

Grid Distance	164490 metres
Scale Factor	0.999629
Spheroidal Distance	164551 metres
Lane Count	1779.35 lanes

SLETTRINGEN - TREASURE SAGA

Grid Distance	152134 metres
Scale Factor	0.999639
Spheroidal Distance	152189 metres
Lane Count	1645.67 lanes

APPENDIX

'BOX-IN' OF REFERENCE TRANSPONDER CODE: SQUARE

Calculation of the position of Statoil reference transponder code: 'square' in Block 6407/1-2.

28 fixes were taken by drifting over the transponder from various headings (to eliminate HPR and Gyro errors)

As all fixes gave no appreciable error all data has been used to average and compute a position.

The found location of the transponder has been computed as:

406812 E
7187677 N

APPENDIX

NBA TDS-7 TEMPERATURE DEPTH AND SALINITY PROBE RESULTS

NBA TDS-7 TEMPERATURE DEPTH AND SALINITY PROBE RESULTS

TEMPERATURE	DEPTH	SALINITY	VELOCITY
10.2	5	31.5	1486.45
10.2	20	31.5	1486.69
8.1	40	31.8	1479.62
7.9	80	32.1	1479.87
8.3	100	32.1	1481.71
8.0	120	32.0	1480.77
8.0	140	32.0	1481.09
7.9	160	32.1	1481.15
8.0	180	32.1	1481.85
8.0	200	32.0	1482.05

Average Velocity 1481.81

APPENDIX

CONSTANTS USED FOR TIDAL REDUCTION

CONSTANTS USED FOR TIDAL REDUCTION

Mean Spring Range - Trondheim	2.5m
Mean Spring Range - Survey Location	2.3m
Ratio	0.92
Mean Sea Level - Trondheim	1.59m
x Ratio	0.92
Mean Sea Level - Survey Location	1.46m

Hourly Factor between high - low water

H.W,	+1,	+2,	+3,	+4,	+5,	L.W.
1.00,	0.93,	0.74,	0.50,	0.27,	0.09,	0.00

Time difference

Survey location 15 mins before Trondheim

APPENDIX

ORIGINAL CALIBRATION TRANSIT OF TREASURE SAGA

Centre of Treasure Saga	430733	7208809
Centre of Transit	430336	7208401

Skomvaer to Treasure Saga	Grid Distance	332665
Skomvaer to Transit Fix	Grid Distance	332228
Skomvaer to Treasure Saga	Spheroidal Distance	332783
Skomvaer to Transit Fix	Spheroidal Distance	332344
Skomvaer to Treasure Saga	Lane Count	3598.49
Skomvaer to Transit Fix	Lane Count	3593.75
	Lane Correction	+4.74

Traena to Treasure Saga	Grid Distance	259020
Traena to Transit Fix	Grid Distance	259585
Traena to Treasure Saga	Spheroidal Distance	259110
Traena to Transit Fix	Spheroidal Distance	259676
Traena to Treasure Saga	Lane Count	2801.84
Traena to Transit Fix	Lane Count	2807.96
	Lane Correction	-6.12

Sklinna to Treasure Saga	Grid Distance	164490
Sklinna to Transit Fix	Grid Distance	164943
Sklinna to Treasure Saga	Spheroidal Distance	164551
Sklinna to Transit Fix	Spheroidal Distance	165004
Sklinna to Treasure Saga	Lane Count	1779.35
Sklinna to Transit Fix	Lane Count	1784.24
	Lane Correction	-4.89

Slettringen to Treasure Saga	Grid Distance	152134
Slettringen to Transit Fix	Grid Distance	151822
Slettringen to Treasure Saga	Spheroidal Distance	152189
Slettringen to Transit Fix	Spheroidal Distance	151877
Slettringen to Treasure Saga	Lane Count	1645.67
Slettringen to Transit Fix	Lane Count	1642.30
	Lane Correction	+3.37