



Santos

ACQUISITION REPORT

PGS Geophysical

Santos Ltd

M/V Orient Explorer

Southern Margin 2D

2003134

12th November to 10th December 2003



version 1

AUTHORISATION

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Singapore,
03 February 2004

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REVISED VERSIONS

NUMBER	CHANGES	AUTHOR	DATE

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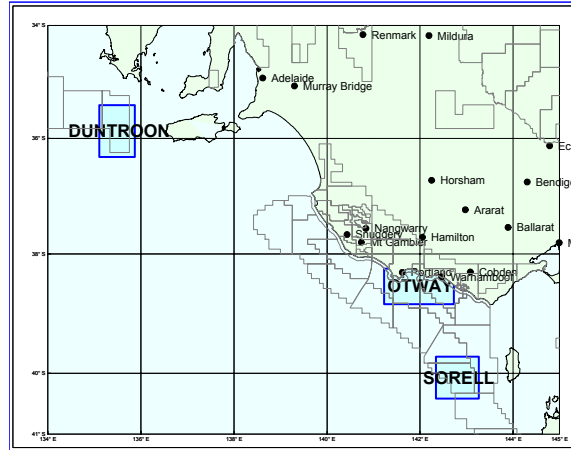
1 Introduction

1.1 Summary

The M/V ORIENT EXPLORER was contracted by Santos Ltd to perform a 2D seismic program offshore Victoria, Australia. The program contained four areas as shown on the picture.

The four areas were:

- VIC/P51, Otway Basin, South of Portland, Victoria
- VIC/P44, Otway Basin, East of Portland, Victoria
- T/35P, Sorell Basin, West of King Island, Bass Strait, Tasmania
- EPP32, Duntroon Basin, West of Kangaroo Island, South Australia



The table below shows the production dates and streamer configuration for the 4 areas:

<u>Area</u>	<u>Start Time</u>	<u>End Time</u>	<u>Streamer Length</u>	<u>Recording Time</u>
VIC/P51	17 Nov 12:30	21 Nov 08:42	4050m	6 seconds
VIC/P44	12 Nov 14:46	17 Nov 07:01	4050m	6 seconds
T/35P	22 Nov 04:47	01 Dec 04:16	6000m	8 seconds
EPP32	05 Dec 08:13	09 Dec 13:09	6000m	8 seconds

The vessel mobilised offshore Portland, Australia on the 12th November 2003 and the production started the same day in block VIC/P51. On the 2nd December, after completion of T/35P, the vessel went to Melbourne for bunker and crew change for the Australian maritime crew. The vessel was back in production on the EPP32 survey in the morning the 5th December. The survey was completed 9th December and the vessel de-mobilized in Port Lincoln 10th December.

1.2 Key parameters

1.2.1 VIC/P51 and VIC/P44

Source	:	1 x 2500 in ³
Streamers	:	1 x 4050 m
Near trace offset	:	95 m

1.2.2 T/35P and EPP32

Source	:	1 x 2500 in ³
Streamers	:	1 x 6000 m
Near trace offset	:	145 m *)

*) The near trace offset was at the start of T/35P 95m, but was increased at client request after sequence 6 to 145m. Area EPP32 was shot with 145m near trace offset.

1.3 Systems

Source type	:	Bolt guns
Streamer type	:	Syntron / Teledyne LDA
Recording system	:	Syntron 960-24, with direct link to Seismic QC
Navigation	:	StarFix DGPS
	:	SkyFix DGPS
Float positioning	:	Seatrack RGPS
Acoustic ranging	:	Sonardyne SIPS1

The acoustic ranging system was used only for offset verification at start of each survey area. It was not used during production.

1.4 Production

Area	Prime Km	Run Out Km	Total Km
VIC/P51	450.075	20.200	470.275
VIC/P44	449.500	34.425	483.925
T/35P	1243.075	93.000	1336.075
EPP32	462.425	45.000	507.425
Total	2605.075	192.625	2797.700

1.5 Survey timing

	Hours		Hours	% of total
Production	490.84	Production prime	288.38	43.17
		Production run-out	21.33	3.19
		Line change	182.25	27.28
Standby	145.07	Fishing	0.67	0.10
		Sea creatures	14.93	2.24
		Client request	6.63	0.99
		Weather	8.35	1.25
		Local travel	74.05	11.09
Port call	39.25	Bunker / crew change	39.25	5.88
Mob / demob	18.22	Mob	2.77	0.41
		Demob	15.58	2.33
Downtime	13.80	Instruments	5.70	0.85
		Mechanical	8.10	1.21
Total	668.00		668.00	100.00

Note:

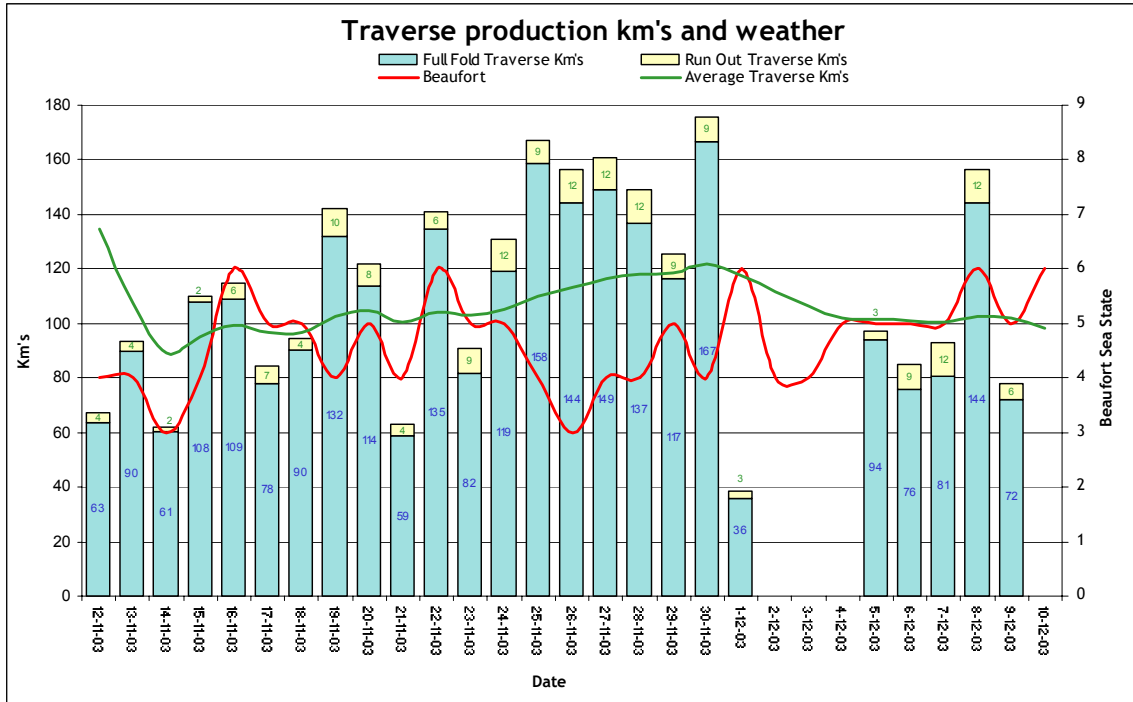
- All times are in hours and decimal hours.
- The times are taken from start of survey on 12 November 2003 at 12:00 to end of demobilisation on 10 December 2003 at 08:00
- The group local travel was used for travel between areas including time spent on re-configuration, recovery or deployment.

2 Sequence of events

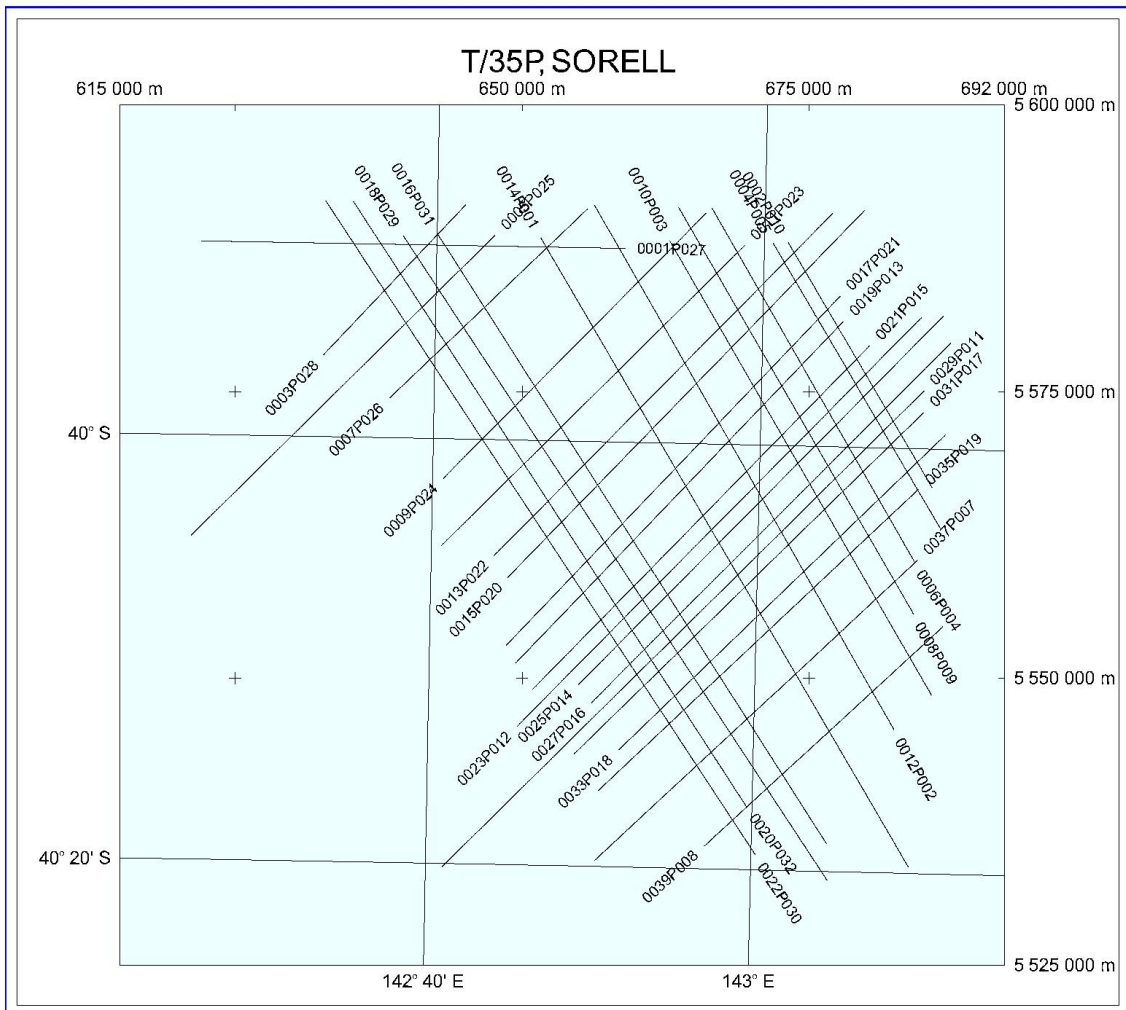
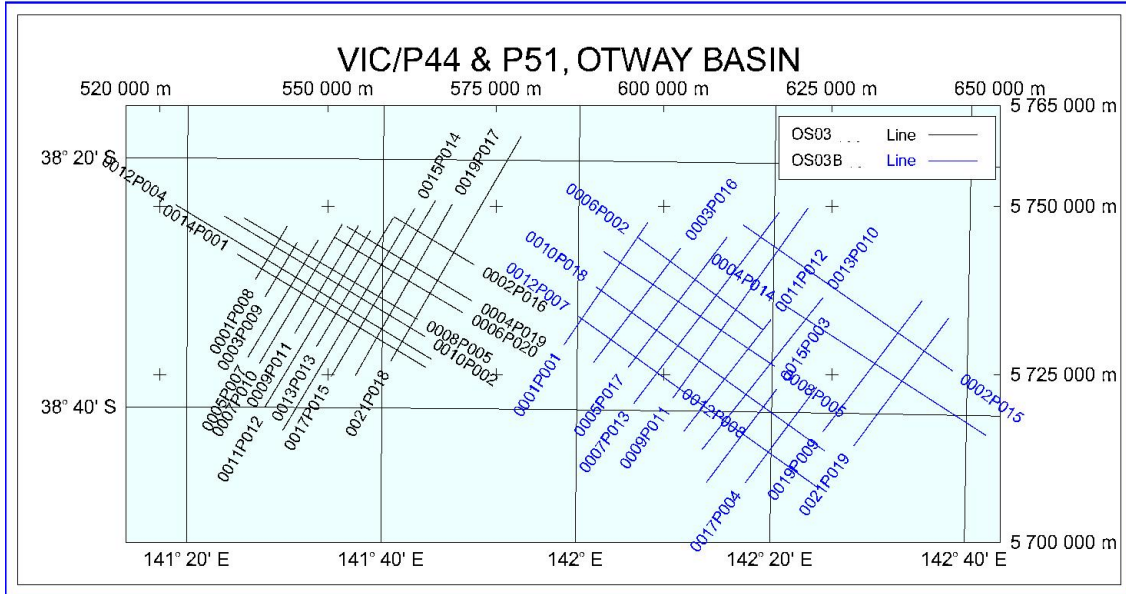
2.1 Daily log

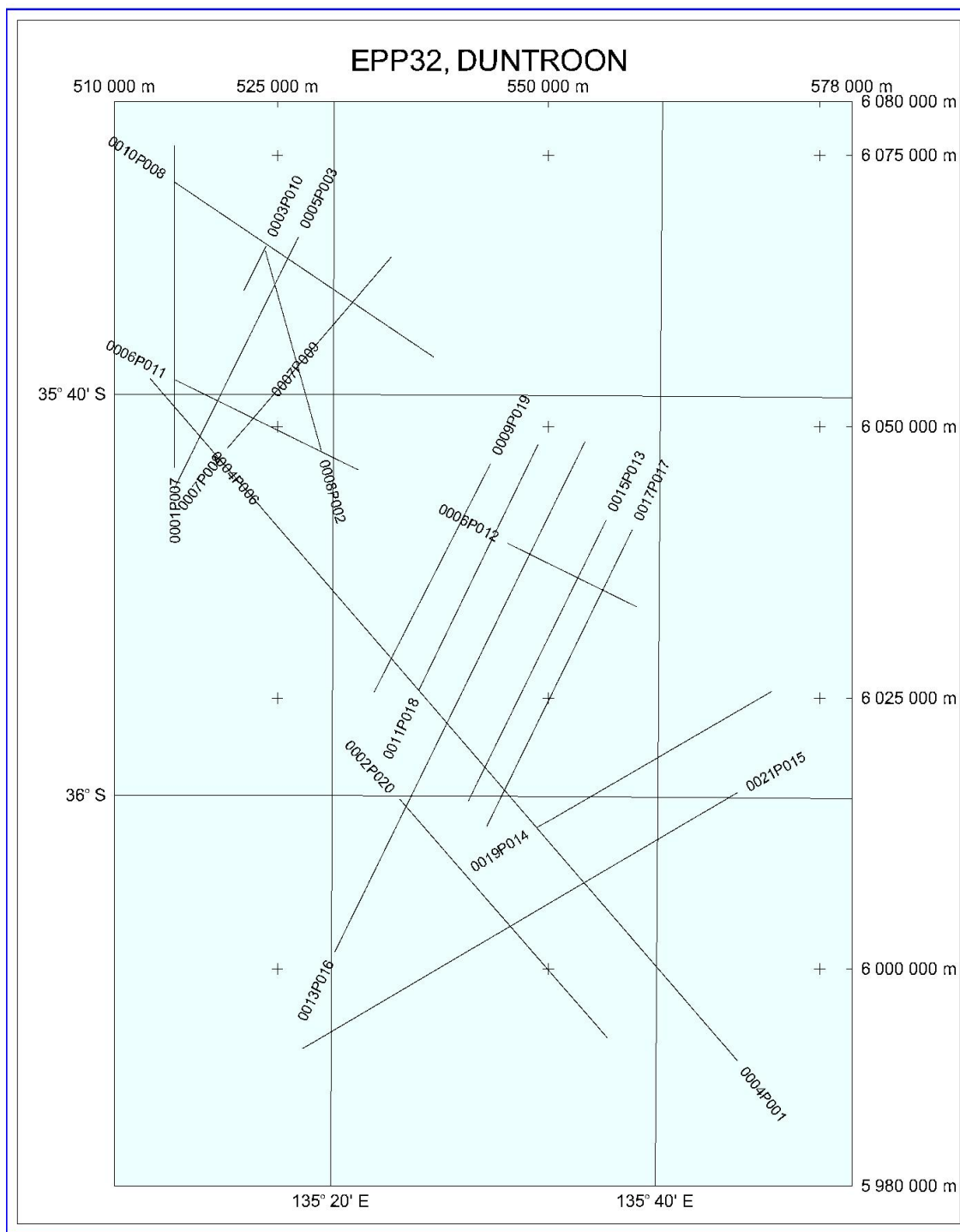
Date	Daily Full Fold Km's	Daily Run Out Km's	Sea State Beaufort	Location	Comments
12-Nov-03	63.35000	4.05000	4	Prospect VIC/P51	Mobilisation at sea starts 12:00. First line started 14:46. Production seq. 001-002
13-Nov-03	89.57500	4.05000	4	Prospect VIC/P51	Production seq. 004-006. Downtime to Instrument 5.70 hrs d/t Syntak crash
14-Nov-03	60.57500	1.50000	3	Prospect VIC/P51	Production seq. 007-011.
15-Nov-03	108.07500	2.02500	4	Prospect VIC/P51	Production seq. 012-014
16-Nov-03	108.87500	6.05000	6	Prospect VIC/P51	Production seq. 015-019
17-Nov-03	78.02500	6.57500	5	Prospect VIC/P44	Production seq. 020. Completed VIC/P51 at 7:01. First line on VIC/P51 started 12:30. Production seq. 001-003
18-Nov-03	90.47500	4.05000	5	Prospect VIC/P44	Production seq. 004-008. Downtime 07.35 hrs to Gun d/t air leakage and compressor
19-Nov-03	132.12500	10.12500	4	Prospect VIC/P44	Production seq. 009-013
20-Nov-03	113.65000	8.10000	5	Prospect VIC/P44	Production seq. 014-017
21-Nov-03	58.90000	4.05000	4	Prospect VIC/P44	Production seq. 018-019. Completed VIC/P44 at 8:42. Transit and reconfiguring before T/35P
22-Nov-03	134.82500	6.00000	6	Prospect T/35P	Transit and reconfiguring before T/35P. First line on T/35P started 04:47. Production seq. 001-002
23-Nov-03	81.60000	9.00000	5	Prospect T/35P	Production seq. 003-006. Recover front of the streamer to improve depth control.
24-Nov-03	119.00000	12.00000	5	Prospect T/35P	Production seq. 007-010. Extended LC between seq.7 and 8 by 45 minutes
25-Nov-03	158.42500	9.00000	4	Prospect T/35P	Production seq. 011-013
26-Nov-03	144.32500	12.00000	3	Prospect T/35P	Production seq. 014-017
27-Nov-03	148.95000	12.00000	4	Prospect T/35P	Production seq. 018-021
28-Nov-03	136.85000	12.00000	4	Prospect T/35P	Production seq. 022-025
29-Nov-03	116.70000	9.00000	5	Prospect T/35P	Production seq. 026-028
30-Nov-03	166.85000	9.00000	4	Prospect T/35P	Production seq. 029-031
01-Dec-03	35.55000	3.00000	6	Prospect T/35P - Transit to Melbourne	Production seq. 032. Completed T/35P at 04:16. Streamer onboard at 10:45. Transit to Melbourne for bunker, Australian crew change, provisions and DNV inspection.
02-Dec-03	0.00000	0.00000	4	Transit / Port Call	Arrived Melbourne 07:35. Departure 19:55
03-Dec-03	0.00000	0.00000	4	Transit to EPP32	Transit to EPP32. Average speed 11 knots
04-Dec-03	0.00000	0.00000	5	Transit / Prospect EPP32	Transit to EPP32. Deployment started 16:13.
05-Dec-03	94.17500	3.00000	5	Prospect EPP32	Deployment. Production were estimated to start 02:00, but Orient was instructed by the client to delay start d/t aerial survey in the same morning. Production started 08:13. Production seq. 001-002
06-Dec-03	76.00000	9.00000	5	Prospect EPP32	Production seq. 003-007. Sequence 4 and 5 was terminated d/t whales.
07-Dec-03	80.87500	12.00000	5	Prospect EPP32	Production seq. 008-013. Sequence 10 and 11 was terminated d/t whales.
08-Dec-03	144.47500	12.00000	6	Prospect EPP32	Production seq. 014-017
09-Dec-03	71.90000	6.00000	5	Prospect EPP32	Production seq. 018-021. Sequence 021 which was a test line with reduced gun volume was terminated after 59 SP's d/t whales. Recovery completed at 19:30. Started transit towards Port Lincoln
10-Dec-03	0.00000	0.00000	6	Transit to Port Lincoln / Port Call	Arrived Port Lincoln at 08:00

2.2 Daily production and sea state



2.3 Post plotted vessel positions





3 Key personnel

Party chief	Esben Jettestad
Chief observer	Werner Beneke
Chief navigator	Geoffrey Weaver
Chief mechanic	Pat Stoltz
Chief geophysicist	Guy Alleman
Navigation Processor	Ken Cormack

Client representative onboard	Drew Murray
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Client contacts onshore	John Hughes
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4 HSE

4.1 Statistics

Exposure hours	Marine crew	16032
	Seismic crew	14696
	Third party crew	1336
	Total	32064

Workboat operations 7

Workboat exposure hours 7.12

4.2 Incidents

Report no.	Date	Classification	Comments
ORI0318	13.11.03	Near Miss	Chase vessel worker nearly fell overboard while loading stores to work boat
ORI0320	25.11.03	Injury	Crew member grazed abdomen on protruding key

5 Survey operations review

5.1 Common to all areas

Steering online was always maintained to keep the common mid point at the top of the theoretical sail line.

The streamer depth was decided on the discretion of the client representative onboard. Streamer depths online varied from 7 to 10 meter depending on shooting direction and swell. Please refer to the observer logs and/or navigation line logs for actual nominal streamer depth during the survey.

The feather was low in all areas and never exceeded 10°.

5.1.1 VIC/P51

The VIC/P51 area was located South and South East of Portland and the vessel started the production in Southern area 12 Nov at 14:46

The production started in the Southern area as this area was expected to be the most popular Cray fishing area. It was requested by the client to prioritise lines in West before the Cray fishing season started 15th November at 09:00. First the sail lines 8,10,12 and 14 in direction NW/SE were done, and then the production continued on lines 1, 3, 5 etc. completing lines from the west side to the east.

Santos kept a good communication line with the commercial fishing fleet in Portland. Maps and production plans were distributed daily. This reduced the conflict between the seismic survey and the fishing fleet to a minimum and no fishing gear were caught on the seismic gear during this survey.

The M/V ORIENT EXPLORER was guarded by PERFECT LADY, a local chase vessel, and during the survey, they removed 29 crayfish pots in front of the Orient Explorer. They were efficiently dealing with local fishermen out at the survey which all removed their pots in time for the ORIENT EXPLORER to pass on the survey lines.

Prior to the start of the survey a bathymetry survey was done near and in the close area of the sail lines ending close to the coastline. Depth contours were plotted on the online navigation system. A plan was developed regarding end of line position for the lines running towards coastline. The criteria's for choosing the end of line position was depth > 13m and distance to coastline > 0.5 nm. Most of the lines in NE/SW direction were ending close to the coastline and not all lines were acquired with full fold coverage. Please refer to the production log for details.

The swell was dominating from the SW and current was dominating in the NW direction. The current was stronger out at deeper water and dropped off towards shallower water.

During an aerial survey on day 2 of the survey, blue whales were spotted feeding in the area west of sail line number 1. The vessel was redirected by the client to choose a line further to the east, and line 1 was later shot with reduced length to maximize the distance to the blue whales.

The vessel approached whales spotted from the bridge twice during this survey. The first time was 13th November when the vessel was in line change mode between line OS030008P005 and OS030005P006. The second time was the same day during line soft start of line OS030005P006 while a whale was spotted on the port bow of the ORIENT EXPLORER. The whale was swimming in opposite direction of the Orient at a distance of approximately 4000m.

The ships traffic in the area was low. Mainly smaller fishing vessels and recreation boats were seen in the area. There were also some supply vessels passing through the survey area, but they were well aware of the operation and never caused any conflicts.

The area was completed on 17th November 2003 at 07:01 and the vessel transited east to the next block, VIC/P44.

5.1.2 VIC/P44

The VIC/P44 area was located east of Portland and the survey commenced on 17th November 2003 at 12:30 hours.

Some Cray fishing activity was expected in this area as well, but not as extensive as in block VIC/P51. The PERFECT LADY was still with the ORIENT EXPLORER as guard vessel, but no crayfish pots or fishing nets were moved during the entire survey. Only a few fishing vessels were operating just south of Port Fairy, but not far enough from the coastline to impact on the seismic survey.

The lines in this block were not as close to the coastline as the lines in block VIC/P51 and all the lines were completed with full fold coverage.

The swell was dominating from the SW and the current from NW.

A pipe layer barge (SEMAC 1) was operating East of the survey area, but the distance to this operation was too far to impact on the seismic survey.

Also in this area there was very little ships traffic.

The area was completed on 21st November 2003 at 08:42 hours and the vessel transited south to the next block, T/35P.

5.1.3 T/35P

This area was located West of King Island and the survey started on 22nd November 2003 at 04:47 hours. On the transit from block VIC/P44, the streamer was reconfigured from 4050 to 6000 meter.

The 6 first sequences were acquired with the near offset of 95m, but from sequence 7 and onwards the near offset was increased to 145m at client request. This reduced the strumming noise on the front traces to some extent.

There was no fishing activity at all in this area and also very little ships traffic.

A new chase vessel was sent out for this survey, as it was expected rougher seas than in the two previous blocks. The chase vessel was called EDWARD J FARNEY.

The rougher seas caused reduced possibilities to use the workboat (WB) for in-sea maintenance of the streamer. After 6 sequences we started the lines going with and against the swell, and this caused the streamer to be too light at the front. Not being able to launch the WB for ballasting of the streamer it had to be recovered to Bird #16 and weights were added.

As for the other survey areas the swell was dominating from SW, but winds tend to be a bit more variable than for the two previous surveys. The wind could turn 360 degrees over a 24 hours period, most likely caused by low-pressure systems passing through the Bass Strait or over Tasmania.

No whales were spotted from the vessel in this area.

The area was completed on 1st December 2003 at 04:16. The vessel recovered the gear and started to transit towards Melbourne for bunkering and crew change of Australian Maritime crew that same day.

5.1.4 EPP32

This area is located West of Kangaroo Island. After approximately 48 hrs of transit from Melbourne, the vessel started production on the morning of 5th December. The vessel was ready to commence production at 02:00 hours, but we had received a request to delay the start of production to wait for an aerial survey. The production started 08:13 hours on the 5th December 2003.

The fishing activity was low on this survey as well, but on line change between line DS030003P005 and DS030004P006 the vessel ran over a depth rope for a long line. The depth rope was cut when it hit the gun arrays, and the Norwegian buoy and some of the depth rope were seen drifting after the rope was cut. The name of the fishing vessel was "SEA ODYSSEY".

No ships traffic was seen in this area.

The swell in this area was predominately from the SW, and the wind was shifting from South to East and from South to West.

Blue whales were feeding in the centre and the western part of this area and the vessel approached whales on several occasions during this survey. Below is a brief table of ORIENT EXPLORER's contact with whales during this survey.

Date	Time (EDT)	Observation	Status Orient Explorer
05 Dec	16:55	Pilot whales passing from starboard to port bow. Distance when spotted 2000m	Recording line DS030004P001. Line shutdown when whales spotted. Heading away opposite direction of the whales.
06 Dec	07:24	Several whales spotted. Believe species was both Blue Whale and Humpback whales.	Line change mode. Soft start was delayed to 09:20 on the approach to line DS030003P005 until no whales were seen within 3 km from the vessel
06 Dec	10:25	Blue Whale spotted on starboard bow. Distance approximately 2000m	Recording line DS030003P005. The line was shut down when the whale was spotted. The Orient then passed with the whale on starboard side and started a port turn to another line.
07 Dec	09:11	Blue Whales spotted on starboard bow.	Recording line DS030003P010. The line was shut down and the Orient passes with the whale feeding on starboard side. Once the whales was out of sight a starboard turn was started to commence onto line DS030006P011
07 Dec	14:33	Blue Whales spotted inside 3 km on both starboard and port bow.	Recording line DS030006P011. Radio communication was maintained with the spotter plane, and the line was shut down when spotter plane estimated to distance to Orient was less than 3 km. The Orient kept the same heading and started a new soft start at 15:20 when the spotter plane informed the whales were outside 3km.
09 Dec	14:25	Pilot whales suddenly spotted closer than 500 m on stbd beam	Recording test-line DS030004T021. The line was shut down and the vessel started recovering all gear due to time strain to be in for crew change in Port Lincoln.

6 System performance

6.1 Source

The guns performed well during the survey. On two occasions the line change was extended to do maintenance on the gun arrays. The extended line changes gave a downtime of 1.75 hrs.

On 18th November during the run-in of seq. 006 in the VIC/P44 area a shuttle valve was jammed and caused an air leakage. This gave 3.03 hrs downtime.

On 18th November during seq. 007 in the VIC/P44 area the compressor running the working air stopped. This working air is also operating the fisher valve which failed operating and the gun pressure were dumped overboard causing the pressure out on the arrays to drop below 90% of the nominal pressure. The vessel circled and this caused 3.32 hrs downtime.

A total of 8.10 hours downtime was caused source related issues. This is equivalent to 1.21% of the total survey time.

6.2 Streamers

The streamer was in good condition throughout the survey with few noisy channels. For area VIC/P51 and VIC/P44 no traces failed the daily test. For survey T/35P and EPP32 there were 3 traces with leakage. These channels were 118, 329 and 345.

The streamer was well balanced for area VIC/P51 and VIC/P44. Once we got down in T/35P and started production with and against the current the streamer was found to be light in the front part of the 6000m long streamer. After 6 sequences on T/35P the front of the streamer was brought in to add more weight. After this the cable balance was good for the remaining of T/35P and the completion of EPP32.

6.3 Recording system

The recording system was working well during this survey. Initially, during recording in VIC/P51 there was a problem with the tape drives (seq. 003) and the Data Collector Card of the recording system (seq. 006). These two happenings caused a total of 5.70 hrs downtime for Instrument department and was also the total for the whole survey. This is equivalent to 0.85% of the total survey time.

6.4 Navigation

The Integrated Navigation System was performing well during this survey. No downtime was related to navigation during this survey.

7 Seismic data quality

7.1 Seismic interference

No seismic interference was detected throughout the survey.

7.2 Swell noise

The swell was high during almost the whole acquisition period. It could be noticed on the stacks and RMS Noise Window displays. A few sequences had very high levels of swell noise.

Examples of such sequences are:

VIC/P44	:	002
VIC/P51	:	007,015 ,017, 018
T35/P	:	007, 008
EPP32	:	002, 003, 004

7.3 Ship noise

There was no ships noise throughout the survey.

7.4 Mud Roll

A strong Mud Roll (similar to Ground Roll in land seismic) was visible on some raw shots in the shallow waters with soft bottom of the Otway VIC/P51 and VIC/P44 surveys. Examples can be found on SEQ 014 and 015 of VIC/P51.

7.5 Strum Noise

Strum noise (or Tug Noise) was constantly monitored from the RMS and shot displays, ensuring that it remained within acceptable limits. Higher levels were visible when the weather was bad. It was of low frequency content and intermittent, sometimes noticeable on more than 10 near channels.

7.6 Multiple Reflected Energy

"Multiple Reflected Energy" was especially prevalent during the acquisition of T/35P and EPP32. These were a continuous feature on all stacks and were visible on some RMS Noise Window Displays.

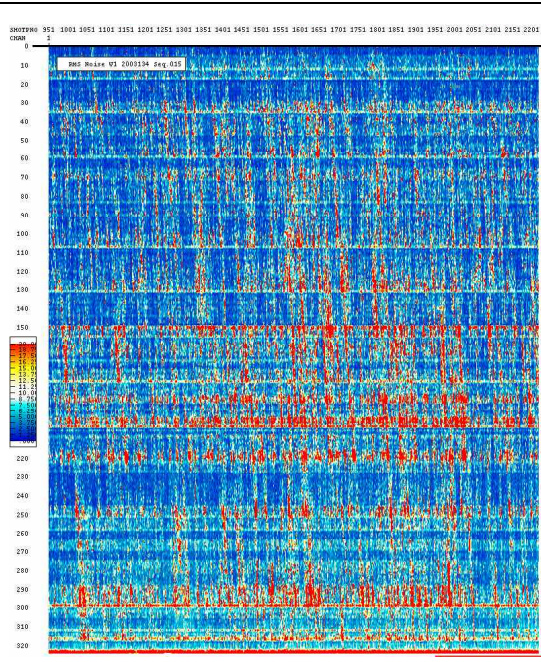
7.7 Bad channels

The number of bad channels remained very low. Even the channels near birds or acoustic devices were quiet. **Random spiking** due to swell was observed at different trace locations and times on sequences affected by bad weather.

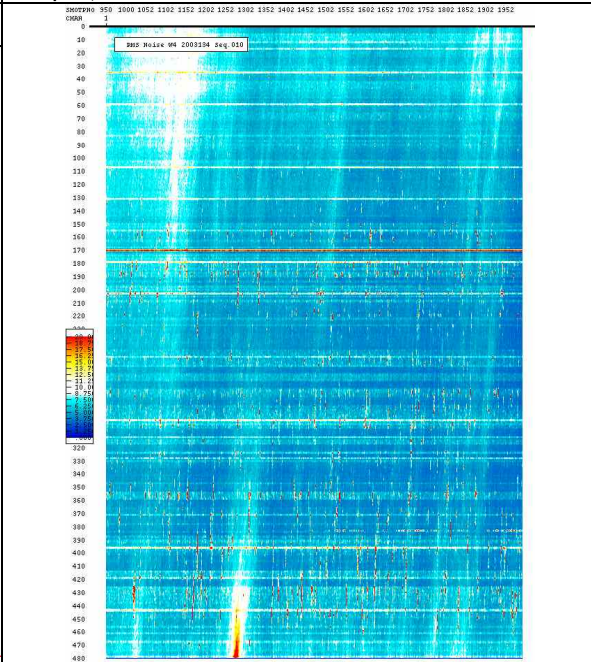
7.8 RMS and noise analysis

The RMS displays/graphs show that the data quality was good considering the rough seas we had most of the time. The background noise ranged from 4-7 μ bar and higher on occasion, when we had high swell noise. The RMS displays/graphs are an excellent evaluation tool for swell noise. Some of the RMS displays were still affected by strong multiples or other events from preceding shots, especially in the deep-water areas (T/35P & EPP32). Window 1 was sometimes affected by direct arrivals on nears for the T/35P area.

Window 1 RMS display of VIC/P51 seq.015 showing strong swell noise.



Window 4 RMS Display on T35/P Seq 010 showing some diffraction or multiples (white/blue zones) and a few swell burst (black spots). The birds show also some weak noise (horizontal blue stripes)



Note: Vertical axis is channels and horizontal axis is shots. Every channel amplitude ranges from blue (less than 5 µbar) to red (more than 25 µbar). See 12.2.1 RMS Noise Analysis for a description of the Syntrek RMS windows

7.9 First break / P1 offset check

Navigation QC plots were generated with the COBRA system (PGS Proprietary Software) and ProMAX. They were checked on a line-to-line basis and validated the near offsets in the navigation P1/90 files.

7.10 Brute stack QC

For VIC/P51 and VIC/P44, the brute stacks were produced online with parameters from the closest line already shot. For T35/P and EPP32 the stacks were produced offline after picking adequate velocities and mutes. The processing flow was optimised for noise detection. However some good and deep geology was often visible on the stack displays. Diffractions and multiples were present throughout the survey area. Tug Noise and swell were sometimes stacking in.

Seismic QC Deliverable:

The Real Time/Offline QC Brute stacks were written to SEGY on disk and archived to tape using a standard Unix tar command on a regular basis. The SEGY format is described in appendix 14.4

7.11 Tape Copy and QC

Each field tape was copied using a standard Unix "tcopy" command. Reading the data back from tape and checking the headers and the seismic data did validating those copies and the original tapes at the same time.

7.12 Syntrak Logs

The Logs automatically generated by the Syntrak Acquisition System (P7 format) and delivered in pdf format were on occasion corrupted. In order to accept those shots some specific header QC was done to ensure that FFID, Shot, Year, Julian Day, Time and GunMask were correct for those shots. Eventual missing shots or guns out of sequence were also monitored. In order to check for eventual spikes, data read from the tape was checked by mapping the maximum amplitude. Any bad shots were logged in the observer log.

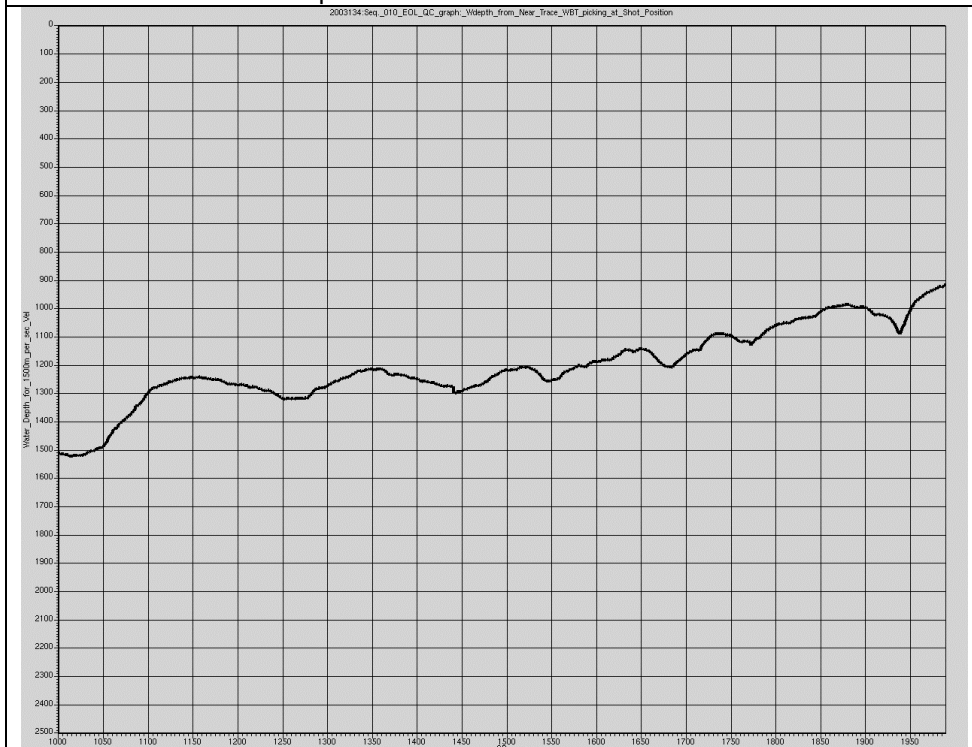
7.13 Autofires

All autofires were checked on screen on the auxiliary channel displays, to confirm that they were not falsely flagged by the GCS90. Only autofires checked as bad shots were left in the observer log.

7.14 Echo Sounder QC

In deep water, areas T35/P and EPP32, the water bottom was picked offline on near trace displays to check the echo sounder depths. The water bottom picked can only be a guideline for despiking/correcting the echo sounder depth as the seismic data does not have the necessary resolution for precise depth calculation. Hence the seismic signal can penetrate the very first layers and give false results. See 12.2.4 (Other QC products) for a detailed description of the procedure used. This was not done in shallow waters or when the water bottom could not be picked.

Example of Water Bottom Picking on a deep water line. Vertical axis is water depth and horizontal axis is shot point.

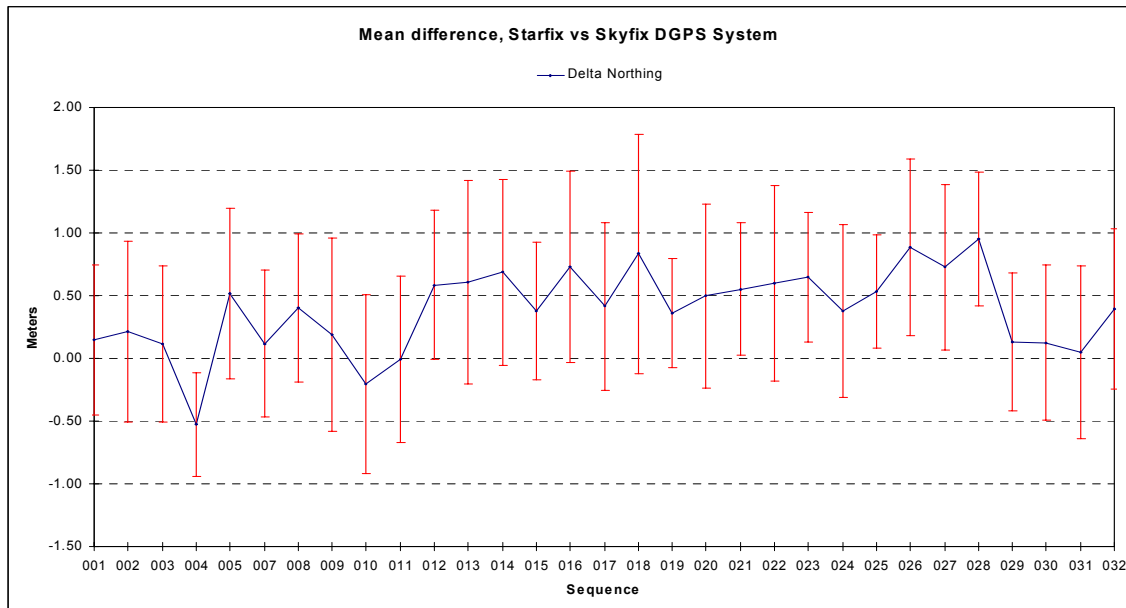
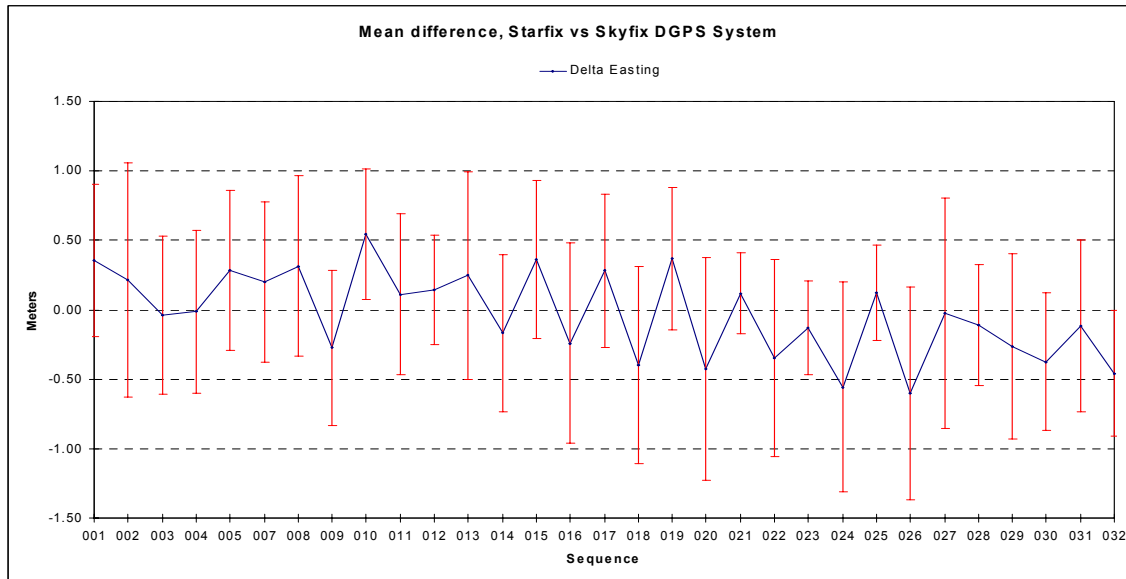


8 Positioning data quality

8.1 Vessel position

Two Differential Global Positioning Systems (DGPS) were utilised through out the survey, namely Fugro's StarFix and Thales' SkyFix. The corrections systems were used with three different software packages MRDGPS (StarFix), Seadiff (StarFix) and MultiFix 4 (SkyFix). Four systems were input to the INS as detailed in the sub sections below and all were used in processing. The quality of data was generally very high with very little atmospheric influences.

The inter-system comparisons were very good. The mean discrepancies were $\pm 0.5\text{m}$ for Easting and $-0.5\text{m} - +0.9\text{m}$ for Northing. The graphs below show comparison of System I and System II for area T/35P.



8.1.1 System I – StarFix (MRDGPS)

This system was configured in 3D mode. StarFix performed well throughout the survey.

8.1.2 System II – SkyFix (MultiFix 4)

This system was configured in 3D mode for the duration of the survey.

MultiFix was generally stable throughout the survey. On sequence 002 of area T/35P this system showed an incorrect position for 200 shots due to a lack of common visible satellites.

8.1.3 System III - StarFix (Seadiff)

This system was configured in 3D mode for the duration of the survey. This system is generally slightly noisier than the other systems but performed well.

8.1.4 System IV – SkyFix (MultiFix 4)

This system is set up exactly the same as System II but using a different computer and receiver. It was not used in processing.

8.2 Acoustic ranges

Acoustic devices were deployed on the head and tail of the streamer but were only used at the start of the job and at any configuration changes to check the offsets.

8.3 RGPS

RGPS pods were attached to all the gun floats and the tail-buoy. Typically the performance of the all the units was good with update rates of between 1-2 seconds. In times of heavy seas the outer gun string on the side of the weather showed times of intermittent position updates due to water washing over the top of the unit and obscuring satellites.

8.4 Compass data

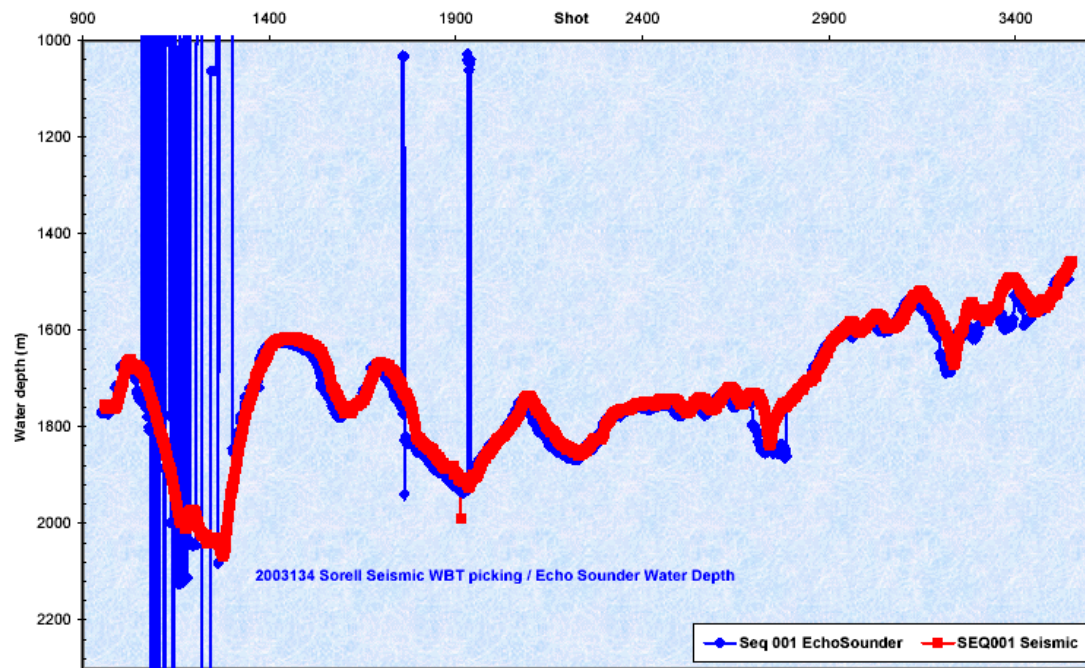
Compass data was good throughout the survey with very little or no editing required. On the start of the T/35P job for sequences 001 - 006 S1C21 was unusable due to noise. When the cable was retrieved for ballasting the bird was found to be detached from its collars. A new bird was placed on this location.

8.5 Water depth

The 210 kHz transducer was the master for the VIC/P51 and VIC/P44 portions of the survey and the echo sounder performed very well in these areas, which were in shallow water.

On the T/35P and EPP32 portion of the survey the master transducer in Spectra was the 33 kHz unit, due to the depth of the area. The echo sounder had trouble tracking in water deeper than 1500 m and at times of steep gradients. The water depth contained in the P1/90 source-receiver files for the T/35P and EPP32 portions of the survey should be considered invalid.

The first breaks for each line were picked by a promax routine from the seismic records and a file containing the two way travel time, (TWT) was created. The TWT files were used to calculate depths and merged with an echo sounder position file for the complete job.



The above graph shows the water depth as generated by Promax compared to the echo sounder.

9 Seismic energy source

9.1 Source details

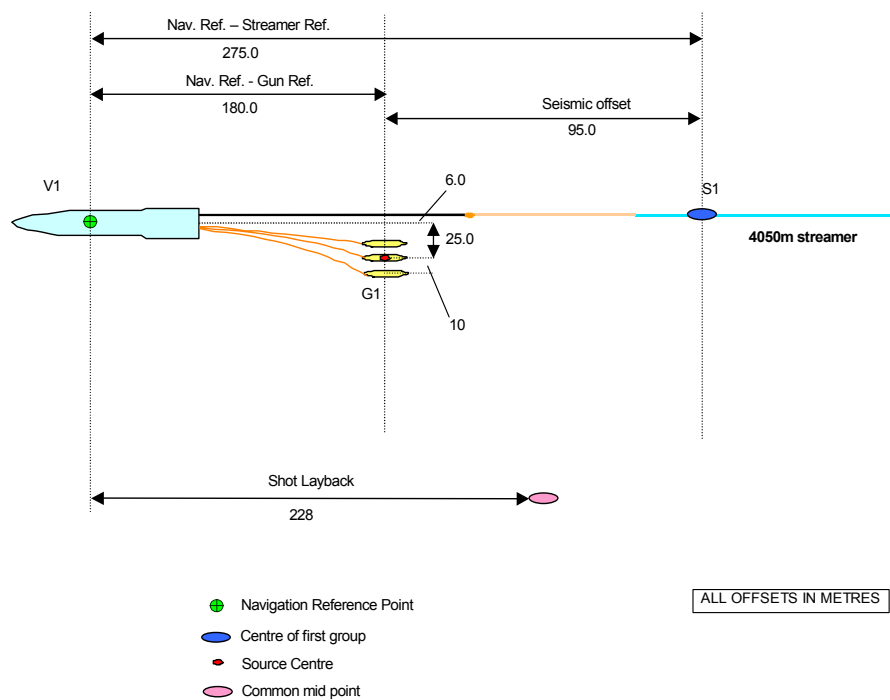
Source type	:	Bolt air guns
Air pressure	:	1800 psi
Volume	:	2500 in ³
Number of sources	:	1
Number of sub-arrays	:	3
Sub-array separation	:	10 m
Source length	:	14 m
Gun synchronisation	:	± 1.0 ms
Drop-out specification	:	90 % of the elements within ± 1.0 ms 10 % of the elements within ± 1.5 ms
Shot interval	:	25 m
Depth	:	6 m
Depth control	:	Fixed depth ropes
Depth monitoring	:	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 section 14.2

9.2 Offset diagram



Towing Configuration

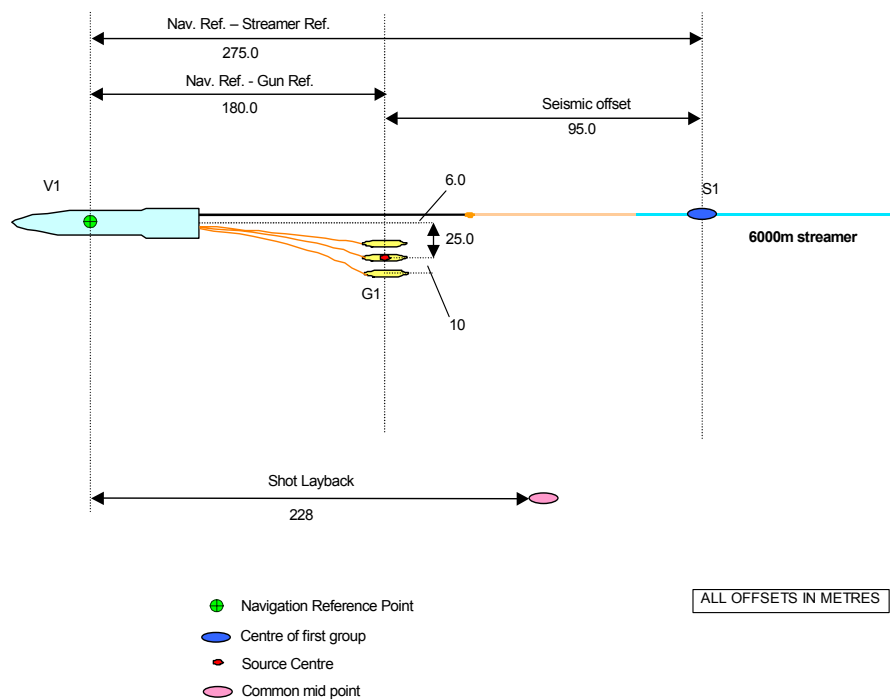
Vessel	: Orient Explorer
Client	: Santos Limited
Area	: Southern Margin 2D
Job number	: 2003134
Start date	: 12 November 2003
Sequence	: VIC/P51, VIC/ P44





Towing Configuration

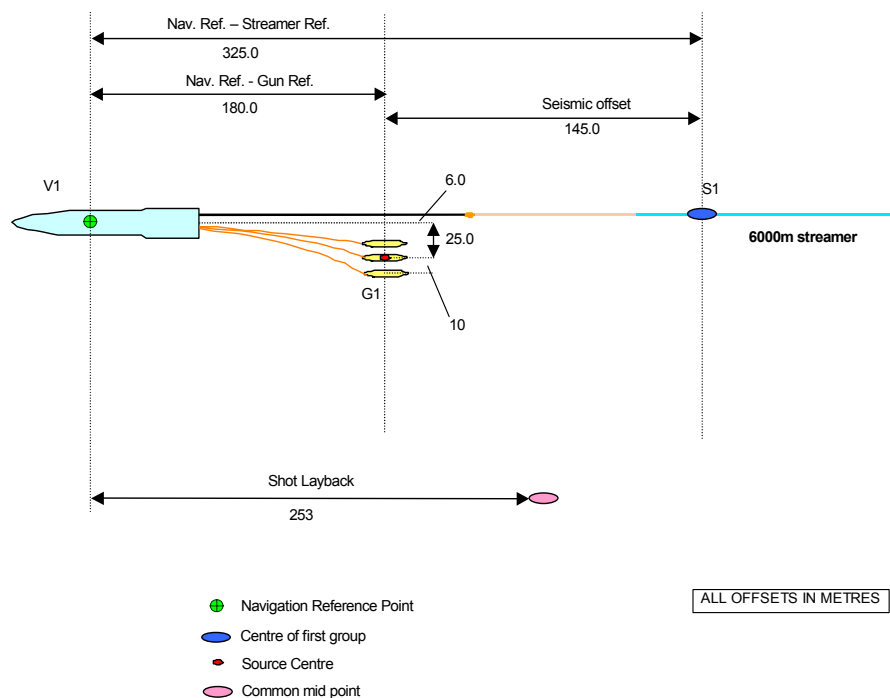
Vessel	: Orient Explorer
Client	: Santos Limited
Area	: Southern Margin 2D
Job number	: 2003134
Start date	: 12 November 2003
Sequence	: T/35P 001 - 006





Towing Configuration

Vessel	: Orient Explorer
Client	: Santos Limited
Area	: Southern Margin 2D
Job number	: 2003134
Start date	: 12 November 2003
Sequence	: T/35P 006 - EOJ

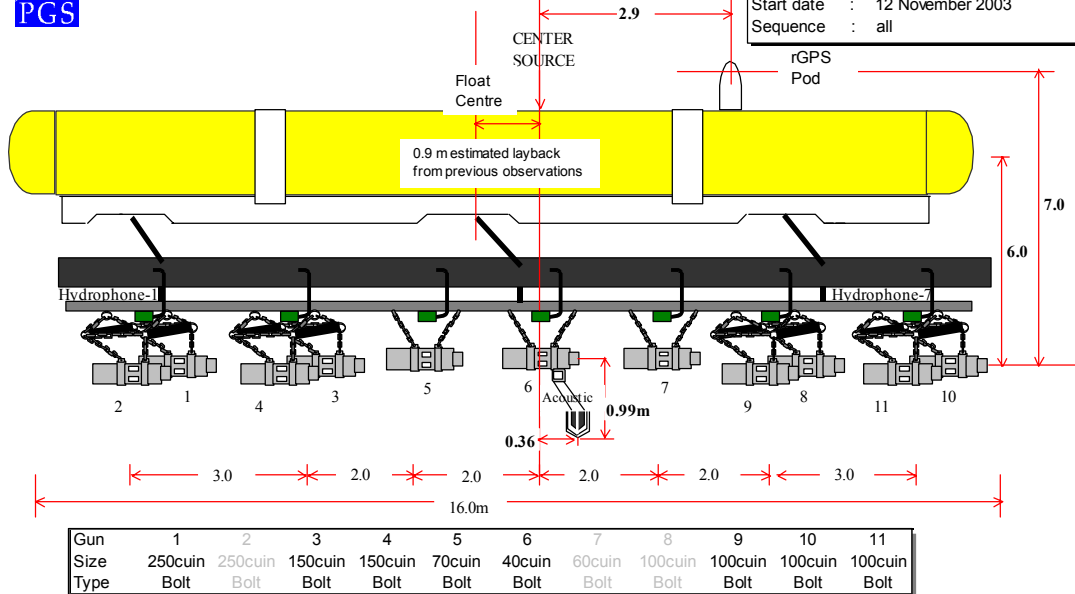


9.3 Gun array layout



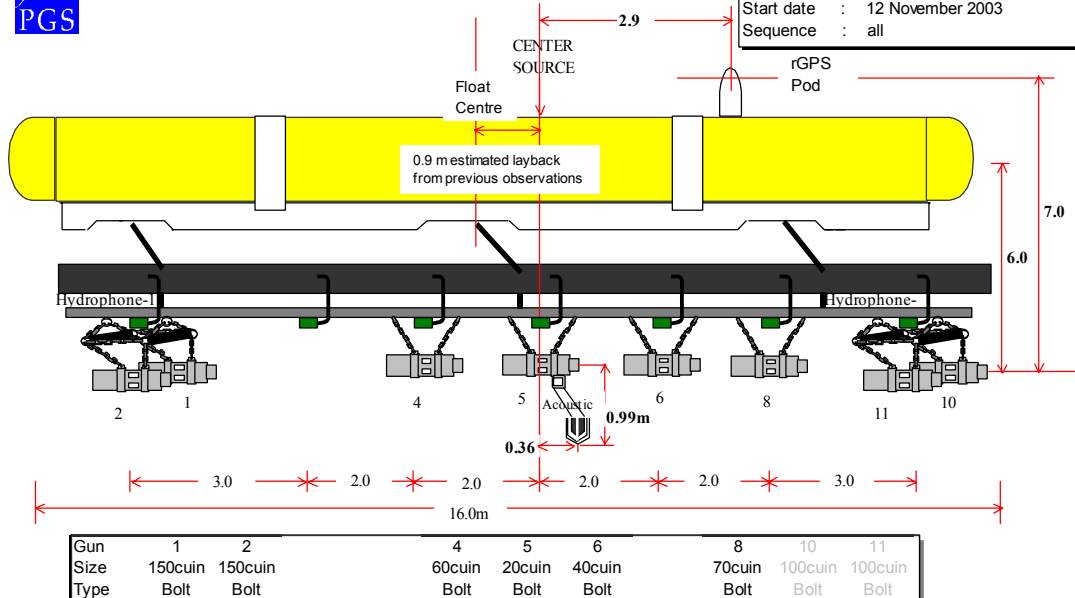
Gun String 1 (y,z) Offsets 2500 cu in active volume per array

Vessel : Orient Explorer
Client : Santos Limited
Area : Southern Margin 2D
Job number : 2003134
Start date : 12 November 2003
Sequence : all



Gun String 2 (y,z) Offsets 2500 cu in active volume per array

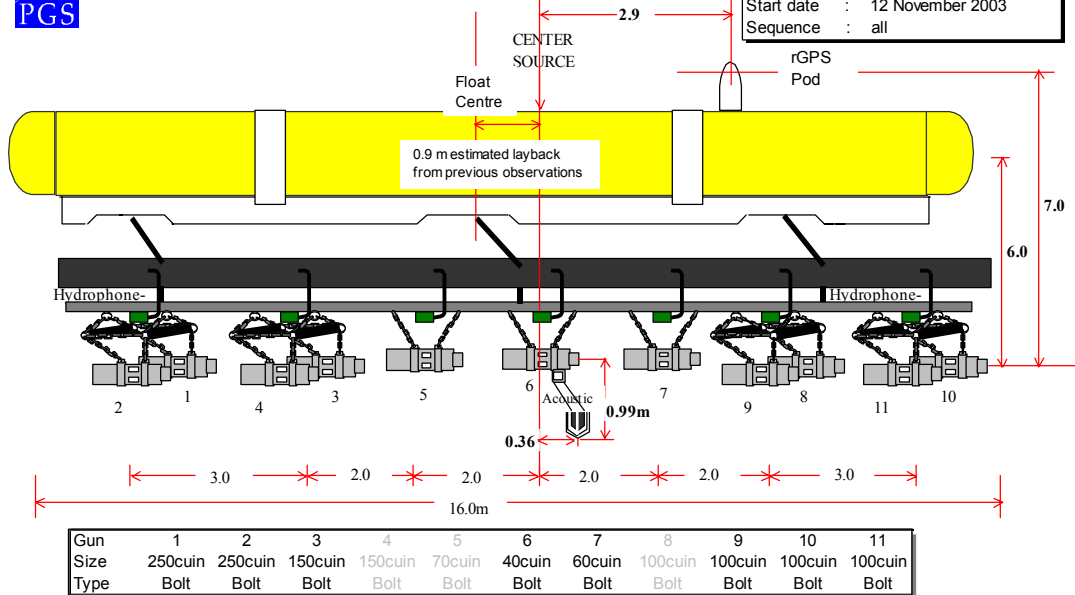
Vessel : Orient Explorer
Client : Santos Limited
Area : Southern Margin 2D
Job number : 2003134
Start date : 12 November 2003
Sequence : all





Gun String 3 (y,z) Offsets
2500 cu in active volume per array

Vessel : Orient Explorer
Client : Santos Limited
Area : Southern Margin 2D
Job number : 2003134
Start date : 12 November 2003
Sequence : all



10 Seismic acquisition system

10.1 System details

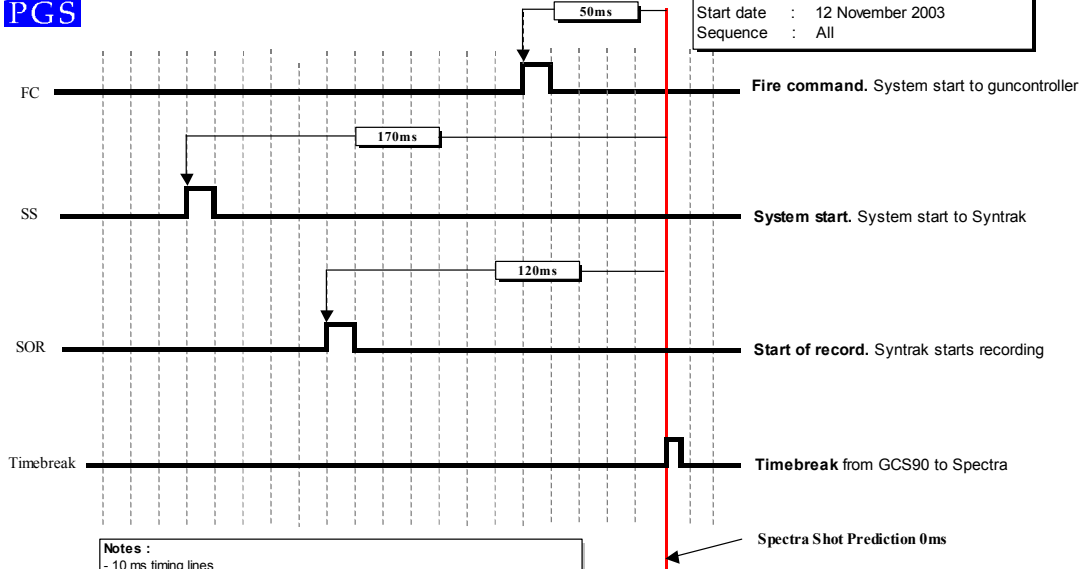
Recording System	:	Syntrak 960-24, with direct VME link to ProMAX
Software Version	:	3.65
Amplitude resolution	:	24 bit
Data Channels	:	324 (VIC/P51 & VIC/P44) 480 (T/35P & EPP32)
Auxiliary Channels	:	48
Tape Transports	:	3 x IBM 3590 cartridge drives
Tape Format	:	SEG D 8058, ref 1
Recording Media	:	3590 Cartridges
Record Length	:	6144 ms (VIC/P51 & VIC/P44) 8192 ms (T/35P & EPP32)
Deep water delay	:	0 ms
Sample Rate	:	2 ms
High Cut Filter	:	206 Hz / 276 dB/octave
Low Cut Filter	:	3 Hz / 12 dB/octave
Gain Setting	:	12 dB
Sensitivity	:	20 V/bar
Amplifier	:	Voltage Mode Differential
Input Range	:	0-2048 mV
A/D Converter	:	Delta Sigma Architecture
Distortion	:	< 0.0005% (-106 dB)
Cross-Feed	:	> 110 dB
Power Consumption	:	7.5 W per module
Polarity Convention	:	SEG, positive pressure gives negative number
SEG-D header description	:	see Appendix section 14.3

10.2 System timing



System Timing Diagram

Vessel : Orient Explorer
Client : Santos Limited
Area : Southern Margin 2D
Job number : 2003134
Start date : 12 November 2003
Sequence : All



Notes :
- 10 ms timing lines
- Time from start of record to recorded data is 120ms
- Record length is 6144 for VIC/P51, VIC/P44 and 8192 for T/35P and EPP32
- All triggers are 10 ms except Timebreak (5ms)

10.3 Streamers

10.3.1 Streamer details

Type of streamer	:	LDA Teledyne / PGS LDA
Number of streamers	:	1
Streamer sensitivity	:	20 V/bar
Streamer length	:	4050 m (VIC/P51 & VIC/P44) 6000 m (T/35P & EPP32)
Number of groups	:	324 (VIC/P51 & VIC/P44) 480 (T/35P & EPP32)
Group interval	:	12.5 m
Group length	:	12.5 m
Hydrophone type	:	T-2
Streamer depth control	:	DigiBIRD 5011
Streamer depth	:	7 m
Number of compass-birds	:	17 (VIC/P51 & VIC/P44) 23 (T/35P and EPP32)

The streamer depth was changed during the survey at the clients request. Depths were varying from 7 to 10 meter depending on the shooting direction and swell noise.

10.3.2 Trace Numbering

STREAMER	TRACE
Streamer 1	1 to 324 (VIC/P51 & VIC/P44)
Streamer 1	1 to 480 (T/35P & EPP32)
Auxiliaries	1 to 48

10.3.3 Component dimensions

VIC/P51 & VIC/P44:

	NUMBER per STREAMER	NOMINAL LENGTH (m)
Lead-in	1	350
Head Stretch Sections	1	1.5
Head Stretch Sections	1	50
Syntrak Module	27	0.358
Live Sections	54	74.54
Tail Stretch Sections	2	50
Power Adapter Section	1	3.80

T/35P, seq 001-006:

	NUMBER per STREAMER	NOMINAL LENGTH (m)
Lead-in	1	350
Head Stretch Sections	1	1.5
Head Stretch Sections	1	50
Syntrak Module	40	0.358
Live Sections	80	74.54
Tail Stretch Sections	2	50
Power Adapter Section	1	3.80

T/35P seq 007-032 and EPP32:

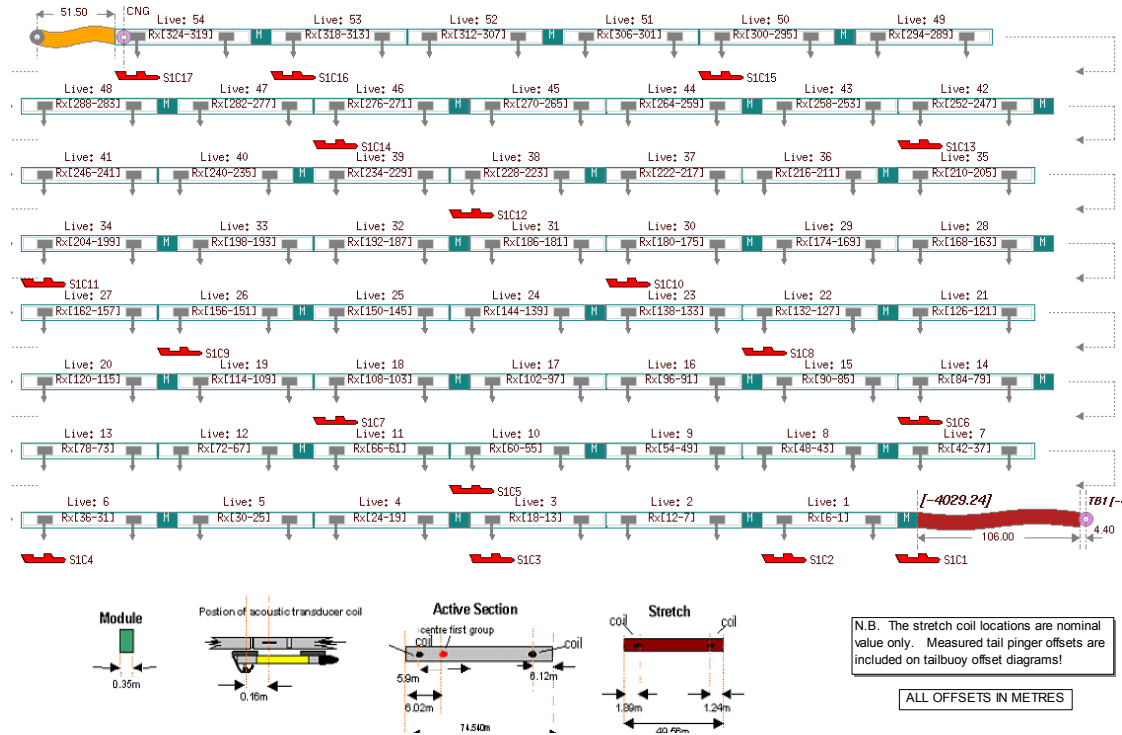
	NUMBER per STREAMER	NOMINAL LENGTH (m)
Lead-in	1	350
Head Stretch Sections	2	50
Syntrak Module	40	0.358
Live Sections	80	74.54
Tail Stretch Sections	2	50
Power Adapter Section	1	3.80

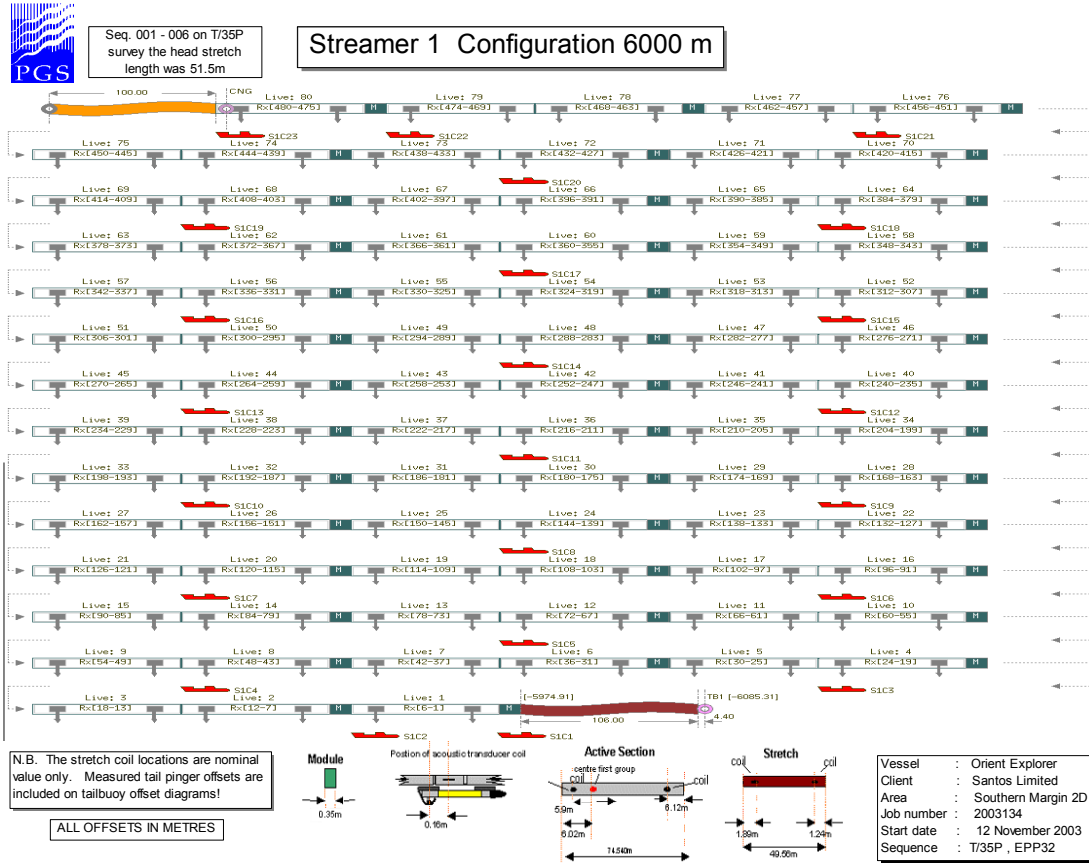
10.4 Streamer layout



Streamer 1 Configuration 4050 m

Vessel	: Orient Explorer
Client	: Santos Limited
Area	: Southern Margin 2D
Job number	: 2003134
Start date	: 12 November 2003
Sequence	: VIC/P51, VIC/ P44





Note: For T/35P seq. 001-006 the front stretch was 50 m.

11 Navigation system

11.1 Geodetic reference

11.1.1 Datums

Survey Datum	:	GDA94
Ellipsoid	:	GRS80
Semi Major Axis	:	6378137 m
1/Flattening	:	298.257222101
<i>GPS Datum</i>	:	<i>WGS84</i>
<i>Ellipsoid</i>	:	<i>WGS84</i>
<i>Semi Major Axis</i>	:	<i>6378137 m</i>
<i>1/Flattening</i>	:	<i>298.257223563</i>
Geoid height VIC/P51 and VIC P44	:	-3.64 m (EGM96) (min. -5.90 m, max. -1.80 m)
Geoid height T/35P	:	-8.1 m (EGM96) (min. -10.66 m, max. -6.03 m)
Geoid height EPP32	:	-13.9 m (EGM96) (min. -17.77 m, max. -11.89 m)

11.1.2 Datum Shift WGS84 to GDA94

EPSG Transformation code #	:	1150
X-Translation	:	0 m
Y-Translation	:	0 m
Z-Translation	:	0 m

GDA94 is a realisation of WGS 84 coincident to within 1.5 metres. This transformation has an accuracy equal to the coincidence figure.

11.1.3 Map projection

Area VIC/P51, VIC P44 and T/35P:

Projection	:	Transverse Mercator
Projection System	:	UTM zone 54S
Central Meridian	:	141° E
Scale Factor on Central Meridian	:	0.9996
Latitude of Origin	:	0°
False Northing	:	10,000,000 m
False Easting	:	500,000 m

Area EPP32:

Projection	:	Transverse Mercator
Projection System	:	UTM zone 53S
Central Meridian	:	135° E
Scale Factor on Central Meridian	:	0.9996
Latitude of Origin	:	0°
False Northing	:	10,000,000 m
False Easting	:	500,000 m
P1 header description	:	see Appendix section 14.4

11.2 Surface positioning

11.2.1 System I

Type	:	StarFix single frequency
Receiver	:	Trimble 4000Si, 9 channel, Nav. version.7.29
Differential Corrections via	:	Spotbeam (Optus sat)
Reference stations	:	Melbourne Adelaide Cobar Bathurst Kalgoorlie, (EPP32 only)
Software	:	MRDGPS v2.06.07
Sub-Contractor	:	Fugro - Survey AS

11.2.2 System II

Type	:	SkyFix single frequency
Receiver	:	Trimble MS750, 12 channel, version 1.33
Differential Corrections via	:	Spotbeam (Optus), Inmarsat (POR)
Reference stations	:	Melbourne Adelaide Sydney Brisbane Perth, (EPP32 only)
Software	:	MultiFix 4, Version 1.01
Sub-Contractor	:	Thales GeoSolutions Norge AS

11.2.3 System III

Type	:	StarFix
Receiver	:	Trimble 510, 9 channel, Nav version 7.29
Differential Corrections via	:	Spotbeam (AP sat), Spotbeam (Optus sat)
Reference stations	:	Melbourne Adelaide Cobar Bathurst Kalgoorlie, (EPP32 only)
Software	:	SEADIFF ver. 7.05n
Sub-Contractor	:	Fugro - Survey AS

11.2.4 System IV

Type	:	SkyFix
Receiver	:	Trimble MS750, 12 channel, version 1.33
Differential Corrections via	:	Spotbeam (Optus), Inmarsat (POR)
Reference stations	:	Melbourne Adelaide Sydney Brisbane Perth, (EPP32 only)
Software	:	MultiFix 4, Version 1.01
Sub-Contractor	:	Thales GeoSolutions Norge AS

11.2.5 Float positioning

Relative GPS	:	Seatrack; 320 (source) 220 (tailbuoys)
GPS receiver	:	Ashtech G 12-L
UHF communication	:	Wood&Douglas, freq. 457.100 and 457.350 MHz
Mode	:	Slant Range Measurement
Software version	:	integrated with Seadiff v7.05n and StarFix Suite, RGPS v2.08.02

11.2.6 Heading reference

GPS Heading / Attitude system	:	Seapath 200, MRU 5.2
Software version	:	SCC 1.02.06, MRC 2.52
Gyro 1	:	Vega
Repeater/Convertor	:	Scandinavian Micro Systems LR40
Gyro 2	:	Litton C.Plath Fabrik Nautischer Instrumente
Repeater/Convertor	:	Scandinavian Micro Systems LR40

The Seapath 200 was used as the prime heading for the duration of the survey.

11.3 Underwater positioning

11.3.1 Acoustic ranging system

System name : Sonardyne SIPS1
Software version : 7.00.05-T
Streamer Transceivers : XSRS v. 7.01 & 6.05
Source Transceivers : HGPS v. 7.01
Frequency : 65.789 to 100 kHz

Acoustics used for offset verification only.

11.3.2 Magnetic compasses

Bird Compasses : DigiCOURSE System 3, 5011 Bird
Software version : System 3, version 3.1.2
Accuracy : +/- 0.5°
Filtering : 2s sample rate, 14s filter period
Number : 17for VIC/P51 & VICP/44, 23 for T35P & EPP32
Location : 300m separation, backup unit 75m from head and tail

11.3.3 Echosounder

Type and model : Krupp Atlas Electronic, Atlas Deso 25
Transceiver Frequency : 210 kHz, 33kHz
Draught : 5.5m

11.3.4 Sound velocity

CDT probe : Valeport 604 CDT

11.3.5 Sound velocity profile

Dip	Date	Time UTC	Location	Average Temp Streamer Depth °C	Average Salinity Streamer Depth (PSU)	Speed of Sound Streamer depth m/s	Max. Depth
1	19 Nov 03	06:32	38°41'55"S 142°14'18"E	14.91 °C	35.66	1507.31 m/s	74 m

The opportunity of doing sound velocity profiles was very limited due to weather conditions and depth of the survey areas. On the last area the vessel did not have a chase vessel and PGS procedures does not allow launching of workboat unless in emergency situations.

11.4 Computer systems

11.4.1 Integrated navigation system

Type	:	SPECTRA
Supplier	:	Concept Systems Ltd.
Software version	:	v 9.8.05
Real Time Interface	:	RTNU (OS9 v. 3.03)
Machine type	:	IBM RS/6000
Operating system	:	AIX Version 4.3.3.0
Tape storage	:	3590
External disks	:	3 X 9 Gbyte

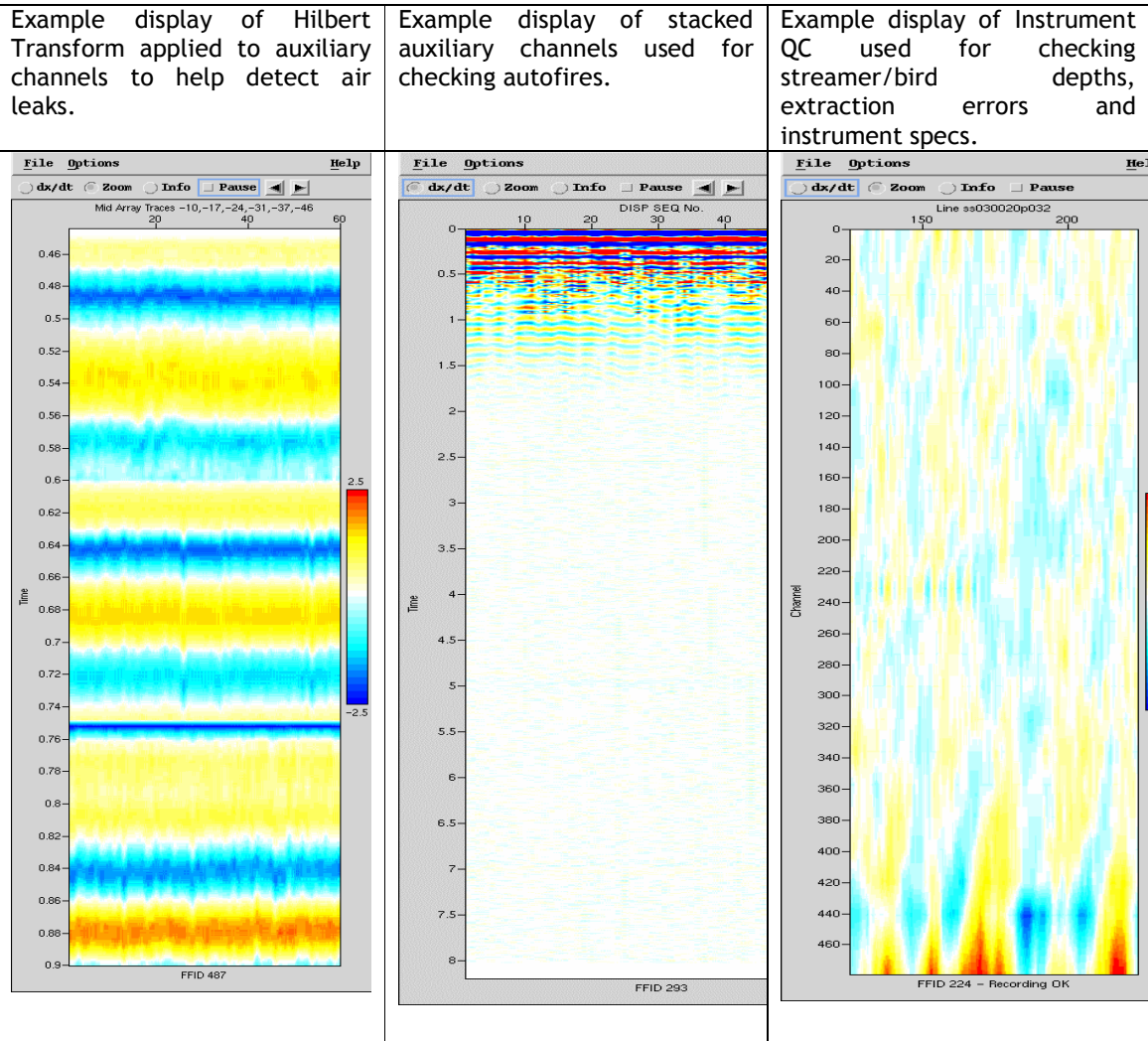
12 Seismic processing

12.1 Online QC

The PGS Cobra QC system was used to provide real time online QC screen displays that included:

- Real Time Brute Stack displayed online and plotted at the end of each line.
- Real Time Display of chosen Near Field Auxiliary Channels, after a Hilbert Transform was applied. Any disturbance in the first 300 ms of the Near Field Hydrophones could be seen and the gunners and navigators were made aware of possible problems (e.g.: air leak). More investigation could then start.
- Real Time Stack of Near Field Hydrophone Channels. If a gun had autofires, it showed a repetition of the gun signal, always visible on top. This QC was a backup to the GCS90 QC.
- Real Time Display of each Near Field Hydrophone Auxiliary Channel, for each shot, at a large scale. This helped making decisions, when another Auxiliary QC was showing potential problems with the guns.
- Real Time Display of Raw Shots (each 5).
- Real Time Display of the RMS Noise Window. This enabled ambient (background) noise estimates to be made while online in addition to noise pollutants such as swell noise, etc.
- Real Time Display of the Instrument QC reading the main SEG-D headers for streamer/gun statistics and specifications: streamer depths, reported errors, flagged gun misfires/autofires, etc

Note: The auxiliary channel connections are described in 14.3 (SEG-D Header)



12.2 Offline QA/QC sequence

Cobra/ProMAX/Cube Manager processing systems were utilised for the subsequent offline QC processing. Problems that occurred during production were investigated using all means available. At the end of each line, in addition to the Syntrek standard QC displays, the following 36 inches plots were produced using ProMAX:

- Raw Shot Plot of a nominated streamer for every 2km
- Near Trace Plot
- Selected NMO'd CDP gathers Plot with the Stacking velocities
- Auxiliary Sub Array Stack Plot (only if autofires were suspected)
- Auxiliary Hilbert Transform Plot
- Brute Stack Plot
- P190 navigation merge QC
- Maximum amplitude RMS display

12.2.1 RMS Noise Analysis

Syntrak real-time RMS calculations were captured for all channels of each shot in four different time windows. The RMS values are calculated after a 5Hz Low Cut Filter.

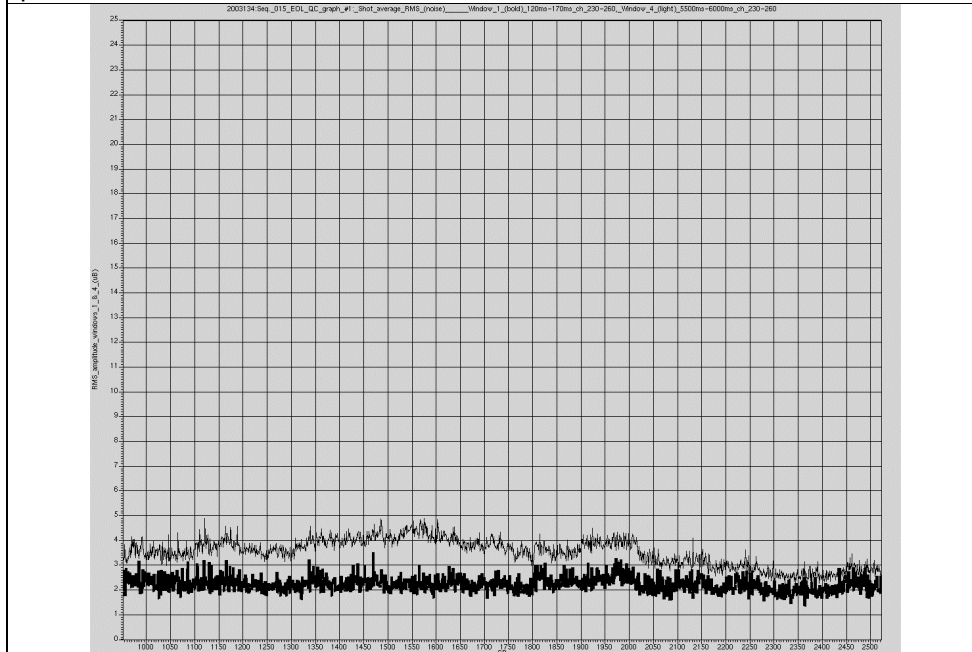
VIC/P44 and P51	From Syntrak	After Instrument Delay correction
'Water column' window =	120 - 170 ms	0 - 50 ms
chosen "Noise Window"		
'Signal' window	1620 - 2120 ms	1500 - 2000 ms
'Intermediate' window	3120 - 3620 ms	3000 - 3500 ms
'End of record' window	5620 - 6120 ms	5500 - 6000 ms
T/35P	From Syntrak	After Instrument Delay correction
'Water column' window	120 - 250 ms	0 - 130 ms
'Signal' window	2120 - 2620 ms	2000 - 2500 ms
'Intermediate' window	4120 - 4620 ms	4000 - 4500 ms
'End of record' window, =	7620 - 68120 ms	7500 - 8000 ms
chosen "Noise Window"		
EPP32	From Syntrak	After Instrument Delay correction
'Water column' window =	120 - 170 ms	0 - 50 ms
chosen "Noise Window"		
'Signal' window	2120 - 2620 ms	2000 - 2500 ms
'Intermediate' window	4120 - 4620 ms	4000 - 4500 ms
'End of record' window	7620 - 8120 ms	7500 - 8000 ms

A Noise RMS Window was chosen for each area, usually in the water column, unless this window was affected by direct arrivals on near channels like in T/35P. In that case the "End of Record" Window was chosen as a Noise Window. For this Noise Window, all channels were displayed for each shot in an RMS Display (see example in 7.8). This was a useful tool to identify the different types of noise encountered.

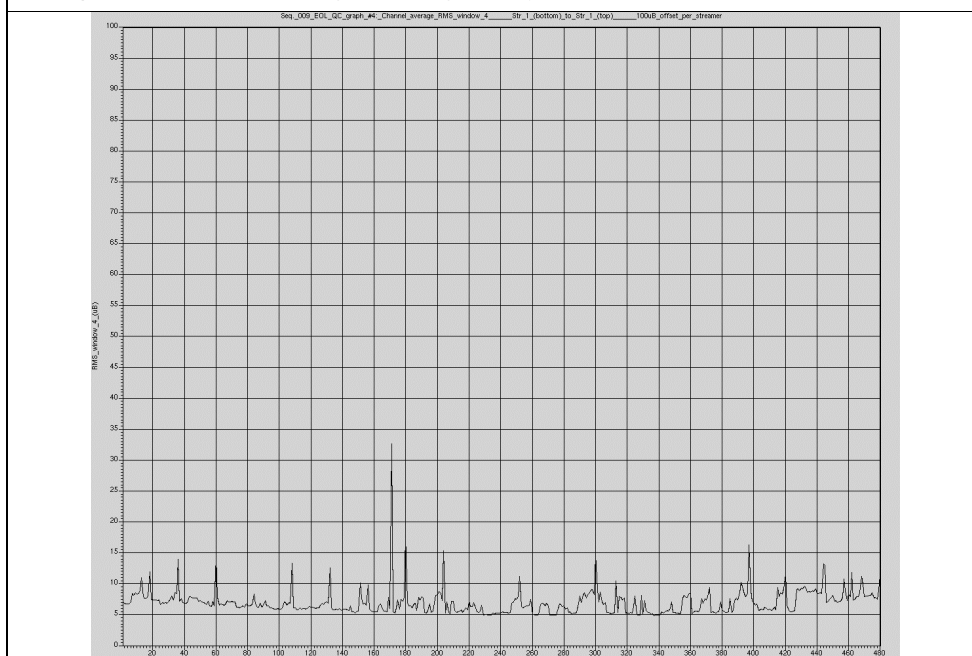
In addition an average shot point RMS noise graph of each window was also generated. This was used to check ambient noise levels. Average RMS channel graphs were also checked for bad channels.

Gif files of the Noise RMS window display and the shot/channel average graphs were made available to the client reps for each sequence shot and were archived on the final project CD.

Example of RMS Shot Average Graph for SEQ 015 of VIC P44. Light is RMS Window 4 and Bold is RMS Window 1. The average Background Noise was between 2 and 4 μ bar



Example of RMS Chan Average showing a noisy channel for SEQ 009 of T/35P



12.2.2 2D QC stack

For each sail-line, a 2D QC brute stack was generated using the following sequence:

- | | |
|----------------------------------|---|
| • Real-time data capture | Using bit3 card to capture data |
| • For T35/P and EPP32 | only odd shots were selected due to system overload |
| • Static Correction | Digital filter delay -120 ms |
| • Trace edits | Bad channels |
| • Anti-alias band pass filter | 0-5-90-120 Hz |
| • Resample | 2 ms to 4ms |
| • Gain | T*V to the power 1.5 plus 2 dB/s |
| • Geometry Assignment | Assign 2D geometry: 480 channels |
| • Mute | 1st break mute |
| • Minimum phase predictive Decon | Time lags: 24-240ms |
| • NMO | using 2D velocities, picked at 4 km interval |
| • Mute | Post NMO mute |
| • Stack | |
| • Gun & Cable static correction | |
| • Display | Raw stack |

In deep water (T35/P and EPP32), the geology was changing so quickly, that velocities were picked on almost every line at a 4 km CDP interval. Pre decon and post NMO mutes had also to be picked on most of the lines as well. Offline stacks then replaced online stacks.

The EBCDIC header on the stacks was set up at the beginning of the survey as 120m nominal. However, during operations, offset values encoded in the geometry varied from 90 to 145 m. Only single nominal offsets were used for each line, and not the true offsets found in the P1/90 files.

12.2.3 Navigation / seismic merge QC

In order to check the near offsets, the P1/90 navigation files were merged with the seismic data. A direct arrival Linear Move Out was then performed using the offset information from the P1/90 files. The Direct arrivals were displayed at a very large scale on 36 inches plots. As the P1/90 offsets were consistent, no shifts were visible on the direct arrivals. This validated the navigation data.

12.2.4 Other QC products

In deep water, for T35/P Sorell and EPP32 Duntroon, the water bottom was picked offline on near trace displays to check/calibrate the echo sounder (see section 7.14).

Offline, ASCII files were delivered to the client and navigation processing. No sophisticated processing was done on the near traces (no NMO, source/receiver depth statics, etc...). The following sequence was used:

- Real Time SEG-D Data Input from Bit3
- Select Near Channel 480
- Apply System Static Correction -120 msec
- Mute Direct Arrival
- First Break Pick (fb_pick)
- Calculate Water Depth = fb_pick * 0.75
- Calculate Echo Sounder Position = Shot + 10
- Write to ASCII file

The ASCII File Format was as following:

File Name: SSS.fbp where SSS is the Sequence Number

```
Project= 2003134
Client= SANTOS_LIMITED
Area= SOUTHERN_MARGIN_2D
Shot Water Bottom TWT (ms) Echo Sounder Position (Shot) Water Depth at 1500 m/sec
1000 2262.00 1010 1696.50
1001 2260.00 1011 1695.00
1002 2254.00 1012 1690.50
...
```

Where:

- Shot is half the distance between the source position and the first channel (480)
- Water Bottom TWT (ms) is the Two Way Travel Time in ms of the picked water horizon on a near trace display
- Echo Sounder Position: The echo sounder is 264 m (~10 shots) in front of the shot position
- Water Depth at 1500 m/sec: Water Depth assuming a water velocity of 1500 m/sec

A copy of all field tapes was made. In order to distinguish between the copy and original field tapes, the prefix "3" was used on the side label number of the copy tapes to replace the "2" found on the original field tapes. Example: the copy of the original field tape 22618 was renumbered 32618. However the tape number on the header of the copy tape was the same as the original field tape. i.e. 22618. QC was performed on all copy tapes through systematic reading in and performing full time/trace analysis.

A detailed log for each sequence was also generated with comments on raw and stacked data. This was delivered in pdf format on the final job CD's. Any comments related to specific shots (e.g. autofires, bad Syntrak logs, etc.) were added directly in the observer log. Checking those logs carefully was also an important task of the QC geophysicist.

12.3 Computer systems

The ProMAX/Cobra/Cube Manager system hardware on the Orient Explorer is set up as follows:

- Data capture via a Bit-3 model 477-1 adaptor (U/S)
- 1st IBM 595 Workstation for Real Time data capture: 2 x 256 Mb Physical memory, 2 x 73 Gb Disk, 2 x 9 Gb Disk, 2 x IBM GTX150M Graphic Adapter.
- 2nd IBM 595 Workstation for Offline QC Processing: 2 x 256 Mb Physical memory, 2 x 73 Gb Disk, 2 x 9 Gb Disk, 2 x IBM GTX150M Graphic Adapter.
- Four 3590 tape drives attached to the first IBM 595 exclusively and two others attached to the second IBM 595 station shared with the SP2 system.
- Network Plotters and printers:
 - Oyo Geospace GS 636 thermal plotter
 - Tektronix Phaser 300I colour printer
 - Hewlett Packard Laser Jet 4000
 - Eltron Label TLP2042 Printer

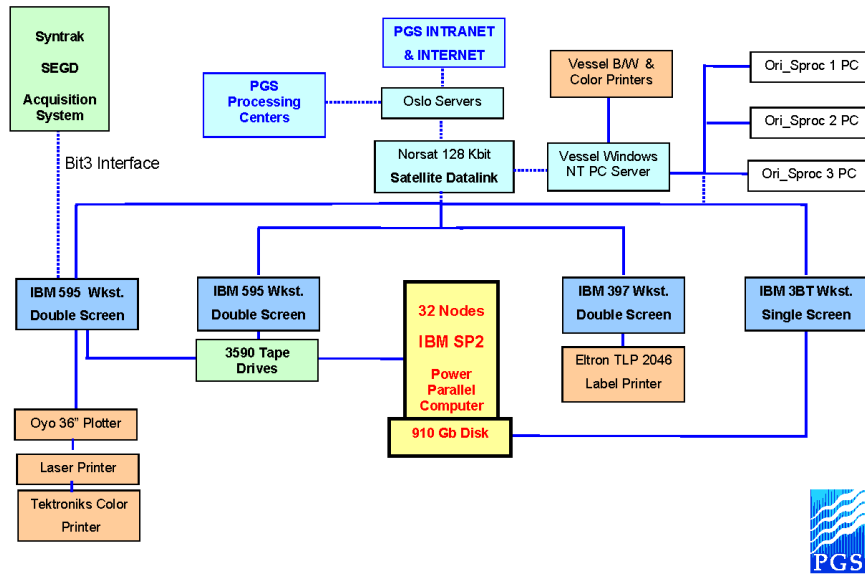
In addition to the QC system described above, there is a full 32 node SP2 mainly dedicated to onboard processing:

- 32 node IBM SP2 nodes (120 Mhz/160Mhz, 512 Mb/1 Gb RAM and 910 Gb of combined hard disk)
- A Control Work Station : IBM 397 Workstation (256 Mb RAM)
- A file server : IBM 3BT Workstation (296 Mb RAM)
- A double screen station for velocity picking and QC : IBM 3BT Workstation (256 Mb RAM)
- Nine 3590 tape drives. Two of the 3590 tape drives are shared with the second QC system IBM 595 station described above.

This system is attached to the same plotters and printers as the Acquisition QA & QC System.

Orient Explorer Onboard Processing Centre and QC System

ORIENT EXPLORER PROCESSING CENTER SYSTEM CONFIGURATION



13 Navigation processing

13.1 Introduction

Data were processed using SPRINT. The processing was comprised of 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.

13.2 Data import

Raw data were recorded to tape and disk in P2/94 format. After the end of the line these data were checked, and if necessary, corrections were made to the header to produce a final archived version. These data were 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

13.3 Pre-processing

All data were 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 were 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.

13.4 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

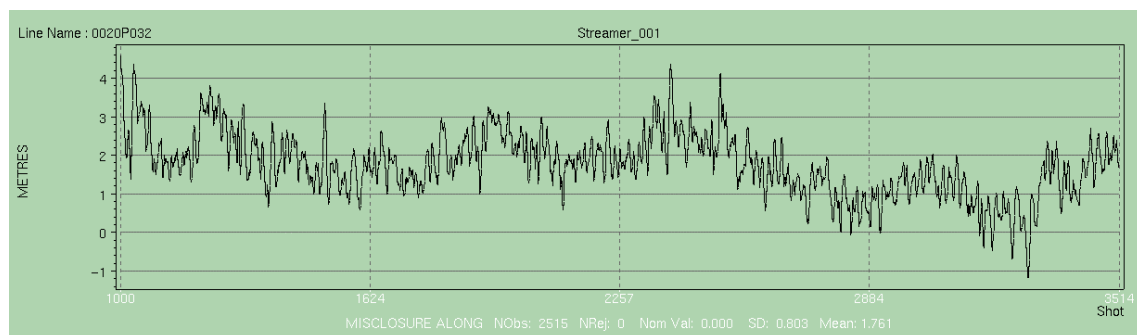
13.5 Data analysis

Data analysis were 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.

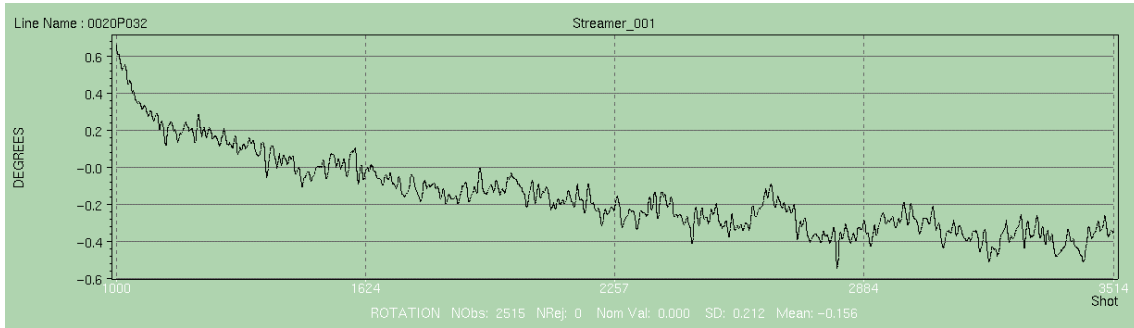
Configuration files were defined to create a standard set of QC plots for every line.

The following plots were included:

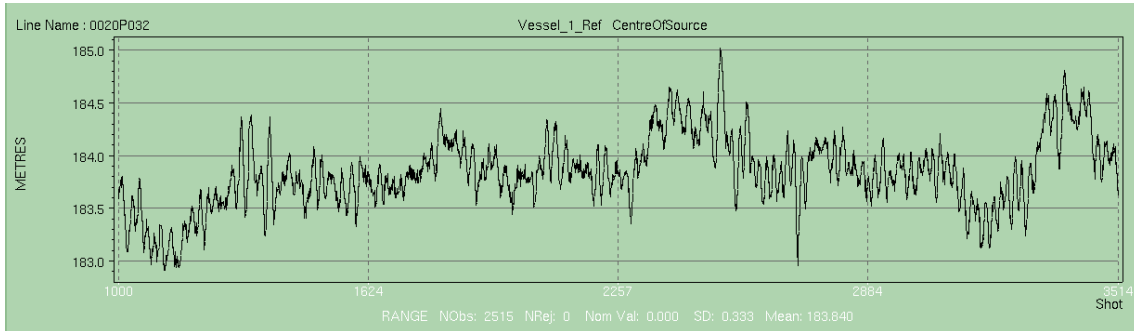
Inline misclosure:



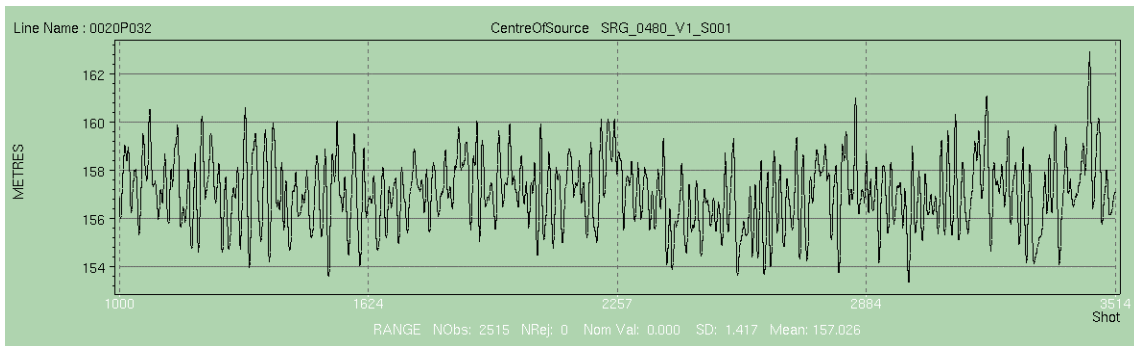
Streamer rotations:



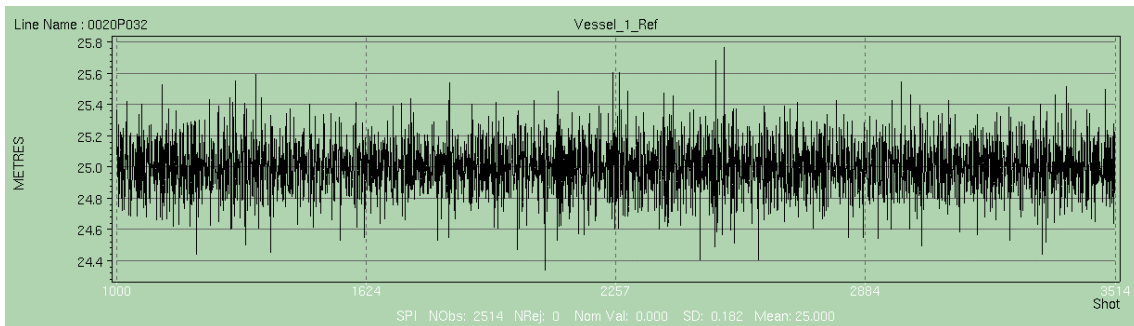
Distance vessel reference point - source:



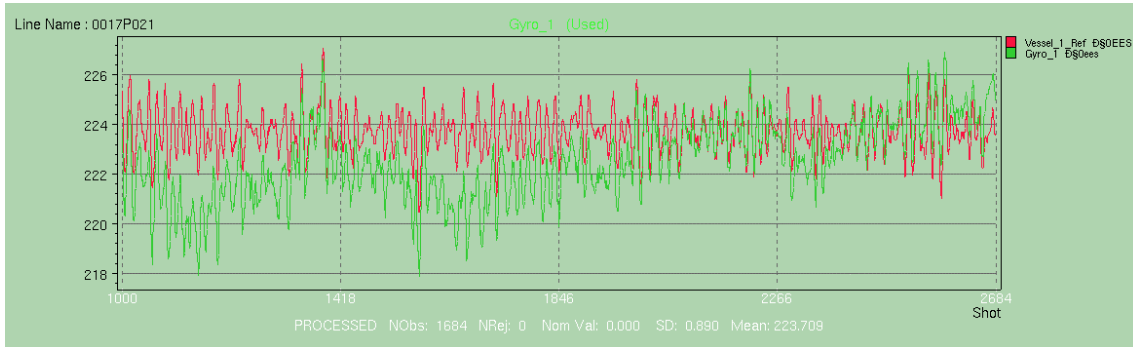
Distance centre source - streamer head:



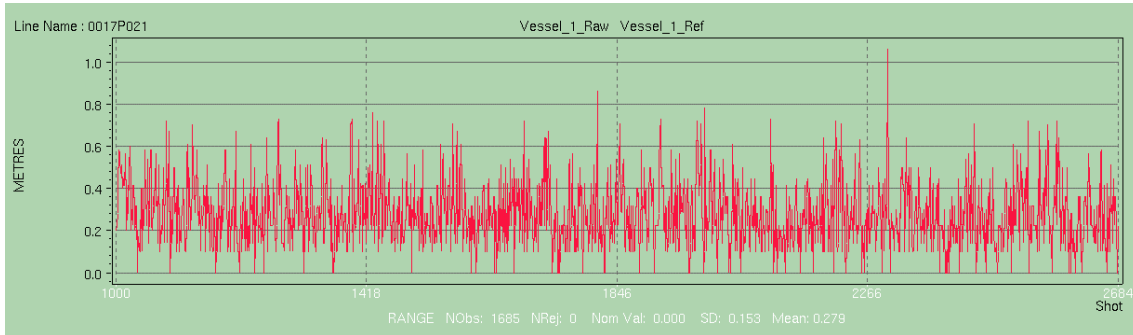
Shot point interval (distance) of vessel ref. position:



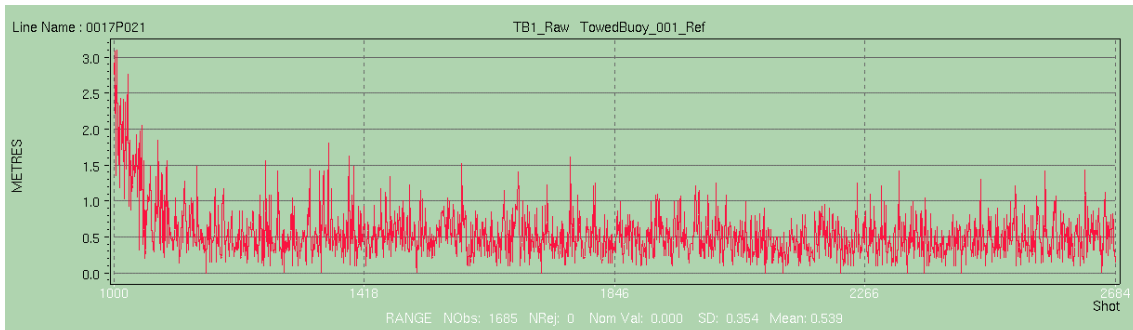
Gyro and course made good of vessel ref (red is CMG, green is gyro):



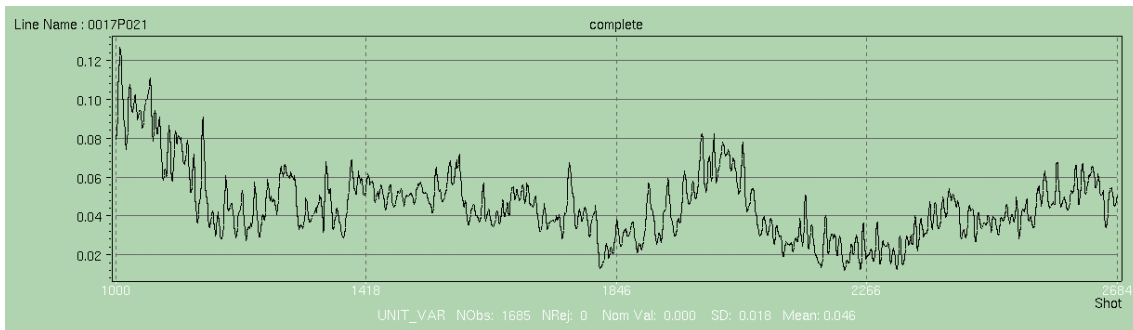
Position comparison vessel reference point (Field position vs. Post-processed position radial dist):



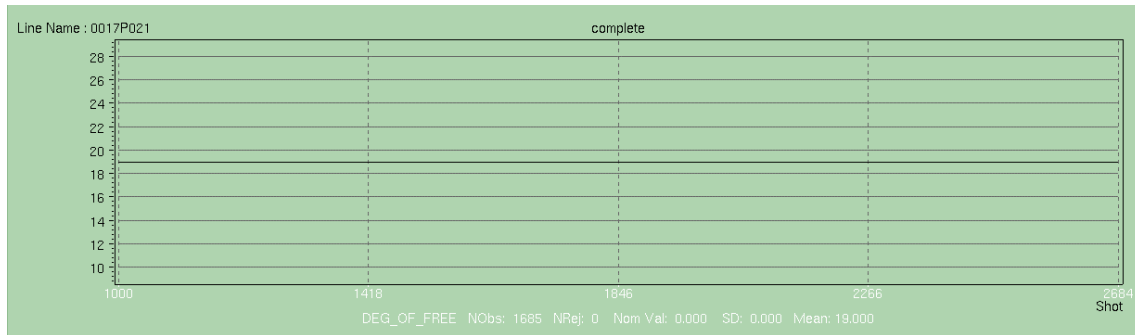
Position comparison of tailbuoy (Field position vs. Post-processed position radial dist):



Network variance factor:



Network degrees of freedom:



13.6 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 were written to 3590 tape cartridges.

13.7 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 were used to verify that data on tape were 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.

13.8 Computer systems

Computer	:	IBM RS/6000 model 595/7013
Operating System	:	AIX 4.3.3.0
Tape storage	:	3590
External disks	:	2 x 9 GByte and 1 x 70 GByte
Type	:	SPRINT
Software version	:	3.1.13
Supplier	:	Concept Systems Ltd.
Printer / Plotter	:	HP LaserJet 4100N / HP DesignJet 755CM

14 Appendix

- 14.1 Data Shipments*
- 14.2 Source Modelling*
- 14.3 SEG-D header*
- 14.4 SEG-Y format*
- 14.5 P1/90 header*

14.1 Data shipments

Date	Proforma	Content	Boxes	Wt	Shipping address	Comment
18.11.03	ORI12800414	Area VIC/P51 (seq.001-020) Originals (set 1) SEG-D, SEG-Y (brute stack), Nav P1/90 and P2/94, CD with tape logs, observer logs and drawings.	1	8 kg	Robertson Research 69 Outram Street West Perth WA 6005 Australia Attn: Mr. Phil Cook	Sent off by chase vessel "Perfect Lady" Agent: Haebich Provedoring PO Box 567 Portland, Victoria Attn: Robert Hope
02.12.03	ORI12800432	Area VIC/P44 (seq.001-019) and T/35P (seq.001-032) Originals (set 1) SEG-D, SEG-Y (brute stack), Nav P1/90 and P2/94, CD with tape logs, observer logs and drawings.	4	28 kg	Robertson Research 69 Outram Street West Perth WA 6005 Australia Attn: Mr. Phil Cook	Sent off during port call in Melbourne 2.12.03. Agent: NT Shipping Attn: R. Robertson
10.12.03	ORI12800444	Area EPP32 (seq. 001-021) Originals (set 1) SEG-D, SEG-Y (brute stack), Nav P1/90 and P2/94, CD with tape logs, observer logs and drawings.			Robertson Research 69 Outram Street West Perth WA 6005 Australia Attn: Mr. Phil Cook	Sent off during port call in Port Lincoln 10.12.03. Agent: NT Shipping Attn: R. Robertson
10.12.03	ORI12800445	Area VIC/P44 (seq.001-019), VIC/P51 (seq.001-020) and T/35P (seq.001-032) Copies (set 2) SEG-D, Nav P1/90 and P2/94 CD with tape logs, observer logs and drawings.			Santos Ltd. 91 King William Str. Adelaide, SA 5000 Australia Attn: Andrew White	Sent off during port call in Port Lincoln 10.12.03. Agent: NT Shipping Attn: R. Robertson
20.01.04	NP-005-2004	Navigation deliverables			Santos Ltd. 91 King William Str. Adelaide, SA 5000 Australia Attn: Andrew White	
20.01.04	NP-006-2004	Navigation deliverables			Robertson Research 69 Outram Street West Perth WA 6005 Australia Attn: Mr. Phil Cook	

One last shipment will be sent off while the vessel reaches Singapore approx. 26 Dec. This will be the last shipment for this survey and contains copy (set2) tapes of EPP32.

Shipping Invoice # :

ORI12800414A



Node : Orient Explorer (128)
Company : PGS Geophysical AS (EXANO)
Department : Seismic processing

18 Nov 2003

Shipper : Haebich Provedoring PO BOX 567 Portland Victoria Australia Attn : Mr Robert Hope Phone : +63 35523 3372 Fax : +63 35523 3790	Destination : Robertson Research 69 Outram Street WEST PERTH WA 6005 AUSTRALIA Attn : Mr Phil Cook Phone : Fax :
---	---

Type of freight : As fast as possible	Order Date : 18/11/2003
--	--------------------------------

Certified true and correct. Values are for Customs purposes only. Delivery terms : Ex. Works	On behalf of PGS Geophysical AS, Marine Acquisition : Sign : Guy Alleman
--	--

Info :

DATA SHIPMENT - PROJECT #:2003134.
SEGD Originals, Navigation Tapes, QC deliverables, Logs for VIC/P51.
Please acknowledge receipt by signing and returning the enclosed copy, either by e-mail or telefax.

Proforma invoice / Packing List

Box	Quantity	Serial #	Description	Weight	Value
1	26.00 Pcs		Data Shipment - See Details. VIC/P51 Otway Basin, South of Portland, Victoria: SEQ 001-020 22 x SEG D 3590 original tapes 1 x 3590 tape P1/90 Navigation 1 x 3590 tape P2/94 Navigation 1 x 8mm tape DISK SEG Y Brute Stack archive 1 x CD with logs, drawings and QC	8.00	(USD) 78.00

Total # of boxes : 1

Total weight : 8.00 kg

Total value : (USD) 78.00

Shipping Invoice # :

ORI12800432A



Node : Orient Explorer (128)
Company : PGS Geophysical AS (EXANO)
Department : Seismic

30 Nov 2003

Shipper : Robbie Robertson NT Shippin Darwin Northern Territory Australia Attn : N/A Phone : (61) 8 89 472 570 Fax : (61) 8 89 472 640	Destination : Robertson Research 69 Outram Street West Perth WA 6005 Australia Attn : Mr Phil Cook Phone : Fax :
--	---

Type of freight : As fast as possible	Order Date :
--	---------------------

Certified true and correct. Values are for Customs purposes only. Delivery terms : DDP	On behalf of PGS Geophysical AS, Marine Acquisition : Sign : _____ Werner Beneke
--	--

Info : DATA SHIPMENT - PROJECT #:2003134,VIC/P44, T/35P SEG-D Originals, Navigation Tapes, QC deliverables, Logs and CD's Please acknowledge receipt by signing and returning the enclosed copy, either by fax or EMail

Proforma invoice / Packing List

Box	Quantity	Serial #	Description	Weight	Value
1	30.00 Pcs		Data Shipment - See Details. T/35P Sorell Basin, King Island, Seq. 001 - 013, 30 x SEGD 3590 original field tapes	8.00	(USD) 90.00
2	30.00 Pcs		Data Shipment - See Details. T/35P Sorell Basin, King Island, Seq. 013 - 029, 30 x SEGD 3590 original field tapes	8.00	(USD) 90.00
3	19.00 Pcs		Data Shipment - See Details. T/35P Sorell Basin, Seq.029 - 032 12xSEGD 3590 original tapes 2x3590 tape P1/90 Navigation,T/35P,VIC/P44 2x3590 tape P2/94 Navigation, T/35P,VIC/P44 2x8mm tape SEG Y Brute Stack archive,T/35P,VIC/P44 1xCD with logs, drawings,QC,T/35P,VIC/P44	6.00	(USD) 45.00
4	19.00 Pcs		Data Shipment - See Details. VIC/P44 Otway Basin, Seq. 001 - 019, 19 x SEGD 3590 original field tapes Paperwork, drawings, etc is included on CD packed in Box 3. P1/90, P2/94, Brute Stack Archive for this job included in Box 3.	6.00	(USD) 57.00

Total # of boxes : 4

Total weight : 28.00 kg

Total value : (USD) 282.00

Shipping Invoice # :

ORI12800444A



Node : Orient Explorer (128)
Company : PGS Geophysical AS (EXANO)
Department : Seismic processing

9 Dec 2003

Shipper : NT Shipping Darwin (8689)
Northern Territory
Australia

Destination :
Robertson Research
69 Outram Street
WEST PERTH, WA 5000

Attn : Robbie Robertson
Phone : (61) 8 89 472 570
Fax : (61) 8 89 472 640

Attn : Phil Cook
Phone :
Fax :

Type of freight : DHL/Equivalent

Order Date :

Certified true and correct.
Values are for Customs purposes only.
Delivery terms : Ex. Works

On behalf of PGS Geophysical AS, Marine Acquisition :

Sign :
Guy Alleman

Info :

DATA SHIPMENT - PROJECT #2003134.
**SEGD Originals, Nav., QC deliv., Logs for EPP32. *Please acknowledge receipt by signing and
returning the enclosed copy, either by e-mail or telefax. *

Proforma invoice / Packing List

Box	Quantity	Serial #	Description	Weight	Value
1	30.00 Pcs		Data Shipment - See Details. EPP32 Duntroon, Seq.001 - 021 SEGD 3590 original tapes	8.00	(USD) 90.00
2	4.00 Pcs		Data Shipment - See Details. EPP32 Duntroon, Seq.001 - 021 1x3590 tape P1/80 Navigation, 1x3590 tape P2/94 Navigation, 1x8mm tape SEG Y Brute Stack archive 1xCD with logs, drawings, QC files	1.00	(USD) 12.00
Total # of boxes : 2			Total weight : 9.00 kg	Total value : (USD) 102.00	

Shipping Invoice # :

ORI12800445A



Node : Orient Explorer (128)
Company : PGS Geophysical AS (EXANO)
Department : Seismic processing

9 Dec 2003

Shipper : UPS SCS (Singapore) Pte Ltd (5600) 6 Changi South Lane 486400 Singapore Singapore	Destination : Santos Ltd. 91 King William Street Adelaide, SA 5000
Attn : N/A Phone : (65) 6548 5642 Fax : (65) 6543 2597	Attn : Andrew White Phone : (61) 8 8224 7260 Fax : (61) 8 8224 7258

Type of freight : DHL/Equivalent	Order Date :
---	---------------------

Certified true and correct. Values are for Customs purposes only. Delivery terms : Ex. Works	On behalf of PGS Geophysical AS, Marine Acquisition : Sign : Guy Alleman
--	--

Info :

DATA SHIPMENT - PROJECT #2003134.
SEGD Copies, Nav., QC deliv., Logs for EPP32. *Please acknowledge receipt by signing and returning the enclosed copy, either by e-mail or telefax.*

Proforma invoice / Packing List

Box	Quantity	Serial #	Description	Weight	Value
1	30.00 Pcs		Data Shipment - See Details. EPP32 Duntroon, Seq.001 - 021 SEGD 3590 Copy tapes	8.00	(SGD) 180.00
2	4.00 Pcs		Data Shipment - See Details. EPP32 Duntroon, Seq.001 - 021 1x3590 tape P1/80 Navigation 1x3590 tape P2/84 Navigation 1x8mm tape SEG Y Brute Stack archive 1xCD with logs, drawings.QC files	1.00	(SGD) 12.00
Total # of boxes : 2			Total weight : 9.00 kg	Total value : (SGD) 192.00	



*******DATA TRANSMITTAL*******

Santos Ltd.
91 King William Str.
Adelaide, SA 5000
Australia

Attn.: Andrew White

SHIPMENT No.: NP 005/2004

Date: 21.01.2004

Project: Souther Marginal 2D

PGS job# 2003134

BoxQty	Contents	Media	Sequences	Tape Name	Description
1 1	P1/90	3590 Tape	001-020	OS03V011	Vessel positions
1 1	P1/90	3590 Tape	001-020	OS03E011	Echosounder pos.
1 1	P1/90	3590 Tape	001-019	OS03BV011	Vessel Positions
1 1	P1/90	3590 Tape	001-019	OS03BE011	Echosounder pos.
1 1	P1/90	3590 Tape	001-032	SS03V011	Vessel positions
1 1	P1/90	3590 Tape	001-032	SS03E011	Echosounder pos.
1 1	P1/90	3590 Tape	001-021	DS03V011	Vessel positions
1 1	P1/90	3590 Tape	001-021	DS03E011	Echosounder pos.
1 1	Plot	Paper		Vessel pos. Plot Otway basin	Scale 1 : 100000
1 1	Plot	Paper		Vessel pos. Plot Sorell	Scale 1 : 100000
1 1	Plot	Paper		Vessel pos. Plot Duntroon	Scale 1 : 100000
1 1	Plot	CD		Vessel pos. Plots as cgm files	Scale 1 : 100000

Dispatched by Navigation Processing Department 21.01.2004

AWB No.: 4914195300

Please acknowledge receipt and return enclosed copy.

Received by:

Date:

PGS Exploration AS
Strandveien 4, Box 290, 1324 Lysaker, Norway - Tel.: +47 67 52 64 00 - Fax: +47 67 52 64 64 - Tlx.: 11590 gexp n

Enterprise No. 960563085



*****DATA TRANSMITTAL*****

Robertson Research
69 Outram Street
West Perth, WA 6005
AUSTRALIA

Attn.: Mr. Phil Cook

SHIPMENT No.: NP 006/2004

Date: 21.01.2004

Project: Souther Marginal 2D

PGS job# 2003134

BoxQty	Contents	Media	Sequences	Tape Name	Description
1 1	P1/90	3590 Tape	001-020	OS03V011	Vessel positions
1 1	P1/90	3590 Tape	001-020	OS03E011	Echosounder pos.
1 1	P1/90	3590 Tape	001-019	OS03BV011	Vessel Positions
1 1	P1/90	3590 Tape	001-019	OS03BE011	Echosounder pos.
1 1	P1/90	3590 Tape	001-032	SS03V011	Vessel positions
1 1	P1/90	3590 Tape	001-032	SS03E011	Echosounder pos.
1 1	P1/90	3590 Tape	001-021	DS03V011	Vessel positions
1 1	P1/90	3590 Tape	001-021	DS03E011	Echosounder pos.

Dispatched by Navigation Processing Department 21.01.2004

AWB No.: 4914185296

Please acknowledge receipt and return enclosed copy.

Received by:

Date:

PGS Exploration AS
Strandveien 4, Box 290, 1324 Lysaker, Norway - Tel.: +47 67 52 64 00 - Fax: +47 67 52 64 64 - Tlx.: 11590 gexp n
Enterprise No. 960563085

14.2 Source modelling



SIGNATURES FROM MARINE AIRGUN SOURCE LIBRARY

NUCLEUS - Marine Source Modeling 4.1.2

Modeling by Andrew Long, PGS Technology, July 2003

Vessel	:	M/V ORIENT EXPLORER
Array	:	2500LB_600_1800_100
Source type	:	Bolt gun
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	:	7.5 m
Hydrophone group length	:	12.5 m
Compensating p-plugs	:	in
Full system response* filter name	:	S-24 g-6.25
Sea temperature	:	14° 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.

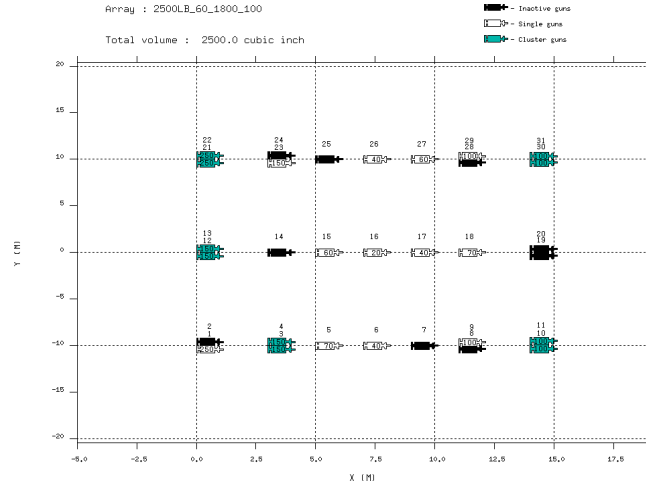


Figure 1: Array configuration top view, i.e. positive Y denotes starboard.

ARRAY LISTING

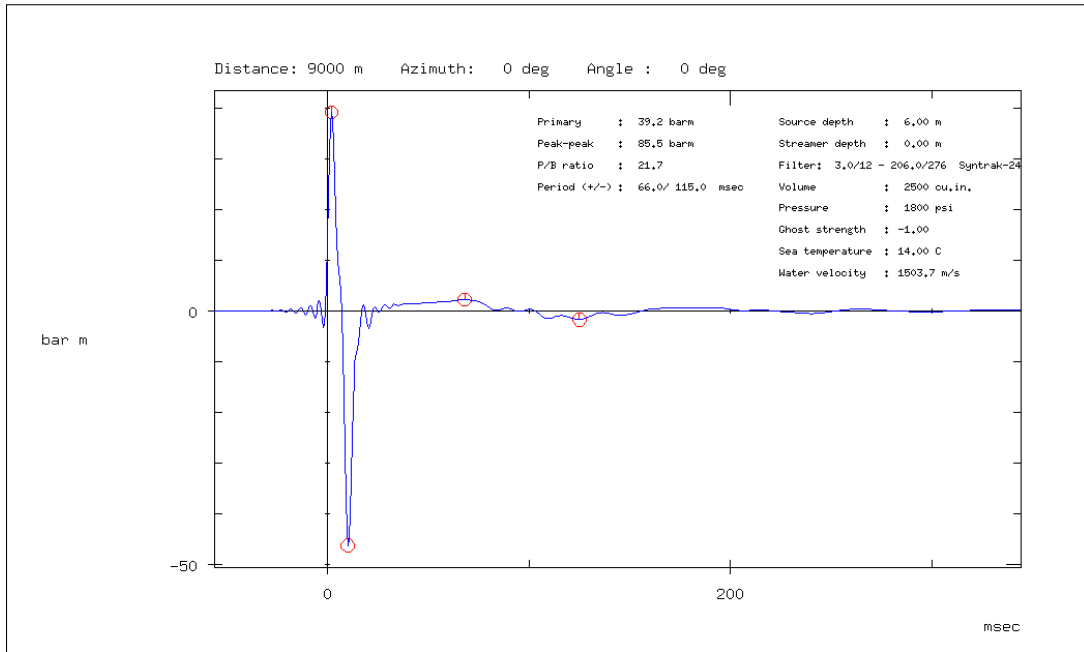
ARRAY NAME : 2500LB_60_1800_100
NUMBER OF ACTIVE GUNS: 22
TOTAL ACTIVE VOLUME : 2500 CU.IN.
NUMBER OF SPARE GUNS : 9

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	-9.50	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
14	13	3.00	0.00	6.00	90	SPARE	1.00	0.00	0
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
19	13	14.00	-0.35	6.00	100	SPARE	1.00	0.00	0
20	13	14.00	0.35	6.00	100	SPARE	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

Far-field signature of array : 2500LB_60_1800_100



Amplitude spectrum of far-field signature of array : 2500LB_60_1800_100

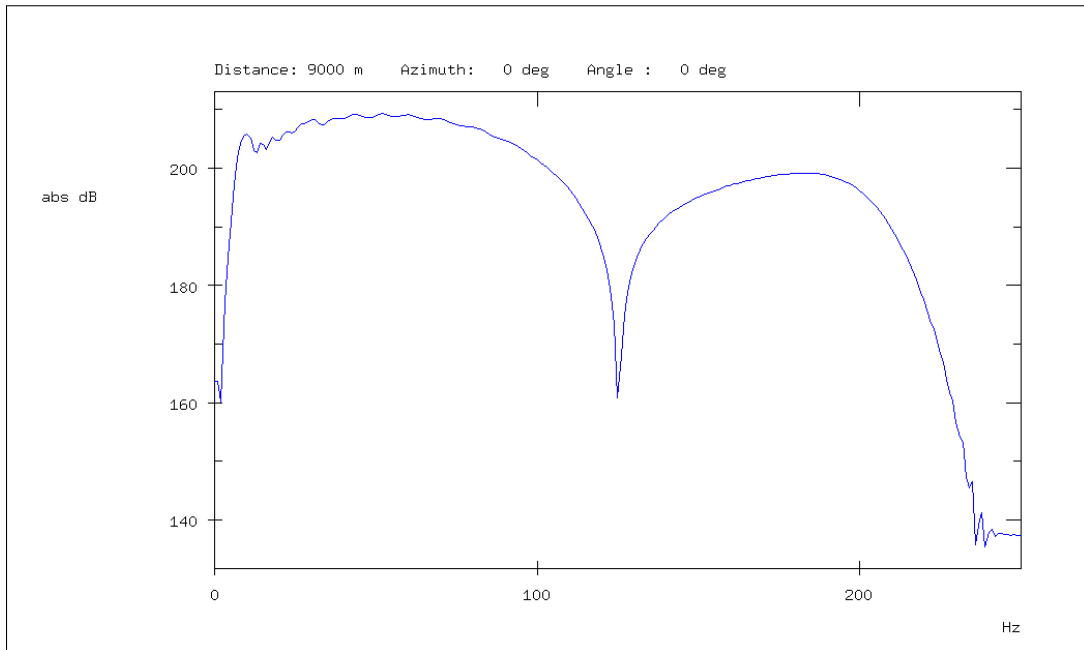
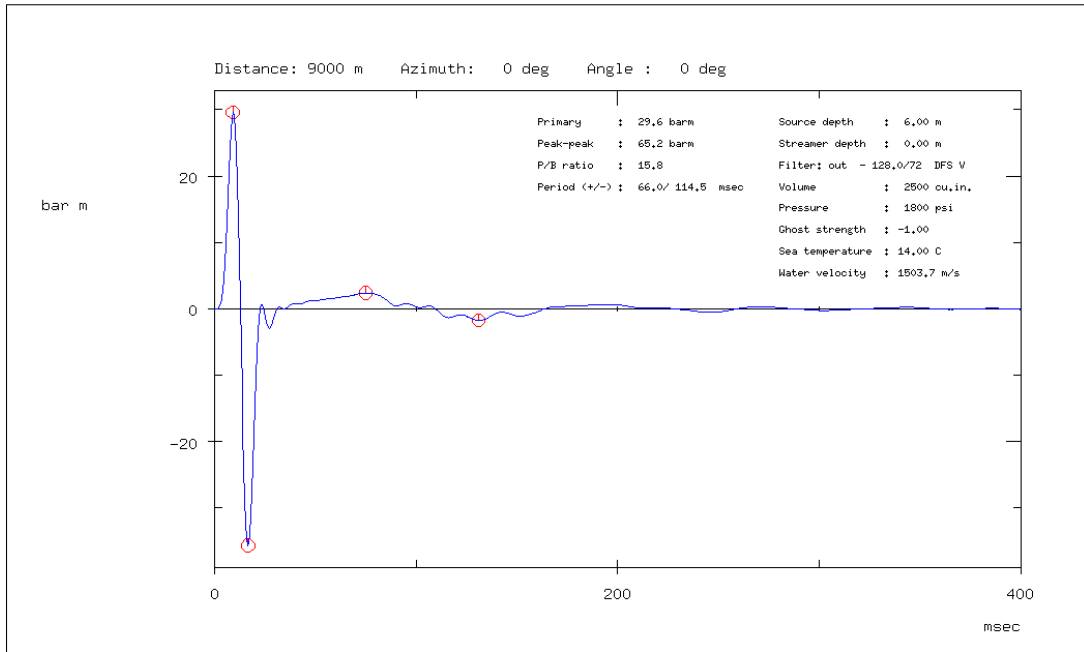


Figure 2: Modelled far-field signature and amplitude spectrum with 24bit recording filter (without receiver ghost).

Far-field signature of array : 2500LB_60_1800_100



Amplitude spectrum of far-field signature of array : 2500LB_60_1800_100

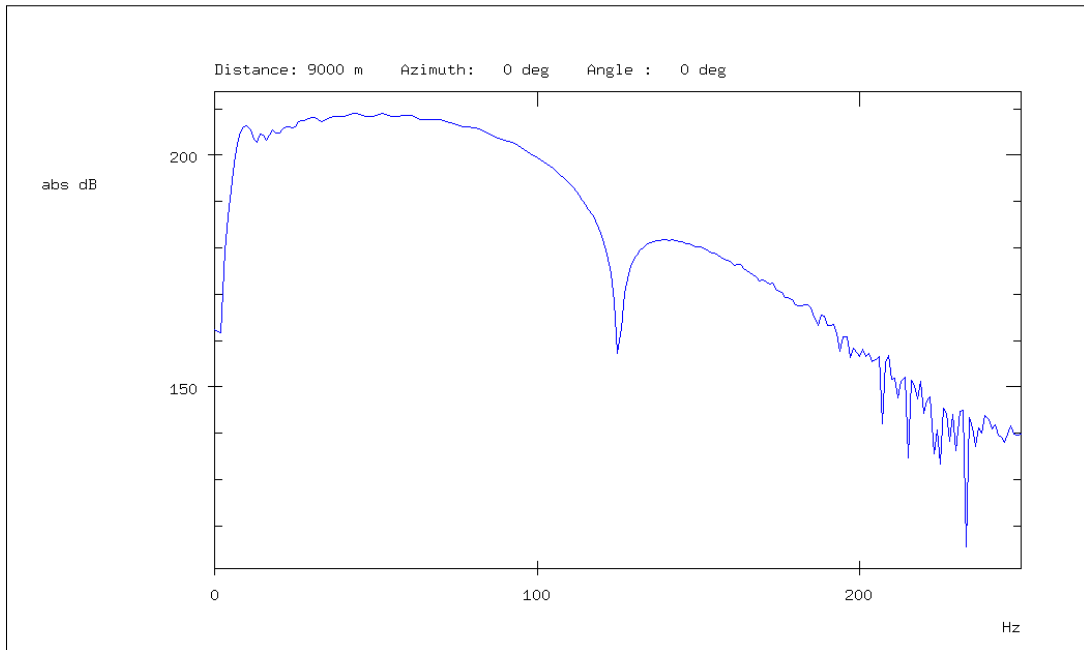
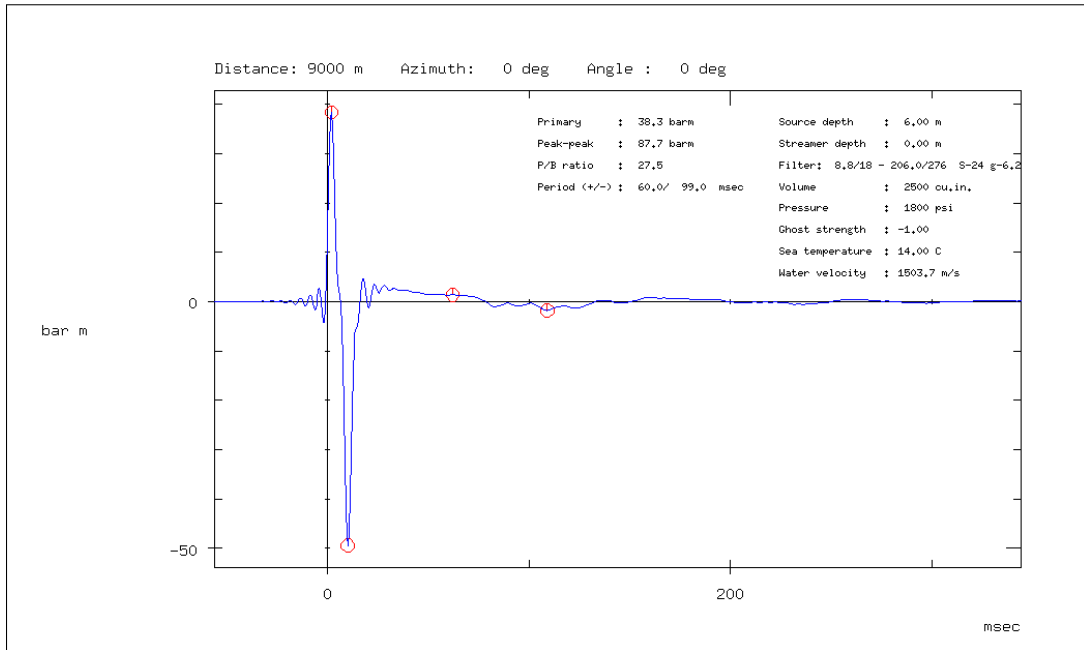


Figure 3: Modeled far-field signature and amplitude spectrum with DFS-V recording filter (without receiver ghost).

Full system response with source ghost only

Far-field signature of array : 2500LB_60_1800_100



Amplitude spectrum of far-field signature of array : 2500LB_60_1800_100

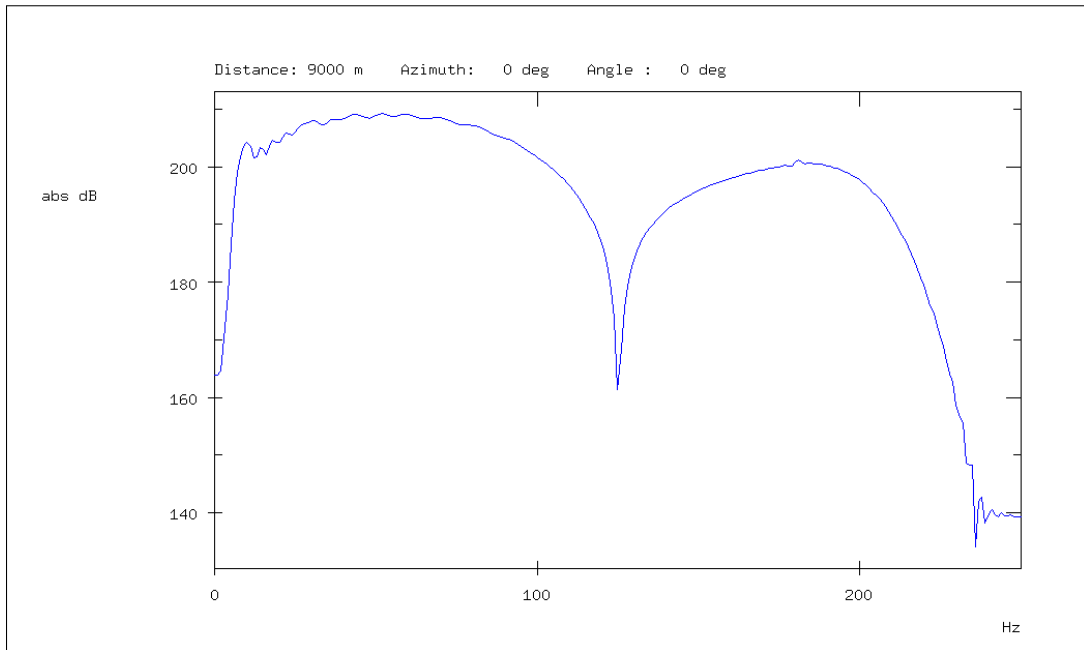


Figure 4: Modeled far-field signature and amplitude spectrum with recording and hydrophone filter effect applied (without receiver ghost).

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
 Primary amplitude : 38.31 bar m
 Peak-peak amplitude : 87.72 bar m
 P/B-ratio : 28.22
 Bubble period (+) : 60.00 msec
 Bubble period (-) : 98.00 msec
 Seawater temperature: 14.00 C
 Seawater velocity : 1503.7 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
 Far-field position :
 Distance : 9000.00 m
 Azimuth : 0.00 deg
 Angle of vertical : 0.00 deg

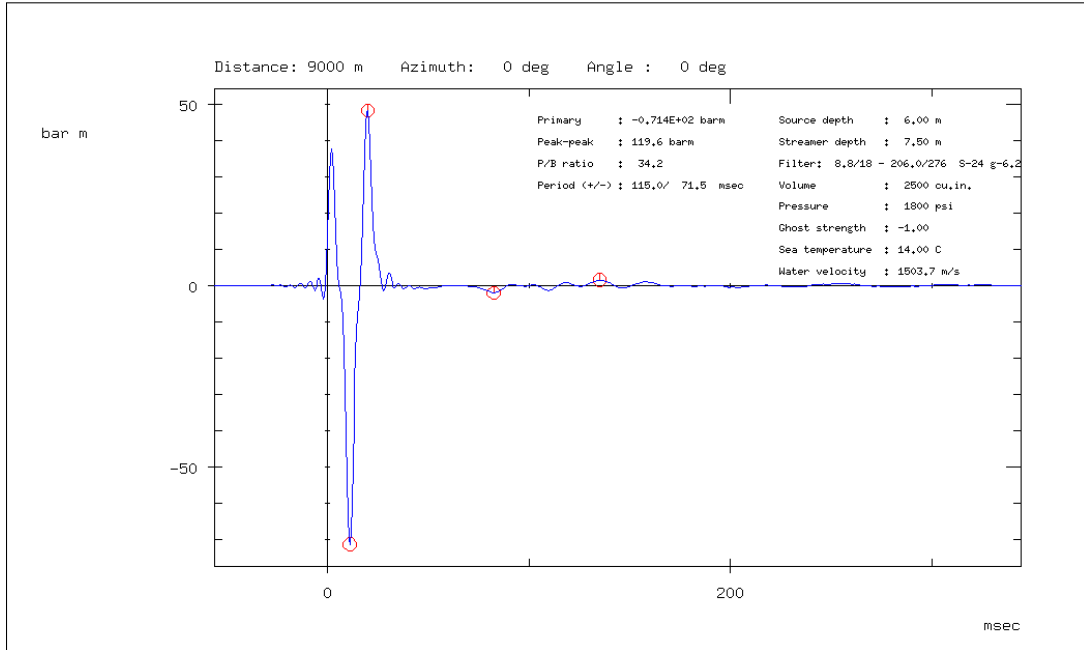
Amplitudes are in bar m
 Time is increasing horizontally

0.000	0.000	0.000	0.002	0.004	-0.026	-0.006
0.019	-0.024	0.057	-0.029	-0.041	0.094	-0.051
0.162	-0.020	0.039	0.012	-0.253	0.236	-0.568
0.553	-0.386	0.089	0.735	-1.545	2.638	-4.288
13.741	38.308	13.049	1.297	-22.071	-49.413	-21.849
-5.868	-1.374	4.558	-0.991	1.972	2.874	1.984
3.273	2.275	2.592	2.582	2.236	2.360	2.219
1.960	1.853	1.752	1.520	1.484	1.434	1.352
1.451	1.384	1.306	1.381	1.282	1.278	1.305
1.086	0.992	0.835	0.460	0.108	-0.488	-0.983
-0.928	-0.709	-0.413	-0.322	-0.665	-0.838	-0.789
-0.646	-0.344	-0.457	-0.948	-1.344	-1.728	-1.728
-1.317	-1.097	-0.920	-0.882	-1.135	-1.191	-1.203
-1.156	-0.787	-0.502	-0.180	0.224	0.287	0.286
0.186	-0.150	-0.240	-0.258	-0.293	-0.033	0.151
0.329	0.663	0.728	0.780	0.857	0.697	0.700
0.713	0.596	0.678	0.639	0.530	0.592	0.460
0.400	0.494	0.393	0.425	0.475	0.330	0.338
0.242	0.010	-0.018	-0.141	-0.231	-0.129	-0.193
-0.170	-0.088	-0.181	-0.089	-0.053	-0.159	-0.092
-0.197	-0.316	-0.280	-0.471	-0.549	-0.494	-0.589
-0.485	-0.389	-0.421	-0.253	-0.199	-0.182	0.041
0.102	0.198	0.391	0.354	0.418	0.476	0.326
0.367	0.335	0.201	0.268	0.161	0.063	0.116
-0.043	-0.088	-0.070	-0.220	-0.187	-0.203	-0.320
-0.241	-0.286	-0.315	-0.164	-0.180	-0.115	0.006
-0.065	-0.016	-0.006	-0.101	-0.001	0.044	0.061
0.196	0.185	0.190	0.247	0.161	0.161	0.185
0.124	0.169	0.155	0.090	0.109		

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

Full system response with source and receiver ghost

Far-field signature of array : 2500LB_60_1800_100



Amplitude spectrum of far-field signature of array : 2500LB_60_1800_100

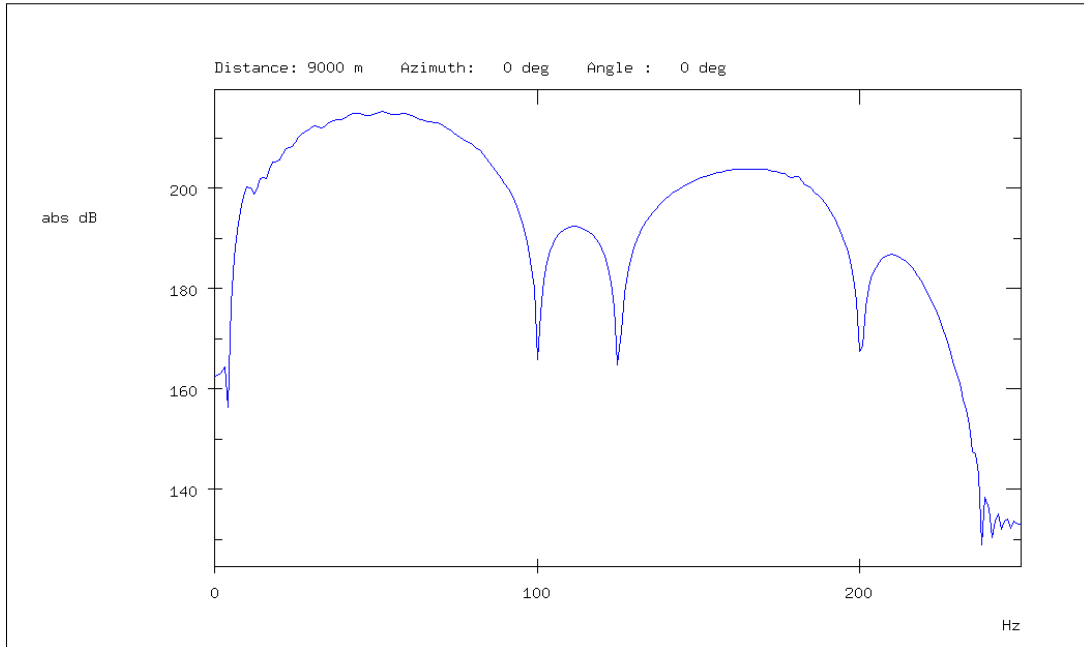


Figure 6: Modelled far-field signature and amplitude spectrum with recording and hydrophone filter effect applied (with receiver ghost).

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 : 7.50 m
 Group length : 12.50 m
 Average pressure : 1800 psi
 Ghost strength : -1.00
 Primary amplitude : -63.58 bar m
 Peak-peak amplitude : 111.78 bar m
 P/B-ratio : 32.76
 Bubble period (+) : 116.00 msec
 Bubble period (-) : 72.00 msec
 Seawater temperature: 14.00 C
 Seawater velocity : 1503.7 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
 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	-0.026	0.053	-0.003	-0.035	0.076	-0.028
0.105	0.011	0.077	-0.080	-0.203	0.074	-0.545
0.510	-0.390	0.333	0.507	-0.982	2.078	-3.880
13.607	37.620	14.551	-1.297	-17.788	-63.584	-59.958
-18.613	-2.578	27.096	48.193	23.431	8.718	3.234
-1.225	3.274	0.574	-0.259	0.234	-0.900	-0.048
-0.634	-0.718	-0.481	-0.835	-0.728	-0.521	-0.498
-0.295	-0.132	-0.175	-0.049	-0.068	-0.171	-0.075
-0.219	-0.386	-0.444	-0.817	-1.193	-1.570	-1.973
-1.758	-1.164	-0.515	0.173	0.318	0.086	-0.084
-0.237	-0.020	0.211	-0.111	-0.557	-1.087	-1.386
-0.855	-0.146	0.426	0.846	0.586	0.120	-0.110
-0.240	0.096	0.633	1.009	1.426	1.438	1.067
0.684	0.024	-0.465	-0.544	-0.578	-0.215	0.303
0.568	0.921	1.018	0.810	0.705	0.364	0.036
-0.013	-0.185	-0.176	-0.056	-0.169	-0.119	-0.134
-0.279	-0.142	-0.137	-0.165	0.018	-0.071	-0.154
-0.150	-0.416	-0.491	-0.469	-0.569	-0.367	-0.201
-0.151	0.055	0.048	0.040	0.140	0.008	-0.003
-0.016	-0.229	-0.225	-0.312	-0.457	-0.295	-0.274
-0.205	0.083	0.126	0.241	0.389	0.301	0.430
0.521	0.449	0.591	0.533	0.375	0.374	0.126
-0.024	-0.018	-0.218	-0.206	-0.165	-0.304	-0.216
-0.243	-0.355	-0.228	-0.284	-0.302	-0.158	-0.233
-0.170	-0.065	-0.129	0.040	0.139	0.125	0.293
0.248	0.147	0.174	0.012	-0.007	0.109	0.076
0.203	0.286	0.189	0.204	0.098	-0.035	0.000
-0.067	-0.077	-0.004	-0.072	-0.074		

Figure 7: Far-field signature listing with 2 ms sampling interval (with receiver ghost).

Source Directivity Plot - azimuth : 0.0 degrees - array 2500LB_60_1800_100

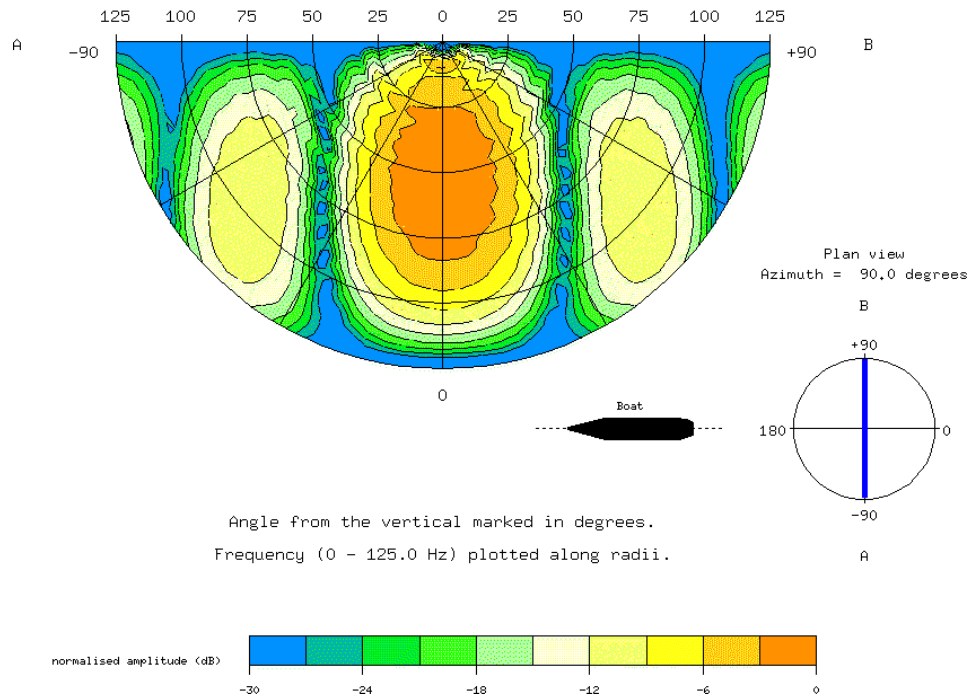
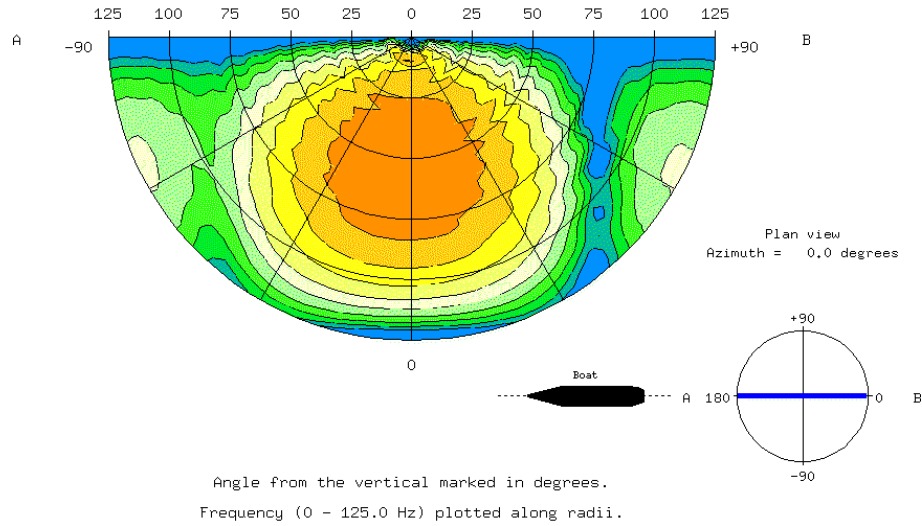
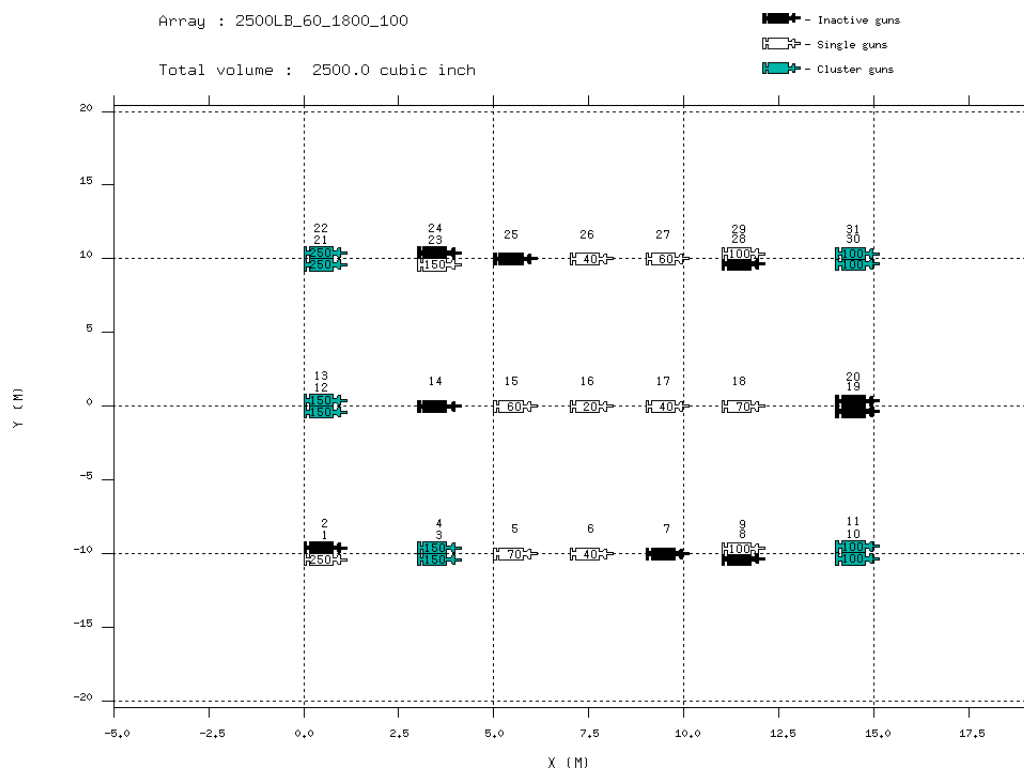


Figure 8: Directivity plot for constant azimuth of 0° and 90°.



Drop-out specification of array:

2500LB_60_1800_100

Bolt 1500LL/600B gun 2500 cu.in. array,

6.0 m depth, 1800 psi pressure,

10.0 m subarray spacing

AUGUST 2003

The drop-out specification covered by this report was performed with NUCLEUS-V 6.1.1 (masomo v.4.1.3) modelling software by Barbara Kajl, PGS Technology – Geophysical Support.

A Hz(dB/oct) filter is used for the modelling.

The drop-out specification enclosed is given for the following criteria:

- ✓ Loss in peak amplitude $\leq 10\%$ compared to nominal signature
- ✓ Loss in peak-to-bubble $\leq 10\%$ compared to nominal signature

APPENDIX A: ARRAY DESCRIPTION

APPENDIX B: DROP-OUT RESULTS FROM THE MODELING

APPENDIX C: DROP-OUT SPECIFICATION

APPENDIX A: ARRAY DESCRIPTION

ARRAY LISTING

ARRAY NAME : 2500LB_60_1800_100
NUMBER OF ACTIVE GUNS: 22
TOTAL ACTIVE VOLUME : 2500 CU.IN.
NUMBER OF SPARE GUNS : 9

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	-9.50	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
14	13	3.00	0.00	6.00	90	SPARE	1.00	0.00	0
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
19	13	14.00	-0.35	6.00	100	SPARE	1.00	0.00	0
20	13	14.00	0.35	6.00	100	SPARE	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

APPENDIX B: DROP-OUT RESULTS FROM THE MODELING

Array : 2500LB_60_1800_100
Gun type : Bolt 1500LL/600B gun
Volume : 2500 cu.in.
Depth : 6.0 m
Air pressure : 1800 psi
Subarray separation : 10.0 m
Sea temperature : Syntrak 24-bit: 3.0(12) - 206.0(276)
Filter : Hz (dB/oct.)
Bubble window : 60 – 200 ms

= gun dropped,

P = primary (barm),

%ch = %change,

P/B = Peak/Bubble ratio,

x-corr = normalized cross correlation coefficient.

AvgdB = average deviation (dB) in frequency domain 10 – 70 Hz

maxdB = max deviation (dB) in frequency domain 10 – 70 Hz

Drop-out combinations:

Dropped #	Dropped gun volumes		P	%ch P	P/B	%ch P/B	x-corr	avgdB	maxdB
<i>1st</i>	<i>2nd</i>	<i>1st</i>	<i>2nd</i>						
Full	arr	ay.		39.16	0	21.68	0	1	0
1		250		36.14	-7.7	19.2	-11.4	0.99956	0.66
3		150		37.96	-3.1	17.96	-17.2	0.9983	0.4
4		150		37.95	-3.1	18.02	-16.9	0.99834	0.4
5		70		37.9	-3.2	20.58	-5.1	0.9997	0.23
6		40		38.11	-2.7	21.12	-2.6	0.99984	0.15
9		100		37.14	-5.2	20.71	-4.4	0.99958	0.4
10		100		37.94	-3.1	19.13	-11.7	0.997	0.55
11		100		37.95	-3.1	19.23	-11.3	0.99702	0.54
12		150		37.77	-3.6	18.64	-14	0.99885	0.41
13		150		37.77	-3.6	18.57	-14.3	0.99886	0.41
15		60		37.66	-3.8	21.09	-2.7	0.99952	0.27
16		20		38.54	-1.6	20.78	-4.1	0.99982	0.08
17		40		38.2	-2.4	20.99	-3.2	0.99973	0.17
18		70		37.54	-4.1	21.11	-2.6	0.9991	0.39
21		250		37.78	-3.5	16.02	-26.1	0.99768	0.47
22		250		37.76	-3.6	15.92	-26.6	0.99769	0.48
23		150		36.63	-6.4	20.77	-4.2	0.99965	0.49
26		40		38.09	-2.7	21.08	-2.7	0.99984	0.16
27		60		37.91	-3.2	21.2	-2.2	0.99977	0.23
29		100		37.35	-4.6	20.6	-4.9	0.99927	0.41
30		100		38.07	-2.8	18.65	-14	0.99697	0.52
31		100		38.08	-2.8	18.69	-13.8	0.99693	0.53
1	3	250	150	34.87	-10.9	15.13	-30.2	0.9964	1.02
1	4	250	150	34.88	-10.9	15.18	-30	0.9964	1.02
1	5	250	70	34.89	-10.9	19.63	-9.5	0.99956	0.89
1	6	250	40	35.1	-10.4	18.46	-14.8	0.9994	0.83
1	9	250	100	34.12	-12.9	19.98	-7.8	0.99924	1.07
1	10	250	100	34.92	-10.8	16.8	-22.5	0.99599	1.08

1	11	250	100	34.93	-10.8	17.01	-21.5	0.9961	1.07	2.54
1	12	250	150	34.74	-11.3	15.61	-28	0.99684	1.04	3.3
1	13	250	150	34.75	-11.3	15.66	-27.8	0.99684	1.04	3.33
1	15	250	60	34.65	-11.5	19.42	-10.4	0.99936	0.93	1.58
1	16	250	20	35.52	-9.3	18.65	-14	0.99947	0.74	1.66
1	17	250	40	35.18	-10.2	18.66	-13.9	0.99933	0.83	1.91
1	18	250	70	34.51	-11.9	19.47	-10.2	0.99895	1.02	1.78
1	21	250	250	34.76	-11.2	15.57	-28.2	0.99728	1.03	3.04
1	22	250	250	34.74	-11.3	15.56	-28.2	0.99738	1.04	3.02
1	23	250	150	33.62	-14.2	20.21	-6.8	0.9994	1.18	1.79
1	26	250	40	35.07	-10.4	18.55	-14.4	0.99942	0.83	1.95
1	27	250	60	34.89	-10.9	19.72	-9	0.99955	0.88	1.42
1	29	250	100	34.33	-12.3	18.59	-14.2	0.99869	1.06	1.85
1	30	250	100	35.05	-10.5	16.46	-24.1	0.99594	1.05	2.65
1	31	250	100	35.06	-10.5	16.63	-23.3	0.99592	1.05	2.66
3	4	150	150	35.65	-9	16.09	-25.8	0.99779	0.72	2.15
3	5	150	70	36.59	-6.6	18	-17	0.99813	0.56	1.74
3	6	150	40	36.91	-5.7	17.34	-20	0.99789	0.52	2.48
3	9	150	100	35.94	-8.2	17.58	-18.9	0.9978	0.68	2.1
3	10	150	100	36.75	-6.2	18.79	-13.3	0.99673	0.67	-2.72
3	11	150	100	36.76	-6.1	19.01	-12.3	0.99674	0.66	-2.72
3	12	150	150	36.57	-6.6	15.19	-29.9	0.99476	0.78	3.95
3	13	150	150	36.57	-6.6	15.08	-30.4	0.99471	0.79	3.86
3	15	150	60	36.47	-6.9	17.91	-17.4	0.99771	0.62	2.29
3	16	150	20	37.35	-4.6	17.21	-20.6	0.99794	0.46	2.22
3	17	150	40	37.01	-5.5	17.43	-19.6	0.99786	0.53	2.36
3	18	150	70	36.34	-7.2	18.11	-16.4	0.9975	0.7	1.85
3	21	150	250	36.58	-6.6	12.77	-41.1	0.9944	0.8	3.47
3	22	150	250	36.57	-6.6	12.74	-41.2	0.99444	0.8	3.5
3	23	150	150	35.44	-9.5	17.77	-18	0.99851	0.71	1.97
3	26	150	40	36.9	-5.8	17.26	-20.4	0.99792	0.52	2.47
3	27	150	60	36.72	-6.2	18.38	-15.2	0.99824	0.52	1.93
3	29	150	100	36.16	-7.7	17.54	-19.1	0.9975	0.66	2.05
3	30	150	100	36.87	-5.8	18.59	-14.2	0.99666	0.65	-2.62
3	31	150	100	36.88	-5.8	18.52	-14.6	0.99657	0.65	-2.68
4	5	150	70	36.57	-6.6	17.91	-17.4	0.99803	0.56	1.77
4	6	150	40	36.9	-5.8	17.23	-20.5	0.99783	0.53	2.58
4	9	150	100	35.93	-8.2	17.55	-19	0.99772	0.68	2.17
4	10	150	100	36.73	-6.2	18.87	-13	0.99671	0.66	-2.72
4	11	150	100	36.74	-6.2	18.78	-13.3	0.99661	0.67	-2.77
4	12	150	150	36.56	-6.6	14.96	-31	0.99483	0.78	3.87
4	13	150	150	36.56	-6.6	15.19	-29.9	0.99487	0.77	3.85
4	15	150	60	36.46	-6.9	18.04	-16.8	0.99772	0.61	2.31
4	16	150	20	37.34	-4.7	17.29	-20.3	0.998	0.45	2.18
4	17	150	40	36.99	-5.5	17.16	-20.8	0.99782	0.53	2.32
4	18	150	70	36.33	-7.2	18.41	-15.1	0.99759	0.69	1.86
4	21	150	250	36.57	-6.6	12.66	-41.6	0.99429	0.8	3.51
4	22	150	250	36.55	-6.7	12.66	-41.6	0.99444	0.8	3.5
4	23	150	150	35.43	-9.5	17.67	-18.5	0.99843	0.71	1.97
4	26	150	40	36.89	-5.8	17.33	-20.1	0.99791	0.52	2.48
4	27	150	60	36.71	-6.3	18.29	-15.6	0.99816	0.52	1.97
4	29	150	100	36.14	-7.7	17.38	-19.8	0.99747	0.66	2.06
4	30	150	100	36.86	-5.9	18.52	-14.6	0.99659	0.65	-2.63
4	31	150	100	36.87	-5.8	18.59	-14.2	0.99662	0.64	-2.67
5	6	70	40	36.69	-6.3	20.07	-7.4	0.99927	0.4	0.94
5	9	70	100	35.89	-8.3	19.61	-9.5	0.99888	0.65	1.65
5	10	70	100	36.68	-6.3	20.7	-4.5	0.9971	0.64	-2.08

5	11	70	100	36.69	-6.3	20.92	-3.5	0.99718	0.64	-2.07
5	12	70	150	36.51	-6.8	19.09	-11.9	0.99871	0.57	-1.15
5	13	70	150	36.51	-6.8	19.1	-11.9	0.99871	0.57	-1.16
5	15	70	60	36.41	-7	19.66	-9.3	0.99862	0.51	1.84
5	16	70	20	37.29	-4.8	19.61	-9.5	0.99919	0.3	0.82
5	17	70	40	36.95	-5.6	20.76	-4.2	0.99909	0.38	1.33
5	18	70	70	36.29	-7.3	19.02	-12.2	0.998	0.63	2.68
5	21	70	250	36.52	-6.7	15.58	-28.1	0.99686	0.66	3.28
5	22	70	250	36.51	-6.8	15.57	-28.2	0.9969	0.67	3.33
5	23	70	150	35.38	-9.6	19.65	-9.3	0.99906	0.72	1.48
5	26	70	40	36.84	-5.9	20.73	-4.4	0.99926	0.37	0.98
5	27	70	60	36.66	-6.4	19.64	-9.4	0.99902	0.46	1.02
5	29	70	100	36.1	-7.8	19.54	-9.9	0.99859	0.6	2.12
5	30	70	100	36.81	-6	19.72	-9	0.99706	0.61	2.12
5	31	70	100	36.82	-6	19.75	-8.9	0.99703	0.61	2.14
6	9	40	100	36.08	-7.9	20.43	-5.7	0.99926	0.57	1.48
6	10	40	100	36.9	-5.8	18.99	-12.4	0.99677	0.64	-2.18
6	11	40	100	36.91	-5.7	19.07	-12	0.99675	0.64	-2.19
6	12	40	150	36.72	-6.2	18.02	-16.9	0.99859	0.55	1.83
6	13	40	150	36.72	-6.2	18.17	-16.2	0.99863	0.54	1.78
6	15	40	60	36.62	-6.5	21.08	-2.7	0.99901	0.42	1.19
6	16	40	20	37.5	-4.2	20.57	-5.1	0.99939	0.23	0.42
6	17	40	40	37.16	-5.1	20.13	-7.1	0.99925	0.32	0.89
6	18	40	70	36.5	-6.8	21.33	-1.6	0.99875	0.51	2.12
6	21	40	250	36.73	-6.2	15.54	-28.3	0.99744	0.59	2.54
6	22	40	250	36.72	-6.2	15.53	-28.4	0.99748	0.6	2.53
6	23	40	150	35.59	-9.1	20.73	-4.4	0.99925	0.65	1.34
6	26	40	40	37.05	-5.4	20.4	-5.9	0.99935	0.32	0.66
6	27	40	60	36.87	-5.8	21.14	-2.5	0.99937	0.37	0.77
6	29	40	100	36.31	-7.3	20.18	-6.9	0.99885	0.54	1.88
6	30	40	100	37.03	-5.4	18.27	-15.7	0.99675	0.61	2.25
6	31	40	100	37.03	-5.4	18.28	-15.7	0.99675	0.61	2.26
9	10	100	100	35.87	-8.4	20.91	-3.5	0.99762	0.8	2.81
9	11	100	100	35.87	-8.4	20.88	-3.7	0.99762	0.79	2.77
9	12	100	150	35.75	-8.7	19.17	-11.6	0.99851	0.7	1.55
9	13	100	150	35.74	-8.7	19.23	-11.3	0.9985	0.7	1.51
9	15	100	60	35.65	-9	20.33	-6.2	0.99887	0.67	1.85
9	16	100	20	36.52	-6.7	19.95	-8	0.99914	0.47	1.38
9	17	100	40	36.18	-7.6	20.7	-4.5	0.99907	0.57	1.83
9	18	100	70	35.52	-9.3	19.69	-9.2	0.99833	0.79	2.67
9	21	100	250	35.76	-8.7	15.47	-28.6	0.99721	0.83	2.3
9	22	100	250	35.74	-8.7	15.53	-28.4	0.99725	0.84	2.28
9	23	100	150	34.62	-11.6	19.89	-8.2	0.99886	0.91	2.06
9	26	100	40	36.08	-7.9	20.71	-4.5	0.99923	0.56	1.53
9	27	100	60	35.9	-8.3	20.21	-6.8	0.99901	0.63	1.89
9	29	100	100	35.33	-9.8	19.92	-8.1	0.99764	0.82	3.15
9	30	100	100	36.05	-7.9	20.83	-3.9	0.99714	0.73	2.82
9	31	100	100	36.06	-7.9	20.98	-3.2	0.99711	0.73	2.81
10	11	100	100	35.86	-8.4	20.88	-3.7	0.99809	0.82	2.75
10	12	100	150	36.55	-6.7	18.83	-13.1	0.99621	0.77	-2.83
10	13	100	150	36.55	-6.7	18.93	-12.7	0.99619	0.77	-2.84
10	15	100	60	36.45	-6.9	20.83	-3.9	0.9968	0.67	2.07
10	16	100	20	37.33	-4.7	18.74	-13.5	0.99679	0.59	-2.29
10	17	100	40	36.98	-5.6	18.89	-12.8	0.99692	0.63	-1.99
10	18	100	70	36.32	-7.2	20.88	-3.7	0.99657	0.75	2.19

10	21	100	250	36.56	-6.6	16.22	-25.2	0.99539	0.79	-2.44
10	22	100	250	36.54	-6.7	16.07	-25.9	0.9953	0.8	-2.43
10	23	100	150	35.42	-9.6	16.8	-22.5	0.99531	0.95	3.08
10	26	100	40	36.88	-5.8	18.53	-14.5	0.99678	0.65	-2.2
10	27	100	60	36.7	-6.3	19.4	-10.5	0.99675	0.65	2.16
10	29	100	100	36.13	-7.7	20.08	-7.4	0.99718	0.75	2.62
10	30	100	100	36.85	-5.9	12.24	-43.5	0.98735	1.08	4.72
10	31	100	100	36.86	-5.9	12.25	-43.5	0.98737	1.08	4.7
11	12	100	150	36.56	-6.6	19.02	-12.2	0.99618	0.77	-2.87
11	13	100	150	36.56	-6.6	18.94	-12.6	0.99622	0.76	-2.85
11	15	100	60	36.46	-6.9	20.62	-4.9	0.99669	0.67	2.11
11	16	100	20	37.34	-4.7	18.79	-13.3	0.99675	0.59	-2.31
11	17	100	40	36.99	-5.5	18.82	-13.2	0.99684	0.63	-2.02
11	18	100	70	36.33	-7.2	20.72	-4.4	0.99648	0.76	2.24
11	21	100	250	36.57	-6.6	16.14	-25.5	0.99537	0.79	-2.49
11	22	100	250	36.55	-6.7	16.13	-25.6	0.99532	0.8	-2.46
11	23	100	150	35.43	-9.5	16.73	-22.8	0.9952	0.95	3.12
11	26	100	40	36.89	-5.8	18.54	-14.4	0.99676	0.64	-2.22
11	27	100	60	36.71	-6.3	19.37	-10.6	0.99669	0.65	2.22
11	29	100	100	36.14	-7.7	19.83	-8.5	0.99707	0.76	2.65
11	30	100	100	36.86	-5.9	12.26	-43.5	0.98733	1.08	4.75
11	31	100	100	36.87	-5.8	12.22	-43.6	0.98733	1.08	4.72
12	13	150	150	35.06	-10.5	18.84	-13.1	0.99912	0.93	1.53
12	15	150	60	36.27	-7.4	18.85	-13	0.99827	0.66	1.65
12	16	150	20	37.15	-5.1	18.19	-16.1	0.99865	0.47	1.48
12	17	150	40	36.81	-6	18.07	-16.6	0.9984	0.56	1.73
12	18	150	70	36.15	-7.7	18.88	-12.9	0.99784	0.73	1.73
12	21	150	250	36.39	-7.1	15.55	-28.3	0.99679	0.75	3.03
12	22	150	250	36.37	-7.1	15.61	-28	0.99683	0.75	2.99
12	23	150	150	35.24	-10	19.81	-8.6	0.99906	0.78	1.74
12	26	150	40	36.7	-6.3	17.96	-17.1	0.99859	0.56	1.79
12	27	150	60	36.52	-6.7	19.34	-10.8	0.99883	0.56	1.32
12	29	150	100	35.96	-8.2	17.89	-17.5	0.99824	0.68	1.52
12	30	150	100	36.68	-6.3	18.17	-16.2	0.9956	0.77	-2.73
12	31	150	100	36.69	-6.3	18.14	-16.3	0.99562	0.77	-2.74
13	15	150	60	36.27	-7.4	18.92	-12.7	0.99827	0.66	1.65
13	16	150	20	37.15	-5.1	18.11	-16.4	0.99866	0.47	1.49
13	17	150	40	36.81	-6	18.1	-16.5	0.99838	0.57	1.73
13	18	150	70	36.15	-7.7	19	-12.4	0.99791	0.72	1.72
13	21	150	250	36.38	-7.1	15.37	-29.1	0.99671	0.75	3.08
13	22	150	250	36.37	-7.1	15.7	-27.6	0.9968	0.76	3.04
13	23	150	150	35.24	-10	19.75	-8.9	0.99911	0.78	1.71
13	26	150	40	36.7	-6.3	17.79	-17.9	0.99859	0.56	1.82
13	27	150	60	36.52	-6.7	19.25	-11.2	0.99883	0.56	1.3
13	29	150	100	35.96	-8.2	17.79	-17.9	0.99822	0.68	1.56
13	30	150	100	36.68	-6.3	18.19	-16.1	0.99552	0.77	-2.77
13	31	150	100	36.68	-6.3	18.24	-15.9	0.9955	0.77	-2.82
15	16	60	20	36.92	-5.7	20.17	-7	0.99886	0.37	0.97
15	17	60	40	36.69	-6.3	21.14	-2.5	0.9987	0.46	1.5
15	18	60	70	36.05	-7.9	19.45	-10.3	0.99729	0.7	2.88
15	21	60	250	36.28	-7.3	15.8	-27.1	0.99679	0.7	3.51
15	22	60	250	36.27	-7.4	15.67	-27.7	0.99684	0.71	3.54
15	23	60	150	35.14	-10.3	20.41	-5.8	0.99899	0.76	1.42
15	26	60	40	36.6	-6.5	21.35	-1.5	0.999	0.43	1.23
15	27	60	60	36.42	-7	20.47	-5.6	0.99875	0.5	1.33
15	29	60	100	35.86	-8.4	20.19	-6.9	0.99881	0.62	2.15
15	30	60	100	36.58	-6.6	19.97	-7.9	0.99666	0.66	2.01

15	31	60	100	36.58	-6.6	20.03	-7.6	0.99659	0.66	2.03
16	17	20	40	37.48	-4.3	20.59	-5	0.99914	0.26	0.69
16	18	20	70	36.91	-5.7	19.87	-8.3	0.99849	0.47	1.93
16	21	20	250	37.16	-5.1	15.43	-28.8	0.99733	0.54	2.43
16	22	20	250	37.15	-5.1	15.55	-28.3	0.99744	0.54	2.42
16	23	20	150	36.02	-8	19.99	-7.8	0.9992	0.57	1.24
16	26	20	40	37.48	-4.3	20.55	-5.2	0.9994	0.24	0.38
16	27	20	60	37.3	-4.8	20.24	-6.6	0.99932	0.3	0.56
16	29	20	100	36.74	-6.2	19.81	-8.6	0.99882	0.48	1.68
16	30	20	100	37.46	-4.3	18.19	-16.1	0.99677	0.57	2.25
16	31	20	100	37.46	-4.3	18.15	-16.3	0.99668	0.57	2.27
17	18	40	70	36.41	-7	21.79	0.5	0.9985	0.59	2.21
17	21	40	250	36.82	-6	15.62	-27.9	0.99743	0.6	2.69
17	22	40	250	36.8	-6	15.59	-28.1	0.99752	0.6	2.7
17	23	40	150	35.68	-8.9	20.55	-5.2	0.99914	0.66	1.35
17	26	40	40	37.14	-5.2	19.95	-7.9	0.99923	0.33	0.86
17	27	40	60	36.95	-5.6	21.45	-1.1	0.99922	0.38	1.03
17	29	40	100	36.39	-7.1	20.35	-6.1	0.9987	0.56	2.19
17	30	40	100	37.11	-5.2	18.32	-15.5	0.99679	0.61	2.11
17	31	40	100	37.12	-5.2	18.24	-15.9	0.99683	0.61	2.1
18	21	70	250	36.16	-7.7	15.89	-26.7	0.99639	0.8	4.08
18	22	70	250	36.14	-7.7	15.76	-27.3	0.99636	0.81	4.12
18	23	70	150	35.02	-10.6	19.88	-8.3	0.9985	0.87	1.86
18	26	70	40	36.47	-6.9	20.85	-3.8	0.9987	0.53	2.11
18	27	70	60	36.29	-7.3	19.58	-9.7	0.99811	0.63	2.14
18	29	70	100	35.73	-8.8	19.84	-8.5	0.99819	0.76	2.95
18	30	70	100	36.45	-6.9	20.28	-6.4	0.9964	0.75	2.03
18	31	70	100	36.46	-6.9	20.32	-6.2	0.9964	0.75	2.05
21	22	250	250	34.7	-11.4	17.67	-18.5	0.99841	1.06	2.58
21	23	250	150	35.19	-10.1	16.09	-25.8	0.99755	0.89	2.35
21	26	250	40	36.71	-6.2	15.82	-27	0.99752	0.6	2.66
21	27	250	60	36.53	-6.7	15.88	-26.7	0.99733	0.66	2.85
21	29	250	100	35.97	-8.1	15.47	-28.6	0.99732	0.79	2.4
21	30	250	100	36.69	-6.3	16.68	-23.1	0.99594	0.74	-2.39
21	31	250	100	36.7	-6.3	16.68	-23	0.99586	0.74	-2.41
22	23	250	150	35.19	-10.1	16.1	-25.7	0.9976	0.89	2.32
22	26	250	40	36.7	-6.3	15.75	-27.3	0.99754	0.61	2.63
22	27	250	60	36.51	-6.8	15.83	-26.9	0.9974	0.67	2.86
22	29	250	100	35.95	-8.2	15.4	-28.9	0.99729	0.8	2.42
22	30	250	100	36.67	-6.4	16.5	-23.9	0.99577	0.76	-2.37
22	31	250	100	36.68	-6.3	16.58	-23.5	0.99582	0.75	-2.37
23	26	150	40	35.55	-9.2	20.2	-6.8	0.99931	0.69	1.38
23	27	150	60	35.4	-9.6	20.38	-6	0.99917	0.74	1.84
23	29	150	100	34.82	-11.1	19.81	-8.6	0.99838	0.92	2.34
23	30	150	100	35.55	-9.2	16.26	-25	0.99537	0.91	3.14
23	31	150	100	35.56	-9.2	16.16	-25.4	0.99527	0.91	3.15
26	27	40	60	36.69	-6.3	20.85	-3.8	0.99942	0.42	0.71
26	29	40	100	36.27	-7.4	19.93	-8	0.99906	0.56	1.77
26	30	40	100	37.01	-5.5	18.15	-16.3	0.99672	0.63	2.28
26	31	40	100	37.01	-5.5	18.01	-16.9	0.99675	0.63	2.28
27	29	60	100	35.89	-8.4	20.23	-6.7	0.9991	0.67	1.98
27	30	60	100	36.83	-6	19.93	-8	0.99691	0.62	2.24
27	31	60	100	36.83	-5.9	19.9	-8.2	0.99691	0.63	2.22
29	30	100	100	36.22	-7.5	20.71	-4.5	0.99742	0.76	2.65
29	31	100	100	36.22	-7.5	20.71	-4.5	0.99751	0.75	2.62
30	31	100	100	35.98	-8.1	21.2	-2.2	0.99806	0.77	2.47

APPENDIX C: DROP-OUT SPECIFICATION

The array contains the following active elements:

Number elements	Name	Type	Total Volume (cu.in)	No of gun in element
2	2x250C	Cluster	500 cu.in	2
2	2x150C	Cluster	300 cu.in.	2
1	2x100C	Cluster	200 cu.in.	2
1	70C	Single gun	70 cu.in.	1
1	60C	Single gun	60 cu.in.	1
1	200	Single gun	200 cu.in.	1
1	150	Single gun	150 cu.in.	1
1	100	Single gun	100 cu.in.	1
1	90	Single gun	90 cu.in.	1
2	70	Single gun	70 cu.in.	1
2	60	Single gun	60 cu.in.	1
3	40	Single gun	40 cu.in.	1
3	20	Single gun	20 cu.in.	1

The specification below is referring to net drop-outs, i.e. after using available spare guns.

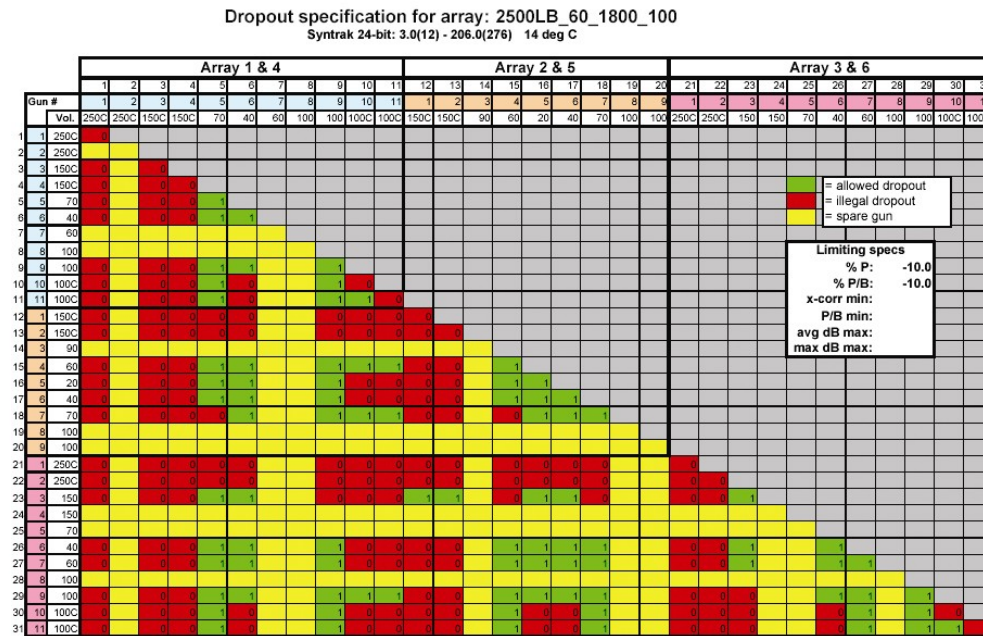


Figure 9: Single (on diagonal) and two gun drop-out diagram. Illegal combinations denoted in red.

14.3 SEG-D header

Example of SEG-D header:

*** General Header #1 information ***

SByte- EByte	Format	Description	
1 - 2	2 I	FFID	= 0699
3 - 4	2 I	Format	= 8058
5 - 10	6 I	General Constant	= 000002003134
11 - 11	1 I	Year	= 03
12 - 12	1 I	# extra blks in gen. header	= 23
13 - 13	1 I	Julian Day	= 341
14 - 16	3x1 I	Time	= 20:15:04
17 - 17	1 I	Manufacturer Code	= 34
18 - 19	1 I	Manufacturer S/N	= 0006
20 - 22	3 I	Bytes per Scan	= 100000
23 - 23	1 I	Scans Interval	= 2
24 - 24	1 I	Polarity & Scans/block exp	= 10
25 - 25	1 I	Scans Block	= 00
26 - 26	1 I	Record Type	= 8
27 - 27	1 I	Record Length	= 8192
28 - 28	1 I	Scan / Types record	= 01
29 - 29	1 I	Channel Sets	= 2
30 - 30	1 I	Skew Blocks	= 00

*** General Header #2 information ***

SByte- EByte	Format	Description	
38 - 39	2 I	Extended Header Blocks #2	= 4256
40 - 41	2 I	External Header Blocks #2	= 32
43 - 44	2 I	SEG-D Revision Number	= 01.00

*** Channel Set Headers ***

SByte- EByte	Format	Description	
97 - 97	1 I	Scan Type Number	= 01
98 - 98	1 I	Channel Set Number	= 01
99 - 100	2 I	Channel Set Start Time	= 0
101 - 102	2 I	Channel Set End Time	= 8192
103 - 103	2 I	Preamplifier Gain Setting	= 0
105 - 106	2 I	Number of Channels	= 0480
107 - 107	.5 I	Channel Set Type	= 10
108 - 108	.5 I	Samples/Channel	= 1
108 - 108	.5 I	Channel Gain (IFP Gain)	= 9
109 - 110	2 I	Alias Filter Frequency	= 0206
111 - 112	2 I	Alias Filter Slope	= 0276
113 - 114	2 I	Low Cut Filter	= 0003
115 - 116	2 I	Low Cut Filter Slope	= 0012
129 - 129	1 I	Scan Type Number	= 01
130 - 130	1 I	Channel Set Number	= 02
131 - 132	2 I	Channel Set Start Time	= 0
133 - 134	2 I	Channel Set End Time	= 8192
135 - 135	2 I	Preamplifier Gain Setting	= 0
137 - 138	2 I	Number of Channels	= 0048
139 - 139	.5 I	Channel Set Type	= 60 IE AUX !
140 - 140	.5 I	Samples/Channel	= 1
140 - 140	.5 I	Channel Gain (IFP Gain)	= 9
141 - 142	2 I	Alias Filter Frequency	= 0206
143 - 144	2 I	Alias Filter Slope	= 0276
145 - 146	2 I	Low Cut Filter	= 0003
147 - 148	2 I	Low Cut Filter Slope	= 0012

*** Extended Header information ***

SByte- EByte	Format	Description	
161 - 161	1 I	External Header Status	= 01
162 - 162	.5 I	Tape Unit used to write	= 0
162 - 162	.5 I	Buffer Used	= 0
163 - 164	2 I	Number of Raw Channels Streamer 1	= 0480
164 - 165	2 I	Number of Raw Channels Streamer 2	= 0000
167 - 168	2 I	Number of Raw Channels Streamer 3	= 0000
169 - 170	2 I	Number of Raw Channels Streamer 4	= 0000
171 - 172	2 I	Number of Raw Channels Streamer 5	= 0000
173 - 174	2 I	Number of Raw Channels Streamer 6	= 0000
175 - 176	2 I	Number of Raw Channels Streamer 7	= 0000
177 - 178	2 I	Number of Raw Channels Streamer 8	= 0000
188 - 188	1 I	Header Revision	= 0.6
189 - 189	1 I	Host Software Revision Level	= 1.8
190 - 191	2 I	No. of 32 byte blocks after SEG-D	= 0000
192 - 192	1 I	Number of Streamers	= 1
193 - 200	8 A	Streamer 1 User ID	= 0021P015
201 - 208	8 A	Streamer 2 User ID	= _____
209 - 216	8 A	Streamer 3 User ID	= _____
217 - 224	8 A	Streamer 4 User ID	= _____
241 - 256	16 A	Reel Number	= 22640
257 - 272	16 A	Client	= SANTOS LTD.
273 - 288	16 A	Contractor	= PGS ASIA PACIFIC

*** START OF EXTERNAL HEADER AT BYTE 4385 ***

SByte - EByte	Format	Description	
4385 - 4386	2 A	Master Block ID	= \$1
4387 - 4390	4 I	Length of External Header	= 0928
4391 - 4394	4 I	Program Revision	= 0002
4395 - 4396	2 I	Shot Switch	= 03
4397 - 4420	24 A	Shot Time	=
201504.48470520031207UTC			
4421 - 4426	6 I	Shot Number	= 001548
4427 - 4442	16 A	Navigation Line Name	= DS030021P015
4443 - 4453	11.6 F	Master Latitude	= -36.059079
4454 - 4464	11.6 F	Master Longitude	= 135.617321
4465 - 4470	6.1 F	Water Depth	= 1032.0
4471 - 4481	11.6 F	Source Latitude	= 0.000000
4482 - 4492	11.6 F	Source Longitude	= 0.000000
4493 - 4497	5.1 F	Master Gyro	= 237.4
4498 - 4502	5.1 F	Master CMG	= 239.6
4503 - 4506	4.1 F	Master Speed	= 4.9
4507 - 4512	6 A	ID String	= *GCS90
4513 - 4516	4 I	Record Length	= 0812
4517 - 4522	6 I	Gun Line Number	= 21P015
4523 - 4526	4 I	Gun Shot Number	= 1548
4527 - 4528	2 I	Active Array Mask	= 07
4529 - 4529	A 1	Trigger Mode	= E
4530 - 4531	2 I	Gun Sequence	= 01
4532 - 4534	3 I	Number of Gun Subarrays	= 003
4535 - 4537	3 I	Number of Guns in Array	= 033
4538 - 4540	3 I	Number of Active Guns	= 022
4541 - 4543	3 I	Number of Delta Errors	= 000
4544 - 4546	3 I	Number of Auto Fires	= 000
4547 - 4549	3 I	Number of Misfires	= 000
4550 - 4552	3 I	Delta Spread	= 007
4553 - 4558	6 I	Volume Fired	= 002500
4573 - 4576	4 I	Manifold Pressure	= 0000
4577 - 4580	4 I	Deep Tow	= 0000

4581 - 4584	4 I	Subarray String Pressure 1	= 1870
4585 - 4588	4 I	Subarray String Pressure 2	= 1869
4589 - 4592	4 I	Subarray String Pressure 3	= 1871
4593 - 4596	4 I	Subarray String Pressure 4	= 81AP
4597 - 4600	4 I	Subarray String Pressure 5	= 1N 0
4601 - 4604	4 I	Subarray String Pressure 6	= 0017

Additional information:

Auxiliary Channel 1 recorded the system time break.

The auxiliary channels were connected to the near field hydrophones as following:

Aux Chan	Hydr.	Aux Chan	Hydr.	Aux Chan	Hydr.	Aux Chan	Hydr.	Aux Chan	Hydr.	Aux Chan	Hydr.
7	1.1	14	2.1	21	3.1	28	4.1	35	5.1	42	6.1
8	1.2	15	2.2	22	3.2	29	4.2	36	5.2	43	6.2
9	1.3	16	2.3	23	3.3	30	4.3	37	5.3	44	6.3
10	1.4	17	2.4	24	3.4	31	4.4	38	5.4	45	6.4
11	1.5	18	2.5	25	3.5	32	4.5	39	5.5	46	6.5
12	1.6	19	2.6	26	3.6	33	4.6	40	5.6	47	6.6
13	1.7	20	2.7	27	3.7	34	4.7	41	5.7	48	6.7

14.4 SEG-Y format

Datasets were written to disk in SEG-Y format and then regularly archived to tape with a Unix standard tar command: tar -cvf /dev/rmt0 FILES. It can be restored to disk using the same command: tar -xvf /dev/rmt0. This assumes that /dev/rmt0 is the tape drive used.

Sequences starting with 5XX are the second part of a line after a Syntrak Crash. Here is an example of the SEG-Y EBCDIC header:

```
C01 CLIENT_____ : SANTOS LTD; VESSEL: ORIENT EXPLORER
C02 SURVEY_NAME___ : SOUTHERN MARGIN; PROJECT_NUMBER : 2003134
C03 CONTRACTOR____ : PGS EXPLORATION PTY LTD
C04 DATE_____ : NOV 2003
C05 DATA_TYPE_____ : BRUTE STACK
C06 DOMAIN_____ : TIME_____ ; POLARITY : SEG NORMAL
C07 ----- DATA ACQUISITION BY PGS GEOPHYSICAL -----
C08 RECORDING_SYSTEM : 24-BIT SYNTRAK FORMAT : SEG-D (8058) REV 1
C09 LO-CUT_FILTER___ : 3HZ@12DB/OCT HI-CUT_FILTER : 206HZ@276DB/OCT
C10 SOURCE_TYPE_____ : BOLT GUNS_____ No. SOURCES : 1
C11 PRESSURE/VOLUME : 1800 PSI/2500 CU IN No. STREAMER : 1
C12 No. GUN ARRAYS___ : 1 X 3 ARRAYS_____ SHOT_INTERVAL : 25.0 M
C13 SINGLE_SOURCE___ : _____ SOURCE_DEPTH : 6 M
C14 STREAMER_LENGTH : 6000 M_____ No. GROUP : 480 CHANNELS
C15 SINGLE_STREAMER : _____ GROUP_INTERVAL : 12.5 M
C16 STREAMER_DEPTH : 7.0+/-1.0 M_____ RECORD_LENGTH : 8172 MSEC.
C17 SAMPLE_INTERVAL : 2 MSEC_____ INLINE_OFFSET : 120 M (NOMINAL)
C18 PROJECTION_SYS___ : SPH WGS84 SMA 6378137M 1/F 298.2572235
C19 DATUM WGS84 PROJ UTM NORTH UTM_ZONE 54 CENT_MER 141 DEG E
C20 GRID_OR_LAT_0_00_00.00N GRID_OR_LON_141_00_00.00E SF 0.99960
C21 FALSE EASTING 500000.00M FALSE NORTHING 10000000M
C22 ----- PROCESSED ONBOARD ORIENT EXPLORER BY PGS GEOPHYSICAL -----
C23 REFORMAT : TRANSCRIBE SEG-D TO PGS INTERNAL FORMAT
C24 INSTRUMENT_DELAY_CORRECTION : -120MS; SELECT_ODD_SHOT_ONLY
C25 TRACE_EDITS_AVAILABLE_AT_START_OF_LINE
C26 FILTER: 0-5-90-120 Hz RESAMPLE TO 4 MS
C27 TRUE_AMPLITUDE_RECOVERY: T**1.5; GAIN: 2dB/sec
C28 APPLY_2D_GEOM: SHOT=MIDPOINT BETWEEN SOURCE AND NEAR_OFFSET
C29 FIRST_BREAK_MUTE DECONVOLUTION: 24/240
C30 NMO_USING_2KM_PICKED_VELOCITY_FIELD
C31 POST_NMO_MUTE STACK
C32 GUN_AND_CABLE_STATICS
C33 WRITE_TO_SEGY_DISK_FORMAT
C34 SHOT=CDP/4
C35 THIS_STACK_WAS_GENERATED_FOR_REAL_TIME_QC_PROCESSING_FLOW
C36 WAS_OPTIMISED_FOR_NOISE_DETECTION_NOT_GEOLOGICAL_INTERPRETATION
C37
C38
C39
C40 = END_EBCDIC
```

14.5 P1/90 header

```
H0100 AREA                      EPP32 DUNTROON SOUTH AUSTRALIA
H0101 GENERAL SURVEY DETAILS    2D, SINGLE VESSEL, SINGLE SOURCE, ONE STREAMER
H0102 VESSEL DETAILS           M/V ORIENT EXPLORER                1
H0103 SOURCE DETAILS           SOURCE G1                        1    1
H0104 STREAMER DETAILS         STREAMER 1 480CH                1    1    1
H0105 OTHER DETAILS            N/A
H0200 DATE OF SURVEY           05 DECEMBER 2003 - CONTINUING
H0201 DATE OF ISSUE OF TAPE    ?? NOVEMBER 2003
H0202 TAPE VERSION IDENTIFIER  DS03P011
H0203 LINE PREFIX              DS03
H0300 CLIENT                   SANTOS LTD
H0400 GEOPHYSICAL CONTRACTOR   PGS GEOPHYSICAL, MARINE ACQUISITION
H0500 POSITIONING CONTRACTOR    FUGRO-SURVEY AS / THALES GEOSOLUTIONS NORGE AS
H0600 POSITIONING PROCESSING     PGS GEOPHYSICAL, MARINE ACQUISITION
H0700 POSITIONING SYSTEM         NAV SYSTEM 1: STARFIX SPOT / OPTUS SPOT
H0700 POSITIONING SYSTEM         NAV SYSTEM 2: SKYFIX SPOT / OPTUS SPOT INMARSAT
H0700 POSITIONING SYSTEM         NAV SYSTEM 3: STARFIX / SEADIFF V7.05N
H0700 POSITIONING SYSTEM         INTEGRATED NAV SYSTEM : SPECTRA VERSION 9.8.03
H0800 COORDINATE LOCATION      CENTER OF SOURCE
H0900 OFFSET SYSTEM TO SOURCE   1    2    25.00 -180.00
H0902 OFFSET SYSTEM TO E/S      1    2     0.00   35.14
H0903 OFFSET SYS TO NAV REF PT  1    2     0.00    0.00
H1000 CLOCK TIME                GMT
H1100 RECEIVER GROUPS PER SHOT  480
H1400 GEODETIC DATUM: SURVEY    GDA94          GRS80          6378137.000 298.2572221
H1401 DATUM SHIFT GDA94-WGS84   0.0    0.0    0.0 0.000 0.000 0.000 0.0000000
H1500 GEODETIC DATUM: POSTPROC. GDA94          GRS80          6378137.000 298.2572221
H1501 DATUM SHIFT GDA94-WGS84   0.0    0.0    0.0 0.000 0.000 0.000 0.0000000
H1600 DATUM SHIFTS              0.0    0.0    0.0 0.000 0.000 0.000 0.0000000
H1700 VERTICAL DATUM            SL                      ECHO SOUNDER POSITION
H1800 PROJECTION                002 UTM SOUTH
H1900 ZONE                      53S
H2000 GRID UNITS                1 INTERNATIONAL METRES    1.000000000000
H2001 HEIGHT UNITS              1 INTERNATIONAL METRES    1.000000000000
H2200 CENTRAL MERIDIAN          135 0 0.000E
H2600
H2600*****
H2600 THE ECHO SOUNDER DEPTH DATA HAS BEEN CORRECTED FOR PITCH, ROLL AND HEAVE
H2600 IN THE ECHO SOUNDER PRIOR TO BEING PASSED TO SPECTRA.
H2600
H2600 THE WATER DEPTH DATA HAS BEEN DESPIKED.
H2600
H2600 THE Z OFFSET OF THE ECHO SOUNDER TRANSDUCER IS -5.5 METRES FROM THE VESSEL
H2600 REFERENCE POINT AT SEA LEVEL.
H2600
H2600 THE V, E, Z, S & T RECORDS HAVE BEEN CORRECTED FOR DRAFT (5.5METRES)
H2600
H2600 THE SOUND VELOCITY SET IN THE ECHO SOUNDER WAS 1500 M/S.
H2600
H2600*****
H2600
H2600          FORMAT OF SHOT RECORDS
H2600          COLUMN      DESCRIPTION
H2600          1           'V', 'E', 'Z', 'S', 'T' OR 'C'
H2600                      V= VESSEL REFERENCE POINT
H2600                      E= ECHO SOUNDER
H2600                      Z= INDIVIDUAL SOURCE POSITION
H2600                      S= CENTER OF SOURCE
H2600                      T= TAILBUOY POSITION
H2600                      C= COMMON MID POINT
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 (DDMMSS.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 OF YEAR
H2600     74-79     TIME (HHMMSS)
H2600
H2600          FORMAT OF RECEIVER RECORD
H2600  COLUMN
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  1: RECEIVERS NUMBERED      1 (FAR) TO  480 (NEAR)
H2600
H2600*****
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 MISCLOSURE VALUES 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 3.1.13 USED FOR ONBOARD NAVIGATION PROCESSING.
H2600
H2600 PGS JOB NUMBER 2003134
H2600
H2600 ALL SHOTS FOR ALL STREAMERS ARE INCLUDED IN THIS FILE, DATA NOT TO BE
H2600 PROCESSED (NTBP) IS INDICATED BELOW AS NECESSARY.
H2600
H2600 LINES CONTAINED IN THIS FILE:
H2600
H2600 LINE: xxxxxxxx          SEQUENCE:  xxx   FSP:   xxxx   LSP:   xxxx
H2600
H2600*****

```