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HSE PLAN	(IN A SEPARATE DOCUMENT FOR THIS SURVEY)

1 INTRODUCTION

Fugro-Geoteam AS will undertake a 2D seismic survey in the VIC/P44, VIC/P51, T/35P and EPP32 licences, Australia. The operators for the survey are Santos LTD. The vessel shall be R/V Polar Duke. Specifications for the vessel are found in Appendix 4.

The survey will start with VIC/P44 (492 Km), proceed to VIC/P51 (506 Km) and then to T/35P (1315 km), without recovering equipment if operational feasible. Then recover all equipment and head for EPP32 (392Km). Polar Duke will upon completion head for Perth for demobilisation. The complete program is about 2708 km surface coverage.

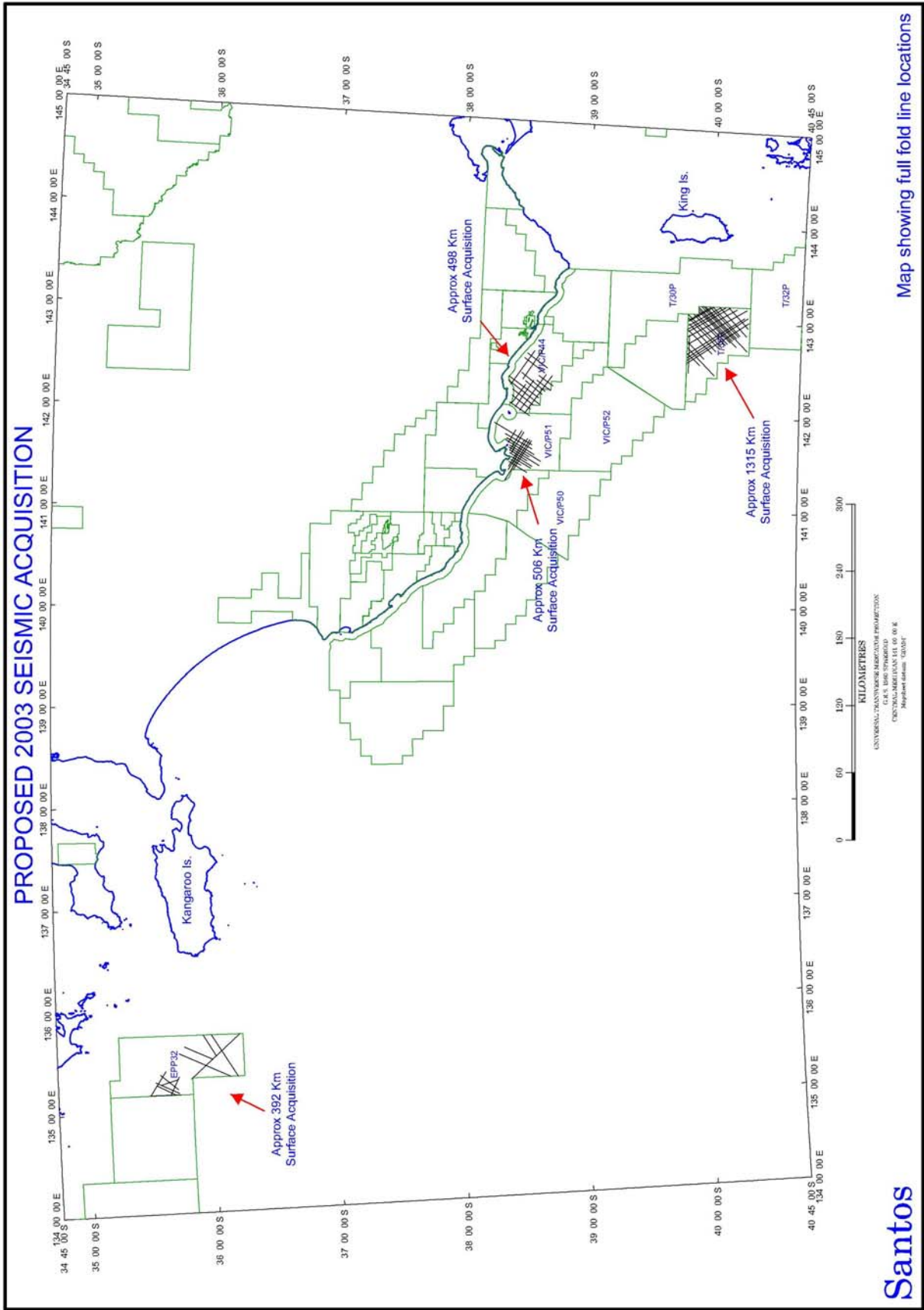
This Project Plan is the guideline for the performance of this project.
Included in this manual is also the MEDEVAC and Emergency Response Plan.
A separate HSE has been made for this project, and has been forwarded to the authorities.

1.1 SCOPE OF WORK

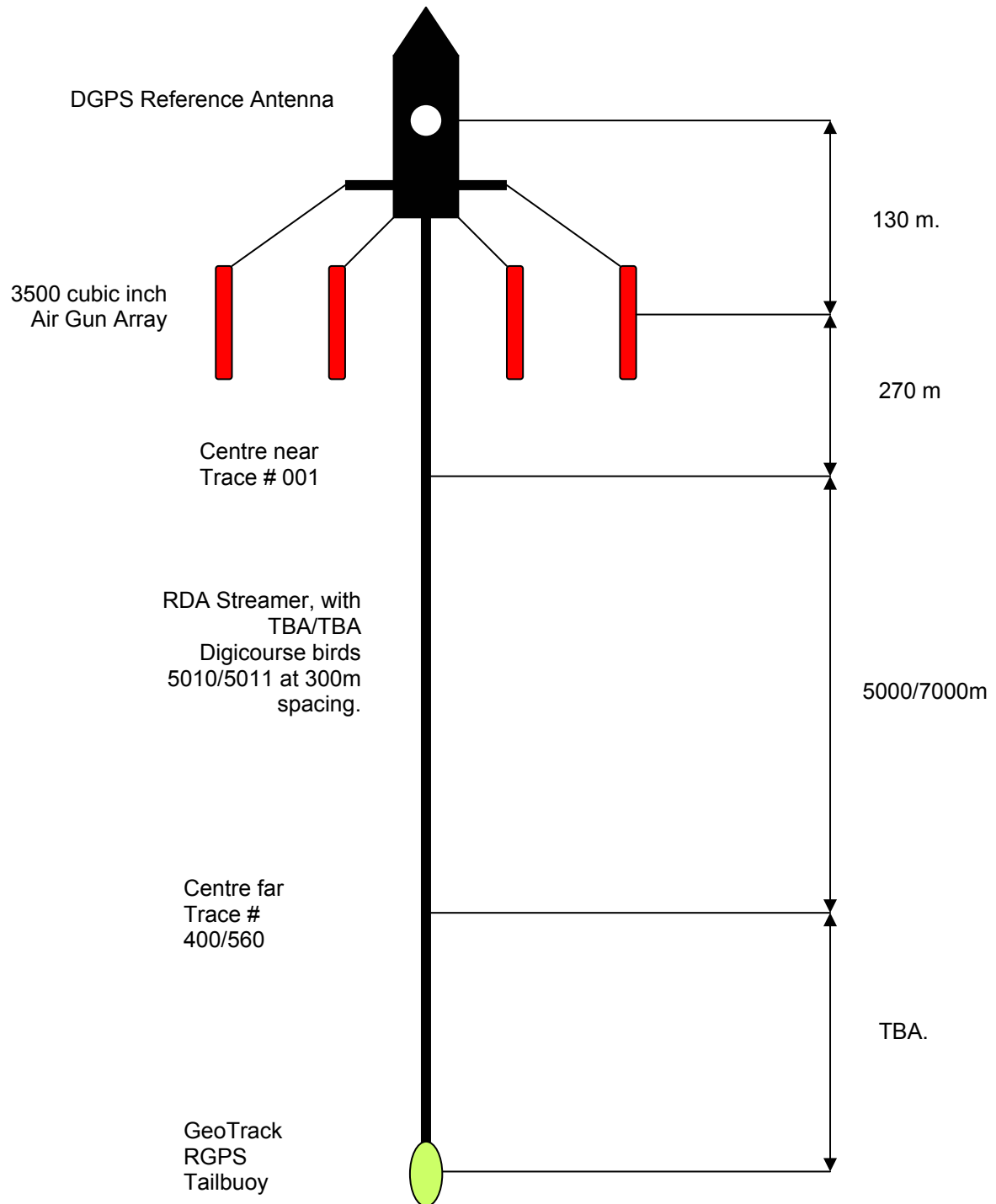
2D seismic survey acquisition:

Client:	Santos Ltd
Location:	South and Sout-west Australia.
Project no:	34949
Survey size:	492 km, 506km, 1315km and 392Km, Total 2708 Surface Km
Vessel:	R/V Polar Duke
Water depth:	> 20 m
Fixed obstructions:	None known.
Number of lines (avg. line):	17(29) km,18(28) km,31(42) km,12(33) km.

1.2 WORK AREA / SURVEY PROGRAM



1.3 SYSTEM LAYOUT



All Dimensions are Nominal

1.4 PLANNING AND PREPARATION - TIME SCHEDULE

Planned start up for the survey is on or around 4th November 2003.
Mobilisation is planned to take place in Singapore.

All of the survey area is within Australian waters. Nearest ports are Portland, Victoria and Penneshaw, off Kangaroo Island, South Australia for site EPP32. The distance from survey areas to closest port are just a few miles, as the sites are close in-shore.

The acquisition phase of the survey should take 40 days, allowing for some delays for weather.

Demobilisation is planned in Portland, Victoria for the three first sites, then Perth on or around 24th December 2003.

The planned duration of the work requires the need for a crew-change during survey. The crew onboard the RV Polar Duke is working a 35-day rotation. The first planned crew change is 26th November 2003. This will hopefully tie in with the completion of the sites in the Bass Strait, before transit to EPP32.

In the case of an emergency port call please find instructions and guidelines in the MEDEVAC Plan specifically made for this project.

1.5 OTHER DOCUMENTATION

The following documentation is referred to directly or indirectly and must be available throughout the survey, to ensure that all information, specifications, guidelines and agreements for this project are available:

- QC Specifications (included in this manual)
- HSE Plan (separate document not included in this manual)
- MEDEVAC Plan (separate document included in this manual)
- Fugro-Geoteam AS' QA and HSE documentation. A master reference list for these documents is found in Appendix 1.
- Health, Safety and Environmental related documents according to contract.

2 ACQUISITION PARAMETERS

Fugro-Geoteam AS will ensure that the equipment in use meets the manufacturers specifications, and also meets Fugro-Geoteam's quality requirement.

2.1 DEFINITION

Acquisition mode:	Single vessel
Configuration:	Single streamer, single source
Shot interval:	25m.
CDP spacing :	12.5 m.
Coverage:	2742 Km full fold

2.2 SEISMIC PARAMETERS.

2.2.1 Seismic recording systems

Recording type:	Syntrac 960
Recording length:	TBA
Sampling rate:	2ms
Low-cut filter:	4 Hz/12 dB
Hi-cut filter:	206Hz , 276dB/Oct
Format:	SEG-D Demux
Tape media:	3590
Source type:	I/O Sleeve Gun.
Recording mod:	Single source

2.2.2 Seismic streamer

Streamer type:	Syntrac RDA
Streamer length:	5000/7000m
Nominal streamer depth:	7 m
Near offset:	70-150 m
No of groups:	400/560
Group interval:	12,5m
Group length:	12,5 m
No of birds:	Every 300m

2.2.3 Energy source:

Source type	:	I/O Sleeve
Air pressure:		2000 psi
Volume:		3500 cubic inch
No of subarray:		4
Source depth:		5 m
Source width:		20m
Source length:		12.5 m
Peak-peak:		106.6 Bm
P/b ratio:		20.9

2.2.4 Gravity and magnetomer

Not planned for this survey.

2.3 GEODETIC PARAMETERS.

2.3.1 Survey datum.

Datum	:	WGS84
Ellipsoid	:	WGS84
Semi Major Axis (a)	:	6.378.137
Inverse Flattening (1/f)	:	298.257
Projection System	:	Universal Transverse Mercator (UTM)
Projection Zone	:	54s
Central Meridian	:	141° East
Scale Factor at CM	:	0.9996
Latitude at Origin	:	0° (Equator)
False Easting	:	500.000
False Northing	:	10.000.000
Grid Units	:	Meters

2.3.2 World Geodetic System 84 (WGS-84)

Ellipsoid	:	WGS84
Semi Major Axis (a)	:	6.378.137,0m
Inverse Flattening (1/f)	:	298,257224

2.3.3 Datum shift WGS-84 to Local datum

X-shift	:	0
Y-shift	:	0
Z-shift	:	0
X-axis rotation	:	0
Y-axis rotation	:	0
Z-axis rotation	:	0
Scale correction	:	0

2.4 LINE NAME CONVENTION

The line naming convention is to be as follows:

XXXX-NNN

Where XXXX is the Prefix, and
NNN is the line number.

2.5 POSITIONING SYSTEMS

Primary Vessel Positioning

System: Starfix Plus with Starfix reference stations
Optus satellite delivering RTCM Type 1 and 3 differential corrections.
Recommended set-up "weighted mean".

Equipment: Starfix Plus Mobile SPM 2000-A
Trimble antenna
Starfix 3000 LR demodulator
Allison Spot antenna
Pentium computer running MRDGPS software

Reference Stations AP-Sat:

Station	ID	Lat	Long	Distance km
Kalgoorlie	315	S 30 40 21	E 121 24 45	2224
Auckland	022	S 36 47 34	E 147 45 50	2769
Broome	185	S 17 57 36	E 122 14 32	3139

Secondary Vessel Positioning

System: STARFIX-MRDGPS with Starfix reference stations.
Optus satellite delivering RTCM Type 1 and 3 differential corrections.
Recommended set-up "VBS".

Equipment: Trimble 4000 DS GPS Receiver
Trimble antenna
Starfix 3000L II demodulator
Allison Spot antenna
Pentium computer running MRDGPS software

Reference Stations Inmarsat POR:

Station	ID	Lat	Long	Distance km
Melbourne	385	S 38 48 29	E 144 57 48	270
Dunedi	026	S 45 52 10	E 170 30 39	2306

2.6 IN SEA POSITIONING SYSTEMS:

Tailbuoy

A Tail-Buoy (TB) will be deployed in the tail of the streamer for positioning.
The TB is fitted with Geo-Track - relative GPS, and radar reflector.

Relevant work book :WB.NAV.002 Tail Buoy Nav. Work Book

Relevant work instruction :WI.NAV.109 Work Instruction for
STARFIX/GEOTRACK Operators

Source Positioning

N/A

Magnetic Compasses and birds

The compasses and birds will be mounted at 300m intervals on the streamer.

A total of TBA depth controllers/compasses will be mounted on the streamer.

The depth controllers / compasses will be Digicourse model 5010 / 5011.

Extra compass birds will be mounted in the front and tail of the streamer for redundancy.

Magnetic Declination

The value at the centre of the survey, , is calculated at.

Location	Centre Survey		Declination
T/35P	40 00 S	143 00 E	11.42 deg
VIC/P44	38 30 S	142 20 E	10.65 deg
VIC/P55	38 25 S	141 35 E	10.27 deg
EPP32	35 50 S	135 30 E	6.94 deg

This is result from using the WMM 2000 model.

2.7 NAVIGATION PROCESSING.

This is to be performed on board, using FGPS Seispos software.

FINAL data format : UKOOA P190
Final data medium : SEG Y
Relevant Procedure : TP.304

3 FIELD WORK PARAMETERS

The contractual commitments for this survey describing the survey performance are found in the attached contract.

3.1 MOBILISATION

Mobilisation will take place in Singapore. End of mobilisation will be in the survey area when the first production shot point is fired, after all equipment and the operation set-up is accepted. During mobilisation the following activities shall take place.

In Port :

- Inventory Check (equipment, consumables and spares)
- Kick-off meeting / Project briefing
- Recording system instrument test
- Final documentation of on board personnel according to requirements
- Final verification that contractual commitments can be met.
- Functionality test of processing equipment
- Test communication facilities/links
- Audit of chase vessel (if chase vessel required)

At Sea :

- Deployment of towed equipment
- Test and demonstrate seismic source performance/timing
- Test and demonstrate streamer performance
- Demonstrate recording system performance
- Demonstrate positioning system performance
- Demonstrate various systems synchronisation and integration to ensure that the total survey package is working together and according to systems specifications.

3.2 CALIBRATION

A complete Gyro check and health check of DGPS system will take place during mobilization in Singapore.

3.3 WEATHER

The climate of the area is temperate with most rainfall occurring during the winter months. Waters are transitional warm to cold temperate, with mean sea surface temperatures varying from 14°C in winter to 19°C in summer. The coastline is typically high energy, with high deepwater wave energy, attenuated by a steep offshore-near shore gradient and offshore reefs which provide for moderate to low energy conditions. Tidal range is small ranging from approximately 0.8 to 1.2 metres range.

During acquisition weather forecasts are available from the Internet on the following address:

<http://buoyweather.com>

Weather forecasts are also available from the NavTex system.

3.4 TIDES AND CURRENTS

Information to be provided during mobilisation or will be obtainable from Admiralty charts and pilot books.

3.5 OBSTRUCTION AND SHALLOWS

There are no known surface obstructions in the area.

3.6 SEISMIC ACTIVITY

Woodside Petroleum is proposing a 3D seismic survey (Antares 3D) in VIC/P37 and part of VIC/P44. Recording for the Woodside survey is scheduled to commence on Oct 1st. This survey should take 20–28 days to complete. Following the Antares 3D for Woodside, Benaris Energy NV is proposing a 3D survey in VIC/P38 and VIC/P43. Recording is scheduled to commence on approximately the 1st Nov and continue for approximately 14 days.

3.7 SHIPPING AND FISHING ACTIVITY

There is expected to be significant shipping traffic, with cargo vessels operating in the busy sea-lanes of the Bass Strait.

There will also be some fishing activity, local vessels operating inshore and foreign and local vessels operating offshore. The amount of fishing activity is not known at this time, however Santos is currently discussing the program with the various fishing cooperatives in the survey areas. Close cooperation will be implemented to ensure minimal impact on seismic and fishing operations. Information will be gained during mobilisation, a chase boat and or fishing liaison skipper will be hired if necessary.

3.8 ENVIRONMENTAL ISSUES

A detailed analysis of environmental issues will be provided in the Environment Plan prepared by Santos. This Project Manual and all other documents relating to the survey must be read in conjunction with the Environment Plan. In addition, the survey operations will comply with all relevant State and Federal Legislation and also any additional conditions placed upon the survey by Environment Australia.

All means to protect the environment from any disturbance caused by the survey will be taken, in accordance with the Environmental Protection Procedure, Marine Operations, SP.711.

3.9 THIRD PARTY INTERFERENCE

There is not expected any third party interference during this survey. Should this occur then the Procedure for dealing with third party action groups SP 703, shall be followed.

3.10 DEMOBILISATION

Demobilisation is expected to take place in Perth, Western Australia, depending on next work. During demobilisation all data that has not been shipped at an earlier time, will be shipped to Santos Ltd.

4 HEALTH, SAFETY AND ENVIRONMENTAL

The Rescue Co-ordination Centre of AusSAR will issue Auscoast warnings through coastal radio stations advising all shipping in the area of the presence of the Polar Duke. It is beholden upon the Master of the Polar Duke to keep the RCC informed of the vessels movements.

The Master shall send a daily fax to the R.C.C. which will identify a box or square of operations by Latitude and Longitude for the next **three** days. Other details shall include the number and length of streamers, and communication details fax, mobile, Inmarsat, etc.

R.C.C. Phone +61 26230 6811

R.C.C. Fax +61 26230 6868

The contractual commitments and instructions regarding HSE for this project are found in the contract.

The following documentation is referred to and forms a part of the requirements / specifications

- E&P Forum 1993, Health Management Guidelines for Remote Land-Based Geophysical Operations. Report No. 6.30/190
- E&P Forum 1994, Health, Safety and Environmental Schedules for Marine Geophysical Operations. Report No. 6.34/206
- E&P Forum 1995, Health, Safety and Environmental Schedules for Land Geophysical Operations. Report No. 6.35/207
- IAGC, 1991, Marine geophysical Operations Safety Manual.
- IAGC, 1994, Environmental Guidelines for World-wide Geophysical Operations.

4.1 HSE ORGANISATION / SAFETY DELEGATE

F-GAS have one safety delegate for each crew onboard the RV Poar Duke

The ships master has overall responsibility for safety of the vessel and crew.

The Party Chief will chair the safety meetings.

The safety delegate will take the meeting minutes.

The Party Chief will report all accidents and near misses

The safety delegate will ensure that all accidents and near misses are reported.

The Party Chief will follow up points from safety meetings and action register.

The Chief Officer will lead the induction tour for new crew members.

The Chief Mate will be responsible for the routine safety round.

4.2 EMERGENCY SITUATIONS

For all emergency situations see the attached HSE plan for instructions.

4.3 HSE ACTIVITY PLAN

Activity

- One MOB drill at mobilisation
- One drill every week and when a major part of the crew has been changed.
- Two toolbox meeting every week at all departments
- One safety meeting every second week
- Safety tour to be given to all new crew members at joining the vessel
- Unsafe act auditing shall be continuous by all crew members.

Res. person

Captain
Captain

Dep. Chief
Captain/PC
Ch Mate

All

4.4 HSE OBJECTIVES

To conduct all aspects of the work in a manner compatible with the high Health, Safety and Environmental standards set out by Santos Ltd. and Fugro-Geoteam AS in their respective Corporate HSE Policies.

To conduct all drills, HSE meetings and Unsafe Act Audits in line with the HSE Activity Plan.

The stringent implementation of contractual HSE requirements.

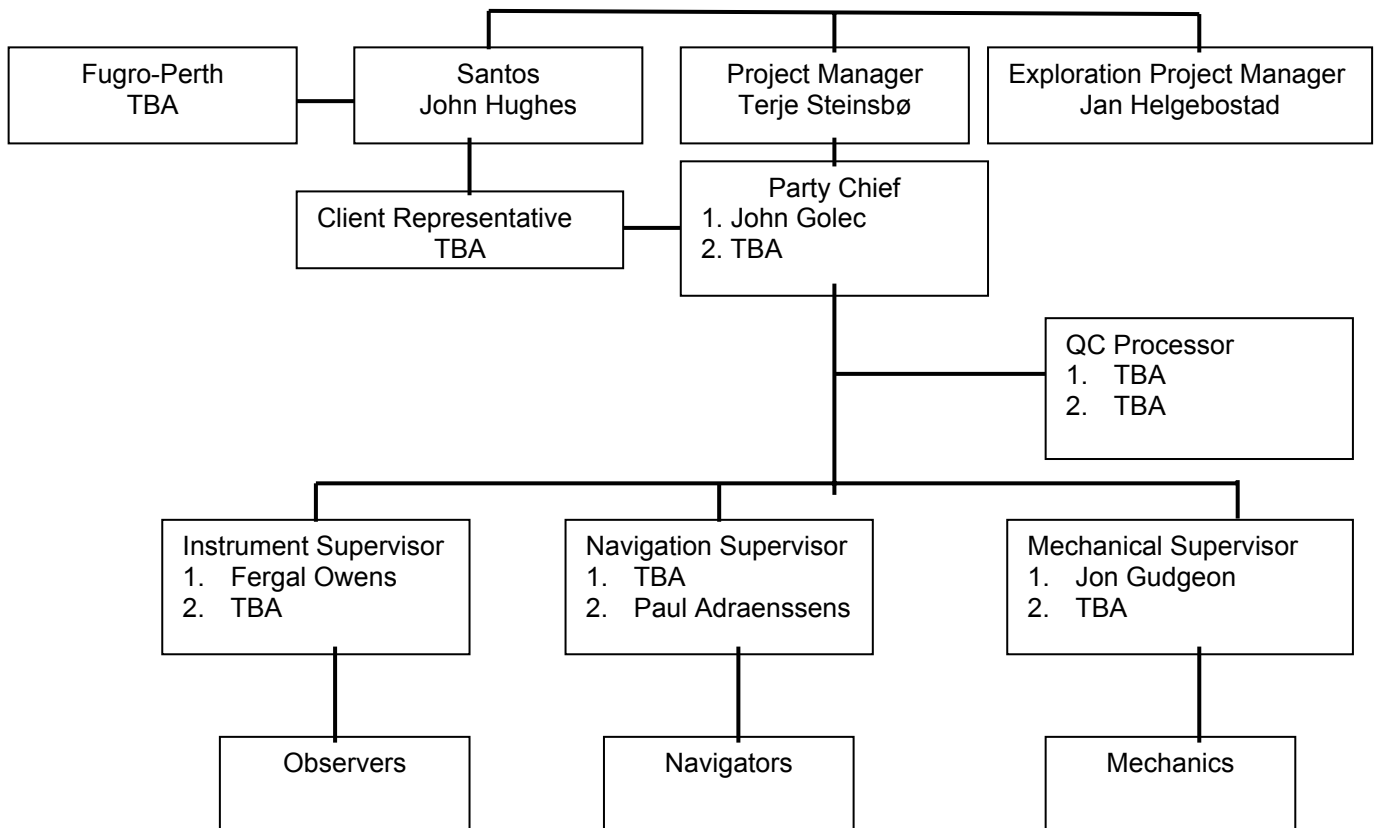
To have an active program of visits by Santos and Fugro-Geoteam AS personnel

4.5 HSE TARGETS

- Zero lost time incidents.
- Zero restricted work cases.
- Minimise the number of minor incidents.
- No incidents regarding the environment. (Pollution, wild life).
- Maintain a working environment free from work related illness.
- Increase the awareness of HSE issues among the employees.
- One MOB drill within first week of project.
- One drill every week.
- A MEDEVAC dry-run at arrival on site.
- Two toolbox meetings every week at all departments.
- Unsafe act auditing shall be continuous by all crew members.
- Near misses and unsafe acts shall be reported.

5 ORGANISATION AND COMMUNICATION

5.1 ORGANISATION CHART



5.2 COMMUNICATION LINES

The communication and reporting lines will follow the lines drawn on the above project organisation.

For emergency situations please revert to the HSE Plan attached.

Santos Ltd and the Party Chief will be advised weekly on the current duty officer for contact outside normal office hours.

A daily report signed by the Client rep onboard and Party Chief will be prepared onboard and sent to Santos Ltd. and Fugro-Geoteam AS offices by electronic mail or fax. This report is to be received at the offices no later than 08:00 UTC the next day.

Mail addresses for the daily report:

Marops@fugro.geoteam.no

t.steinsbo@fugro.geoteam.no

j.helgebostad@fugro.geoteam.no

Daily report to be sent to Santos Ltd by fax or email to:

john.hughes@santos.com

andrew.white@santos.com

thom.jewell@santos.com

5.3 CREW LIST AND PERSONNEL

Crew lists are found in Appendix 2.

Key personnel/positions are defined as:

- Project Manager
- Captain
- Chief Officer
- Party Chief
- Safety Delegate
- Chief Observer
- Chief Surveyor
- Chief Gun
- Chief Seismologist

5.4 PERSONNEL REQUIREMENTS AND QUALIFICATIONS

All personnel sailing with the vessel should have a valid safety training course, i.e. basic fire fighting, first aid and survival training. All personnel sailing with the vessel must have a valid health certificate.

6 RESOURCE REQUIREMENTS

The project manager shall insure that adequate resources are made available to satisfy the project requirements in accordance with the contract and the relevant QA system technical procedures. These shall include, but not be limited to:

- A review of the personnel resources, with reference to Fugro-Geoteam AS Staff Training and Training Procedure (Document no AP.211)
- Material resources
- Consumable resources
- Time
- Hired in resources

Ref.: Fugro-Geoteam AS Project Management Procedure Document no AP.209

6.1 DURING PLANNING AND PREPARATION

The Project Manager has overall responsibility for all preparations prior to mobilisation, to make sure that required resources are available when needed.

He will work in co-operation with the Party Chief to ensure that the requirements for personnel, equipment and consumables are met.

The Project Manager will request assistance if needed.

6.2 DURING MOBILISATION

This will take place on or around 1st October, Singapore. An onboard briefing will be held for all survey and ship's crew. Mobilisation time in port will be kept to a minimum.

There should not, under normal condition, be any further need for resources other than the personnel dedicated to the project and found in the Project Organisation Chart.

If other resources are required, these will be ordered by the Project Manager.

The Party Chief will be responsible for carrying out equipment deployment and testing using the resources available on board. It is essential that the Party Chief ensure that required on board resources are made available during mobilisation.

6.3 DURING ACQUISITION

Additional resources shall be ordered by the Project Manager if required.

6.4 DURING DEMOBILISATION

There should be no need for additional resources during demobilisation.

6.5 EXTERNAL RESOURCES AVAILABILITY / QUALIFICATION.

If needed, the Project Manager will order external resources.

7 ADMINISTRATION

The project manager and in his absence the deputy project manager is responsible for all primary contact with Santos for this project.

The project manager will set up all sub-contracts, deals with all major suppliers and control the financial aspects of the project. The project manager will set up mobilisation and acquisition plans. The vessel manager will supervise actual vessel mobilisation and day-to-day co-ordination of the vessel operations.

The Navigation Supervisor will supervise the installation and setting up of the DGPS for the vessel.

DGPS will be supported from FUGRO-GEOTEAM A.S in Oslo.

Final reporting will be carried out in Oslo. The project manager will be overall responsible for the report.

7.1 EQUIPMENT MAINTENANCE, TEST, INSPECTION AND MODIFICATION

It is the responsibility of the Chief of each department on board to ensure that all survey equipment is maintained, tested, inspected and modified according to manufacturer specifications and Fugro-Geoteam AS procedures.

Any non-conforming equipment shall be reported to the Party Chief who will report to the Client representative and Fugro-Geoteam AS Project Manager.

Relevant Technical Procedures :

TP. 308 Equipment Maintenance and Repair

TP. 309 Control of Inspection, Measuring and Test Equipment

7.2 EQUIPMENT AND SERVICE PURCHASE

Purchase of equipment and service shall be according to Fugro-Geoteam AS. Purchasing Procedure, AP 201.

For purchasing of equipment and service regarding this specific project the Fugro-Geoteam AS Project Manager will have overall responsibility, and any purchase shall be reported to, or confirmed by, him.

7.3 INTERNAL COMMUNICATION AND REPORTING

Internal communication and reporting shall follow the lines drawn in the Project Organisation Chart.

The supervisor for each department shall report status and progress to the Party Chief.

The Party Chief shall prepare a "Daily Fax". This shall be forwarded to:

1. Client representative on board for comments
2. Santos by fax or e-mail
3. Fugro-Geoteam AS Project Manager per fax or modem or Email

7.4 PROGRESS PLANS AND FOLLOW-UP CONTROL

The data acquisition for the project is scheduled to be completed in approximately 8 weeks inclusive of mobilisation and demobilisation.

Project progress will be reported by the Party Chief according to above instructions to the Project Manager and the Client representative.

Project Manager will compare progress plan and project progress and keep track of project development. Project Manager will report to the Manager of Marine Operations.

7.5 COMMUNICATION AND REPORTING TO CLIENT

On board

All on board communication and reporting with the Client will be :

- Between the Party Chief and the Client representative regarding operational matters on board.

On shore / Office

Fugro-Geoteam AS responsible contact person will be the Project Manager. All communication between the Client and Fugro-Geoteam AS office regarding contractual matters and the performance of the work will be with the Project Manager.

7.6 INVOICE AND COST CONTROL/HANDLING

The Project Manager will handle all cost control and invoicing. He will be responsible for keeping cost and penalties to a minimum.

The invoice will be prepared according to contract.

7.7 DATA SHIPMENT / SHIPMENTS IN GENERAL

All material shall be protected from damage or detonation during handling, storage and delivery using suitable packing. Packages or boxes shall be sufficient labelled to ensure that identification and tracing of material is assured at all times.

Originals and Copies of data cartridges will be shipped separately.

The Copies will be held onboard until the originals have been received at the processing centre.
To summarise

Shipment 1: Originals set 1.

Shipment 2: Copies set 1 + Originals set 2

Shipment n: Copies set (n-1) + Originals set n.

All material shall be packed for delivery prior to shipping. The shipment shall be fully documented. The documentation shall contain sufficient details to ensure that identification and tracing of material is assured at all times.

Ref.: Fugro-Geoteam AS Material Handling Procedure, AP.207

Data will be shipped to: To be advised at a later date.

8 AUDITS

It is Fugro-Geoteam AS's policy to conduct internal audit on the vessels once a year. On these audits there will be a general part, a follow up of external audit performed on the vessel, and one specific part where Fugro-Geoteam AS will audit one special item or procedure.

It is the policy of Fugro-Geoteam AS to conduct internal audits in the office.

Fugro-Geoteam AS may have the need to use sub-contractors on both equipment and personnel. These sub-contractors will have to meet Fugro-Geoteam AS QA procedure "Vendor/sub-contractor assessment and selection procedure" doc no AP.208.

9 EXPERIENCE AND FEEDBACK

Fugro-Geoteam AS experience and feedback shall be included in the Project File prepared by the Party Chief for each project and forwarded to the Project Manager. It is important also to register Clients' feedback and comments during the progress of the fieldwork. It is the responsibility of the Party Chief to collect and log such feedback. Copies of all Feedback Forms and Client Feedback Log will be passed to the Project Manager.

Prior to or during demobilisation it is the responsibility of the Project Manager to ensure that the Party Chief gives feedback.

Project Manager will approach Client / Client representative for feedback at completion of the work, and collect information regarding:

- Vessel
- Safety
- Accommodation
- Technical solutions
- Survey/work performance
- Survey Crew qualifications and performance

Copies of the Feedback Form will also be forwarded to the QA/HSE Manager,

9.1 FEEDBACK EVALUATION AND CONTROL

The Project Manager, Manager Marine Operations and QA/HSE Manager will evaluate all feedback. Personnel and/or personnel involved in operations affected by the feedback might be contacted to ensure that the feedback is understood correctly.

9.2 ACTIVATION OF IMPROVEMENTS

Based on the feedback given and evaluation and control performed conclusions for improvements are made. Details of improvements found necessary will be passed back to involved personnel and/or Client.

The manager of Marine Operations or the QA/HSE Manager is responsible for activation of the improvements.

10 CONTACTS AND ADDRESSES

10.1 CONTRACTOR

Fugro-Geoteam AS
Hoffsveien 1C
PO Box 490 Skøyen
N-0213 Oslo, Norway

Operations Manager,

Hans Christian Vaage
+47 22 13 46 08 (office)
+47 91 63 24 85 (mobile)
h.c.vaage@fugro.geoteam.no (e-mail)

Project Manager,

Terje Steinsbø
+47 22 13 46 61 (office)
+47 97 61 18 87 (mobile)
t.steinsbo@fugro.geoteam.no (e-mail)

For contract matters

Jan Helgebostad
+47 22 13 46 18 (office)
+47 97 01 67 25 (mobile)
j.helgebostad@fugro.geoteam.no (e-mail)

Emergency contacts:

Duty Officer telephone (mobile): +47 900 55391 (24 hour)
Duty officer with private telephone number will be announced each week

10.2 CLIENT

Santos Ltd

Project Manager

John Hughes
Chief Operations Geophysicist
+61 8 8224 7952 (office)
+61 8 8224 7258 (facsimilie)
john.hughes@santos.com (email)

Stuart Brew
Senior Staff Geophysicist
+61 8 8224 7625 (office)
+61 8 8224 7258 (facsimilie)
stuart.brew@santos.com (email)

Emergency contacts:

Duty Officer No: TBA

10.3 RV POLAR DUKE

Port of Registration: Bergen

Flag: NIS

Phone/Fax numbers:

Marisat: PC Office +871/+873/+874 325 745 512

Marisat: Bridge +871/+873/+874 325 745 511

Marisat Radio Room: +871/+873/+874 325 745 510

Marisat Fax: +871/+873/+874 325 745 514

10.4 VESSEL OWNERS

Rieber-Shipping AS

Solheimsgt 13

PO Box 1114, Sentrum

N-5809 Bergen

Norway

Contact: Norvald Boge

Tel +47 55599632

Fax +47 55599605

superintendents@rieber-shipping.no

10.5 CHASE BOAT

10.6 AGENTS

10.6.1 Melbourne, Victoria

Beaufort Shipping Agency Co
99 Queensbridge St
Southbank
VIC, 3006
Ph 03 9254 599

H0100	PERMIT	VIC/P44					
H0101	SURVEY NAME	OS03B MSS (OTWAY SANTOS 2003B MARINE SEISMIC SURVEY)					
H0102	VESSEL DETAILS	R/V POLAR DUKE					
H0200	SURVEY DATE	PROPOSED NOVEMBER 2003					
H0202	TAPE VERSION	UKOOA P1/90					
H0203	LINENAME PREFIX	OS03B-					
H0300	CLIENT	Santos Pty. Ltd.					
H0400	GEOPHYSICAL CONTRACTOR	FUGRO-GEOTEAM AS					
H1400	GEODETIC DATUM AS SURVEYED	WGS-84	WGS-84	6378137.000	298.2572240		
H1401	TRANSFORMATION TO WGS-84	0.0	0.0	0.0	0.000	0.000	0.0000000
H1500	GEODETIC DATUM AS PLOTTED	GDA-94	GRS-80	6378137.000	298.257222101		
H1501	TRANSFORMATION TO GDA-94	0.0	0.0	0.0	0.000	0.000	0.0000000
H1800	PROJECTION TYPE	Universal Transverse Mercator					
H1900	PROJECTION ZONE	54 S					
H2000	GRID UNITS	1METRES					1.000000000000
H2001	HEIGHT UNITS	1METRES					1.000000000000
H2002	ANGULAR UNITS	1DEGREES					
H2200	CENTRAL MERIDIAN	141 0 0.000E					
H2301	GRID ORIGIN (LAT, LONG)	0 0 0.000N 141 0 0.000E					
H2302	GRID ORIGIN (EAST, NORTH)	500000.00E10000000.00N					
H2401	SCALE FACTOR	0.9996000000					
H2402	LAT/LONG WHERE SCALE DEF	0 0 0.000N141 0 0.000E					
H2600	OTHER DETAILS	PROPOSED FULL FOLD LINE ENDS					
OS03B-01		101383452.04S	1415832.17E	584976	5729254		
OS03B-01		1000382553.15S	1420611.18E	596281	5745739		
OS03B-02		101382539.68S	1421806.40E	613628	5745928		
OS03B-02		1000383630.26S	1423836.27E	643091	5725397		
OS03B-03		101383512.16S	1420235.78E	590863	5728569		
OS03B-03		1000382649.56S	1421031.94E	602581	5743922		
OS03B-04		101383118.75S	1422101.86E	617729	5735415		
OS03B-04		1000384055.11S	1424041.18E	645963	5717178		
OS03B-05		101383635.43S	1420510.17E	594568	5725959		
OS03B-05		1000382656.63S	1421415.49E	607997	5743633		
OS03B-06		101382602.48S	1420558.54E	595971	5745455		
OS03B-06		1000383240.00S	1421742.54E	612867	5732980		
OS03B-07		101383931.75S	1420544.90E	595343	5720514		
OS03B-07		1000382455.36S	1421933.40E	615757	5747264		
OS03B-08		101382756.67S	1420353.51E	592899	5741971		
OS03B-08		1000383622.31S	1422021.57E	616617	5726072		
OS03B-09		101383904.28S	1420945.42E	601167	5721289		
OS03B-09		1000382435.12S	1422230.32E	620057	5747825		
OS03B-10		101383001.86S	1420143.08E	589695	5738148		
OS03B-10		1000384219.25S	1422411.95E	622021	5714986		
OS03B-11		101384039.16S	1421158.68E	604350	5718323		
OS03B-11		1000383228.21S	1421953.47E	616042	5733298		
OS03B-12		101383223.50S	1415954.39E	587015	5733811		
OS03B-12		1000384515.84S	1422330.13E	620928	5709558		
OS03B-13		101384206.64S	1421352.42E	607062	5715590		
OS03B-13		1000383038.70S	1422510.62E	623772	5736559		
OS03B-15		101384443.04S	1421419.34E	607647	5710760		
OS03B-15		1000383803.40S	1422032.63E	616839	5722952		
OS03B-17		101384547.32S	1421718.00E	611932	5708719		
OS03B-17		1000383855.24S	1422338.89E	621318	5721287		
OS03B-19		101384134.99S	1422512.27E	623499	5716328		
OS03B-19		1000383150.53S	1423418.72E	637009	5734129		
OS03B-21		101384241.13S	1422823.62E	628089	5714216		
OS03B-21		1000383313.61S	1423702.68E	640934	5731499		

H0100	PERMIT	VIC/P51			
H0101	SURVEY NAME	OS03 MSS (OTWAY SANTOS 2003 MARINE SEISMIC SURVEY)			
H0102	VESSEL DETAILS	R/V POLAR DUKE			
H0200	SURVEY DATE	PROPOSED NOVEMBER 2003			
H0202	TAPE VERSION	UKOOA P1/90			
H0203	LINENAME PREFIX	OS03-			
H0300	CLIENT	Santos Pty. Ltd.			
H0400	GEOPHYSICAL CONTRACTOR	FUGRO-GEOTEAM AS			
H1400	GEODETIC DATUM AS SURVEYED	WGS-84	WGS-84	6378137.000	298.2572240
H1401	TRANSFORMATION TO WGS-84	0.0	0.0	0.0	0.0000000
H1500	GEODETIC DATUM AS PLOTTED	GDA-94	GRS-80	6378137.000	298.257222101
H1501	TRANSFORMATION TO GDA-94	0.0	0.0	0.0	0.0000000
H1800	PROJECTION TYPE	Universal Transverse Mercator			
H1900	PROJECTION ZONE	54 S			
H2000	GRID UNITS	1METRES		1.000000000000	
H2001	HEIGHT UNITS	1METRES		1.000000000000	
H2002	ANGULAR UNITS	1DEGREES			
H2200	CENTRAL MERIDIAN	141 0 0.000E			
H2301	GRID ORIGIN (LAT, LONG)	0 0 0.000N 141 0 0.000E			
H2302	GRID ORIGIN (EAST, NORTH)	500000.00E1000000.00N			
H2401	SCALE FACTOR	0.9996000000			
H2402	LAT/LONG WHERE SCALE DEF	0 0 0.000N141 0 0.000E			
H2600	OTHER DETAILS	PROPOSED FULL FOLD LINE ENDS			
OS03-01	101383409.30S1412338.07E	534315	5730949		
OS03-01	1000382530.82S1413007.17E	543818	5746884		
OS03-02	101382458.22S1414150.20E	560872	5747778		
OS03-02	1000382829.02S1414927.20E	571896	5741189		
OS03-03	101383112.33S1412752.64E	540503	5736375		
OS03-03	1000382629.37S1413123.73E	545664	5745069		
OS03-04	101382547.24S1413702.21E	553878	5746317		
OS03-04	1000383124.13S1414915.94E	571575	5735794		
OS03-05	101383603.25S1412609.55E	537964	5727420		
OS03-05	1000382639.08S1413315.72E	548377	5744754		
OS03-06	101382630.32S1413527.49E	551573	5745004		
OS03-06	1000383220.68S1414819.82E	570201	5734063		
OS03-07	101383632.56S1412721.59E	539702	5726508		
OS03-07	1000382549.89S1413522.63E	551463	5746251		
OS03-08	101382524.03S1412706.45E	539437	5747116		
OS03-08	1000383253.17S1414339.72E	563412	5733118		
OS03-09	101383408.54S1413055.69E	544905	5730920		
OS03-09	1000382542.80S1413712.36E	554125	5746452		
OS03-10	101382516.66S1412505.81E	536513	5747357		
OS03-10	1000383417.31S1414429.29E	564591	5730515		
OS03-11	101384005.91S1412754.89E	540474	5719928		
OS03-11	1000382517.87S1413903.33E	556821	5747202		
OS03-12	101382342.11S1411841.25E	527198	5750308		
OS03-12	1000383524.60S1414341.91E	563428	5728450		
OS03-13	101383510.37S1413312.08E	548194	5728995		
OS03-13	1000382547.55S1414013.14E	558507	5746275		
OS03-14	101382738.75S1412459.70E	536345	5742978		
OS03-14	1000383603.53S1414305.26E	562532	5727257		
OS03-15	101384047.89S1413037.77E	544403	5718613		
OS03-15	1000382350.30S1414319.01E	563042	5749855		
OS03-17	101383733.88S1413441.89E	550339	5724558		
OS03-17	1000382421.08S1414432.13E	564808	5748892		
OS03-19	101383620.17S1413801.78E	555188	5726798		
OS03-19	1000382329.01S1414706.97E	568577	5750466		
OS03-21	101383619.41S1414046.87E	559181	5726793		
OS03-21	1000381811.40S1415356.09E	578597	5760165		

H0100	PERMIT	EPP32							
H0101	SURVEY NAME	DS03 MSS (DUNTROON SANTOS 2003 MARINE SEISMIC SURVEY)							
H0102	VESSEL DETAILS	R/V POLAR DUKE							
H0200	SURVEY DATE	PROPOSED NOVEMBER 2003							
H0202	TAPE VERSION	UKOOA P1/90							
H0203	LINENAME PREFIX	DS03-							
H0300	CLIENT	Santos Pty. Ltd.							
H0400	GEOPHYSICAL CONTRACTOR	FUGRO-GEOTEAM AS							
H1400	GEODETIC DATUM AS SURVEYED	WGS-84	WGS-84	6378137.000	298.2572240				
H1401	TRANSFORMATION TO WGS-84	0.0	0.0	0.0	0.000	0.000	0.000	0.0000000	
H1500	GEODETIC DATUM AS PLOTTED	GDA-94	GRS-80	6378137.000	298.257222101				
H1501	TRANSFORMATION TO GDA-94	0.0	0.0	0.0	0.000	0.000	0.000	0.0000000	
H1800	PROJECTION TYPE	Universal Transverse Mercator							
H1900	PROJECTION ZONE	53 S							
H2000	GRID UNITS	1METRES			1.000000000000				
H2001	HEIGHT UNITS	1METRES			1.000000000000				
H2002	ANGULAR UNITS	1DEGREES							
H2200	CENTRAL MERIDIAN	135 0 0.000E							
H2301	GRID ORIGIN (LAT, LONG)	0 0 0.000N 135 0 0.000E							
H2302	GRID ORIGIN (EAST, NORTH)	500000.00E10000000.00N							
H2401	SCALE FACTOR	0.9996000000							
H2402	LAT/LONG WHERE SCALE DEF	0 0 0.000N135 0 0.000E							
H2600	OTHER DETAILS	PROPOSED FULL FOLD LINE ENDS							
DS03-01	101354347.26S1351016.75E	515493	6046007						
DS03-01	1000352923.36S1351014.03E	515471	6072622						
DS03-02	101353914.32S1351012.82E	515409	6054416						
DS03-02	1000354326.65S1352049.36E	531387	6046600						
DS03-03	101354146.88S1351014.70E	515448	6049716						
DS03-03	1000353230.10S1351554.62E	524037	6066850						
DS03-04	101353432.86S1351623.52E	524754	6063066						
DS03-04	1000354253.96S1351917.32E	529078	6047615						
DS03-05	101354308.45S1351114.50E	516946	6047200						
DS03-05	1000353202.78S1351753.75E	527039	6067683						
DS03-06	101352919.93S1351007.00E	515294	6072728						
DS03-06	1000353707.26S1352419.76E	536721	6058268						
DS03-07	101354248.50S1351324.12E	520204	6047808						
DS03-07	1000353428.06S1352205.26E	533356	6063186						
DS03-08	101354921.22S1351931.32E	529390	6035683						
DS03-08	1000361311.26S1354504.48E	567520	5991411						
DS03-09	101360754.54S1352006.74E	530161	6001379						
DS03-09	1000354352.74S1353426.22E	551904	6045700						
DS03-11	101355954.59S1353027.41E	545751	6016099						
DS03-11	1000354633.58S1353822.62E	557810	6040708						
DS03-13	101360137.65S1353225.42E	548688	6012908						
DS03-13	1000355533.97S1354504.26E	567766	6023987						
DS03-15	101361143.49S1352006.84E	530139	5994325						
DS03-15	1000355941.02S1354501.05E	567627	6016376						

H0100 PERMIT	T/35P		
H0101 SURVEY NAME	SS03 MSS (SORELL SANTOS 2003 MARINE SEISMIC SURVEY)		
H0102 VESSEL DETAILS	R/V POLAR DUKE		
H0200 SURVEY DATE	PROPOSED NOVEMBER 2003		
H0202 TAPE VERSION	UKOOA P1/90		
H0203 LINENAME PREFIX	SS03-		
H0300 CLIENT	Santos Pty. Ltd.		
H0400 GEOPHYSICAL CONTRACTOR	FUGRO-GEOTEAM AS		
H1400 GEODETIC DATUM AS SURVEYED	WGS-84	WGS-84	6378137.000 298.2572240
H1401 TRANSFORMATION TO WGS-84	0.0	0.0 0.0 0.000	0.000 0.000 0.0000000
H1500 GEODETIC DATUM AS PLOTTED	GDA-94	GRS-80	6378137.000 298.257222101
H1501 TRANSFORMATION TO GDA-94	0.0	0.0 0.0 0.000	0.000 0.000 0.0000000
H1800 PROJECTION TYPE	Universal Transverse Mercator		
H1900 PROJECTION ZONE	54 S		
H2000 GRID UNITS	1METRES		1.000000000000
H2001 HEIGHT UNITS	1METRES		1.000000000000
H2002 ANGULAR UNITS	1DEGREES		
H2200 CENTRAL MERIDIAN	141 0 0.000E		
H2301 GRID ORIGIN (LAT, LONG)	0 0 0.000N 141 0 0.000E		
H2302 GRID ORIGIN (EAST, NORTH)	500000.00E1000000.00N		
H2401 SCALE FACTOR	0.9996000000		
H2402 LAT/LONG WHERE SCALE DEF	0 0 0.000N141 0 0.000E		
H2600 OTHER DETAILS	PROPOSED FULL FOLD LINE ENDS		
SS03-01	101395053.59S1422754.17E	625335	5588062
SS03-01	1000395052.72S1425140.52E	659233	5587458
SS03-02	101395019.45S1430121.42E	673062	5588184
SS03-02	1000400018.33S1430922.17E	684043	5569451
SS03-03	101395615.00S1423304.05E	632527	5578028
SS03-03	1000395016.28S1424009.48E	642831	5588906
SS03-04	101395022.38S1430026.23E	671748	5588123
SS03-04	1000400213.49S1430957.02E	684783	5565880
SS03-05	101400329.92S1422653.60E	623517	5564766
SS03-05	1000395017.69S1424338.53E	647799	5588768
SS03-06	101395023.22S1425753.53E	668118	5588178
SS03-06	1000400524.81S1430940.54E	684249	5559990
SS03-07	101395812.84S1423709.77E	638293	5574291
SS03-07	1000395017.49S1424731.68E	653341	5588665
SS03-08	101395025.01S1425553.17E	665256	5588185
SS03-08	1000400752.89S1430942.18E	684177	5555423
SS03-09	101400157.87S1424031.95E	642959	5567264
SS03-09	1000395024.91S1425448.67E	663723	5588221
SS03-10	101395022.62S1425408.68E	662774	5588312
SS03-10	1000401005.05S1430940.46E	684037	5551349
SS03-11	101400347.52S1424212.57E	645279	5563838
SS03-11	1000395031.95S1425854.20E	669554	5587877
SS03-12	101395022.68S1425044.38E	657918	5588412
SS03-12	1000401321.39S1430840.95E	682483	5545329
SS03-13	101400533.47S1424344.56E	647395	5560529
SS03-13	1000395018.32S1430231.44E	674727	5588181
SS03-14	101395021.90S1424615.65E	651531	5588565
SS03-14	1000401811.27S1430828.94E	681983	5536397
SS03-15	101400633.74S1424435.76E	648571	5558647
SS03-15	1000395008.78S1430428.32E	677512	5588411
SS03-16	101395016.06S1423957.65E	642550	5588918
SS03-16	1000401713.55S1430321.41E	674764	5538349
SS03-17	101400824.02S1424615.56E	650866	5555200
SS03-17	1000395249.00S1430447.88E	677862	5583460
SS03-18	101395021.50S1423750.22E	639518	5588806
SS03-18	1000401857.05S1430324.12E	674754	5535156
SS03-19	101400912.15S1424653.75E	651740	5553698
SS03-19	1000395400.59S1430502.00E	678146	5581245
SS03-20	101395021.96S1423607.27E	637071	5588836
SS03-20	1000400129.23S1424553.05E	650587	5568000
SS03-21	101401026.84S1424758.57E	653227	5551364
SS03-21	1000395506.94S1430640.64E	680440	5579144
SS03-22	101395021.45S1423426.88E	634685	5588894
SS03-22	1000401923.49S1430021.08E	670415	5534440
SS03-23	101401335.03S1424520.53E	649374	5545636
SS03-23	1000395506.18S1430806.28E	682474	5579119
SS03-25	101401132.72S1424904.34E	654741	5549301
SS03-25	1000395501.10S1430926.57E	684384	5579230
SS03-27	101401223.38S1424953.20E	655864	5547715
SS03-27	1000395615.81S1430955.04E	685004	5576910
SS03-29	101401854.50S1424239.37E	645375	5535860
SS03-29	1000395711.33S1431003.66E	685167	5575193

SS03-31	101401328.88S1425037.27E	656864	5545674
SS03-31	1000395812.30S1431003.94E	685128	5573313
SS03-33	101401434.65S1425137.63E	658248	5543616
SS03-33	1000400034.96S1430941.55E	684490	5568927
SS03-35	101401511.39S1425212.11E	659039	5542466
SS03-35	1000400149.48S1430952.17E	684686	5566623
SS03-37	101401831.34S1425203.27E	658700	5536305
SS03-37	1000400510.14S1430955.27E	684609	5560434
SS03-39	101401902.08S1425700.13E	665687	5535206
SS03-39	1000400934.47S1430947.44E	684225	5552288



R/V POLAR DUKE

C O N T E N T S

1. VESSEL

- 1.1. VESSEL GENERAL
- 1.2. VESSEL NAVIGATION AIDS
- 1.3. VESSEL COMMUNICATION
- 1.4. VESSEL SAFETY

2. SEISMIC

- 2.1. SEISMIC RECORDING INSTRUMENT
- 2.2. STREAMER
- 2.3. ENERGY SOURCE
- 2.4. NAVIGATION EQUIPMENT
- 2.5. ONBOARD PROCESSING

1. VESSEL

1.1. VESSEL GENERAL

Name:	R/V Polar Duke
Owner:	Rieber Shipping AS
Operator:	Rieber Shipping AS
Type:	2D Seismic vessel
Port of Registration:	Bergen
Flag:	NIS
Class:	DnV+1A1-E0-HELDK-Sealer.
DNV Id. No.	13520
Call Sign:	LACS4
IMO:	8200838
Year Built/Rebuilt:	1983 Norway, Rebuilt to 2D Seismic-May 1998
Length overall:	66,80 m
Beam:	13,00 m
Draught, loaded:	5,80 m
Tonnage:	1696 GRT, 509 net
Cruising Speed:	13 knots, 10 knots with one engine
Operation Range:	11625 N.M. at 12,5 knots
Endurance seismic : days max. load.:	42 days
Main Engine:	2 x MaK 6M 453aK, 2250 HP each (1650 Kw)
Gearbox:	Tacke NDS 2251A Twin input, Single output. PTO for shaft generator.
Propulsion:	Propeller Hjelset RKT 260/R500/90.
Rudder:	Standard Spade with heel bearing.
Steering:	Tenfjord I-12M260/2GM430.12t*m /80bar
Azimuth thruster:	Brunvoll SPX-VP 578 HP Electric Driven
Bow Thruster:	Brunvoll SPX-VP 578 HP Electric Driven
Main engine monitoring:	Autronica
Electrical power:	Shaft gen.1 x Stamford MHC 734-H.1650 kva,3x440V,60hz 2 X Stamford MC 534C-305 kVA aux generator 440 / 220V / 60Hz 1 x Stamford MC 334C-112,5 kVA aux generator (Harbour Gen.)
Emergency generator:	GM Detroit 1043-7305, 175 bhp
Clean power:	UPS 1: IMV Victron D5/6/8/10-11ups 6kva/4.8kw UPS 2: Sola 610, 10kva
Fuel Capacity:	(660m3 90% Full / 740m3 100%)
Fuel Consumption:	(Sailing: 13 m3, working 11 m3)
Fresh water capacity:	110m3
Fresh water consumption:	
Fresh water generator:	Atlas AFGU-E2, 3,5m3/day Alfa Laval JWP-16-C40, 7m3/day
Sewage treatment plant:	N/a
Incinerator:	Golar Marine Incenirator Type OG 200
Black water:	No
Grey water:	2 m3

Bilge water:	14.5 m3
Sludge:	1.3 m3
Lub. oil	14.9 M3
Dirty oil:	11.1 M3
Stabilising system:	Antiroll tank/ Integrated roll reduction tank
Deck Machinery:	
Crane:	1 Maritime Hydraulics 12T @ 15 m- 22T @ 8 m 1 Maritime Hydraulics 1,2T @ 7,5 m 1 HIAB 1,5T @ 7,5 m
A-frame:	N/A
Winches:	Streamer: (MPD) 1 x 8000 meter Gun: (2 dual MPD) 4 x 300 meter
Windlass,	1 off Brattvåg B6 KCN,
Capstan	2 off Rapp Hydema CF 600
Paravane:	N/A
Gate valve:	N/A
Hydraulic power pack:	MPD 2 x 55 kW @ 133 l/min. 210 Bar / ea Odin 155 kW. 400 l/min. 210 Bar
Accommodation:	Crew: 12 cabins, 13 berths Charterer: 14 cabins, 26 berths Hospital: 1 cabin, 3 berths Total safe capacity: 27 cabins, 42 berths
Galley stores:	Deep freeze: 20 m³ Cool room: 19 m³ Store room: 50 m³
Mess:	Seating capacity: 24 Size: 32 m²
Day room:	44 m²
Exercise room	12,0 m²
Air condition:	Tropical
Helicopter landing zone:	Yes

1.2. VESSEL NAVIGATION AIDS

Auto Pilot:	Anschutz NP2010 Basic Type AP01-S01
GPS:	1x Furuno GP-80 1 x Furuno GP-70
Differential GPS receiver:	None.
Radar no.: 1	1 x Furuno FR 2115, 3cm band – X band
Radar no.: 2	1 x Raytheon M 34 Arpa, 10cm – S band
Gyro no.: 1	1 x Anschutz STD 20
Gyro no.: 2	1 x Anschutz STD 20 Compact
Speedlog:	Simrad NL Doppler Log
VHF direction finder	Simrad Taiyo ADDF TD L1520
Wind sensor:	Nautic System. Speed and direction
Nav. Echo Sounder:	1 x Simrad ED 161 T3003E 1 x Furuno Color Video Sounder FCV 271
Electronic chart:	None.
Navtex:	Furuno NX-500

Weather fax:
Sonar

Furuno FAX 210
Furuno Color Sonar CH-12

1.3. VESSEL COMMUNICATION

GMDDS:

A1, A2, A3.

Satellite fixed line:

None.

Inmarsat:

Nera Saturn B, voice/fax/64 Bits data
1 x inmarsat C. Skanti

GSM:

1 off

WAN

N/A

M/F and H/F:

Skanti TRP 8750

VHF stationary:

1 x Sailor RT 143

1 x Sailor RT 144

VHF portable:

3 x Tron GMDSS Emergency

UHF portable:

5 x Moterola GP300

UHF helicopter communication

N/A

Non-directional beacon

N/A

Watchkeeper:

Skanti WR 6000

Internal communication:

Stentor Pamex MPC

Phone & Fax numbers:

Inmarsat:

Radio Room +<satcode 325 745 510

Captain/ Bridge +870 325 745 511

Party Chief +870 325 745 512

Instrument room +870 325 745 513/5

Fax Radio room +870 325 745 514

E-mail addresses

Party Chief

Master

pc.duke@fugro.no

master.duke@rieber-shipping.no

1.4. VESSEL SAFETY

Safety manning level:

42 persons

Lifeboat:

2 off Waterman-Fiskars OY, 50 person ea.

Rescue / MOB Boat:

N/A

Workboat:

Malo 20', 127 Hp, F6.622

Inflatable Life Rafts:

4 x Viking Type DK, 2 persons

Man Overboard Liferaft:

2 x Jonbuoy

Survival Suits:

30 off FCO-OBAN MK90, Universal size.

5 off FCO-OBAN MK90, XL size

45 off Fitzwright of Canada

Working Suits

2 off Helly Hansen

4 off Helly Hnasen

Life Jackets:

53 x Seamaster 1983

Life rings:

14 x

Smoke hoods:

1 in each cabin

Inflatable Work vest:	9 x Crewsaver
	5 x Remploy
	5 x Remploy Compact II
Emergency radios:	4 x
Emergency beacons:	1 x Tron 40S
Radar Transponders:	2 x Jotron TronSart
Fire detector system:	Eletek Marine Anx 95
Fire pumps:	2 + 1 Emergency fire pump
Fire suits:	2 sets
Halon systems:	All engine room
Foam systems:	Streamer winches and streamer deck

2. SEISMIC

2.1. SEISMIC RECORDING INSTRUMENTS

Type:	Sercel Syntrak 960-24 bit system
Number of Channels:	Max 1 x 960 channels @ 2ms.
Number of waterbreaks:	4 channels each streamer, 1 every 100m
Number of auxiliary:	12 channels
Sample Rate:	1, 2 and 4 ms
Filters:	
Low Cut:	Analog: 3Hz, 6dB/oct Digital: 2 Hz, 6 dB/octave 4 Hz, 12 dB/octave 6 Hz, 12 dB/octave 8 Hz, 18 dB/octave
High Cut:	1 mS: 412 Hz, 276 dB/octave 2 mS: 206 Hz, 276 dB/octave 4 mS: 103 Hz, 276 dB/octave
Recording Format:	SEG-D rev 1 (8015,8036,8038,8048,8058)
Recording Medium:	3 x IBM Magstar 3590
QC System:	Promax 2D ver 1998.6 Offline QC All QC data, QC plots – AGC or fixed gain; harmonic distortion analyses; noise analyses; spectral analysis;
On-line Display:	Oyo GS 624-2 / GS 622
Single channel recorder	N/A

2.2. STREAMER

Type:	Sercel Syntrak-24 bit (RDA)
Length:	Max 1x 7200 m
Max. outer separation	N/A
Available Group interval:	6.25 / 12.5 / 18.75 / 25 m
Section length:	74.5 m
Group pr. section:	6
Hydrophone type:	Benthos
No. of Hydrophones / Group:	16 per 12,5 m group
Streamer diameter:	63.5 mm
Streamer sensitivity:	20 V/Bar
Depth Controller / Compass:	Input / Output DigiBIRD 5011
Acoustic	N/A
Cable oil super clean:	3000 ltr's.
Cable oil clean:	3000 ltr's.
Cable oil dirty:	7000 ltr's.

2.3. ENERGY SOURCE

Type:	I/O Sg I and Sg II Sleeve Gun
Size of guns:	40, 70, 100, 150, 210, 300 Cu. Inch
Max. volume:	1 x 3500 Cu. Inch
Maximum output 6 m depth. 0-206 Hz.	100 Barm. P/B 29,7 at 2000 PSI
Number of Sub. Arrays:	4
Configuration	Single source
Tow width:	
Firing control:	Sercel GCS-90, 48 guns.
QC:	GCS 90.
Depth transducers:	3 each string.
Tow system:	Partnerplast, PE module based floats
Offset:	Typically 100 to 150 m. 100 (60) m can be achieved
Compressor:	2 off Hamworthy 800 E 2 off Hamworthy 4TH565W100
Compressor capacity:	1600 SCFM at 2000 PSI
Air Pressure:	2000 psi

2.4. POSITIONING SYSTEM

On-line Navigation System:	Concept Spectra 9.8.03, Red Hat Linux 7.0
Primary Navigation:	Starfix PLUS, DGPS, Fugro
Demodulator:	Starfix 3000LR
GPS receiver:	Trimble T4000SSI
Secondary navigation:	Starfix.SPOT. DGPS, Fugro
Demodulator:	Starfix 3000LR
GPS receiver	Trimble T4000SSI
Tailbuoy tracking	Geotrack RGPS
Laser:	N/A
Gun array tracking	Seatrack 320 Gun Buoys
Acoustic	N/A
Dynamic sound velocity	N/A
Laser:	N/A
VRU	N/A
Navigation Processing System:	FGPS Seispos ver 11.71
Binning:	N/A
Multi beam echosounder	N/A
Echosounder:	Simrad EA500
Echosounder transducer:	Simrad 12KHz, Atlas 33 kHz (3000 m range) + 210 kHz
Streamer Position:	Input / Output DigiBIRD 5011 Compass bird
Speed log:	Simrad NL Doppler Log
Acoustic doppler profiler	N/A
CTD probe	Mini STD/CTD Saiv SD 204
SVP probe	N/A
Water level recorder	N/A

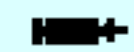
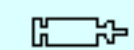
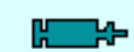
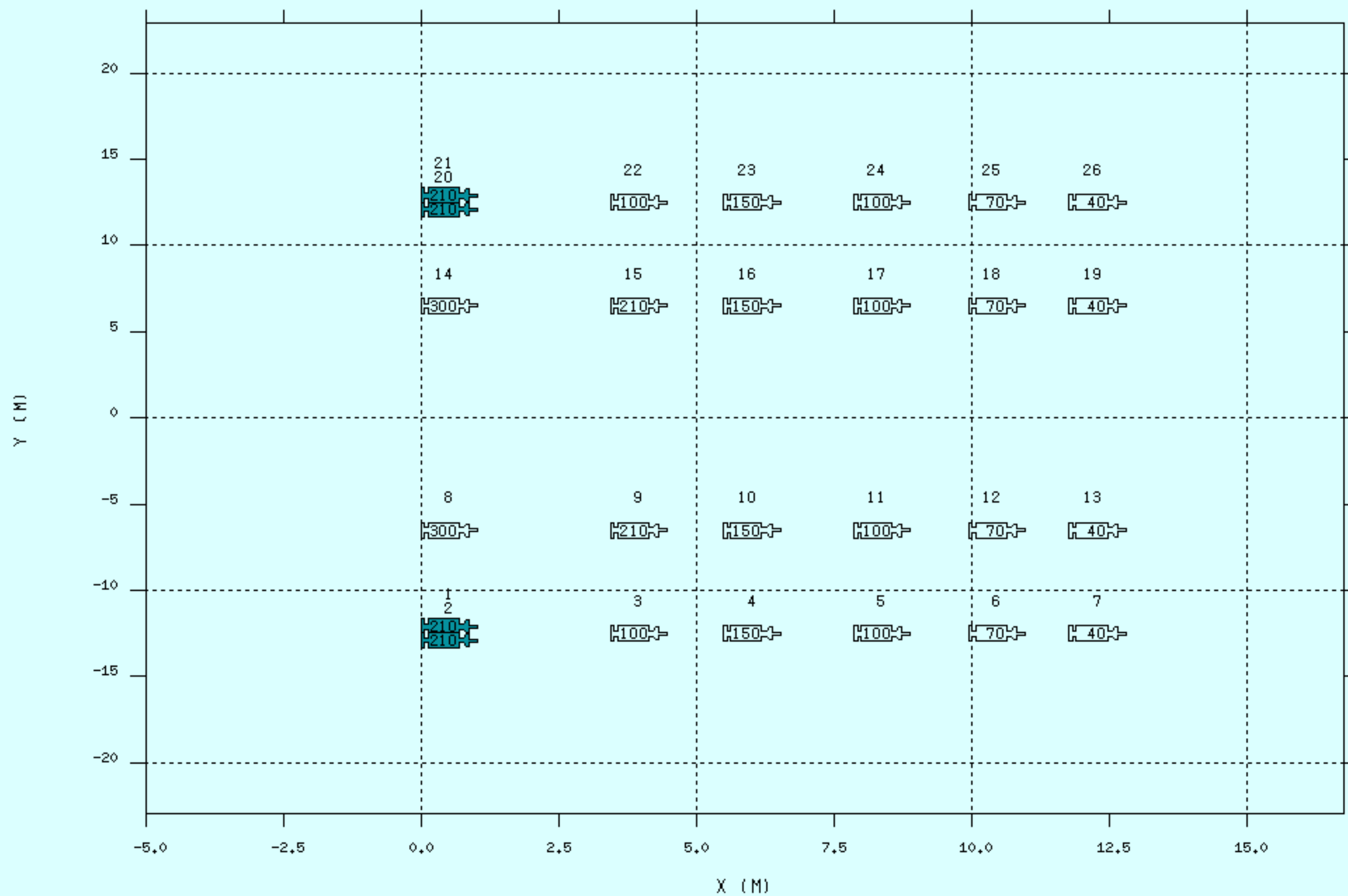


2.5. ONBOARD PROCESSING

Hardware:	Sun Ultra 60 w/ SUN OS 5.6, 1024 Mb Ram, 70Gb disk.
Software:	Promax 2D, 1998.6
Capabilities	Full 2D QC processing
Tape drives:	2 x 3590 IBM Magstar 1 x 8mm Exabyte Drive
Plotter:	Oyo 624
Data compression software	N/A

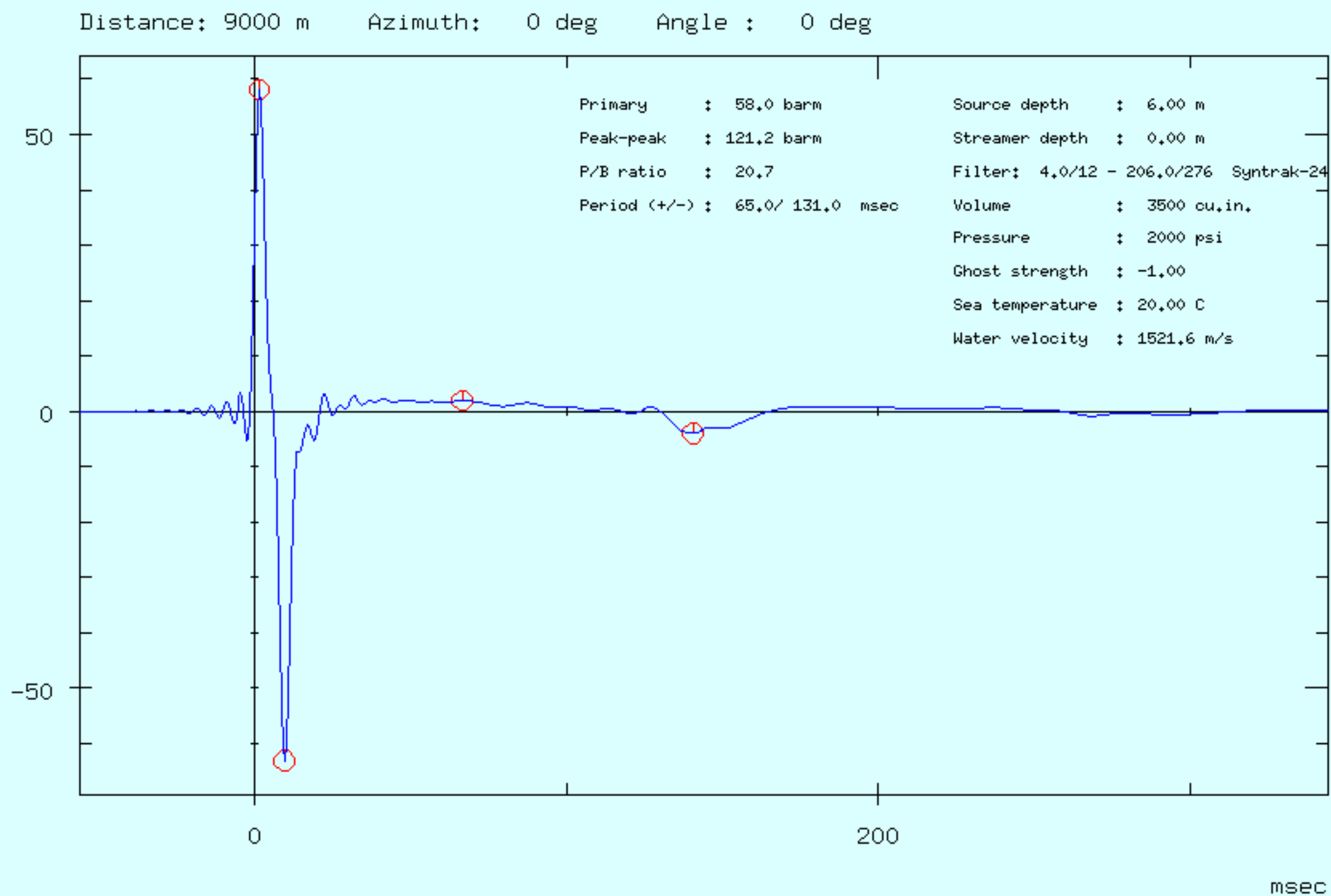
Array : pd-3500-60-r

Total volume : 3500.0 cubic inch

 - Inactive guns - Single guns - Cluster guns

Continue

Far-field signature of array : pd-3500-60-r

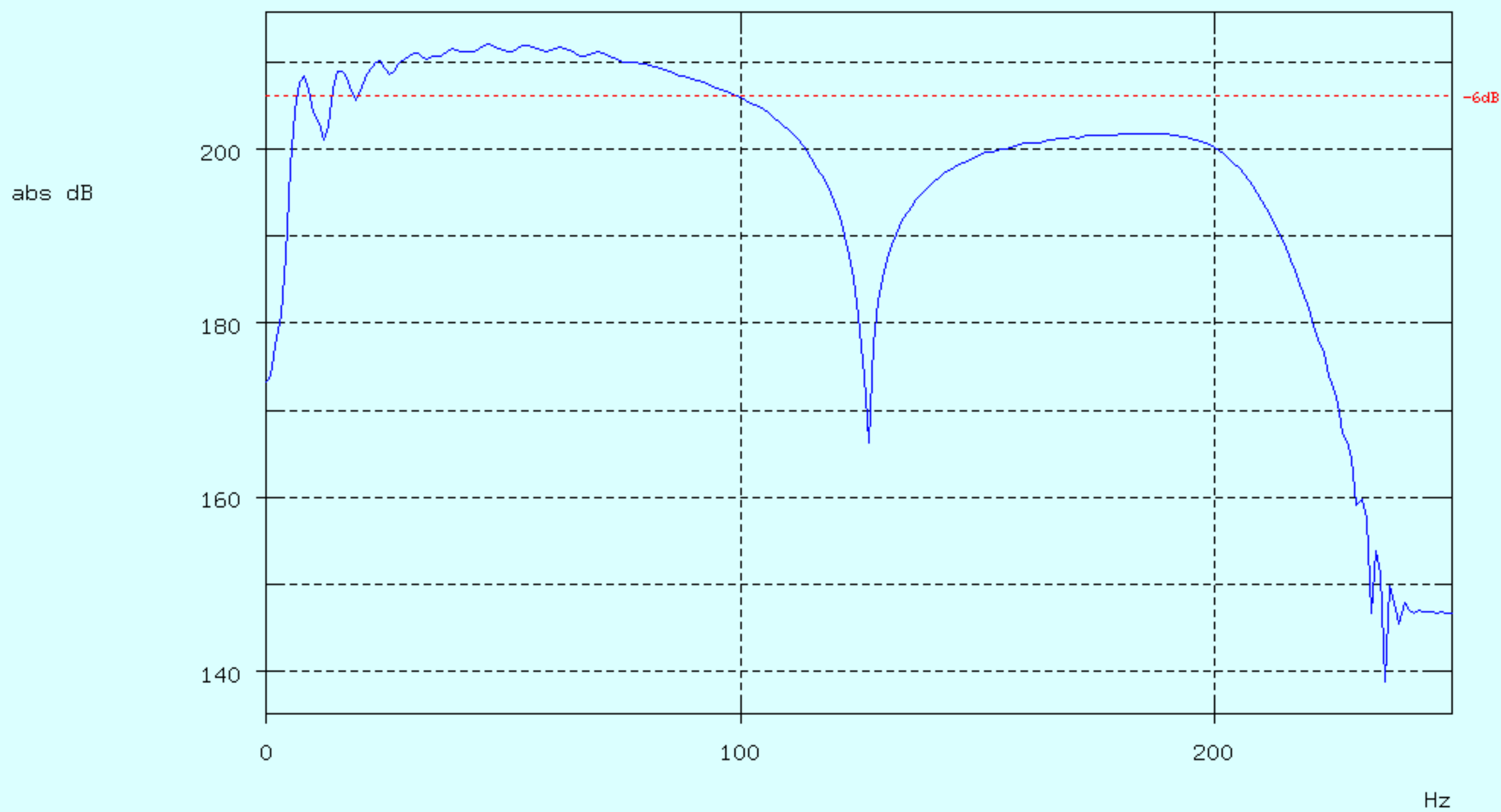


Amplitude spectrum of far-field signature of array : pd-3500-60-r

Distance: 9000 m

Azimuth: 0 deg

Angle : 0 deg



	CLIENT FEEDBACK RECORD	
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To be completed by recipient.

Project Number:	Reference Number:
Project Name:	Date Received:
Party Chief / Project Manager:	

To be completed by Client (if possible or by recipient).

Client Name / Company:	Date:
Nature of Feedback:	

To be completed by Responsible Manager.

Responsible Manager's Name / Title:	
Comments:	
Date:	Action:

Feedback Closed: Yes / No	Date:
Sign Responsible Manager:	Date:
Sign QA/HSE Manager:	Date:

FUGRO-GEOTEAM AS	FUGRO-GEOTEAM AS MEDEVAC PLAN AND SAFETY INFORMATION	
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MEDEVAC PLAN

2003 SOUTHERN MARGINS 2D SURVEYS SANTOS Ltd.

Project No. 34949

Date	:	September 2003
Revision	:	1
Responsible Manager	:	Einar Edstrøm
Author	:	Terje Steinsbø



C O N T E N T S

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2.4 TRAVEL INSURANCE	3

1. GENERAL INSTRUCTION

The Rescue Co-ordination Centre of AusSAR will issue Auscoast warnings through coastal radio stations advising all shipping in the area of the presence of the Geo Arctic. It is behoven upon the Master of the Geo Arctic to keep the RCC informed of the vessels movements.

The Master shall send a daily fax to the R.C.C. which will identify a box or square of operations by Latitude and Longitude for the next **three** days. Other details shall include the number and length of streamers, and communication details fax, mobile, Inmarsat, etc.

R.C.C. Phone +61 26230 6811

R.C.C. Fax +61 26230 6868

The MEDEVAC Plan shall be initiated according to Fugro-Geoteam AS MEDEVAC Procedure SP.715.

This MEDEVAC Plan is made according to above.

The Master has the on board responsibility for activation of this procedure.

2. MEDEVAC ALTERNATIVES - GENERAL INFORMATION

This MEDEVAC Plan is based on using the following two alternatives depending on the location. Following sub-articles describes some general information about the two alternatives.

For operation within VIC/P44, VIC/P51 and T35/P, Melbourne is planned used for MEDEVAC. Distance from locations to Melbourne is approximately 125, 157 and 143 nautical miles respectively.

For work in EPP32 licence, Adelaide is planned used for MEDEVAC, distance from location about 145 nautical miles.

Possible destinations / hospitals :

Melbourne, Victoria
Adelaide, South Australia.



FUGRO-GEOTEAM AS

2.1 *To/Via Melbourne, Victoria*

The recommended hospital to be used is TBA

2.2 *To/Via Adelaide, South Australia*

The recommended hospital to be used is TBA.

2.3 *Norwegian Air Ambulance*

Fugro-Geoteam AS has an agreement with Norwegian Air Ambulance for MEDEVAC of company and third party personnel from operations in foreign countries to their home country. It's important that they are contacted as soon as possible after the local MEDEVAC arrangement has been established.

Norwegian Air Ambulance, Operating Centre
1474 Nordbyhagen
Norway
Telephone : + 47 67 92 74 00
Telefax : + 47 67 92 74 11

2.4 *Travel Insurance*

All employees in Fugro-Geoteam AS are insured with the Norwegian insurance company "Gjensidige".

Contact numbers:

SOS International, Denmark	-	Tel:	+45 70 10 50 50
Gjensidige, Norway	-	Tel:	+47 22 96 80 00



3 MEDEVAC INSTRUCTIONS

The Medevac action shall be carried out according to the following diagram:

Analyse injury on board
by medical crew responsible.

Treatment is not
time critical

Treatment is time critical

Contact port and local
Facilities at Melbourne
Burnie or Hobart, whichever
Is closest.

Contact RCC Canberra

Recover equipment and
Take the vessel to port

Prepare the casualty for
helicopter pickup

Inform Fugro-Geoteam AS' duty
officer according to MEDEVAC
procedure, SP.715. Initiate reporting
according the procedure, item 6.6.

Call Norwegian Air Ambulance to
inform them about the situation.
+ 47 67 92 74 00

2D ACQUISITION PARAMETERS & QUALITY CONTROL STANDARDS

1 GENERAL

1.1 Location

The survey is located off the coast of South Australia, Victoria and North Western Tasmania. Maps of the 2D survey lines are included in Annexure G.

1.2 Survey Size

The 2D Survey will cover approximately 2,700 line kilometres. Operational efficiency will influence the shooting directions of the 2D survey.

However, **Santos** reserves the right to increase the program by an amount of +25% of the stated kilometres. Notification of any modification to the survey size will be made in writing to the **Contractor** prior to completion of the assigned program.

1.3 Water Depth

The 2D program is in water depths of greater than 20m with no known surface obstructions. Nevertheless the safe execution of this project will call for significant pre-survey planning by both **Santos** and the **Contractor**. Such pre-survey planning will allow the **Contractor** to complete the assigned program safely, with minimal environmental risk, without endangering the personnel, vessels or equipment and without causing unreasonably long delays.

1.4 Start Date

The start date for the survey will ideally be between the 1st and 15th October 2003.

1.5 Positioning

Refer to Annexure 'D' for details of Survey specifications. **Contractor** will supply the positioning system and will be responsible for operating and maintaining all positioning equipment. Any time lost due to poor signals or equipment failure will be treated as Downtime.

1.6 Supervision

The **Contractor** will provide at least one qualified and experienced QC capable of providing total quality control of all seismic and navigation data acquired. **Santos** will also supply at least one qualified and experienced QA person.

2 ACQUISITION PARAMETERS

Streamer Type/Instruments	Digital (Syntrack 960-24 or similar)
Streamer Length	5000/7000 metres
Groups/Streamer	400/560
Group Interval	12.50 metres
Sample Rate	2 msec
Record Length	6/8 Seconds
Recording Filters Lo-cut	3 Hz (6 dB/Octave)
Recording Filters Hi-Cut	206 Hz (276 dB/Octave)
Streamer Depth	7 metres average
Recording media	3590 Cartridge in SEG D Format
	2 outputs required – dual recorded
Source Type	Tuned airgun array
Source array volume	at least 3000 cu inches
Number of Sources	1(2 subarrays)
Source Array depth	5 metres
Source operating pressure	1800-2000 psi
Shotpoint interval	25 metres
Required nominal offset	70-100 metres
Navigation System	DGPS
Recording direction	At contractor's discretion

3 QUALITY CONTROL STANDARDS

3.1 Standards

These standards will be strictly adhered to. However, **Santos'** Quality Control Supervisor will have the right to suitably alter them in order to accommodate the variable operating conditions.

Contractor shall evaluate data quality using all available systems. At the start of the survey all equipment shall comply with all technical specifications. During each 24-hour period, daily instrument tests shall be undertaken and analysed, and results submitted to **Santos'** quality control supervisor for approval.

3.2 Requirements During Mobilisation

During mobilisation **Contractor** shall undertake the following and inform **Santos'** quality control supervisor of the results before sailing:

- Provide a copy of recent performance statistics for streamer compasses.
- Provide recent Gyro compass calibration, calculated from static or dynamic observations.
- DGPS configuration dockside check.
- Most recent monthly seismic instrument tests.
- Sample datum transformation calculation (satellite datum to local datum and vice versa); and
- Provide a list of onboard equipment spares.

When on location during streamer deployment **Contractor** shall provide the following:

- Streamer configuration and deployment diagrams

- Antenna diagrams and location of any navigation reference points
- Printout of all survey parameters input into INS
- Results of analysis of monthly instrument tests

3.3 Unacceptable Misfire Rates

A line or line segment shall not be accepted if there are:

8 or more consecutive misfires,
12 misfires in any 24 consecutive records,
16 misfires in any 40 consecutive records

The cumulative misfires shall not exceed 5.0% for a line or line segment or 2.0% for the survey

Definition of a Misfire

Any one of the following shall be considered as a misfire:

- No seismic data recorded (or incomplete record)
- No navigation data recorded (or incomplete record)
- Loss of time zero
- No shot fired
- Tape parity error
- Data extraction errors
- Source synchronisation error
- Acquisition/recording parameters do not meet performance specification
- Recording instruments do not meet performance specification
- Streamer parameters and performance do not meet performance specification
- Streamer feathering exceeds performance specifications
- Streamer noise levels exceeds performance specifications
- Streamer balance/depth do not meet performance specification
- Number of bad streamer channels do not meet performance specification
- Source signature does not meet performance specification
- Source volume does not meet performance specification
- Air pressure does not meet performance specification
- Source timing and/or synchronisation does not meet performance specification
- Source depth does not meet performance specification
- Failure of source depth indicator
- Vessel primary positioning does not meet performance specification
- Source positioning does not meet performance specification
- No gyro information
- Fathometer not operating for more than 5 kilometres
- Any QA system not operating for more than 5 kilometres, in real time or post processing

3.4 Acquisition Procedures and Minimum Line Lengths

All of the following acquisition procedures and minimum line lengths shall be met/

adhered to:

- Guns shall be fired in sufficient time prior to start of line to allow for warming up and tuning.
- Line run-in distance should be sufficient to ensure that the streamer is optimally positioned prior to the start of acquisition unless approved by **Santos'** Quality Control Supervisor
- Soft start procedures as per Environment Australia guidelines must be commenced at least 20 minutes before first production record on line and the time of commencement of soft start ramp up logged.
- Source firing shall be initiated with a single gun or cluster.
- Single guns or clusters will be added to the source after each 3 shots until operational volume is achieved.
- Line run outs to achieve full fold coverage are required at the end of each line
- The minimum acceptable line segment shall not be less than 2 streamer lengths.
- The maximum number of allowable line segments per line shall be 3
- Any line re-shoot shall be recorded in the same direction as the original line.
- Line naming convention will be agreed prior to survey start.
- Resumed lines will bear a suffix such that A represents a second attempt, B a third attempt etc.
- Every line attempt shall be accorded a unique consecutive number regardless of whether the line is accepted or subsequently rejected (Sequence Number).
- Shot number convention will be such that the ends of the lines with the lowest shot numbers will all be aligned towards one side of the survey. As such lines will have incrementing or decrementing shot numbers depending on the direction of shooting.
- The practice of incrementing shotpoints by 1,000 or 10,000 etc. for reshoots shall not be used.

3.5 Energy Source

For the airgun array used for this survey, a digital far field signature and Frequency Spectra of the airgun array must be supplied together with the exact gun sizes, depth, the delay time for the guns and an other data used to produce the above report and the frequency spectra. Synthetic signatures shall also be run to support proposed gun drop specifications. No change in the airgun parameters, including gun drop specifications, must take place without rerunning the synthetic signature and gaining approval from **Santos'** Quality Control Supervisor. **Validity of the above information will be established prior to the start of the survey**

Source Minimum Requirements

Energy source shall meet all of the following minimum requirements.

- The air pressure shall be displayed in the recording room and recorded on the seismic tape;
- Individual guns shall be monitored by a hydrophone and/or a transducer located as close to the centre of explosion as practical; Hydrophone per array accepted;
- Source controller systems shall be able to:

- detect and display the fire time of each individual gun relative to the fire command time to an accuracy of 0.25 milliseconds;
- display individual timing errors graphically;
- synchronise all guns within a specific time window;
- provide alarms for:
 - autofiring guns; and
 - out of sequence firing (flip/flop); and single gun misfires.
- determine standard deviation of timing errors for each gun at each shot and display graphically; and
- at the end of each line produce a summary of gun performance during the line and display graphically.

Source Performance Specifications

A gun is considered to have misfired and shall be shut down under any one of the following conditions:

- autofiring;
- air leak;
- variations in the near field signature, and/or
- synchronisation more than ± 1.25 millisecond from time zero.

The following specifications shall govern the operation of the source(s). Individual records which do not meet these specifications shall be considered as a misfire:

- malfunction of source controller system;
- source depth ± 1 meter from specified depth;
- autofiring gun(s);
- variations or inconsistencies in signature from shot to shot;
- peak pressure less than 90% of full array volume (subject to agreed dropouts);
- primary/bubble ratio less than 90% of full array value (subject to agreed dropouts)
- air pressure below 90% of specified pressure, and/or
- loss of time break.

Source QC Checks And Tests

The following checks shall be undertaken prior to start of survey and at any other time at Santos's Quality Control Supervisor's request:

- signature evaluation using seismic QC and/or processing systems;
- verification of delay between start of record and field time break;
- verification that record length and speed are compatible with source re-cycle times;
- measurement of towing ropes, wires and chains;
- correct operation of source mask (flip/flop) identifier using single trace recorder or seismic QC system; and
- verification of in-line source to near trace offset.

3.5.2 Gun Drop Specifications

A gun is considered “out of specification” and shall be shut down, under any of the following circumstances:

- The time-break is not recorded. The absence of recorded time-break can be temporarily tolerated (up to 3 hours) if MGC can demonstrate that the gun fires within the specified time window by analysing the near-field hydrophone signal;
- Gun firing more than once in the recording cycle (auto-fire);
- Synchronisation of gun out of specification during 6 consecutive shot points;
- Gun showing continuous or intermittent misfiring or malfunctioning;
- Gun with an air leak (even if the source air pressure can be maintained within specification);
- Characteristics of the near-field signature of the gun such as peak-to-peak amplitude, peak-to-bubble ratio, bubble period, below Manufacturer's specifications.

3.6 Seismic Streamers

Contractor's seismic streamers shall meet the following minimum requirements, performance specifications, and QC checks and tests.

Streamer Minimum Requirements

Contractor's seismic steamer(s) shall meet the following minimum requirements.

- The streamer skin shall be suitable for the area of operation;
- Towing speed shall be between 4.0 and 5.5 knots (through the water);
- Initial balancing shall be undertaken in the area of operations, with depth controllers and modules in place and the vessel at survey speed (nominally 5.0 knots), until the streamer is neutrally buoyant at the specified depth;
- After streamer balancing, wing angles of depth controllers shall not permanently exceed 5°;
- Depth controllers shall be spaced not more than 300 meters apart;
- Depth controllers shall be fitted with depth indicators; and
- Streamer section depth indicators (other than depth controllers) shall be equally spaced midway between each depth controller (i.e. nominally 300 meters apart).

Streamer Performance Specifications

At a minimum, **Contractor's** seismic streamer shall meet the following performance specifications. **Contractor** shall endeavour to reduce the number of any bad traces at each new streamer deployment. The following specifications shall govern the operation of the streamer(s). Individual records which do not meet these specifications shall be considered as a misfire:

at the start of, or during, a line the maximum number of bad traces per streamer shall not exceed:

- 2 randomly distributed in any 80 or

- 4 randomly distributed in any 160 or
- 8 randomly distributed in any 320 or
- 16 randomly distributed in any 640
- the near trace shall always be operational
- there shall be no more than 2 adjacent bad traces
- average streamer depth shall not vary by more than ± 1 meter from specified depth; and maximum distance between depth indicators shall not exceed 400 meters.

Bad Trace Definitions

Any of the following conditions shall qualify as a bad trace:

- Any hydrophone within a group is reversed polarity
- Sensitivity down by more than 3 dB from manufacturer's specifications;
- Trace is dead;
- Trace is spiking or wild; or
- Signal distorted or out of phase by more than 30° or 1 milliseconds.

Streamer Noise Definitions

Streamer noise shall be given in microbars RMS (Root Mean Square) and measured over the full recording cycle with recording filters and with the streamer at the specified tow depth.

The following guidelines shall be used for determination of acceptable levels of coherent noise and swell noise but shall depend on geophysical objectives. Whenever possible the use of onboard processing/QC systems shall be used to further evaluate the effects of noise on the data. In any case the final decision shall rest with Santos in consultation with its representative.

Ambient noise levels shall not exceed $75/(L)$ μbar , for traces near the vessel, depth controllers and modules; and $37.5/(L)$ μbar , for all other traces, where L = group length in meters as, measured through an 8 Hz low cut filter.

Swell noise of up to 25 μbar can be tolerated if appearing on less than 5% of shot records on any line and is less than 2 seconds in duration. Higher noise levels may be acceptable subject to Santos Quality Control Supervisor's approval.

Coherent noise shall be assessed according to the following:

- amplitude of the interfering signal;
- duration of the noise;
- repetition and synchronisation of the interference; and
- moveout of the interference.

Constant interference up to 10 μbar shall only be tolerated up to a maximum duration of 4 seconds;

As a general rule, coherent noise shall not exceed the following limits:

Noise coming from astern of the streamer:

Moveout	Max. Noise (µbar RMS)
More than 250 milliseconds	20 µbar
125-250 milliseconds	12 µbar
0-125 milliseconds	5 µbar

Noise coming from ahead of the streamer:

Moveout	Max. Noise (µbar RMS)
More than 2000 milliseconds	20 µbar
1400-2000 milliseconds	12 µbar
0-700 milliseconds	5 µbar

Streamer Feathering

Maximum streamer feathering shall be $< 10^\circ$. In severe tidal regimes or in unpredictable currents the Company's Quality Control Supervisor may relax the above limits

Streamer QC Checks and Tests

Trace polarity shall be in accordance with SEG (Society of Exploration Geophysicists) convention namely a compression wave shall produce a negative number on tape, downward deflection on camera monitor and a white trough on the trace recorder.

Streamer sensitivity, electrical resistance, crossfeed and insulation shall be verified at the beginning of each line or at any time if requested by Santos's Quality Control Supervisor. Streamer sensitivity shall be evaluated from a series of fixed gain displays.

Streamer noise tests shall be undertaken on the run in and at the end of every line and recorded on the production tape. A reference signal shall also be recorded on an auxiliary channel.

During noise tests:

- the vessel shall be at survey speed (nominally 4.5 knots);
- the recording settings shall be as per the specified acquisition parameters; and
- the streamer shall be at the specified depth.

The source to near trace in-line offset shall be verified at the start of each line by using waterbreak phones or acoustic devices or any other reliable method. A change in linear source to near trace offset of more than 1/2 group length from the mean shall be investigated and remedied.

3.7 Recording System

Contractor's recording system shall meet the following minimum requirements; performance specifications; and QC checks and tests.

Recording System Minimum Requirements

Contractor's recording system shall meet all of the following minimum requirements:

- The equipment shall be calibrated and meet manufacturer's specifications;
- Polarity shall be in accordance with SEG convention
- Only new recording media shall be used.
- Acceptable media is IBM 3590 compatible cartridge tapes;
- There shall be a density identification burst at the beginning of each tape;
- No data shall be recorded after the end of tape marker;
- The last record on each tape shall be followed by a double EOF (End of File); and
- The seismic channels shall be displayed on oscilloscopes.

Recording System Performance Specifications

Individual records which exhibit any of the following, do not meet these specifications and shall be considered as a misfire:

- loss of time zero;
- tape parity errors;
- data extraction errors;
- loss of synchronisation between field time break and start of data;
- loss of more than 3 channels;
- performance below manufacturer's specifications;
- no data recorded;
- incomplete record;
- loss of multi-channel monitor or section plotter for more than 1 kilometre;
- loss of fathometer data for more than 1 kilometre.

Recording Instruments QC Checks and Tests

Instrument tests shall be performed in accordance with manufacturer's recommendations and/or **Contractor's** procedures approved by Santos's Quality Control Supervisor and shall comprise all of the following:

Monthly tests for IFP (Instant Floating Point) systems shall comprise, but not be limited to, the following:

- Preamplifier calibration;
- Amplifier RMS noise and DC offset;
- Equivalent input noise and offset referenced to 1 μ volt (with and without low cut filter);
- Hydrophone group sensitivity;
- Filter impulse response;
- Harmonic distortion;
- Cross feed checks; and

- Dynamic range determination.

Daily tests for IFP systems shall comprise, but not be limited to, the following:

- Dynamic range determination;
- Equivalent input noise and offset referenced to 1 μ volt (with and without low cut filter);
- Streamer noise test;
- Streamer continuity and leakage test;
- Data transmission validity; and
- Amplifier RMS noise and DC offset.

Daily tests shall be recorded on media equivalent to that of the production tapes. Monthly tests shall be processed by **Contractor** onboard the vessel. Equipment which does not meet manufacturer's specifications shall be replaced and another set of tests performed. A set of monthly tests shall be undertaken following any software and/or hardware changes. A polarity check shall be made at the start of the survey and whenever a streamer section is replaced. Polarity may be determined by a tap test or evaluation of first break arrivals (if feasible). Multi-channel camera records shall be taken every 1 kilometre

Field Cartridges

All seismic data will be recorded on new magnetic cartridges of Santos approved manufacture and brand. Cartridges labels will be systematically annotated. Proper precautions will be observed in storing and transporting both new and recorded tapes. Duplicate copies of field cartridges are required, either dual-recorded or copied.

3.8 Positioning and Data Quality Assurance

3.8.1 Integrated Navigation System (INS)

Contractor's integrated navigation system shall meet all of the following minimum requirements, binning display minimum requirements, recording requirements and filtering requirements.

INS Minimum Requirements

The system shall be able to determine in real time the location of the vessel, sources and all receiver arrays by integration of satellite positioning data, gyro compass data, streamer compass data, laser systems data (if used) and acoustic systems data at the same instant in time. Where time de-skewing is required to correct for age of data, this shall be kept to a minimum.

The system shall be able to:

- interface positioning data from satellite systems
- record up to 20 lines of position and use up to 10 lines of position in a single computation, using a least squares solution, for both vessel, headbuoys and tailbuoys;
- compute and display in real time residual range values for each LOP (Line of Position);
- mix LOP's from multiple interfaced systems in a single computation;
- compute and display in real time,
 - position differences between primary, secondary and tertiary systems
 - the locations of all positioning nodes on the towed survey spread;
 - the location of all source and receiver positions in the survey spread
- compute and display in real time LOP geometry and the standard deviation of the least squares solutions;
- navigate between 2 points in either great circle or grid line mode;
- undertake seven parameter datum transformation calculations;
- compute survey line pre-plots;
- display vessel progress along each survey line to include speed and distance off-line;
- compute and display coordinates in either geographic or rectangular coordinate systems referenced to the specified survey datum, spheroid and projection;
- generate an unambiguous remote display to facilitate steering of the vessel along the survey line;
- produce end of line QC plots in the form of histograms, scatter grams and time series plots for each system used for positioning and for each computation made by the INS, for end of line statistical analysis; and
- generate shotpoint closures in either time or distance mode.

INS Recording Requirements

The system shall record to industry standard 8mm Exabyte or 3590 tape all raw positions solutions and sensor data in UKOOA (United Kingdom Offshore Operators Association) P2/94 format (other formats require Santos approval).

As minimum at each shot the following parameters shall be recorded:

- time (UTC);
- shot number;
- all raw positioning data for all systems and sensors (radio, satellite, laser etc.);
- primary position;
- secondary position;
- number of GPS (Global Positioning System) SV's (Satellite Vehicles) and ID's (Identifications) used with elevations;
- GPS HDOP (Horizontal Dilution of Precision) and PDOP (Position Dilution of Precision) values;
- standard deviation of the least squares position for primary system (or 95% horizontal error ellipse for DGPS (Differential Global Positioning System) systems);

- standard deviation of the least squares position for secondary system (or 95% horizontal error ellipse for DGPS systems)
- gyro heading and water depth.

All C-O's, delays, propagation velocity factors shall be input into the INS software not the mobiles.

Before the start of line a file containing all initialisation parameters shall be recorded containing:

- spheroid/datum parameters;
- projection parameters;
- Wide area differential station locations;
- all antenna and other fixed offsets.

INS Filtering

Where any form of filtering is applied to raw sensor data, the minimum filter value that is consistent with non-erratic navigation, shall be selected. In any case all raw unfiltered data shall be retained and recorded as specified. Santos's Quality Control Supervisor shall be informed regarding the application of smoothing filters.

3.8.2 Positioning

Contractor shall verify all geodetic parameters, station coordinates and datum transformation parameters to be used for the work and shall ensure that these are correct and appropriate for the area of operation.

Contractor shall provide the necessary onboard positioning and navigation quality control computers to achieve the specified accuracy and tolerances.

DGPS Positioning

Contractor's DGPS positioning system shall meet all of the following specifications; including network minimum requirements; performance specifications; height aiding requirements; mobilisation requirements; QC checks and tests; laser range and bearing systems; streamer compasses; and towing geometry.

Any Differential Global Positioning System supplied by **Contractor** shall have an acceptable proven QC system.

Statistical testing utilising the F-test and W-test shall be carried out for each position fix to identify and eliminate systematic bias errors and range outliers.

The 95% a-posteriori horizontal error ellipse of the 2-dimensional position shall be used as the basis for acceptance.

For vessel positioning, the semi-major axis of the a-posteriori horizontal error ellipse shall not exceed 5 meters for at least 90% of shot points on a line and shall not exceed 7 meters for more than 5% of shotpoints on a line.

In instances when the Marginally Detectable Error (MDE) indicates a possible horizontal movement of greater than 5 metres, the positions will be carefully investigated and other pertinent QC parameters checked..

Data latency shall be better than 10 seconds. Computation update rates shall be better than 3 seconds.

DGPS Network Minimum Requirements

Contractor's DGPS network shall meet all of the following minimum requirements:

- A minimum of 4 reference stations shall be continuously monitored from the mobile site;
- Reference stations and mobile station shall monitor the same satellite constellation;
- There shall be at least one monitoring station which shall be continuously manned (such monitoring station may be located at a reference station);
- Spares complement of 100% (preferably in "hot standby" mode) including emergency generating power, for each reference station and monitor station;
- Spares complement at the mobile installation shall be 100% to include receivers, antennas, cabling, power supply and computer hardware and software;
- Transmission formats shall adhere to recognised standards e.g. RTCM-104 (Radio Transmission Common Code);
- Distances from the survey area to individual reference stations shall be kept to a minimum;
- For "Local" DGPS systems, maximum distance from reference stations to survey area shall not be more than 300 kilometres. Wide Area DGPS systems with multi-reference station options shall be considered on a case by case basis.
- Satellite prediction software with latest updated almanac shall be available throughout the survey. Such software shall be used to plan operations and identify any poor coverage windows.
- **Contractor** or it's subcontractor shall make every effort to verify there are no additional users of equipment, operating in or near to the survey area, which transmit on a frequency or frequencies, likely to impair the performance of the system.

DGPS Performance Specifications

The following specifications shall govern the operation of the DGPS. Individual records which do not meet these specifications shall be considered as a misfire:

For Vessel Positioning:

Whenever possible the maximum available number of healthy satellites which meet minimum elevation criteria shall be used in any computation. A multiple reference station derived position may be used subject to the above requirements.

Height Aiding

Height aiding (i.e. where the equipotential surface is treated as a pseudo position line) may only be used if:

the physical variation in antenna height due to tide, pitch, roll and heave, is less than 2 meters

an average ellipsoid height has been determined from a statistically analysed dataset of continuous readings whose standard deviations are less than 2 meters.

its use is minimal and in any case for never more than 30 minutes on any single survey line

DGPS Requirements During Mobilisation

During mobilisation, **Contractor's** DGPS system shall meet all of the following requirements:

- Integrity Monitor Check (as detailed in 2.5)
- During the verification the complete fully interfaced installation, to include all reference stations, **Contractor's** INS, all hardware and software shall be verified;
- During mobilisation the DGPS shall be installed in the proposed configuration for the survey while the vessel is stationary at the dockside where the differential corrections can be correctly received;
- The DGPS antenna shall be coordinated by land-survey methods and DGPS positions shall be determined over a period of 30 minutes of good satellite coverage
- A scatter plot shall be produced showing the distribution about the coordinated location from which the following shall be determined and provided:
 - mean excursion eastings;
 - maximum excursion eastings
 - mean excursion northings;
 - maximum excursion northings;
 - mean excursion height; and
 - maximum excursion height.
- A similar check may be required at the end of the survey or at any time during the survey if necessary or if requested by Santos's Quality Control Supervisor.

DGPS QC Checks and Tests

Contractor shall conduct all of the following QC checks and tests on **Contractor's** DGPS system:

- As a matter of routine monitor station information concerning status and health of all satellites shall be continuously available and monitored;
- Internally generated quality control indicators such as HDOP, GDOP, PDOP, VDOP shall be continuously available and monitored;

Streamer Compasses

Where streamer compasses are to be used for determination of streamer feathering

the following shall apply:

- the latest value of magnetic declination (horizontal intensity) to be used shall be obtained from either latest IGRF (International Geomagnetic Reference Field) published tables or from a recognised magnetic observatory, and/or
- **Contractor** shall provide calibration certificates and the date and information on the most recent static verification check.

Towing Geometry

When the required geometry has been established, towing wires and chains shall be marked to ensure the geometry remains the same following each deployment.

Near trace offset (i.e. the linear distance between centre source and centre near trace) shall not vary by more than $\pm 1/2$ group length unless such variation is as a result of tides and/or currents influencing towing characteristics.

During mobilisation the following components shall be accurately measured and documented:

Streamer front end:

- lead in;
- stretch sections;
- gun locations and distances;

3.9 Ancillary Equipment

The following minimum requirements shall apply to all of **Contractor's** ancillary equipment.

Gyro Compass Minimum Requirements

The following minimum requirements apply to **Contractor's** gyrocompass:

- One or more units are required and shall be interfaced to the INS;
- The unit shall be calibrated against a known azimuth, during mobilisation while the vessel is stationary at the dockside or using statistics derived from dynamic observations;
- Dockside calibrations shall be undertaken by an experienced surveyor. Each gyro heading shall agree with the surveyed azimuth to within 0.5° ;
- No dockside calibration shall be started until the gyrocompass has been allowed to stabilise for 2 hours;
- Additional calibrations shall be undertaken during the course of the survey and at the end of the survey if requested by Santos's Quality Control Supervisor;
- **Contractor** shall provide historical information regarding previous gyro calibration results;

Single Trace Recorder Minimum Requirements

The following minimum requirements shall apply to **Contractor's** single trace

recorder:

- As minimum **Contractor** shall provide a method for displaying near trace data throughout the survey. Such system shall be able to be used to assist in the detection of source out of sequence firing in multi-source operations;
- **Contractor** may propose an alternative to a near trace recorder. Any proposed alternative is to be agreed by Santos;
- Failure of the near trace recorder (or acceptable alternative) for more than 1 kilometre shall not be allowed; and
- Paper monitors shall be clearly annotated with date and line number and have a fix mark generated every kilometre against which the shot number shall be recorded.

Shot Record Monitor Minimum Requirements

The following minimum requirements shall apply to **Contractor's** shot record monitor:

- **Contractor** shall provide a means for monitoring and displaying all seismic channels from which dead, weak, or otherwise bad or noisy channels may be identified and the level of noise quantified;
- Records shall be annotated with date, line number and shot number and shall be taken at the beginning and end of each line and at intervals of 1 kilometre or as requested by Santos Representative.

Fathometer Minimum Requirements

The following minimum requirements shall apply to **Contractor's** fathometer:

- A dual single frequency digital fathometer shall be available throughout the survey;
- The unit shall be calibrated in accordance with manufacturer's specifications;
- The unit shall be adjusted for velocity of sound in water;
- Fathometer readings shall be draft compensated (i.e. referenced to sea surface);
- Every opportunity shall be taken throughout the course of the survey to verify fathometer accuracy during port calls and/or when crossing well locations;
- Paper monitors shall be clearly annotated with date and line number and have a fix mark generated every kilometre against which the shot number shall be recorded; and
- A diagram showing location of fathometer transducer relative to the primary antenna or navigation reference point shall be provided.

Sound Velocity Measures

A properly calibrated and working system shall be available throughout the survey to directly determine velocity of sound in water for use with all acoustic devices. The unit may be hand held or a permanent installation. Readings shall be taken weekly, or more frequently if deemed necessary, to at least streamer depth. **Contractor** shall define and Santos may approve the procedures and formulae to be used for determination of velocity.

4 DELIVERABLES

Contractor shall provide the following on completion of the survey:

- Dual copies of all seismic field tapes.
- Copies of all observers' logs and instrument test results.
- Post plotted positioning data tapes in UKOOA P1/90 format upon completion of seismic data acquisition;
- All field raw positioning data tapes in UKOOA P2/94 format;
- Final base maps (film copies) of single/composite shotpoint positions at a scale requested by Santos;
- Six copies of final post mission report of all field activity; and
- Six copies of final post mission report of all navigation processing.

Positioning Post Processing

Wherever possible **Contractor** shall process all positioning data onboard the survey vessel and provide UKOOA P1/90 format tapes on completion of the work. Full quality control and processing of all positioning data is required.

Contractor shall undertake additional QC as necessary at **Contractor's** offices onshore, on lines, which have been identified as being problematic, by either Quality Control Supervisor.

Contractor shall provide a full description of the equipment and algorithms used for the post plotting of all navigation and positioning data, together with a description of the quality control procedures for each phase of the processing.

5 SURVEY DATUM AND MAPPING PARAMETERS

All navigation systems used during acquisition, will be operated using WGS84 as the reference datum. Ancillary systems which may require to work on a plane will use the following projection on the reference spheroid.

Projection	:	U.T.M.
Zone	:	54S
Central Meridian	:	141°E
Zone Width	:	6°
False Northing	:	10,000,000
False Easting	:	500,000
Scale Factor along C.M.	:	0.9996

The following are agreed to be the appropriate ellipsoid parameters

	:	WGS84
Semi Major Axis	:	6,378,137
Inverse Flattening	:	298.257
Geodetic Datum	:	WGS84