ACQUISITION REPORT

PGS Geophysical	Origin Energy Resources LTD
M/V Orient Explorer	Shearwater 3D & 2D Survey Victoria Australia
PGS Job number 2005120	14th November to 10th December 2005

version 1

PGS Geophysical – Marine Acquisition, SINGAPORE

AUTHORISATION

Tom Moore   Singapore

Operations Manage   *P. Mo*   30th December 2005

DISTRIBUTION

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REVISED VERSIONS

NUMBER	CHANGES	AUTHOR	DATE

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1 Introduction

1.1 Summary

M/V ORIENT EXPLORER was contracted by ORIGIN ENERGY to do a seismic survey in the Bass Strait offshore Victoria, Australia.

The survey consisted of a 208 km^2 3D survey and 202 sail km of 2D lines.

Mobilisation started at 12:00 hours on 14th November 2005, with all the gear already deployed arriving from the SE after finishing another job in the same area. The production started in the evening of the same day, but on the morning of 15th November all the gear had to be recovered for crew change. The crew change took place at Burnie, in Tasmania on the morning of 16th November 2005.

On the evening of 16th November, after crew change, deployment commenced The M/V ORIENT EXPLORER was back in production just after midnight on 18th November 2005.

The survey was occasionally interrupted by marginal weather. After acquiring a total of 90 sequences (3D and 2D included) the survey was completed on 9th December 2005. The M/V ORIENT EXPLORER then recovered all the gear and de-mobilised arriving Melbourne on 10th December 2005.

1.2   Key parameters

Source	:	$2 \times 2500\ in^3$
Source depth	:	6 m
Streamers	:	4 x 4350 m
Streamer spacing	:	100 m
Streamer depth	:	8 m
Near trace offset	:	96 m

1.3   Systems

Source type	:	Bolt 1500LL / 600B guns
Streamer type	:	Syntron / Teledyne LDA
Recording system	:	Syntrak / gAS
Navigation	:	StarFix.L1 DGPS
	:	SkyFix.XP Clock/Orbit corrected GPS
Float positioning	:	Seatrack 220 / 320 RGPS
Acoustic ranging	:	Sonardyne SIPS 1

1.4   Production

	Sail line km	CDP km
Prime chargeable	1150.46	9203.68
Infill	399.45	3195.60
Infill percentage	34.7%	
Total	**1549.91**	

Above table includes 3D production only (run-out included). In addition 202.50 km of 2D sail line km was acquired (run-out included).

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1.5 Survey timing

	Hours		Hours	% of total
Production	390.07	production prime	164.57	26.37
		production infill	48.58	7.79
		line change	176.92	28.35
Standby	188.85	weather	113.95	18.26
		sea creatures	3.32	0.53
		crew change port call	71.58	11.47
Mob / Demob	34.28	mob (transit)	7.98	1.28
		demob	26.30	4.21
Downtime	10.80	streamers	2.60	0.42
		mechanical	8.20	1.31
Total	**624.00**		**624.00**	**100.00**

Start 12:00 local time 14th November and end 12:00 local time 10th December 2005.

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2   Sequence of events

2.1   Daily log

Date	Daily 3D total Sail km	Daily 3D Prime Sail km	Daily 3D Infill Sail km	Daily 2D total km	Sea State Beaufort	Location	Comments
14/Nov/05	0.000	0.000	0.000	20.700	4	Prospect	Transiting from Benaris prospect to Origin survey. Production seq 001.
15/Nov/05	0.000	0.000	0.000	13.200	6	SE of prospect	Production seq 002. Hauling equipment at 02:04 to go in for a port call crew change. Alongside Burnie 22:00
16/Nov/05	0.000	0.000	0.000	0.000	4	Burnie	Crew change / fuel / provisions and start up meeting. Sailing 16:50. Started deployment 18:20
17/Nov/05	0.000	0.000	0.000	0.000	4	SE of prospect	Deployment.
18/Nov/05	100.294	100.294	0.000	0.000	4	Prospect	Production seq 003-007. Production started 01:39. Seq 7 terminated d/t auto-fires.
19/Nov/05	106.838	83.832	23.006	0.000	6	Prospect	Production seq 008-012.
20/Nov/05	115.088	115.088	0.000	0.000	5	Prospect	Production seq 013-017.
21/Nov/05	115.069	69.038	46.031	0.000	3	Prospect	Production seq 018-022.
22/Nov/05	69.056	46.050	23.006	0.000	5	Prospect	Production seq 023-025. Down for weather from 15:56
23/Nov/05	53.156	30.131	23.025	0.000	6	Prospect	Down for weather until 09:48. Production seq 027-030. Seq 029 terminated for air leakage.
24/Nov/05	57.825	57.825	0.000	0.000	7	Prospect	Production seq 031-033. Seq 032 terminated d/t whale. Down for weather from 15:50.
25/Nov/05	69.038	46.013	23.025	0.000	7	Prospect	Down for weather until 09:09. Production seq 034-036
26/Nov/05	78.113	69.057	9.056	0.000	6	Prospect	Down for weather from 05:47 to 12:33. Production seq 037-041
27/Nov/05	106.875	92.062	14.813	0.000	5	Prospect	Production seq 041-045.
28/Nov/05	114.225	46.031	68.194	0.000	5	Prospect	Production seq 046-050.
29/Nov/05	23.006	23.006	0.000	0.000	8	Prospect	Production seq 051-052. Seq 052 NTBP d/t poor navigation solution caused by weather. Down for weather from 07:06
30/Nov/05	69.019	46.013	23.006	0.000	8	Prospect	Down for weather until 09:06. Production seq 053-055.
1/Dec/05	115.106	92.100	23.006	0.000	5	Prospect	Production seq 056-060.
2/Dec/05	114.731	91.706	23.025	0.000	6	Prospect	Production seq 061-065.
3/Dec/05	22.988	0.000	22.988	25.200	5	Prospect	Production seq 066-067. Down for weather from 06:00 to 18:27.
4/Dec/05	23.025	23.025	0.000	40.800	6	Prospect	Production seq 068-072. Down for weather from 20:17
5/Dec/05	26.456	26.456	0.000	0.000	9	Prospect / S of prospect	Down for weather until 18:46. Production seq 073-074.
6/Dec/05	111.675	65.625	46.050	0.000	4	Prospect	Production seq 074-078.
7/Dec/05	58.331	27.113	31.219	31.200	4	Prospect	Production seq 079-083. **3D survey completed 14:24**
8/Dec/05	0.000	0.000	0.000	40.800	7	Prospect	Production seq 084-087. Down for weather from 03:25 to 13:31.
9/Dec/05	0.000	0.000	0.000	30.600	6	Prospect / NNE of prospect	Production seq 088-090. **2D survey completed 09:42.** Start recovery of guns and streamers
10/Dec/05	0.000	0.000	0.000	0.000	7	Transit to Melbourne	All gir recovered 02:40. In transit to Melbourne. Vessel arrives 13:29

2.2   Daily production and sea state

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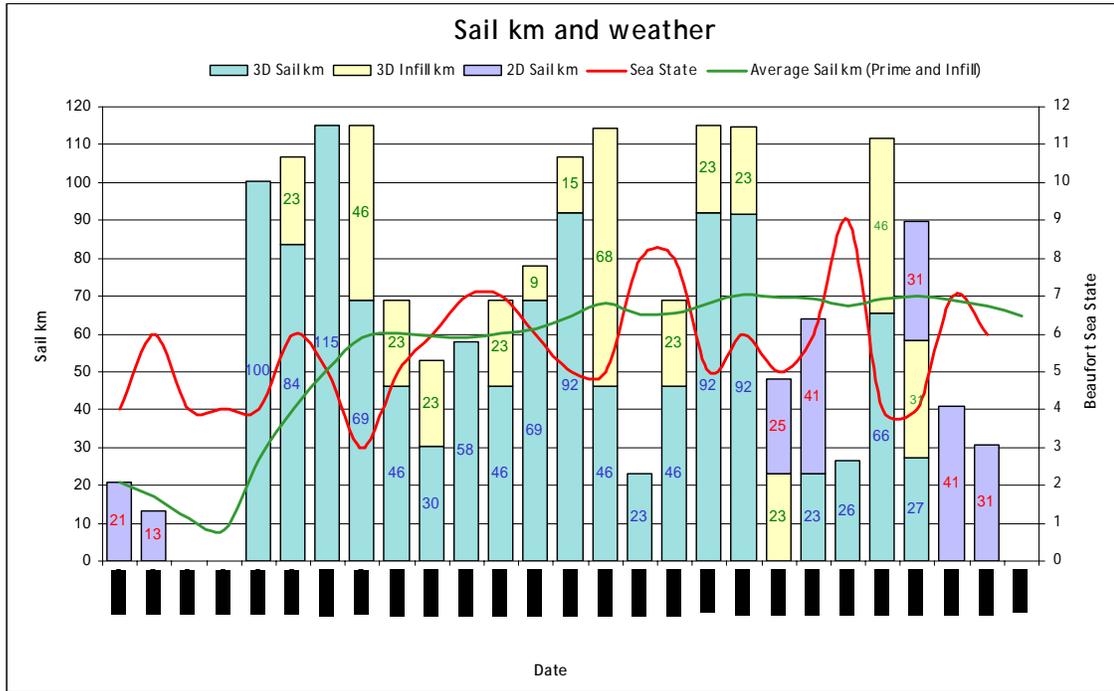
2.3 Post plotted vessel positions

3   Key personnel

	12th November to 16th November 2005	16th November to 10th December 2005
Party Chief	Stephen Beer	Esben Jettestad
Chief observer	Georgiy Astvatsaturov	Torkil Fenstad
Chief navigator	Jeremy Tate	Anthony van der Wal
Chief mechanic	William Tivendale	David Olson
Chief geophysicist	Erwan Le Duff	Guy Alleman
Client representative onboard	Drew Murray	Drew Murray
	Jim Kennard	Jim Kennard
Client contacts onshore	Frank Renton	Frank Renton

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4 HSE

4.1 Statistics

Exposure hours	Marine crew	15480
	Seismic crew	14976
	Third party crew	2592
	Total	33048

Workboat operations	9
Workboat exposure hours	22.83

Safety meetings	2
Safety training meetings	4
Toolbox meetings	12
Audits	11
Drills	4
STOP cards	11

4.2 Incidents

Report no.	Date	Action by	Classification	Status	Comments
ORI0531	14.11.05	Captain	Equipment	Open	Leakage discovered in forward sea water ballast tank
ORI0532	23.11.05	Captain	Equipment	Open	Boiler flue catches fire
ORI0533	03.12.05	Client	First Aid Case	Closed	Chase boat AB bruised shoulder in rough sea conditions

5   Survey operations review

5.1   Survey area information

Oilfield installations

Platform Yolla A in position 39º 51'S, 145º 49'E was located 35 km east of the centre of the 3D prospect. Two of the 2D lines were selected shooting towards the rig instead of having the run-in close to the rig. The closest approach was 3nm from the platform.

Oilfield activity

No activity around the above mentioned platform caused any delays to the production.

Shipping Activity

There was very little shipping activity in the area. Occasionally cargo vessels passed nearby the survey area and with the use of the AIS system early radio communication was established to inform about the survey. These vessels were co-operative throughout the survey.

There was daily ferry traffic between Devenport and Melbourne, and also between Burnie and Melbourne. It took only a few days for the ferries to be aware of our operations and they always gave us a good distance, normally 5 nm or more.

Sea Conditions, Tides And Currents

There was a tidal pattern in the currents of the area, but not very strong currents. For the duration of the survey there were no noticeable currents stronger than 0.5 knots. However, due to the average production being 5 lines per day, we were constantly out of the tidal period, which caused the infill to end close to 35%.

In Sea Dangers

The survey depth was between 57-73 meters with a flat seabed.

Sharks were observed in the area and one section had to be changed out with 3 compartments being attacked by what is believed to be a shark. See picture below.
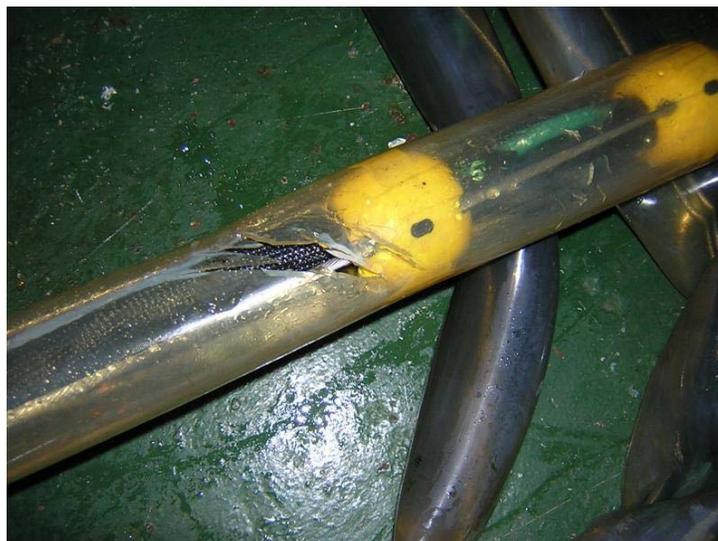
Fishing Activity

It was reported that shark fishing with nets might occur in the area. There was no fishing activity observed during the survey.

Weather

Near gale and occasionally gale force winds were experienced quite frequently during the survey. This caused nearly 5 days delay of production. The strong winds were a result of tropical low pressures passing south of the survey. The significant swell built up very fast due to the strong winds and swell up to 6m was experienced. The main swell direction was from southwest.

Cetaceans

Marine Mammal Observers were working from both the MV ORIENT EXPLORER and the chase boat MV PACIFIC CONQUEST. Only one whale was sighted during the survey. This was a Humpback whale that was observed during Sequence 32, about 4km before the end of line. The whale was spotted about 2-3 km ahead of the MV ORIENT EXPLORER and the line was terminated immediately.

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6   Seismic energy source

6.1   Source details

Source type	:	Bolt 1500LL / 600B air guns
Air pressure	:	1800 psi
Volume	:	2500 in^3
Number of sources	:	2
Number of sub-arrays	:	3 per source
Source separation	:	10 m
Sub-array separation	:	50 m
Source length	:	14 m
Gun synchronisation	:	± 1.5 ms
Shot interval	:	18.75 m for 3D / 25.0 m for 2D
Depth	:	6 m
Depth control	:	Fixed depth ropes
Depth monitoring	:	AG and Syntron depth transducers, GCS-90
Spacing control	:	Spread-ropes on sliding collars
Near field signatures	:	7 phones per subarray
Compressors	:	5 x Hamworthy 565
Source controller	:	GCS-90, version 4.76
Modelled source signature	:	See Appendix 12.3

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6.2 Offset diagram
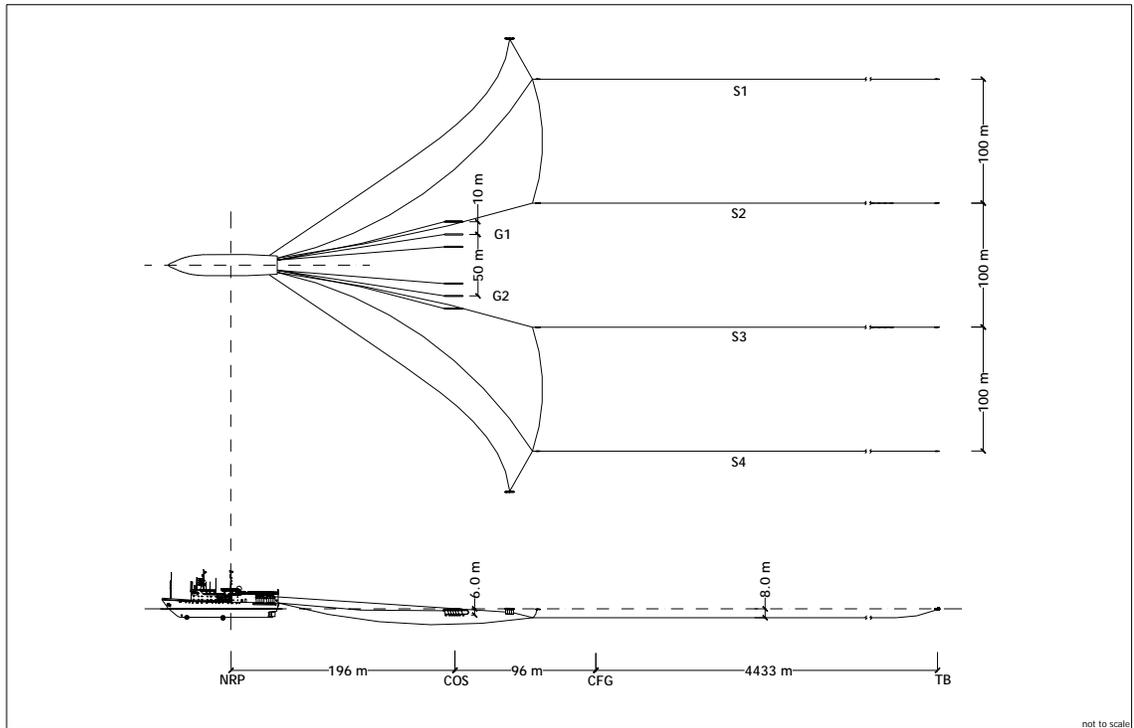
6.3 Gun array layout
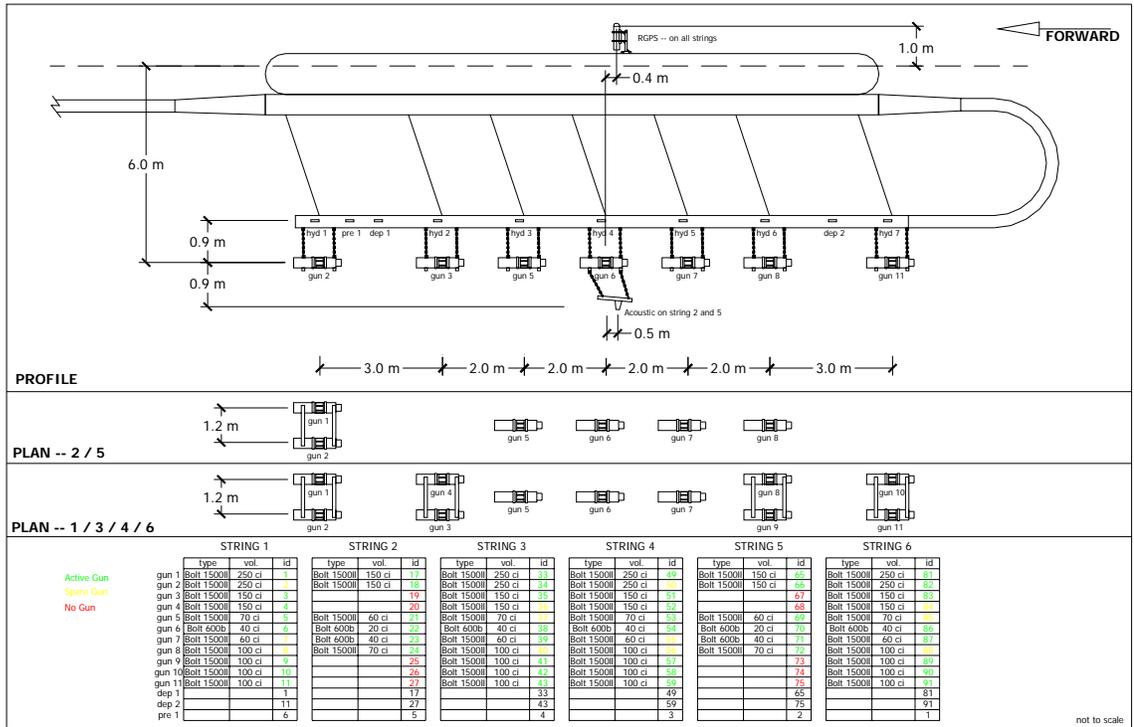
7   Seismic acquisition system

7.1   System details

Recording System	:	PGS gAS (geophysical Acquisition System) with Bit3 capture card on Syntrak 960-24 system
Software Version	:	gAS 3.0.2 - 6
Amplitude resolution	:	24 bit
Data Channels	:	4 x 348
Auxiliary Channels	:	48 (attached to streamer 1)
Tape Transports	:	6 x IBM 3590 cartridge drives
Tape Format	:	SEG D 8036
Recording Media	:	3590 data tapes
Record Length	:	5120 ms
Sample Rate	:	2 ms
High Cut Filter	:	206 Hz /276 dB per octave
Low Cut Filter	:	3 Hz /12 dB per octave
Gain Setting	:	12 dB
Amplifier	:	Voltage Mode Differential
Input Range	:	0-2048 mV
A/D Converter	:	Delta Sigma Architecture, with 23 bits + sign
Distortion	:	< 0.0005 % (- 106 dB)
Cross-Feed Isolation	:	> 110 dB
Power Consumption	:	7.5 W per module
Polarity Convention	:	SEG, positive pressure gives negative number
SEG-D header description	:	see Appendix 12.4

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7.2   System timing

Orient Explorer shot predict

Orient Explorer system start (SS) — 10 ms

Orient Explorer start of record (SOR) — 10 ms

Orient Explorer system ready (SR)

Orient Explorer fire command (FC) — 10 ms

Orient Explorer time break (TB) — 5 ms

50 ms

120 ms

170 ms

not to scale

7.3   Streamers

7.3.1   Streamer details

Type of streamer	:	Syntron / Teledyne LDA 2.6″
Number of streamers	:	4
Streamer sensitivity	:	20 V/bar
Streamer length	:	4350 m
Number of groups	:	348 per streamer
Group interval	:	12.5 m
Group length	:	12.5 m
Hydrophone type	:	T-2
Streamer depth control	:	Digibird 5011
Streamer depth	:	8 m
Number of compass-birds	:	18 per streamer

7.3.2   Trace Numbering

STREAMER	TRACE
Streamer 1	1 to 348
Streamer 2	349 to 696
Streamer 3	697 to 1044
Streamer 4	1045 to 1392
Auxiliaries	1 to 48

7.3.3   Component dimensions

	NUMBER per STREAMER	NOMINAL LENGTH (m)
Lead-in	1	
Head AP Stretch Sections	1	3
Head Conventional Stretch Section	1	50
Syntrak Module	29	0.358
Live Sections	58	74.54
Tail Conventional Stretch Sections	2	50
Power Adapter Section	1	3.80

7.4   Recording System

The Syntrak 960-24 bit Acquisition Instrument is designed and manufactured by Syntron, Inc. Houston, Texas, USA. It is a digital seismic recording instrument with 24-bit in sea data acquisition modules. Its principal components are the 24-bit data acquisition module, streamer telemetry interface (MSTS), recording system (MSRS) and a system controller. PGS gAS is the recording system, using a Bit3 Card in the Syntrak MSRS chassis.

7.4.1   Recording System performance

The recording system performed well throughout the survey.

There were some low count (1-6) parity errors on streamer 1 and occasionally on streamer 4. Some extraction errors were also logged on streamer 1, but were confirmed as good data by the QC.

Standard daily, weekly and monthly Syntrak system tests confirmed the consistency of the recording system.

For Sequence 59, the second recorder failed and tapes were copied from SET1, so that both SEG-D sets covered the whole survey area. Details about the recording system performance can be found in the line by line gAS logs.

During Sequence 67, wrong survey parameters were chosen when changing from 3D to 2D recording mode, causing some SEGD headers to be wrong for this 2D line.

7.5   Streamer layout
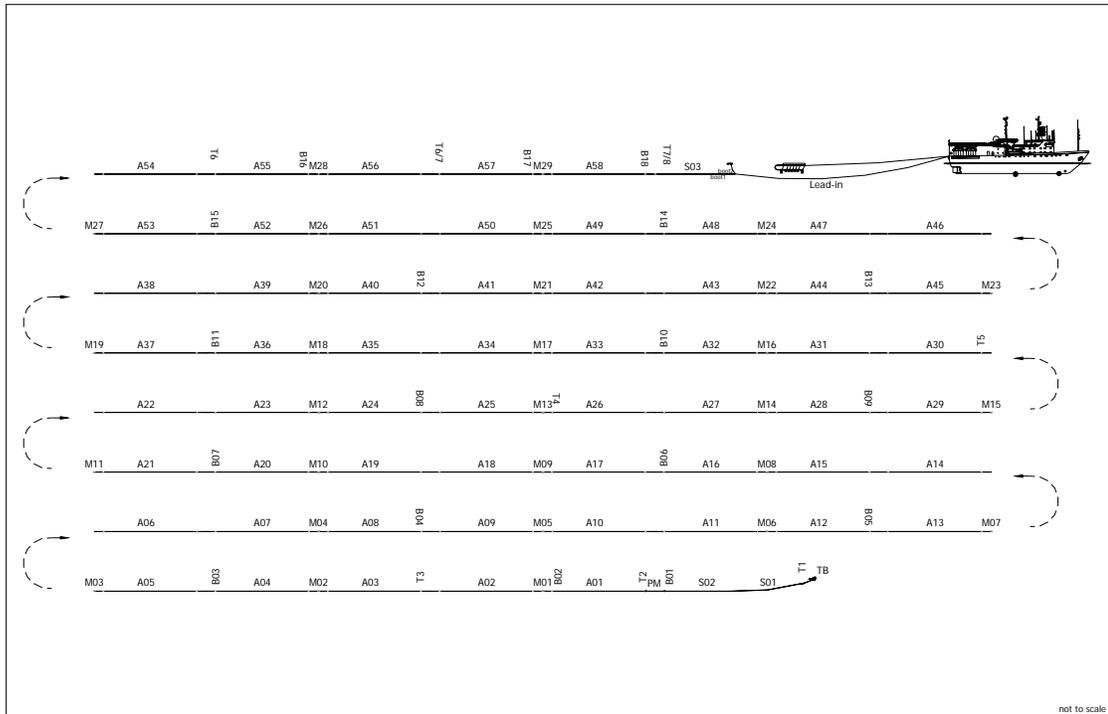
Abbreviations used above (all numbered from the tail):

S03   –   Stretch number 3
A24   –   Active section number 24
B12   –   DigiCourse Bird number 12
M17   –   Active module number 17
T4   –   Acoustic pinger number 4
PM   –   Power module
TB   -   Tailbuoy

8 Navigation and Positioning

8.1 Geodetic reference

8.1.1 Survey Datum

Survey datum	:	GDA94
Ellipsoid	:	GRS 1980
Semi Major Axis	:	6378137 m
1/Flattening	:	298.2572221

GPS Datum	:	WGS84
Ellipsoid	:	WGS84
Semi Major Axis	:	6 378 137 m
1/Flattening	:	298.257223563

8.1.2 Datum shift from WGS84 to GDA94

EPSG Transformation code no.	:	1150
X translation	:	0 m
Y translation	:	0 m
Z translation	:	0 m

Geoid height – 3D	:	-1.2 m
Geoid height – 2D SW	:	-1.6 m
Geoid height – 2D NE	:	-1.0 m

Australian Government requirements dictated that GDA94 was used as the survey datum. The difference between GDA94 and WGS84 is negligible for marine seismic surveys; the only practical difference can be seen in the shape of the ellipsoid used (reference flattening figures).

8.1.3 Map projection

Projection	:	Transverse Mercator
Projection System	:	UTM
Zone	:	55 South
Central Meridian	:	147°E
Scale Factor on Central Meridian	:	0.9996
Latitude of Origin	:	0°
False Northing	:	10 000 000 m
False Easting	:	500 000 m

8.1.4 Binning grid
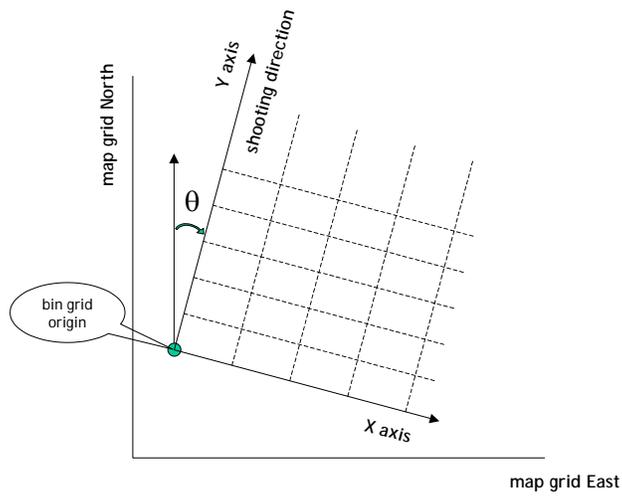
	:	
Origin Easting (m)	:	351556.18
Origin Northing (m)	:	5578658.54
Rotation (deg)	:	20.29

	X	Y
Origin bin number	921	787
Bin number increment	1	0.333
Area size (m)	14000	29400
Bin interval (m)	25.0	6.25
Bin size minimum (m) at 100 m offset	37.5	6.25
Bin size maximum (m) at 4450 m offset	75.0	6.25

8.2   Surface positioning

8.2.1   System I

Type	:	SkyFix.XP Clock/Orbit corrected GPS
Differential Corrections via	:	Inmarsat B (POR), Spot (109E APSat).
Reference stations	:	Satellite clock/ephemeris corrections.
Software	:	Multifix4, version 1.07.
Sub-Contractor	:	Fugro-Survey AS.

Pre-survey QC of the positioning systems was conducted in Portland by logging dual-frequency carrier-phase and code data for a period of 6 hours. The data was later sent to Natural Resources Canada's (NRCan) free Internet based processing service. This data was adjusted using enhanced orbit and clock corrections. A mean position difference between the NRCan and System I and II solutions was determined to be better than 0.5 m in north and east directions.

System performance was relatively good. The average radial difference between system I and II was 0.6 m. Differences were generally larger during afternoon and evening periods (local time) when ionospheric activity is greatest. This was to be expected when comparing a dual frequency system with a single frequency system.

Mean difference, Skyfix XP vs Starfix L1 area:3D

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Mean difference, Skyfix XP vs Starfix L1 area:3D

Mean difference, Skyfix XP vs Starfix L1 area 2D

Mean difference, Skyfix XP vs Starfix L1 area 2D

8.2.2   System II

Type	:	StarFix.L1 single-frequency, DGPS
Differential Corrections via	:	Inmarsat B (POR), Spot (109E APSat).
Reference stations	:	Melbourne 230 km distant
		Bathurst 800 km distant
		Ceduna 1360 km distant
		Brisbane 1540 km distant
Software	:	MRDGPS, version 3.03.04.
Sub-Contractor	:	Fugro-Survey AS.

From the 4 reference stations specified for this project it was possible to receive all 4 of them on POR and 3 on APSat. Brisbane was missing from APSat.

The Inmarsat POR system was intermittent during periods of rough weather, latency often reached 2 minutes. From 6th December 2005 2230 UTC to 7 December 2005 02:43, Fugro moved the APSat corrections temporarily to another carrier. The alternate carrier signal was not available east of 140° longitude. This had an effect on positioning for Sequence 081.

During Sequence 081 Inmarsat POR corrections were available but as mentioned earlier intermittent in rough weather. The age mask for the StarFix.L1 system was raised to 300 seconds; this allowed positioning to continue even when the corrections were unavailable for up to 3 minutes. After discussion with onboard QC Representatives it was decided to accept the positioning data given that:

1. the coverage being acquired was in the far offset zone, and
2. While Selective Availability (SA) is off, the rate of change of pseudorange corrections (PRCs) is very low.

Additionally during Sequence 081, the SkyFix.XP solution "fell back" to stand-alone GPS when the latency exceeded approximately 3 minutes. From the graphs below it can be seen that positioning with StarFix.L1 using PRCs older than 2 minutes had only marginal effects on the positioning for Sequence 081.

8.2.3   Positioning system comparison – North Sequence 081
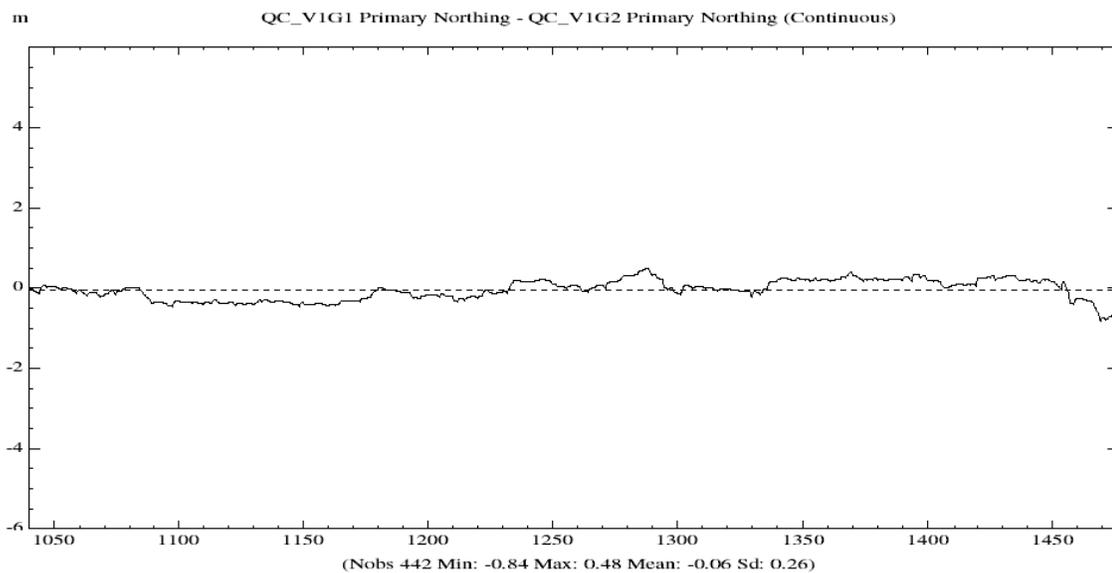
8.2.4   Positioning system comparison – East Sequence 081
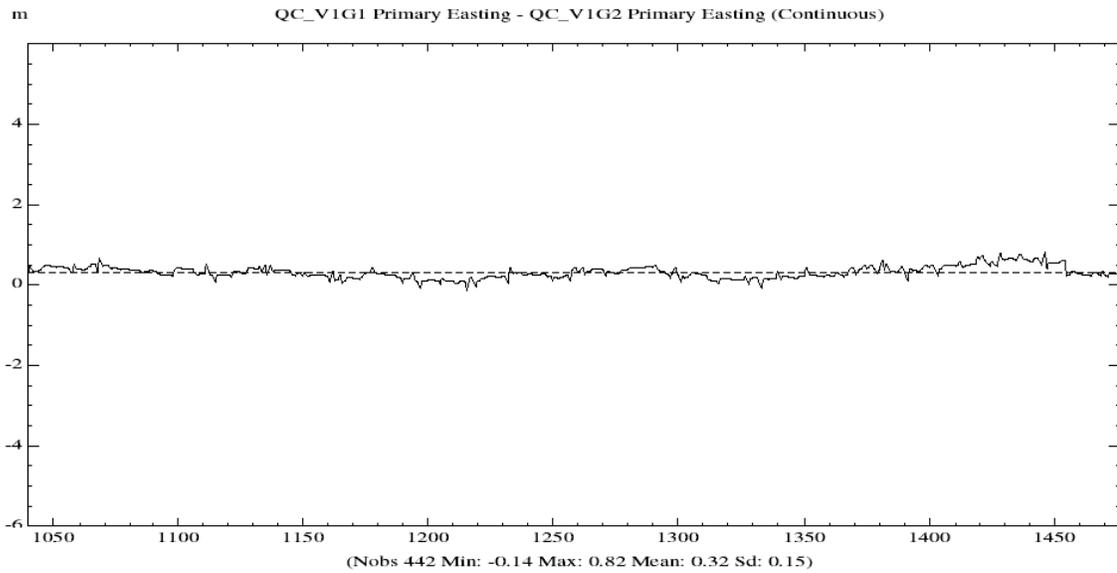
8.2.5   StarFix.L1 PRC latency – Sequence 081

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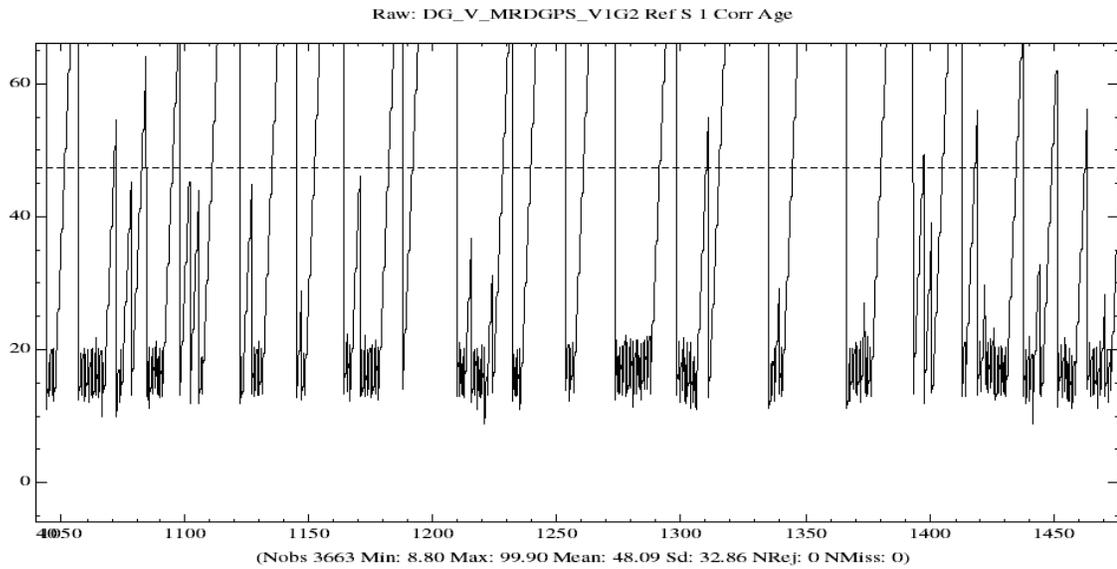
8.2.6 Float positioning

Relative GPS	:	Seatrack 220/320.
GPS receiver	:	Ashtech G 12-L.
UHF communication	:	Wood & Douglas radio / Seatrack VCU.
Software version	:	Fugro RGPS, version 3.02.04.

Seatrack RGPS units were installed on each of the six gun strings for QC purposes only. The units on gun strings 2 and 5 were used for source positioning.

The RGPS unit on gun string 6 failed for 4 consecutive sequences (039-042). It was replaced with a spare when sea conditions permitted safe recovery of the gun string.

8.2.7 Heading reference

GPS Heading / Attitude system	:	Seatex Seapath 200, MRU 5.2.
Gyro	:	Litton C.Plath Navigat II.

The Seapath 200 used as the prime heading for the survey. Due to poor satellite constellation, Sequence 016 was processed with the secondary gyro (C.Plath).

8.2.8 Delivered P1/90 and P2/94

Raw navigation data was recorded in UKOOA P2/94 format during acquisition and written to 3590 tape and hard disk. At the conclusion of each sequence, the data format was checked and necessary updates made to the header to produce a final, deliverable P2/94 file. Two sets of P2/94 data on 3590 tape were delivered to the client, and one additional set on 3590 tape was archived at PGS offices in Oslo, Norway.

Processed navigation data was provided in UKOOA P1/90 format. The P1/90 data was written to 3590 tapes with individual sequence headers and included position records for vessel, sources, tailbuoys, echosounder, and all receiver groups. Two sets of P1/90 data on 3590 tape were delivered to the client, and one additional set on 3590 tape was archived at PGS offices in Oslo, Norway.

8.3 Underwater positioning

8.3.1 Acoustic ranging system

System name	:	Sonardyne SIPS1.
Software version	:	7.00.07-T.
Frequency	:	EHF, 55-110 kHz.

The acoustic ranges were good for this survey when weather conditions allowed. Several lines were severely affected by weather conditions. However, due to the nature of the survey area and the outlook of continuous bad weather, the onboard QC Representative permitted several lines to be accepted which would normally have failed QC inspection or be deemed marginal at best, In particular, Sequences 010, 018, 031-033, 036, 037, 047 and 082. Sequences 026, 038, and 052 were scratched due to excessive compass and acoustic range noise levels.

Additional acoustics were used in the front of streamer 2 and 3 to help overcome interference from the ship's propeller wash. Reflected or unreliable ranges were removed either in pre-processing or during the net adjust process.

8.3.2 Acoustic network
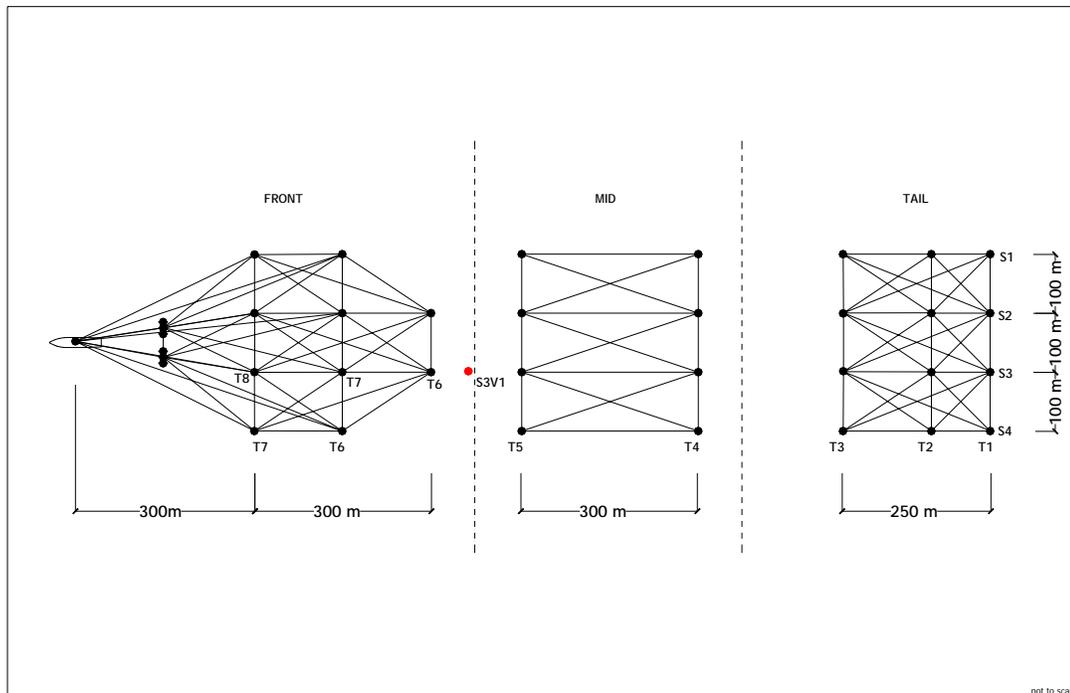
8.3.3 Magnetic compasses

Bird Compasses	:	Digicourse model 5011.
Software version	:	Digicourse Sys3. version 3.1.2.
Magnetic variation – 3D	:	12.6°.
Magnetic variation – 2D SW	:	12.6°.
Magnetic variation – 2D NE	:	12.7°.

Magnetic variations are derived from the IGRF-10 (2005) model for 15 November 2005.

Compass data was good during quiet weather periods. Significant editing was required on several lines due to sea conditions. Of note were Sequences: 010, 018, 031, 033-033, 036, 037, 040, 042, 046, 051, and 082.   Sequence 026, 038, and 052 were scratched partly due to noisy compass data.

During poor weather periods where the compass data was noticeably noisy, it was necessary in some instances to:

1. use a rate of change "gate" to automatically eliminate spurious observations and, where this failed, manually edit compass raw data;

2. "loosen" the a-priori standard deviation from the usual value of 0.5° up to as high as 0.9° and;

3. Increase the period of the low-pass Wiener filter so that the interpolated (filtered) values were somewhat smoother.

Three sequences were affected by poor communication with the tail of streamer 4 – Sequence Nos.: 027, 040, and 076. Data from the far 7 Digicourse birds during these sequences was intermittent, but this did not have a significant effect on the positioning quality.

8.3.4 Echosounder Performance and Water Depth corrections

Type and model	:	Simrad Hydrographic Echosounder EA500.
Transceiver frequency	:	200/38 kHz (200 kHz set to Master).
Heave compensated	:	Yes. PRH from Seatex-MRU5.

The master transducer for this survey was the 200 kHz unit. During post-processing a low-pass Wiener filter (0.05 Hz) was applied and any obvious spikes were manually removed.

The propagation velocity set in the echo sounder was 1500 meters per second. Depths were recorded at transducer level, i.e. no draught correction has been applied.

Both transducers performed well throughout the survey. Occasionally one transducer would lose track of the bottom during heavy sea conditions – this was always less than 1 minute duration.

After the job was completed, one special P1/90 tape **OS05E011** containing echo sounder positions and water depths corrected for draft and sound velocity was created.

A draft correction of 5.8m was applied. Full column velocity profiles were used for sound velocity corrections.

Below is shown an extraction from the header of the P1/90 tape **OS05E011**. This shows what the water depth data has been corrected for.

```
H2600
H2600 THIS FILE CONTAINS ECHO SOUNDER POSITIONS WITH WATER DEPTHS CORRECTED
H2600 DRAFT AND SOUND VELOCITY.
H2600
H2600 DRAFT CORRECTION APPLIED: 5.8M
H2600
H2600 SOUND VELOCITY SET IN ECHO SOUNDER: 1500M/S
H2600
H2600 SOUND VELOCITY PROFILES USED:
H2600
H2600 PROFILE:             DATE:             POSITION:
H2600    1             14.11.05          39 59.3S 145 45.3E
H2600    2             18.11.05          39.43.7S 145 27E
H2600    3             28.11.05          39 45.1S 145 27.3E
H2600
H2600 THE ECHO SOUNDER DEPTH DATA WAS CORRECTED FOR PITCH, ROLL AND HEAVE
H2600 PRIOR TO BEING PASSED TO THE INTEGRATED NAVIGATION SYSTEM.
```

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8.3.5 Sound velocity

CDT probe   : Valeport Midas SVP 5000DB s.n. 22249.

Real time sensors   : SIPS1 CT.

8.3.6 Speed of Sound Profiles

Profile no.	Date	Latitude	Longitude	SOS (m/s)	Temp. (°C)	Max. depth (m)
1	14-Nov-05	39° 59.3' S	145° 45.3' E	1507.5	15.0	19
2	18-Nov-05	39° 43.7' S	145° 27.0' E	1508.4	14.4	75
3	28-Oct-05	39° 45.1' S	145° 27.3' E	1508.9	14.8	75
4	08-Dec-05	39° 48.0' S	145° 30.0' E	1509.1	14.8	10
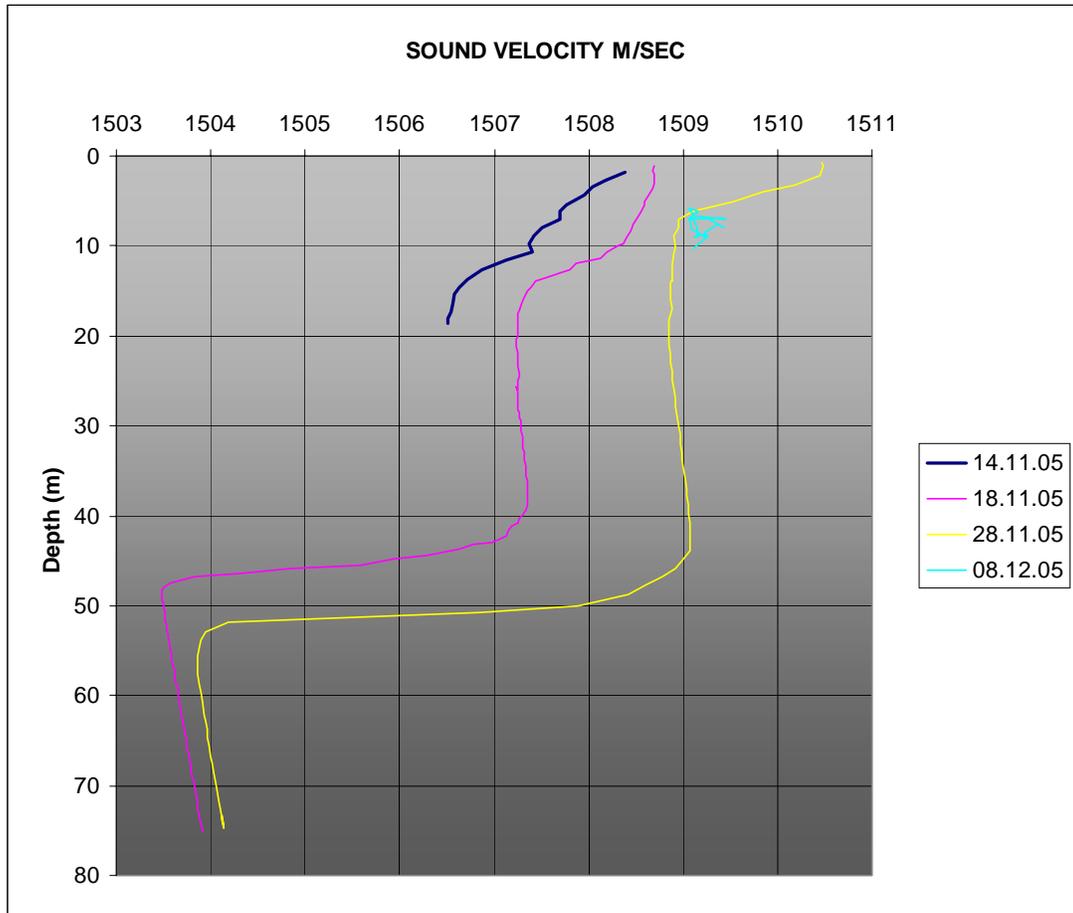
8.4   Navigation and binning systems

8.4.1   Integrated navigation system

Type	:	Spectra.
Supplier	:	Concept Systems Ltd.
Software version	:	10.9.01 (Linux RH9).
Real Time Interface	:	RTNU CMDS ver. 10.7.1, OS9 ver. 3.03.
Machine type	:	IBM x 235 server
Tape storage	:	DDS4 (20 GB).

8.4.2   Binning system

Type	:	Census.
Supplier	:	I/O.
Software Version	:	4.4.1.
Machine type	:	IBM F50 PowerPC (AIX4.3.2).
Tape storage	:	IBM 3950 type B1A.
External disks	:	54GB online, 45GB offline.

8.5   Calibration and Verification of positioning systems

Swift Survey Pte Ltd was appointed by PGS Geophysical (AP) to carry out gyro calibrations and GPS verifications on the 07 June 2005, at JSML Yard in Singapore. The Surveyors were required to perform:

- StarFix.Plus and SkyFix.XP verification.
- Seapath, Vega, and C-Plath gyro calibrations in one direction.
- RGPS verification.

The Surveyor's calculated minus observed (c-o) mean differences are summarised below.

Sensor	East (m)	North (m)
Starfix.Plus (V1G2)	-0.58	0.18
Skyfix.XP (V1G1)	-0.40	-0.05
Starfix.Plus (V1G3 - backup)	-0.56	0.17

Sensor	Dir'n. NE (°)
Seapath 200 GPS/INS	-0.20
C-Plath gyro	-1.48
Vega gyro	n/a due to power failure.

Sensor	Bearing (°)	Dist. (m)
Seatrack 220 s.n. 900	-0.070	-0.60
Seatrack 220 s.n. 210	-0.169	-0.71
Seatrack 220 s.n. 211	-0.182	-0.28
Seatrack 220 s.n. 247	-0.129	0.08

9   Navigation processing

9.1   Introduction

Data was processed using SPRINT. The processing comprised the following steps:

- Data import
- Data pre-processing
- Network adjustments
- Data export
- Final quality control

Each of these steps is covered in more detail below.

9.2   Data import

Raw data was recorded to tape and disk in P2/94 format. After the end of the line this data was checked, and if necessary, corrections were made to the header to produce a final archived version. This data was then imported into Sprint, and a QC report generated. Included in this report were:

- P2/94 format errors or inconsistencies
- differences in configuration between successive files
- changes in gun sequence
- time between shots not within specified limit
- jump in shot numbers
- number of headers

9.3   Pre-processing

All data was pre-processed to ensure consistent results in the adjustment phase.

During pre-processing, observations were grouped by sensor type. Predefined spike rejection gates and noise suppression filters were applied to the raw data. Configuration files were used to save all gating and filter values. After analysis, the final values were applied in a batch mode.

Where circumstances dictated, the values were changed interactively before the data was batched.

After pre-processing of all the observations, a quality report was generated containing the following information:

Nobs	:	Number of raw observations.
Nrej	:	Number of data observations missing after processing.
Bad block	:	Maximum block of missing raw data (in seconds).
Nominal	:	Nominal values computed from the logged offsets, or user assigned.
Mean	:	Mean value of the observation.
Max. Delta	:	The maximum shot to shot increment.
Units	:	In which unit data is recorded.

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9.4 Network adjustments

The network adjustment stage consisted of a least squares adjustment of the processed observations for each shot point. The software allows the observations to be treated as either a complete net, or a series of sub nets (e.g.: vessel antenna, front net, tail net, etc.). Sub nets were used for analysis of problem lines. A complete net was used for final adjustment after the individual sub nets were solved.

The streamer-shaping algorithm in use was an arc of curve fit through the pre-processed compasses. The streamer shape is adjusted through network computed node positions.

At the end of the net adjustment, a quality report was generated. Items included were:

- Network configuration
- Statistics on node covariances
- All observations scale/correction/SD in use
- Statistics on node shot point intervals
- Statistics on observation residuals
- Statistics on network variance factor and degrees of freedom
- The error ellipse (semi-major axis/skew) of all defined nodes
- Streamer rotation

9.5 Data analysis

Data analysis was performed for all lines and allowed all data from the Ingres database to be displayed. There were two main uses for this facility. The first was to produce a standard set of QC plots for each line, and the second was to act as an investigation tool for problems seen at any stage of processing.

Configuration files were defined to create a standard set of QC plots for every line.

The following plots were included:

Inline misclosure
Streamer rotations
Streamer separation
Distance vessel-sources, vessel-streamer heads
Shot point interval (distance and time) of vessel ref. position
Gyro and course made good of vessel ref.
Position comparisons (Field position vs. Post-processed position)
Network variance factor and degrees of freedom

9.6 Data export, P1/90 output

During the export process the receiver positions were computed and a P1/90-file was generated. The in-line misclosure error was accounted for by applying a linear distribution of the error to computed receiver positions. A header was added to the data during export.

The data was written to 3590 tape cartridges.

9.7   Data quality control procedures

The first line was sent to the office for QC. Both the P1 and P2 headers were checked. The line was processed and the solution was compared with the P190 file from the vessel. This procedure was repeated after each crew change to make sure there were no errors introduced. In addition, lines were sent to the office when the QC parameters exceeded the thresholds given in the PGS standard procedures, or the Client's specifications.

The final P2/94 tapes were checked using PGS internal software **p2list**. This program checked and returned the following information:

- Which files were on a tape and if each file had a complete header.
- Number of end-of-file markers and if the last record had an EOF mark.
- The filename, the sequence, the media label identifier (H0003), the number of shots, the number of shot inconsistencies (missing or double shots) and the number of records.
- A checksum, which was used to verify that data on tape was identical to data on disk.
- For every file the first and last E1000 record was printed.
- If there were shot inconsistencies, the E1000 records surrounding the inconsistency were printed.

Final quality control performed on the data included a number of streamer comparisons, both inline and streamer-to-streamer.

- Vessel, source and receiver positions were checked for internal consistency.
- The applied streamer rotations and the inline misclosures were checked.
- Latitude/longitude and grid coordinates were checked against the datum/projection defined in the header.
- PGS internal software was used to plot the rotated and unrotated streamer shapes. The unrotated plots provided a plan view of the post-processing results. The rotated plots displayed the streamer shapes for every shot at a 90 degree rotation; this allowed the shot to shot consistency to be checked.

The final P1/90 files were also checked using a Sprint QC tool, which checked:

- Contents of the first and last vessel record.
- Source id of the first and last source record.
- Number of even and odd shot points with different source id.
- Number of header records found.
- Number of vessel, source, tail buoy and receiver records expected and how many were found.
- Number of new line characters found.

The final P1/90 files were checked using a PGS internal software **p1plot**. This program checked and returned the following information:

- Tape name and date of issue.
- Datum/projection information from the header.
- For every line in the file: start/end shot and start/end co-ordinates.
- Standard comment record (H2600) concerning lines and shots in the file.
- Linefeeds in the file.
- All records 80 bytes long.
- Number of end-of-file markers and if the last record had an EOF mark.
- Grid co-ordinates correspond to the latitude and longitude with the given datum and projection.
- A checksum, which were used to verify that data on tape were identical to data on disk.

The final P1/90 tapes were checked using PGS internal software **p1list**. This program checked and returned the following information:

- Which files were on a tape and if each file had a complete header.
- Number of end-of-file markers and if the last record had an EOF mark.
- The filename, the tape version identifier (H0202) and the number of records.
- A checksum, which were used to verify that data on tape were identical to data on disk.
- For every line in the file the line name, FSP, LSP and the position of SOL and EOL was given.

Results of the P2list, P1list and p1plot were saved and copies are archived in the Oslo office.

All tape labels were created using PGS internal software **mklab**. All information on the labels was extracted from the files on the tapes.

9.8   Computer systems

Computer	:	BM RS/6000 7025-F50
Operating System	:	AIX 4.3.3.0 ML 10
Tape storage	:	2x IBM Magstar 3590 B1A
External disks	:	RAID5 SSA (Serial Storage Architecture) 64GB
Type	:	SPRINT
Software version	:	3.1.20
Supplier	:	Concept Systems Ltd.
Printer / Plotter	:	HP LaserJet 4200 / DesignJet 755CM

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10 Seismic data quality

In general seismic data quality was very good during the survey with minimum in-sea equipment failure and reliable source. As the weather conditions were sometimes marginal, swell Noise was the worse noise visible during the whole survey, even if it stayed in acceptable limits most of the time. For the 2D lines, all 4 streamers were recorded with one source firing. All 4 streamers were QC'd, letting future processing centres try any combination. Some of those 2D lines were acquired in very marginal weather conditions and so were noisy. This was specially the case at the end of the survey, after sequence 83.

10.1 Swell noise

Sequences 13, 18, 32-34, 37, 42, 45 and 74 were affected by swell to different extend.

Some sequences were shot at 9m streamer depth to minimise seismic and compass noise effects: 46, 69. Some 2D lines were even shot at 10m streamer depth: Sequence 68, 83, and 84, 85, 86, 87, 88, 89, 90.

Some lines had to be rejected due to too much noise: Sequences 26 and 38.

On the worst accepted lines, the swell bursts rarely reached the target zone (2-2.5 sec) on the QC brute stack displays. Details can be found in the gAS Line Logs.

Testing was done on some lines with PGS's swell removal processing tool (SINK). This confirmed that this random low frequent noise was easy to remove. It did not affect a lot of traces and then again only in the deeper part of the stack.
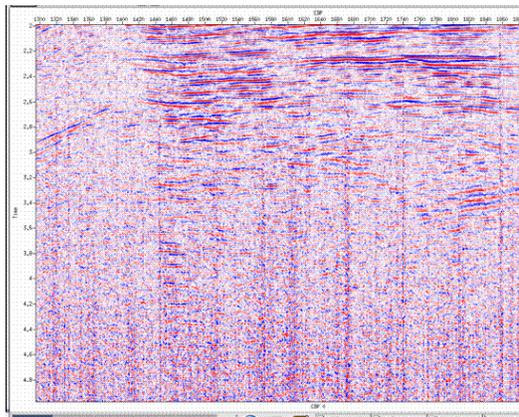
1, 4 to 4,8 sec zoom on Line 1076 Sequence 040 Brute Stack. This was the worst accepted line.
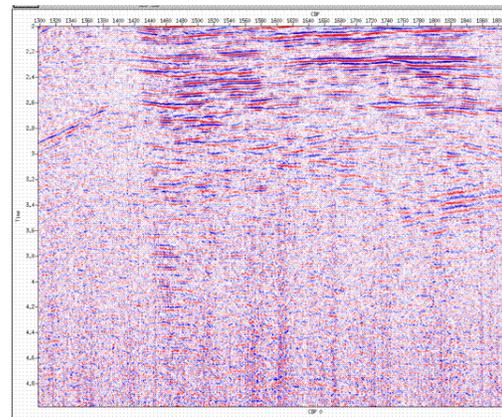
1, 4 to 4,8 sec zoom on Line 1076 Sequence 040 Brute Stack with Sink applied before Stack.

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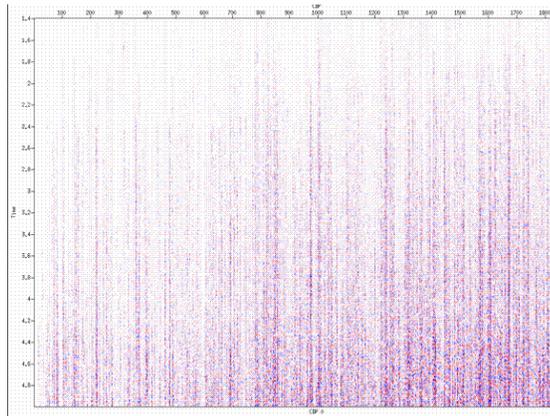
1, 4 to 4,8 sec zoom on Line 1076 Sequence 040 Difference plot showing only the swell noise.

10.2 Ship noise

On a few sequences (13, 18, 22, 23, 61, 66) some ship noise could be seen at low levels (<15 µBar on the 4500-5000 msec RMS window). This was mainly due to some merchant traffic.

10.3 Bad channels

For every line, the RMS level of spiky/noisy channels was checked against specification and observer logs updated accordingly. The number of bad channels remained within contract specifications with an average of less than 1% of traces being bad.

Some very low intermittent cross feeding (< 5 µBar) was visible at the beginning of the survey on streamer 1 and later on streamer 2. The worst sequences affected were 21 and 28. This was quickly solved and had no consequences on the general quality of the data.

The Syntrak recording system flagged some low count Extraction errors on streamer 1 and 3. Those were more important when the weather deteriorated. Every affected shot was checked offline and data accepted.

10.4 Streamer Front End Noise

The noise on the near channels stayed low (<10-15 µBar on the 4500-5000 msec RMS window). Only during bad weather, values reached 20 µBar in the same window, due to some minor low frequent (<20 Hz) intermittent tug/strum noise.

Some propeller noise was also visible on the data. It had low amplitudes of typically 5µB above ambient noise. Its broad/high frequency band ranged from 40Hz-Nyquist. It had a move out with roughly water velocity. The number of near channels affected depended on the water depth and the velocity of very shallow geological layers. Some near traces, typically 300-320, showed stronger propeller noise. This was related to the critical angle of the reflection. For shorter offset (< critical angle) the energy was mostly absorbed in the shallow layers. At critical angle, the maximum of the amplitude was reflected to the surface. This was fading out on longer offset.

10.5 Source

The source was very stable. Very few gun failure required spare gun utilisation. The bubble test run at the beginning of the project validated gun specifications.
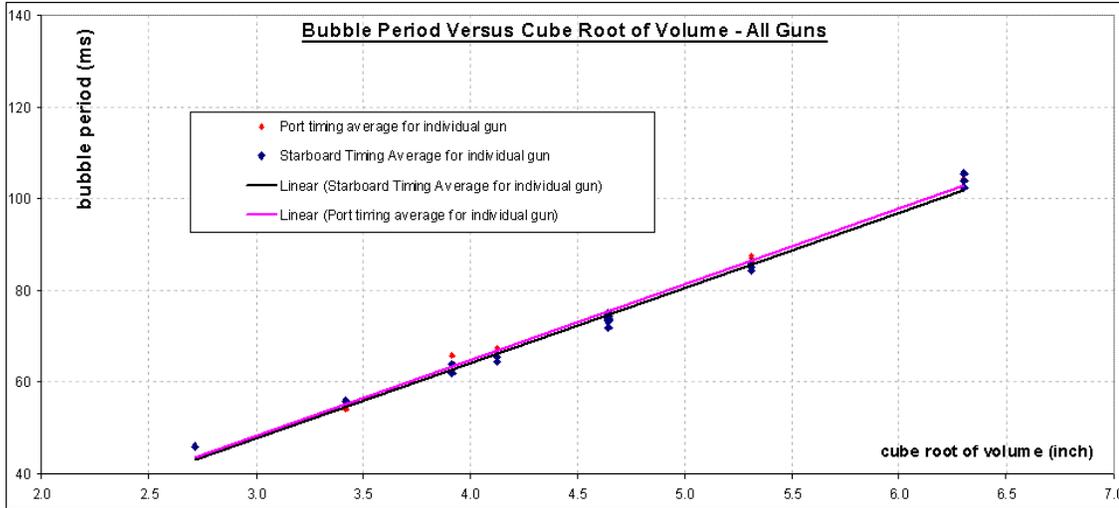
Some autofires were seen online and the guns switched off as required on sequences: 5, 6, 7 and 27 A few air-leaks were immediately spotted by the gAS QC system and action taken as required on sequences: 29, 40 and 62.
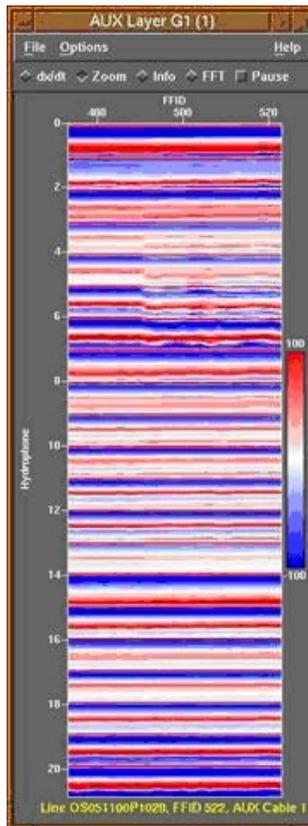
Example of an air leak detected on gAS online Auxiliary channel QC display on sequence 29

10.6 RMS and noise analysis

RMS values for water column, End of Record and the 2 signal windows were reviewed for each streamer. RMS amplitude for each shot/streamer were converted to trace samples and displayed. Noisy, spiking and weak channels were determined this way. External noises like swell noise, ship noise, etc…could also identified this way.
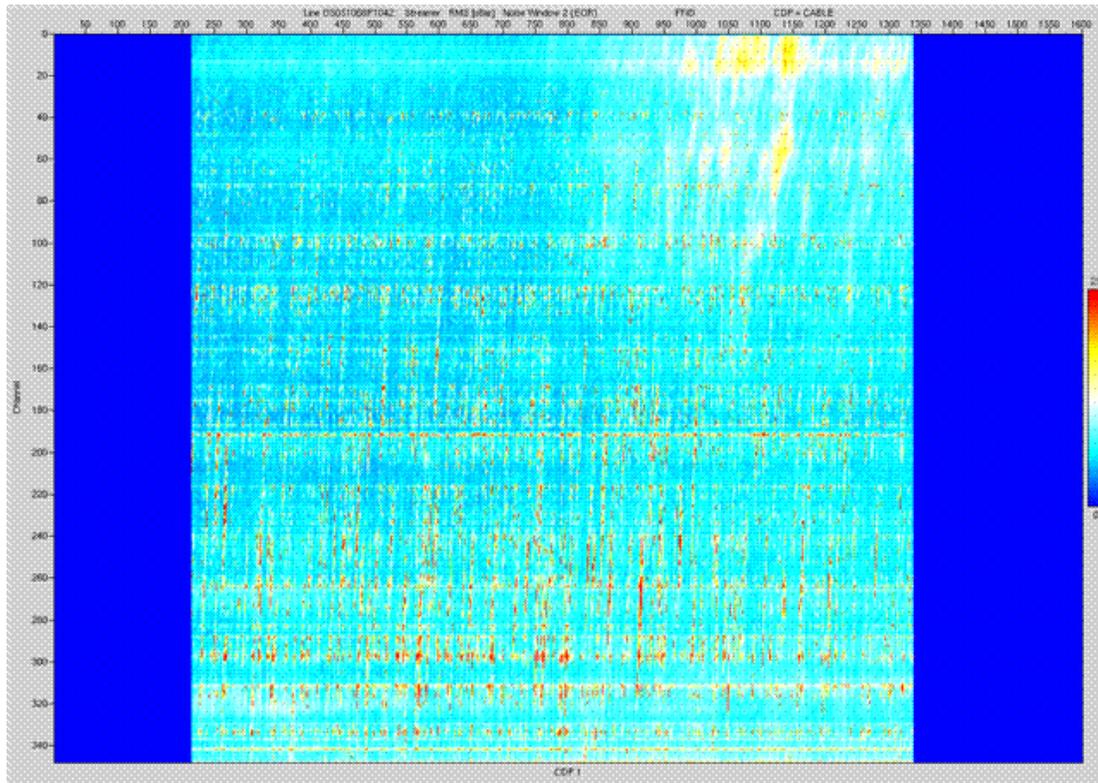
Sequence 42, Streamer 1, End of Record RMS display, showing swell noise above 25 µBar.
Colour bar from Dark blue = 0 µBar to Red 25 µBar. Horizontal axis is shot and vertical axis is channel.

10.7 First break / P1 offset check

For every sequence, the navigation P190 files offsets were checked versus the direct arrival on every shot. Those near offsets were validated for the whole survey.

10.8 Attribute cube

In addition to a line-by-line analysis, some maps of different RMS windows were generated, in order to compare the amplitudes over the whole survey. This shows the very good quality and consistency of the data. Note some lines show stronger background noise since affected by swell noise.
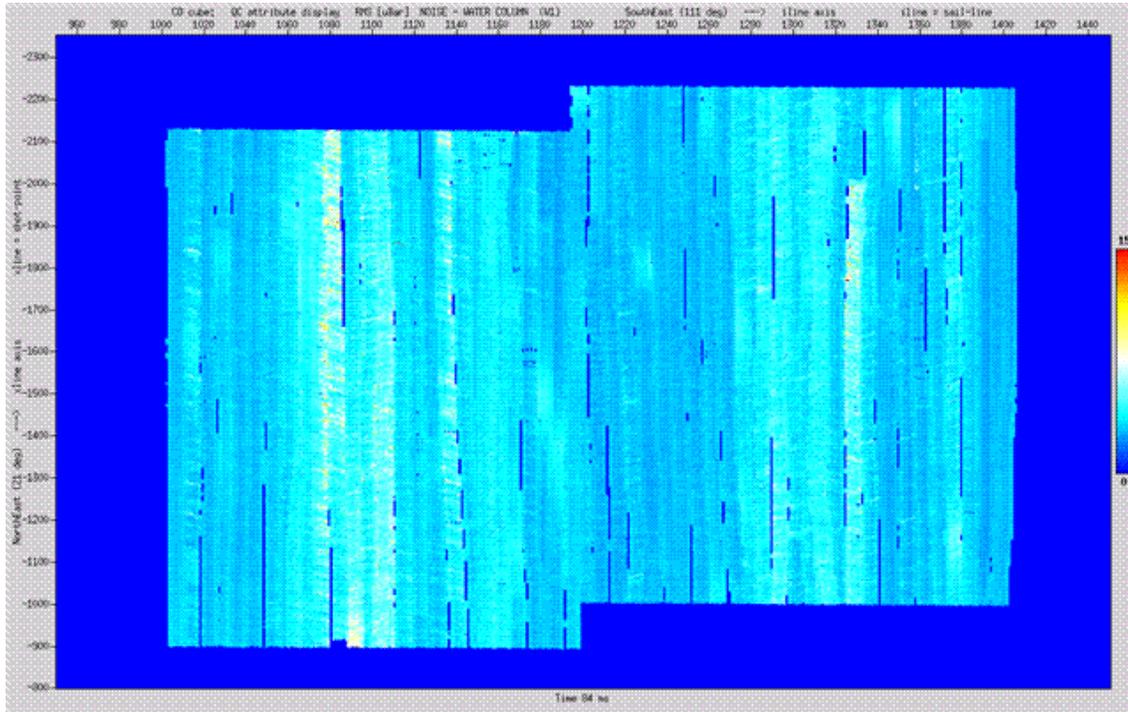
End of Record RMS window for the whole 2005120 3D survey. Colour bar from Dark blue = 0 µBar to Red 15 µBar. Vertical axis is crosslines and horizontal axis is inlines.

10.9 Common offset cube

As a further means of testing the accuracy of the tie between seismic and navigation data, a common offset cube was built. A common offset trace (250m offset) was selected for each streamer and merged with the final processed p190 navigation data and loaded into a cube volume in VIPER system. This product had minimal processing (resample at 4msec with appropriate anti alias filter), the aim was to look for time shifts indicating recording errors and potential miss-ties at swath or sail line boundaries. Inline, cross-line and time-slice displays were produced and analysed at regular intervals in order to detect any miss-ties between the seismic and navigation data. This validated again the navigation data. A SEGY tape of the Common Offset cube was made available at the end of the survey as an additional product to the standard PGS QC procedure.
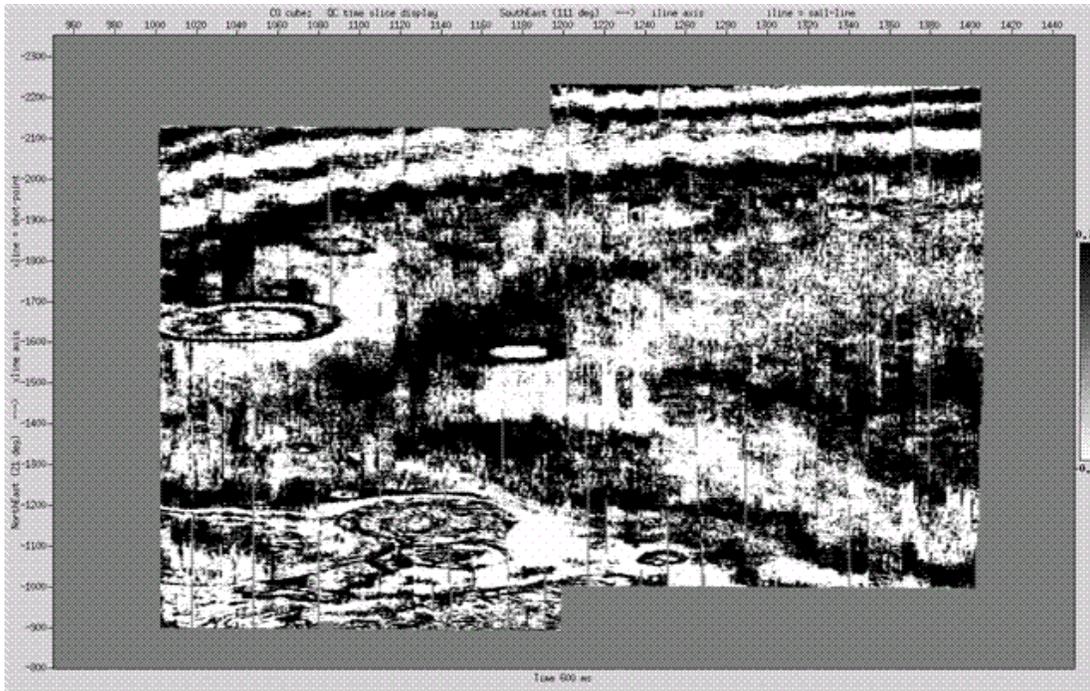
Near Trace Cube Time Slice 600 msec for the whole 2005120 3D survey. Vertical axis is crosslines and horizontal axis is inlines.

```
C01 2005120 Victoria, Australia -Shearwater 3D & 2D
C02 Project: 2005120         2
C03    Sequences 003-066,072-082
C04 Acquired:               Nov-Dec 2005
C05 Syntrak 24 Bit Format:    SEG-D 8036 (3590)
C06 Sample interval: 4ms      Record length:  5000 ms
C07 Recording Filters:        3Hz, 12dB/oct - 206Hz, 276dB/oct
C08 Polarity:                 SEG normal convention: compression=neg.
C09 Source: Sodera G-Guns     Sources: 2 x 3 sub-arrays
C10 Array separation: 18.75m   Gun volume: 3090 cu.in.  Pressure: 2000psi
C11 Shot interval: 18.75m      Source depth: 6m +/-1m
C12 Cables:  4                Groups:  4x 348channels
C13 Nominal offset: 100m      Cable depth : 8m +/- 1m
C14 Cable length: 4350m       Group interval: 12.5m
C15 Cable Separation:         100m
C16 Navigation System 1: Fugro Skyfix
C17 Navigation System 2: Fugro Starfix Plus
C18
C19 PROCESSING By PGS Acquisition Seismic QC using Gas and VIPER
C20 Reformat SEG-D 8036 to Internal Format. Trace length=5120 ms
C21 P190 Navigation merge with the seismic trace
C22 -120 ms static shift (Syntrak Digital Filter Delay)
C23 Anti-alias filter 3,6,90,120 and resample to 4ms
C24 Apply NMO based on regional velocity function
C25 3D Common Offset cube binning
C26
```

```
C27
C28
C29
C30
C31
C32
C33 Starting  Bytes of Trace Header Words
C34 Shot Point: I4 17
C35 CDP:        I4 21
C36 Cable No:   S2 207
C37 Gun Mask:   S2 213
C38 xline I4 181,   iline I4 85,    bin-x F4 217,     bin-y F4 221
C39 wbt I4 201,    cable I4 207,    swdep I4 193,    gwdep I4 197
C40 END EBCDIC
```

10.10 Brute stack QC

The brute stacks were produced offline. Quality of reflections was very satisfying, considering the very basic processing involved. Brute stack was tuned for noise detection and in no case for signal to noise enhancement. There is no doubt that further processing will improve the images. Reflections are visible on the all recording time. Faults, sills are visible with complex structure in the target zone (2.0 to 2.5s) and below.
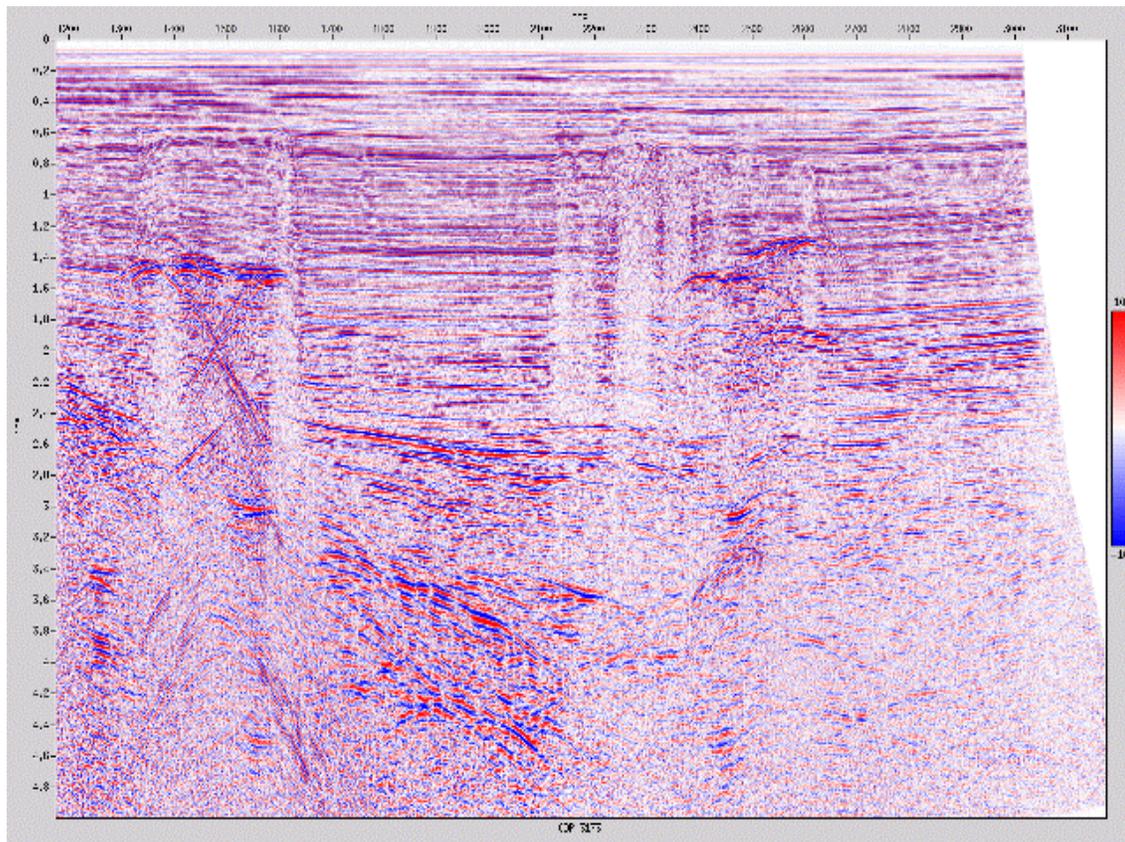
11   QC Processing

The PGS Acquisition Quality Control system includes a set of standard products for online and offline QC, general seismic data QC processing, investigations and data archiving. Seismic QC is performed using PGS gAS and Viper systems. The geophysical Acquisition System is the recording system and produces a number of automated online QC displays. The Viper system performs the offline QC. Both packages use a common source code and the interaction between gAS and Viper provides a seamless system. The intention with these systems is to automate as many functions and displays as appropriate, use interactive display facilities rather than rely on paper plots, and to investigate / display upon exceptions. The Viper system has a number of ported geophysical modules from PGS' proprietary processing software Cube Manager such as swell noise attenuation (SINK) that can be used for QC purposes.

11.1 Online QC

While on line the gAS system performs the following tasks:

- Data are captured and passed to the Viper system real time, and stored on disk.
- SEG-D headers for all shots are saved to disk
- RMS values for up to 4 windows are calculated on the recording system and captured to disk for all shots & channels. These include the last 500ms window for a 'noise' estimate and any client specified signal window. In cases where the water is deep enough a measure of true ambient noise would be taken from the water column.
- Full spike scanning of the entire record length for all shots and all channels
- Gun QC
- Automated external noise detection
- Dual Recording of SEG-D tapes with QC and verification
- Options for instant hard copy generation via a networked A3 printer
- Archive and restore features

Key QC displays include:

- Real time movie image of RMS values in microbars for all streamers & all channels, together with graphical display of minimum, maximum and average values per shot
- SEG-D header converted to seismic QC traces in colour as a movie image for easy detection of errors and out-of-spec values e.g. streamer depths, parity errors, spikes, extraction count errors, autofires and misfires
- Real-time shot record displays for all shots, all streamers, with point & click ability for interactive analysis of data and header values
- Real-time SINK difference shot display for external noise and autofire detection
- Mean per channel RMS with annotated bird and pinger locations
- Real-time single trace and auxiliary channel displays including autofire and airleak detection displays (stacked and layered auxiliary displays)
- Real-time display of time break
- RMS values for each window/shot/streamer were recorded during line acquisition and the 2 ambient windows (water column, End of Record) were displayed for QC purposes via the gAS recording system. Shot to shot (port vs. starboard) RMS levels were displayed for the direct arrival and the two signal windows to assist in identification of source output differences caused by air-leaks and air pressure drops.

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At the end of each line, together with the GCS90 and a Syntrak Logs, some QC graphs were made available in "pdf" format:

- Start of Line RMS Noise
- End of Line RMS Noise
- Average Trace RMS Time Series Plot
- Overlay Trace RMS Time Series Plot
- Shot-Average RMS Time Series Plot
- RMS Shaded Image Plot
- Average Bird Depth Time Series Plot
- Bird Depth Shaded Image Plot
- Gun Volume Time Series Plot
- Gun Pressure Time Series Plot
- Gun Depth Time Series Plot

All acquisition and QC relevant information was synthesised in the line by line gAS logs.

11.2 Offline QA/QC sequence

All recorded seismic data and RMS values were captured to the Viper QC disk in real time using Bit3 card. Auxiliary channels and RMS value files were also written to the gAS system disk in SEGY format for subsequent retrieval and QC analysis.

In the event of a failure of gAS data capture, seismic data (streamer traces and auxiliary traces) were read in from field tapes via Viper and RMS files were regenerated offline in the gAS system.

In addition to specific noise or data investigation the Viper operator did a routine production of the following on-screen displays and/or electronic files:

- Shot records displayed at a suitable interval to sample data quality
- Near trace display with Navigation merge
- NMO corrected gathers display (or super-gathers as dictated by fold)
- Brute stack plot
- SINK stack plot and SINK difference plots when required
- RMS plots

11.2.1 2D QC stack

The following processing flow was used for a 2D brute stack. The aim of this product was not attenuating noise, but to review data quality after stack.

- Recording delay correction
- Temporal anti-alias filter
- Low-cut filter (incorporated in the anti-alias filter)
- Resample from 2ms to 4ms
- Adjacent trace summation with differential NMO
- Gain recovery
- Pre-deconvolution mute
- Predictive deconvolution before stack (DBS)
- NMO. Velocities picked using 2km x 2km picked velocities in Promax.
- Mute
- Stack
- Gun & cable static correction
- Display

In addition, a stack including SINK (applied pre-stack) was produced for evaluation of swell noise when required. In order to evaluate the amount of noise attenuated by this process stacks with and without SINK applied, including difference plots, were generated. SINK ('Seismic Interference Noise Killer') is PGS' proprietary threshold limited noise attenuation software. Commonly applied pre-stack, it can be run to target swell noise and/or interference noise. Additionally, SINK attenuation operators can be designed using limited bandwidths for more robust interference/signal separation.

11.2.2 Navigation / seismic merge QC and Common offset cube

A range of common offset traces from each streamer for every shot and for every line was selected and loaded to a common offset cube after merging with the P190 navigation data and interactive QC. Timeslice and crossline displays of this nominal single fold 3D cube were used for QC of the navigation/seismic merge. In addition, LMO corrected gathers after navigation merge, and navigation derived offsets (NDO) versus seismic derived offsets (SDO) were evaluated for navigation QC purposes.

11.3 RMS and noise analysis

Five RMS windows were calculated by the gAS system, displayed online and captured in real time by Viper. This allowed online and offline noise analysis.

	Channel Range	From gAS	After Instrument Delay correction
Water column window	1-348	150 – 300 ms	30 – 180 ms
Direct Arrival *	116-232	From Pick -250 to Pick +500ms	
Signal window 1	116-232	500 – 1000 ms	380 – 880 ms
Signal window 2	116-232	2400-4000 ms	2280 – 3880 ms
End of record window	1-348	4500 – 5000 ms	4380 – 4880 ms

Note: * Direct arrival is picked automatically and the window is calculated from that time.

In addition to the RMS products listed above, an attribute cube containing RMS values for signal and noise windows was generated in Viper. A selection of meaningful aerial displays of noise, signal and Signal/Noise estimates were generated, together with other QC attributes like Water Bottom Time and Water Depth.

11.4 Computer systems

The gAS and Viper systems run on generic PC's and IBM Xenon X335 PCs, respectively and use Redhat Linux as the operating system.

Viper QC system:

Three IBM x335 slim nodes running RedHat Linux V7.3 and Viper (PGS proprietary) software:

Mamba: 3.2GHz CPU, 2GB RAM, 2x 282GB SCSI disks
Cpu01: 2.8GHZ CPU, 2GB RAM, 2x 282G SCSI disks
Cpu02: 3,066GHZ CPU, 2GB RAM, 2x 282GB SCSI disks

HP Procurve 2708 network switch – 8x 10/100/1000Mbps Ethernet ports.

3x 3590 tape drives connected to 2 nodes via Differential SCSI adapters.
One node has a gigabit Ethernet connection to the gAS recording system for real-time transfer of SEGD data.

ProMAX Off-line System:

IBM RS/6000 595 running AIX and ProMAX 2D version 1998.1

2 x 256 Mb Physical memory, 2 x 73 Gb Disk, 2 x 9 Gb Disk, 2 x IBM GTX150M Graphic Adapter.

Plotter:

Oyo GS 624 thermal plotter

12 Appendix

12.1 Data shipments

Date	Proforma	Content	Boxes	Wt	Shipping address	Comment
10 Dec 05	ORI12801041	Complete set no 1 Seq. 001-090 SEG-D data. Navigation P1/90 data. Navigation P2/94 data SEG-Y Common offset cube. CD with project info.	6	48kg	Origin Energy Resources Ltd. 339 Coronation Drive Milton, QLD 4064 Australia Attn : Mr Randall Taylor	Picked up by Origin (by C. Williams) while alongside in Melbourne 10 Dec 2005.
10 Dec 05	ORI12801042	Complete set no 2 Seq. 001-090 SEG-D data. Navigation P1/90 data. Navigation P2/94 data. CD with project info.	7	51kg	Fugro Seismic Imaging P/L Level 1 69 Outram Street West Perth WA 6005 Attn: K.Beauglehole / P. Cook	Picked up by agent NT shipping while alongside in Melbourne. Sent by DHL to Perth 12 Dec 05.

12.2 Additional navigation deliverables

The following deliverables were issued from PGS offices in Oslo after the survey was completed.

- Vessel position tapes, **OS05V011, OS2DV011**
- Processed water depth tape **OS05E011**, with corrected water depths (corrected for draft, sound velocity.)
- Vessel pos. plots Scale 1:50 000.
- Contour plot, Scale 1:50 000.
- Coverage maps, all zones unflexed scale 1: 50 000.

The plots were delivered on paper and CD-Rom in cgm format.

12.3 Source modelling

SIGNATURES FROM MARINE AIRGUN SOURCE LIBRARY
NUCLEUS - Marine Source Modeling 4.3.1
Modeling by Steve Campbell, PGS Technology – Geophysical Support, October 25, 2005

Survey name	:	Origin Energy Resources
PGS project No	:	2005120
Survey area	:	Shearwater 3D/2D
Vessel	:	M V ORIENT EXPLORER
Array	:	2500LB_60_1800_100
Source type	:	Bolt 1500/600B
Source volume	:	2500 cu.in.
Air pressure	:	1800 psi
Source depth	:	6.0 m
Subarray separation	:	10.0 m
Recording filter	:	Syntrak-24bit system, 3(12) – 206(276) Hz (dB/oct.)
Receiver depth	:	8 m
Hydrophone group length	:	12.5 m
Compensating p-plugs	:	in
Full system response* filter name	:	S-24 g-6.25
Sea temperature	:	15° C

Enclosed are:

Figure 1: Array configuration top view, i.e. positive Y denotes starboard.
Figure 2: Modeled far-field signature and amplitude spectrum with 24bit recording filter (without receiver ghost).
Figure 3: Modeled far-field signature and amplitude spectrum with DFS-V recording filter (without receiver ghost).
Figure 4: Modeled far-field signature and amplitude spectrum with recording and hydrophone filter effect applied (without receiver ghost).
Figure 5: Far-field signature listing with 2 ms sampling interval (without receiver ghost).
Figure 6: Modeled far-field signature and amplitude spectrum with recording and hydrophone filter effect applied (with receiver ghost).
Figure 7: Far-field signature listing with 2 ms sampling interval (with receiver ghost).
Figure 8: Directivity plot for constant azimuth of 0° and 90°.

---

* Full system response contains the effect of the recording filter including the effects due to the hydrophone capacitors connected in parallel.
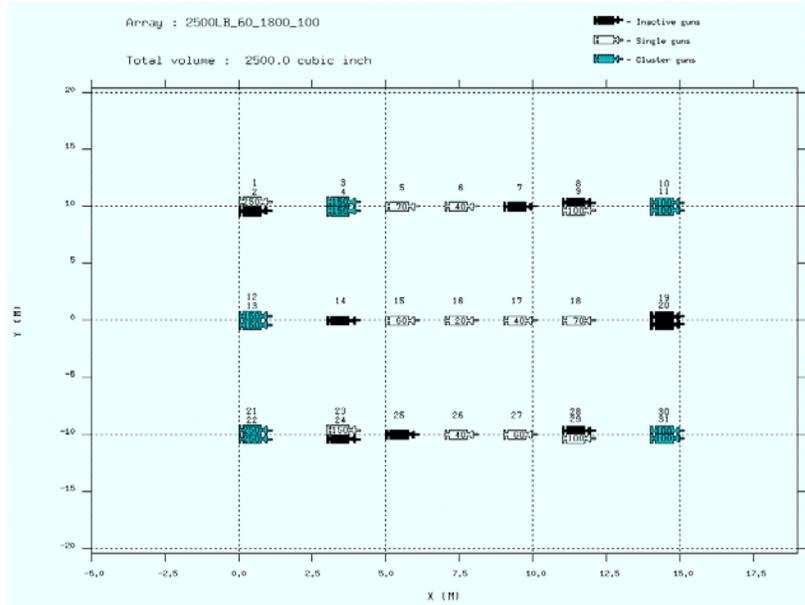
Figure 1: Array configuration top view, i.e. positive Y denotes starboard.

ARRAY LISTING

GUN #	GUN TYPE	X (m)	Y (m)	Z (m)	VOLUME (cu.in)	PRESSURE (psi)	WSK	DELAY (ms)	CLUSTER NUMBER
1	13	0.00	10.40	6.00	250	1800	1.00	0.00	0
2	13	0.00	9.60	6.00	250	SPARE	1.00	0.00	0
3	13	3.00	10.40	6.00	150	1800	1.00	0.00	1
4	13	3.00	9.60	6.00	150	1800	1.00	0.00	1
5	13	5.00	10.00	6.00	70	1800	1.00	0.00	0
6	2	7.00	10.00	6.00	40	1800	1.00	0.00	0
7	13	9.00	10.00	6.00	60	SPARE	1.00	0.00	0
8	13	11.00	10.35	6.00	100	SPARE	1.00	0.00	0
9	13	11.00	9.65	6.00	100	1800	1.00	0.00	0
10	13	14.00	10.35	6.00	100	1800	1.00	0.00	2
11	13	14.00	9.65	6.00	100	1800	1.00	0.00	2
12	13	0.00	0.40	6.00	150	1800	1.00	0.00	3
13	13	0.00	−0.40	6.00	150	1800	1.00	0.00	3
15	13	5.00	0.00	6.00	60	1800	1.00	0.00	0
16	2	7.00	0.00	6.00	20	1800	1.00	0.00	0
17	2	9.00	0.00	6.00	40	1800	1.00	0.00	0
18	13	11.00	0.00	6.00	70	1800	1.00	0.00	0
21	13	0.00	−9.60	6.00	250	1800	1.00	0.00	4
22	13	0.00	−10.40	6.00	250	1800	1.00	0.00	4
23	13	3.00	−9.60	6.00	150	1800	1.00	0.00	0
24	13	3.00	−10.40	6.00	150	SPARE	1.00	0.00	0
25	13	5.00	−10.00	6.00	70	SPARE	1.00	0.00	0
26	2	7.00	−10.00	6.00	40	1800	1.00	0.00	0
27	13	9.00	−10.00	6.00	60	1800	1.00	0.00	0
28	13	11.00	−9.65	6.00	100	SPARE	1.00	0.00	0
29	13	11.00	−10.35	6.00	100	1800	1.00	0.00	0
30	13	14.00	−9.65	6.00	100	1800	1.00	0.00	5
31	13	14.00	−10.35	6.00	100	1800	1.00	0.00	5

THE GUN TYPES ARE: 13: BOLT 1500 LL   2: BOLT 1900C

"WSK" IS THE RATIO BETWEEN THE PRIMARY VOLUME AND TOTAL CHAMBER VOLUME IN A BOLT 1500C GUN (TYPE 1) WITH WAVESHAPE KIT

N.B: Spare guns 14, 19 and 20 in the diagram on page1 of this document are not present, and have therefore been removed from this listing.
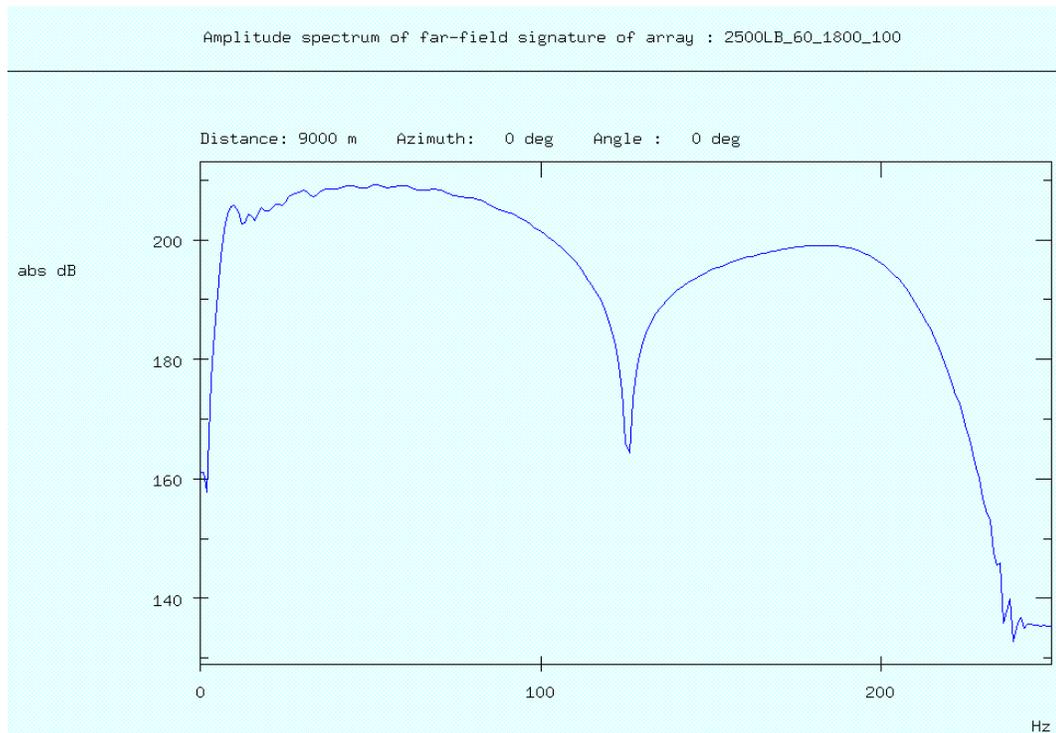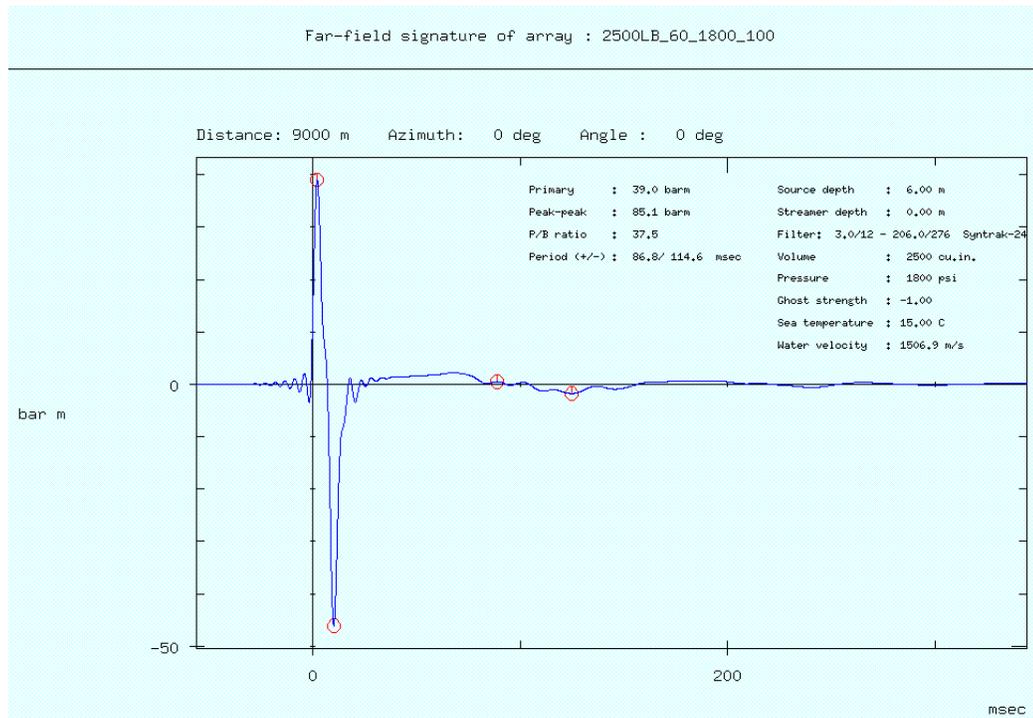
M/V Orient Explorer
PGS job number 2005120

ACQUISITION REPORT
version 1

Origin Energy Resources LTD
Shearwater 3D & 2D Survey Victoria Australia
14th November to 10th December 2005

Figure 2: Modeled far-field signature and amplitude spectrum with 24bit recording filter (without receiver ghost).
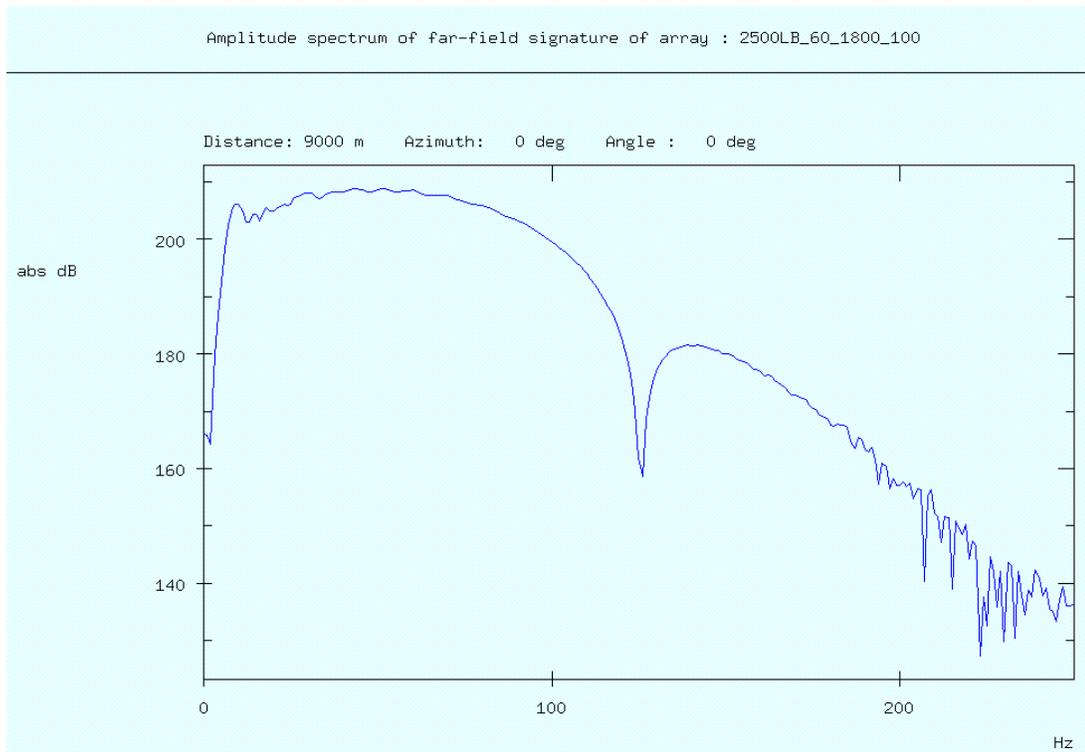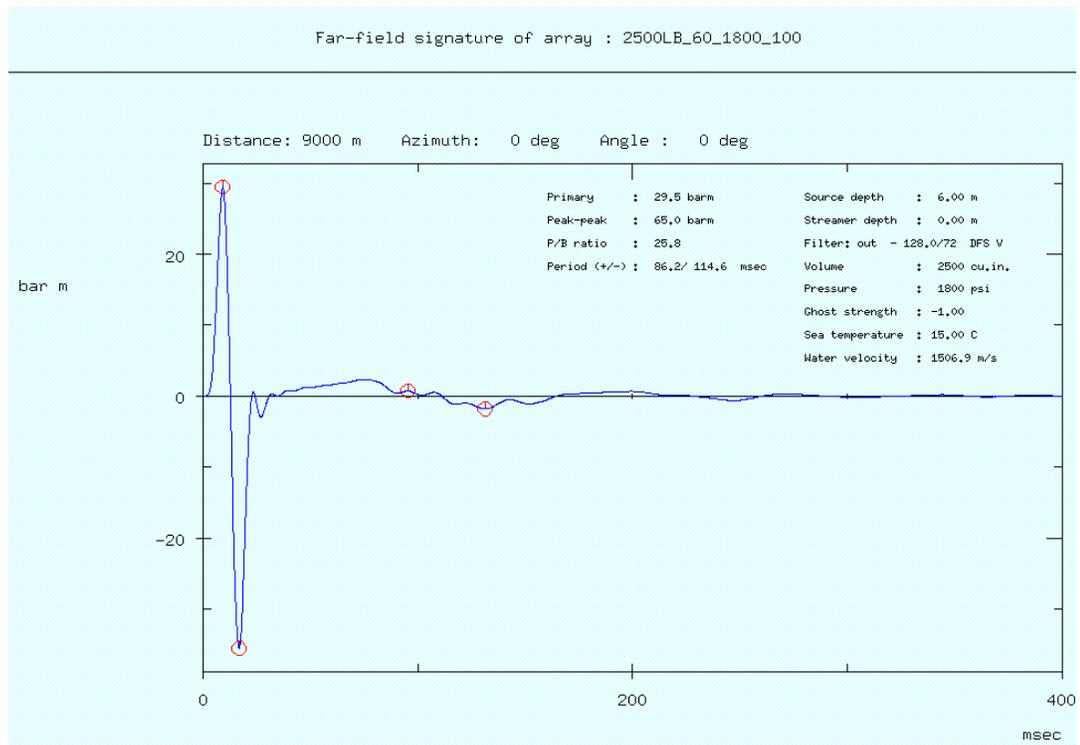
Figure 3: Modeled far-field signature and amplitude spectrum with DFS-V recording filter
(without receiver ghost).

Full system response with source ghost only

Figure 4: Modeled far-field signature and amplitude spectrum with recording and hydrophone filter effect applied (without receiver ghost).

M/V Orient Explorer   ACQUISITION REPORT   Origin Energy Resources LTD
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14th November to 10th December 2005
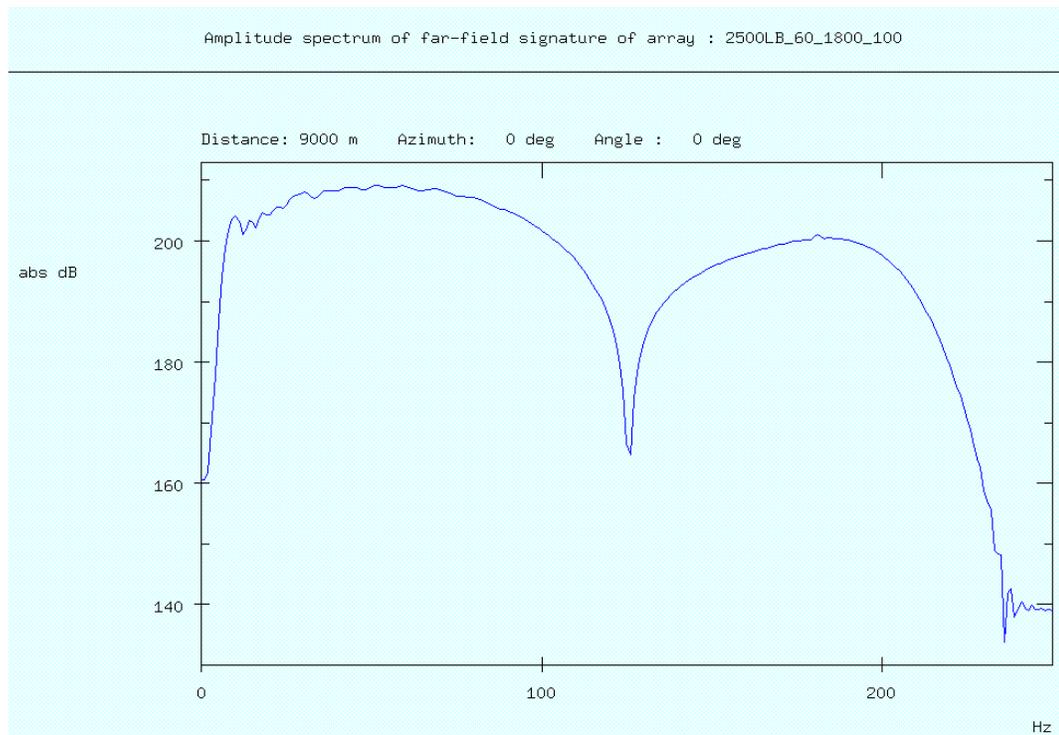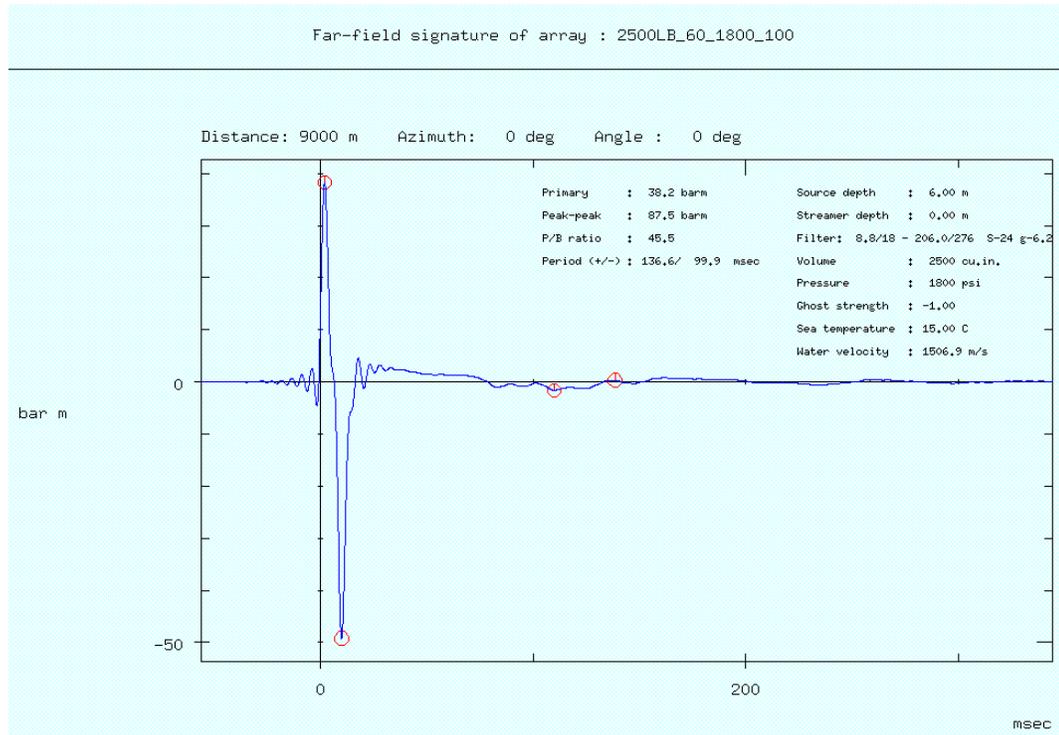
Full system response with source ghost only

```
FAR-FIELD SIGNATURE LISTING

Array name          :   2500LB_60_1800_100
Total volume        :     2500 cu.in.
Source depth        :     6.00 m
Streamer depth      :     0.00 m
Group length        :     0.00 m
Average pressure    :     1800 psi
Ghost strength      :    -1.00
Seawater temperature:    15.00 C
Seawater velocity   :   1506.9 m/s
Filter              :
  Low-cut frequency :     8.80 Hz
  Low-cut slope     :    18.00 dB/oct
  High-cut frequency:   206.00 Hz
  High-cut slope    :   276.00 dB/oct
  Instrument        :   S-24 g-6.25
  Time of 1st sample:   -56.00 msec i.e. index of time zero =  29.0
Sample interval     :     2.00 msec resampled from 0.5 ms.
Far-field position  :
  Distance          : 9000.00 m
  Azimuth           :     0.00 deg
  Angle of vertical :     0.00 deg

Amplitudes are in bar m
Time is increasing horizontally

      0.000     0.000     0.000     0.002     0.004    -0.026    -0.006
      0.019    -0.024     0.056    -0.029    -0.040     0.094    -0.051
      0.162    -0.021     0.039     0.012    -0.252     0.236    -0.567
      0.554    -0.390     0.094     0.727    -1.538     2.634    -4.287
     13.711    38.135    13.096     1.336   -22.219   -49.137   -21.579
     -5.870    -1.368     4.466    -1.026     1.970     2.842     1.983
      3.247     2.259     2.577     2.562     2.225     2.345     2.205
      1.947     1.842     1.741     1.510     1.475     1.425     1.344
      1.442     1.372     1.294     1.366     1.269     1.270     1.299
      1.079     0.977     0.814     0.452     0.119    -0.468    -0.977
     -0.958    -0.773    -0.478    -0.365    -0.688    -0.857    -0.824
     -0.681    -0.307    -0.246    -0.556    -0.903    -1.390    -1.599
     -1.392    -1.259    -1.081    -1.019    -1.247    -1.289    -1.289
     -1.233    -0.858    -0.563    -0.223     0.202     0.291     0.310
      0.215    -0.129    -0.237    -0.280    -0.333    -0.085     0.093
      0.273     0.612     0.688     0.751     0.834     0.680     0.688
      0.706     0.595     0.681     0.643     0.538     0.598     0.466
      0.406     0.499     0.401     0.439     0.501     0.380     0.421
      0.361     0.162     0.144     0.001    -0.134    -0.091    -0.206
     -0.215    -0.147    -0.238    -0.136    -0.092    -0.193    -0.125
     -0.230    -0.346    -0.308    -0.497    -0.576    -0.527    -0.628
     -0.530    -0.439    -0.471    -0.302    -0.246    -0.223     0.006
      0.075     0.179     0.379     0.349     0.420     0.483     0.339
      0.384     0.355     0.225     0.294     0.189     0.096     0.152
      0.000    -0.035    -0.008    -0.148    -0.109    -0.124    -0.245
     -0.179    -0.243    -0.291    -0.158    -0.189    -0.134    -0.022
     -0.099    -0.056    -0.054    -0.155    -0.060    -0.019     0.001
      0.140     0.136     0.149     0.213     0.133     0.139     0.167
      0.111     0.159     0.148     0.085     0.106
```

Figure 5: Far-field signature listing with 2 ms sampling interval (without receiver ghost).

Full system response with source and receiver ghost
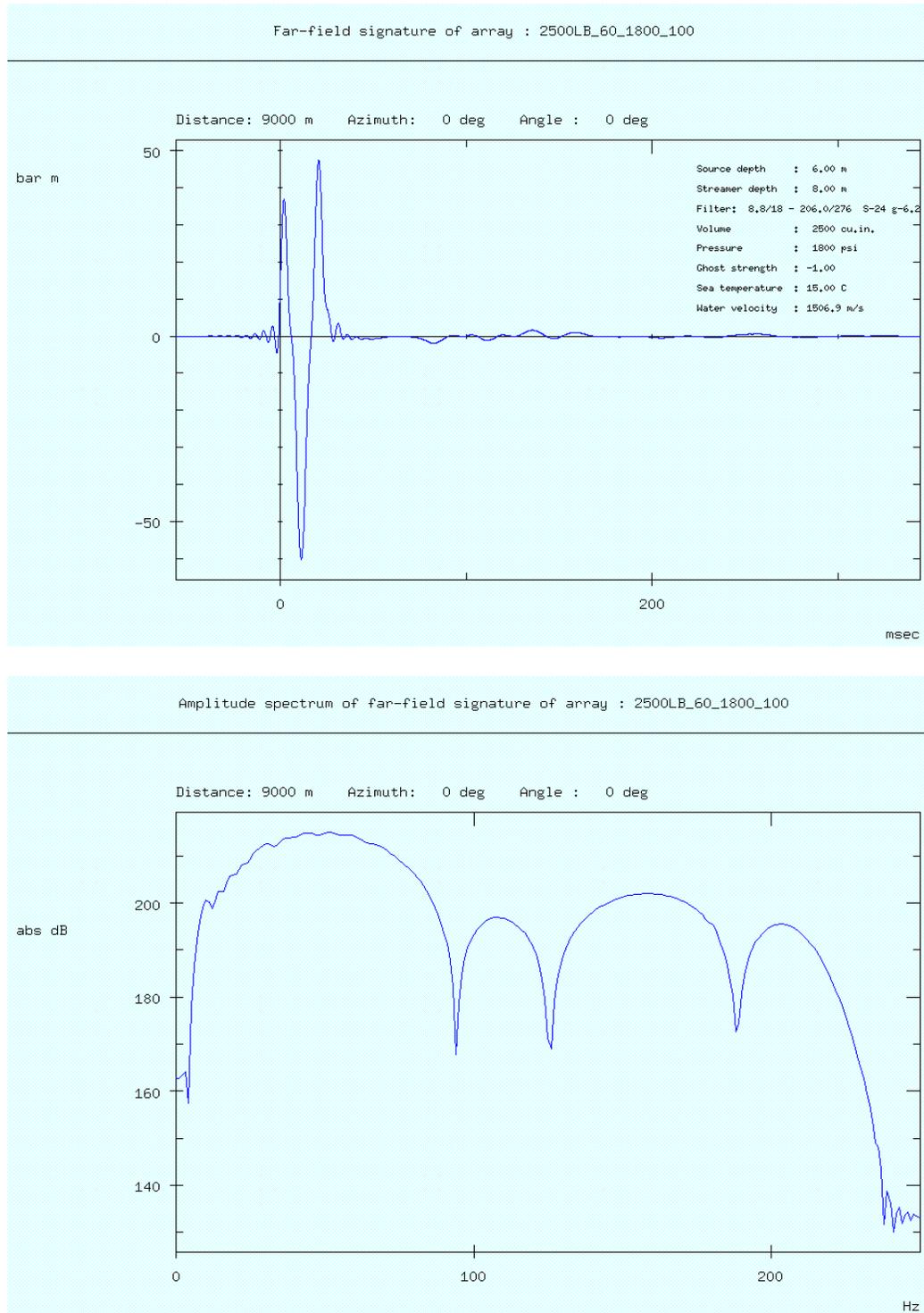
Figure 6: Modeled far-field signature and amplitude spectrum with recording and hydrophone filter effect applied (with receiver ghost).

Full system response with source and receiver ghost

```
FAR-FIELD SIGNATURE LISTING

Array name          :   2500LB_60_1800_100
Total volume        :     2500 cu.in.
Source depth        :     6.00 m
Streamer depth      :     8.00 m
Group length        :     0.00 m
Average pressure    :     1800 psi
Ghost strength      :    -1.00
Seawater temperature:    15.00 C
Seawater velocity   :   1506.9 m/s
Filter              :
  Low-cut frequency :     8.80 Hz
  Low-cut slope     :    18.00 dB/oct
  High-cut frequency:   206.00 Hz
  High-cut slope    :   276.00 dB/oct
  Instrument        :   S-24 g-6.25
  Time of 1st sample:   -56.00 msec i.e. index of time zero =  29.0
Sample interval     :     2.00 msec  resampled from 0.5 ms.
Far-field position  :
  Distance          :  9000.00 m
  Azimuth           :     0.00 deg
  Angle of vertical :     0.00 deg


Amplitudes are in bar m
Time is increasing horizontally


    0.000    0.000    0.000    0.002    0.004   -0.026   -0.006
    0.019   -0.024    0.051   -0.013   -0.018    0.070   -0.032
    0.133   -0.042    0.118   -0.076   -0.229    0.151   -0.656
    0.617   -0.528    0.404    0.521   -1.165    2.534   -4.525
   14.349   36.824   14.734   -0.557  -20.252  -52.817  -57.136
  -28.466   -4.004   15.226   45.207   34.375   10.227    5.879
   -0.954    1.837    2.195   -0.775    0.447   -0.747   -0.352
   -0.412   -0.847   -0.513   -0.803   -0.797   -0.591   -0.509
   -0.348   -0.197   -0.171   -0.090   -0.077   -0.139   -0.115
   -0.211   -0.374   -0.493   -0.791   -1.196   -1.619   -1.966
   -1.852   -1.334   -0.710   -0.107    0.183    0.141    0.011
   -0.104    0.041    0.328    0.283   -0.069   -0.638   -1.178
   -1.185   -0.808   -0.297    0.216    0.344    0.173   -0.001
   -0.088    0.138    0.611    1.075    1.476    1.573    1.294
    0.852    0.225   -0.331   -0.571   -0.629   -0.365    0.119
    0.506    0.862    1.032    0.929    0.775    0.489    0.169
    0.018   -0.116   -0.152   -0.086   -0.122   -0.126   -0.149
   -0.238   -0.183   -0.146   -0.145   -0.023   -0.011   -0.063
   -0.076   -0.240   -0.364   -0.411   -0.527   -0.501   -0.414
   -0.359   -0.213   -0.119   -0.038    0.068    0.047    0.023
   -0.016   -0.159   -0.233   -0.321   -0.428   -0.356   -0.290
   -0.224   -0.017    0.112    0.222    0.353    0.360    0.447
    0.549    0.542    0.617    0.604    0.483    0.411    0.218
    0.049   -0.013   -0.150   -0.199   -0.189   -0.257   -0.241
   -0.244   -0.306   -0.253   -0.243   -0.257   -0.183   -0.194
   -0.186   -0.133   -0.153   -0.066    0.036    0.070    0.180
    0.204    0.137    0.113    0.020   -0.025    0.054    0.086
    0.170    0.273    0.250    0.227    0.155    0.038    0.016
   -0.017   -0.047   -0.014   -0.036   -0.067
```

Figure 7: Far-field signature listing with 2 ms sampling interval (with receiver ghost).
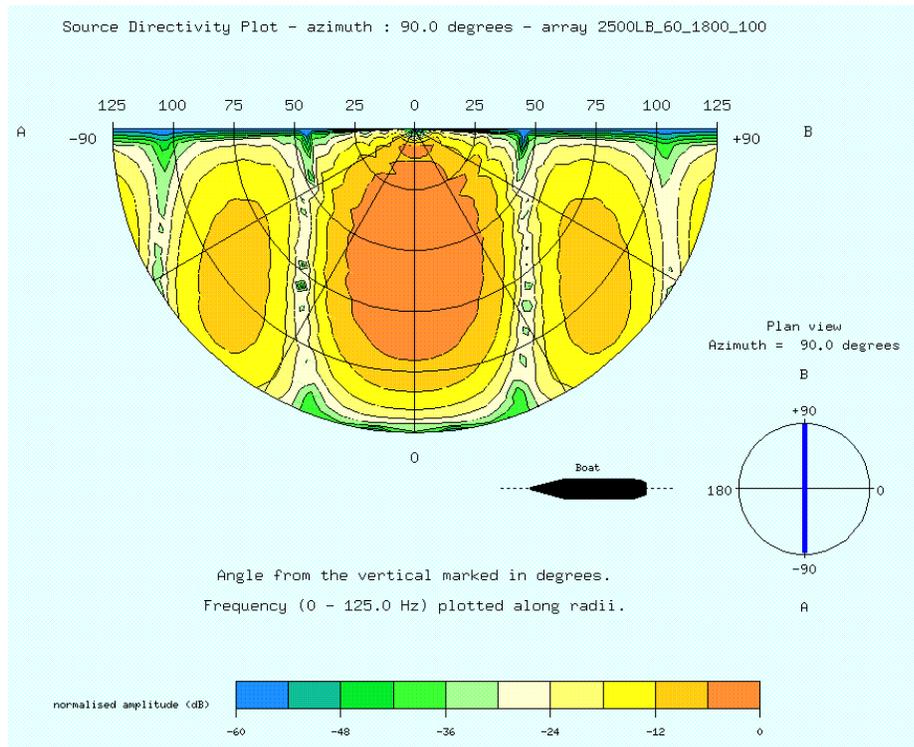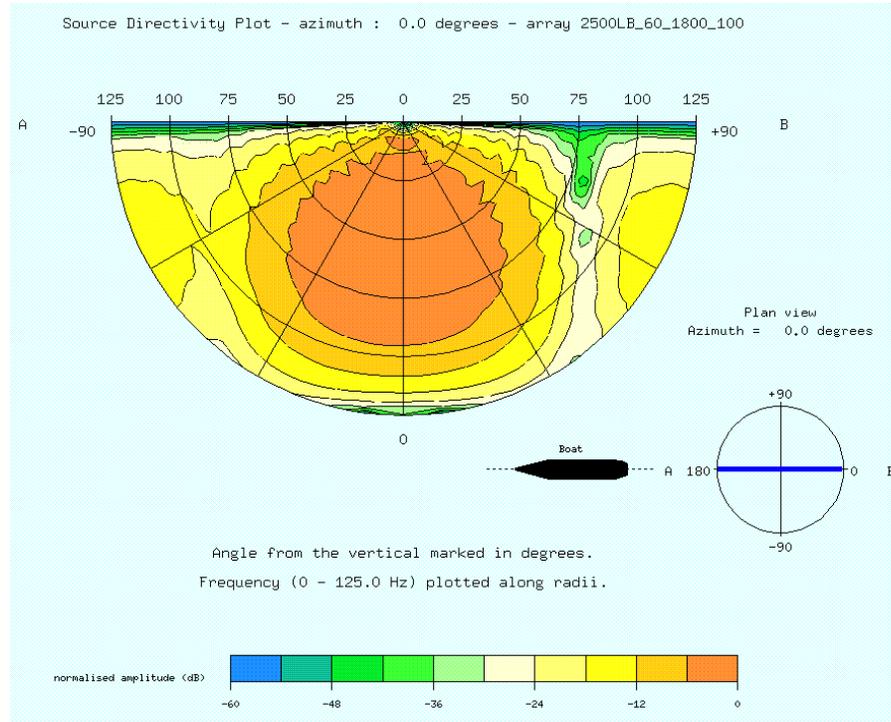
Figure 8: Directivity plot for constant azimuth of 0° and 90°.

12.4 SEG-D header

```
--------------------------------------------------------------------------------
GENERAL HEADER #1                            Starting byte 0
Bytes     Description                        Value
--------------------------------------------------------------------------------
01-02     File Number                        1031
03-04     SEGD Format                        8036
          Bits Per Sample                    24
05-10     General Constants
11        Year                               2005
12        Additional Header Blocks           2
12-13     Day                                340
14        Hour                               15
15        Minute                             13
16        Second                             34
17        Manufacturer's Code                41
18-19     Header Revision                    6
20-22     Not Used
23        Base Scan Interval (ms)            2.0
24        Polarity
25        Scan/Block Exponent
26        Record Type                        Normal Record
27        Record Length (ms)                 5120
28        Scan-types / Record                1
29        Channel Sets/Scan Type             5
30        Skew Blocks                        0
31        Extended-Header Blocks             0xFF
32        External-Header Blocks             87


--------------------------------------------------------------------------------
GENERAL HEADER #2                            Starting byte 32
Bytes     Description                        Value
--------------------------------------------------------------------------------
01-03     Expanded File Number               0
04-05     Extended Channel Sets              0
06-07     Extended Header Blocks             520
08-09     External Header Blocks             0
10        Reserved
11-12     SEG-D Revision Number              Rev. 0.0
13-14     General Trailer
15-17     Extended Record Length             200
18-19     General Header Block Number        2
20-31     Reserved
32        Extended Record Length             12


--------------------------------------------------------------------------------
GENERAL HEADER #3                            Starting Byte 64
Bytes     Description                        Value
--------------------------------------------------------------------------------
01-03     Reserved
04-06     Source Line Number (int)           0
07-09     Source Line Number (fract)         0
10-12     Source Point Number (int)          1928
13-15     Source Point Number (fract)        0
14        Source Point Index                 Not Used
15        Phase Control                      Not Used
16        Type Vibrator                      Not Used
17-18     Phase Angle                        Not Used
19        General Header Block Number        3
20        Source Set Number                  0
21-32     Reserved
```

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                                                                 14th November to 10th December 2005

```
--------------------------------------------------------------------------------
CHANNEL SET HEADER #1                       Starting Byte 96
Bytes     Description                       Value
--------------------------------------------------------------------------------
01        Scan Type Number                  1
02        Channel Set Number                1
03-04     Channel Set Start Time (ms)       0
05-06     Channel Set End Time (ms)         5120
07-08     Pre-Amp Gain (dB)                 12
09-10     Number of Channels                348
11        Channel Set Type                  Seismic Data
12        Scans per Base Scan               1
13-14     Alias Filter Frequency            206
15-16     Alias Filter Slope                276
17-18     Low Cut Filter                    3
19-20     Low Cut Filter Slope              12
21-22     First Notch Filter                0
23-24     Second Notch Filter               0
25-26     Third Notch Filter                0
27-28     Extended Channel Set Number       0
29        Extended Header Flag              0
30        Vertical Stack                    0
31        Cable Number                      0
32        Array Forming                     0


--------------------------------------------------------------------------------
CHANNEL SET HEADER #2                       Starting Byte 128
Bytes     Description                       Value
--------------------------------------------------------------------------------
01        Scan Type Number                  1
02        Channel Set Number                2
03-04     Channel Set Start Time (ms)       0
05-06     Channel Set End Time (ms)         5120
07-08     Pre-Amp Gain (dB)                 12
09-10     Number of Channels                48
11        Channel Set Type                  AUX Data
12        Scans per Base Scan               1
13-14     Alias Filter Frequency            206
15-16     Alias Filter Slope                276
17-18     Low Cut Filter                    3
19-20     Low Cut Filter Slope              12
21-22     First Notch Filter                0
23-24     Second Notch Filter               0
25-26     Third Notch Filter                0
27-28     Extended Channel Set Number       0
29        Extended Header Flag              0
30        Vertical Stack                    0
31        Cable Number                      0
32        Array Forming                     0


--------------------------------------------------------------------------------
CHANNEL SET HEADER #3                       Starting Byte 160
Bytes     Description                       Value
--------------------------------------------------------------------------------
01        Scan Type Number                  1
02        Channel Set Number                3
03-04     Channel Set Start Time (ms)       0
05-06     Channel Set End Time (ms)         5120
07-08     Pre-Amp Gain (dB)                 12
09-10     Number of Channels                348
11        Channel Set Type                  Seismic Data
12        Scans per Base Scan               1
13-14     Alias Filter Frequency            206
15-16     Alias Filter Slope                276
17-18     Low Cut Filter                    3
19-20     Low Cut Filter Slope              12
21-22     First Notch Filter                0
23-24     Second Notch Filter               0
25-26     Third Notch Filter                0
27-28     Extended Channel Set Number       0
29        Extended Header Flag              0
30        Vertical Stack                    0
31        Cable Number                      0
32        Array Forming                     0
```

```
--------------------------------------------------------------------------------
CHANNEL SET HEADER #4                     Starting Byte 192
Bytes     Description                     Value
--------------------------------------------------------------------------------
01        Scan Type Number                1
02        Channel Set Number              4
03-04     Channel Set Start Time (ms)     0
05-06     Channel Set End Time (ms)       5120
07-08     Pre-Amp Gain (dB)               12
09-10     Number of Channels              348
11        Channel Set Type                Seismic Data
12        Scans per Base Scan             1
13-14     Alias Filter Frequency          206
15-16     Alias Filter Slope              276
17-18     Low Cut Filter                  3
19-20     Low Cut Filter Slope            12
21-22     First Notch Filter              0
23-24     Second Notch Filter             0
25-26     Third Notch Filter              0
27-28     Extended Channel Set Number     0
29        Extended Header Flag            0
30        Vertical Stack                  0
31        Cable Number                    0
32        Array Forming                   0


--------------------------------------------------------------------------------
CHANNEL SET HEADER #5                     Starting Byte 224
Bytes     Description                     Value
--------------------------------------------------------------------------------
01        Scan Type Number                1
02        Channel Set Number              5
03-04     Channel Set Start Time (ms)     0
05-06     Channel Set End Time (ms)       5120
07-08     Pre-Amp Gain (dB)               12
09-10     Number of Channels              348
11        Channel Set Type                Seismic Data
12        Scans per Base Scan             1
13-14     Alias Filter Frequency          206
15-16     Alias Filter Slope              276
17-18     Low Cut Filter                  3
19-20     Low Cut Filter Slope            12
21-22     First Notch Filter              0
23-24     Second Notch Filter             0
25-26     Third Notch Filter              0
27-28     Extended Channel Set Number     0
29        Extended Header Flag            0
30        Vertical Stack                  0
31        Cable Number                    0
32        Array Forming                   0


--------------------------------------------------------------------------------
HOST RECORDING SYSTEM STATUS BLOCK #1   Starting Byte 256
Bytes     Description                     Value
--------------------------------------------------------------------------------
01        External Header Status          OK
02        Tape Unit for Writing           1
02        Buffer Used                     0
03-04     Number of Channels (Cable 1)    348
05-06     Number of Channels (Cable 2)    348
07-08     Number of Channels (Cable 3)    348
09-10     Number of Channels (Cable 4)    348
11-12     Number of Channels (Cable 5)    0
13-14     Number of Channels (Cable 6)    0
15-16     Number of Channels (Cable 7)    0
17-18     Number of Channels (Cable 8)    0
19-20     Reserved
21        Transient Removal               Yes
22        Filter Samples Removed          22
23        Additional Host Blocks          1
23        Module Type                     24-bit
24        Number of Physical Cables       0
24        MSRS Chassis                    Single Chassis Used
25        Number of Receiver Lines        0
26        System Type                     Non-Receiver Line
27        Record Status                   Production Record
28        Header Revision                 6
29        Software Revision               18
30-31     Blocks after SEG-D Area         0
32        Number of Cables                4
```

```
-------------------------------------------------------------------------------
HOST RECORDING SYSTEM STATUS BLOCK #2    Starting Byte 288
Bytes     Description                    Value
-------------------------------------------------------------------------------
01-02     Number of Channels (Cable 9)   0
03-04     Number of Channels (Cable 10)  0
05-06     Number of Channels (Cable 11)  0
07-08     Number of Channels (Cable 12)  0
09-10     Number of Channels (Cable 13)  0
11-12     Number of Channels (Cable 14)  0
13-14     Number of Channels (Cable 15)  0
15-16     Number of Channels (Cable 16)  0
17-31     Reserved
32        Number of Physical Cables      125


-------------------------------------------------------------------------------
LINE ID BLOCK #1                         Starting Byte 320
Bytes     Description                    Value
-------------------------------------------------------------------------------
01-08     Cable 1 Line ID                196P1079
09-08     Cable 2 Line ID                196P1079
17-24     Cable 3 Line ID                196P1079
25-32     Cable 4 Line ID                196P1079


-------------------------------------------------------------------------------
REEL NUMBER HEADER                       Starting Byte 352
Bytes     Description                    Value
-------------------------------------------------------------------------------
01-02     Shot Time: Day                 340
03        Shot Time: Hour                15
04        Shot Time: Minute              13
05        Shot Time: Second              34
06-08     Shot Time: Microseconds        510868
09        Acquisition Hardware           Syntrak System
10-12     Not Used
13        External Header 1              Nav & GCS90 Combined
14        External Header 2              Digicourse Header
15        External Header 3              Not Defined
16        External Header 4              Not Defined
17-32     Reel Number                    29878


-------------------------------------------------------------------------------
NAVIGATION HEADER #1                     Starting Byte 16896
Bytes     Description                    Value
-------------------------------------------------------------------------------
01-02     Master Block ID                $1
03-06     Length of Message              1666
07-10     Program Revision               0002
11-12     Shot Switch                    On-Line
13-26     Shot Time                      151334.63072620051206
34-36     Time Reference                 UTC
37-42     Shot Number                    001928
43-58     Current Line Name                OS051196P1079
59-69     Master Latitude                -39.770060
70-80     Master Longitude               145.429819
81-86     Water Depth (meters)            70.3
87-97     Source Latitude                -39.771717
98-108    Source Longitude               145.428871
109-113   Master Gyro (degrees)          13.4
114-118   Master CMG (degrees)           23.0
119-122   Master Speed (knots)           4.5
```

```
-------------------------------------------------------------------------------
GCS90 GUN-CONTROLLER HEADER #1        Starting Byte 17018
Bytes     Description                 Value
-------------------------------------------------------------------------------
01-06     ID String                   *GCS90
07-10     Length of Block             1550
11-16     Line Number                 6P1079
17-20     Shot Number                 1928
21-22     Active Array Mask           07
23        Trigger Mode                External
24-25     Current Sequence Number     02
26-28     Number of Sub-Arrays        006
29-31     Number of Guns in Array     066
32-34     Number of Active Guns       022
35-37     Number of Delta-Errors      000
38-40     Number of Auto-Fires        000
41-43     Number of Mis-Fires         000
44-46     Delta Spread                013
47-52     Volume Fired                002500
53-66     Spare
67-70     Manifold Pressure           0000
71-74     Deep Tow                    0000
75-78     Sub-Array String Pressure   1870
79-82     Sub-Array String Pressure   1895
83-86     Sub-Array String Pressure   1870
87-90     Sub-Array String Pressure   1851
91-94     Sub-Array String Pressure   1877
95-98     Sub-Array String Pressure   1867
```

12.5 P1/90 header

12.5.1 3D lines

```
H0100 AREA                      SHEARWATER OS3D, BASS STRAIT, AUSTRALIA
H0101 GENERAL SURVEY DETAILS    3D SINGLE VESSEL, DUAL SOURCE, FOUR STREAMERS
H0102 VESSEL DETAILS            M/V ORIENT EXPLORER       1
H0103 SOURCE DETAILS            STBD SOURCE               1   1
H0103 SOURCE DETAILS            PORT SOURCE               1   2
H0104 STREAMER DETAILS          STREAMER  1 348CH (STBD)  1       1   1
H0104 STREAMER DETAILS          STREAMER  2 348CH         1       2   2
H0104 STREAMER DETAILS          STREAMER  3 348CH         1       3   3
H0104 STREAMER DETAILS          STREAMER  4 348CH (PORT)  1       4   4
H0105 OTHER DETAILS             N/A
H0200 DATE OF SURVEY            14 NOV 2005 - CONTINUING
H0201 DATE OF ISSUE OF TAPE     ?? NOVEMBER 2005
H0202 TAPE VERSION IDENTIFIER   OS05P011
H0203 LINE PREFIX               OS05
H0300 CLIENT                    ORIGIN ENERGY RESOURCES LTD
H0400 GEOPHYSICAL CONTRACTOR    PGS GEOPHYSICAL, MARINE ACQUISITION
H0500 POSITIONING CONTRACTOR    FUGRO-SURVEY AS
H0600 POSITIONING PROCESSING    PGS GEOPHYSICAL, MARINE ACQUISITION
H0700 POSITIONING SYSTEM        NAV SYSTEM I: SKYFIX.XP
H0700 POSITIONING SYSTEM        NAV SYSTEM II: STARFIX
H0700 POSITIONING SYSTEM        INTEGRATED NAV SYSTEM : SPECTRA VERSION 10.9.1
H0800 COORDINATE LOCATION       CENTER OF SOURCE
H0900 OFFSET SYSTEM TO SOURCE 1  1   2   25.00 -196.00
H0901 OFFSET SYSTEM TO SOURCE 2  1   2  -25.00 -196.00
H0902 OFFSET SYSTEM TO E/S       1   2    0.00   18.60
H0903 OFFSET SYS TO NAV REF PT   1   2    0.00    0.00
H1000 CLOCK TIME                GMT
H1100 RECEIVER GROUPS PER SHOT  1392
H1400 GEODETIC DATUM AS SURVEY  GDA94      GRS1980      6378137.000 298.2572221
H1401 GDA94 TO WGS84              0.0    0.0    0.0 0.000 0.000 0.000 0.0000000
H1500 GEODETIC DATUM FOR POST   GDA94      GRS1980      6378137.000 298.2572221
H1501 GDA94 TO WGS84              0.0    0.0    0.0 0.000 0.000 0.000 0.0000000
H1600 DATUM SHIFT H1400-H1500    0.0    0.0    0.0 0.000 0.000 0.000 0.0000000
H1700 VERTICAL DATUM            ES                       ECHO SOUNDER POSITION
H1800 PROJECTION                002 UTM SOUTH
H1900 ZONE                      55S
H2000 GRID UNITS                1 INTERNATIONAL METERS    1.000000000000
H2001 HEIGHT UNITS              1 INTERNATIONAL METERS    1.000000000000
H2002 ANGULAR UNITS             1 DEGREES
H2200 CENTRAL MERIDIAN          147 0 0.000E
H2600
H2600****************************************************************************
H2600
H2600 THE SOUND VELOCITY SET IN THE ECHO SOUNDER WAS 1500 METERS/SECOND.
H2600
H2600 THE Z OFFSET OF THE ECHO SOUNDER TRANSDUCER IS -5.8 METRES FROM THE
H2600 VESSEL REFERENCE POINT AT SEA LEVEL.
H2600
H2600 THE ECHO SOUNDER DEPTH DATA WAS CORRECTED FOR PITCH, ROLL AND HEAVE
H2600 PRIOR TO BEING PASSED TO THE INTEGRATED NAVIGATION SYSTEM.
H2600
H2600****************************************************************************
H2600
H2600          FORMAT OF SHOT RECORDS
H2600     COLUMN            DESCRIPTION
H2600        1              'V', 'E', 'Z', 'S' OR 'T'
H2600                       V=VESSEL REFERENCE POINT
H2600                       E=ECHOSOUNDER POSITION
H2600                       S=CENTER OF SOURCE
H2600                       Z=INDIVIDUAL SOURCE POSITON
H2600                       T=TAILBUOY POSITION
H2600      2-13             LINE NAME
H2600       17              VESSEL IDENTIFIER
```

```
H2600           18              SOURCE IDENTIFIER
H2600           19              TAILBUOY/OTHER IDENTIFIER
H2600        20-25              SHOT POINT NUMBER
H2600        26-35              LATITUDE (DDMMSS.SS)
H2600        36 46              LONGITUDE (DDDMMSS.SS)
H2600        47-55              MAP GRID EASTING IN METERS
H2600        56-64              MAP GRID NORTHING IN METERS
H2600        65-70              WATER DEPTH
H2600        71-73              JULIAN DAY
H2600        74-79              TIME HHMMSS
H2600
H2600           FORMAT OF RECEIVER RECORD
H2600            1               'R'
H2600          2-5              RECEIVER NUMBER
H2600         6-14              MAP GRID EASTING IN METERS
H2600        15-23              MAP GRID NORTHING IN METERS
H2600        24-27              RECEIVER DEPTH REFERENCED TO SEA LEVEL
H2600        28-31              RECEIVER NUMBER
H2600        32-40              MAP GRID EASTING IN METERS
H2600        41-49              MAP GRID NORTHING IN METERS
H2600        50-53              RECEIVER DEPTH REFERENCED TO SEA LEVEL
H2600        54-57              RECEIVER NUMBER
H2600        58-66              MAP GRID EASTING IN METERS
H2600        67-75              MAP GRID NORTHING IN METERS
H2600        76-79              RECEIVER DEPTH REFERENCED TO SEA LEVEL
H2600           80              STREAMER CODE
H2600
H2600*******************************************************************************
H2600
H2600 STREAMER AND TAILBUOY NUMBERING INCREMENTS FROM STARBOARD TO PORT.
H2600
H2600 STREAMER  1: RECEIVERS NUMBERED    1 (FAR) TO  348 (NEAR)
H2600 STREAMER  2: RECEIVERS NUMBERED  349 (FAR) TO  696 (NEAR)
H2600 STREAMER  3: RECEIVERS NUMBERED  697 (FAR) TO 1044 (NEAR)
H2600 STREAMER  4: RECEIVERS NUMBERED 1045 (FAR) TO 1392 (NEAR)
H2600
H2600 STREAMER ROTATIONS HAVE BEEN APPLIED ON A SHOT BY SHOT BASIS.
H2600
H2600 SPRINT CALCULATED INLINE MISCLOSURES ARE DERIVED ON A SHOT BY SHOT BASIS.
H2600 THESE INLINE MISCLOSURES ARE DISTRIBUTED LINEARLY OVER THE ACTIVE
H2600 STREAMER LENGTH. THE CORRECTED STREAMER LENGTH IS USED TO COMPUTE THE
H2600 FINAL RECEIVER POSITIONS.
H2600
H2600 SPRINT VERSION 3.1.20 USED FOR ONBOARD NAVIGATION PROCESSING
H2600
H2600 PGS JOB NUMBER 2005120
H2600
H2600 ALL SHOTS FOR ALL STREAMERS ARE INCLUDED ON THIS TAPE, DATA NOT TO BE
H2600 PROCESSED (NTBP) IS INDICATED BELOW AS NECESSARY.
H2600
H2600 LINES CONTAINED IN THIS FILE:
H2600
H2600 LINE: ???                 SEQUENCE: ???  FSP:  ????  LSP:  ????
H2600
```
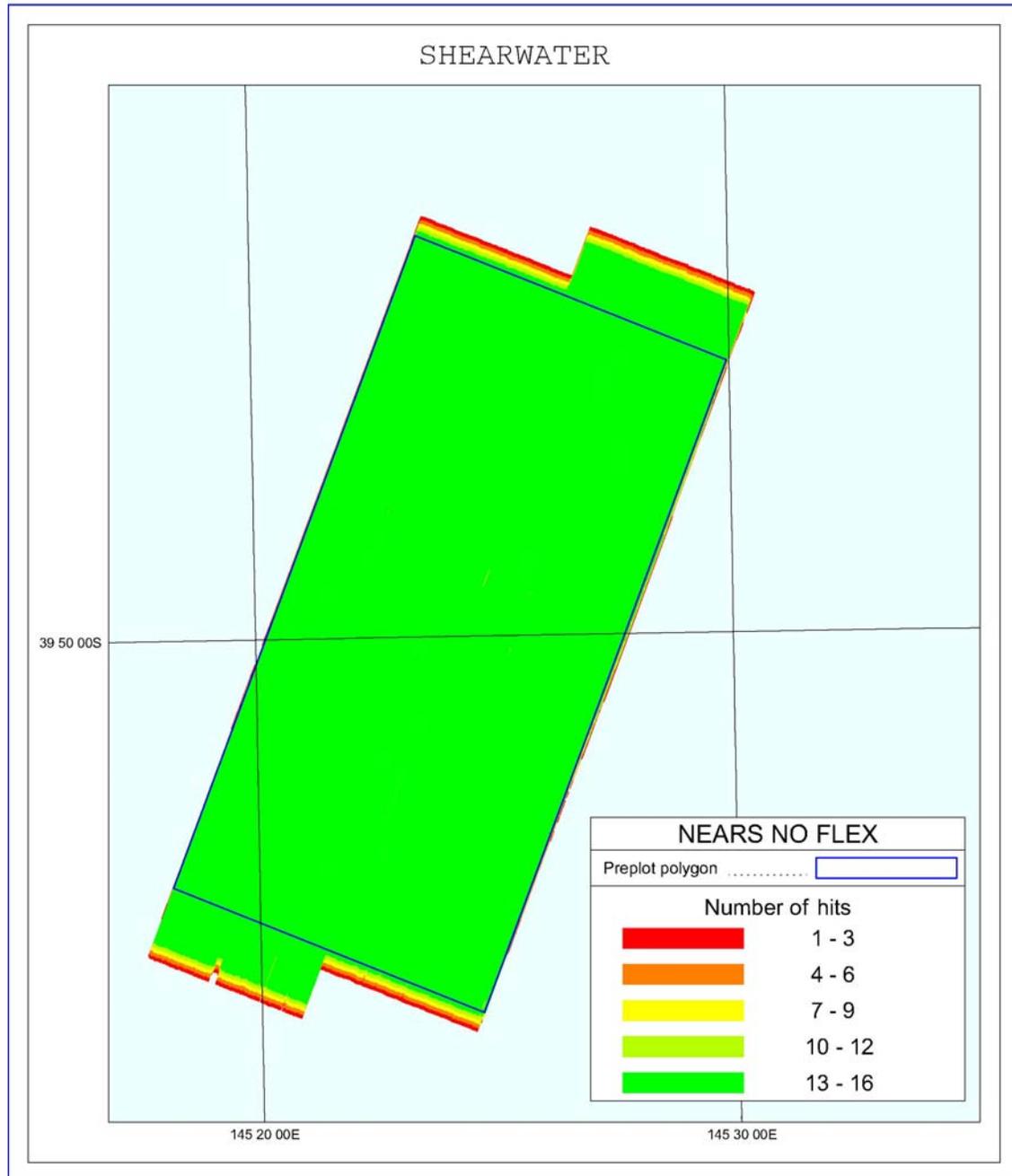
12.5.2 2D lines

```
H0100 AREA                    SHEARWATER OS2D, BASS STRAIT, AUSTRALIA
H0101 GENERAL SURVEY DETAILS  2D SINGLE VESSEL, SINGLE SOURCE, FOUR STREAMERS
H0102 VESSEL DETAILS          M/V ORIENT EXPLORER        1
H0103 SOURCE DETAILS          STBD SOURCE                1   1
H0104 STREAMER DETAILS        STREAMER  1 348CH (STBD)   1        1   1
H0104 STREAMER DETAILS        STREAMER  2 348CH          1        2   2
H0104 STREAMER DETAILS        STREAMER  3 348CH          1        3   3
H0104 STREAMER DETAILS        STREAMER  4 348CH (PORT)   1        4   4
H0105 OTHER DETAILS           N/A
H0200 DATE OF SURVEY          14 NOV 2005 - CONTINUING
H0201 DATE OF ISSUE OF TAPE   ?? NOVEMBER 2005
H0202 TAPE VERSION IDENTIFIER OS2DP011
H0203 LINE PREFIX             OS2D
H0300 CLIENT                  ORIGIN ENERGY RESOURCES LTD
H0400 GEOPHYSICAL CONTRACTOR  PGS GEOPHYSICAL, MARINE ACQUISITION
H0500 POSITIONING CONTRACTOR  FUGRO-SURVEY AS
H0600 POSITIONING PROCESSING  PGS GEOPHYSICAL, MARINE ACQUISITION
H0700 POSITIONING SYSTEM      NAV SYSTEM I: SKYFIX.XP
H0700 POSITIONING SYSTEM      NAV SYSTEM II: STARFIX
H0700 POSITIONING SYSTEM      INTEGRATED NAV SYSTEM : SPECTRA VERSION 10.9.1
H0800 COORDINATE LOCATION     CENTER OF SOURCE
H0900 OFFSET SYSTEM TO SOURCE 1   1   2   25.00 -196.00
H0901 OFFSET SYSTEM TO E/S        1   2    0.00   18.60
H0902 OFFSET SYS TO NAV REF PT    1   2    0.00    0.00
H1000 CLOCK TIME              GMT
H1100 RECEIVER GROUPS PER SHOT 1392
H1400 GEODETIC DATUM AS SURVEY GDA94      GRS1980      6378137.000 298.2572221
H1401 GDA-94 TO WGS-84          0.0    0.0    0.0 0.000 0.000 0.000 0.0000000
H1500 GEODETIC DATUM FOR POST  GDA94      GRS1980      6378137.000 298.2572221
H1501 GDA-94 TO WGS-84          0.0    0.0    0.0 0.000 0.000 0.000 0.0000000
H1600 DATUM SHIFT H1400-H1500   0.0    0.0    0.0 0.000 0.000 0.000 0.0000000
H1700 VERTICAL DATUM          ES                        ECHO SOUNDER POSITION
H1800 PROJECTION              002 UTM SOUTH
H1900 ZONE                    55S
H2000 GRID UNITS              1 INTERNATIONAL METERS    1.000000000000
H2001 HEIGHT UNITS            1 INTERNATIONAL METERS    1.000000000000
H2002 ANGULAR UNITS           1 DEGREES
H2200 CENTRAL MERIDIAN        147 0 0.000E
H2600
H2600****************************************************************************
H2600
H2600 THE SOUND VELOCITY SET IN THE ECHO SOUNDER WAS 1500 METERS/SECOND.
H2600
H2600 THE Z OFFSET OF THE ECHO SOUNDER TRANSDUCER IS -5.8 METRES FROM THE
H2600 VESSEL REFERENCE POINT AT SEA LEVEL.
H2600
H2600 THE ECHO SOUNDER DEPTH DATA WAS CORRECTED FOR PITCH, ROLL AND HEAVE
H2600 PRIOR TO BEING PASSED TO THE INTEGRATED NAVIGATION SYSTEM.
H2600
H2600****************************************************************************
H2600
H2600          FORMAT OF SHOT RECORDS
H2600      COLUMN           DESCRIPTION
H2600         1              'V', 'E', 'Z', 'S' OR 'T'
H2600                        V=VESSEL REFERENCE POINT
H2600                        E=ECHOSOUNDER POSITION
H2600                        S=CENTER OF SOURCE
H2600                        Z=INDIVIDUAL SOURCE POSITON
H2600                        T=TAILBUOY POSITION
H2600      2-13             LINE NAME
H2600        17             VESSEL IDENTIFIER
H2600        18             SOURCE IDENTIFIER
H2600        19             TAILBUOY/OTHER IDENTIFIER
H2600      20-25            SHOT POINT NUMBER
H2600      26-35            LATITUDE (DDMMSS.SS)
H2600      36 46            LONGITUDE (DDDMMSS.SS)
H2600      47-55            MAP GRID EASTING IN METERS
```

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PGS job number 2005120   version 1   Shearwater 3D & 2D Survey Victoria Australia
14th November to 10th December 2005

```
H2600       56-64           MAP GRID NORTHING IN METERS
H2600       65-70           WATER DEPTH
H2600       71-73           JULIAN DAY
H2600       74-79           TIME HHMMSS
H2600
H2600           FORMAT OF RECEIVER RECORD
H2600        1              'R'
H2600        2-5            RECEIVER NUMBER
H2600        6-14           MAP GRID EASTING IN METERS
H2600       15-23           MAP GRID NORTHING IN METERS
H2600       24-27           RECEIVER DEPTH REFERENCED TO SEA LEVEL
H2600       28-31           RECEIVER NUMBER
H2600       32-40           MAP GRID EASTING IN METERS
H2600       41-49           MAP GRID NORTHING IN METERS
H2600       50-53           RECEIVER DEPTH REFERENCED TO SEA LEVEL
H2600       54-57           RECEIVER NUMBER
H2600       58-66           MAP GRID EASTING IN METERS
H2600       67-75           MAP GRID NORTHING IN METERS
H2600       76-79           RECEIVER DEPTH REFERENCED TO SEA LEVEL
H2600        80             STREAMER CODE
H2600
H2600****************************************************************************
H2600
H2600 STREAMER AND TAILBUOY NUMBERING INCREMENTS FROM STARBOARD TO PORT.
H2600
H2600 STREAMER  1: RECEIVERS NUMBERED    1 (FAR) TO  348 (NEAR)
H2600 STREAMER  2: RECEIVERS NUMBERED  349 (FAR) TO  696 (NEAR)
H2600 STREAMER  3: RECEIVERS NUMBERED  697 (FAR) TO 1044 (NEAR)
H2600 STREAMER  4: RECEIVERS NUMBERED 1045 (FAR) TO 1392 (NEAR)
H2600
H2600 STREAMER ROTATIONS HAVE BEEN APPLIED ON A SHOT BY SHOT BASIS.
H2600
H2600 SPRINT CALCULATED INLINE MISCLOSURES ARE DERIVED ON A SHOT BY SHOT BASIS.
H2600 THESE INLINE MISCLOSURES ARE DISTRIBUTED LINEARLY OVER THE ACTIVE
H2600 STREAMER LENGTH. THE CORRECTED STREAMER LENGTH IS USED TO COMPUTE THE
H2600 FINAL RECEIVER POSITIONS.
H2600
H2600 SPRINT VERSION 3.1.20 USED FOR ONBOARD NAVIGATION PROCESSING
H2600
H2600 PGS JOB NUMBER 2005120
H2600
H2600 ALL SHOTS FOR ALL STREAMERS ARE INCLUDED ON THIS TAPE, DATA NOT TO BE
H2600 PROCESSED (NTBP) IS INDICATED BELOW AS NECESSARY.
H2600
H2600 LINES CONTAINED IN THIS FILE:
H2600
H2600 LINE: ???                  SEQUENCE: ???  FSP:  ????  LSP:  ????
H2600
```
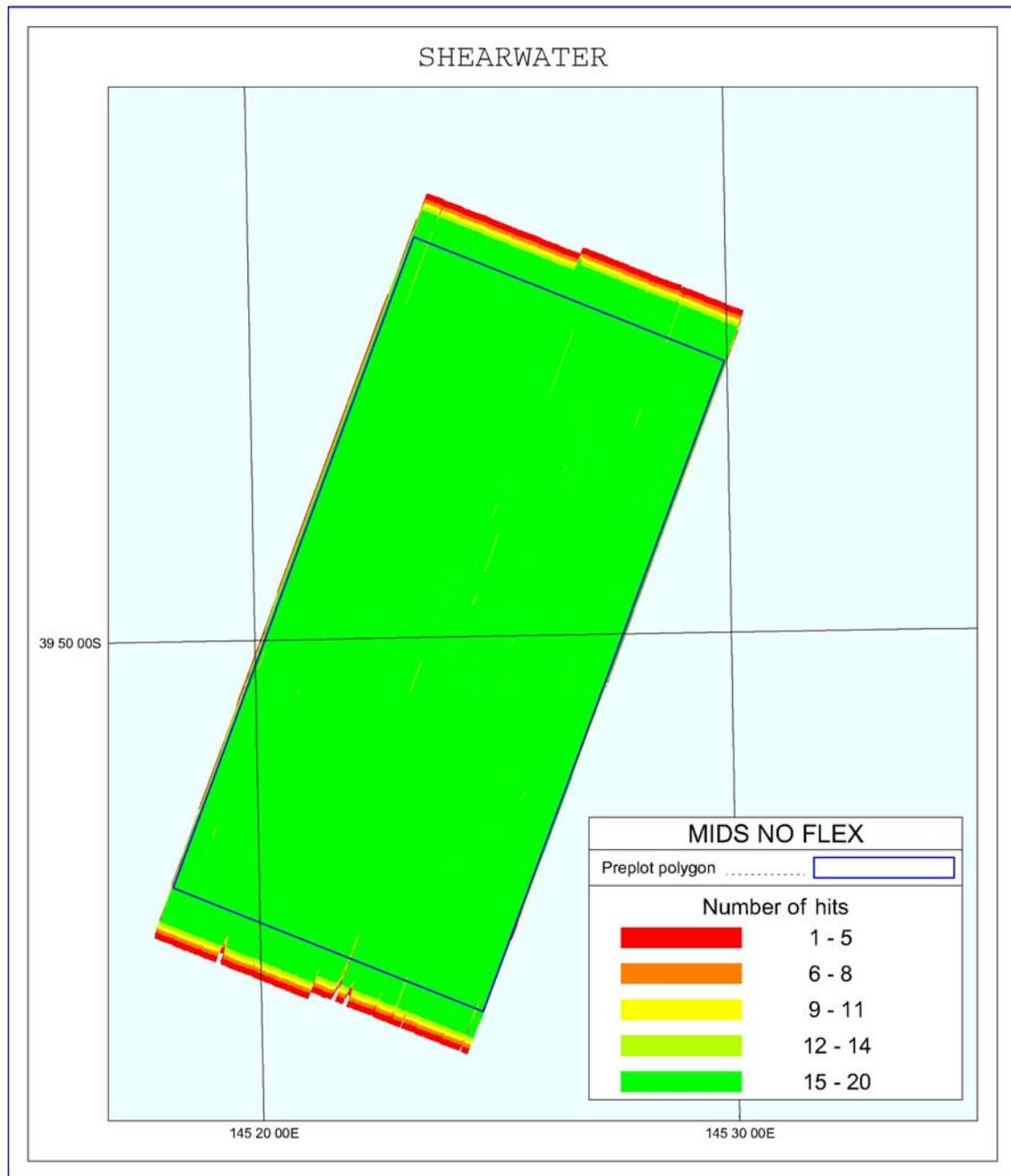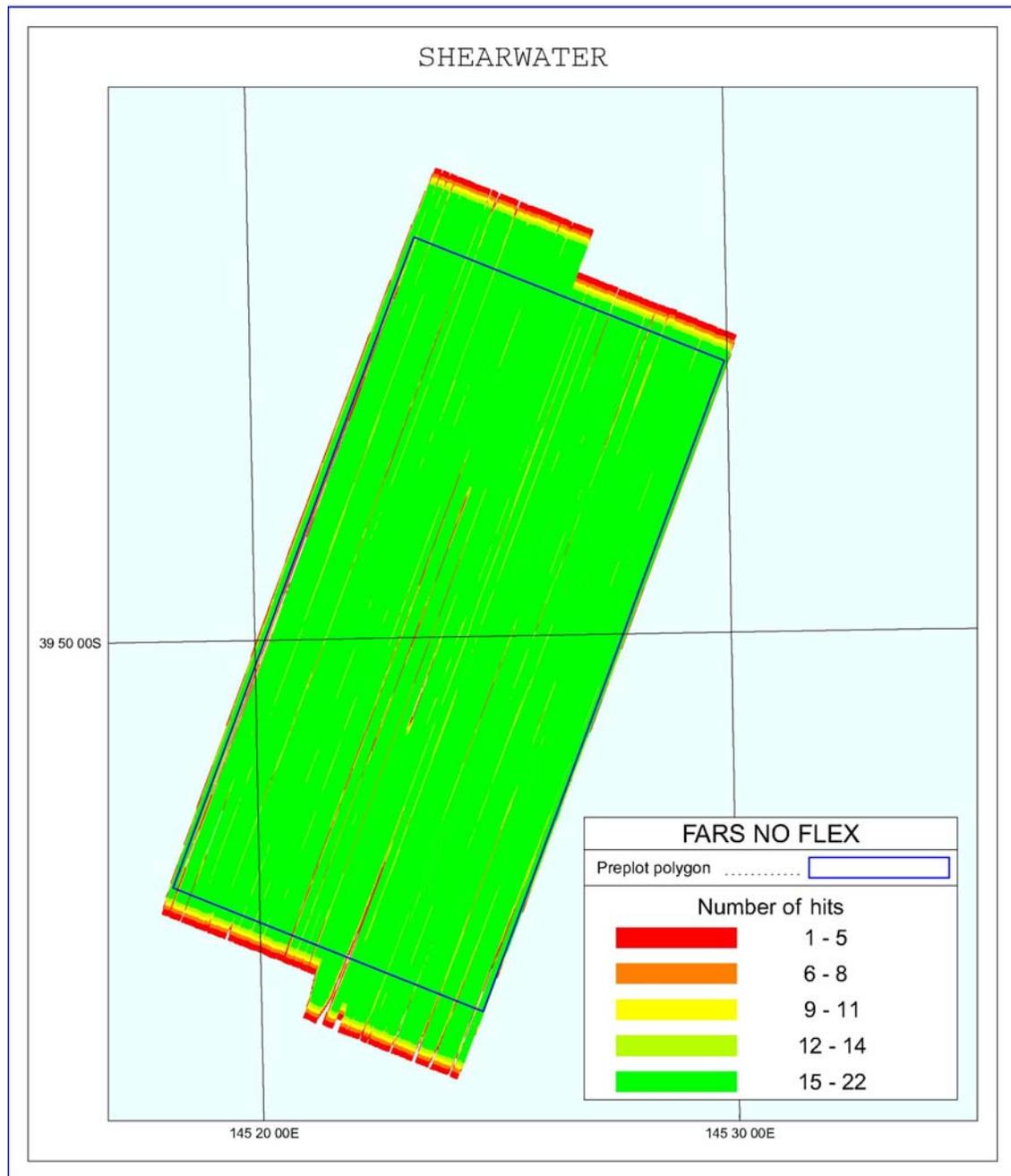
12.6 Coverage plots

12.6.1 Nears no Flex

12.6.2 Mids no Flex

M/V Orient Explorer   ACQUISITION REPORT   Origin Energy Resources LTD
PGS job number 2005120   version 1   Shearwater 3D & 2D Survey Victoria Australia
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12.6.3 Fars no Flex

M/V Orient Explorer   ACQUISITION REPORT   Origin Energy Resources LTD
PGS job number 2005120   version 1   Shearwater 3D & 2D Survey Victoria Australia
14th November to 10th December 2005

12.6.4 Alls no Flex