ACQUISITION REPORT

PGS Geophysical

Santos Australia Limited

M/V PACIFIC EXPLORER

2007 Mako 3D MSS
Block VIC/P55 Offshore Victoria, Australia

2007097

11th to 28th November 2007

version 1

PGS GEOPHYSICAL – MARINE ACQUISITION, SINGAPORE

AUTHORISATION

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Singapore
09th January 2008

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REVISED VERSIONS

NUMBER	CHANGES	AUTHOR	DATE

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1 Introduction

1.1 Summary

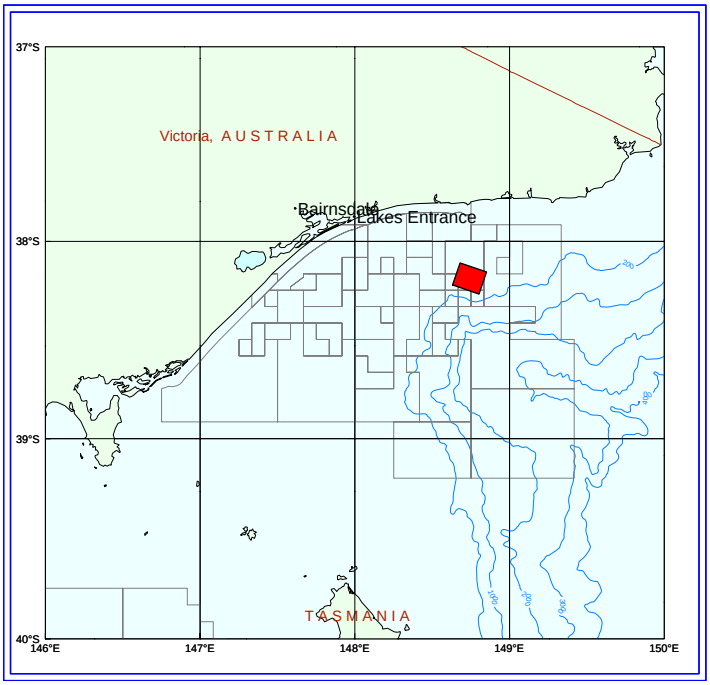
PGS was contracted by Santos Australia Limited to acquire the Mako 3D survey using the M/V PACIFIC EXPLORER.

The seismic survey area was situated approximately 20 nm south of the mainland and 50 nm east-southeast of Lakes Entrance, Victoria, in the Bass Strait.

The vessel mobilised in Port Kembla, New South Wales after taking on supplies, bunkers and doing some remedial work for class certification.

On the morning of 10th November 2007, the vessel sailed and headed direct to the prospect area.

On prospect, the area was scouted for obstacles and a TS-dip measurement taken before commencing to deploy the seismic gear.



The initial deployment took 32 hours longer than anticipated due to a technical fault with one of the streamers, but once the set up of the equipment was complete, and the acquisition of seismic data started, it all went very well. Mobilisation was completed on 21st November 2007.

There were very little ship or fishery activities in the area, as most of the traffic passed to the southeast of us. Cetacean sightings were very common during deployment when we were closer to the coast but not so common once production commenced.

A crew change for the seismic crew was safely conducted by helicopter on 20th, 21st, 22nd & 23rd November 2007.

In the evening of the 21st November parts of streamer 1 came to the surface in a turn, due to a faulty bird going into reset cycle in a turn. Due to unfavourable wind and seas, this caused an entanglement of tail buoys 1 and 2. The weather did not permit the workboat to go out and fix the problem, and trying to turn to untangle the buoys was unsuccessful. But we were allowed to continue the operation by the onboard Client rep. The problem caused some noise on the tail end of streamers 1 and 2, and 5 traces on each cable had to be edited out. The tail buoys came apart again in the morning of the 23rd November. The tail of streamer 2 appeared to be heavy after this, and at the first opportunity, the workboat was launched for inspection, and the stretch had to be changed. When getting the old stretch onboard, it was revealed that about 50 litres of kerosene had seeped out.

A refuelling from the M/V PACIFIC CREST was planned when the weather became optimal on 26th November. At air pressure testing of the fuelling hose, the hose did not hold pressure. The operation was aborted, and the vessel sent to Port Welsh Poole to check the hose. On 28th November the hose was tested with a 5 bar when coiled out on the dock, and there was no drop in pressure after 30 minutes.

The last line was acquired in the early hours on the 28th November, and the vessel started transiting to the next survey area while carrying out maintenance work on the streamers.

1.2 Key parameters

Source	:	2 x 3090 in^3
Source depth	:	6 m
Streamers	:	6 x 6000 m
Streamer spacing	:	100 m
Streamer depth	:	7 m
Near trace offset	:	108 m

1.3 Systems

Source type	:	Bolt LLXT guns
Streamer type	:	PGS RDH-S
Recording system	:	NTRS
Navigation	:	SkyFix.XP DGPS
	:	StarFix.HP DGPS
Float positioning	:	Fugro RGPS
Acoustic ranging	:	I/O Digicourse

1.4 Production

	Sail line km	**CDP km**
Prime chargeable	696.61875	8359.425
Infill	210.6000	2849.475
Infill percentage	29.78 %	
Total	**907.21875**	**11208.900**

1.5 Survey Timing

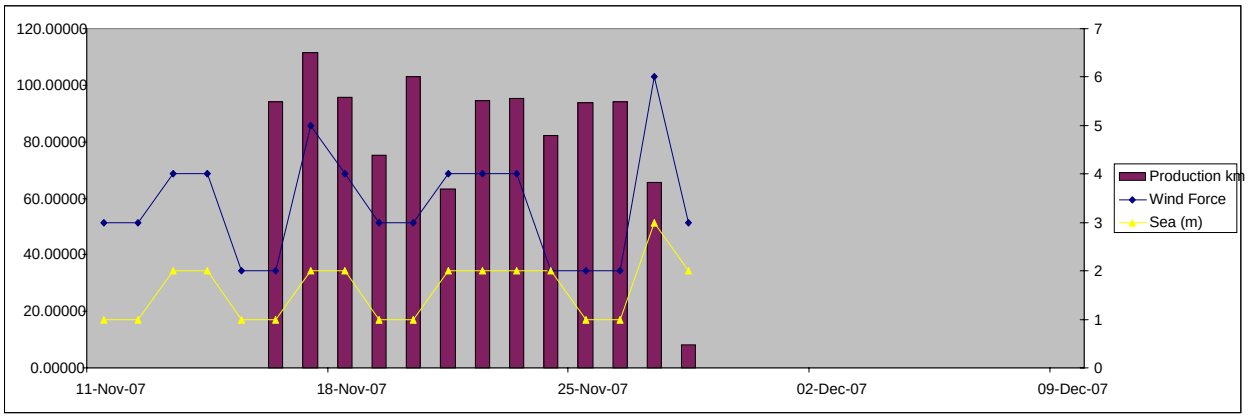
	Hours		Hours	% of total
Production	248.59	Prime Production	126.12	29.19 %
		Line Change	78.50	18.17 %
		Infill	24.38	5.64 %
		Run Out (Prime)	14.97	3.47 %
		Run Out (Infill)	4.62	1.07 %
		Local Transit/Prospect Change	20.00	4.63 %
Standby	55.67	Line Change Standby	16.32	3.78 %
		Scouting	8.00	1.85 %
		Global Transit	8.00	1.85 %
		Helicopter at Sea	3.35	0.78 %
Mob / Demob	75.40	Streamer Deployment	54.00	12.50 %
		Reconfiguration	8.00	1.85 %
		Source Deployment	6.00	1.39 %
		Extended Mob, Instrumentation	2.00	0.46 %
		Extended Mob, Navigation	2.00	0.46 %
		Extended Mob, Operations	1.77	0.41 %
		General Demob	1.63	0.38 %
Downtime	52.34	Leakage, x-feed, Telemetry	33.87	7.84 %
		Active, Passive Modules	6.33	1.47 %
		Streamer Interface Software	5.70	1.32 %
		Streamer Interface Hardware	3.65	0.84 %
		Other Towing Hardware	2.62	0.61 %
		Software problems inc. Crash	0.17	0.04 %
total	**432.00**		**432.00**	**100.00 %**

2 Sequence of events

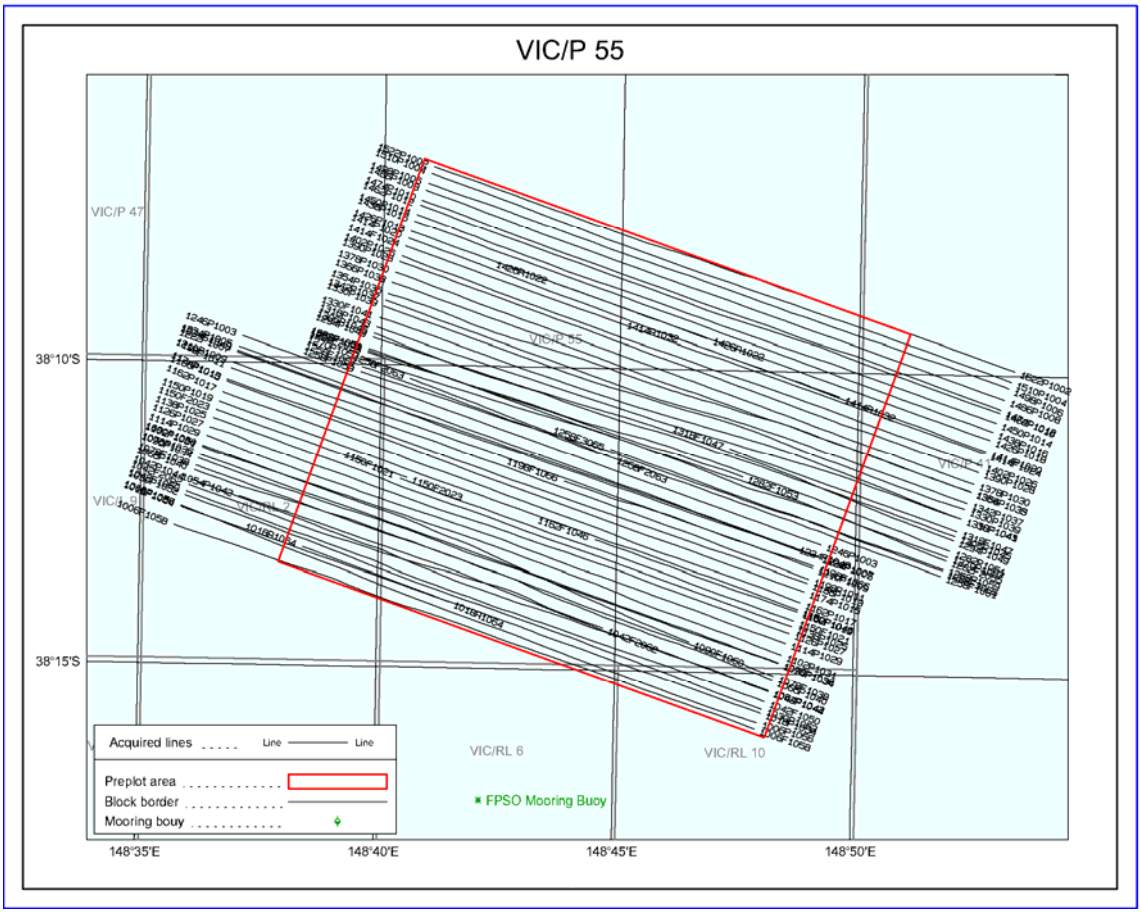
2.1 Daily log

DATE	Total Km	Prime FF	Prime Runout	Infill FF	Infill Runout	Wind F'ce	Swell (m)	Location & Comments
11-Nov						3		START OF 2007097 SURVEY FOR SANTOS Arrived in area. Scouted deployment & prospect area. Commenced deployment.
12-Nov						3		Deployed str.1,2&6 wide. Streamer 5 & 3 deploying at end of day.
13-Nov						4		Deployed str.3&5 wide. Streamer 4 still deploying at end of day.
14-Nov						4		All streamers out wide. Guns deployed & tested good. Str.3 telemetry problems could not be resolved in-sea. Recovered gun arrays and str.3
15-Nov						2		Str.3 telemetry problems resolved to acceptable level. Redeployed gun arrays and str.3
16-Nov	94.18125	79.18125	15.00000			2	1	Production seq.002,003,004,005,006
17-Nov	111.60000	95.00625	16.59375			5	2	Production seq.007,008,009,010,011,012
18-Nov	95.56875	79.16250	16.40625			4	2	Production seq.013,014,015,016,017
19-Nov	75.33750	47.51250	9.00000	15.82500	3.00000	3	1	Production seq.018(edit for telemetry),019,020(edit for telemetry), 021(aborted for telemetry),022(telemetry reshoot of 018 hole),023(edit str6)
20-Nov	103.20000	72.35625	12.00000	15.84375	3.00000			Production Sequence 024(edit str.6),025,026,027,028,029
21-Nov	63.46875	54.31875	9.15000			4	2	Production Sequence 29, 30, 31, 33. TB 1 and 2 tangled
22-Nov	94.46250	63.33750	14.85000	15.82500	0.45000	4	2	Production Sequence 33, 34, 35, 36, 37, 38 Tb 1 and 2 tangled
23-Nov	95.13750	63.31875	10.42500	15.84375	5.55000	4	2	Production Sequence 38, 39, 40, 41, 42, 43. Crew chg completed, 2 helicopters
24-Nov	82.25625	44.21250	6.00000	26.04375	6.00000	2	2	Production Sequence 44, 45, 46, 47, 48, 49. Wb out. Life boat drill.
25-Nov	93.65625	50.73750	12.00000	27.91875	3.00000	2	1	Production Sequence 49, 50, 51, 52, 53 aborted - telemetry, 54 hole, telemetry. Wb out.
26-Nov	94.12500	47.47500	9.00000	31.65000	6.00000	2	1	Production Sequence 55, 56, 57, 58, 59. Wb changed tailstretch streamer 2, skin damage in tangle. Attempted refuelling, but stopped d/t airleak in pressure test. Garbage transfer with Wb.
27-Nov	65.58750			53.58750	12.00000	6	3	Production Sequence. 60,61. 62, 63, 64(reshoot), 65. Streamer 6 syncproblems.
28-Nov	8.06250			8.06250		3	2	Production se 66. End of survey.

2.2 Daily production and sea state



2.3 Post plotted vessel positions



3 Key personnel

	11th November 2007 to 20 November 2007	20th November 2007 to 28th November 2007
Party Chief	Andrew Sinnott	Per Kåre Hovland
Chief observer	Errol Wright	Mike Coble
Chief navigator	Pete Jenkins	Richard Murchie
Chief mechanic	Kenny Brock	Larry Granzin
Chief geophysicist	Colin Hughes	Rune Strømme
Client representative onboard	Drew Murray	Alex White
	Bill Lloyd	Ray Doughty
Client contacts onshore	Andrew White	

4 HSE

4.1 Statistics

Total Man Hours (uncorrected)	21720
Correction Ratio	1.00
Survey Hours	432.00
Hours in Calculation (# daily Conds. * 24)	432.00
Total Man Hours (corrected)	21,720.00
Small Boat Launches	13
Small Boat Exposure (man hours)	97.37
Incident Reports	3
Toolbox Meetings	26
Drills	4
Helicopter Ops	11
Helicopter Exposure (man hours)	75.77
MMO Sightings	36
MMO where action reqd.	0

4.2 Incidents

Report no.	Date	Action by	Classification	Comments
10774/07/MA	27-11-07	PGS	NM	Spill of 50 ltrs of kerosene from burst stretch over some days.
10667/07/MA	26-11-07	PGS	NM	Air pressure test on bunker hose failed. Operation aborted. Vessel went to port for check.

5 Survey operations review

5.1 Survey area information

Oilfield installations

None in the prospect area, but to the west and the south there were major developments.

Oilfield activity

At one of the installations (Basker), diving operations were being conducted at the start of our survey. We made initial contact with their operations before leaving Port Kembla, and kept them updated of our arrival in-field. Once on location, we kept them informed of our timing, in particular in respect to the firing of the airgun source arrays.

No effects of our activities impinged on their operation, so we in turn were unaffected by their programme. The diving operations were concluded on 17th November.

Shipping Activity

The main shipping lane was to the south east of the prospect running southwest to northeast. Very little traffic strayed into the survey area.

Sea Conditions, Tides And Currents

The sea conditions were good for most of the time, with winds mainly from SE to NE. For the majority of the time around force 4 to 5. On one occasion it started to cause more noise on the streamers, and the streamers were brought down to 7.5-8 meters depth. The increasing seas were also a contributing factor when streamer one came to the surface and tangled with tail buoy 2 on 21st November.

The currents were running in the direction North East – South West, and seemed to follow the tidal swing. Due to the short line lengths it was impractical to shoot on tides, and the feather matches were not good between adjacent lines.

In Sea Dangers

The main in-sea danger was from immersion, the temperature being around 15°C. To mitigate this, all occupants of the small boats wore immersion suits with integral flotation.

There were sightings of sharks but not in any great quantity.

Time sharing

No other seismic surveys were being conducted in the adjacent area at the time.

Fishing Activity

No fishing activity was experienced in the survey area and the near vicinity.

Weather

The weather was fair for all the time on the survey, and no time was lost due to weather standby.

The main direction for the wind was North Easterly and South Westerly, with a swell around 2 metres for most of the time. This limited the use of the workboat to deal with problems on the in-sea equipment.

Cetaceans

A dedicated marine mammal observer (MMO) was present throughout the survey and diligently logged the many sightings. The majority of the sightings were logged while off the prospect area, to the north, during deployment and no mitigating actions were required at that stage. A comprehensive list of sightings can be found in appendix 12.7

Naval Activity Including Civil Unrest

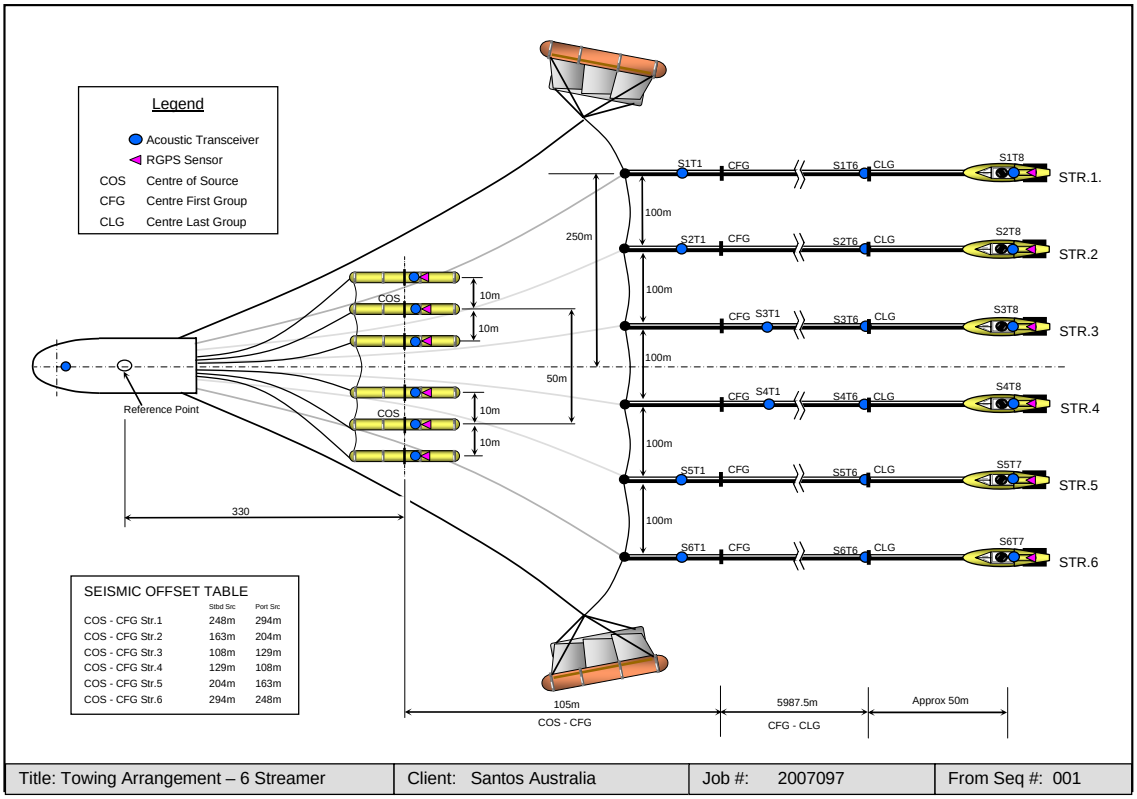
There were no naval activities during the survey.

6 Seismic energy source

6.1 Source details

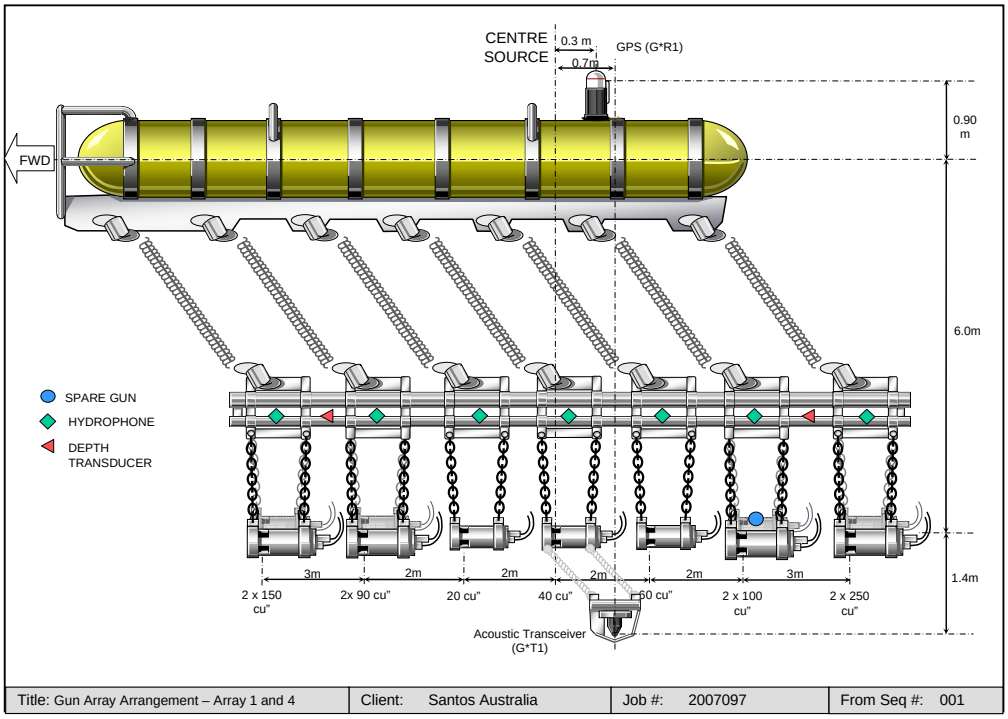
Source type	:	Bolt 1900 LLXT air guns
Air pressure	:	2000 psi
Volume	:	3090 in^3
Number of sources	:	2
Number of sub-arrays	:	6 (2x3)
Source separation	:	50 m
Sub-array separation	:	10 m
Source length	:	14 m
Gun synchronisation	:	± 1.0 ms
Drop-out specification	:	5 %
Shot interval	:	18.75 m
Depth	:	6 +/-1 m
Depth control	:	Fixed depth ropes
Depth monitoring	:	AGG depth transducers, GCS-90
Spacing control	:	Spread-ropes on sliding collars
Near field signatures	:	7 phones per subarray
Compressors	:	4 x Chirco
Source controller	:	GCS-90
Modelled source signature	:	See Appendix section 12.2

6.2 Offset diagram



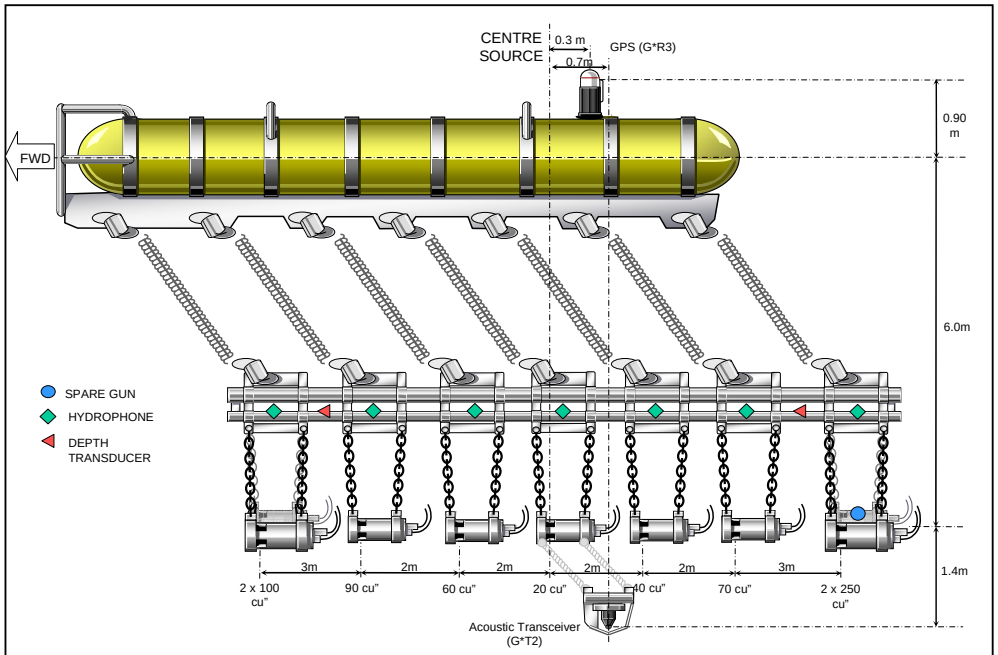
6.3 Gun array layout

Array #1 & 4



Title: Gun Array Arrangement – Array 1 and 4	Client: Santos Australia	Job #: 2007097	From Seq #: 001

Array #2 & 5



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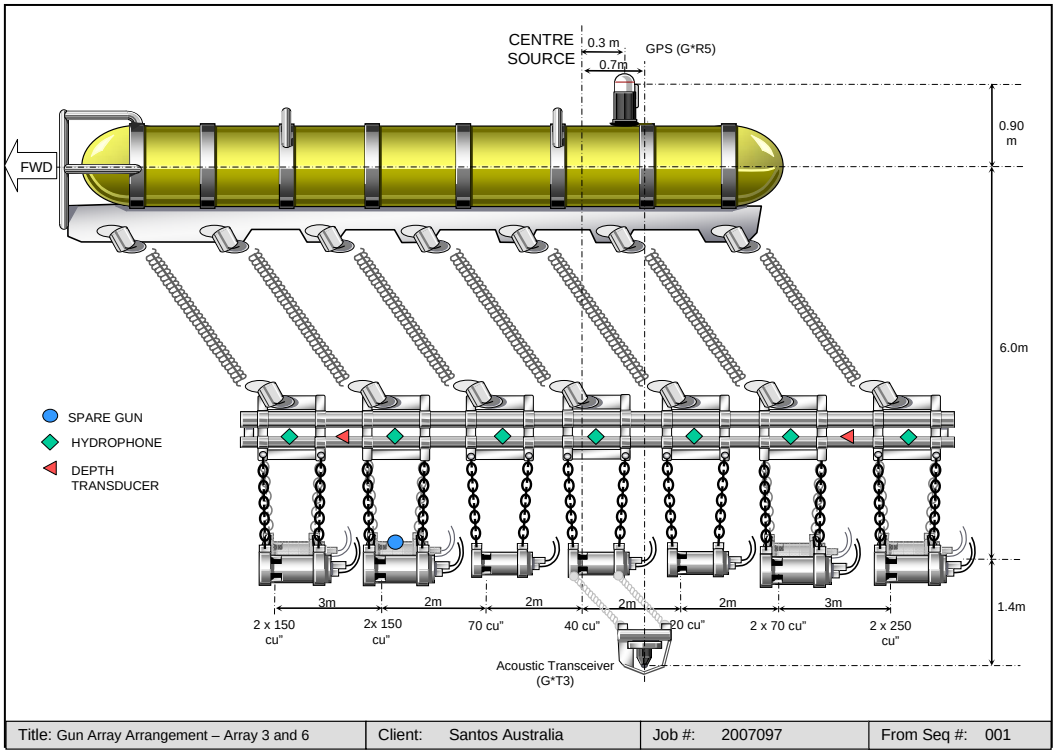
Array #3 & 6


CENTRE SOURCE
0.3 m
0.7m
GPS (G*R5)
FWD
0.90 m
6.0m
1.4m
SPARE GUN
HYDROPHONE
DEPTH TRANSDUCER
3m
2m
2m
2m
2m
2m
3m
2 x 150 cu"
2x 150 cu"
70 cu"
40 cu"
20 cu"
2 x 70 cu"
2 x 250 cu"
Acoustic Transceiver (G*T3)
Title: Gun Array Arrangement – Array 3 and 6
Client: Santos Australia
Job #: 2007097
From Seq #: 001

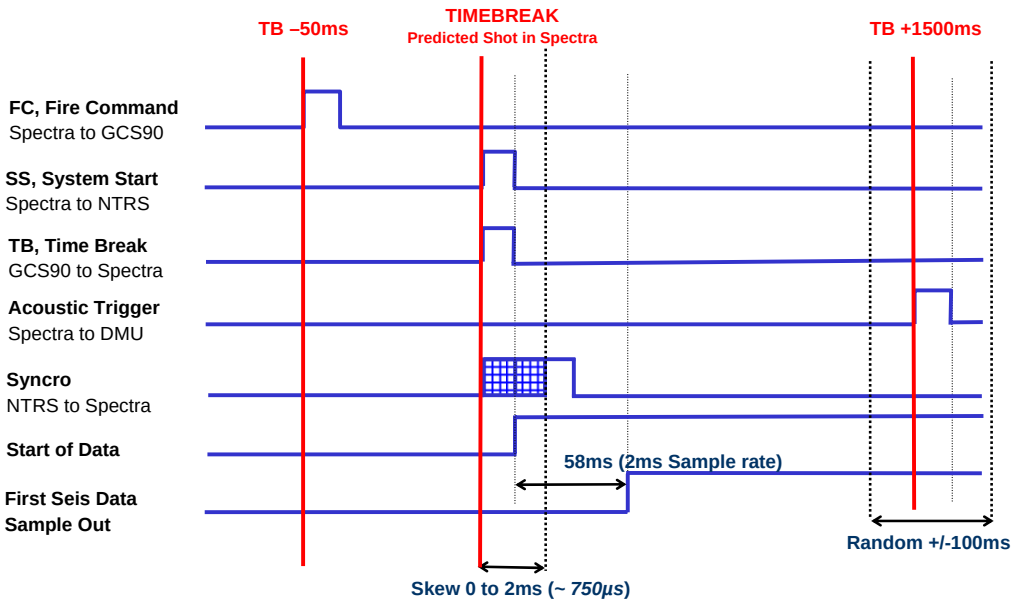
7 Seismic acquisition system

7.1 System details

Recording System	:	NTRS / gAS
Software Version	:	Version A.70a build 10581
Amplitude resolution	:	24 bit
Data Channels	:	6 x 480 = 2880
Auxiliary Channels	:	48 channels recorded to tape
Tape Transports	:	4 x IBM 3592 cartridge drives
Tape Format	:	8036 SEG D,
Recording Media	:	IBM 3592
Record Length	:	6144 ms
Deep water delay	:	0 ms
Sample Rate	:	2 ms
High Cut Filter	:	206 Hz /276. 20dB/octave
Low Cut Filter	:	4.60 Hz /6.00dB/octave
Gain Setting	:	12 dB
Polarity Convention	:	SEG, positive pressure gives negative number
SEG-D header description	:	see Appendix section 12.3

7.2 System timing

NOTES
1. Timebreak recorded on Aux channel 1



Title: System Timing Diagram	Client: Santos Australia	Job #: 2007097	From Seq #: 001

7.3 Streamers

7.3.1 Streamer details

Type of streamer	:	Teledyne RDH-S
Number of streamers	:	6
Streamer sensitivity	:	20 V/bar
Streamer length	:	6000m
Number of groups	:	6 per section
Group interval	:	12.5 m
Group length	:	12.5 m
Hydrophone type	:	T-2
Streamer depth control	:	Digibird 5011
Streamer depth	:	7m
Number of compass-birds	:	23/streamer (extra bird for outer streamers to compensate for door wash)

7.3.2 Trace Numbering

STREAMER	TRACE
Streamer 1	1 to 480
Streamer 2	481 to 960
Streamer 3	961 to 1440
Streamer 4	1441 to 1920
Streamer 5	1921 to 2400
Streamer 6	2101 to 2880
Auxiliaries	1 to 48

7.3.3 Component dimensions

	NUMBER per STREAMER	NOMINAL LENGTH (m)
Lead-in	1	700
Mini Lead-in Boot	1	3.5
Head Conventional Boot	1	2.7
Head AP Stretch Section	1	5
Head Dead section	1	15
Hydroscience Module	41	0.350
Live Sections	80	75
Tail Stretch Sections	1	50
Power Adapter Tail Swivel	1	0.340

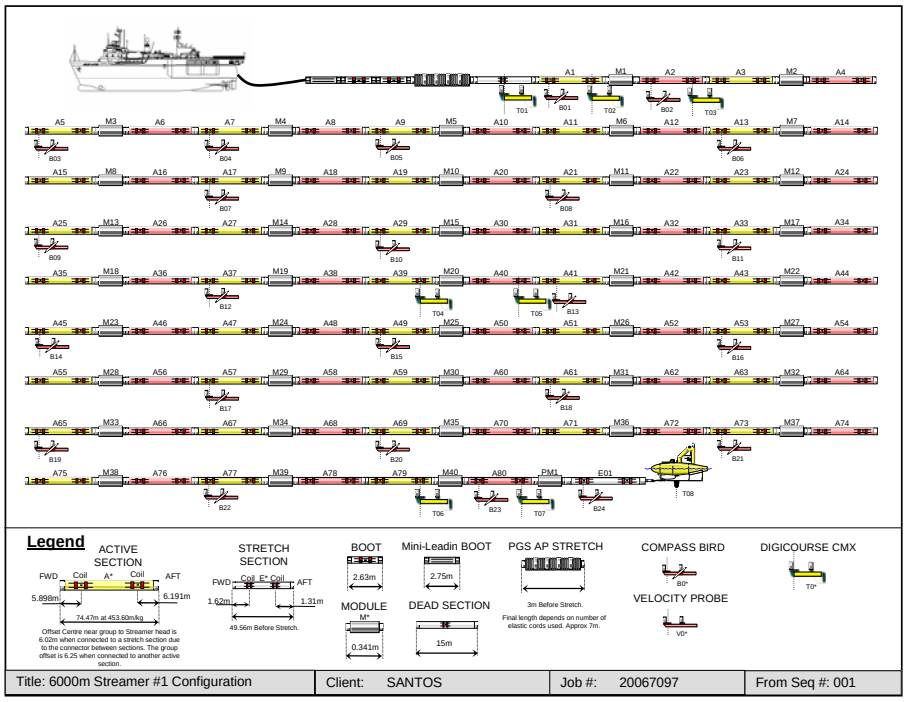
7.4 Recording System

7.4.1 Recording System performance

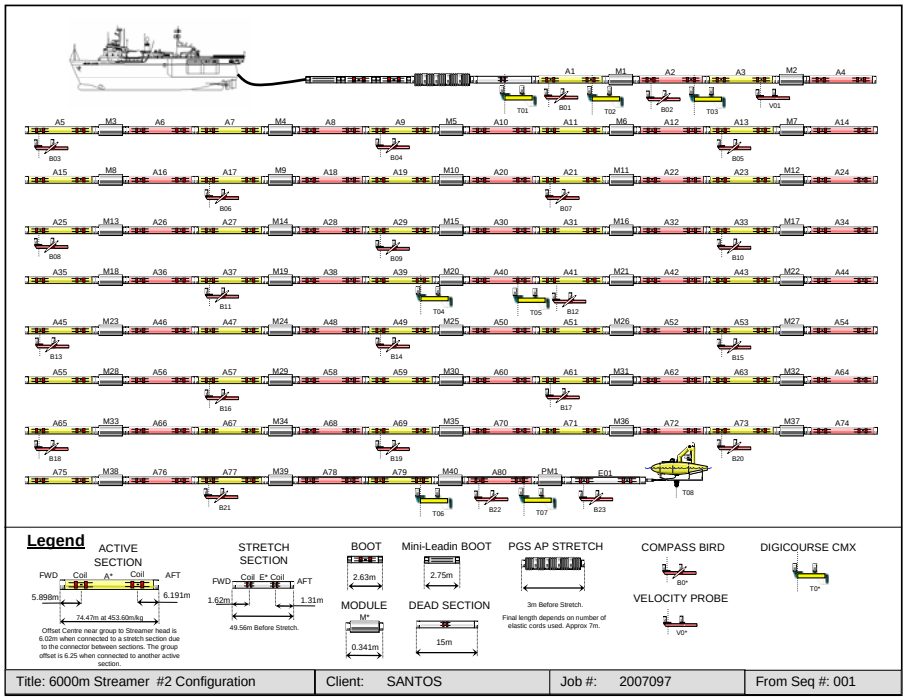
The NTRS and gAS systems performed well throughout the job.

7.5 Streamer layout

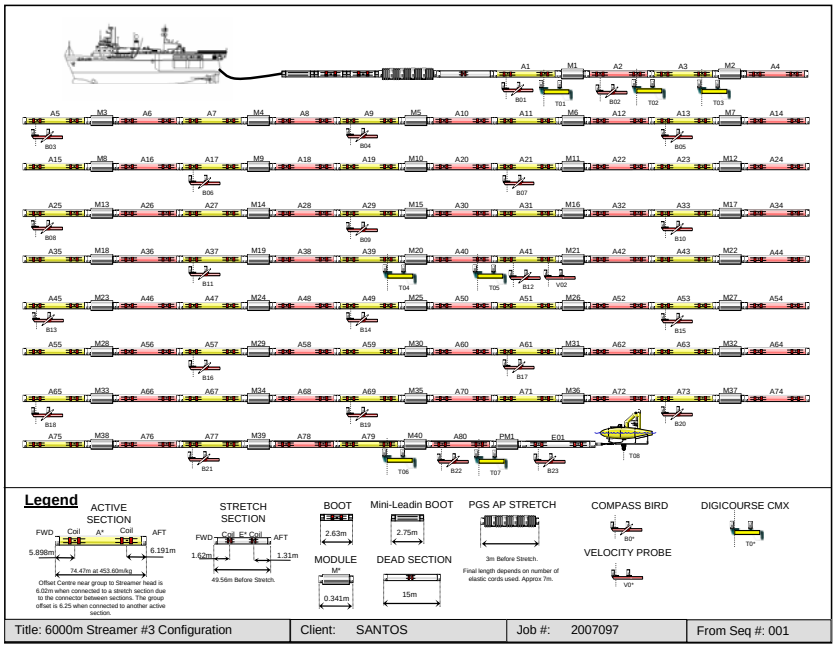
Streamer #1



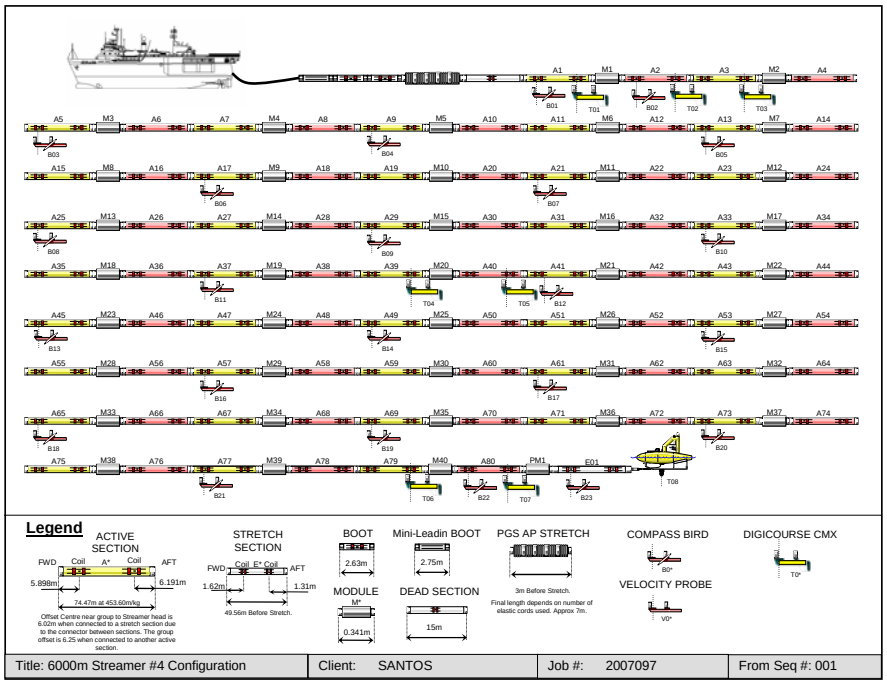
Streamer #2



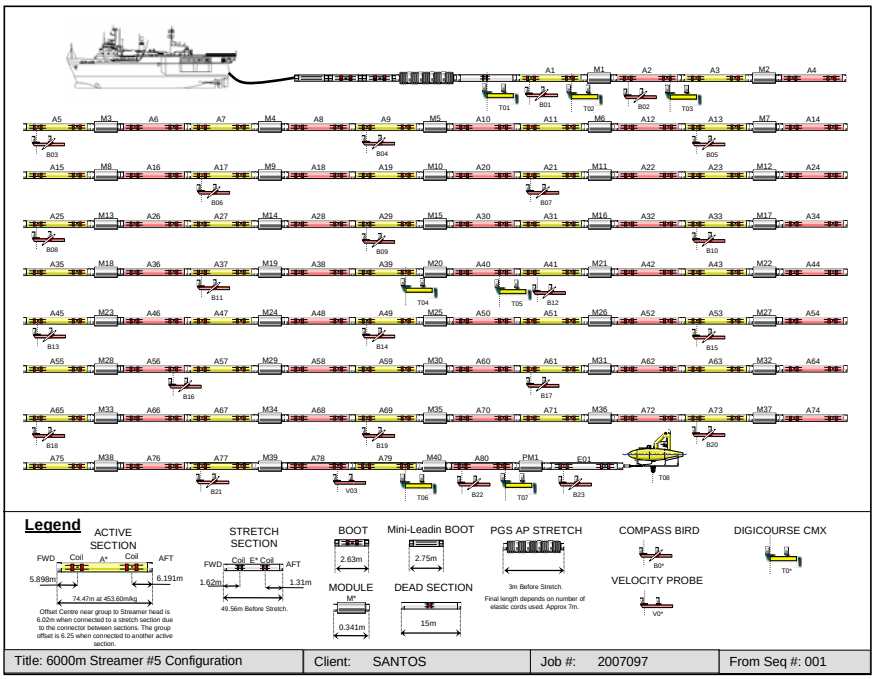
Streamer #3



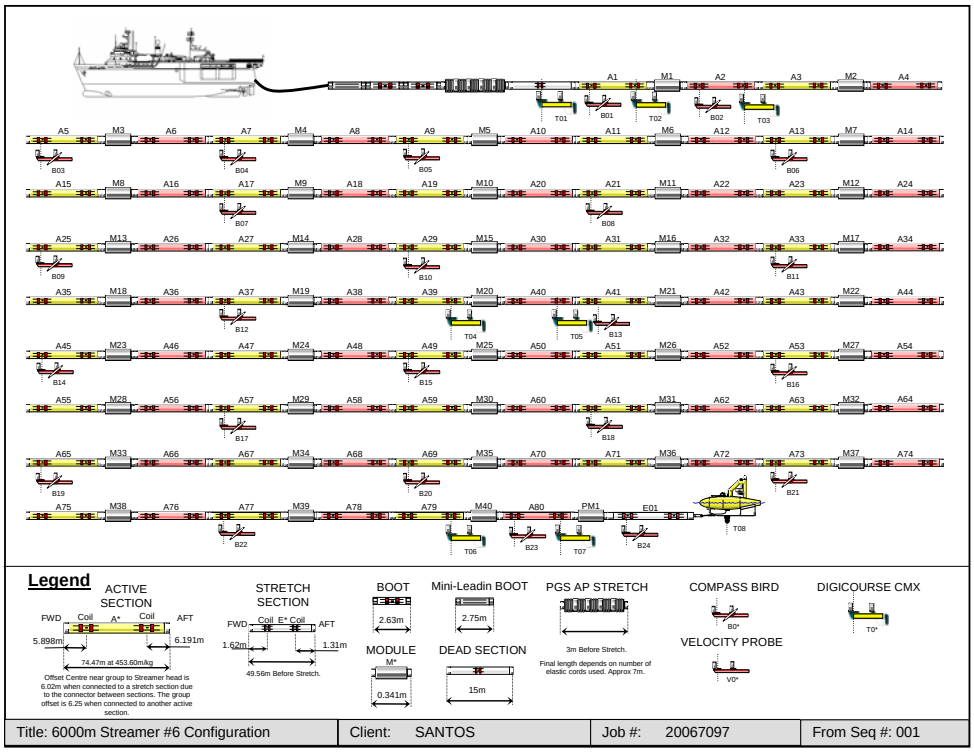
Streamer #4



Streamer #5



Streamer #6


Legend
ACTIVE SECTION
FWD
Coil
A*
Coil
AFT
5.898m
6.191m
74.47m at 453.60m/kg
Offset Centre near group to Streamer head is 6.02m when connected to a stretch section due to the connector between sections. The group offset is 6.25 when connected to another active section.
STRETCH SECTION
FWD
Coil
E*
Coil
AFT
1.62m
1.31m
49.56m Before Stretch.
BOOT
2.63m
MODULE
M*
0.341m
Mini-Leadin BOOT
2.75m
DEAD SECTION
15m
PGS AP STRETCH
3m Before Stretch.
Final length depends on number of elastic cords used. Approx 7m.
COMPASS BIRD
B0*
VELOCITY PROBE
VD*
DIGICOURSE CMX
T0*
Title: 6000m Streamer #6 Configuration
Client: SANTOS
Job #: 20067097
From Seq #: 001

8 Navigation and Positioning

8.1 Geodetic reference

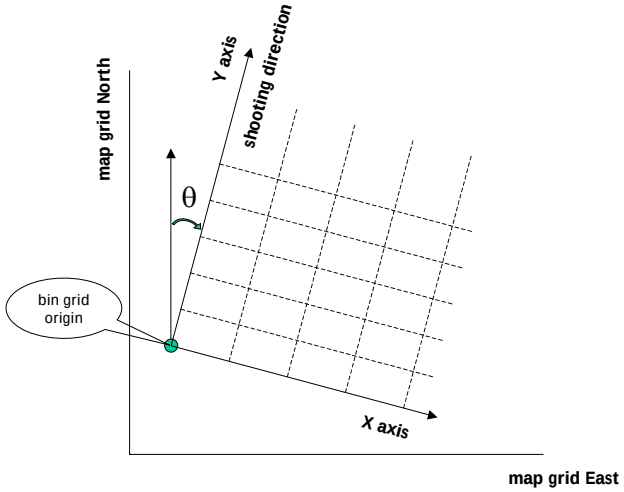
8.1.1 Survey Datum

Survey Datum	:	WGS84
Ellipsoid	:	WGS84
Semi Major Axis	:	6378137 m
1/Flattening	:	298.257223563
GPS Datum	:	WGS84
Ellipsoid	:	WGS84
Semi Major Axis	:	6378137 m
1/Flattening	:	298.257223563
Geoid height EGM90 model (for point 38º11'19.6''S 148º44'29.7''E)	:	5.35m (4.66m *min*, 6.01m *max*)

8.1.2 Map projection

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

8.1.3 Binning grid



Origin Easting (m)	:	660,831.55
Origin Northing (m)	:	5,761,257.19
Rotation (deg)	:	289.96

	X	Y
Origin bin number	1528	1845
Bin number increment	1	0.33
Area size (m)	14175	22831.25
Bin interval (m)	25	6.25
Bin size minimum (m) at 100 m offset	25	6.25
Bin size maximum (m) at 6100m offset	75	6.25

Two different offset divisions and coverage requirements were specified:

For ACQUISITION and steering the spread

	% Nominal Fold	Nominal Fold	Required Fold
For near offset segment (100 m to 1600 m)	70	20	14
For near-mid offset segment (1600 m to 3100 m)	80	20	16
For far-mid offset segment (3100 m to 4600 m)	70	20	14
For Far offset segment (4600 m to 6100 m)	65	20	13

For INFILL ALLOCATION

	% Nominal Fold	Nominal Fold	Required Fold
For near offset segment (100 m to 1600 m)	75	20	15
For near-mid offset segment (1600 m to 3100 m)	85	20	17
For far-mid offset segment (3100 m to 4600 m)	75	20	15
For Far offset segment (4600 m to 6100 m)	65	20	13

P6/98 Full fold coverage perimeter listing : see Appendix section 12.5

8.2 Surface positioning

8.2.1 System I

Type : SkyFix.XP, SDGPS Orbit and Clock Corrected
System Corrections via : Inmarsat (POR) and AP-SAT High Power Spot

Software : Multifix 4, version 2.01
Sub-Contractor : Fugro A/S
GPS Receiver : SPM 2000 TopCon

The SkyFix.XP service uses a technique called Satellite Differential GPS (SDGPS); a worldwide network of reference stations is used to calculate, in real time, the orbital information (ephemeris) of each GPS satellite with more precision than that transmitted by the satellite. Corrections to the broadcast ephemeris are then uploaded to the user via the existing SkyFix/StarFix satellite communication infrastructure.

8.2.2 System II

Type : StarFix.HP, DGPS
Differential Corrections via : Inmarsat (POR) and AP-SAT High Power Spot

Reference Stations in use : Melbourne 334 km distant
Bathurst 555 km distant
Cobar 790 km distant
Brisbane 1258 km distant

Software : SPM 2000, version 4.26
Sub-Contractor : Fugro A/S
GPS Receiver : SPM 2000 TopCon

The StarFix.HP service provides centimetre-level accuracy by measuring the carrier-phase differences on both GPS signal frequencies (L1 and L2) to more accurately model the state of the ionosphere, minimising errors associated with the transmission path between the satellite and the receiver. As with standard Differential GPS networks, corrections are derived by a network of reference stations located within the geographical area of operations and transmitted to the user via geostationary satellite links to provide coverage over wide areas

8.2.3 Float positioning

Relative GPS	:	Seatex models 320 & 220
GPS receiver	:	Ashtech G 12-L
UHF communication	:	Wood & Douglas, frequency 450-470 MHz
Software version	:	StarFix Suite RGPS v3.02.04

The relative GPS system works through using the pseudo-range phase differencing technique to provide the true range and bearing from the master antenna on the vessel to the GPS receivers on the in-sea equipment.

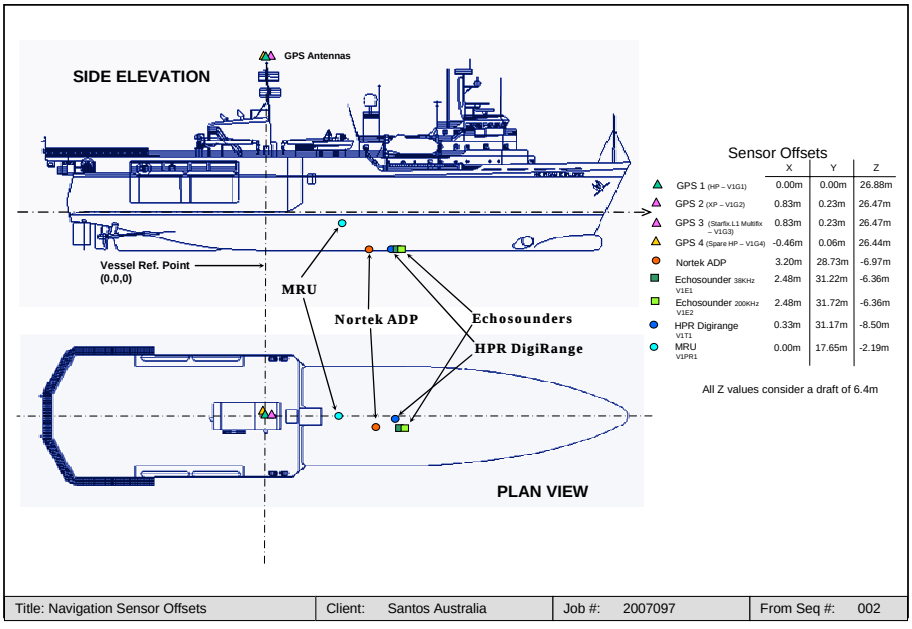
8.2.4 Heading reference

GPS Heading / Attitude system	:	Seapath 200
Gyro	:	SG Brown 1000S Gyro Compass

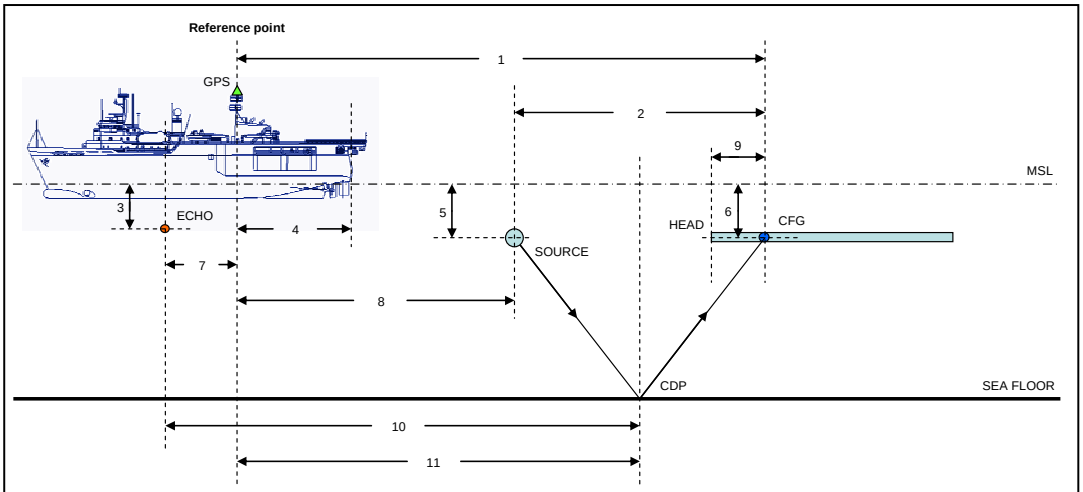
The Seapath 200 is an integrated GPS/Inertial attitude and positioning system. It is comprised of dual GPS antennae determining heading and position using carrier phase measurement. Inertial data from the Motion Reference Unit provides acceleration and angular information about three axes. Static speed and latitude corrections were applied to the gyrocompass via the internal controls and not automatically from the navigation system.

The Seapath 200 was used as main heading reference throughout the survey.

8.2.5 Navigation Sensor Offsets



8.2.6 Navigation Offsets



Key	Range	Distance (m)	Key	Range	Distance (m)
1	Streamer inline offset	435	7	Echo-sounder inline offset	31.47
2	Seismic offset	105	8	Source inline offset	330
	Nominal seismic offset input SCN / Census	*100*	9	Streamer head to Centre first group	6.25
3	Echo-sounder depth	6.36	10	Echo-sounder to CDP	413.97
4	Reference to Stern	32	11	Layback	382.5
5	Source depth	6		*Nominal layback input SCN*	*380*
6	Streamer depth	7			

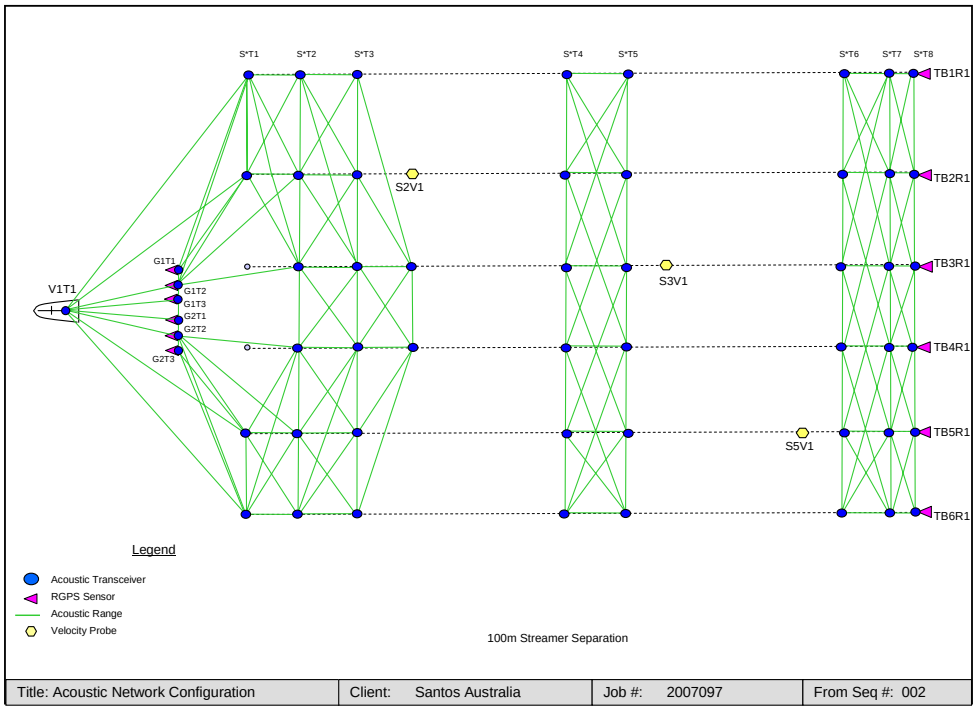
Title: Side View Offsets	Client: Santos Australia	Job #: 2007097	From Seq #: 002

8.3 Underwater positioning

8.3.1 Acoustic ranging system

System name	:	DigiRANGE
Software version	:	System 3, version 6.01
Operating frequency	:	50 – 100 kHz in 5 discrete frequencies

8.3.2 Acoustic network



8.3.3 Magnetic compasses

Bird Compasses	:	DigiCOURSE 5011 Compass/Bird
Software version	:	System 3, version 6.01
Compass Filtering	:	2s Sample rate, 14s filtering time
Magnetic variation	:	13.37°

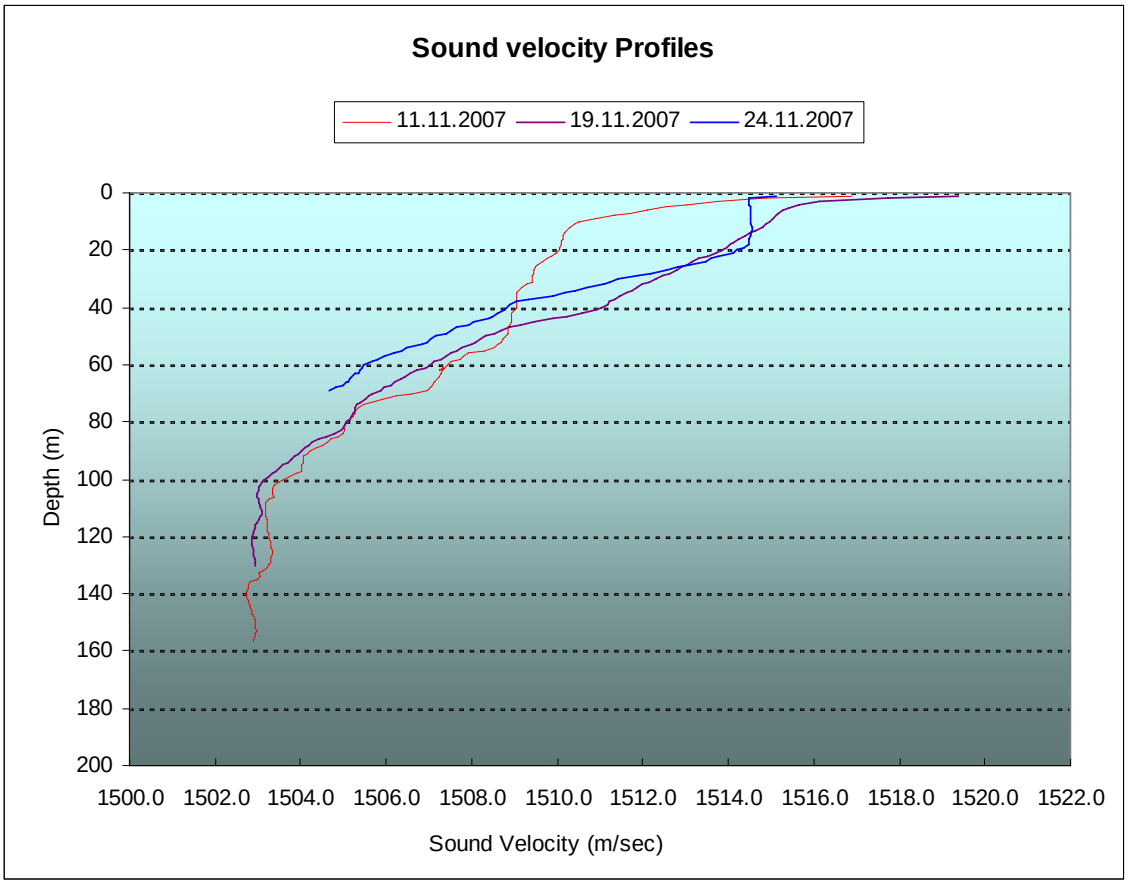
8.3.4 Echosounder

Type and model	:	Simrad EA500
Transceiver frequencies	:	38 kHz, 200 kHz
Heave compensated	:	Yes

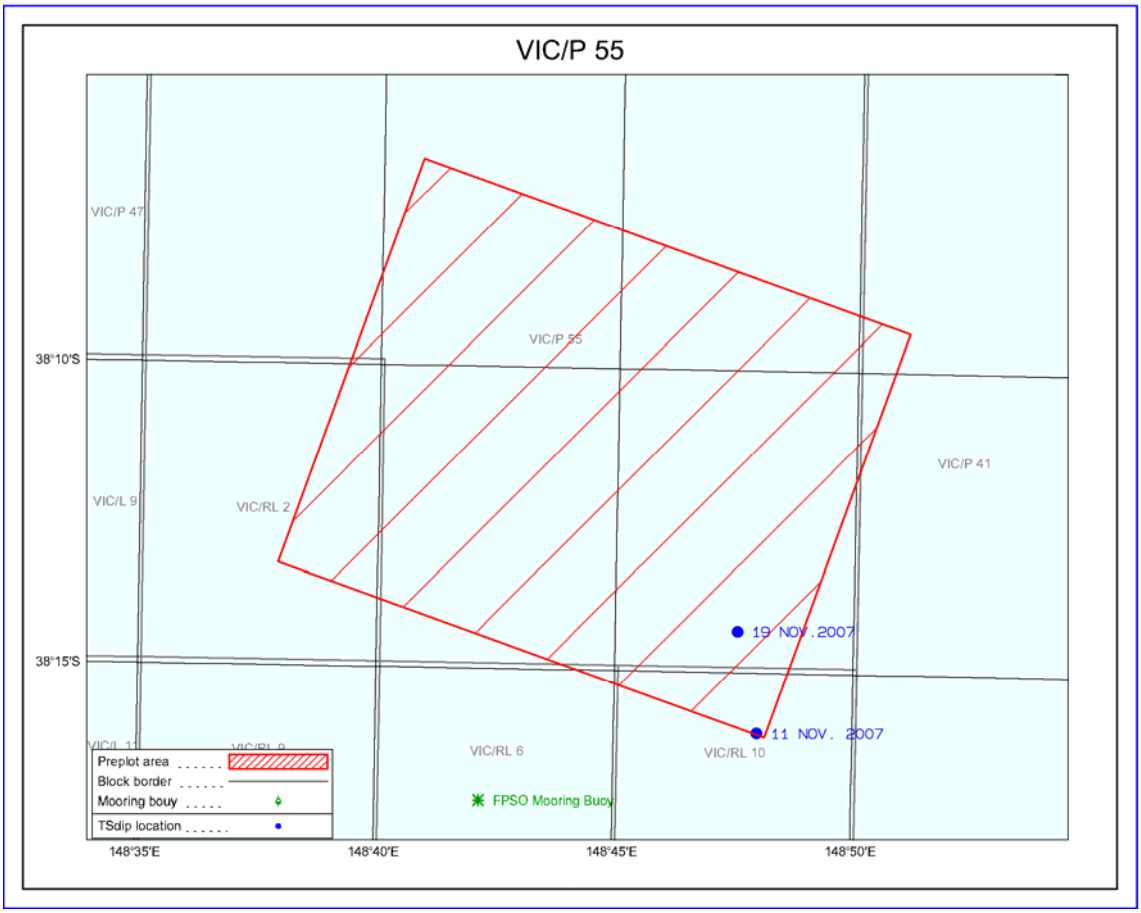
8.3.5 Sound velocity

CTD probe	:	Model 600 CTD (1000μbar)
Serial	:	13829
Calibration Date	:	15th March 2007
Supplier	:	Valeport
Real time sensors	:	DigiCOURSE model 7000 (Velocimeter)
Software version	:	System 3, version 6.01

The following chart shows the results produced with data from the Valeport probe. A total of three profiles were collected during the course of the survey.



Tsdip taken 24th November was not used when corrected water depths for velocity variations. Profile was not deep enough.



Dip location

After the survey was finished a special waterdepth tape was created.
Waterdepths were corrected for draft, sound velocity and tide.

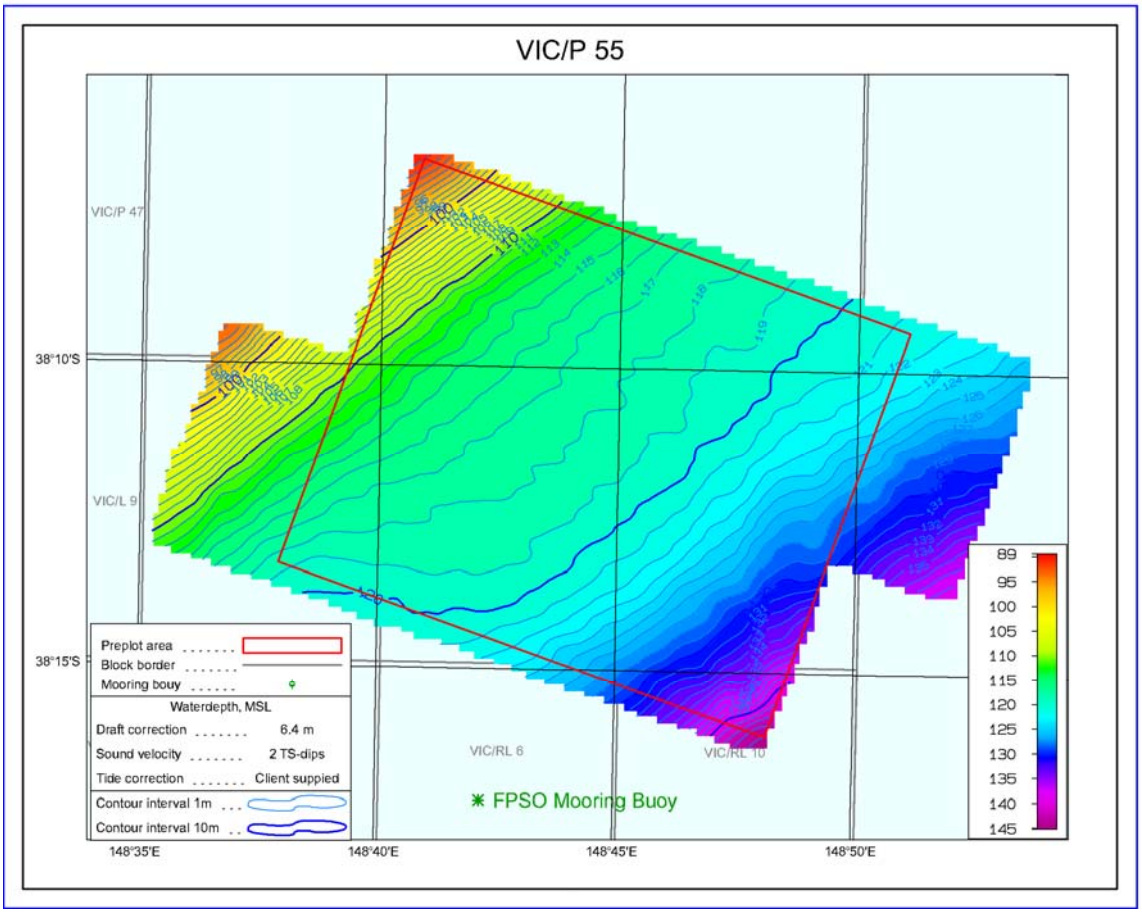
Draft applied: 6.4m

Ts-Dip used to corrects for sound velocity variations:

Profile	Date	Position
Profile #1	11.11.07	38°16'S 148°48'E
Profile #2	19.11.07	38°14.19'S 148°47 34'E

Tide Corrections to MSL were supplied by the client.

File name : Vicp55.Txt
Location : 38°11'10"S 148° 44' 40"E



Waterdepth after correction applied. Depths varied between 90 and 145m.

8.4 Navigation and binning systems

8.4.1 Integrated navigation system

Type	:	SPECTRA
Operating System	:	Linux Redhat 9
Supplier	:	Concept Systems Ltd.
Software version	:	10.09.01
Real Time Interface	:	PowerRTNU version 4.4.2
Machine type	:	2 x IBM X325 Servers
		2 x IBM Intellistation
Tape storage	:	IBM 3590 / DAT
Disk Storage per Server	:	240GB
Disk Storage per Workstation	:	35GB
Disk storage device	:	RAID

8.4.2 Binning system

Type	:	Census
Supplier	:	Input / Output Systems
Software Version	:	4.4.1
Machine type	:	IBM RS6000 model 44P
Operating System	:	IBM AIX 4.3.3
Tape storage	:	IBM 3590
Hard Disk storage	:	75GB online, 75GB offline

8.5 Navigation System Performance

8.5.1 Vessel position

Two DGPS systems were operational for vessel positioning, SkyFix.XP and StarFix.HP. During the project, comparisons between the systems for the computed vessel position (easting and northing axis) indicated both systems performed well, with the mean difference less than 1.0 metre and the maximum difference less than 1.0 metres.

8.5.1.1 SkyFix.XP

The SkyFix.XP solution performed well for the entire survey with very few failures. When the system did fail to provide a converged solution the cause was determined to be firmware resets of the SPM2000 GPS receiver. The cause of the resets is part of an ongoing investigation by Fugro. Once the GPS position data string to the MultiFix software producing the XP solution fails it will cause the systems filtering algorithm to be reset. There is then a period when the solution will be rejected until the position re-converges.

8.5.1.2 StarFix.HP

The StarFix.HP solution also performed well for the survey period, with no problems. Even though the system has a similar SPM2000 to the SkyFix.XP there is still an ongoing investigation by Fugro into why some systems exhibit reset problems at times while others do not.

8.5.2 Acoustic ranges

The acoustic data for this survey was of good quality through out the survey providing a strong network solution for each of the sub-nets. One additional transceiver was added to the front end of each streamer, from the original proposal of two per cable, to provide added redundancy in case of any unit failures in the front net. As is normal, the only poor performance were the available ranges between streamers 3 & 4 and between the sources in the front net, the area directly affected by the prop wash and gun bubble with its associated aerated water.

8.5.3 Compass Data

Twenty-four compasses were deployed on each of the outer streamers and twenty-three on each of the remaining inner streamers. The compass data was good throughout the survey. Compass data for all sequences were analysed for biases, stuck values and excessive noise with unacceptable compasses being rejected from the post-processing solution and physically replaced on the streamers when appropriate.

8.5.4 Remote Positioning

Positioning of the remote targets, both source arrays and tail buoys, was generally very reliable, although a small amount of radio interference was observed on both operating frequencies. The units had all previously been used on a previous short job, and had been found to be operating within its standards of accuracy.

8.5.5 Echo Sounder

The echo sounder data output in the final P1/90 depth records was derived from the 200 KHz transducer, which performed well throughout the survey. The raw data was not draft corrected and a fixed water velocity of 1500m/s was used internally by the echo sounder. Final bathymetry data was produced after survey completion in the PGS Oslo office.

8.5.6 Heading Sensors

The Seapath system was used as the primary vessel-heading indicator for all sequences while the conventional SG Brown gyrocompass served as back-up and a redundancy check. Seapath performed without interruption and was used as the heading indicator for all sequences. The heading data was de-spiked to remove gross outliers, but not filtered.

8.6 Delivered P1/90 and P2/94

Raw navigation data were recorded in UKOOA P2/94 format during acquisition and verified for accuracy before a deliverable P2/94 dataset was produced. These datasets were recorded to 3590 tape cartridge. One set of P2/94 tapes client tapes was included with the seismic data delivered to the processing centre at CGG Singapore, one set included with the copy of the seismic data sent to the Santos Adelaide office, and a final set shipped to the PGS office in Lysaker for archiving. The format for these tapes is:

Data Format:	ASCII
Record Length:	80 bytes (no LF)
Tape Format:	dd, block size = 8000

Processed navigation data were delivered in UKOOA P1/90 format, recorded on 3590 tape cartridge. Each dataset included position records for vessel, sources, tail buoys, echo sounder, and all receiver groups. One set of P1/90 tapes was included with the seismic data delivered to the processing centre at CGG Singapore, one set included with the copy of the seismic data sent to the Santos Adelaide office, and a final set shipped to the PGS office in Lysaker for archiving. The format for these tapes is:

Data Format:	ASCII
Record Length:	80 bytes (no LF)
Tape Format:	dd, block size = 8000

9 Navigation processing

9.1 Introduction

The final P190 was generated using either the NRT or SPRINT post processing systems. NRT is the SPECTRA near real time navigation processing module. The NRT system delivers a delayed position solution (P190) and associated quality assessment a few minutes after completion of the survey line. The delayed solution minimises the impact of latencies in certain observation streams and provides access to a portion of future data. This ensures that the NRT will provide a valid positioning solution significantly more often than is possible in the real-time solution. If manual processing were required, either due to NRT reported problems, abnormal QC statistical results, or observed situations on-line, the data was reprocessed using SPRINT.

9.2 NRT

The NRT is a separate licensed Spectra module. It gets the required information, data and from the Spectra Data-server and a NRT specific parameter file. The NRT data flow:

1. **NCN Calculated Positions**
   NRT uses the real time positions calculated by Spectra as the basis for gating outlying observations.
2. **Raw Sensor Data**
   Raw DGPS, RGPS, Acoustic, Compass, Velocimeter, Gyro, Echo sounder, Depth sensor data acquired by Spectra.
3. **Outlier Rejection**
   Based on the Spectra NCN calculated positions and observations, outliers in the raw sensor data (spikes and biases) are rejected. Note that this does not apply to compass observations, as these generally have low redundancy.
4. **30 Shot Filter Buffer**
   Raw observations (after outliers have been removed) are filtered to remove noise. Future data (60 shots) is used to improve the quality of filtering. Secondary spike rejection – based on time series – is applied to remove remaining spikes. This is particularly useful for compass observations.
5. **Compass Drift Detection**
   Temporary biases (drifts) in compasses are removed based on deviations from the smoothness of the streamers.
6. **Least Squares Adjustment**
   All filtered observations are used to update the positions in the network in a least squares adjustment. The weights of these observations are proportional to the quality of the data.
7. **Qualifier**
   An extensive set of checks is applied to the data and the solution. Which quality flag is assigned to the data is determined on the basis of the results of these checks.
8. **P1/90**
   The final positions are exported to a P1/90 file.
9. **QC End of Line Report**
   A QC report is created, containing the outcome from the main qualifier checks. A statistical report similar to the standard Sprint end of line report is also produced.

9.3 SPRINT

The SPRINT 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.

9.3.1 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

9.3.2 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.

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

9.3.4 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.

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Nrej : Number of data observations missing after processing.
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Mean : Mean value of the observation.
Max. Delta : The maximum shot to shot increment.
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- Statistics on node shot point intervals
- Statistics on observation residuals
- Statistics on network variance factor and degrees of freedom
- The error ellipse (semi-major axis/skew) of all defined nodes
- Streamer rotation

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

Problem lines were more thoroughly investigated and required different plots for analysis.

9.7.1 Data export, P1/90 output

During the export process the receiver positions were computed and a P1/90-file was generated. The in-line miss-closure 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.

9.8 Data quality control procedures

The first line was sent to the office for quality purposes; 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 miss-closures were checked.
- Latitude/longitude and grid coordinates were checked against the datum/projection defined in the header.

- The final P1/90 files were also checked using a variety of software tools; Sprint QC tool, p1Plot and p1List, the two latter tools being PGS internal software. These software tools provided checks on the following:

Sprint QC:

- 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.

p1check:

- 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.
- format of integers, real, text fields, date/time and lat/long. for every line in the file
- jumps in the locations of consecutive receiver groups.
- continuous receiver group numbers.
- check of receiver depth
- correct gun sequence numbers.
- data present for T-records
- equal depth in V- /E-records
- echo sounder change
- depth date jump shot to shot larger than50m
- depth data 0.0
- unknown record types in file

p1list:

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

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

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

9.9 NRT vs Sprint P190 Position Comparisons.

Periodically during the survey NRT P190 positions were checked by comparison with P190 data produced by post processing with Sprint. This was nominally every 10th line. Lines which were reprocessed for problems are not included in the comparison since they naturally contain differences related to the reason for reprocessing.

Maximum position difference (m)						
Sequence	**Line name**	**Vessel**	**Sources**	**Tailbuoys**	**Receivers**	**Comment**
002	1522P1002	0.30	4.50	4.50	-7.00	
012	1462P1012	0.60	2.80	2.80	6.60	
022	1426R1022	0.30	2.30	2.00	3.80	
029	1114P1029	-0.30	3.80	3.80	-7.70	
040	1066P1040	-0.50	-3.70	-3.40	10.10	
050	1024F1050	-0.70	2.80	-2.60	-5.60	
060	1090F1060	-0.80	-3.90	-3.90	6.20	
064	1018R1064	-0.30	-3.00	-3.00	9.50	

10 Seismic data quality

10.1 Seismic interference

Not an issue.

10.2 Ship & rig noise

Seen on a couple of lines. A few Sequences 56-60, had higher levels of ship/rig noise occurring when we were passing by the Basker FPSO station. Ship/screw/propnoise seen on 5, 12, 13, 14, 21, 29, 30, 34, 54, 56-60 and 62, not affecting the acceptable stack signal quality in the target zone.

10.3 Swell noise

Sequence 64 had marginal levels of swell, otherwise the level of swell never entered the target zone in a way which called for marginal data discussions. Swell seen on: 28, 35, 36, 37, 41, 49, 62, 64, 65 and 66.

10.4 Strum/tug noise

Some variable front end strum noise has been seen on streamer 1 mainly, but also streamer 2 and 6 had lines with apparent FEN noise. Vessel speed was adjusted when RMS levels were getting past 20-25uB on the nearest traces.

The Sequences 032 through 039 had the tailbuoys on streamers 1 and 2 tangled together introducing a lot of linear strum/tug noise. Particular investigation resulted in acceptance from the clients after applying a narrow targeting FK filter. In addition the tail last 5 (476 to 480) traces were edited on streamer 1 and 2.

10.5 Noise due to barnacle growth

Not an issue.

10.6 Mud/ground Roll

Seen on this survey but not a dominating feature on the data acquired.

10.7 Source Separation Errors

Source separations were monitored online and actions taken to correct when needed. Not a significant contributor to problems on this survey

10.8 Telemetry and Parity Errors

A few lines had parity errors and telemetry problems. Edits were made when required for the affected streamers.

The Sequences 23 and 24 were recorded without streamer 6, dt telemetry problems.

10.9 Streamer Depth Errors

These were generally logged in the Observer logs as QC warnings.

On client request the target depth would be adjusted deeper to improve streamer control and continue recording.

10.10 Bad channels and Recording System Problems

After each sequence, all the recorded traces were checked for excessive RMS noise levels, weak or dead traces and for electrical spikes. This was done both automatically and interactively on-screen. The number of bad channels, 4-6, stayed pretty much constant.

Spikes
Automated spike detection was running on all the traces, across the entire record length, on the gAS recording system as well as online on Viper using Pandeldiff. The number of spikes was usually small, and the number of bad traces was always well within spec. The spikes can be identified by analysing the observers' logs. They should be removed during processing either automatically using a de-spike algorithm or manually by referencing the observers' logs. The big spikes are edited.

Cross-feed
Not an issue for great concern on this survey. Intermittent and weak crossfeed could be seen on streamer 4 at times, throughout the whole survey. Very weak and intermittent crossfeed appeared on streamer 2 on a few sequences.

Header corruption
Header data transferred from the navigation system to the seismic recording system was sometimes corrupted affecting values stored in the extended header. These events were flagged in the observers' log as "nav header short" which can cause zero values in some of the navigation header fields such as shot point number or source identifier. These errors can be fixed in processing by manipulating the headers to restore the correct values so that these shots can still be used. Using the time stamp in the general header is an option. This time is GPS corrected and relatively accurate (Approx +- 1s window).

10.11 Skew Correction for NTRS Recording

The NTRS acquisition system used on this survey is a continuous recording system, enabling recording with nearly zero dead time between records. However, as a result of this, time zero does not necessarily fall on a sample time. This automated system sub-sample correction is known as the skew and is defined as the interval between time zero and the next following sample.

Any skew correction factor errors were identified by time-break analysis and the relevant shots were flagged as edits. Most commonly the skew errors were flagged automatically by the recording system.

10.12 Air leaks and Auto-fires

Any auto-fires flagged by gas were checked by QC and removed from the log if proven to be false. The majority of air leaks were spotted immediately online and action taken.

Summary of causes of scratched and incomplete line sequences

Cause	Scratched	Incomplete or Edit
Air leak		
Source separation errors		
Compressor failure		
Auto-fire, misfire		
SI / timesharing		
Ship noise		
Weather		
Depth control errors		
Observing software / hardware		018 020 042
Navigation software / hardware		
Strum noise		
Telemetry/parities/module failure		053 054 063
Coverage		
Fishing activity & fishing gear		
Other	001(Testline)	

10.13 RMS and noise analysis

RMS Windows		
RMS Window 1 (Water Column):	60 - 300 ms	relative to start of record
RMS Window 2 (RMS minimum):	500ms	sliding window
RMS Window 3 (Signal 1):	1000 – 1500 ms	relative to start of record
RMS Window 4 (Signal 2):	1500 - 2000 ms	relative to start of record
RMS Window 5 (End of Record):	5500-6000 ms	relative to start of record

The gAS system produced online RMS values taken from 5 windows calculated on 1ms sample interval data. No instrument delay static was applied prior to analysis but a 5-8-90-120 Hz common band-pass filter was applied to all windows to remove noise occurring outside the bandwidth of the data. These RMS values were passed to the Viper system in real-time when needed to facilitate both online and offline RMS analysis. These values were also used to create areal rms and attribute displays using the PGS holoSeis visualisation software package and Viper BinXYZ areal attribute handling.

1: Water Column noise window
The water column noise window (window 1) displayed the ambient background noise levels, and was also useful for assessing external sources of noise, such as ship noise. Noisy channels are generally much more obvious in this window too. The front traces, and in particular those on the centre streamers nearest the guns, recorded high amplitudes due to first break energy entering the window, and were of little use for QC purposes. To analyse these channels, the end of record RMS window was used.

2: Minimum RMS
RMS was computed for 250ms about each sample of each trace, i.e. in a sliding 500ms window down each trace. The minimum RMS value for each trace is then stored in a header which can subsequently be plotted. This method ensures that the signal contribution to the RMS value is minimised.

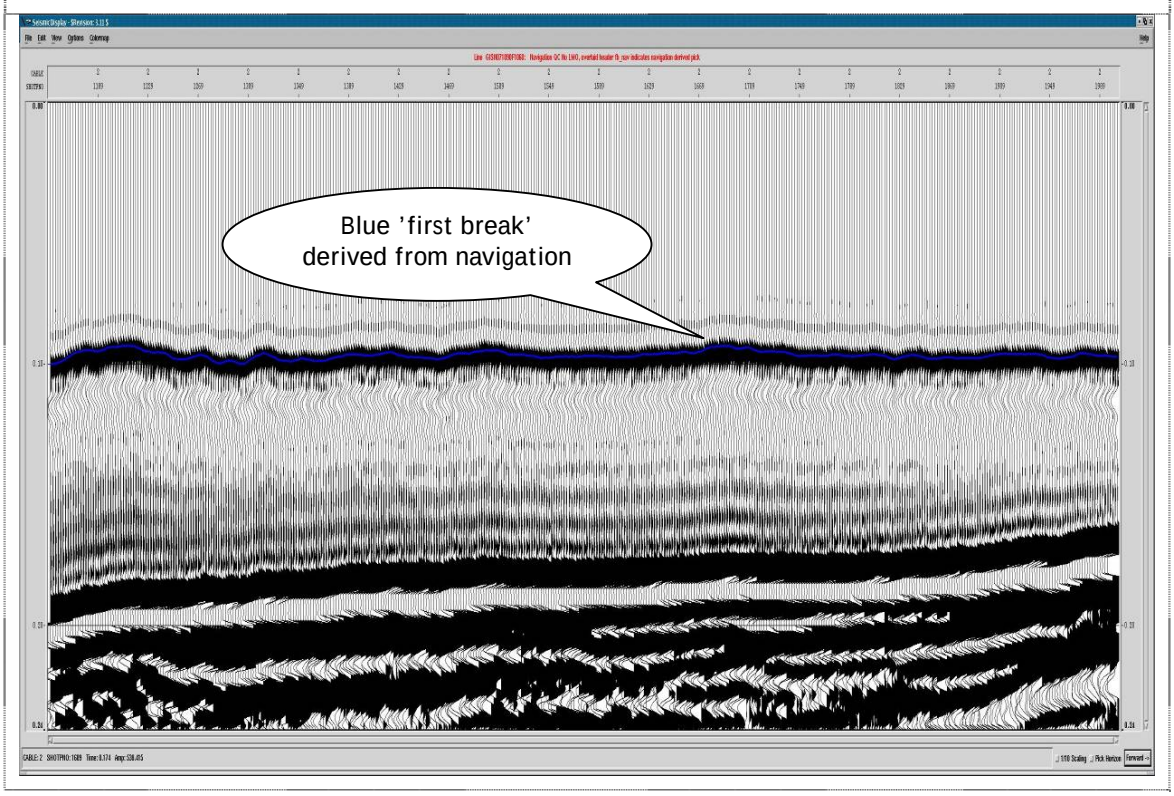
3, 4: Signal Windows
The RMS signal was calculated by the gAS QC system in both windows 3 and 4, as detailed in the table above. Reviewing the amplitudes of individual channels in these RMS windows could highlight weak or dead hydrophones, as the resulting contrast in the recorded amplitudes are greatest here.

5: End-of-record windows
This RMS end of record window (window 5) was used for monitoring ambient noise levels in addition to the water column window. This window was particularly useful for examining the ambient RMS levels on the near traces that were affected by first break energy in RMS window 1. The amount of shot-generated energy recorded in this window was much higher here than in window 1, and so external noise sources, for example ship noise, would not necessarily be as easily seen in the end-of-record window.

10.14 First break / P190 offset check

The nearest traces were merged with the P1/90 navigation data, and the navigation-derived first break was overlaid on the seismic data and checked on screen. In general, there was a good match between the P1/90 and the seismic data. The common offset cube was additionally used to verify navigation quality.

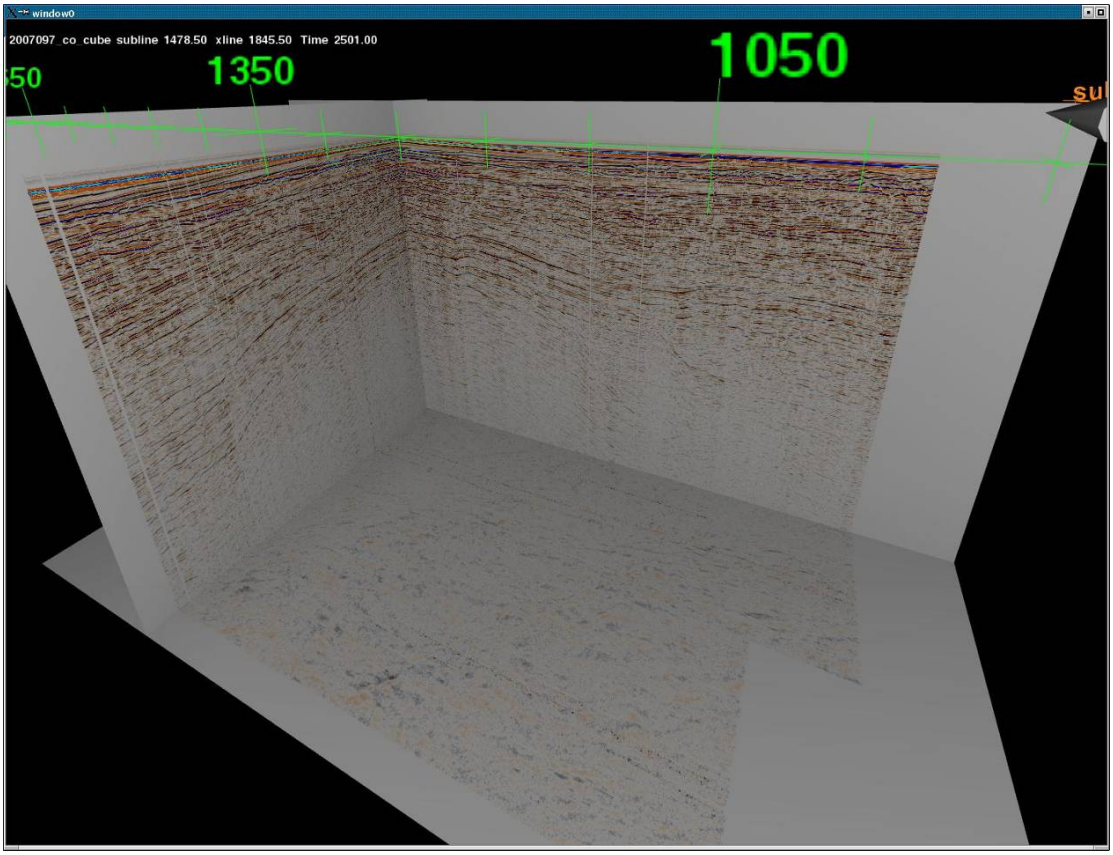
This diagram shows an example from line GISN071090F1060, streamer 2.



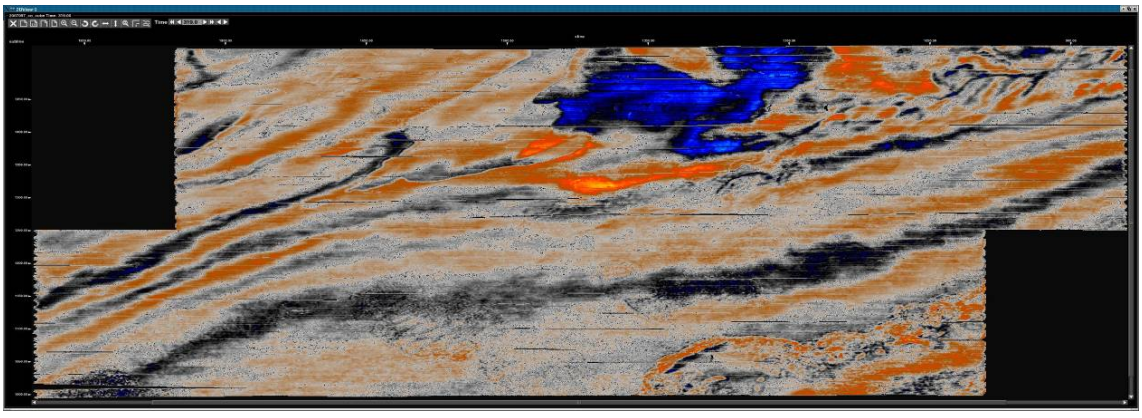
10.15 Common offset cube

The common offset cube was created using PGS' proprietary 'HoloSeis' 3D visualisation program. The main purpose of the cube analysis was to assist with QC of the navigation data after having been merged with seismic. The appearance of miss-ties or busts between lines in the cube could indicate problems with the navigation data.

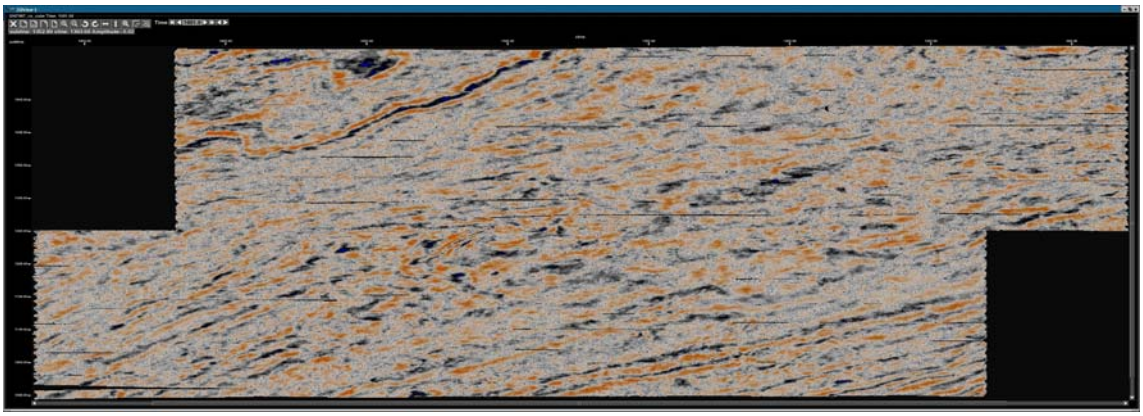
Holoseis plane view



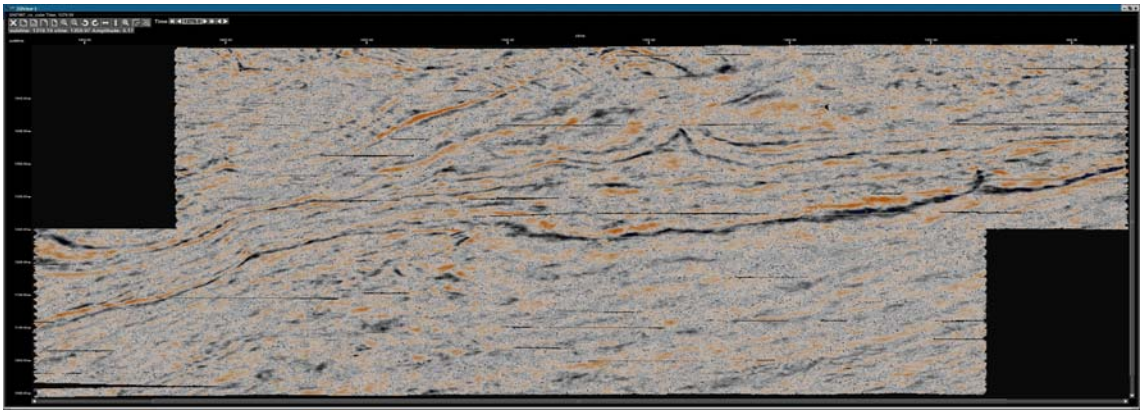
Timeslices



319ms

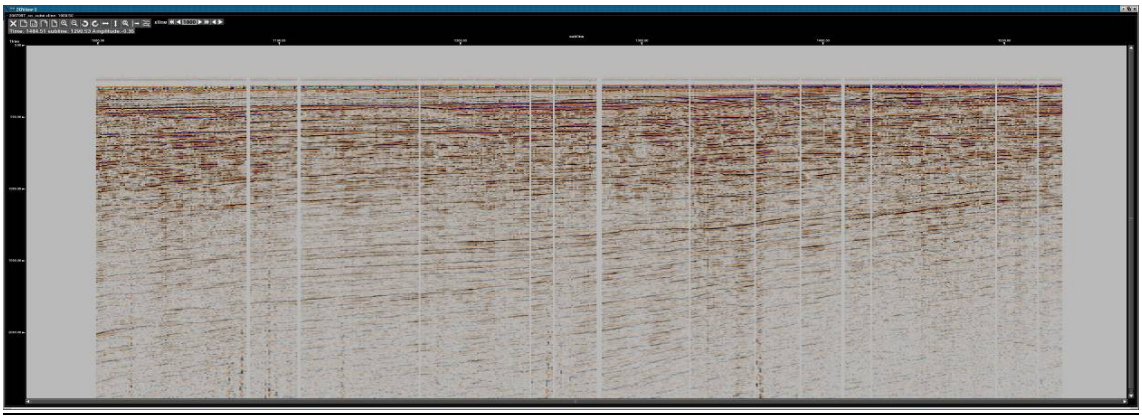


1001ms

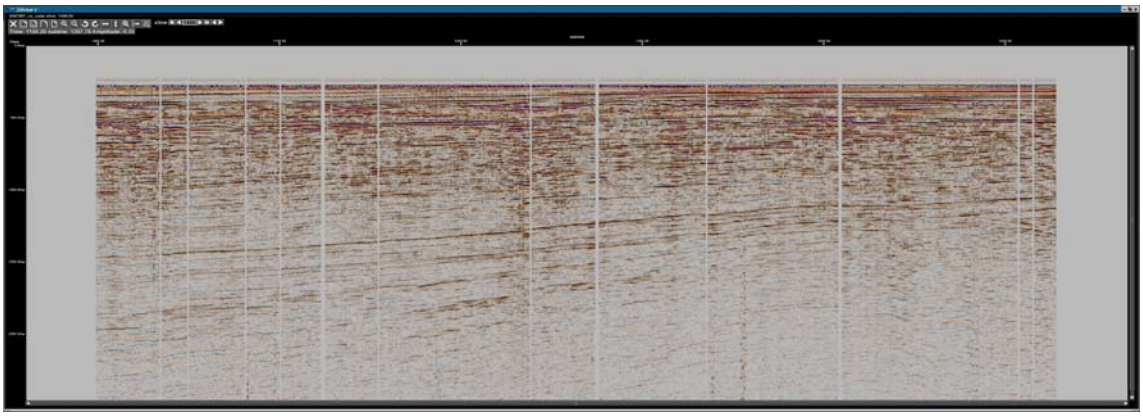


1279ms

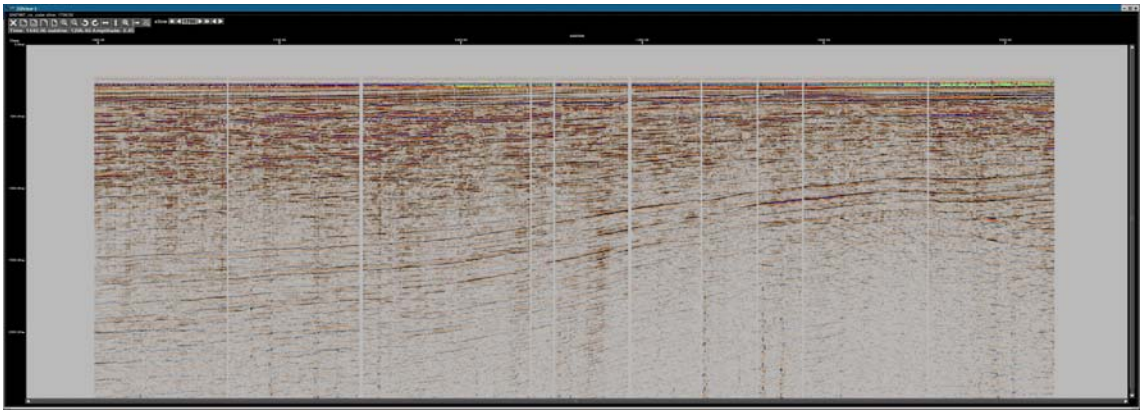
Crosslines



Xline 1000

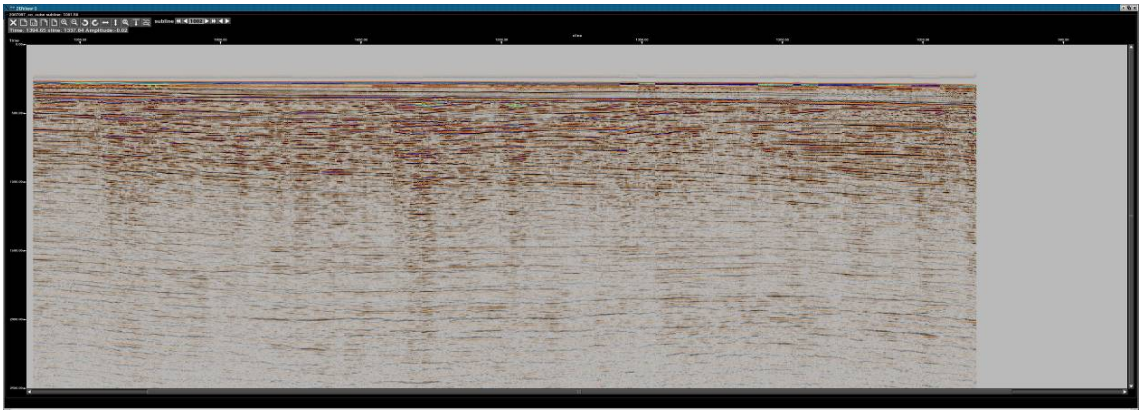


Xline 1400

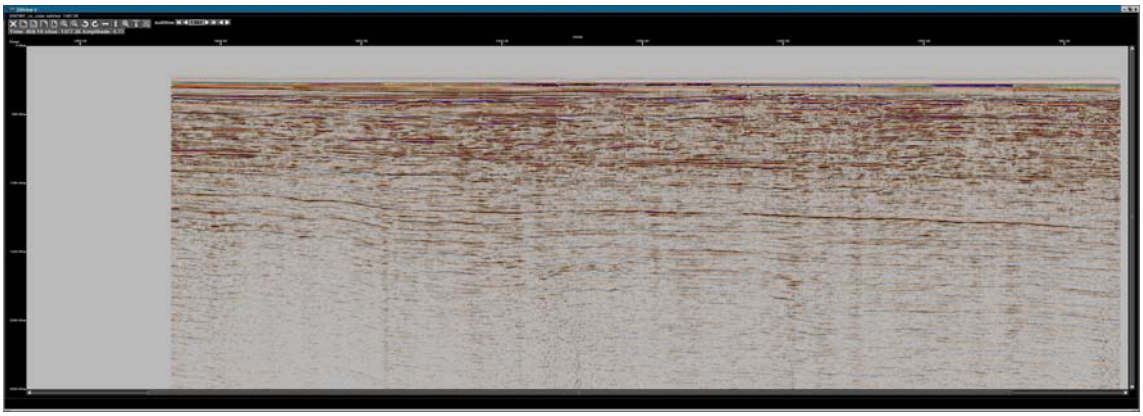


Xline 1700

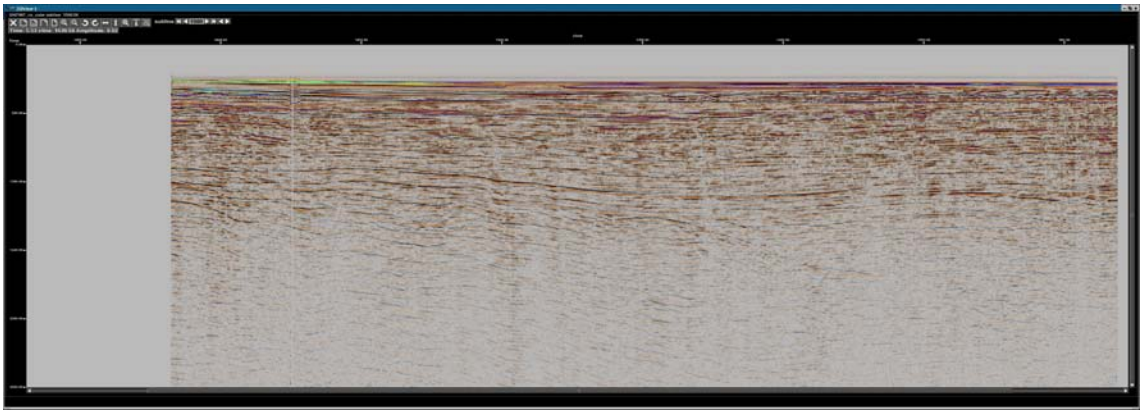
Inlines



Inline 1002



Inline 1302



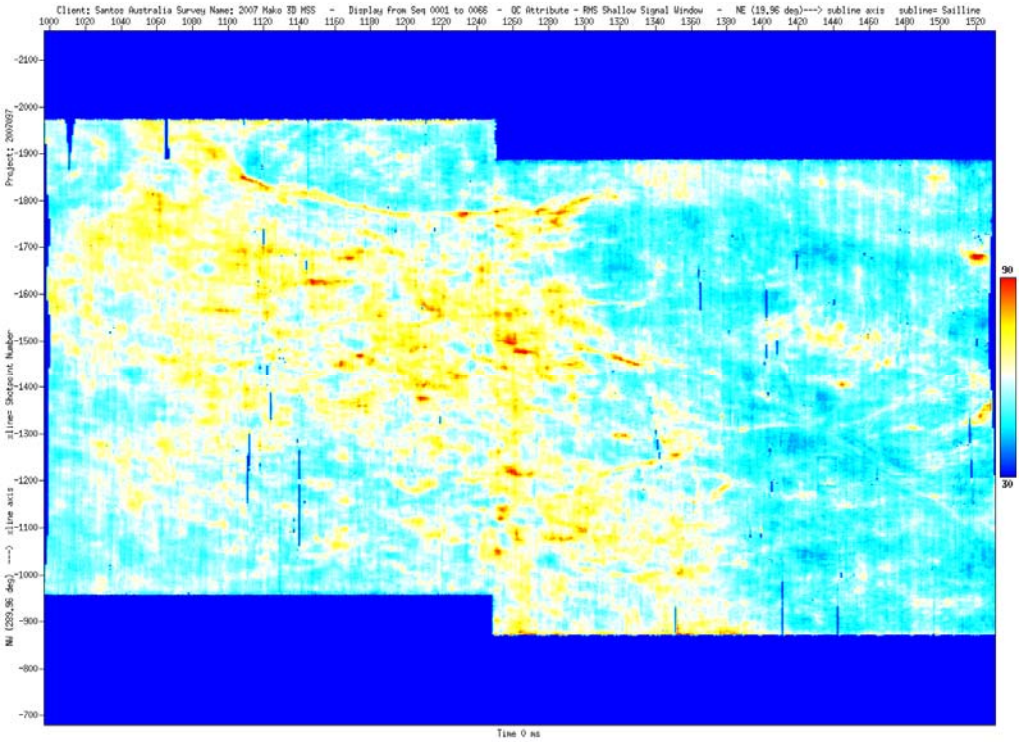
Inline 1500

10.16 Seismic data attributes

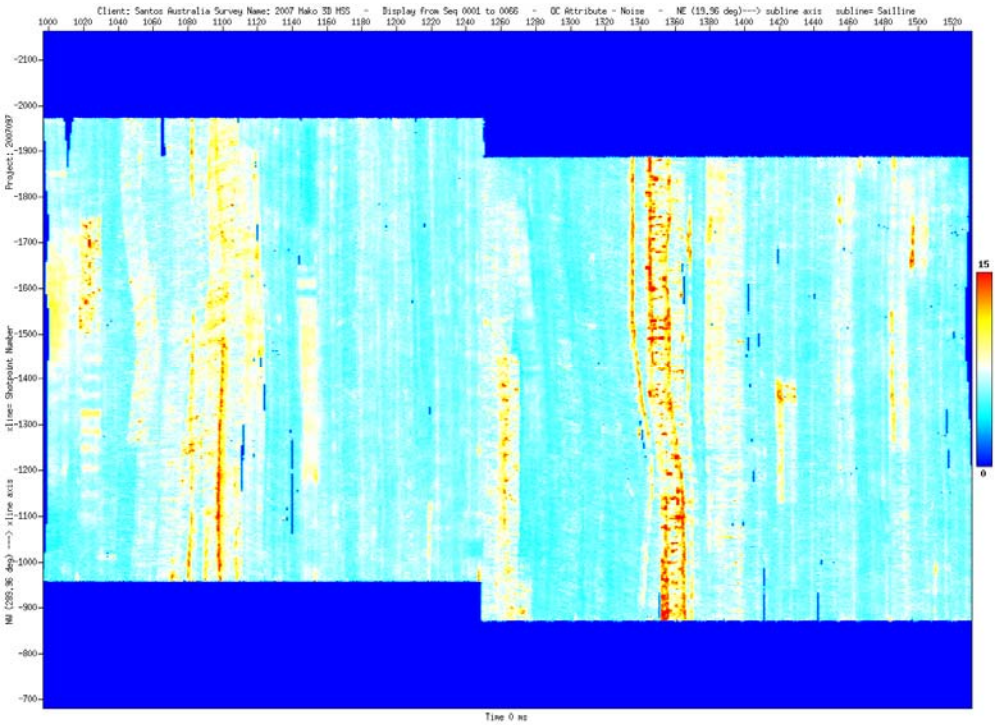
A number of attributes were calculated and binned both using holoseis and viper BinXYZ attribute handling to allow for investigation of streamer to streamer comparison and line to line comparison and matching over the whole survey.

RMS attributes were frequently investigated to quantify marginal lines with other lines previously accepted.

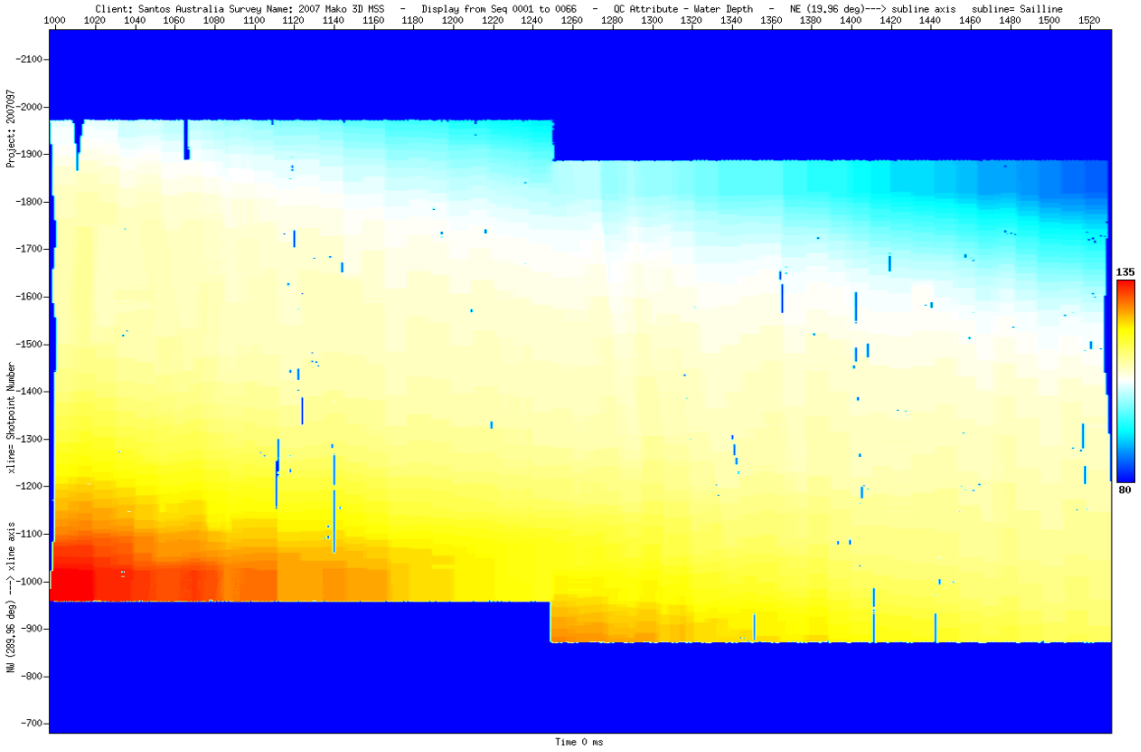
RMS signal window



RMS noise window

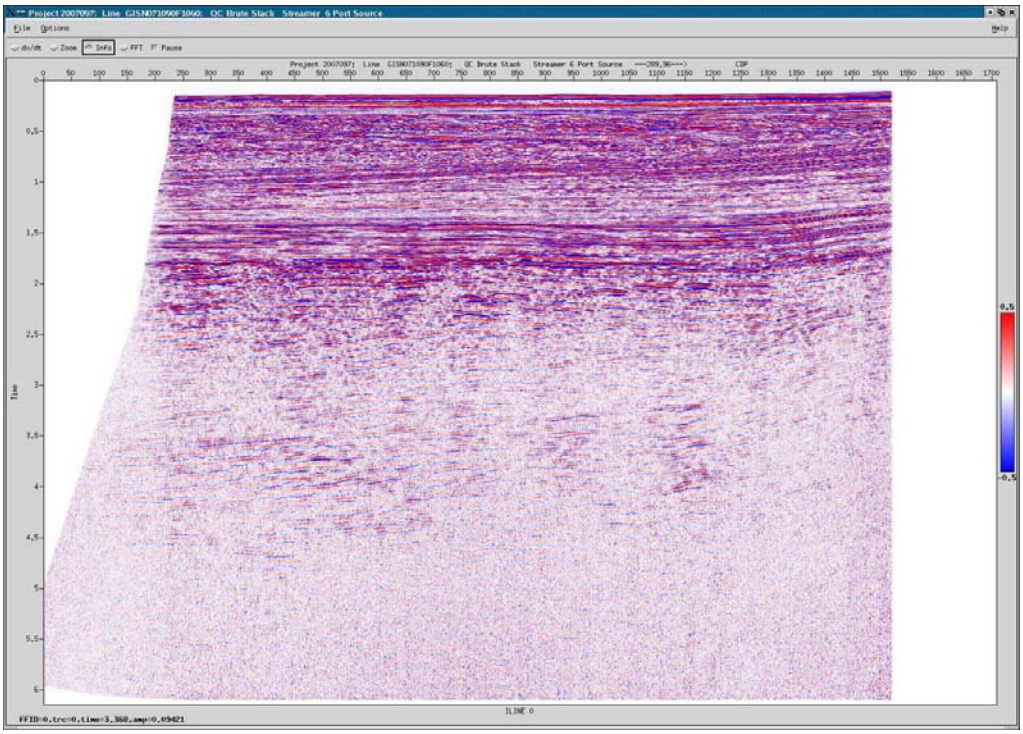


Water depth [m]



10.17 Brute Stack Data

Screen Display Stack GISN071090F1060



11 QC

11.1 QC

The gAS acquisition system was used to monitor and record data in real time. The VIPER processing system was then utilised for the subsequent offline QC processing. Problems that occurred during production were investigated using all means available.

Real-time RMS calculations were performed by the online gAS QC system for all channels of each shot, in five different time windows, as defined and explained in the section "RMS and noise analysis".

The PGS gAS acquisition system was used to provide real-time online QC displays that included:

- 2 x shot gathers, rotating through all streamers for every shot plus a further shot display fixed on one streamer.
- 'End of Record' and 'Water Column' RMS displays indicating the RMS levels of each channel for each shot point, for all 6 streamers. This enabled ambient noise estimates to be made, and external noise, such as ship noise, to be quantified.
- Cable depth variations display.
- Shot-to-shot difference display, for random noise analysis.
- Single near trace display, at full record length.
- Line graph display of gun volume, gun pressure and gun depth.
- Full-length auxiliary trace display from every gun hydrophone for the current shot.
- Stacked auxiliary trace display at full record length for each active shot, used for auto-fire detection.
- 2 x layered hydrophone display (one port array, and one starboard array) of the first 150ms of each auxiliary trace, for monitoring any variation in the gun signature along the line.
- Time break single trace display.

11.2 Offline QC

At the end of each line, as a minimum, the following displays were produced:

- Screen displays of one shot/km rotating through streamers
- RMS noise screen displays for bad channels and other noise analysis
- RMS signal screen displays for traces that might be weak
- Graphical RMS noise display of average channel RMS
- Stacked auxiliary near field phone data on screen for auto-fire analysis
- Layered hydrophone display of top 300ms of auxiliary hydrophone data to monitor variations in gun signature which might indicate an air leak or sub-array separation problem as well as a comparison with recent other line sequences to check for a possible signature change between lines
- Recorded time break screen display
- 'Smash Stack' shot-domain stacked data screen display to highlight any electrical cross-feed in particular.
- 2D Brute Stack paper plot.
- First break display with overlaid navigation offset on screen for comparison.

Further investigations were carried out as needed.

11.2.1 2D QC brute stack

A brute stack was produced for each line sequence in order to assess how noise interference (e.g. ship noise, swell noise, strum noise etc.) was likely to affect the final processed data. Each brute stack had deconvolution applied.

Brute Stack Processing Sequence

Transcription	From SEGD to Viper internal format
Static Correction	Skew correction (< 1ms) for continuous recording system
Geometry Assignment	Nominal 2D geometry (from preplot)
Select	One Source/Streamer combination for stack
Edit (zero)	Bad channels, Bad shots
Static Correction	–58 ms filter delay
High-pass filter	3-6 Hz
SINK (only tested on seq 59)	Swell or SI noise attenuation processing (if required)
Amplitude Recovery	TV gain (using average velocity)+ 2dB/s (down to 4s)
Mute	First break mute
Deconvolution	Minimum phase Predictive Deconvolution (Length 240ms/Gap 24ms)
NMO Correction	Using picked velocities
Mute	Post-NMO mute
Stack	Stack CDP gathers
Static Correction	+8.6 ms gun and cable static to mean sea level
Display	Paper plot (with adjacent trace averaging before plotting)

11.2.2 Navigation / seismic merge QC

A near trace dataset was merged with the final P1/90 files for all streamers. The navigation-derived first break was overlaid on the seismic near trace for each streamer and checked on screen. The measured sound velocity was used to determine the calculated arrival time from the P1/90 offset.

11.2.3 Common offset cube

A second P1/90 QC step was to build a single fold common offset (CO) cube to check for anomalies and miss-ties between sail lines on cross-line sections and time slices.

For each source/streamer combination, one trace was selected by offset (~ 350m) and merged with P1/90 positional data then loaded to the common offset cube. The data was pre-processed and truncated to 1000 ms prior to loading. Once loaded to the cube, inline, cross-line and time-slice displays were viewed to check for potential navigation merge errors.

The cube was viewed using PGS' HoloSeis software package in full 3D. This software makes it possible to view all inline, cross-line and time slices, and permits interactive rotation, translation and stretch of the 3D common offset cube to enable a more detailed analysis of the data.

11.3 Computer systems

The Viper system hardware on the Pacific Explorer is set up as follows…

- 2 x IBM x3650 nodes (2 x dual core processors/node, each node having 4 gb of RAM and 3 x 75gb disk drives) [mamba, python]. There is also 6.5 tb of external RAID disk attached to the mamba node.
- 3 x IBM x335 nodes (dual 2.8 GHz Intel Xeon processors/node, each node having 1.5 Gb of RAM and 2 x 146 GB SCSI disk drives) [Cpu01, Cpu02, Cpu03]
- 2 x Dell Precision 470 node (dual 3.0 Ghz Intel Xeon, with 3.84Gb of RAM and 2 x 360 Gb disks) [Hol01, Hol02]

Viper Node Configuration	
MAMBA:	Data-capture node, with real-time link to gAS recording system Control workstation Data-Processing node
PYTHON:	Data-Processing node and spare mamba replacement
CPU01:	Data-Processing node 3 IBM 3592 tape drive attached 2 IBM 3590 tape drive attached
CPU02:	Data-Processing node 1 IBM 3592 tape drive attached 2 IBM 3590 tape drive attached
CPU03:	Data-Processing node
HOL01:	Data-Processing node HoloSeis 3D viewing node
HOL02:	Data-Processing node HoloSeis 3D viewing node

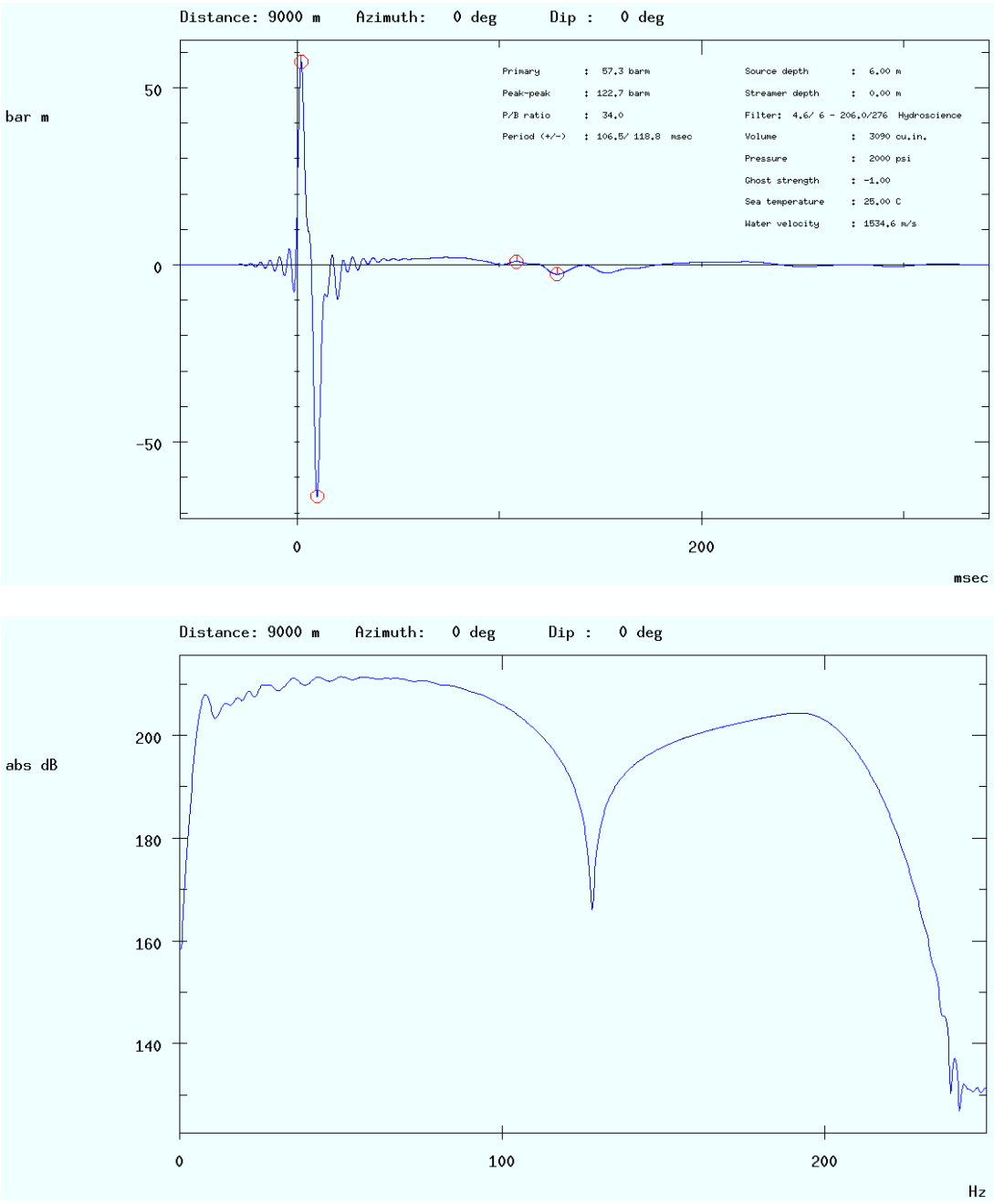
This system runs Viper V4.0.2-3, a data QC and pre-processing suite of software tools on the CentOS v4 Red Hat operating system.

12 Appendix

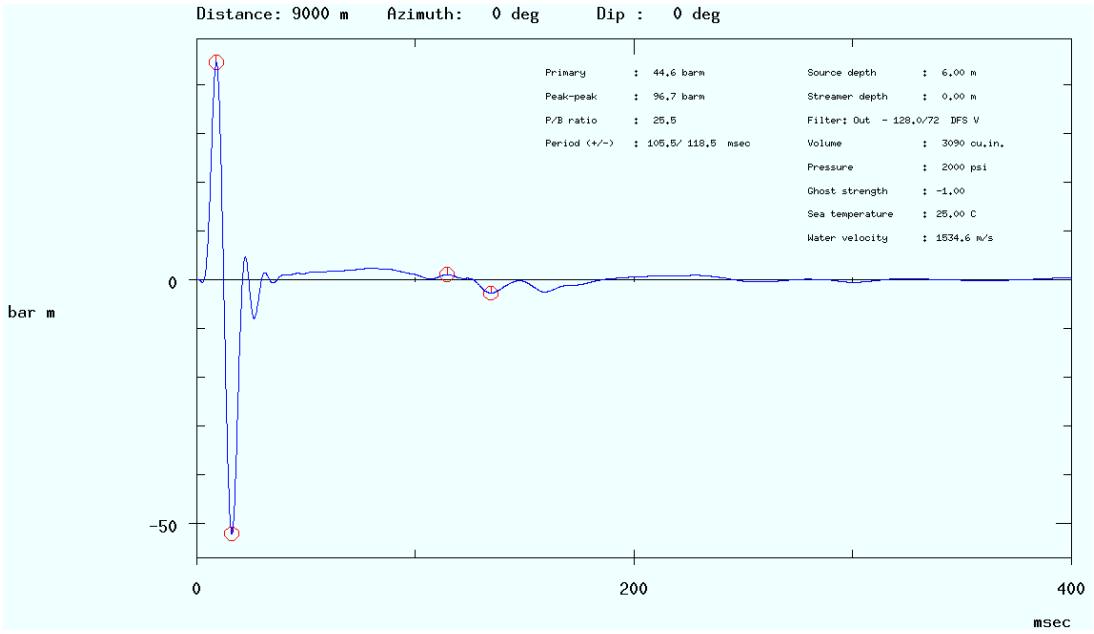
12.1 Data shipments

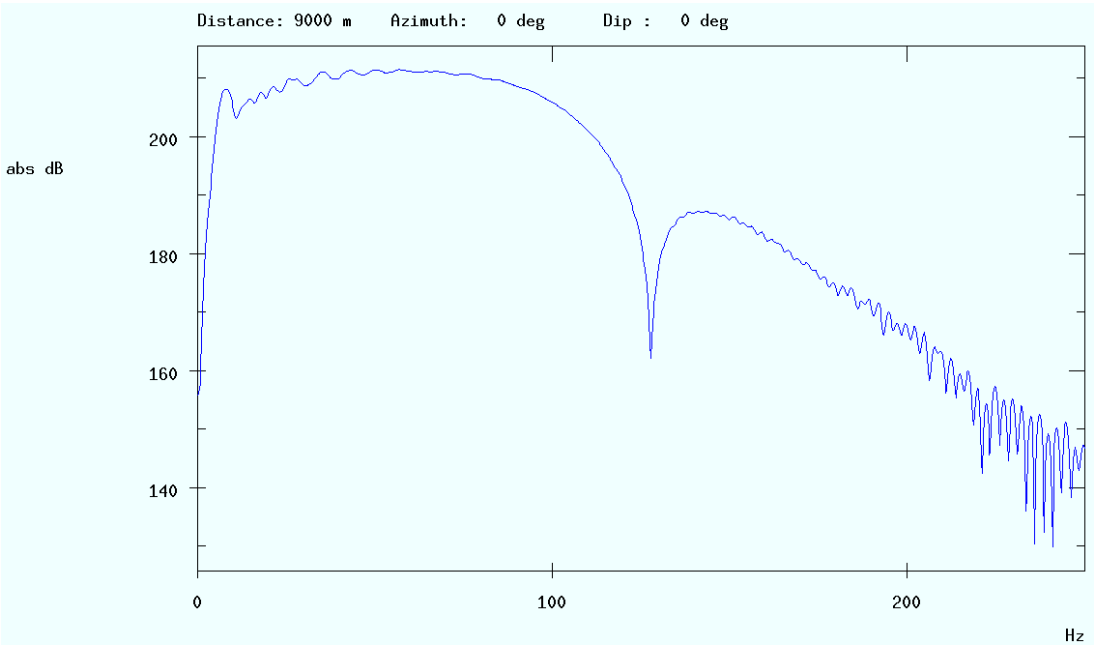
Date	Proforma	Content	Boxes	Wt	Shipping address	Comment
3rd Dec 07	PAC13003562A	66 x 3592 data tapes (data set 1) 3 x P294 tapes 3 x P190 tapes 1 x DVD containing observer logs Project 2007097	4	22 Kg	CGG Veritas 37 Jalan Pemimpin 06-01 Union Industrial Building 577177 Singapore Attn: Don Pham	Via NT Shipping Agencies PTY Ltd PO BOX 443 0828 Berrimah NT Australia Attn: Robbie Robertson Tel +61 8894 72570 Fax +61 8894 72640
Still to be shipped (awaiting confirmation of receipt of data set 1)	PAC13003563A	66 x 3592 data tapes (data set 2) 3 x P294 tapes 3 x P190 tapes 1 x DVD containing observer logs Project 2007097	4	22 Kg	Santos Ltd. c/o Toll Priority Basement, 191 Pultney Street ADELAIDE S.A. 5000 email: nick.papanicolaou@santos.com Attn: Nick Papanicolaou Tel +61 8 8116 7833 Fax +61 8 8116 7258	Via NT Shipping Agencies PTY Ltd PO BOX 443 0828 Berrimah NT Australia Attn: Robbie Robertson Tel +61 8894 72570 Fax +61 8894 72640
3rd Dec 07	PAC13003569A	3 x 3592 tapes with QC deliverables: AMAB8529-Tar of all SEGY brute stacks and velocities. AMAB8532-All SEGY Auxiliaries. AMAB8534-QC SEGY CO Cube Project 2007097	1	1 Kg	Santos Ltd. c/o Toll Priority Basement, 191 Pultney Street ADELAIDE S.A. 5000 email: nick.papanicolaou@santos.com Attn: Nick Papanicolaou Tel +61 8 8116 7833 Fax +61 8 8116 7258	Via NT Shipping Agencies PTY Ltd PO BOX 443 0828 Berrimah NT Australia Attn: Robbie Robertson Tel +61 8894 72570 Fax +61 8894 72640
7 Dec 07	NP81/2007	P190 vespos P190 echo waterdepth corr for draft, sound and tide(MSL) Vespos plot Contour plot Coverage plots Noflex all zones P698 CD with files and plots			Santos Australia Ltd. C/o TollPriority Basement, 191 Pultney Street ADELAIDE S.A. 5000 Att: Nick Papanicolaou	DHL no6355335766

12.2 Source modelling



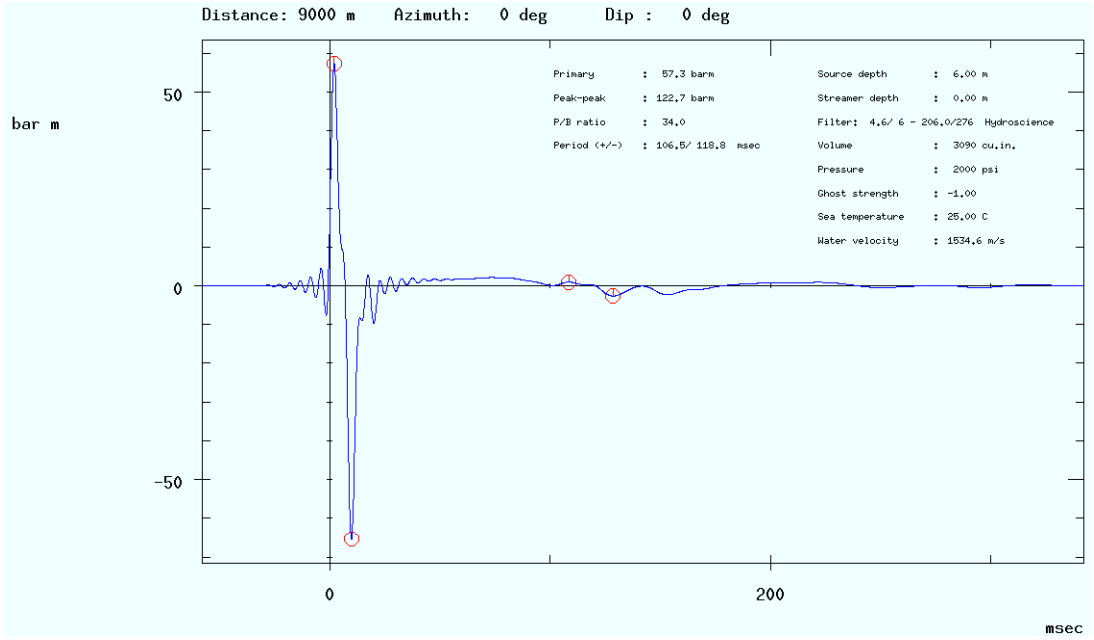
Modeled far-field signature and amplitude spectrum with Hydroscience recording filter (without receiver ghost).

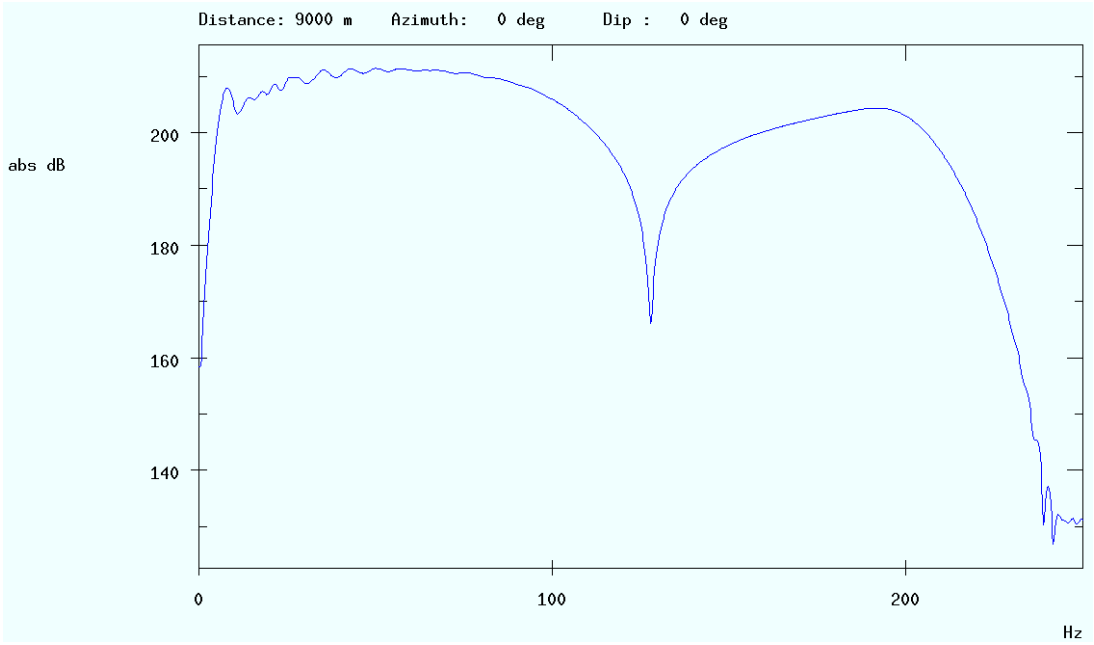




Modeled far-field signature and amplitude spectrum with DFS-V recording filter (without receiver ghost).

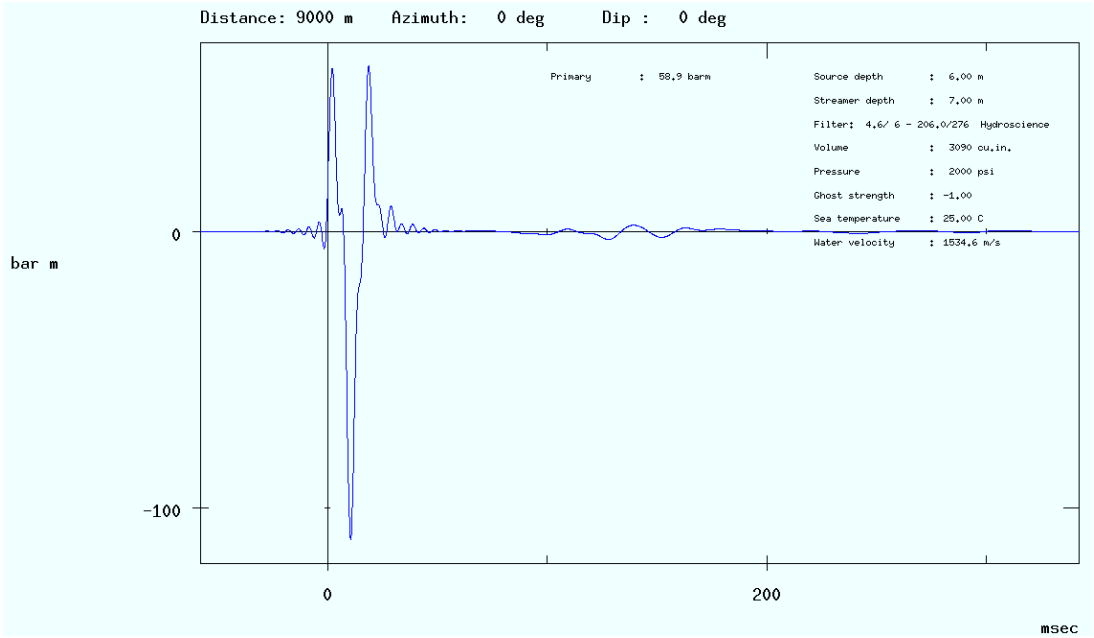
Full system response with source ghost only

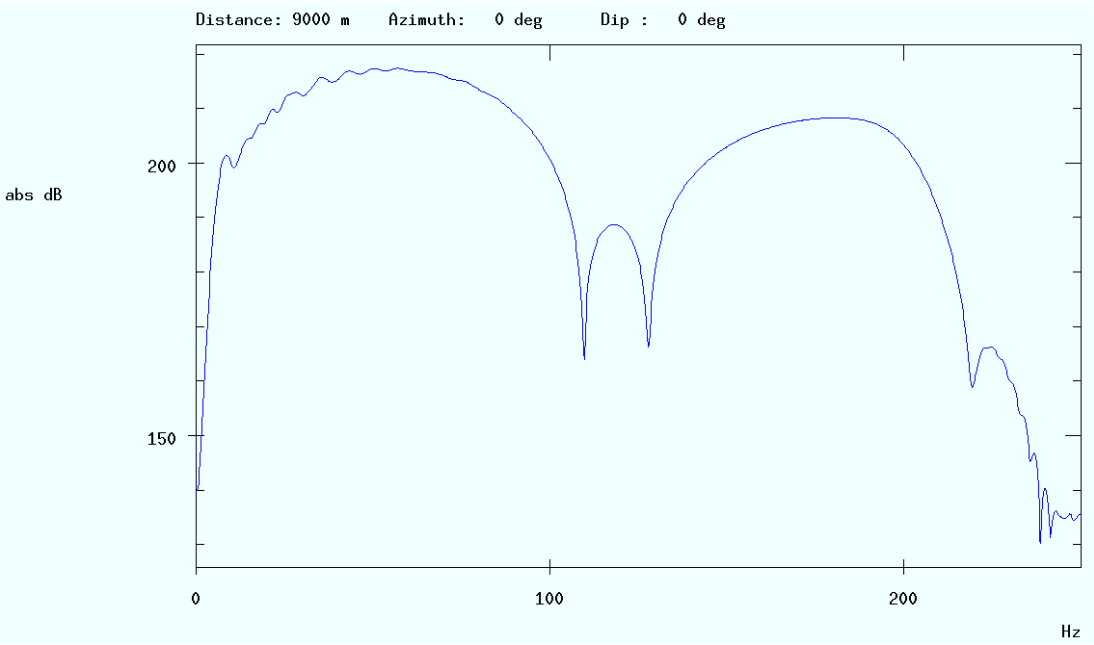




Modeled far-field signature and amplitude spectrum with full system response filter effect applied (without receiver ghost).

Full system response with source and receiver ghost





Modeled far-field signature and amplitude spectrum with recording and hydrophone filter effect applied (with receiver ghost).

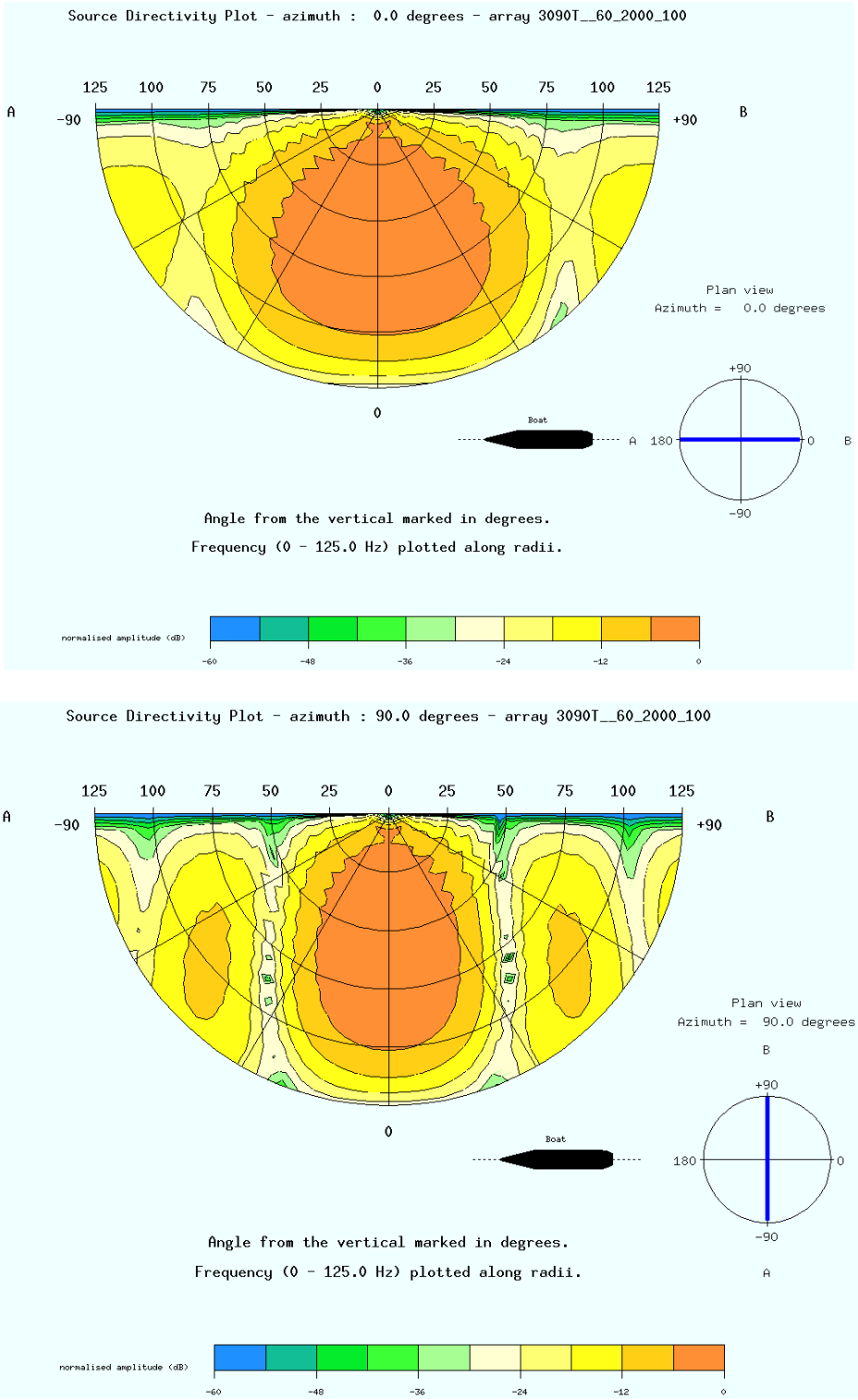


Figure 1: Directivity plot for constant azimuth of 0° and 90°.

12.3 SEG-D header

Header dump from Seq 10 file 544

GENERAL HEADER #1		Starting byte 0
Bytes	Description	Value
01-02	File Number	544
03-04	SEGD Format	8036
	Bits Per Sample	24
05-10	General Constants	
11	Year	2007
12	Additional Header Blocks	2
12-13	Day	321
14	Hour	3
15	Minute	38
16	Second	5
17	Manufacturer's Code	41
18-19	Manufacturer's Serial Number	15
20-22	Not Used	
23	Base Scan Interval (ms)	2.0
24	Polarity	
25	Scan/Block Exponent	
26	Record Type	Normal Record
27	Record Length (ms)	170496
28	Scan-types / Record	1
29	Channel Sets/Scan Type	7
30	Skew Blocks	0
31	Extended-Header Blocks	0xFF
32	External-Header Blocks	0xFF

GENERAL HEADER #2		Starting byte 32
Bytes	Description	Value
01-03	Expanded File Number	0
04-05	Extended Channel Sets	0
06-07	Extended Header Blocks	890
08-09	External Header Blocks	119
10	Reserved	
11-12	SEG-D Revision Number	Rev. 0.0
13-14	General Trailer	
15-17	Extended Record Length	200
18-19	General Header Block Number	2
20-31	Reserved	
32	Extended Record Length	6

GENERAL HEADER #3		Starting Byte 64
Bytes	Description	Value
01-03	Reserved	
04-06	Source Line Number (int)	0
07-09	Source Line Number (fract)	0
10-12	Source Point Number (int)	1312
13-15	Source Point Number (fract)	0
14	Source Point Index	Not Used
15	Phase Control	Not Used
16	Type Vibrator	Not Used
17-18	Phase Angle	Not Used
19	General Header Block Number	3
20	Source Set Number	0
21-32	Reserved	

CHANNEL SET HEADER #1		Starting Byte 96
Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	1
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	0
09-10	Number of Channels	480
11	Channel Set Type	Seismic Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206
15-16	Alias Filter Slope	214
17-18	Low Cut Filter	5
19-20	Low Cut Filter Slope	6
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

CHANNEL SET HEADER #2		Starting Byte 128
Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	2
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	0
09-10	Number of Channels	480

11	Channel Set Type	Seismic Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206
15-16	Alias Filter Slope	214
17-18	Low Cut Filter	5
19-20	Low Cut Filter Slope	6
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

CHANNEL SET HEADER #3 Starting Byte 160

Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	3
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	0
09-10	Number of Channels	480
11	Channel Set Type	Seismic Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206
15-16	Alias Filter Slope	214
17-18	Low Cut Filter	5
19-20	Low Cut Filter Slope	6
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

CHANNEL SET HEADER #4 Starting Byte 192

Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	4
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	0
09-10	Number of Channels	480
11	Channel Set Type	Seismic Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206

15-16	Alias Filter Slope	214
17-18	Low Cut Filter	5
19-20	Low Cut Filter Slope	6
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

CHANNEL SET HEADER #5 Starting Byte 224

Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	5
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	0
09-10	Number of Channels	480
11	Channel Set Type	Seismic Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206
15-16	Alias Filter Slope	214
17-18	Low Cut Filter	5
19-20	Low Cut Filter Slope	6
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

CHANNEL SET HEADER #6 Starting Byte 256

Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	6
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	0
09-10	Number of Channels	480
11	Channel Set Type	Seismic Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206
15-16	Alias Filter Slope	214

17-18	Low Cut Filter	5
19-20	Low Cut Filter Slope	6
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

CHANNEL SET HEADER #7 Starting Byte 288

Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	7
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	0
09-10	Number of Channels	48
11	Channel Set Type	AUX Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206
15-16	Alias Filter Slope	214
17-18	Low Cut Filter	5
19-20	Low Cut Filter Slope	6
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

HOST RECORDING SYSTEM STATUS BLOCK #1 Starting Byte 320

Bytes	Description	Value
01	External Header Status	OK
02	Tape Unit for Writing	0
02	Buffer Used	1
03-04	Number of Channels (Cable 1)	480
05-06	Number of Channels (Cable 2)	480
07-08	Number of Channels (Cable 3)	480
09-10	Number of Channels (Cable 4)	480
11-12	Number of Channels (Cable 5)	480
13-14	Number of Channels (Cable 6)	480
15-16	Number of Channels (Cable 7)	0
17-18	Number of Channels (Cable 8)	0
19-20	Reserved	

21	Transient Removal	No
22	Filter Samples Removed	0
23	Additional Host Blocks	0
23	Module Type	24-bit
24	Number of Physical Cables	7
24	Not Used	
25	Number of Receiver Lines	0
26	System Type	Non-Receiver Line
27	Record Status	Production Record
28	Header Revision	1
29	Software Revision	1
30-31	Blocks after SEG-D Area	198
32	Number of Cables	7

LINE ID BLOCK #1		Starting Byte 352
Bytes	Description	Value
01-08	Cable 1 Line ID	cable01
09-08	Cable 2 Line ID	cable02
17-24	Cable 3 Line ID	cable03
25-32	Cable 4 Line ID	cable04

LINE ID BLOCK #2		Starting Byte 384
Bytes	Description	Value
01-08	Cable 5 Line ID	cable05
09-08	Cable 6 Line ID	cable06
17-24	Cable 7 Line ID	cable07
25-32	Cable 8 Line ID	cable08

REEL NUMBER HEADER		Starting Byte 416
Bytes	Description	Value
01-02	Shot Time: Day	321
03	Shot Time: Hour	3
04	Shot Time: Minute	38
05	Shot Time: Second	5
06-08	Shot Time: Microseconds	0
09	Acquisition Hardware	Seatrak System
10-12	Not Used	
13	External Header 1	Nav & GCS90 Combined
14	External Header 2	Digicourse Header
15	External Header 3	Not Defined
16	External Header 4	Not Defined
17-32	Reel Number	

CLIENT NAME	Starting Byte 448	
Bytes	Description	Value
01-32	Client Name	Santos Australia

CONTRACTOR NAME	Starting Byte 480	
Bytes	Description	Value
01-32	Contractor Name	PGS GEOPHYSICAL - MARINE ACQUIS

SURVEY NAME	Starting Byte 512	
Bytes	Description	Value
01-32	Survey Name	2007 Mako 3D MSS

PROJECT CODE	Starting Byte 544	
Bytes	Description	Value
01-16	Project Code	2007097
17-18	Line Type	Off Line
19-24	Swath Number	0000.0
25-32	Sequence Number	10

CABLE #1	STATUS BLOCK 1	Starting Byte 576
Bytes	Description	Value
01-03	Transmitted Scan Count	0
04-06	Received Scan Count	0
07-09	Transmitted Extraction Count	0
10-12	Received Extraction Count	0
13	Scan/Extraction Count Status	No Error
14	Time Break Status	No Error
15	Logical Cable	0
16-17	Not Used	
18	First Channel Set	0
19	Last Channel Set	0
20-23	Not Used	
24	Physical Cable Number	0
25-32	Not Used	

CABLE #2	STATUS BLOCK 1	Starting Byte 608
Bytes	Description	Value
01-03	Transmitted Scan Count	0
04-06	Received Scan Count	0
07-09	Transmitted Extraction Count	0
10-12	Received Extraction Count	0
13	Scan/Extraction Count Status	No Error
14	Time Break Status	No Error
15	Logical Cable	0
16-17	Not Used	
18	First Channel Set	0
19	Last Channel Set	0
20-23	Not Used	
24	Physical Cable Number	0
25-32	Not Used	

CABLE #3	STATUS BLOCK 1	Starting Byte 640
Bytes	Description	Value
01-03	Transmitted Scan Count	0
04-06	Received Scan Count	0
07-09	Transmitted Extraction Count	0
10-12	Received Extraction Count	0
13	Scan/Extraction Count Status	No Error
14	Time Break Status	No Error
15	Logical Cable	0
16-17	Not Used	
18	First Channel Set	0
19	Last Channel Set	0
20-23	Not Used	
24	Physical Cable Number	0
25-32	Not Used	

CABLE #4	STATUS BLOCK 1	Starting Byte 672
Bytes	Description	Value
01-03	Transmitted Scan Count	0
04-06	Received Scan Count	0
07-09	Transmitted Extraction Count	0
10-12	Received Extraction Count	0
13	Scan/Extraction Count Status	No Error
14	Time Break Status	No Error
15	Logical Cable	0
16-17	Not Used	
18	First Channel Set	0
19	Last Channel Set	0
20-23	Not Used	
24	Physical Cable Number	0
25-32	Not Used	

CABLE #5	STATUS BLOCK 1	Starting Byte 704
Bytes	Description	Value
01-03	Transmitted Scan Count	0
04-06	Received Scan Count	0
07-09	Transmitted Extraction Count	0
10-12	Received Extraction Count	0
13	Scan/Extraction Count Status	No Error
14	Time Break Status	No Error
15	Logical Cable	0
16-17	Not Used	
18	First Channel Set	0
19	Last Channel Set	0
20-23	Not Used	
24	Physical Cable Number	0
25-32	Not Used	

CABLE #6	STATUS BLOCK 1	Starting Byte 736
Bytes	Description	Value
01-03	Transmitted Scan Count	0
04-06	Received Scan Count	0
07-09	Transmitted Extraction Count	0
10-12	Received Extraction Count	0
13	Scan/Extraction Count Status	No Error
14	Time Break Status	No Error
15	Logical Cable	0
16-17	Not Used	
18	First Channel Set	0
19	Last Channel Set	0
20-23	Not Used	
24	Physical Cable Number	0
25-32	Not Used	

CABLE #7	STATUS BLOCK 1	Starting Byte 768
Bytes	Description	Value
01-03	Transmitted Scan Count	0
04-06	Received Scan Count	0
07-09	Transmitted Extraction Count	0
10-12	Received Extraction Count	0
13	Scan/Extraction Count Status	No Error
14	Time Break Status	No Error
15	Logical Cable	0
16-17	Not Used	
18	First Channel Set	0
19	Last Channel Set	0
20-23	Not Used	
24	Physical Cable Number	0
25-32	Not Used	

NAVIGATION HEADER #1		Starting Byte 28800
Bytes	Description	Value
01-02	Master Block ID	$1
03-06	Length of Message	1666
07-10	Program Revision	0002
11-12	Shot Switch	On-Line
13-26	Shot Time	033805.63668920071117
34-36	Time Reference	UTC
37-42	Shot Number	001312
43-58	Current Line Name	GISN071474P1010
59-69	Master Latitude	-38.150694
70-80	Master Longitude	148.787660
81-86	Water Depth (meters)	112.2
87-97	Source Latitude	-38.149540
98-108	Source Longitude	148.784155
109-113	Master Gyro (degrees)	106.8
114-118	Master CMG (degrees)	108.3
119-122	Master Speed (knots)	4.9

GCS90 GUN-CONTROLLER HEADER #1		Starting Byte 28922
Bytes	Description	Value
01-06	ID String	*GCS90
07-10	Length of Block	1550
11-16	Line Number	4P1010
17-20	Shot Number	1312
21-22	Active Array Mask	07
23	Trigger Mode	External
24-25	Current Sequence Number	02
26-28	Number of Sub-Arrays	006
29-31	Number of Guns in Array	066
32-34	Number of Active Guns	028
35-37	Number of Delta-Errors	000
38-40	Number of Auto-Fires	000
41-43	Number of Mis-Fires	000
44-46	Delta Spread	009
47-52	Volume Fired	003090
53-66	Spare	
67-70	Manifold Pressure	1992
71-74	Deep Tow	0000
75-78	Sub-Array String Pressure	1977
79-82	Sub-Array String Pressure	2001
83-86	Sub-Array String Pressure	1978
87-90	Sub-Array String Pressure	1976
91-94	Sub-Array String Pressure	2013
95-98	Sub-Array String Pressure	1935

12.4 P1/90 header

```
H0100 AREA                        BLOCK VIC/P55 MAKO 3D - VICTORIA AUSTRALIA
H0101 GENERAL SURVEY DETAILS      3D, SINGLE VESSEL, DUAL SOURCE, SIX STREAMERS
H0102 VESSEL DETAILS              PACIFIC EXPLORER           1
H0103 SOURCE DETAILS              STBD SOURCE                1   1
H0103 SOURCE DETAILS              PORT SOURCE                1   2
H0104 STREAMER DETAILS            STREAMER 1 480CH           1       1   1
H0104 STREAMER DETAILS            STREAMER 2 480CH           1       2   2
H0104 STREAMER DETAILS            STREAMER 3 480CH           1       3   3
H0104 STREAMER DETAILS            STREAMER 4 480CH           1       4   4
H0104 STREAMER DETAILS            STREAMER 5 480CH           1       5   5
H0104 STREAMER DETAILS            STREAMER 6 480CH           1       6   6
H0105 OTHER DETAILS               N/A
H0200 DATE OF SURVEY              11 NOV 2007 - CONTINUING
H0201 DATE OF ISSUE OF TAPE       16 NOVEMBER 2007
H0202 TAPE VERSION IDENTIFIER     GISN07P011
H0203 LINE PREFIX                 GISN07
H0300 CLIENT                      SANTOS AUSTRALIA
H0400 GEOPHYSICAL CONTRACTOR      PGS GEOPHYSICAL - MARINE ACQUISITION
H0500 POSITIONING CONTRACTOR      FUGRO SURVEY AS
H0600 POSITIONING PROCESSING      PGS GEOPHYSICAL - MARINE ACQUISITION
H0700 POSITIONING SYSTEM          NAV SYSTEM 1: STARFIX.HP  SPM_4.26
H0700 POSITIONING SYSTEM          NAV SYSTEM 2: SKYFIX.XP   MULTIFIX 4 V2.01 XP
H0700 POSITIONING SYSTEM          INTEGRATED NAV SYSTEM: SPECTRA VERSION 10.9.01
H0800 COORDINATE LOCATION         CENTER OF SOURCE
H0900 OFFSET SYS TO NAV REF PT     1   2    0.00    0.00
H0901 OFFSET SYSTEM TO SOURCE 1    1   2   25.00 -330.00
H0902 OFFSET SYSTEM TO SOURCE 2    1   2  -25.00 -330.00
H0903 OFFSET SYSTEM TO E/S    2    1   1    2.48   31.22
H1000 CLOCK TIME                  GMT
H1100 RECEIVER GROUPS PER SHOT    2880
H1400 GEODETIC DATUM AS SURVEY    WGS84       WGS84        6378137.000 298.2572236
H1401 DATUM SHIFT WGS84 TO WGS84   0.0   0.0   0.0 0.000 0.000 0.000 0.0000000
H1500 GEODETIC DATUM POST PROC    WGS84       WGS84        6378137.000 298.2572236
H1501 DATUM SHIFT WGS84 TO 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              ES                      ECHO SOUNDER POSITION
H1800 PROJECTION                  002 U.T.M SOUTH
H1900 ZONE                        55
H2000 GRID UNITS                  1 INTERNATIONAL METERS    1.000000000000
H2001 HEIGHT UNITS                1 INTERNATIONAL METERS    1.000000000000
H2200 CENTRAL MERIDIAN            147 0 0.000E
H2600*****************************************************************************
H2600 THE Z OFFSET OF THE ECHO SOUNDER TRANSDUCER IS -6.36 METERS FROM THE
H2600 VESSEL REFERENCE POINT AT SEA LEVEL. TRANSDUCER DEPTH CORRECTIONS WERE
H2600 NOT APPLIED TO WATER DEPTHS.
H2600
H2600 THE SOUND VELOCITY SET IN THE ECHO SOUNDER WAS 1500 METERS/SECOND.
H2600 THE WATER DEPTH DATA HAS BEEN DESPIKED.
H2600 THE ECHO SOUNDER DEPTH DATA HAS BEEN CORRECTED FOR HEAVE PRIOR TO BEING
H2600 PASSED TO THE INTEGRATED NAVIGATION SYSTEM.
H2600*****************************************************************************
H2600             FORMAT OF SHOT RECORDS
H2600      COLUMN           DESCRIPTION
H2600           1           'V', 'E', 'Z', 'S', 'T'
H2600                       V= VESSEL REFERENCE POINT
H2600                       E= ECHO SOUNDER
H2600                       Z= INDIVIDUAL SOURCE POSITION
H2600                       S= CENTER OF SOURCE
H2600                       T= TAILBUOY POSITION
H2600         2-13          LINE NAME
H2600           17          VESSEL IDENTIFIER
H2600           18          SOURCE IDENTIFIER
H2600           19          TAILBUOY/OTHER IDENTIFIER
```

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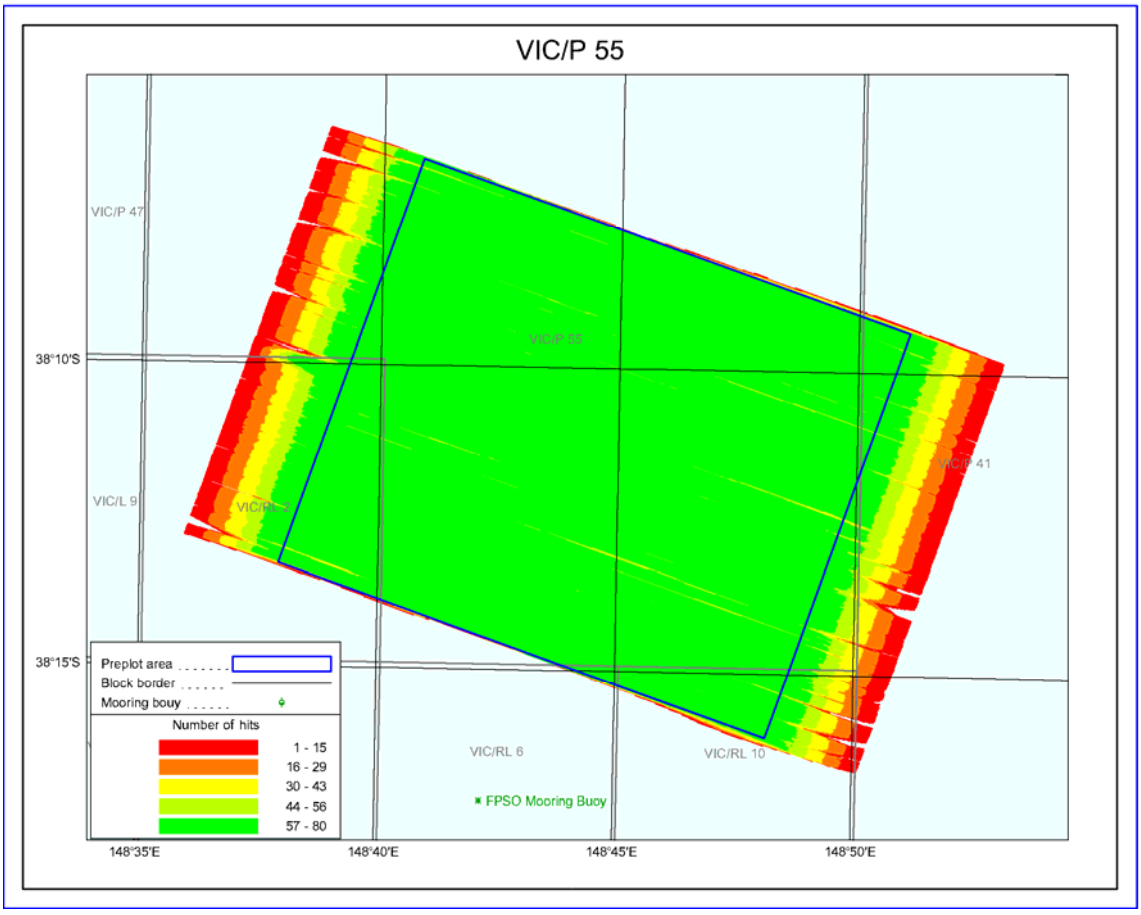
H2600       20-25           SHOT POINT NUMBER
H2600       26-35           LATITUDE (DDMMSS.SS)
H2600       36-46           LONGITUDE (DDDMMSS.SS)
H2600       47-55           MAP GRID EASTING IN METERS
H2600       56-64           MAP GRID NORTHING IN METERS
H2600       65-70           WATER DEPTH
H2600       71-73           JULIAN DAY OF YEAR
H2600       74-79           TIME (HHMMSS)
H2600
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 STREAMER AND TAILBUOY NUMBERING INCREMENTS FROM STARBOARD TO PORT
H2600
H2600 STREAMER  1: RECEIVERS NUMBERED  480 (FAR) TO    1 (NEAR)
H2600 STREAMER  2: RECEIVERS NUMBERED  960 (FAR) TO  481 (NEAR)
H2600 STREAMER  3: RECEIVERS NUMBERED 1440 (FAR) TO  961 (NEAR)
H2600 STREAMER  4: RECEIVERS NUMBERED 1920 (FAR) TO 1441 (NEAR)
H2600 STREAMER  5: RECEIVERS NUMBERED 2400 (FAR) TO 1921 (NEAR)
H2600 STREAMER  6: RECEIVERS NUMBERED 2880 (FAR) TO 2401 (NEAR)
H2600
H2600 STREAMER ROTATIONS HAVE BEEN APPLIED ON A SHOT BY SHOT BASIS.
H2600
H2600 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*****************************************************************************
H2600 PGS JOB NUMBER 2007097
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: 1522P1002             SEQUENCE:  002   FSP:   1845   LSP:    841
H2600
H2600 FOR SEISMIC DATA EDIT, PLEASE SEE THE OBSERVERS LOG
H2600
```

12.5 P6/98 Full fold coverage perimeter

```
H0100 3D SURVEY NAME            Block VIC/P55 MAKO,AUSTRALIA
H0200 BIN GRID DESCRIPTOR       ACQUISITION
H0300 GEODETIC DATUM NAME       WGS84
H0400 ELLIPSOID-AXIS-INV FLAT   WGS84        6378137.000 298.2572236
H0500 PROJECTION METHOD          002  U.T.M. SOUTH
H0510 PROJECTION ZONE NAME      ZONE 55
H0530 LON OF CM (DMS E/W)        1470000.000E
H0600 DESCR OF LINEAR UNITS     1 INTERNATIONAL METERS     1.000000000000
H0700 DESCR OF ANGULAR UNITS    1  DEGREES
H0800 BIN GRID ORIGIN (Io,Jo)     1001.0000   1001.0000
H0900 BIN GRID ORIGIN (E,N)        657707.93E   5762936.88N
H1000 SCALE FACTOR AT (I,J)     1.0000000000      1.0000      1.0000
H1100 NOM BIN WIDTH ON I AXIS    25.0000
H1150 NOM BIN WIDTH ON J AXIS    18.7500
H1200 GRID BEAR J AXIS (DMS)     2895736.000
H1300 BIN NODE INCREMENT I AXIS     0.330
H1350 BIN NODE INCREMENT J AXIS     1.000
H1400 COORDS (I,J,E,N) FST NODE   1001.0000   1107.0000    655839.82  5763615.34
H1401 COORDS (LAT,LON) FST NODE   381543.172S  1484652.621E
H1410 COORDS (I,J,E,N) SEC NODE   1001.0000   1423.0000    650270.72  5765637.92
H1420 COORDS (I,J,E,N) GEN PNT    1088.0000   1423.0000    652520.62  5771832.92
H2300 DATA EXTENT BIN GRID        1844.0000   1001.0000   1174.0000   1001.0000
H2400 DATA EXTENT MAP GRID        5780651.36  5762936.88   662181.87   642851.14
H2501 DATA EXTENT GEOG (N/S)      380635.843S   381604.000S
H2502 DATA EXTENT GEOG (E/W)     1485103.894E  1483754.940E
H2700 NUMBER OF PERIMETERS       1
H3101 FULL FOLD COV # OF NODES     3
H3201 FULL FOLD COV (I,J,E,N)     1001.0000   1844.0000    642851.14  5768332.57
H3201 FULL FOLD COV (I,J,E,N)     1174.0000   1844.0000    647325.08  5780651.36
H3201 FULL FOLD COV (I,J,E,N)     1174.0000   1001.0000    662181.87  5775255.67
H3201 FULL FOLD COV (I,J,E,N)     1001.0000   1001.0000    657707.93  5762936.88
H8002 EPSG PROJECTED CS NAME    WGS84  /UTM 55S
H8003 EPSG PROJECTED CS CODE    32755
H8006 EPSG DATABASE VERSION      6.10
```

12.6 Coverage Plot – All No Flex



12.7 Cetacean sightings

Date	Species	Inside Excl. Zone?	Any Action	Duration of any action	Comments	Sighted by	Position
12/11/2007@08:39	larger whale	true / 3000m	none	0	Deployment - no guns firing	mmo	-37.94222 148.96026
12/11/2007@12:35	larger whale	true / 3000m	none	0	Deployment - no guns firing	mmo	-37.94951 149.32242
12/11/2007@15:33	dolphin / porpoise	false / 0m	none	0	Deployment - no guns firing	mmo	-37.99419 149.08797
12/11/2007@16:19	larger whale	true / 3000m	none	0	Deployment - no guns firing	mmo	-37.99474 149.01554
12/11/2007@16:34	dolphin / porpoise	false / 0m	none	0	Deployment - no guns firing	mmo	-37.99494 148.99081
12/11/2007@18:41	larger whale	true / 3000m	none	0	Deployment - no guns firing	mmo	-37.99716 148.81448
13/11/2007@07:35	larger whale	true / 3000m	none	0	Deployment - no guns firing	mmo	-38.06006 149.13384
13/11/2007@10:20	dolphin / porpoise	false / 0m	none	0	Deployment - no guns firing	mmo	-38.03421 148.86791
13/11/2007@13:51	larger whale	false / 3000m	none	0	Deployment - no guns firing	mmo	-37.9936 148.55013
13/11/2007@14:50	larger whale	true / 3000m	none	0	Deployment - no guns firing	mmo	-37.95213 148.59591
13/11/2007@15:36	larger whale	true / 3000m	none	0	Deployment - no guns firing	mmo	-37.95532 148.66226
13/11/2007@17:37	larger whale	true / 3000m	none	0	Deployment - no guns firing	mmo	-37.9937 148.8257
13/11/2007@19:06	dolphin / porpoise	false / 0m	none	0	Deployment - no guns firing	mmo	-38.02599 148.94642
14/11/2007@14:18	dolphin / porpoise	false / 0m	none	0	Dolphins within 400m of the source during a bubble test so only single guns firing in turn.	mmo	-37.97804 149.17116
15/11/2007@07:23	larger whale	true / 3000m	none	0	No guns firing dt cable work	mmo	-38.10541 148.66218
15/11/2007@07:41	larger whale	true / 3000m	none	0	No guns firing dt cable work	mmo	-38.09962 148.64055
15/11/2007@08:30	larger whale	true / 3000m	none	0	No guns firing dt cable work	mmo	-38.0799 148.55434
15/11/2007@11:24	dolphin / porpoise	false / 0m	none	0	No guns firing dt cable work	mmo	-38.09742 148.45205
15/11/2007@16:11	dolphin / porpoise	false / 0m	none	0	No guns firing dt cable work	mmo	-38.16291 148.87809

Date	Species	Inside Excl. Zone?	Any Action	Duration of any action	Comments	Sighted by	*Position*
15/11/2007@16:55	dolphin / porpoise	false / 0m	none	0	No guns firing dt cable work	mmo	*-38.18817* *148.94198*
15/11/2007@17:42	dolphin / porpoise	false / 0m	none	0	No guns firing dt cable work	mmo	*-38.23375* *148.96044*
16/11/2007@07:00	dolphin / porpoise	false / 0m	none	0	In production - seq.003	mmo	*-38.12439* *148.54815*
16/11/2007@07:07	dolphin / porpoise	false / 0m	none	0	In production - seq.003	mmo	*-38.12439* *148.54815*
16/11/2007@07:21	dolphin / porpoise	false / 0m	none	0	In production - seq.003	mmo	*-38.10695* *148.54255*
16/11/2007@10:44	dolphin / porpoise	false / 0m	none	0	In production - seq.004	mmo	*-38.15982* *148.84622*
16/11/2007@12:13	dolphin / porpoise	false / 0m	none	0	In production - seq.004	mmo	*-38.23268* *148.93886*
16/11/2007@13:32	larger whale	false / 3000m	none	0	In production - Line Change	mmo	*-38.2106* *148.79411*
16/11/2007@15:43	dolphin / porpoise	false / 0m	none	0	In production - seq.005	mmo	*-38.15299* *148.59396*
17/11/2007@06:51	dolphin / porpoise	false / 0m	none	0	In production - Line Change	mmo	*-38.2193* *148.80183*
17/11/2007@07:32	larger whale	false / 3000m	none	0	In production - Line Change	mmo	*-38.19704* *148.72016*
17/11/2007@07:36	larger whale	true / 3000m	none	0	In production - Line Change	mmo	*-38.19704* *148.72016*
17/11/2007@15:50	dolphin / porpoise	false / 0m	none	0	In production - seq.010	mmo	*-38.21073* *148.76239*
18/11/2007@19:57	dolphin / porpoise	false / 0m	none	0	In production - Line Change	mmo	*-38.1819* *148.6264*