FINAL SURVEY REPORT

CGGVeritas

Santos

VESSEL: M/V PACIFIC TITAN

- Marine 2D & High Resolution SEISMIC REFLECTION METHOD ACQUISITION -

Location	:	**AUSTRALIA**
Area	:	**West of Tasmania - Australia**
Survey	:	**T/48P KING ISLAND 2D - SOSN08C MARINE SEISMIC SURVEY**
Client	:	**SANTOS OFFSHORE Pty Ltd**
Duration	:	**04th March 2008 - 12th March 2008**
C.G.G.V. SURVEY N°	:	**501 11 89 07 06 00 (Job N°: 6374)**
CONTRACT N°	:	**859832**

Table of Contents

1. Survey Information and Objectives

Santos have agreed to enter into a service contract for the purpose of acquisition of a marine seismic 2D survey of app.733 km. full fold along the North West coast of Tasmania, Australia.

The survey was located on the North-West coast of Tasmania.

Water depth in the survey area was a minimum of 80 meters to a maximum of 1949 meters.

The seismic acquisition was performed by CGGVeritas using the survey vessel Pacific Titan, owned by Swire Pacific Offshore.

Source volume was 3040 cubic inches at a depth of 6 m.
Streamer length was 6000 m, towed at a depth of 8 m.
Recording length was 6 sec.

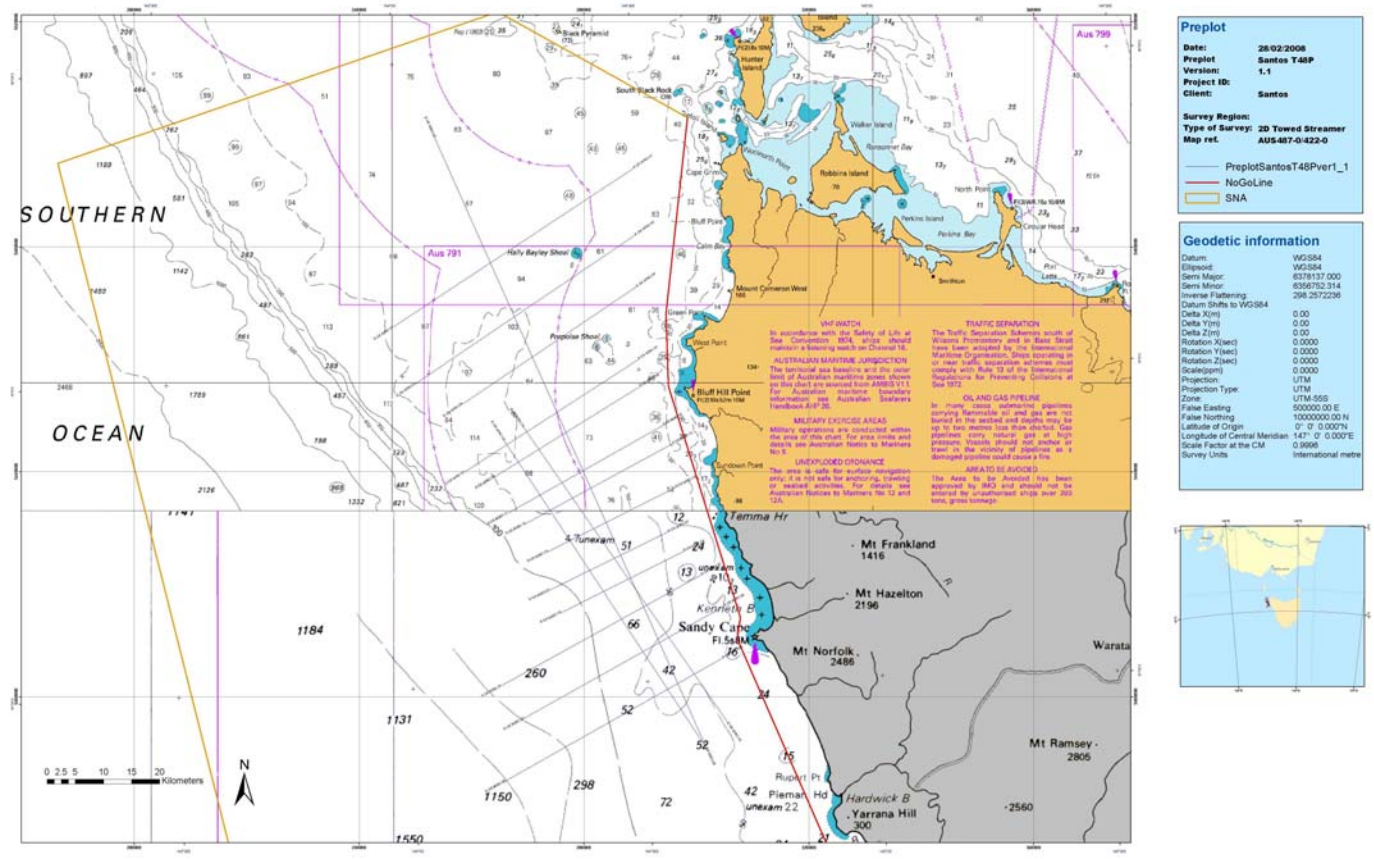
Chargeable production started on the 4th March at 18:37 and completed 12th March at 04:30 local Australian east coast time.

All lines were pre-fixed with SOSN08C where C denotes block C, A survey sequence number was used as the last 3 characters in the name, unique for each line in the survey. Sequence number started from 001.

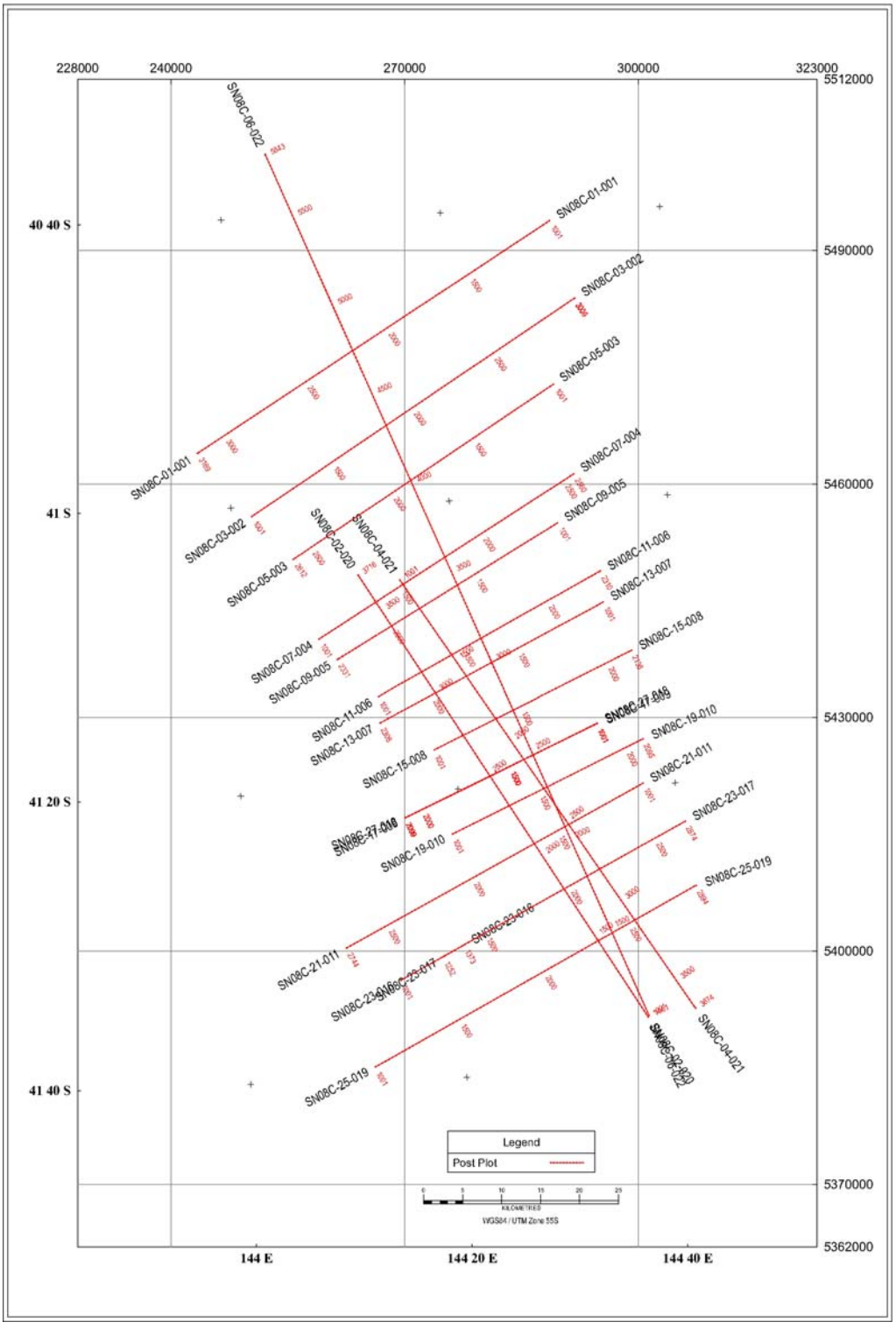
Upon survey completion, Pacific Titan recovered all in water equipment and departed the area.

2. Survey Area (T/48P KING ISLAND 2D - SOSN08C)

2.1. Preplot Map



2.2. Postplot Map.



3. Contract Work Order

CONTRACT

Client:	SANTOS Ltd
Vessel(s):	Pacific Titan
Job number:	6374
Bid number:	
Client contract number/ref:	
Name:	Southern Margins, Tasmania
Area:	North West Tasmania and King Island, -Australia
Type of survey:	2D Towed streamer
Area or total km's:	733km approximately
Line heading:	Variable
Number of lines:	17
Line Length:	Variable
Acquisition method:	2D Single Streamer, Single Source
Estimated start date (yyyy-mm-dd):	4 March 2008
Estimated duration:	1 week
QHSE checklists completed:	

STREAMER

Type of streamer:	Sercel Seal, digital streamer, Solid Streamer
Number of streamers:	1
Separation:	N/A
Streamer length:	6000 metres.
Number of channels:	480
Group interval:	12.5 metres
Streamer depth and tolerance:	8 metres +/-1 metre
Water depth:	80 - 1950

RECORDING

Instrument type:	Sercel Seal Sercel Seal
Record length:	6 seconds.
Sample rate:	2 milliseconds
Recording filter, Hi-cut:	206Hz @ 276dB/Oct
Recording filter, Low-cut:	Analog (built in) 3Hz @ 6dB/Oct, Digital Low-Cut: IN (4.7Hz effective)
Filter type:	Butterworth
Pre-amplifier gain:	0dB, (1600mV)
Tape format:	SEGD 8058
Recording media:	IBM 3590
Tape copy:	2 data sets of Field Tapes to be delivered

	SOURCE
Source type:	Bolt Long Life, Tuned array
Source controller:	Seamap Gunlink 2000
Number of sources:	1
Volume per source:	3040 cu in
Source depth and tolerance:	6 metres +/- 1.0 metres
Source pressure and tolerance:	2000 psi +/- 10%
Source length:	15 metres
Number of sub-arrays per source:	3
Sub-array separation:	10 metres
Flip/flop:	N/A
Shot point interval per shot:	25 metres
Shot point location:	
Near fields to be recorded?	Yes
Source firing specifications:	+/- 1.2 milliseconds

4. Vessel Description

4.1. Vessel Specifications – Pacific Titan

M/V Pacific Titan is capable of doing both 2D and 3D seismic data acquisition work. For 2D work the vessel can tow 12 000 meters streamers. For 3D seismic work the vessel can do dual source/dual streamer (2X8000m) or dual source/three streamer (3X4000m) operation providing high quality 2D and 3D seismic data for the industry. Features include a SEAL-24 system configurable for multiple streamers. Options include real-time seismic processing, acoustic source positioning, and acoustic streamer positioning and onboard navigation. The following are general specifications for the vessel and seismic equipment on board.

Vessel Information

Description:	6,400 BHP Seismic Survey Vessel
Classification:	A1 (E) Seismic Research AMS ACCU
Built:	Japan, 1982, Conversion later in Seattle
Flag:	Singapore
Call Sign:	9V5935
IMO No. :	8208385

Dimensions

Length, overall:	64.5 m
Length BP:	55.2 m
Breadth, moulded:	18.5 m
Depth, moulded:	6.0 m
Summer Draft:	5.18 m
GRT:	3211.0
NRT:	963.0

Machinery

Main engines:	4 x 1,600 BHP, 6Z-ST Total 6,400 BHP Propellers in Kort Nozzles
Bow Thruster:	420 BHP Yanmar 6LAAL-DTN 5 tones thrust, CP propeller
Rudders:	Trailing Flap
Generator:	3 x 280 kW Yanmar 6LAAL-DTN
Speed:	4 x engines, Max: 12.0 kts/14 tons/day Service: 10 kts/10 tons/day 2 x engines: 9.0 kts/9 tons/day

Electronics

Radar:	Furuno FR 1505 Mk III ARPA
Secondary Radar:	Furuno FR 1510 Mk III
GPS:	Furuno GP 30
Echo Sounder:	Simrad ED-162 and Simrad EA 600
Communications:	G.M.D.S.S. Skanti SSB, VHF, Inmarsat C 456304540 / 456304550
Weather Fax:	Furuno 207
Satcom B:	NERA Inmarsat phone/fax Tel (870) 356 304 510
Vsat:	Instrumentroom +47 51 40 76 11 Party Chief +47 51 40 76 12 Chiefs office +47 51 40 76 13 Bridge/Fax +47 51 40 76 14
High Speed data link:	NERA Inmarsat system: Tel (870) 356 304 510

Miscellaneous:

Fire monitoring and detection to all work areas
USCG approved sewage treatment plant.
Incinerator, macerator and compactor.
Six man inflatable Man-overboard boat on quick release davit
LSA equipment for 45 persons excluding survival suits.
Foam deluge system covering streamer winches, streamer storage reels and helideck.
P.A. System
Stainless steel gun deck.
Helideck rated for Bell 212 or equivalent with lights.
FRC: 21 feet Nor Power.

4.2. Seismic Particulars

4.2.1. Streamer and Sensors Details

Item	Description	Type	Amount	Remark
Streamer	24 bit, digital distributed electronic	Sercel solid SEAL	Up to 12 km active	64 mm diameter
Depth Control	Digicourse	5011	22	Located every 300 m along the streamer
Buoyancy		Foam		
Retrievers	Concorde	500	7	1 every 900 meters
Streamer skin	Polyurethane	Solid		3.5 mm thickness
Hydrophones	Sercel Radial	Piezoelectric		Sercel 12-element radial
Section Length	150 m			
Section diameter	64 mm			
Lead-in	Sercel	Armoured	350 m.	
Group Length	12.5 m			
No of hydrophones per group	8	Sercel 12 element radial.		790 nF Group capacitance 21.5 V/Bar sensitivity
Max number of channels	2000			12.5 m @ 2ms
Telemetry data link	Dual twisted quartet	AWG 22		
Aux. Data link	4 twisted pair	AWG 22		
Power lines	Dual	AWG 14		
Connectors	28 points	AWG 16		

4.2.2. Recording System Details

Item	Description	Type	Amount	Remark
Acquisition	SEAL V 5.0	Sercel	1	Max 10 000 channels
Format	SEG D Vs1	De-multiplexed		
Recording	IBM via Argus	IBM computer	4	3590 cartridges
Computer	Sun	Blade 2000	2	
Bird Controller		Digicourse	22	
Graphic user I/F	Unix/Seapro	X11 Ultra 5		Sercel
Terminal	Sun	21”	2	
Sampling				¼,1/2,1,2,4 ms
Aux channels			36	Max 255
Plotter	24”	Veritas	1	On-line
Printer	A4			Label
Printer	A4			Logs, tests etc.
Network	Ethernet	Twisted pair		Category 5 TCP/IP
Argus Raid	Intel Xeon	Raid drive		Data storage/Backup

4.2.3. Seismic QC Details

Item	Description	Type	Amount	Remark
Online Qc	SEAPRO QC Vs 4.0	Sercel	1	Online seismic QC, fully Integrated with recording system.
Offline Qc	ProMAX	Landmark	1	Brute stacks, etc
Plotter	24”	Veritas	1	
Computer	Supermicro	Dual Xeon 3.2 Ghz	1	
Terminals	Sun	21”	2	
Graphic user interface	Linux	RedHat		
Remote	X terminal			Sat. link
Network	Ethernet	Twisted pair		Category 5 TCP/IP
Product options		High resolution seismic record display. Pre-filtering of seismic data. Attribute calculation First break picking. Signal to noise ratio. Seismic trace energy. Noise level. Seismic trace frequency analysis. Single trace displays. Attribute db generation		

4.2.4. Navigation Details

Item	Description	Type	Amount	Remark
Navigation online	Concept Systems	Spectra		
Navigation offline	FGPS	Seispos		
Work Stations	PC workstations	Shuttle	2	
Network	Ethernet	Twisted pair		Category 5 TCP/IP
PC workstation	Sony	Shuttle		
Printer	HP	Laser		Network to 12”
Compasses	Digicourse	5011	22	Every 300 meter along the streamer + more in the front and tail end.
Streamer positioning	RGPS	Geotrack 220	1	Tracks
Source Positioning	RGPS	Geotrack 320	3	1 on each sub-array.
Acoustics	N/A			
Data logging	UKOOA	P2/94 P1/90		3590, CD-Rom, Online hard disk
Echo Sounder	Simrad	EA600		12 KHz & 200 KHz
Gyro	Simrad HS 50			GPS Gyro
Autopilot	Robertson	AP9 Mk III		
Steering	RobTrack	STS500		
Helmsman Steering display	Spectra	Sony Shuttle	1	Located on the bridge

4.2.5. Source and Mechanical Department Details

Item	Description	Type	Amount	Remark
Acoustic source	Long Life	Bolt		6 acoustic positions per sub-array 8 sources per sub-array
Hanging Plates	Multiwave design	Multiwave		
Chambers	40 – 300 cu. inch.			
Cluster	8-ea clusters	Bolt		3 clusters on the outmost sub-arrays, 2 on the centre sub-array
Near field hydrophones	2540	I/O		3 per sub-array
Depth/pressure Sensors	2527B	I/O		3 per sub-array
Source	Varying configuration	Multiwave / Bolt	Single /dual	Typical: 90-110bar output
Compressors	Frick	TDSB 355	3	Capacity 3 x 2000 cu.ft/min
	Aerial	JGA4	3	
	Caterpillar	Prime mover	3	1 for ea. set of Frick/Aerial
Source controller	Gunlink 2000	Seamap		32 guns, expandable
Solenoid Power Supply	Gunlink 2000	Seamap		25 ms fire pulse width
Deflector	Multiwave	6 foils	2	
Gun Winches	Single	Odim remote ctrl.	5	Slip-ring, Air
Streamer winches	Single	Odim remote ctrl.	4	Each 9000 m (50 mm)
Spooling Device	Marine Project Development	Linear	4	Spooling on each streamer winch individually
Tow Points	Odim	Flexible	4	
Winch Control	Odim		2	

5. List of Key Personnel

5.1. Onboard Personnel

POSITION	Crew 1
Party Chief	Sigurd Østerud
Captain	Theodore Strockyj
Chief Engineer	Carl Sayers
Chief Observer	Allan Beatie
Shift Leader Observer	Jun Lamabas
Chief Navigator	Paul Stafford
Shift Leader Navigation	Christopher Hernandez
Chief Mechanic	Roger Steffensen
Shift Leader Mechanic	Ronaldo Morales
QC leader	Steffi Schwarz
Client Representative	William Lloyd

5.2. Office Support Personnel

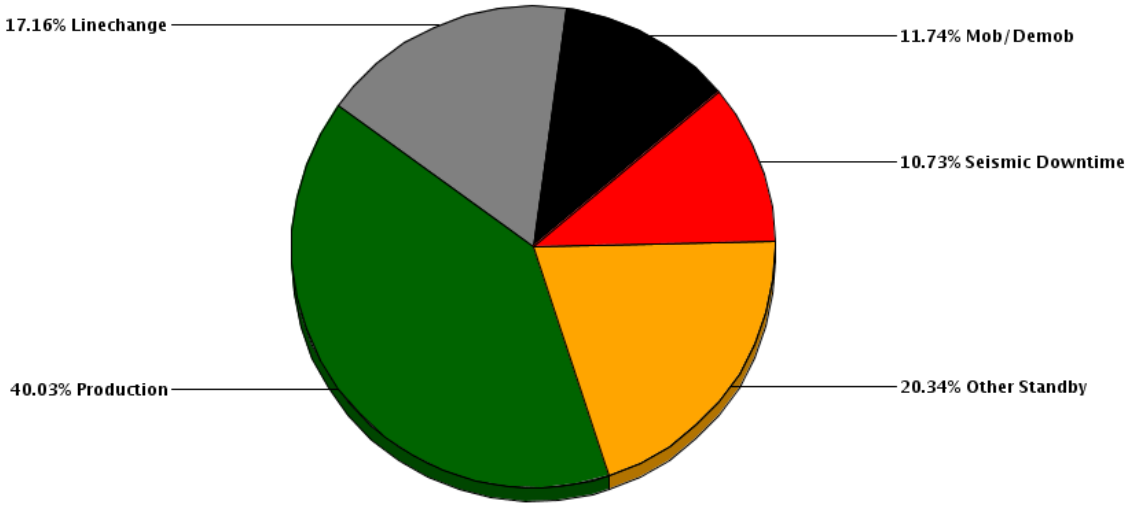
POSITION	NAME
Vice President Operation	Christian Brige
Operation Manager	Serge Laigre
Instrument Manager	Joar Vestrheim
Navigation Manager	Rafael Bouraly
Mechanic Manager	Steinar Hovland
QC support	Christophe Massacand

6. Field Information and Observations

6.1. Time Statistics

Time Distribution

M/V Pacific Titan **Client :** (6734) Seboa - Group Shoot - Australia **Survey:** 550 11 89 07 06 00 **Area:** 2D (Project SEBOA)
Date: 03.03.2008 - 11.3.2008 (GMT Time)



Time Distribution

M/V Pacific Titan **Client:**(6734) Seboa - Group Shoot - Australia **Survey:** 550 11 89 07 06 00 **Area:** 2D (Project SEBOA)
Date: 03.03.2008 - 11.3.2008

		CHARGE CODES								Hidden downtime	
ACTIVITY		13	22	23	24	C CGG Time	Tc corr	Total hours	%	RC hrs	RB hrs
Linechange											
LChnom	Linechange, nominal		35.85					35.85	17.16%		
TOTAL			35.85					35.85	17.16%		
Mobilisation / Demobilisation											
MOdepl	Mobilisation, deploying gear					13.87		13.87	6.64%		
MOothr	Mobilisation, other					10.67		10.67	5.11%		
TOTAL						24.53		24.53	11.74%		
Production											
PROD2D	Production 2D Line	78.13						78.13	37.40%		
PRORUN	Production Runout	5.50						5.50	2.63%		
TOTAL		83.63						83.63	40.03%		
Standby Environment											
ENvfis	Environmental, fishing activities			12.45				12.45	5.96%		
ENvoth	Environmental, other			12.15				12.15	5.82%		
TOTAL				24.60				24.60	11.78%		
Standby Other											
STbcli	Standby on clients request			11.38	6.50			17.88	8.56%		
TOTAL				11.38	6.50			17.88	8.56%		
TD MEC Source											
MEsumb	Mechanical, source, umbilical (cable)						12.47	12.47	5.97%		
TOTAL							12.47	12.47	5.97%		
TD REC In-sea equipment											
REidcc	Recording, in-sea, depth controller/compass						9.95	9.95	4.76%		
TOTAL							9.95	9.95	4.76%		
TOTAL		83.63	35.85	35.98	6.50	24.53	22.42	208.92	100.00%		

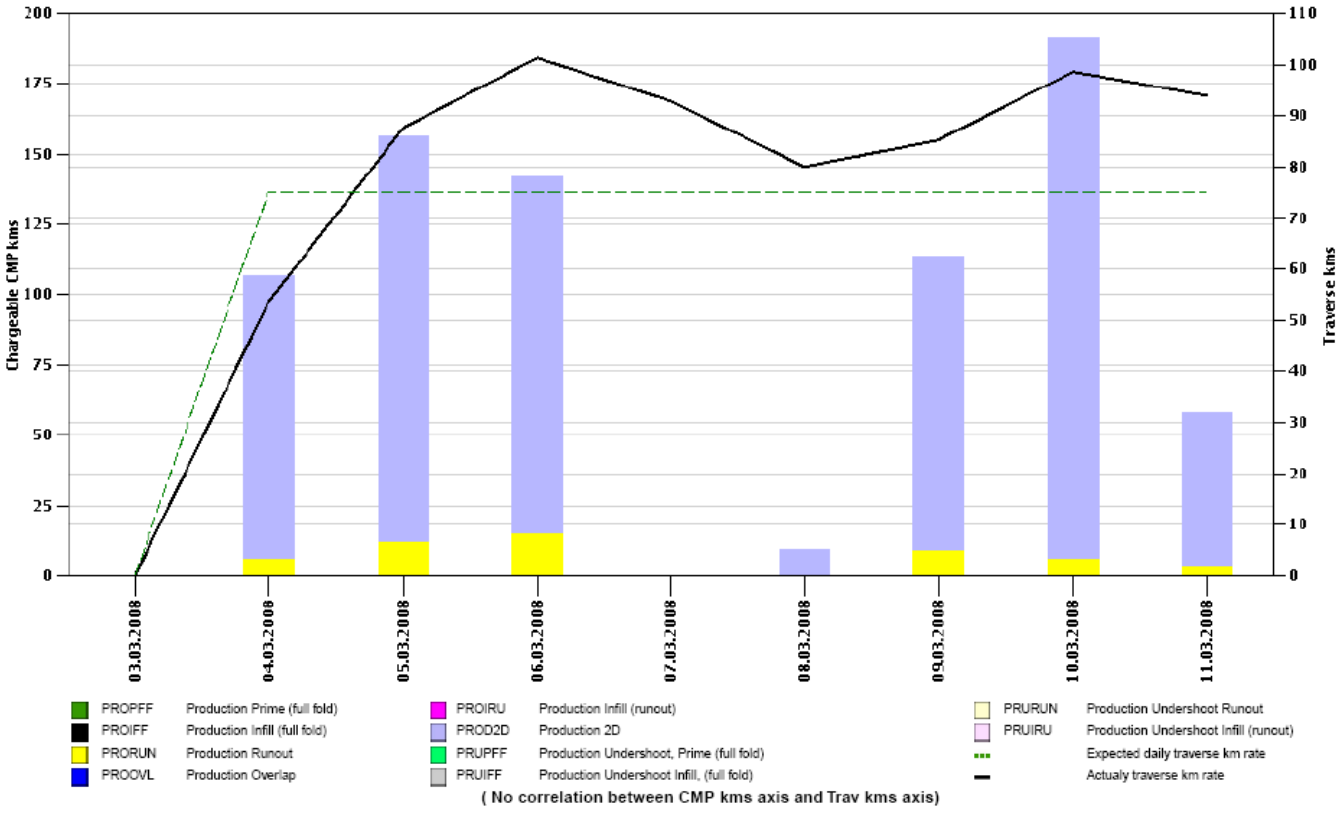
Charge codes in use

13	Santos 2D and runout		
22	Chargeable linechange	Tc	CGG Technical Downtime Corrective
23	Standby under 12 hrs Santos	C	CGG Time
24	Standby under 12 hrs TAP		

Printed: 17.03.2008 05:44:03

6.2. Production Statistics

Production Summary
M/V Pacific Titan **Client:**(6734) Seboa - Group Shoot - Australia **Survey:** 550 11 89 07 06 00 **Area:** 2D (Project SEBOA)
Date: 03.03.2008 - 11.03.2008



Printed: 17.03.2008 05:40:31

6.3. Production Time Follow up.

CGGVERITAS

Production Log: Santos Survey T48P
M/V Pacific Titan (6734) Seboa - Group Shoot - Australia **Area:** 2D (Project SEBOA)
Date: 04.03.2008 11.03.2008 **Survey:** 550 11 89 07 06 00

Date	Line	Time	Total Time	Dir	FSP	LSP	TOT SPs	Chargeable CMP kms	Primary	Secondary	Comments	Standby per Instance	Date (Local)	Time (Local)	Time (Local)
04-Mar-08	SOSN08C-01-001	07:37 - 13:23	5.77	238	1001	3049	2049	51.225	Recording	Production	Production 2D Line		04 & 05-Mar-08	18:37	00:23
04-Mar-08	SOSN08C-01-001	13:23 - 13:41	0.30	238	3050	3169	120	3	Recording	Production	Production Runout		05-Mar-08	00:23	00:41
04-Mar-08		13:41 - 16:33	2.87						Line Change	Linechange	Linechange, nominal		05-Mar-08	00:41	03:33
04-Mar-08	SOSN08C-03-002	16:33 - 21:40	5.12	58	1001	2884	1884	47.1	Recording	Production	Production 2D Line		05-Mar-08	03:33	08:40
04-Mar-08	SOSN08C-03-002	21:40 - 22:00	0.33	58	2885	3004	120	3	Recording	Production	Production Runout		05-Mar-08	08:40	09:00
04-Mar-08		22:00 - 23:45	1.75						Line Change	Linechange	Linechange, nominal		05-Mar-08	09:00	10:45
04-Mar-08	SOSN08C-05-003	23:45 - 00:00	0.25	238	1001	1097	97	2.425	Recording	Production	Production 2D Line		05-Mar-08	10:45	11:00
05-Mar-08	SOSN08C-05-003	00:00 - 03:38	3.63	238	1098	2492	1395	34.875	Recording	Production	Production 2D Line		05-Mar-08	11:00	14:38
05-Mar-08	SOSN08C-05-003	03:38 - 03:59	0.35	238	2493	2612	120	3	Recording	Production	Production Runout		05-Mar-08	14:38	14:59
05-Mar-08		03:59 - 06:35	2.60						Line Change	Linechange	Linechange, nominal		05-Mar-08	14:59	17:35
05-Mar-08	SOSN08C-07-004	06:35 - 10:27	3.87	58	1001	2440	1440	36	Recording	Production	Production 2D Line		05-Mar-08	17:35	21:27
05-Mar-08	SOSN08C-07-004	10:27 - 10:46	0.32	58	2441	2560	120	3	Recording	Production	Production Runout		05-Mar-08	21:27	21:46
05-Mar-08		10:46 - 12:14	1.47						Line Change	Linechange	Linechange, nominal		05-Mar-08	21:46	23:14
05-Mar-08	SOSN08C-09-005	12:14 - 15:32	3.30	239	1001	2211	1211	30.275	Recording	Production	Production 2D Line		05 & 06-Mar-08	23:14	02:32
05-Mar-08	SOSN08C-09-005	15:32 - 15:52	0.33	239	2212	2331	120	3	Recording	Production	Production Runout		06-Mar-08	02:32	02:52
05-Mar-08		15:52 - 17:43	1.85						Line Change	Linechange	Linechange, nominal		06-Mar-08	02:52	04:43
05-Mar-08	SOSN08C-11-006	17:43 - 20:50	3.12	62	1001	2190	1190	29.75	Recording	Production	Production 2D Line		06-Mar-08	04:43	07:50
05-Mar-08	SOSN08C-11-006	20:50 - 21:09	0.32	62	2191	2310	120	3	Recording	Production	Production Runout		06-Mar-08	07:50	08:09
05-Mar-08		21:09 - 22:26	1.28						Line Change	Linechange	Linechange, nominal		06-Mar-08	08:09	09:26
05-Mar-08	SOSN08C-13-007	22:26 - 00:00	1.57	242	1183	1710	528	13.2	Recording	Production	Production 2D Line		06-Mar-08	09:26	11:00
06-Mar-08	SOSN08C-13-007	00:00 - 01:20	1.33	242	1711	2186	476	11.9	Recording	Production	Production 2D Line		06-Mar-08	11:00	12:20
06-Mar-08	SOSN08C-13-007	01:20 - 01:40	0.33	242	2187	2306	120	3	Recording	Production	Production Runout		06-Mar-08	12:20	12:40
06-Mar-08		01:40 - 03:22	1.70						Line Change	Linechange	Linechange, nominal		06-Mar-08	12:40	14:22
06-Mar-08	SOSN08C-15-008	03:22 - 06:15	2.88	65	1001	2016	1016	25.4	Recording	Production	Production 2D Line		06-Mar-08	14:22	17:15
06-Mar-08	SOSN08C-15-008	06:15 - 06:35	0.33	65	2017	2136	120	3	Recording	Production	Production Runout		06-Mar-08	17:15	17:35
06-Mar-08		06:35 - 08:38	2.05						Line Change	Linechange	Linechange, nominal		06-Mar-08	17:35	19:38
06-Mar-08	SOSN08C-17-009	08:38 - 11:19	2.68	245	1001	1979	979	24.475	Recording	Production	Production 2D Line		06-Mar-08	19:38	22:19
06-Mar-08	SOSN08C-17-009	11:19 - 11:38	0.32	245	1980	2099	120	3	Recording	Production	Production Runout		06-Mar-08	22:19	22:38
06-Mar-08		11:38 - 13:09	1.52						Line Change	Linechange	Linechange, nominal		06 & 07-Mar-08	22:38	00:09
06-Mar-08	SOSN08C-19-010	13:09 - 15:45	2.60	65	1001	1975	975	24.375	Recording	Production	Production 2D Line		07-Mar-08	00:09	02:45
06-Mar-08	SOSN08C-19-010	15:45 - 16:04	0.32	65	1976	2095	120	3	Recording	Production	Production Runout		07-Mar-08	02:45	03:04
06-Mar-08		16:04 - 17:26	1.37						Line Change	Linechange	Linechange, nominal		07-Mar-08	03:04	04:26
06-Mar-08	SOSN08C-21-011	17:26 - 21:47	4.35	243	1001	2624	1624	40.6	Recording	Production	Production 2D Line		07-Mar-08	04:26	08:47
06-Mar-08	SOSN08C-21-011	21:47 - 22:06	0.32	243	2625	2744	120	3	Recording	Production	Production Runout		07-Mar-08	08:47	09:06
06-Mar-08		22:06 - 00:00	1.90						Line Change	Linechange	Linechange, nominal		07-Mar-08	09:06	11:00
07-Mar-08		00:00 - 00:14	0.23						Line Change	Linechange	Linechange, nominal		07-Mar-08	11:00	11:14
07-Mar-08	SOSN08C-23-012	00:14 - 01:11	0.95	62	1001	1342	342		Regional D/T	Standby	NTBP due to: Environmental, other: Whale pod came within near zone causing shutdown. Line segment too short to keep.	1st instance	07-Mar-08	11:14	12:11
07-Mar-08		01:11 - 04:53	3.70						Regional D/T	Standby	Environmental, other, Whale pod caused shutdown		07-Mar-08	12:11	15:53
07-Mar-08		04:53 - 05:49	0.93						Technical D/T	REC	NTBP due to: Recording, in-sea, depth controller/compass: Streamer too shallow at bird 16, when recovered no fishing gear found attached.		07-Mar-08	15:53	16:49
07-Mar-08		05:49 - 14:50	9.02						Technical D/T	REC	Recording, in-sea, depth controller/compass		07 & 08-Mar-08	16:49	01:50
07-Mar-08	SOSN08C-23-014	14:50 - 19:22	4.53	62	1001	2554	1554		Regional D/T	Standby	NTBP due to: Environmental, fishing activities: bird 12 going shallow in spots. Later this was found to be out of collars along with bird 11 due to fishing gear.	2nd instance	08-Mar-08	01:50	06:22
07-Mar-08	SOSN08C-23-014	19:22 - 19:43	0.35	62	2555	2674	120		Regional D/T	Standby	Environmental, fishing activities		08-Mar-08	06:22	06:43
07-Mar-08		19:43 - 00:00	4.28						Regional D/T	Standby	Environmental, fishing activities, circling to start of line 23 due to good segment was under 12.5 km. (only 10 km)		08-Mar-08	06:43	11:00
08-Mar-08		00:00 - 03:17	3.28						Regional D/T	Standby	Environmental, fishing activities		08-Mar-08	11:00	14:17
08-Mar-08	SOSN08C-23-015	03:17 - 04:01	0.73	62	1001	1263	263		Regional D/T	Standby	Environmental, other, Aborted due to whales and DNP'd due to segment shorter than 12 km (2 cable lengths as specified in contract)	3rd instance	08-Mar-08	14:17	15:01
08-Mar-08		04:01 - 07:01	3.00						Regional D/T	Standby	Environmental, other, circling due to whales, picking up guns for umbilical maintenance		08-Mar-08	15:01	18:01
08-Mar-08		07:01 - 19:29	12.47						Technical D/T	MEC	Mechanical, source, umbilical (cable), swapping around umbilicals due to air leak inside gun string 2 umbilical at reel. Needed rewiring at patch panel as well.		08 & 09-Mar-08	18:01	06:29
08-Mar-08	SOSN08C-23-016	19:29 - 20:29	1.00	62	1001	1371	371	9.275	Recording	Production	Production 2D Line, aborted early due to whales. Client decided it was enough to keep.		09-Mar-08	06:29	07:29
08-Mar-08		20:29 - 23:55	3.43						Regional D/T	Standby	Environmental, other, circling due to whales		09-Mar-08	07:29	10:55
08-Mar-08	SOSN08C-23-017	23:55 - 00:00	0.08	62	1252	1276	25		Regional D/T	Standby	Environmental, other, overlap caused due to whales	4th instance	09-Mar-08	10:55	11:00
09-Mar-08	SOSN08C-23-017	00:00 - 00:15	0.25	62	1277	1371	95		Regional D/T	Standby	Overlap due to: Environmental, other: circled due to whales		09-Mar-08	11:00	11:15
09-Mar-08	SOSN08C-23-017	00:15 - 03:23	3.13	0	1372	2554	1183	29.575	Recording	Production	Production 2D Line		09-Mar-08	11:15	14:23
09-Mar-08	SOSN08C-23-017	03:23 - 03:42	0.32	0	2555	2674	120	3	Recording	Production	Production Runout		09-Mar-08	14:23	14:42
09-Mar-08		03:42 - 06:45	3.05						Line Change	Linechange	Linechange, nominal		09-Mar-08	14:42	17:45
09-Mar-08	SOSN08C-27-018	06:45 - 09:21	2.60	245	1001	1979	979	24.475	Recording	Production	Production 2D Line, reduced gun volume test line. repeat coverage of line 17		09-Mar-08	17:45	20:21
09-Mar-08	SOSN08C-27-018	09:21 - 09:40	0.32	245	1980	2099	120	3	Recording	Production	Production Runout		09-Mar-08	20:21	20:40
09-Mar-08		09:40 - 14:43	5.05						Line Change	Linechange	Linechange, nominal		09 & 10-Mar-08	20:40	01:43
09-Mar-08	SOSN08C-25-019	14:43 - 19:29	4.77	62	1001	2774	1774	44.35	Recording	Production	Production 2D Line		10-Mar-08	01:43	06:29
09-Mar-08	SOSN08C-25-019	19:29 - 19:49	0.33	62	2775	2894	120	3	Recording	Production	Production Runout		10-Mar-08	06:29	06:49
09-Mar-08		19:49 - 23:21	3.53						Line Change	Linechange	Linechange, nominal		10-Mar-08	06:49	10:21
09-Mar-08	SOSN08C-02-020	23:21 - 00:00	0.65	330	1001	1245	245	6.125	Recording	Production	Production 2D Line		10-Mar-08	10:21	11:00
10-Mar-08	SOSN08C-02-020	00:00 - 06:05	6.08	330	1246	3596	2351	58.775	Recording	Production	Production 2D Line		10-Mar-08	11:00	17:05
10-Mar-08	SOSN08C-02-020	06:05 - 06:24	0.32	330	3597	3716	120	3	Recording	Production	Production Runout		10-Mar-08	17:05	17:24
10-Mar-08		06:24 - 08:06	1.70						Line Change	Linechange	Linechange, nominal		10-Mar-08	17:24	19:06
10-Mar-08	SOSN08C-04-021	08:06 - 15:00	6.90	147	1001	3554	2554	63.85	Recording	Production	Production 2D Line		10 & 11-Mar-08	19:06	02:00
10-Mar-08	SOSN08C-04-021	15:00 - 15:20	0.33	147	3555	3674	120	3	Recording	Production	Production Runout		11-Mar-08	02:00	02:20
10-Mar-08		15:20 - 17:16	1.93						Line Change	Linechange	Linechange, nominal		11-Mar-08	02:20	04:16
10-Mar-08	SOSN08C-06-022	17:16 - 00:00	6.73	0	1001	3520	2520	63	Recording	Production	Production 2D Line		11-Mar-08	04:16	11:00
11-Mar-08	SOSN08C-06-022	00:00 - 05:48	5.80	337	3521	5723	2203	55.075	Recording	Production	Production 2D Line		11-Mar-08	11:00	16:48
11-Mar-08	SOSN08C-06-022	05:48 - 06:07	0.32	337	5724	5843	120	3	Recording	Production	Production Runout		11-Mar-08	16:48	17:07
11-Mar-08		06:07 - 17:30	11.38						Regional D/T	Inter-move	Standby on clients request, Recover gear and transit to TAP prospect. Halfway point given as 40 deg 11 min 35 sec S and 144 deg 54 min 29 sec E.		11 & 12-Mar-08	17:07	04:30

Production w/ runouts and linechanges	119.48 Hours
Standby - (First 12 hours per instance)	24.60 Hours
Standby - (Over 12 hours per instance)	0.00 Hours
Inter Program moves	11.38 Hours

6.4. Daily Summary

All daily logs are in GMT time.

Tue, 11 Mar 2008, week 11
Finished up production on the Santos project with around 58 km production today. No problems today. We finished production at 06:07 GMT (17:07 local time) we then recovered gear and did a TS dip before transiting to the TAP Oil project. Weather is good again today with high pressure over us.
Midnight fuel balance 842.385 cubic M, Consumed 13.934 cubic M
HSE
Total personnel onboard: 35 (16 Maritime, 17 Seismic, 2 client)
12 x toolbox meetings (8 x Dept. Handovers, 1 x gun retrieval, 1 x streamer retrieval, 1 x door recovery, 1 x TSA dip)
0 x FMM Training (Lifting incident presentation)
5 x Observation cards

Mon, 10 Mar 2008, week 11
Good production with around 192 km production today. No real problems today. Weather is good again today with promising forecast for the next few days. We estimate finishing the prospect if all goes well by 18:00 local time on the 11th.
Midnight fuel balance 856.319 cubic M, Consumed 14.694 cubic M
HSE
Total personnel onboard: 35 (16 Maritime, 17 Seismic, 2 client)
8 x toolbox meetings (8 x Dept. Handovers)
1 x FMM Training (Lifting incident presentation)
2 x Observation cards
Vers3 updated added midnight SP

Sun, 09 Mar 2008, week 11
We had around 113 km production today. We finally finished line 23 and the reduced volume test line 27. We had a weather front pass over us last night causing choppy seas. No real problems with noise on streamer. Weather good again today. We estimate finishing the prospect if all goes well by late tomorrow local time. Midnight fuel balance 871.013 cubic M, Consumed 13.451 cubic M
HSE
Total personnel onboard: 35 (16 Maritime, 17 Seismic, 2 client)
10 x toolbox meetings (8 x Dept. Handovers, 1 x gun retrieval, 1 x gun deployment)
0 x FMM Training
3 x Observation cards
1 x CSV (Incinerator operation)
2 x MSV

Sat, 08 Mar 2008, week 10
Not much production today again due to whales and technical problems. We started production on line 23 again at 03:17 GMT but had to abort due to whales. We then tried to use the time circling to do some umbilical repairs. This took longer than expected and turned into a major job causing over 12 hours of technical down time. We attempted line 23 again and once again encountered whales causing a total shutdown. It was decided this time we had enough km to keep and then circled to continue line 23 with a cable length overlap. Weather has deteriorated a bit with 25 kts winds and choppy seas. Expected to get worse over the next day as a low front passes.
.
Midnight fuel balance 884.464 cubic M, Consumed 14.5 cubic M
HSE
Total personnel onboard: 35 (16 Maritime, 17 Seismic, 2 client)
10 x toolbox meetings (8 x Dept. Handovers, 1 x gun retrieval, 1 x gun deployment)
0 x FMM Training

4 x Observation cards
Vers 2 Abort time changed from 20:30 to 20:29 on seq 16

Fri, 07 Mar 2008, week 10

No production today. We started production on line 23 at 00:14 GMT and after 8.5 kilometers we had to abort due to whales. Around again and after 8.5 kilometers on line 23 we aborted due to shallow bird. This bird was found to have jammed wings and motor failure. The streamer was retrieved to change it out. This was put down as 9.95 hours of technical down time. Once the streamer was back out, we shot line 23 again. After we finished the line the decision was made not to accept the SPs 1401 onwards due to bird 11 going out of spec intermittently. This resulted in going all the way back to the beginning because the accepted segment was only 10 km. The work boat was sent to investigate bird 11 and 12 and found both had been pulled out of collars by fishing gear.
Weather very good at the moment with very little wind but long swell.
Midnight fuel balance 898.964 cubic M, Consumed 13.6 cubic M
HSE
Total personnel onboard: 35 (16 Maritime, 17 Seismic, 2 client)
13 x toolbox meetings (8 x Dept. Handovers, 1 x streamer recovery, 1 x streamer deployment, 1 x gun retrieval, 1 x gun deployment, 1 x work boat launch)
0 x FMM Training
8 x Observation cards
vers3 code change to standby for Santos under 12 hours

Thu, 06 Mar 2008, week 10

Good production today with around 141 km. We had one part of line 21 with no fathometer data when depths went over 1000 m. We consulted with client and used the first break picks from near trace data to fill in this missing portion for the P190. Weather still
good.
Midnight fuel balance 912.564 cubic M, Consumed 14.253 cubic M
HSE
Total personnel onboard: 35 (16 Maritime, 17 Seismic, 2 client)
8 x toolbox meetings (Dept. Handovers)
2 x FMM Training (lifting and handling)
7 x Observation cards

Wed, 05 Mar 2008, week 10

Good production today with around 156 km. Seq 4 ended early by 34 SP's due to proximity of SNA. First good SP on line 13 (seq 7) was 1183 due to the same reason causing cable bend at start of line. Production on line 13 continues over midnight GMT.
Weather still fairly good. Expected to pick up a bit tomorrow.
Midnight fuel balance 926.817 cubic M, Consumed 15.0 cubic M
HSE
Total personnel onboard: 35 (16 Maritime, 17 Seismic, 2 client)
6 x toolbox meetings
1 x FMM Training (lifting and handling)
3 x Observation cards

Tue, 04 Mar 2008, week 10

Today we finished deployment and mobilization for the group shoot Santos prospect. Production began at 07:37 GMT (18:37 local). The weather became a bit choppy but did not significantly affect the streamer and we shot at 8m streamer depth. We had 10 or 11
bad shots due to timing or spread errors on first two lines combined. Feathering looking good.
Midnight fuel balance 941.817 cubic M, Consumed 15.0 cubic M
HSE
Total personnel onboard: 35 (16 Maritime, 17 Seismic, 2 client)
6 x toolbox meetings
1 x General muster drill
3 x Observation cards
0 x Safety Induction tours
vers2 due to added prod before midnight

Mon, 03 Mar 2008, week 10
Continued Crew Change, bunkers and provisions during the morning. We also had the job startup meeting onboard the Titan with clients, Santos, TAP Oil, and CUE Energy. We started the mobilization of the Group shoot at 07:05 GMT (18:05 local time) by steaming for the Santos prospect area. Equipment deployment began at 17:45 GMT. The weather is very good at the time being. Wind did pick up to around 25 kts towards the end of the day. The outlook is still good for the next day or two. Midnight fuel balance 956.817 cubic M, Consumed 6.0 cubic M, 350.00 cubes received.
HSE
Total personnel onboard: 29 (18 Maritime, 11 Seismic)
6 x toolbox meetings
0 x Observation cards
4 x Safety Induction tours

CHASE BOAT: The chase vessel Shandara, communicated and performed it's duties well. We had trouble at times raising her on the radio. I actually had to call on the cell phone once to confirm the locations of cray pots near the start of a line. Good job done by all during the survey.

6.4.1. Obstructions / Installations in the Field

No obstructions of any kind observed within the survey area other than whales and some cray pots which the local fishing community moved for us when requested.

6.4.2. Traffic / Shipping Lanes

No commercial shipping traffic was observed thought out the duration of the survey.

6.4.3. Fishing Activity

Majority of fishing activity was in waters less than 200m. All fishing gear was dragged or recovered by the chase boat if it affected the survey and the owner was notified. Generally little activity noticed throughout the survey.

6.4.4. Seismic Interference and Time Share

No seismic interference was observed during the survey.

6.4.5. Environmental Obstacles

There were several line aborts during the survey due to whale sightings within the 2 km zone.

6.4.6. Operational Observations

We had one day of major down time due to a shallow bird requiring the recovery of the streamer and also one gun umbilical which needed swapping over.

7. HSE Summary

No environment incidents during the Santos survey.
We performed the requested audit with checklist of points at the end of the survey to make sure all points that were required were performed according to the environmental specifications.

Prior to the Survey start all new crew members were given a safety introduction tour to get familiarized with the vessel's safety details.

Prior to all safety critical operations, i.e. deploying and recovery of seismic equipment, a "Toolbox Meeting" was held to verify and eliminate any hazards related to the operation.

Each operation has its own dedicated procedures, laid down in the CGGVeritas QHSE system and these were carefully followed throughout the survey.

HSE summary stats for the Santos project:

Personnel Breakdown for the week

Marine	146	Total man-days for Master Vessel
CGG	139	309
Sub Contract	16	Total Exposure hrs
Client	8	7416
	6	Total man-days for chase
	0	6
	0	
	0	Total Chase Exposure hrs
	0	144
	0	
Total Exposure hrs All		7560

Fuel Figures Breakdown this week

Vessels	End of week R.O.B.	Fuel used	Fuel bunkered
Pacific Titan	842.385	120.396	2359
	0	0	3
	0	0	0
	0	0	0
	0	0	0
	0	0	0
	0	0	0
	total ROB	total used	total bunkered
Chase totals	0	0	3
Totals for all vessels		120.396	2362

HSE Breakdown for the week - Master Vessel

induction tour seismic	6
induction tour marine	3
HSE Commitee Meeting	1
HSE Crew Meeting	0
Department Meeting	4
PRM	0
OGP_FMM HSE training	4
Small Boat Sortie	1
External Audits	0
Xdepartment Audit	0
Newopen action	0
Action Closed	0
CSV	1
MSV	2
NC	0
OFI	1
JSA:	0
Observation_cards	33
Tool Box meetings:	77
Drills	1
Incident	3

7.1. Observation Cards during the Survey:

Safety Observation Card Register

M/V Pacific Titan

Last update 17-Mar-08

Card #	Date	Short Description	Deficient PPE	Negative attitude towards HSE rule	Deficient maintenance	Sharp parts / cutting tools	Deficient equipment	Poorly designed equipment	Deficient means of communication	Training deficiency	Deficient information	Working at height / afoot	Slippery surfaces / tripping hazards	Lifting / Handling	Spare boat anchor	Deficient housekeeping	Misc. Transport	Hygiene	Other	Action Taken or Recommendation	Action By
			0	3	5	0	4	7	0	0	1	0	3	0	0	6	0	2	2		
952	54-Mar-08	Spare fire hose nozzle loose					x													Shown Ch Officer fire extinguisher	Hse a
953	54-Mar-08	Smoke from incinerator entering instrument room						x												Discuses how to solve this problem with Ch Eng	Ch/Eng
954	54-Mar-08	Toilet in marine accomadation placed in wrong position						x												Poor workmanship in Singapore, will discuss at next SCM	Ship Managers
955	64-Mar-08	Weather damaged sign on upper seismic door, unable to read					x													Removed damaged sign	Hse a
956	64-Mar-08	Brooms, mop and bucket stored near exit door		x																Asked Steward to remove equipment from corridor and not store there in future	Hse a
957	64-Mar-08	Fwd deck internal stairs are a slip hazard, repeopted to the chief											x							Ch Officer will investigate, no loose equipment found	Ch/Officer
958	74-Mar-08	Cylinders on helideck, exposed to the weather														x				Suggest to Ch Eng to move to covered area	Ch/Eng
959	74-Mar-08	Crane leaking, this was supposed to be corrected at Singapore			x															Inform Swires to complain to Singapore of poor workmanship	Ship Managers
960	74-Mar-08	Hooks on hatch on helideck are in need of replacement				x														Replace with correct hooks for lifting hatch up	Ch/Officer
961	74-Mar-08	Drums of Kero on helideck														x				Speak with Ch Obs	Recording
962	74-Mar-08	Compressor blocking walkway										x								Speak with Ch Eng to move compressor for better access	Ch/Eng
963	74-Mar-08	Container catching oil from blowoff pipe from compressors need replacing					x													Replace with new container if leak can not be rectified	Ch/Eng
964	74-Mar-08	Lot of old pipes in storage that have corroded, ask Ch Mech if still needed														x				Remove unwanted corroded pipes from storage area	Source
965	84-Mar-08	SOPEP boxes have missing equipment in them after the dock visit														x				Replaced missing equipment	Hse a
966	84-Mar-08	Secure loose SOPEP box on gun deck						x												Tie down SOPEP box to be more secure on back gun deck	Hse a
967	84-Mar-08	Flashback arrester seized on cylinders outside electrician workshop			x															Inform Ch Eng of situation. Have been removed.	Ch/Eng
968	84-Mar-08	Drains in freezer/chiller room blocked, unable to clean out fully						x												Inform ship owners of situation, if Ch Eng unable to fix this problem, Next port call at Burnie, workman have been arranged to fix problem	Ch/Eng
969	84-Mar-08	Bolt on Port access zone more robust and secured with bolt																	x	Placed large bolt in door frame and used a nut to secure it in place	Hse a
970	84-Mar-08	No hot water in cabin number 9, and cold water is brown																x		Inform Ch Eng of problem	Ch/Eng
971	84-Mar-08	Smoke from incinerator entering accommodation area																x		Inform Ch Eng of problem	Ch/Eng
972	84-Mar-08	New fuel line for the workboat, handle is already corroding, needs to be cleaned and covered to prevent further damage						x												Ch Mech to organise cleaning the fuel pump handle and cover for pump handle to be made, note, completed good job	Source
973	84-Mar-08	Pressurised container in the incinerator		x																Rubbish segregation re-explained to the crew, NOTE, Need to make both sets of crew aware of importants of rubbish segregation	Hse a
974	94-Mar-08	Galley floor wet and slippery, trip hazard											x							Spoke with cooks to ensure floor is dry as possible for meal times	Hse a
975	94-Mar-08	Power supply for charging the workboat battery was plugged in to the incorrect socket						x												Spoke with mechs to ensure power supply is fitted in to the correct plug	Source
975	94-Mar-08	Navigation pod missing from the workboat, delayed launch operation			x															Due to workboat being sent off the vessel for maintenance, all spare equipment was removed from the craft but not refitted on its return	Positioning
976	104-Mar-08	Rubbish stored under stairs near the incinerator may damage copper pipe on machine spare part stored there														x				Inform Ch Officer	Ch/Officer
977	104-Mar-08	Vent cover missing on port side pipe																	x	Inform Ch Eng	Ch/Eng
978	104-Mar-08	During crane operations, the hatch leading from the gun deck, pipework is in the way of supplies going through the gap						x												This problem has already been discussed with Ch Eng	Ch/Eng
979	114-Mar-08	Empty plastic bottle's left behind acetylen gas cylinders														x				Cleared rubbish away	Hse a
980	114-Mar-08	Corrosion on emergency escape ladder leading from the helideck too the gun			x															Shown the captain this problem, will report to the Ch Officer	Ch/Officer
981	114-Mar-08	Drain pipe on Port aft of the helideck severly corroded			x															Report to the Ch Officer	Ch/Officer
982	114-Mar-08	No SWL stamped on the seismic drum lifting gear								x										Will stencil correct information on equipment	Hse a
983	114-Mar-08	SOPEP box on the helideck was half filled with welding rubbish		x																Cleared all rubbish out of the SOPEP box and restocked with correct equipment	Hse a

7.2. Production-Log

Production Log
M/V Pacific Titan **Client:** (6734) Seboa - Group Shoot - Australia **Survey:** 550 11 89 07 06 00 **Area:** 2D (Project SEBOA)
Date: 03.03.2008 - 11.03.2008

Date	Seq	Line	Dir	FSP	LSP	TOT SPs	SP int (m)	BSP (kn)	Final CMP mult	Traverse kms	Chargeable CMP kms	Chargeable km²	Seis tapes	NTBP	Comments
04.03	00001	SOSN08C-01-001	238.0°	1001	3049	2049	25.00	4.8	1.00	51.22500	51.22500		1-2		Production 2D Line, Complete
04.03	00001	SOSN08C-01-001	238.0°	3050	3169	120	25.00	5.4	1.00	3.00000	3.00000		2		Production Runout, Complete
04.03	00002	SOSN08C-03-002	058.0°	1001	2884	1884	25.00	5.0	1.00	47.10000	47.10000		3-4		Production 2D Line, Complete
04.03	00002	SOSN08C-03-002	058.0°	2885	3004	120	25.00	4.9	1.00	3.00000	3.00000		4		Production Runout, Complete
04.03	00003	SOSN08C-05-003	238.0°	1001	1097	97	25.00	5.2	1.00	2.42500	2.42500		5		Production 2D Line, Midnight SP
05.03	00003	SOSN08C-05-003	238.0°	1098	2492	1395	25.00	5.2	1.00	34.87500	34.87500		5-6		Production 2D Line, Complete
05.03	00003	SOSN08C-05-003	238.0°	2493	2612	120	25.00	4.6	1.00	3.00000	3.00000		6		Production Runout, Complete
05.03	00004	SOSN08C-07-004	058.0°	1001	2440	1440	25.00	5.0	1.00	36.00000	36.00000		7-8		Production 2D Line, Complete
05.03	00004	SOSN08C-07-004	058.0°	2441	2560	120	25.00	5.1	1.00	3.00000	3.00000		8		Production Runout, Complete
05.03	00005	SOSN08C-09-005	239.0°	1001	2211	1211	25.00	5.0	1.00	30.27500	30.27500		9		Production 2D Line, Complete
05.03	00005	SOSN08C-09-005	239.0°	2212	2331	120	25.00	4.9	1.00	3.00000	3.00000		9		Production Runout, Complete
05.03	00006	SOSN08C-11-006	062.0°	1001	2190	1190	25.00	5.2	1.00	29.75000	29.75000		10		Production 2D Line, Complete
05.03	00006	SOSN08C-11-006	062.0°	2191	2310	120	25.00	5.1	1.00	3.00000	3.00000		10		Production Runout, Complete
05.03	00007	SOSN08C-13-007	242.0°	1183	1710	528	25.00	4.5	1.00	13.20000	13.20000		11		Production 2D Line, Midnight SP
06.03	00007	SOSN08C-13-007	242.0°	1711	2186	476	25.00	4.8	1.00	11.90000	11.90000		11		Production 2D Line, Complete
06.03	00007	SOSN08C-13-007	242.0°	2187	2306	120	25.00	4.9	1.00	3.00000	3.00000		11		Production Runout, Complete
06.03	00008	SOSN08C-15-008	065.0°	1001	2016	1016	25.00	4.8	1.00	25.40000	25.40000		12		Production 2D Line, Complete
06.03	00008	SOSN08C-15-008	065.0°	2017	2136	120	25.00	4.9	1.00	3.00000	3.00000		12		Production Runout, Complete
06.03	00009	SOSN08C-17-009	245.0°	1001	1979	979	25.00	4.9	1.00	24.47500	24.47500		13		Production 2D Line, Complete
06.03	00009	SOSN08C-17-009	245.0°	1980	2099	120	25.00	5.1	1.00	3.00000	3.00000		13		Production Runout, Complete
06.03	00010	SOSN08C-19-010	065.0°	1001	1975	975	25.00	5.1	1.00	24.37500	24.37500		14		Production 2D Line, Complete
06.03	00010	SOSN08C-19-010	065.0°	1976	2095	120	25.00	5.1	1.00	3.00000	3.00000		14		Production Runout, Complete
06.03	00011	SOSN08C-21-011	243.0°	1001	2624	1624	25.00	5.0	1.00	40.60000	40.60000		15-16		Production 2D Line, Complete
06.03	00011	SOSN08C-21-011	243.0°	2625	2744	120	25.00	5.1	1.00	3.00000	3.00000		16		Production Runout, Complete
07.03	00012	SOSN08C-23-012	062.0°	1001	1342	342	25.00	4.9	1.00	8.55000			17	NTBP	NTBP due to: Environmental, other: Whale pod came within near zone causing shutdown. Line segment too short to keep.
07.03	00013	SOSN08C-23-013	062.0°	1001	1349	349	25.00	5.0	1.00	8.72500			18	NTBP	NTBP due to: Recording, in-sea, depth controller/compass: Streamer too shallow at bird 16, when recovered no fishing gear found attached.
07.03	00014	SOSN08C-23-014	062.0°	1001	2554	1554	25.00	4.6	1.00	38.85000			19-20	NTBP	NTBP due to: Environmental, fishing activities: bird 12 going shallow in spots. Later this was found to be out of collars along with bird 11 due to fishing gear.
07.03	00014	SOSN08C-23-014	062.0°	2555	2674	120	25.00	4.6	1.00	3.00000			20		Environmental, fishing activities
08.03	00015	SOSN08C-23-015	062.0°	1001	1263	263	25.00	4.8	1.00	6.57500			21		Environmental, other, Aborted due to whales and DNP'd due to segment shorter than 12 km (2 cable lengths as specified in contract)
08.03	00016	SOSN08C-23-016	062.0°	1001	1371	371	25.00	5.0	1.00	9.27500	9.27500		22-23		Production 2D Line, aborted early due to whales. Client decided it was enough to keep., Incomplete
08.03	00017	SOSN08C-23-017	062.0°	1252	1276	25	25.00		1.00	0.62500			24		Environmental, other, overlap caused due to whales, Midnight SP
09.03	00017	SOSN08C-23-017	062.0°	1277	1371	95	25.00	5.1	1.00	2.37500			23		Overlap due to: Environmental, other: circled due to whales
09.03	00017	SOSN08C-23-017	000.0°	1372	2554	1183	25.00	5.1	1.00	29.57500	29.57500		23		Production 2D Line, Complete
09.03	00017	SOSN08C-23-017	000.0°	2555	2674	120	25.00	5.1	1.00	3.00000	3.00000		23		Production Runout, Complete
09.03	00018	SOSN08C-27-018	245.0°	1001	1979	979	25.00	5.1	1.00	24.47500	24.47500		24		Production 2D Line, reduced gun volume test line. repeat coverage of line 17, Complete
09.03	00018	SOSN08C-27-018	245.0°	1980	2099	120	25.00	5.1	1.00	3.00000	3.00000		24		Production Runout, Complete
09.03	00019	SOSN08C-25-019	062.0°	1001	2774	1774	25.00	5.0	1.00	44.35000	44.35000		25-26		Production 2D Line, Complete
09.03	00019	SOSN08C-25-019	062.0°	2775	2894	120	25.00	4.9	1.00	3.00000	3.00000		26		Production Runout, Complete
09.03	00020	SOSN08C-02-020	330.0°	1001	1245	245	25.00	5.1	1.00	6.12500	6.12500		27		Production 2D Line, Midnight SP
10.03	00020	SOSN08C-02-020	330.0°	1246	3596	2351	25.00	5.2	1.00	58.77500	58.77500		27-28		Production 2D Line, Complete
10.03	00020	SOSN08C-02-020	330.0°	3597	3716	120	25.00	5.1	1.00	3.00000	3.00000		28		Production Runout, Complete
10.03	00021	SOSN08C-04-021	147.0°	1001	3554	2554	25.00	5.0	1.00	63.85000	63.85000		29-30		Production 2D Line, Complete
10.03	00021	SOSN08C-04-021	147.0°	3555	3674	120	25.00	4.9	1.00	3.00000	3.00000		30		Production Runout, Complete
10.03	00022	SOSN08C-06-022	000.0°	1001	3520	2520	25.00	5.1	1.00	63.00000	63.00000		31-33		Production 2D Line, Midnight SP
11.03	00022	SOSN08C-06-022	337.0°	3521	5723	2203	25.00	5.1	1.00	55.07500	55.07500		33-34		Production 2D Line, Complete
11.03	00022	SOSN08C-06-022	337.0°	5724	5843	120	25.00	5.1	1.00	3.00000	3.00000		34		Production Runout, Complete
TOTAL										845.80000	777.10000	0.00000			

8. Shipment List

Performa invoice nr.	Date	Job#	Description	Receiver	Destination
PT-2008-021		6374	Santos T48P 2D Primary (Seq 1 - 22)	Fugro Seismic Imaging, Perth	Australia
PT-2008-022		6374	Santos T48P 2D Copy (Seq 1 - 22)	Santos, Adelaide	Australia

8.1. Shipment Details

PROFORMA INVOICE AND PACKING LIST

PT-2008-021

Date: 12-Mar-08

SENDER:

M/V Pacific Titan IN TRANSIT
c/o NT Shipping Agencies
P.O. Box 443
Berrimah
Northern Territory 0828
Australia
Attn: Robbie Robertson
Mob: +61 417 819 593
E-mail: robbie@ntshipping.com.au

Consignee:

Fugro Seismic Imaging
69 Outram Street
West Perth
WA, 6005
Australia

Attn: Phil Cook

Type of freight: Air

Comments: SEBOA Group Shoot, Bass Straight, SANTOS, T48P, Primary data

Box	Item	General description of content	Weight(kg)	Value(USD)
1	1-30	3590 Data tapes containing seismic data (Tapes 1 - 30) (sequence 1 - 21)	7	100
2	1-4	3590 Data tapes containing seismic data (Tapes 31 - 34) (sequence 22)	7	100
	5	3590 Data Tape containing SOJ and EOJ tests	0.2	3
		Observers' data		
	6	1 x CD containing Observers/Source/Tape Logs/Timing Diagram, Shipping Proforma	0.1	10
		Nav data		
	7	1 x DVD Navigation Data containing: Final P1/90, Raw P294, Production/Processing Log	0.1	10
		QC data		
	8	1 x DVD containing QC Deliverable Data	0.1	10
		Please confirm receipt of goods to chobs.titan@cggveritas.com		
			14.5	

Total boxes: 2 Total value: 233

Certified true and correct
CGG Veritas
M/V Pacific Titan

Sign

Allan Beattie
Chief Observer

PROFORMA INVOICE AND PACKING LIST

PT-2008-022

Date: 12-Mar-08

SENDER:

M/V Pacific Titan IN TRANSIT
c/o NT Shipping Agencies
P.O. Box 443
Berrimah
Northern Territory 0828
Australia
Attn: Robbie Robertson
Mob: +61 417 819 593
E-mail: robbie@ntshipping.com.au

Consignee:

Operations Geophysics
Santos Ltd
c/- Toll Priority
Basement, 191 Pultney Street
Adelaide, SA, 5000
Australia

Attn: Nick Papanicolaou

Type of freight: Air

Comments: SEBOA Group Shoot, Bass Straight, SANTOS, T48P, Copy data

Box	Item	General description of content	Weight(kg)	Value(USD)
1	1-30	3590 Data tapes containing seismic data (Tapes 1 - 30) (sequence 1 - 21)	7	100
2	1-4	3590 Data tapes containing seismic data (Tapes 31 - 34) (sequence 22)	7	100
	5	3590 Data Tape containing SOJ and EOJ tests	0.2	3
	6	Observers' data 1 x CD containing Observers/Source/Tape Logs/Timing Diagram, Shipping Proforma	0.1	10
	7	Nav data 1 x DVD Navigation Data containing: Final P1/90, Raw P294, Production/Processing Log	0.1	10
	8	QC data 1 x DVD containing QC Deliverable Data	0.1	10
		Please confirm receipt of goods to chobs.titan@cggveritas.com		
			14.5	

Total boxes 2 Total value: 233

Certified true and correct
CGG Veritas
M/V Pacific Titan

Sign Allan Beattie
Chief Observer

9. Crew Lists

Monday, March 17, 2008

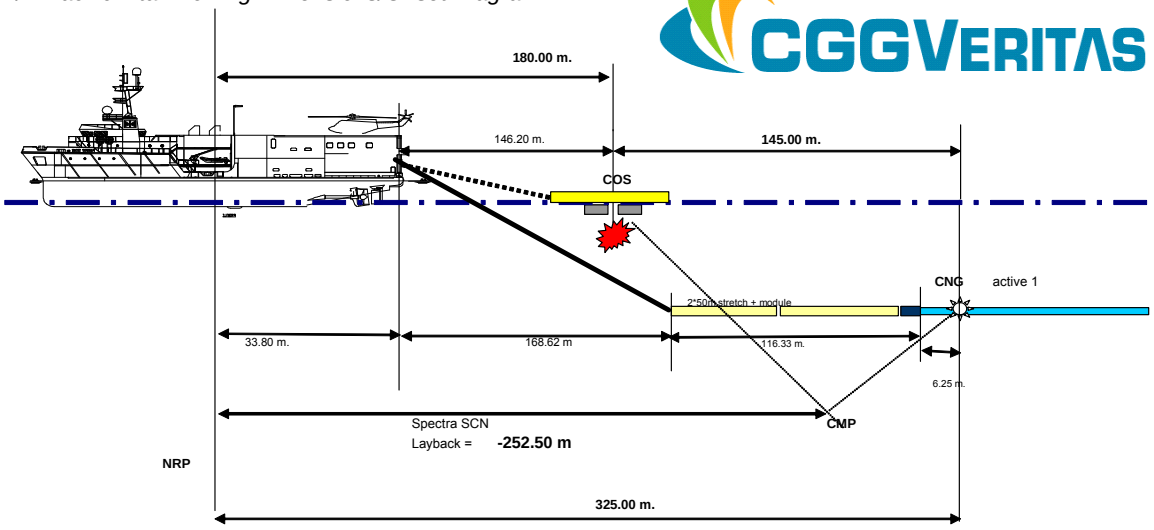
Crew List for M/V Pacific Titan

CGGVERITAS

	Department	Name	Title	Date Of Birth	Nationality	Passport Number	Expiry Date
1	Seismic	Sigurd Osterud	Party Chief	15-Oct-61	Norwegian	20761184	24-Feb-15
2	Seismic	Jun Marcelino Lumabas	S/L Observer	31-Oct-80	Filipino	ZZ229544	29-Jun-12
3	Seismic	Dervin Arenal Victorio	Observer	23-Oct-80	Filipino	QQ0522130	14-Oct-10
4	Seismic	Paul Stafford	Ch Navigator	05-May-70	British	099024130	24-Apr-12
5	Seismic	Ronaldo Maravilla Morales	S/L Mechanic	22-Mar-59	Filipino	ZZ145454	18-May-10
6	Seismic	Reynaldo Poud Vega	Mechanic	17-Sep-62	Filipino	UU0385562	19-Dec-11
7	Seismic	Victor Neoda Satago	Mechanic	05-Aug-68	Filipino	LL308971	05-Aug-08
8	Seismic	Jose Naldoza Peralta	Mechanic	01-Jun-50	Filipino	SS0035761	01-Dec-10
9	Seismic	Dennis Paras Aquino	Geophy	02-Aug-79	Filipino	NN0348967	14-Jul-09
10	Seismic	Dennis Basallaje Maranon	Observer	22-Sep-77	Filipino	QQ0076201	17-Mar-10
11	Seismic	Christopher Ibasco Hernandez	Navigator	05-Dec-83	Filipino	SS0131590	08-Dec-10
12	Seismic	Roberto Obras Sibayan	Doctor	13-May-65	Filipino	TT0947029	23-Oct-11
13	Seismic	Allan Beattie	Observer	23-Mar-65	British	93105388	03-Dec-13
14	Seismic	Richard Sykes	HSE Advisor	18-Jun-66	British	761103260	28-Feb-16
15	Seismic	Roger Steffensen	Ch. Mech	06-Aug-53	Norwegian	25245636	11-Apr-16
16	Seismic	Clement Le Du	Navigator	23-Mar-77	French	03TE 59624	28-Jan-14
17	Seismic	Steffi Schwarz	Chief Geo	02-Apr-73	Australian	M2598263	09-Feb-15
18	Seismic	William Lloyd	Client		Australian	E 1022292	14-Mar-15
19	client	Carol Dawn Sutherland	MMO	28-Aug-63	New Zealand	AB718594	11-Aug-10
20	Marine	Theodore Strockyj	Captain	15-Sep-50	Australian	M5129759	05-Sep-16
21	Marine	Carl Sayers	Chief Engineer	24-May-49	New Zealand	AA647005	14-Mar-13
22	Marine	Shan Mudiyanselege	Comp Mech	01-May-63	SRI Lankan	M1858320	31-Mar-09
23	Marine	James Riley	Chief Officer	11-Nov-80	Australian	L7347221	26-Apr-09
24	Marine	Hemaka Dissanayake	2nd Mate	26-Feb-72	New Zealander	EA888314	29-Oct-12
25	Marine	Alexander Ivanoff	1st Engineer	05-Dec-60	Australian	M5216687	22-Nov-15
26	Marine	Alexander Saldanha	2nd Engineer	04-Mar-64	Australian	M1239195	12-Feb-14
27	Marine	Kerin Ross	G.P.	06-Jul-46	Australian	L7195273	08-Feb-09
28	Marine	Chris Pitman	G.P.	16-Nov-48	New Zealander	AA500827	18-Jun-12
29	Marine	Michael Howard	G.P.	29-Jul-73	Australian	M7562140	01-Oct-17
30	Marine	John Mason	G.P.	17-May-47	Australian	E 7592880	30-Aug-12
31	Marine	Donald Crawford	Chief Stwd	13-Apr-46	Australian	M5345157	21-Jul-16
32	Marine	Graeme Scott	Stwd	09-Jul-56	Australian	M1975283	26-Nov-14
33	Marine	Christopher Milne	Ch Cook	03-Apr-61	Australian	M5791813	01-Apr-16
34	Marine	Anthony Raines	Cook	07-Mar-54	Australian	M1656991	19-Jul-14
35	Marine	Peter Brown	Comp mech	26-Jun-62	Australian		

10. Towing Configuration

M/V Pacific Titan Towing Dimensions/Offset Diagram



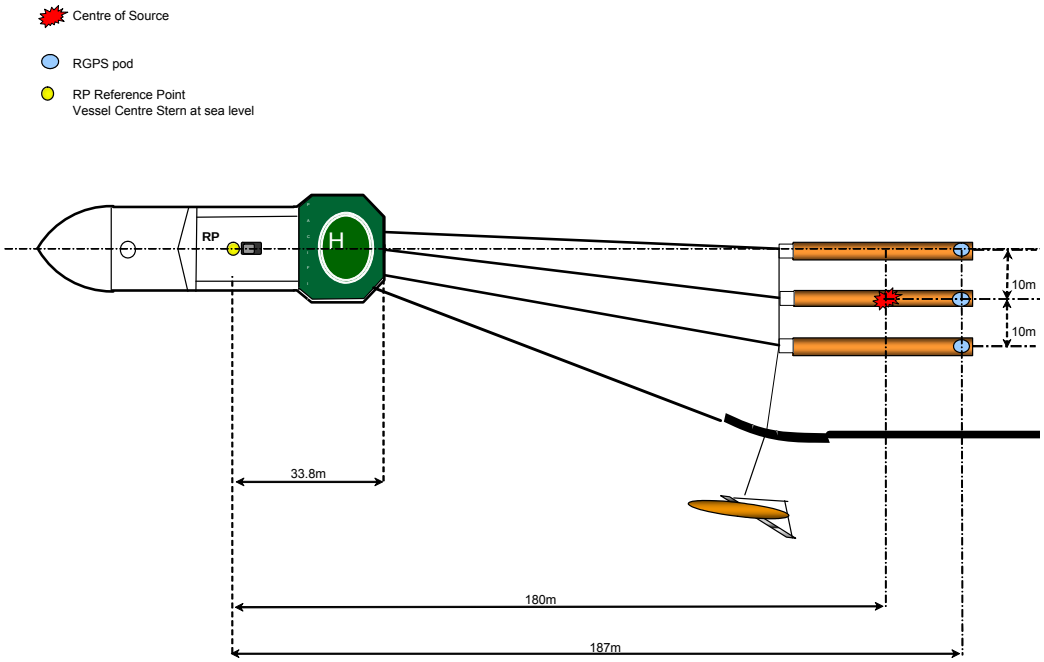
Principal Distances:			Principal Offsets:		Used as:
NRP-Stern	33.80 m.		COS-CNG	145.00 m.	
Stern-COS	146.20 m.		**NRP-CMP**	**-252.50 m**	**Spectra SCN Layback**
Stern-CNG	291.20 m.				
NRP-COS	**180.00 m.**		**NRP-CNG**	**325.00 m.**	**Offset from NRP**

Centre near group derived from Seal manuals = 6.25m from coupling

Key:	
NRP	Navgation reference point (centre of mast @ sea level)
COS	Centre of source
CNG	**Centre of near group (Trace # 001)**
CDP	Common depth point
NTRP	Near trace reflection point

10.1. Towing Offset Diagram

Pacific Titan
General Towing arrangement



10.2. Streamer System Description

Streamer System Parameters	
Number of Streamers	1
Type of Streamer	Seal Solid
Streamer Length	6000m
Number of channels	480
Groups per Section (150 m)	12
Group Intervals	12.5 m (no overlap)
Active Group Array Length	12.5 m
Outside Diameter	55 mm
Solid Streamer Material	Outer 3.5mm Polypropylene
Normal maximum towing tension	55.6kN Ultimate breaking at 278kN
Connectors (Pins)	28
Channels per Module	60 at 2 ms
Data Transmission Link	Dual twisted Quad AWG 22
Power	+/- 360 V DC
Leakage	30 mA differential circuit breaker
Near Offset (centre source – centre near group)	145m nominal
Streamer Depth	8m +/- 1.0m
Number of Front 50 m Stretch Sections	2 (85 mm diameter)
Number of Tail 50 m Stretch Sections	1 (50 mm diameter)
Number of Compasses per Streamer	23 (within digibirds)
Number of Depth Sensors per Streamer	23 (within digibirds)

Trace allocation	Near	Far	Aux
Streamer 1	1	480	
Auxiliary (in AXCU)			a1 – a30

Hydrophone Parameters	
Hydrophone Specification	Sercel 12 element radial
No of Channels per Section	12
No of Hydrophones per Channel	8 in parallel
Active Length of Channel	12.5m
Channel Centre Spacing	12.5 m under a 1000daN load
Hydrophone Spacing	1.78m
Low Frequency Cut	3 Hz
Nominal Sensitivity, without electronics @ 1 bar @ 20°C	20 V/bar
Nominal Hydrophone Sensitivity	21.5 v/bar
Capacitance per Group	790 nF +/-10% at 22°C
Minimum Leakage Resistor	500 Mohm under 50 V

10.3. Streamer Layout

6000m

Item	Position	S/N	RDU	Bird Collar	SRD Collar	Trace N.O	Weights
DCXU		696502					
Slip ring							
PORT AFT REEL							
Lead-in		n/a					
SHS		1350					
HAU		124					
HESE		1861			13489		10
HESE		1665	1	15797			10
HESA		1332					
SSAS	01	30497	2	34113	12090	1-12	6
SSAS	02	30362	3	29978		13-24	2
SSAS	03	30552	4	30495		25-36	5
SSAS	04	30613				37-48	3
SSAS	05	30352	5	30672	13491	49-60	3
LAUM	01	775					
SSAS	06	30522				61-72	5
SSAS	07	30529	6	27772		73-84	3
SSAS	08	30251				85-96	5
SSAS	09	30531	7	29983		97-108	5
SSAS	10	30515				109-120	2
LAUM	02	513					
SSAS	11	30394	8	40854	12083	121-132	4
SSAS	12	30521				133-144	3
SSAS	13	30136	9	30256		145-156	4
SSAS	14	30578				157-168	7
SSAS	15	30553	10	29096		169-180	4
LAUM	03	515					
SSAS	16	30504				181-192	5
SSAS	17	30447	11	30334	13493	193-204	3
SSAS	18	30160				205-216	4
SSAS	19	30454	12	15076		217-228	4
SSAS	20	30572				229-240	4
LAUM	04	731					
SSAS	21	30508	13	30246		241-252	6
SSAS	22	30495				253-264	3
SSAS	23	30494	14	30137	13490	265-276	7
SSAS	24	30249				277-288	5
SSAS	25	30443	15	31507		289-300	2
LAUM	05	737					
SSAS	26	30152				301-312	2
SSAS	27	30571	16	31053		313-324	5
SSAS	28	30567				325-336	4
SSAS	29	30557	17	22740	13492	337-348	4
SSAS	30	30502				349-360	3
LAUM	06	734					
SSAS	31	30582	18	30329		361-372	4
SSAS	32	30583				373-384	3
SSAS	33	30576	19	30511		385-396	2
SSAS	34	30569				397-408	5
SSAS	35	30574	20	30674	36201	409-420	4
LAUM	07	908					
SSAS	36	30584				421-432	4
SSAS	37	30581	21	31120		433-444	5
SSAS	38	30590				445-456	3
SSAS	39	30580	22	40035	36206	457-468	4
SSAS	40	30588	23	30359		469-480	4
TAPU	01	104					
TES	01	1703					
Tailbuoy	01						

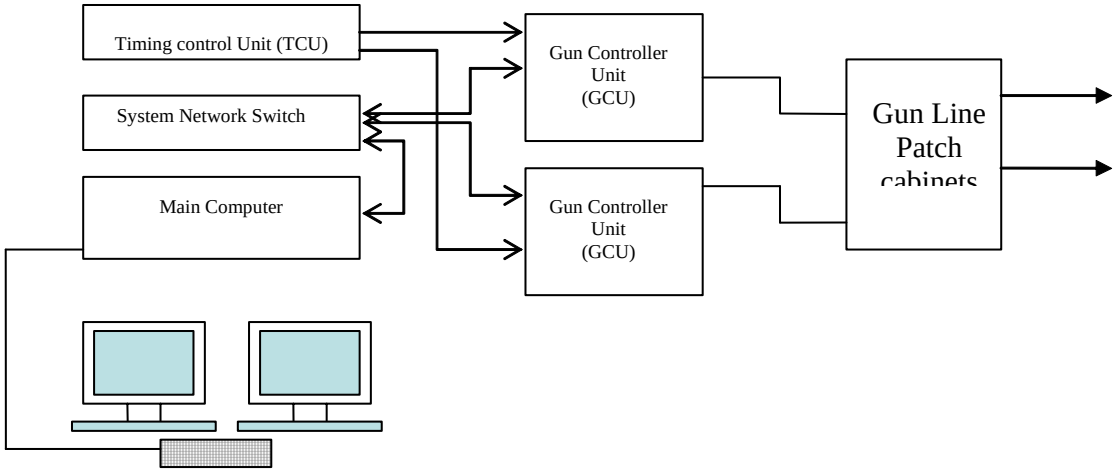
11. Source Configuration

11.1. Source System Description

Source Parameters	
Source Controller	Gunlink 2000
Number of Sources	1
Number of Sub-Arrays (Strings) per Source	3
Array Length	14.7m
Sub-Array Separation	10m
Source Width	20m
Source Separation	n/a
Source Volume	3040 Cubic inches
Number of Hydrophones per String	6
Number of Depth Transducers per String	3
Number of Pressure Transducers per String	1
Number of Guns per String	Strings 1 & 3 = 9 / String 2 = 8
Number of Clusters per String	Strings 1 & 3 = 3 / String 2 = 2
Airgun Type	Bolt, 1500 & 1900 Long Life
Operating Pressure	2000 PSI
Depth of Guns	6.0 m +/- 1.0m
Peak to Peak Amplitude	106.2 barm
Primary to Bubble Ratio	23.0

Gun Controller Description
The Gunlink 2000 Seismic Source Control and Acquisition System is the first phase of Seamap's range of new generation seismic gun controller systems.
The system uses the latest high speed micro processors to provide onboard firing control and sensor timing monitoring, continuous monitoring of near field phones and interrogation of depth and pressure sensors.
In addition the system monitors the voltage and current of the firing pulses applied to the gun solenoids allowing the user to monitor variations in the performance of the guns and improve maintenance schedules.

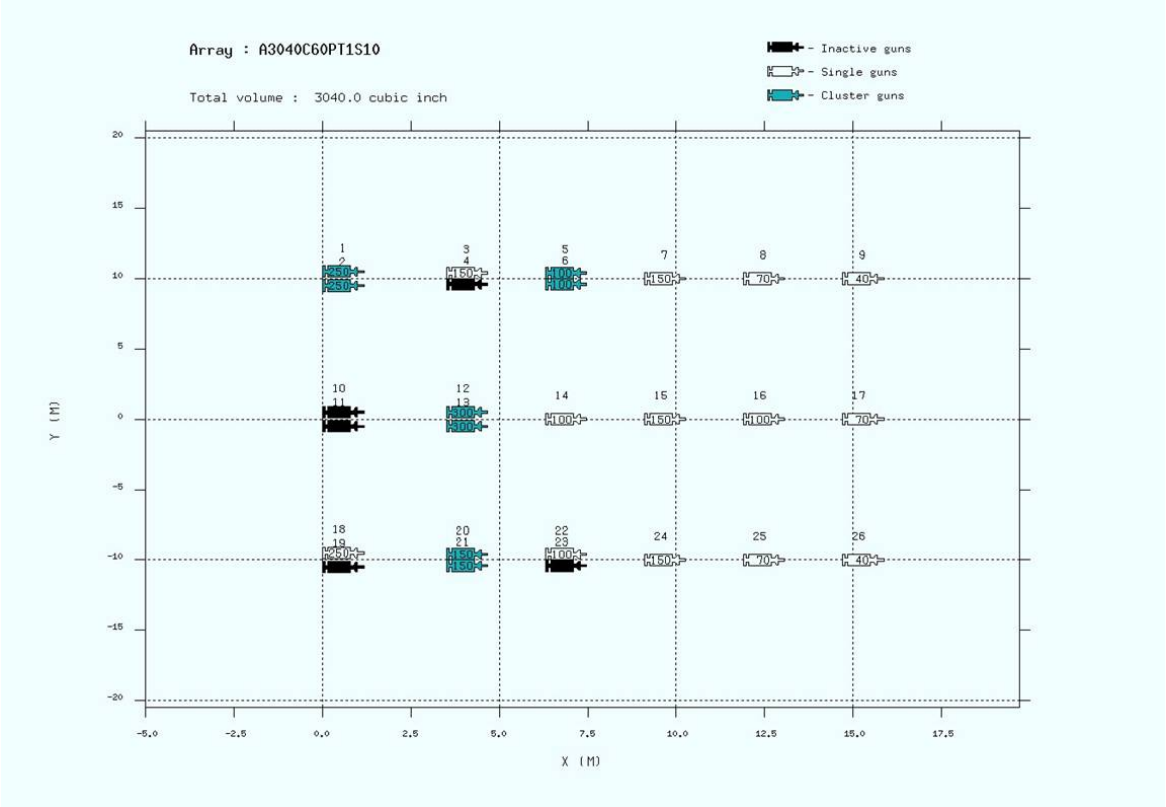
An innovated Graphical User Interface (GUI) makes use of the latest advances in software design to provide the operator with maximum information on the operation and performance of the system without the clutter of text.
An internal database maintains records of all system statistics and the data can be accessed via the in built web server using standard web browser programs.
To further reduce operator fatigue, the system draws the operator's attention to gun misfires, auto-fires and other faults by use of voice alerts issued from the system speakers.



11.1.1. Gun Controller Specifications

Channels available	
Monitored Variables	Gun Fire time Near field Hydrophone Data Depth Sensor value Gun air pressure Value Solenoid coil current
Controlled Variables	Gun Fire time Gun Firing pulse length and Voltage
System Timing	0.01 ms
Fire Detect Window	120 ms
Synchronization Mode	Automatic
Fire Detect Method	Sensor
Fire Time Pick Method	Peak detect
Near Field Hydrophone S.I.	0.1 ms
Near Field Hydrophone Res.	16 Bit
Software	Version 2.5.2

11.1.2. Source Layout

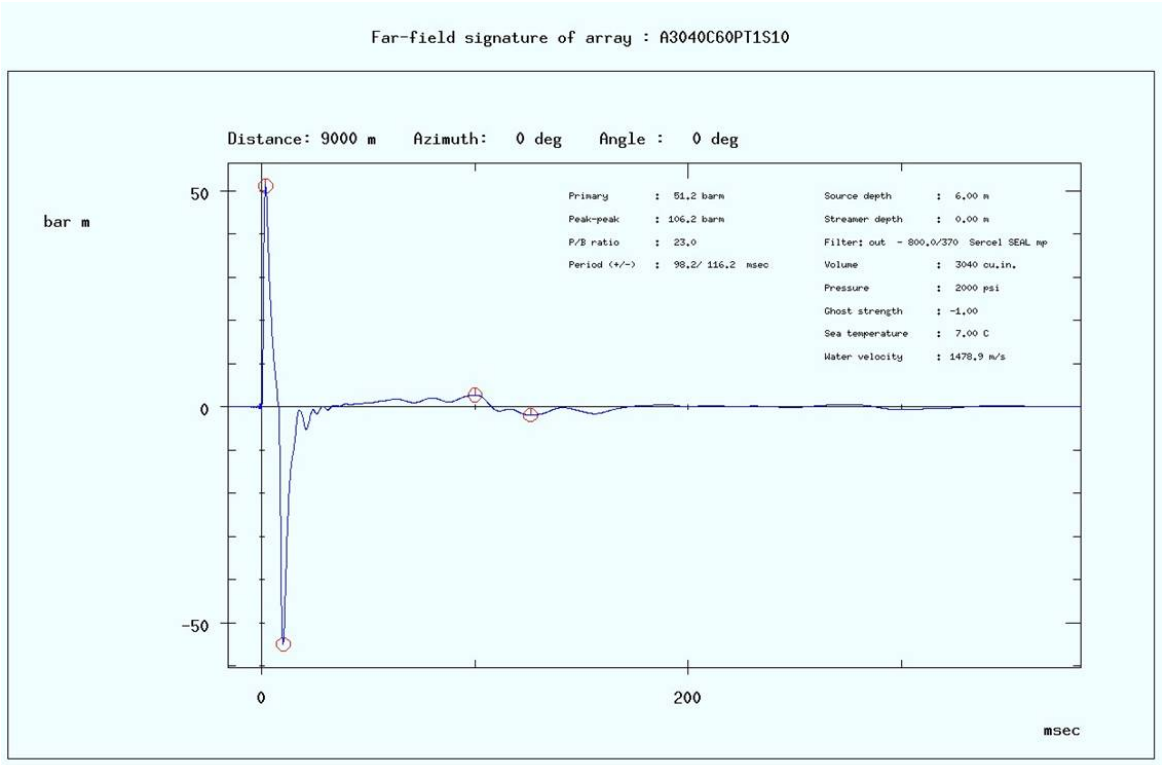


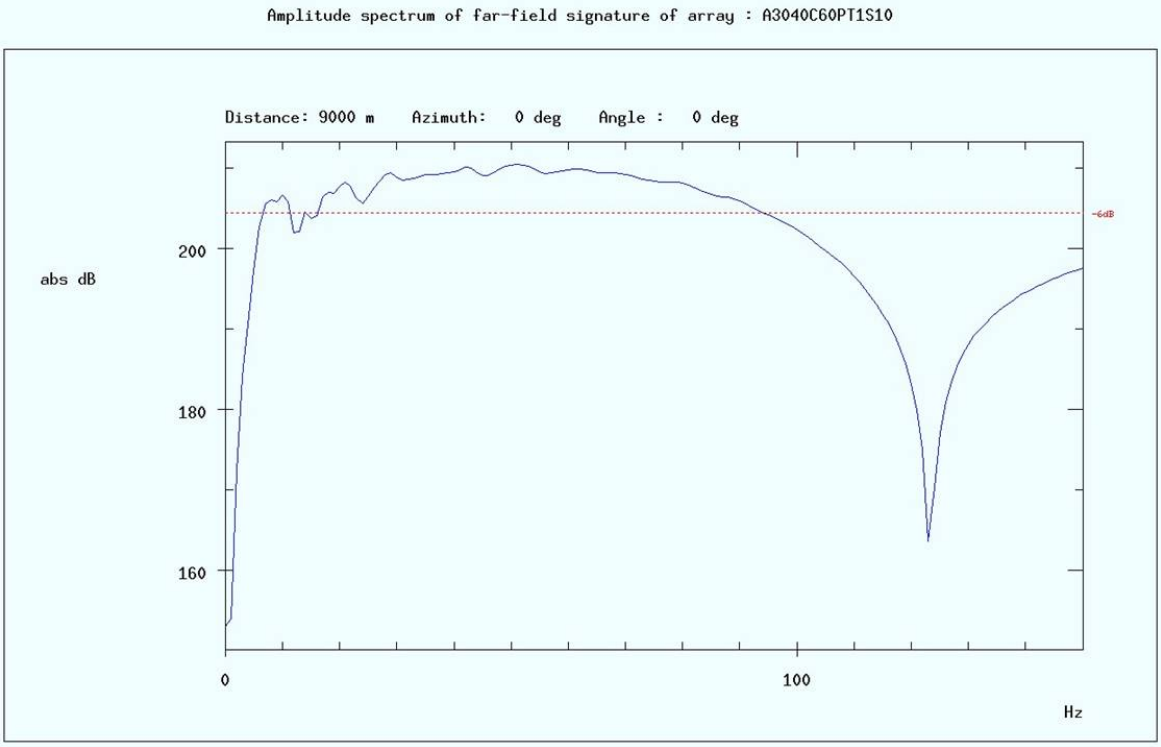
11.1.3. Array Listing

Total active volume: 3040 in^3 Nominal pressure 2000 psi.

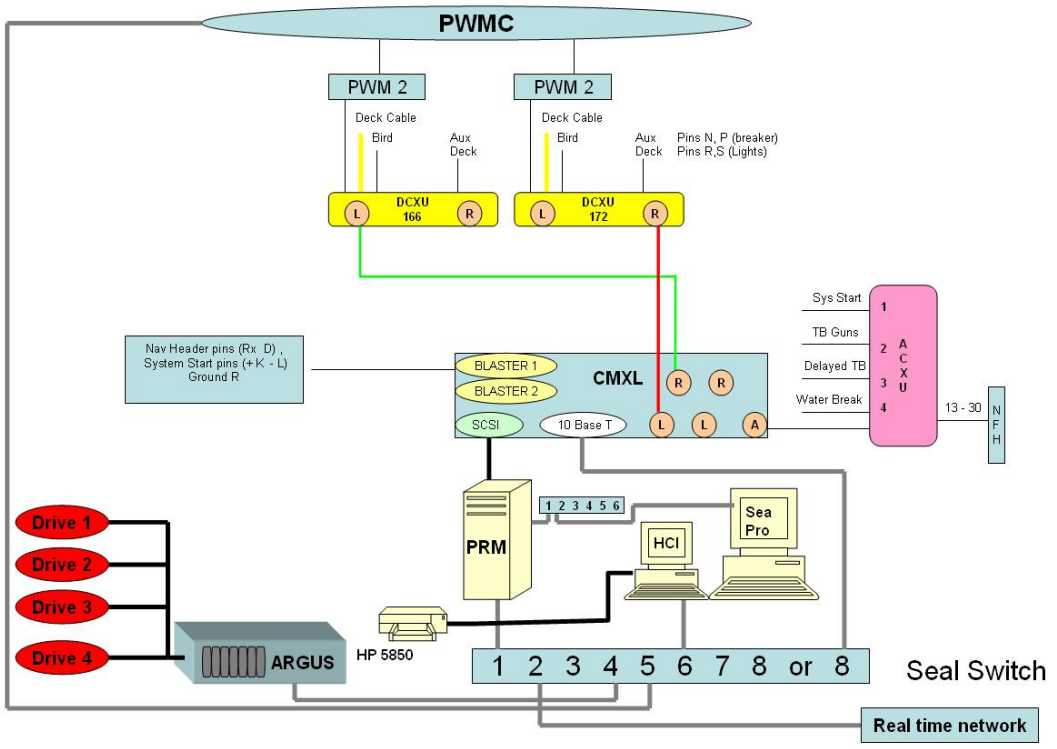
GUN#	GUN TYPE	Dist X (m)	Dist Y (m)	Dist Z (m)	Volume	Active / Spare	Sub-array #
1	1500LL	0	10.5	6	250	Active	1
2	1500LL	0	9.5	6	250	Active	1
3	1900LLX	3.5	10.5	6	150	Active	1
4	1900LLX	3.5	9.5	6	150	Spare	1
5	1900LLX	6.3	10.5	6	100	Active	1
6	1900LLX	6.3	9.5	6	100	Active	1
7	1900LLX	9.1	10	6	150	Active	1
8	1900LLX	11.9	10	6	70	Active	1
9	1900LLX	14.7	10	6	40	Active	1
10	1500LL	0	0.5	6	300	Spare	2
11	1500LL	0	-0.5	6	300	Spare	2
12	1500LL	3.5	0.5	6	300	Active	2
13	1500LL	3.5	-0.5	6	300	Active	2
14	1900LLX	6.3	0	6	100	Active	2
15	1900LLX	9.1	0	6	150	Active	2
16	1900LLX	11.9	0	6	100	Active	2
17	1900LLX	14.7	0	6	70	Active	2
18	1500LL	0	-9.5	6	250	Active	3
19	1500LL	0	-10.5	6	250	Spare	3
20	1900LLX	3.5	-9.5	6	150	Active	3
21	1900LLX	3.5	-10.5	6	150	Active	3
22	1900LLX	6.3	-9.5	6	100	Active	3
23	1900LLX	6.3	-10.5	6	100	Spare	3
24	1900LLX	9.1	-10	6	150	Active	3
25	1900LLX	11.9	-10	6	70	Active	3
26	1900LLX	14.7	-10	6	40	Active	3

11.2. 3040 Cu-Inch Pulse Response and Spectrum at 6m.





12. Instrumentation Room System Diagram



13. Navigation and Positioning System Description

13.1. System Configuration

13.1.1. Navigation Hardware and Software

System	Hardware (Type and Serial No.)	Software version
CONCEPT Spectra	RTNμ (30/207P & 30/208P)	Spectra 10.9.01.10
	IBM E Server Workstations	Red Hat ELWS3.6
External Header	N/A	Labo Header
Acoustic System	N/A	
TS-meter	Saiv AS STD/CTD model SD 204	
Echo sounder	Simrad EA600	

13.1.2. System Timing

Spectra issued closures to the source firing system and recording system 50 milliseconds before the predicted time of peak pressure. Spectra received the time break back from the GunLink source controller and all Spectra system positions are output for this time.

An additional trigger was issued from spectra 450 milliseconds after time zero, this was sent to the recording system as a timing verification. The trigger was 5 milliseconds in duration.

13.2. Survey Positioning Method Used

This survey was carried out using CGGVeritas standard mode of operation for single streamer/single source surveys.

Positioning of the vessel was by 3 Single/Dual frequency differential GPS systems using a delivery of differential correction data in RTCM 104 format and recorded in the P2/94 files.

The sources were positioned relative to the vessel using a network consisting of rGPS units mounted on sub-arrays 1, 2 and 3.

The centre near group of the streamer was positioned by a combination of compass heading units and nominal offsets from the vessel.

The centre last group of the streamer was positioned using a network consisting of a rGPS system unit mounted on the tail buoy, a nominal offset to the tail buoy and a streamer mounted compass heading unit.

The streamer shape was modelled by 23 Digicourse series 5011 combined streamer depth control and magnetic compass units on the streamer.

Least squares condition equations for the streamer assuming circular arcs between compasses and relating the tracking nodes, compasses, tension corrected distances between compasses, rotation bias and scale were used to compute scale, rotation and individual compass corrections. The streamer shape was then computed by the circular arc method.

13.3. Surface Positioning

13.3.1. Vessel Navigation

Summary

The SPM2000 with SPM 5.16 software provides single and dual frequency GPS positioning, using corrections generated by the Fugro Starfix network of reference stations broadcast via geostationary communication satellites.

The standard single frequency service is Starfix and the dual frequency services are Starfix.Plus, Skyfix.XP and Starfix.HP (High Performance).

Both, Starfix and Starfix.Plus are sub-metre level accuracy services. Starfix-Plus is the recommended service for equatorial regions where the standard service cannot achieve metre level accuracy during any peak of the solar cycle.

Starfix.HP is the Fugro positioning service with decimetre level accuracy at distances up to 1000 km from Starfix.HP reference stations making this system ideal for offshore applications requiring very precise horizontal and vertical positioning. The HP engine is now aided with the Starfix.XP engine to provide more robust and accurate position.

Skyfix.XP is Fugro's Positioning service based purely on State Space corrections.

Differential Correction Systems:

Fugro Skyfix via Spot Beam (OCSAT) satellite and Fugro Starfix via Inmarsat (IOR) and NTrip (Corrections received via VSAT)

All systems had the same accuracy and were set to have the same weight in the solution.

Fugro Multifix is a multiple reference station DGPS system tailored for the specific needs of seismic surveying. Algorithms combine reference station data and pseudo range measurements into the best position estimates.

By employing a correlation model for weighting the multiple range corrections in a least squares estimation process, the optimum pseudo-range corrections are obtained. W-testing and F-testing techniques detect and reject correction outliers.

Quality control is based upon UKOOA's recommended DGPS quality indicators - the precision and reliability of the fix are displayed as an Error Ellipse and Marginally Detectable Errors (MDE).

The differential corrections were transmitted to, and received on-board the vessel by three independent means and provided a high degree of redundancy to ensure continuous vessel positioning.

- **Further information is given in Appendix 1.**

Although Selective Availability was turned off in May 2000 differential corrections are still required to provide a high quality continuous vessel position. Less frequent updates are required however.

13.3.2. Float Navigation

Source and Tailbuoy surface navigation was provided by Seatex Seatrack relative GPS. The in-sea units incorporated a GPS receiver and interfacing for direct data transmission of the raw satellite pseudo-range data via UHF link to the vessel.

On board the vessel, the raw pseudo-range data from the float unit was matched with simultaneously received data at the vessel's GPS receiver to compute a vector describing the location of the float unit relative to the vessel from which the float position was derived. Relative positioning CEP was better than 2 m.

13.4. Streamer and Source Positioning

13.4.1. Streamer Compasses

23 series 5011 Digicourse combined magnetic compass and streamer depth controllers were attached to each streamer. All compasses were used for positioning and shaping the streamers.

Compass Sampling Rate	=	2 second
Averaging constant	=	14 seconds

Compass performance was monitored on a line-to-line basis throughout the acquisition phase of the survey.

13.4.2. Gyro Compass

The gyrocompasses used during the survey were:

Gyro 1	- Simrad HS50 GPS
Gyro 2	- Tokyo Keiki MK.ES

The gyro correction values as computed during the mobilisation calibration were as follows:

Gyro 1	**- plus 1.35 degrees**
Gyro 2	**- plus 2.20 degrees**

13.5. Auxilliary Navigation Sensors

13.5.1. Echo Sounder

The echo sounder speed of sound was set to 1500 m/s. A draught correction of zero was entered in the echo sounder. Due to the proximity of the survey and the depths encountered the 12KHz transducer was used as the master echo sounder.

14. Survey Pre-plots

14.1. Geodetics

Satellite/Survey Datum
Datum Name: WGS84
Spheroid Name: WGS84
Semi Major Axis: 6378137.0
Inverse Flattening: 298.2572236

Projection Type: Universal Transverse Mercator 55° S
Origin Longitude: 147.000E
Origin Latitude: 0000.00N
False Easting: 500,000.00E
False Northing: 10,000,000.00N

14.2. Preplot

H0100Survey Area Tasmania
H0101General Survey Details Preplot 2D Santos T48P
H0200Date of Survey N/A
H0201Date of Issue 28 Feb 2008
H0202Tape Version P1/90
H0203Line Prefix
H0300Client Santos
H0400Geophysical Contractor CGGVeritas
H0500Positioning Contractor CGGVeritas
H0600Position Processing CGGVeritas
H0800Co-ordinate Location Preplot Sail Line Locations
H1100Receiver Groups per Shot 0
H1400Surveyed Datum WGS84 WGS84 6378137.000 298.2572236
H1401Transformation to WGS84 0.0 0.0 0.0 0.000 0.000 0.000 0.0000000
H1500Post Plot Datum N/A
H1501Transformation to WGS84 N/A
H1600Transformation H14 to H15 N/A
H1700Vertical Datum SL Echo Sounder
H1800Projection Type 2Universal Transverse Mercator
H1900Projection Zone 55S
H2000Grid Units 1Meters 1.000000000000
H2001Height Units 1Meters 1.000000000000
H2002Angular Units 1Degrees
H2200Long of Cent Meridian 1470000.000E
H2301Grid Origin 0000000.000N1470000.000E
H2302Grid Coords at Origin 00500000.00E10000000.00N
H2401Scale Factor 0.9996000000
H2402Lat/Long of Scale Factor 0000000.000N1470000.000E
H2600SHOT POINT INTERVAL 25.00 m
H2600LINE GENERATION MODE Great Circle
H2600NUMBER OF 2D LINES 17
H2600TOTAL 2D LINE LENGTH 733.12 kilometres
H2600AVG. LINE LENGTH 43.12 kilometres
H2600
H2600 Line Details
H2600
H2600 Format is:

```
H2600 LINENAME(A12) SEGMENT(I2) FSP(I6) LSP(I6) AZIMUTH(F7.3) LENGTH(F8.1)
H2600
H2600 S OS N08C-01  1   1001   3049 058.500 051200.0
H2600 S OS N08C-02  1   1001   3596 148.524 064875.0
H2600 S OS N08C-03  1   1001   2884 057.887 047075.0
H2600 S OS N08C-04  1   1001   3554 147.163 063825.0
H2600 S OS N08C-05  1   1001   2492 057.853 037275.0
H2600 S OS N08C-06  1   1001   5723 157.879 118050.0
H2600 S OS N08C-07  1   1001   2474 058.922 036825.0
H2600 S OS N08C-09  1   1001   2211 060.006 030250.0
H2600 S OS N08C-11  1   1001   2272 062.295 031775.0
H2600 S OS N08C-13  1   1001   2186 063.315 029625.0
H2600 S OS N08C-15  1   1001   2016 065.049 025375.0
H2600 S OS N08C-17  1   1001   1939 065.627 023450.0
H2600 S OS N08C-19  1   1001   1975 065.163 024350.0
H2600 S OS N08C-21  1   1001   2624 062.803 040575.0
H2600 S OS N08C-23  1   1001   2634 062.595 040825.0
H2600 S OS N08C-25  1   1001   2774 062.323 044325.0
H2600 S OS N08C-27  1   1001   1939 065.627 023450.0
H2600
VS OS N08C-01      1001405512.20S1435905.11E 246090.05465739.0
VS OS N08C-01      3049404040.80S1443004.03E 288810.65493984.3
VS OS N08C-02      1001410627.31S1441238.79E 265791.05445550.0
VS OS N08C-02      3596413618.22S1443701.64E 301433.35391329.3
VS OS N08C-03      1001410041.49S1440142.00E 250106.05455709.0
VS OS N08C-03      2884404706.78S1443002.58E 289115.65482080.1
VS OS N08C-04      1001410515.50S1441510.19E 269253.05447877.0
VS OS N08C-04      3554413411.13S1444003.98E 305548.45395364.5
VS OS N08C-05      1001410248.20S1440733.31E 258442.05452076.0
VS OS N08C-05      2492405203.06S1443001.03E 289340.05472941.7
VS OS N08C-06      1001403711.91S1440505.41E 253411.05499342.0
VS OS N08C-06      5723413612.55S1443705.02E 301506.75391506.4
VS OS N08C-07      1001410921.41S1440731.11E 258791.05439947.0
VS OS N08C-07      2474405903.01S1443000.31E 289693.65459990.2
VS OS N08C-09      1001410953.72S1441120.01E 264159.05439125.0
VS OS N08C-09      2211410141.99S1443001.50E 289861.85455088.0
VS OS N08C-11      1001411327.10S1441248.31E 266428.05432610.0
VS OS N08C-11      2272410526.48S1443253.69E 294078.15448279.0
VS OS N08C-13      1001411427.91S1441506.19E 269698.05430837.0
VS OS N08C-13      2186410715.09S1443400.86E 295738.95444973.2
VS OS N08C-15      1001411715.89S1441746.19E 273584.05425773.0
VS OS N08C-15      2016411127.73S1443413.47E 296250.45437189.7
VS OS N08C-17      1001412056.12S1441752.09E 273933.05418984.9
VS OS N08C-17      1939411541.42S1443309.69E 294985.05429324.3
VS OS N08C-19      1001412309.39S1441913.19E 275945.05414933.0
VS OS N08C-19      1975411736.76S1443502.94E 297719.65425840.8
VS OS N08C-21      1001412958.80S1441121.12E 265390.05401958.0
VS OS N08C-21      2624411954.77S1443713.12E 300864.45421668.1
VS OS N08C-23      1001413311.91S1441401.82E 269307.05396122.0
VS OS N08C-23      2634412259.88S1444001.68E 304936.55416065.6
VS OS N08C-25      1001413909.08S1441126.09E 266058.05384989.0
VS OS N08C-25      2774412758.28S1443937.65E 304627.15406847.4
VS OS N08C-27      1001412056.12S1441752.09E 273933.05418984.9
VS OS N08C-27      1939411541.42S1443309.69E 294985.05429324.3
```

15. Navigation Systems Verification and Monitoring

15.1. Gyro Monitoring

Dockside verification was performed in Balikpapan, Indonesia over 07-08th August 2007.
An additional 1 sided calibration took place in Singapore on February 2008

- **The gyro verification results are in Appendix 3**

15.2. GPS Monitoring

Health checks onshore were carried out to verify that the installation was satisfactorily operational (data reception, transmission, processing and Logging were verified) and that operational settings were correct**.** Each system used, including duplicates was verified.

- **The onshore Health Check results are in Appendix 3**

15.3. RGPS Health Checks

The last RGPS verifications were held at Loyang Shipyard and onboard using a zero base line technique.

Previously verifications took place at Semayang Wharf, Balikpapan, Indonesia over the 07-08th of August 2007.

- **The onshore Health Check results are in Appendix 3**

16. Navigation Processing

16.1. The FGPS Seispos System

SeisPos is an off-line navigation QC and post-processing system for 2D and 3D streamer surveys supplied by Fast Geophysical Processing Services. It runs under various Windows operating systems and has a graphical front end. A relational database management system is used for data storage. SeisPos is capable of automatic filtering and gating of the observations in addition to manual editing, before new adjustments are calculated. There is a comprehensive set of QC tools available such as graphical plots of any node or observation parameters and combinations of these, comparison of online and processed P1/90.

16.2. First Line Test data

A first-break analysis was performed during the first line and to confirm the nominal offsets for the front end of the streamer. An offset shot test line was also performed after any streamer re-deployment.

16.3. Initial QC

Initial QC consisted of on-line monitoring of the systems and of producing an end of line QC report utilising the Spectra QCN (Quality Control Node). The report was generated as a PDF document. If any discrepancies were found, they would be further investigated and any problems were noted in the navigation line-logs.

The report included comparisons between the systems, plots of network reliability, SMA (Semi Major Axis), MDE (Mean Detectable Error) and TS-plots of compasses, depths and source separation.

16.4. Post-processing Flow

The lines were post processed using CGGVeritas standard 3D processing flow consisting of the following stages:

- Import P2/94 to database and check for header changes.
- Check for missing shots and perform shot edits.
- Update a-priori SD's and magnetic declination if required.
- Pre-process data applying standard gating and filtering, hand-edit any remaining observation spikes.
- Compass calibration and bias check.
- Network adjustment
- Processing QC report generation.
- Export final P1/90
- QC of final P1/90
- Comparison of online and final P1/90

16.5. Final QC

Final QC was performed during the post processing and consisted of checking the various reports and plots generated by SeisPos, checking consistency of logs and P1/90 QC and comparison. Any discrepancy was noted in the processing log.

16.6. Water Depth Processing

The recorded water depth data was corrected for vessel draught, speed of sound and finally the data was tidally corrected using a tide file supplied from the client
All three corrections were carried out in post-processing.

17. Observations

17.1. Navigation Summary

All systems performed well throughout the survey. Each systems performance is described in further detail below.

17.1.1. DGPS Systems-

Occasional drop out of data generated by SPM 2. SPM 1 remained stable throughout the survey and thus always provided 2 solutions.

17.1.2. Echo Sounder

The 12 kHz transducer worked well throughout the survey. The 200 kHz transducer was not output due to the fact that the vast majority of the survey was acquired in depths of over 300m. During seq 11 for around 7.5 km, at depths greater than 1000m the echo sounder failed to output data owing to gates being incorrectly set. The hole in the depth data was filled using first break analysis generated from processing. Depth data generated by the echo sounder either side of the hole was used to calibrate the depth data generate by the first break analysis that was used to fill the hole.

17.1.3. Gyro

The primary and secondary gyro performed well during the survey.

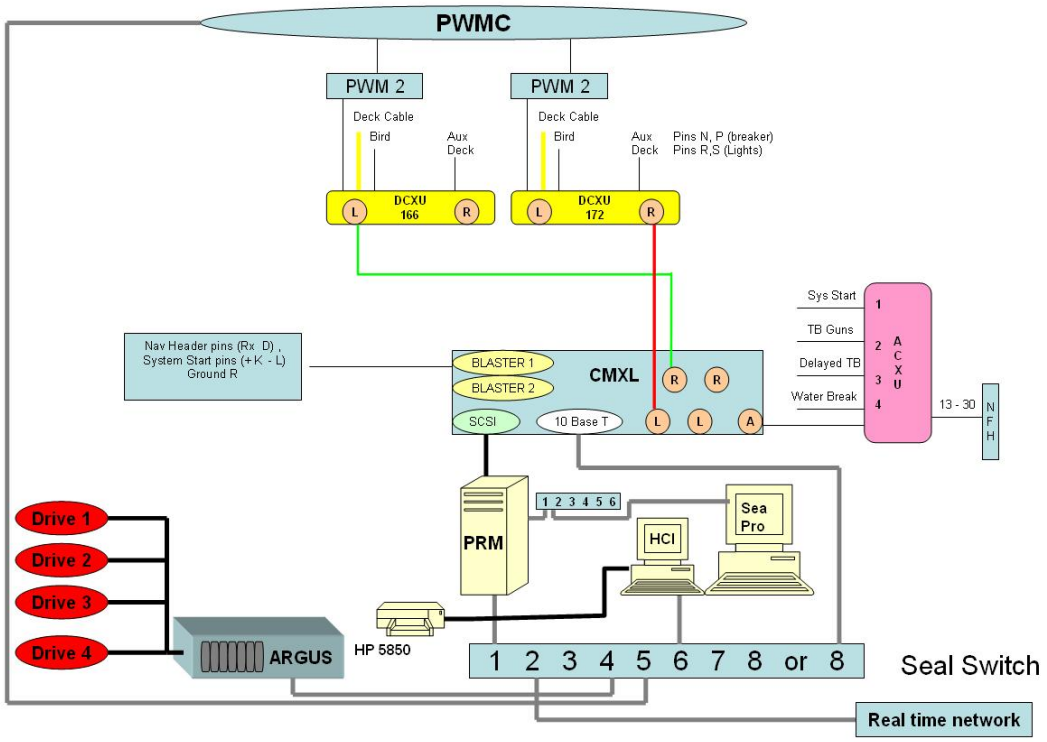
17.1.4. RGPS

All RGPS systems performed well throughout the survey.

17.2. Processing and QC Summary

No problems recorded

18. Instrumentation and QC System Description



Unit Type	Manufacturer	Software version
Recording	Sercel Seal	Version 5.1.14
Argus	Profocus: Raid disk and data management	Version 4.0
Tape drives	IBM 3590E	
Plotter	Versatech 24inch	
Onboard QC	Seal Seapro QC and ARGUS QC	Version 4.0
Source Controller	Seamap Gunlink 2000	Version 2.4.2
Auxiliary Systems	48 channel (Sercel AXCU)	
Bird Controller	Digicourse DMU + PC	Sys 3v01
Bird Type	Digicourse 5011E	Sys 3v01

19. Instrumentation and QC tests

19.1. Start-up tests

Before the beginning of the survey started, and after the streamer was deployed, a complete set of instrument/sensors tests were performed.

These tests were as follows:

Instrument tests
1 Harmonic distortion
2 System noise
3 Common mode rejection ratio
4 Gain error/ phase error
5 Cross talk

Sensor tests
6 Hydrophone capacitance
7 LF cut-off
8 Leakage resistance

At the start of the survey a complete set of instrument tests were performed and sent to the processing centre together with the seismic data. The results of the Start of Job Instrument/Sensor tests were:
Channels 21, 277 & 377 failing Capacitance, Channel 277 failing Low Frequency Cut off and channels 181 & 242 failing Hydrophone Leakage.

19.2. Additional client tests

Polarity tests were carried out at the start of contract and verified on Promax. Channel 59 had polarity reversed.

19.3. Daily Instrument and Sensor tests

The daily instrument and sensor tests consisted of the same 8 tests which were used to verify the Seal and Streamers performance at the start and throughout the contract. Results were printed out daily and also recorded to tape at start-up, interim monthly and end of contract. These tests were run daily to confirm that the Seal recording system and streamer performance were in specification.
The series of tests results showed the recording system to be in specification throughout the survey. The overall system performance was stable throughout the survey with test performance repeatable from day to day.

19.3.1. Seal tests performed daily

The following page shows the tests performed daily and their results.

Instrument tests
1 Harmonic distortion
2 System noise
3 Common mode rejection ratio
4 Gain error/ phase error
5 Cross talk
Sensor tests
6 Hydrophone capacitance
7 LF cut-off
8 Leakage resistance

19.3.2. Seal system and streamer test results

Streamer 1

	System tests						Sensor tests			
Date Local	HD	Sys noise	CMRR	Gain err	X talk odd	X talk even	Cap	LF cut-off	Leakage	Remarks
04-Mar-08	OK	OK	OK	OK	OK	OK	3	1	2	Ch. 21, 277 & 337 failed capacitance. Ch. 277 failed cut-off. Ch. 181 & 242 failed leakage.
05-Mar-08	OK	OK	OK	OK	OK	OK	3	1	1	Ch. 21, 277 & 337 failed capacitance. Ch. 277 failed cut-off. Ch. 181 failed leakage.
06-Mar-08	OK	OK	OK	OK	OK	OK	4	1	1	Ch. 21, 190, 277 & 337 failed capacitance. Ch. 277 failed cut-off. Ch. 181 failed leakage.
07-Mar-08	OK	OK	OK	OK	OK	OK	4	2	1	Ch. 21, 190, 277 & 337 failed capacitance. Ch. 181 & 277 failed cut-off. Ch. 181 failed leakage.
08-Mar-08	OK	OK	OK	OK	OK	OK	3	0	0	Ch. 21, 91 & 337 failed capacitance.
09-Mar-08	OK	OK	OK	OK	OK	OK	3	0	0	Ch. 21, 91 & 337 failed capacitance.
10-Mar-08	OK	OK	OK	OK	OK	OK	3	0	1	Ch. 21, 91 & 337 failed capacitance. Ch. 242 failed leakage.
11-Mar-08	OK	OK	OK	OK	OK	OK	3	0	1	Ch. 21, 91 & 337 failed capacitance. Ch. 242 failed leakage.

2.3.3. End of job test

At the end of the survey a complete set of instrument tests were performed. These tests were as follows:

Instrument tests
1 Harmonic distortion
2 System noise
3 Common mode rejection ratio
4 Gain error/ phase error
5 Cross talk

Sensor tests
6 Hydrophone capacitance
7 LF cut-off
8 Leakage resistance

The SOJ, Interim Monthly and EOJ tests listed above were recorded to tape, and sent to the processing centre together with the Seismic data.

The result of the End of Job Instrument/Sensor tests were: Channel 21, 91, 337 failing Capacitance, Channels 242 failing Hydrophone Leakage.

The overall Seal and Solid streamer system performance was stable and repeatable throughout the survey.

19.3.3. QC Processes

Seismic Observer QC displays

Seal system QC displays showing shot records and rms residual noise were used to monitor seismic data shot by shot. RMS levels were colour scaled to give good visual assessments to the operator of sea swell and ship noise effects on the streamer.

QC products and processing sequence

A Promax system was in use during the survey to further monitor the quality of the Seismic data, and to produce Gathers, Brute and Raw stacks.

19.3.4. Production tape logs

Client	Santos						BOX	1
Area	South East Basin, Offshore Australia							
Survey	2D, T48P						Vessel	M/V Pacific Titan
Job #	6374							
Date	Line Name	Tape	Seq	FF	LF	FSP	LSP	Comments
04 March 2008	SOSN08C-01-001	1	1	979	2526	981	2526	SOL
04 March 2008	SOSN08C-01-001	2	1	2527	3169	2527	3169	EOL
04 March 2008	SOSN08C-03-002	3	2	979	2526	979	2526	SOL
04 March 2008	SOSN08C-03-002	4	2	2527	3005	2527	3004	EOL
04 March 2008	SOSN08C-05-003	5	3	979	2526	981	2526	SOL
05 March 2008	SOSN08C-05-003	6	3	2527	2613	2527	2612	EOL
05 March 2008	SOSN08C-07-004	7	4	979	2526	981	2526	SOL
05 March 2008	SOSN08C-07-004	8	4	2527	2561	2527	2560	EOL
05 March 2008	SOSN08C-09-005	9	5	979	2332	981	2331	SOL / EOL
05 March 2008	SOSN08C-11-006	10	6	979	2311	981	2310	SOL / EOL
05 March 2008	SOSN08C-13-007	11	7	979	2307	981	2306	SOL / EOL
06 March 2008	SOSN08C-15-008	12	8	979	2137	981	2136	SOL / EOL
06 March 2008	SOSN08C-17-009	13	9	979	2100	981	2099	SOL / EOL
06 March 2008	SOSN08C-19-010	14	10	979	2096	981	2095	SOL / EOL
06 March 2008	SOSN08C-21-011	15	11	979	2526	981	2526	SOL
06 March 2008	SOSN08C-21-011	16	11	2527	2745	2527	2744	EOL
07 March 2008	SOSN08C-23-012	17	12	979	1343	981	1342	NTBP
07 March 2008	SOSN08C-23-013	18	13	979	1350	981	1349	NTBP
07 March 2008	SOSN08C-23-014	19	14	979	2526	981	2526	NTBP
07 March 2008	SOSN08C-23-014	20	14	2527	2675	2527	2674	NTBP
08 March 2008	SOSN08C-23-015	21	15	979	1264	981	1263	NTBP
08 March 2008	SOSN08C-23-016	22	16	979	1374	981	1371	Incomplete
08 March 2008	SOSN08C-23-017	23	17	1230	2675	1230	2674	SOL / EOL
09 March 2008	SOSN08C-27-018	24	18	979	2100	981	2099	SOL / EOL
09 March 2008	SOSN08C-25-019	25	19	979	2526	981	2526	SOL
09 March 2008	SOSN08C-25-019	26	19	2527	2895	2527	2594	EOL
09 March 2008	SOSN08C-02-020	27	20	979	2526	981	2526	SOL
09 March 2008	SOSN08C-02-020	28	20	2527	3717	2527	3716	EOL
10 March 2008	SOSN08C-04-021	29	21	979	2526	981	2526	SOL
10 March 2008	SOSN08C-04-021	30	21	2527	3675	2527	3674	EOL
Client	Santos						BOX	2
Area	South East Basin, Offshore Australia							
Survey	2D, T48P						Vessel	M/V Pacific Titan
Job #	6374							
Date	Line Name	Tape	Seq	FF	LF	FSP	LSP	Comments
10 March 2008	SOSN08C-06-022	31	22	979	2526	981	2526	SOL
10 March 2008	SOSN08C-06-022	32	22	2527	4074	2527	4074	Continued
10 March 2008	SOSN08C-06-022	33	22	4075	5622	4075	5622	Continued
10 March 2008	SOSN08C-06-022	34	22	5623	5844	5623	5843	EOL
11 March 2008		35		1	12			SOJ / EOJ Tests
		End of Job Santos T48P						

20. Onboard QC Personnel and System

20.1. Onboard QC Processing Geophysicists

3rd Mar 2008 - 2nd Apr 2008 Steffi Schwarz CGGVeritas, Chief Field Geophysicist

Dennis Jerome Aquino CGGVeritas, Field Geophysicist

20.2. Onshore QC Processing Support

Ronny Tømmerbakke, Support Geophysicist.
Cathrine Myrmehl, Support Geophysicist
Christophe Massacand, Chief Operations Geophysicist.

20.3. Seismic Processing Hardware Description

Machines : 1 x Supermicro, built on SC833T-R760 Chassis

(Dual Core Xenon 2x3.2GHz CPU, 8Gb RAM)

1 x Win XP SP2 PC
Hard Disk Drives : 1.6Tb Disk
Monitors : 4 x 19in LCD Monitors
Tape Drives : 2 x IBM 3590 tape drives

Plotters : 1 x Isys V24 24in Thermal Plotter (B&W)

20.4. Seismic Processing Software Description

Processing software : ProMAX 2D version 2003.12.1
Operating System : Red Hat Enterprise WS 3.0 Update 6

Plotting software : ZehPlot Express 4.7.0

21. Acquisition Quality Control

21.1. Introduction

This report provides a summary of the steps taken for the onboard seismic data QC for this survey. Information important for the onshore processing of this data is either contained within this document, or its location is referenced.

The SEBOA survey is comprised of several 2D seismic surveys for the SEBOA consortium (Santos, 3D Oil, Bass Straits Oil Company, Cue Energy Resources, Eagle Bay Resources, Exoil and Tap Oil). The survey sites are located offshore South East Basin and Bass Strait Basin in Australia and cover around 10,900 sq kms.

This report covers the Santos survey of block T48P.

Acquisition parameters for the project are the following:

- 1 streamer x 6000m,
- single source,
- 25m SP interval, and
- 6sec record length.

21.2. QC Processing Objectives

The main objective of the onboard QC processing was to identify problems associated with the data acquisition and recording. This included the assessment of noise in the data on a line by line basis in order to give an overall impression of the data quality.

Various QC methods, including RMS noise displays, single and multi-trace displays, gun hydrophone channels and stacks were used to assess compliance with various acceptance criteria and to isolate any other acquisition issues.

The general aim of the QC processing was not to attenuate noise but to show the data as it was recorded, or how it would be presented to the processing centre.

A brute stack was produced for every line with minimal processing to enable a thorough QC of the data onboard. In addition to brute stack processing, gun hydrophone channels were checked to QC the performance of the source, near trace and Shot vs. Channel RMS displays were generated and examined to identify any noise problems.

21.3. Parameter Testing

Parameter testing consisted of choosing suitable parameters on the first sequence, along with NMO mutes, and post stack scaling for the displays, and checking that these parameters remained appropriate throughout the survey.

After intial cable deployment and after each subsequent redeployment, a near-offset test was performed using the gun closest to the centre of the source to ascertain the actual distance from the sorce to the centre of the first receiver group.

21.4. QC Processing Sequence

Data was recorded by the Observer department in duplicate onto 3590 tape cartridges (10Gb capacity). One 'primary' tape set and one 'copy' tape sets were generated. Upon completion of a line, the ‘original’ (or ‘primary’) tape was read to confirm the integrity of the data on tape. All SEG-D data on the primary tape was extracted and written to the ProMAX system disk. A listing of the field files (FFID), shot point numbers (SP) and number of channels was printed to clearly identify any lost shots or shots with missing navigation headers.

The data included 480 seismic channels and 30 auxiliary channels (-1 to –30). Informative auxiliary channels are Aux1 - System Start, Aux2 - Time Break, Aux4 - Waterbreak, Aux13 to Aux30 - Gun Near Field Hydrophones. Also recorded were the start of line (SOL) and end of line (EOL) noise records.

Seismic data, noise records and auxiliary channels were input with a record length of 6000ms, and a 2ms sample interval was used in the acquisition. The cable length was 6000 meters with hydrophone group separation of 12.5 meters, and shotpoints were recorded at 25m intervals.

A bulk shift static correction was applied to the data to correct for the 50ms instrument delay of the recording system.

For QC purposes a nominal 2D geometry was applied to all the seismic trace data. The resulting offset / CDP binning information calculated was then loaded into the seismic trace headers. The data was re-sampled from 2 ms to 4 ms using a minimum phase, high fidelity anti-alias filter applied prior to resample. Further data reduction involved 2-to-1 Marine Trace Decimation after differential NMO, which increased the receiver spacing from 12.5 to 25 meters.

To balance the amplitudes of the shot record, true amplitude recovery using a t square correction was used and applied to the whole shot record. Band pass filtering (Ormsby 6-8-90-120) was also applied to the data, prior to NMO and stacking.

Water bottom picks were automatically generated and manually QC’ed for the near channel.

Trace editing involved killing any bad traces or shots based on Observer log comments and results of the QC.

21.5. Velocity Analysis

Brute velocities were picked for every line at a 2 km interval using ProMAX’s interactive velocity analysis package. This comprised of a semblance display with RMS stacking velocity graph and interval velocity graph, CDP super gather panel and function stack panels.

To improve the signal to noise ratio, super gathers were formed by combining 15 adjacent CDP gathers. Stack panels were created from these 15 CDP’s using 31 functions varying +/- 35% from the regional velocity function of the first two sequences. Thereafter, the velocity functions of the nearest adjacent line shot in the same direction, were used as a guide.

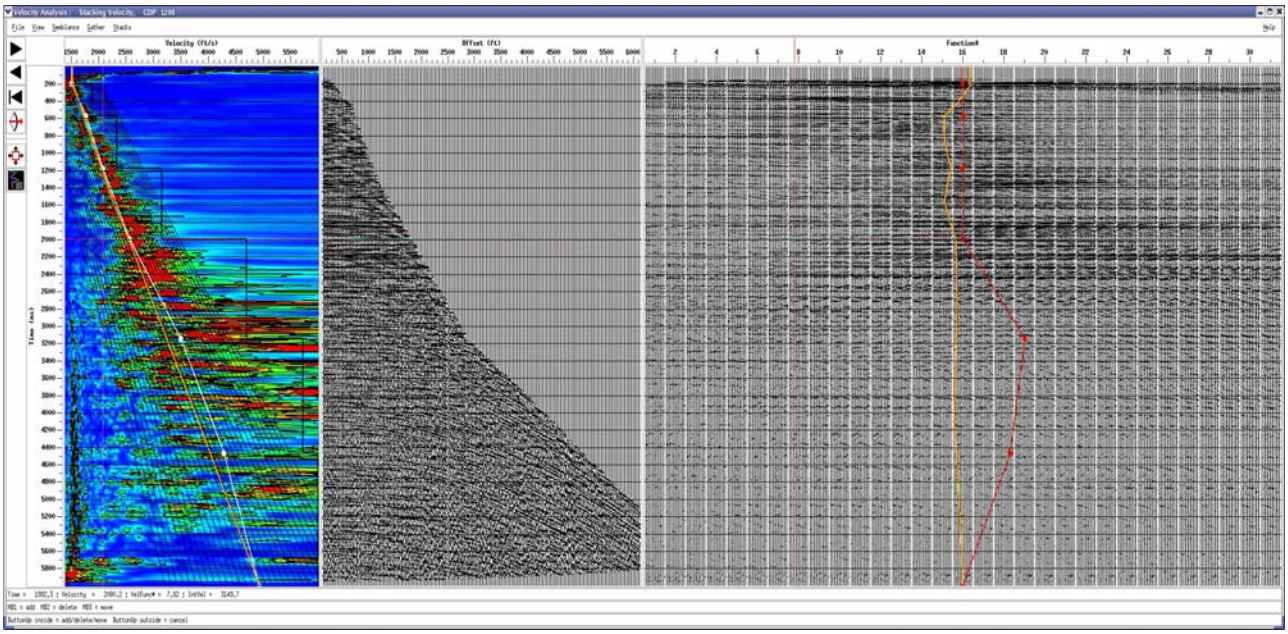


Figure 21-1: Velocity analysis for seq. 011. Graphical user interface with semblance, super-CDP gather and function stacks.

To speed up the on-screen velocity picking procedure, the velocity analysis displays were pre-computed. Normal move-out was applied to the gather to check that the events were lining up well.

NMO corrected gathers were also displayed onscreen: both, at and between velocity locations, for further verification.

Velocity tables for each sequence were exported to ASCII format.

21.6. Brute Stack

Brute stacks were produced as soon as possible after each line and presented to the onboard client to assess the noise impact on the data.

A straight mean vertical stack algorithm was used for CDP stacking, with a root power scalar for normalization of 0.5. A bulk shift static correction was applied post-stack to correct for the gun and cable depths. Filtering was limited to a 6-8-90-120 Hz Ormsby band-pass filter. The raw brute stacks were captured to jpg and plotted to paper.

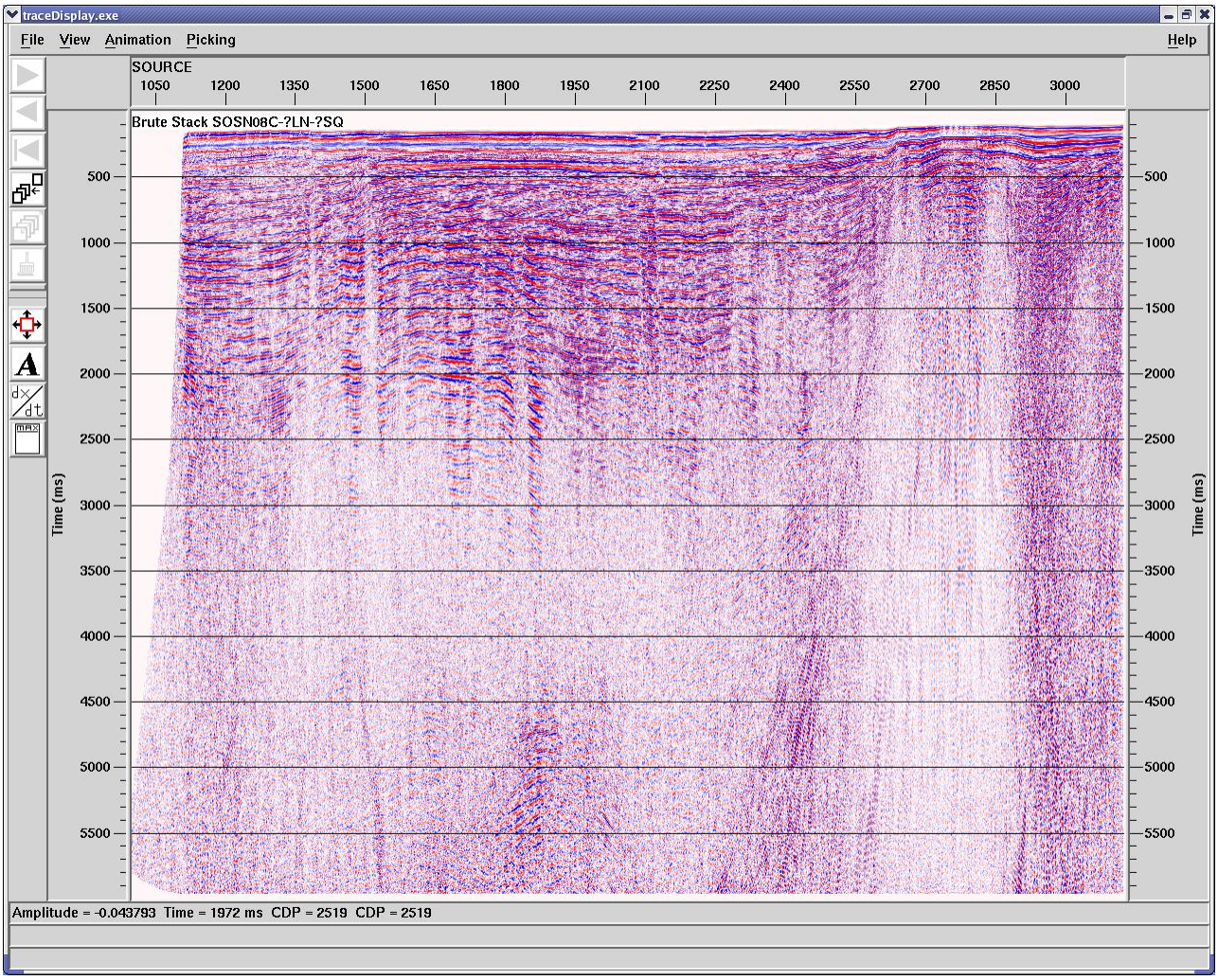


Figure 21-2: Brute stack for seq. 002.

21.7. QC processing steps

This section describes the quality control steps that were taken. This acquisition QC allows for the onboard processors to find, log and analyse any potential problems in conjunction with the other onboard departments, in order that the highest possible standards of acquisition are maintained.

The onboard QC includes a full set of quality controls used to detect seismic and positioning problems.

STEP	DETAILS	QC PROCEDURE/PRODUCT
Reformat to ProMAX internal format	Input full length record - 6000ms, 480 channels + 30 auxiliary channels	Check Job Listing for FFID/Shot numbering, Gun Seq, Main headers. Check for missing data
Noise Record	Start And End Of Line. Ambient RMS Calculation	Check screen display and noise level Screen capture SOL & EOL records
Noise History	Append Noise Calculation to History	Screen capture Noise History – single display for entire project
Raw Shots Display	Every 2km, 480 channels 6000ms	Check Channel Edits Check Data Quality
Auxiliary Channel QC	Create Aux Channel Gathers Vertical Stack Gun Hydrophones for each Gun string	QC of Aux Channels Check for autofires, gun timing, air leaks
Near Trace Display	Select First Channel and Display	Check record length, data quality Screen capture
Shot vs Chan RMS Analysis	• Ormsby, Zero Phase, 4-8-90-120 Hz BPF applied. • 2 Windows. 50-500ms & 5450-5950ms. • Shot by shot Average Noise Calculation.	Check levels against job specs Check for bad channels Screen capture for both displays
RMS History	Calculate Average for Sequence and append to RMS History File	Screen capture RMS History – single display for entire project
Trace Decimation Flow	• Input Raw Shots • Apply Shot and Channel Edits based on Observer Logs and QC • -50ms static shift for Instrument Filter Delay • Ormsby, Minimum Phase, 4-8-90-120 Hz Band Pass Filter • Apply 2D Nominal Marine Geometry	
Decimated shot display	Every 1250 m shot display on screen	Check shots
Velocity Analysis	Every 4 km, Semblance,Gathers, Variable Velocity Percentage Stack Panels	Pick velocities every 2km
Velocity QC	Start ProMAX Interactive Velocity QC and Editing tool.	Check velocity Field for Spikes and Picking errors. Display as Interval Velocities for additional QC
NMO gathers	Every 2km NMO CMP gathers on screen	Check moveout of primaries.

STEP	DETAILS	QC PROCEDURE/PRODUCT
Export Vels	Export Velocity Table to ASCII	Save ASCII Vel file
Stack RMS Flow	Calculate water column RMS value for posting on top of the stack	
Shot Stack Flow	Calculate average RMS level of each shot over entire line, measured within a 5450-5950 window. Post in ProMAX database	QC for anomalous values Screen capture
Channel Stack Flow	Calculate average RMS level of each channel over entire line, measured within a 5450-5950 window. Post in ProMAX database	QC for anomalous values Screen capture
Stack Flow	• Input Decimated Shots • Sort to CMP order • Moveout with picked Velocity Field • Surgical NMO mute • 1/sqrt(n) fold compensated stack • Apply Gun and Cable Statics • Time square amplitude recovery • Ormsby, Minimum Phase, 4-8-90-120 Hz Band Pass Filter	Check quality of stack Check completeness of Stack and corresponding SPs, FFIDs and CDPs Screen capture
Stack Plot	Time Variable Amplitude Compensation	QC of stack
SEG-Y stack	Write to SEG-Y & QC	Save deliverable file
Nav Merge QC	Merge lead trace of each cable with P190. Calculate direct arrival time and display over Seismic Near Trace Gather.	Check that predicted Direct Arrival Time closely follows the seismic data. Check that all traces have merged successfully. End of Job

21.8. Noise Record and Channel RMS graph

The noise records were recorded at the start and end of every line, and displayed for QC. Channel RMS values were computed for all 480 channels over the entire record for noise analysis, and graphed above the display. For every sequence the noise record at SOL and EOL was displayed on screen and archived to GIF format.

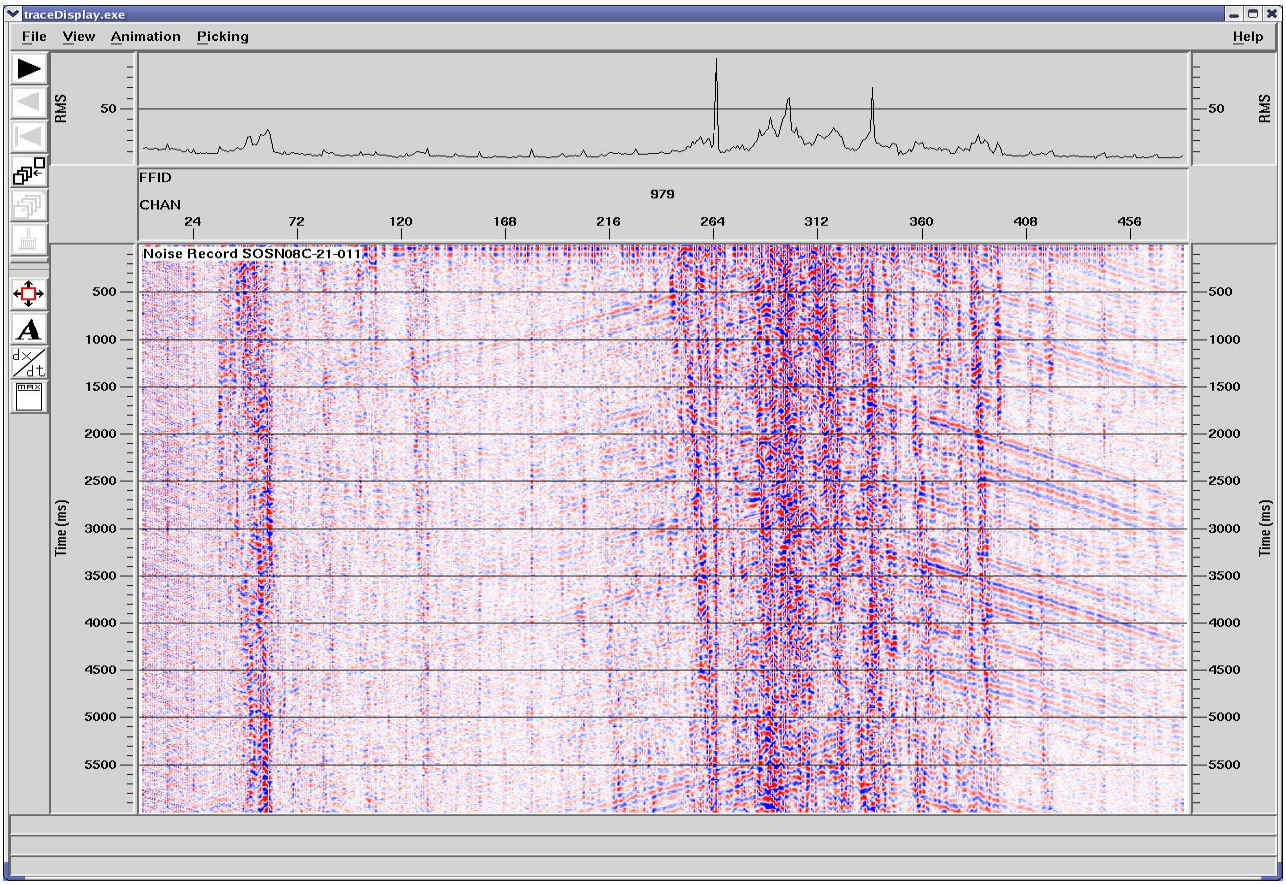


Figure 21-3: Example Noise Record with Channel RMS levels annotated, seq. 011. Note noisy channel 265, and bend noise in the middle of the streamer.

For each noise record a noise analysis is performed. The average ambient noise encountered in the noise records is recorded in the QC log.

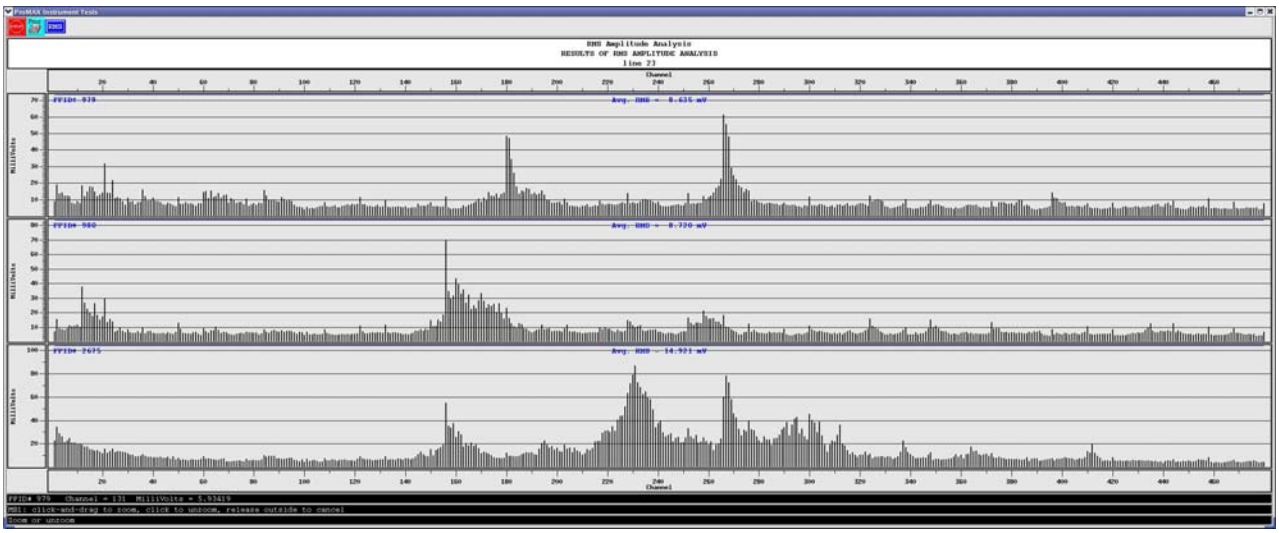


Figure 21-4: Example of analysis of Noise Records for seq. 014 (NTBP). Swell noise is evident, exceeding 25µb and affecting about 10% of traces. Average Ambient RMS: 10.8µb.

21.9. Ambient noise - Shot Vs Channel RMS Display

Colour displays of Shot vs. Channel RMS values were produced for the whole cable for every line to assess the ambient noise level and the channel quality. Raw data with a sample rate of 1 ms was used to calculate the RMS values for every channel on every shot.

RMS values were calculated from two windows, a shallow window of 50-500ms at the start of the record, and a deep window of 5450-5950ms at the end of the record. RMS values from all channels were averaged for each shot. They were displayed on the graph.

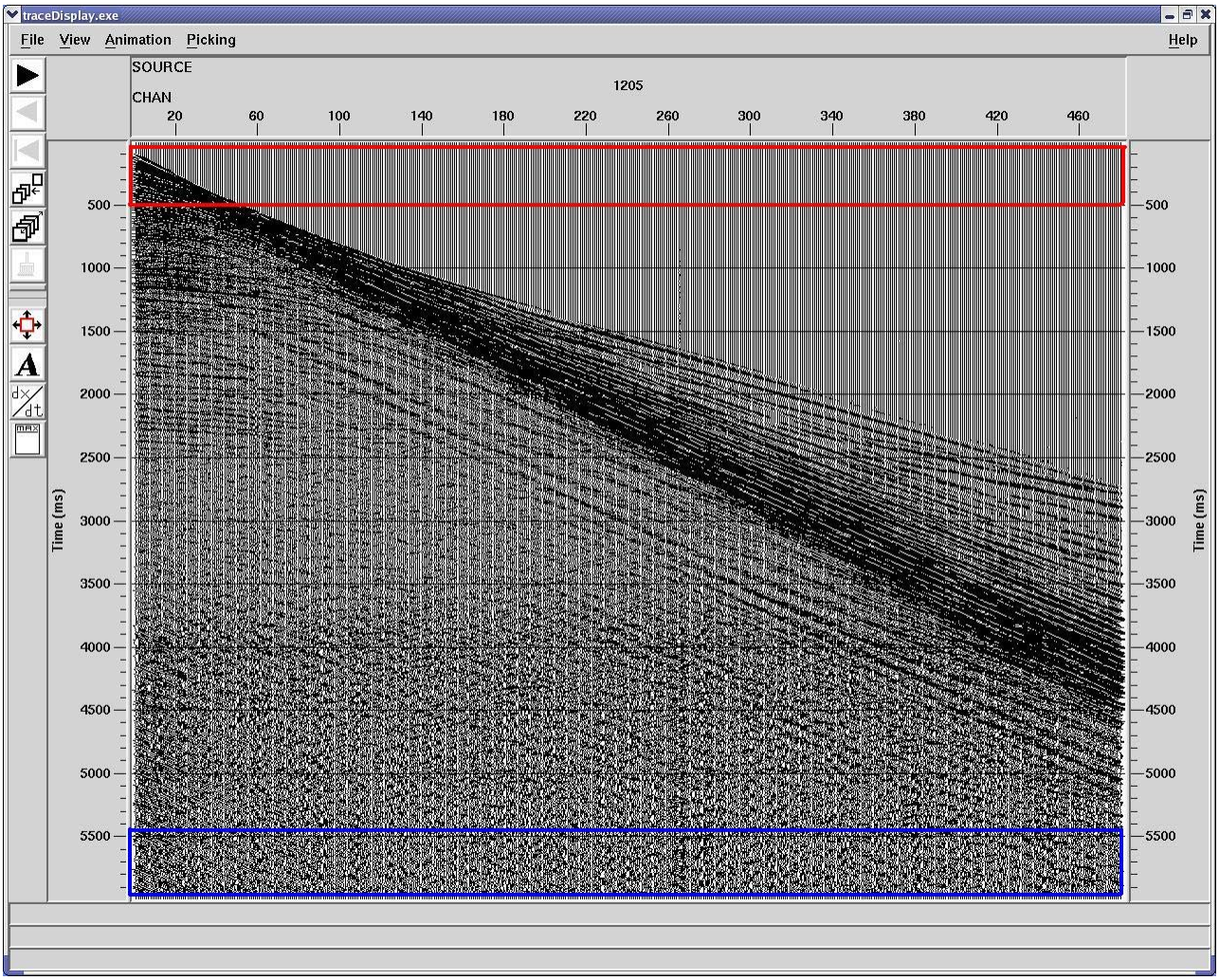


Figure 21-5: Shot gather with shallow and deep RMS analysis windows annotated.

For all RMS computations a scaling factor of 46.5 was used to convert from millivolts to microbars, the instrument sensitivity being 21.5 Volts/Bar.

The shallow and deep colour RMS displays were viewed on screen, and screen images were then saved as JPG files. The displays were used to show noise trends along the line such as swell noise, noisy/bad channels, bird noise, cable tug, front end noise, cable strikes, auto-fires and misfires, multiple interference,

etc. Noisy channels could be clearly identified and deteriorating channels could be spotted using this display. The on screen analysis also allowed the exact shot and channel location of any noise trend to be located and investigated. All suspicious shots were then examined in the raw shot display to find and edit noisy shot records.

The shallow window was overdriven for the first 50 channels and the deep window was overdriven from time to time, as can be seen on the plot below (red bar at top of display). This is due to the water depth of the survey area, and the impossibility of finding an adequate water column window at the top of the trace, free from the seismic impulse. Therefore it was impossible to determine average values of ambient noise from the rms displays.

At the end of the survey a composite display was created showing average RMS values per channel on a sequence-by-sequence basis.

ASCII format files of the ambient RMS can be found on the Deliverables CD as well as the QC log for the survey area

.

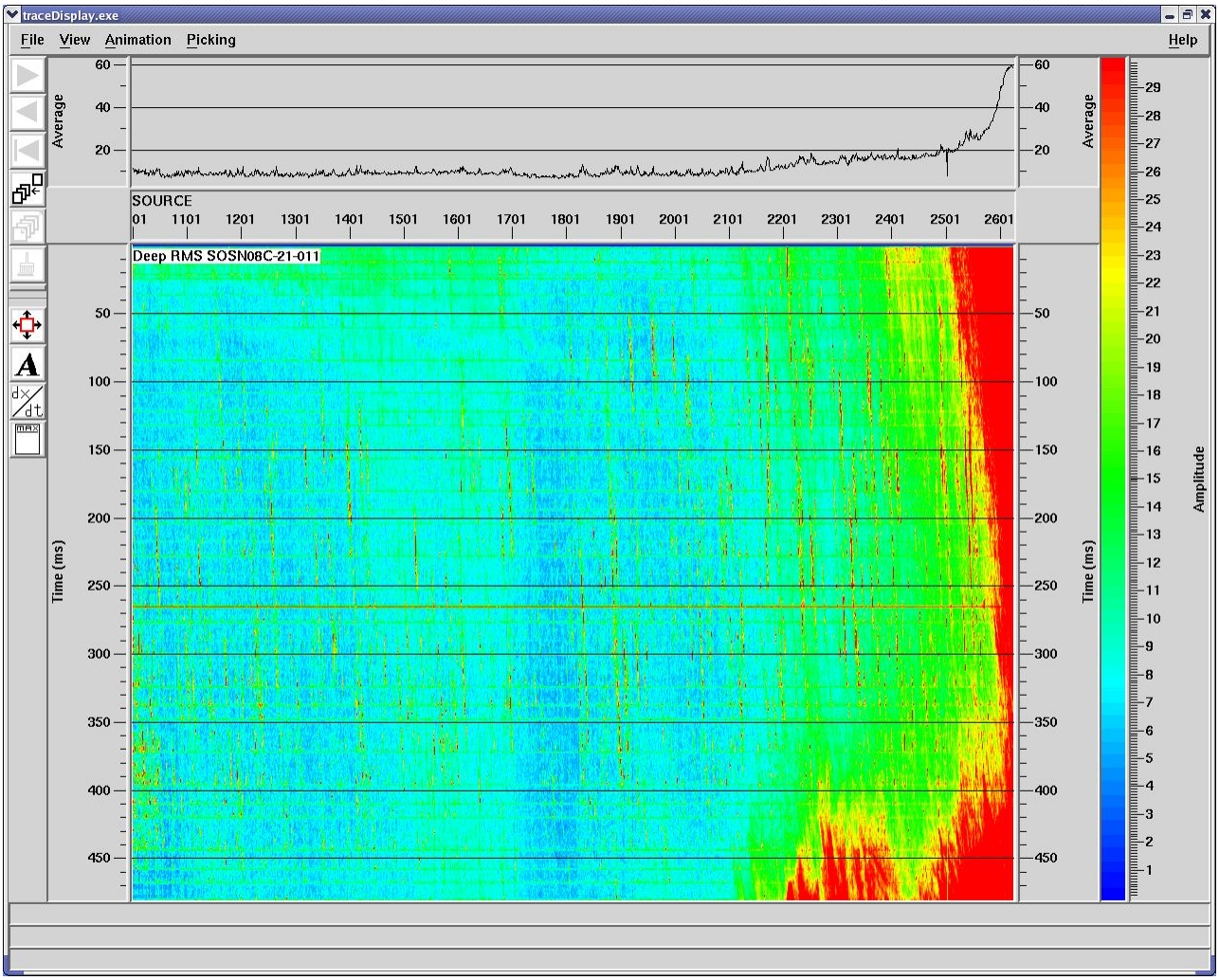


Figure 21-6: Deep RMS window for seq. 011. Note increased residual energy towards deeper end of prospect at

EOL.

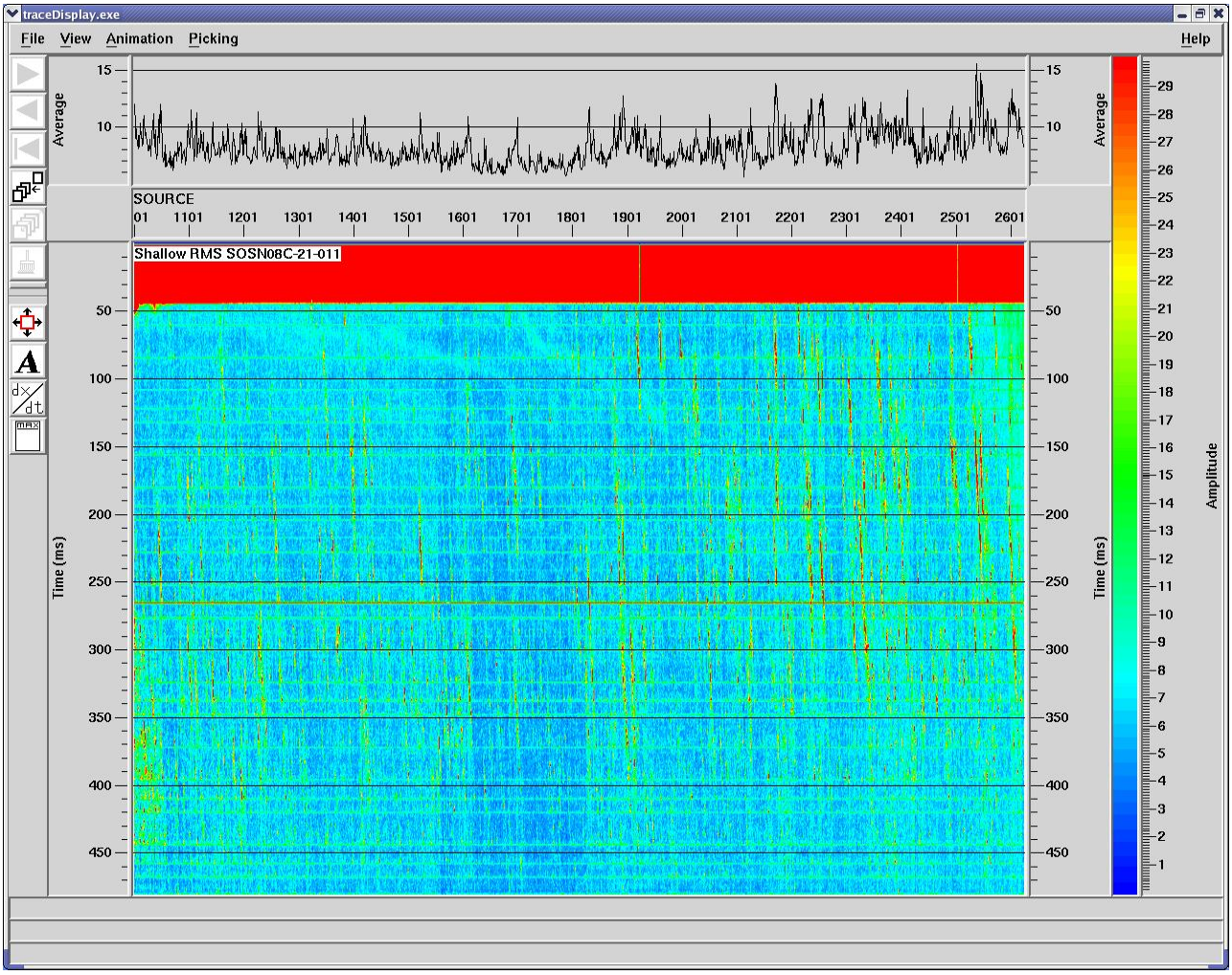


Figure 21-7: Examples of Shallow rms window QC from seq. 011. The first 50 channels are dominated by direct arrival energy. Noise on trace 265 and swell noise are evident.

21.10. Near Trace Display

The near traces were displayed on screen for every line in order to quickly determine any possible errors with acquisition, e.g. gun volume changes, bad records, time-break problems and any auto-fires not reported by the recording system. The near traces also provided a good indication of the geological conditions, including strength of the water bottom multiples, residual seismic multiple energy and swell noise contamination.

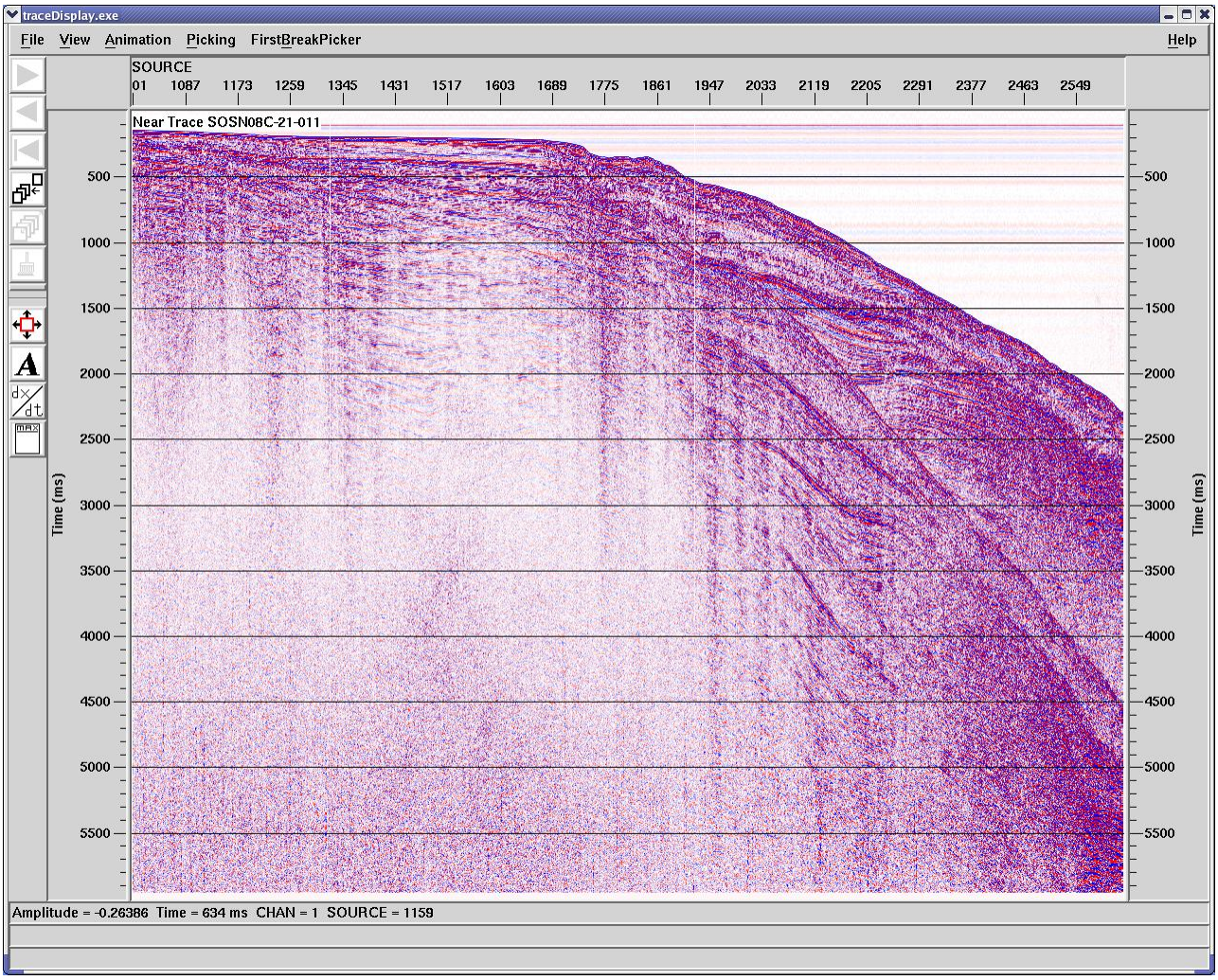


Figure 21-8: Near trace display, seq. 011.

21.11. Auxiliary Channel QC

The 30 auxiliary channels (-1 to -30) loaded during the SEG-D read, were separated from the 480 data channels, stored in a separate data file, and used for on screen analysis. These records consisted of the time break, the water break, and 6 near-field hydrophones for each of the 3 sub-arrays.

Time break and water break channels were displayed as a single trace display on screen. The first 500ms from all 6 hydrophones within each sub-array were stacked vertically and displayed in order to evaluate the performance of the guns. This proved useful in distinguishing genuine gun problems from noise on the trace. The auxiliary channel displays were used to locate air leaks and autofires.

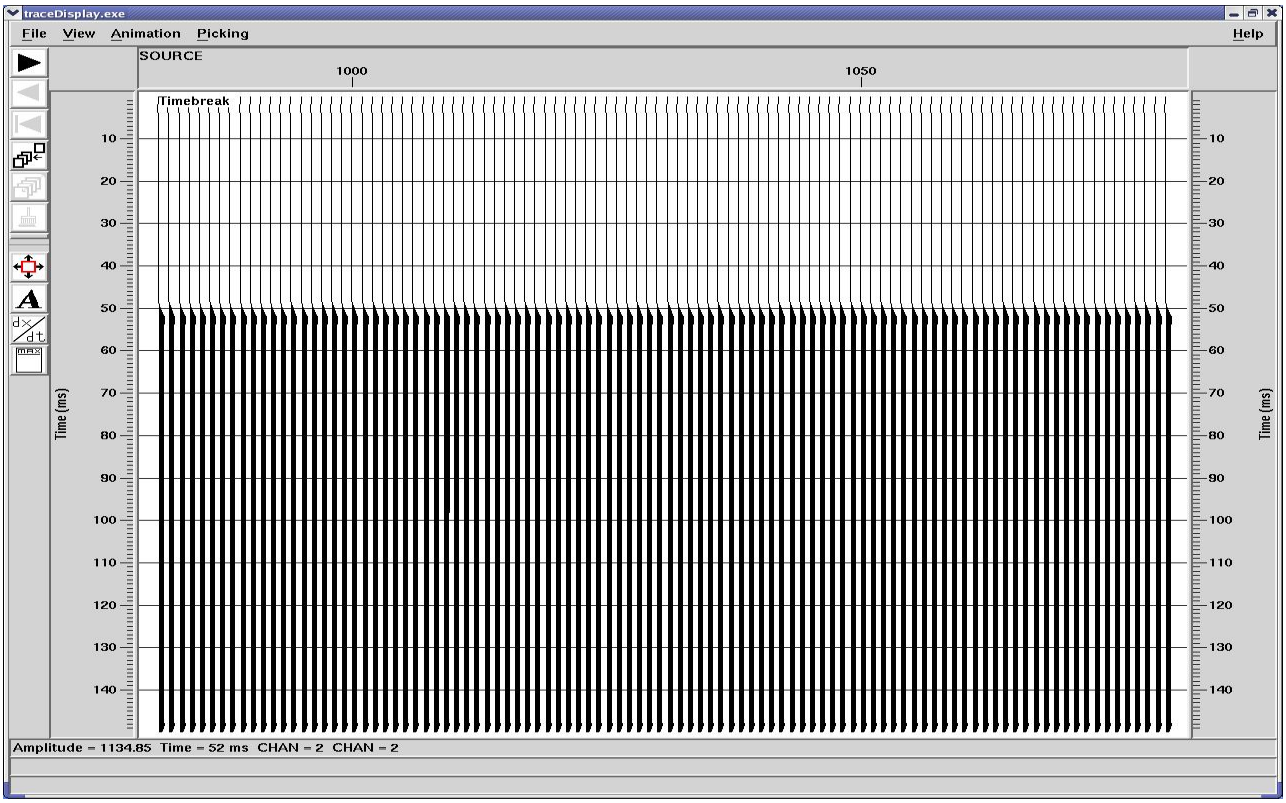


Figure 21-9: Timebreak QC (Auxiliary channel 1).

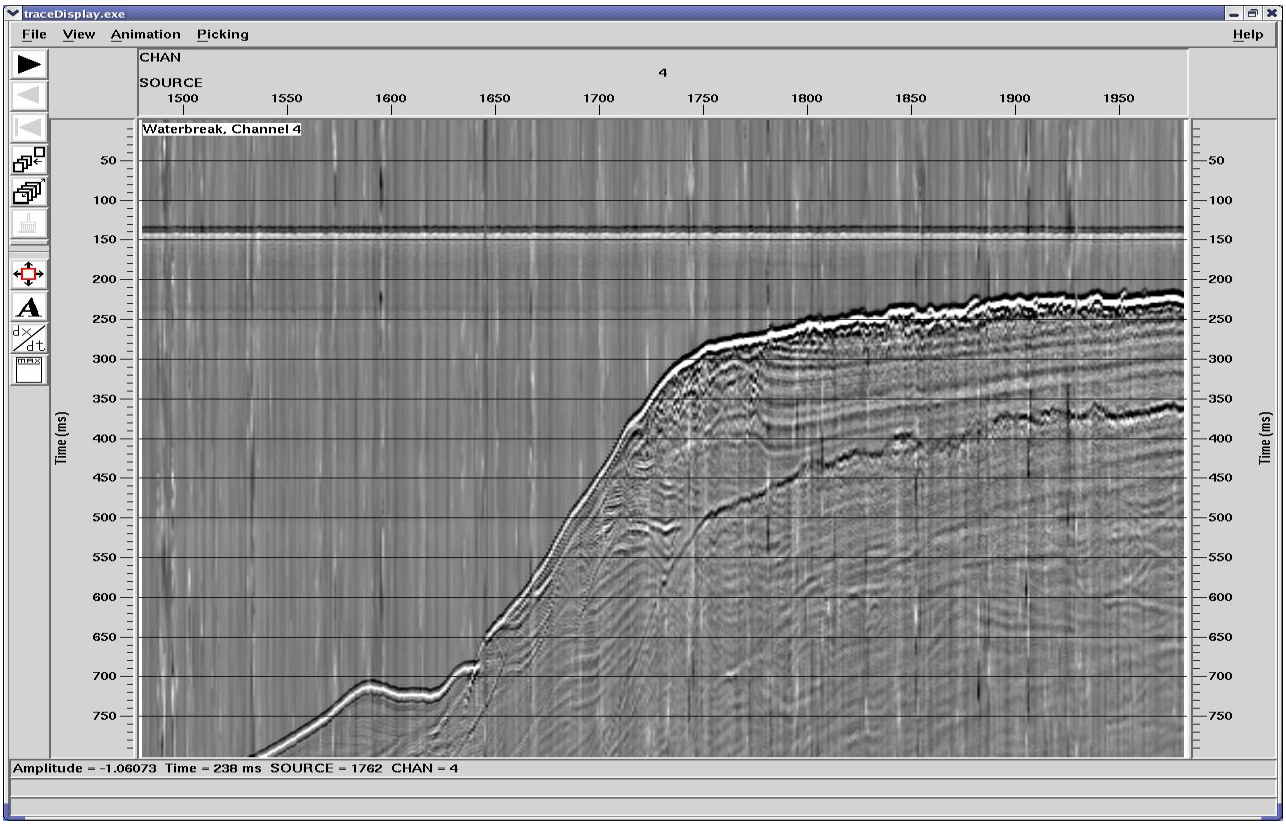


Figure 21-10: Waterbreak hydrophone QC (Auxiliary channel 4).

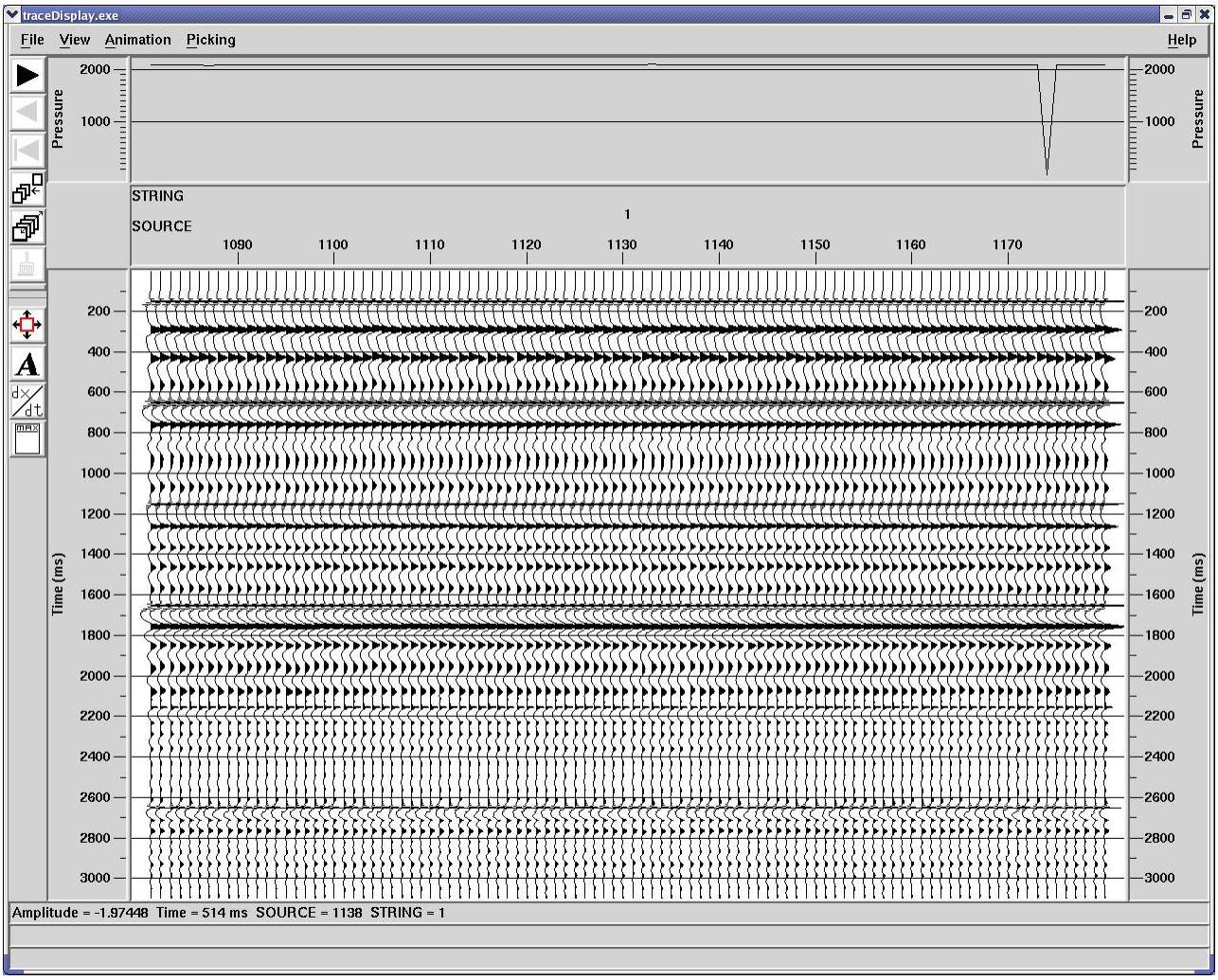


Figure 21-11: QC of vertically stacked near field hydrophones 1 to 6 on gunstring 1 (Auxiliary channels 13 to 18). Note annotation of gun pressures, missing header for SP 1174.

21.12. Shot Record Displays

Shot records were band pass filtered (Ormsby 6-8-90-120) and balanced with a true amplitude gain recovery. They were displayed on screen at 51 shot point intervals for each line.

Additional records were also examined on screen if an issue with acquisition was suspected, such as noise, residual seismic energy or auto-fires. The colour RMS displays were frequently used to pinpoint bad/suspicious shots, the shot gathers of which were subsequently investigated onscreen.

Consistently noisy channels were also identified on the raw shot displays, and cross checked against the Observer Logs, which were modified if necessary.

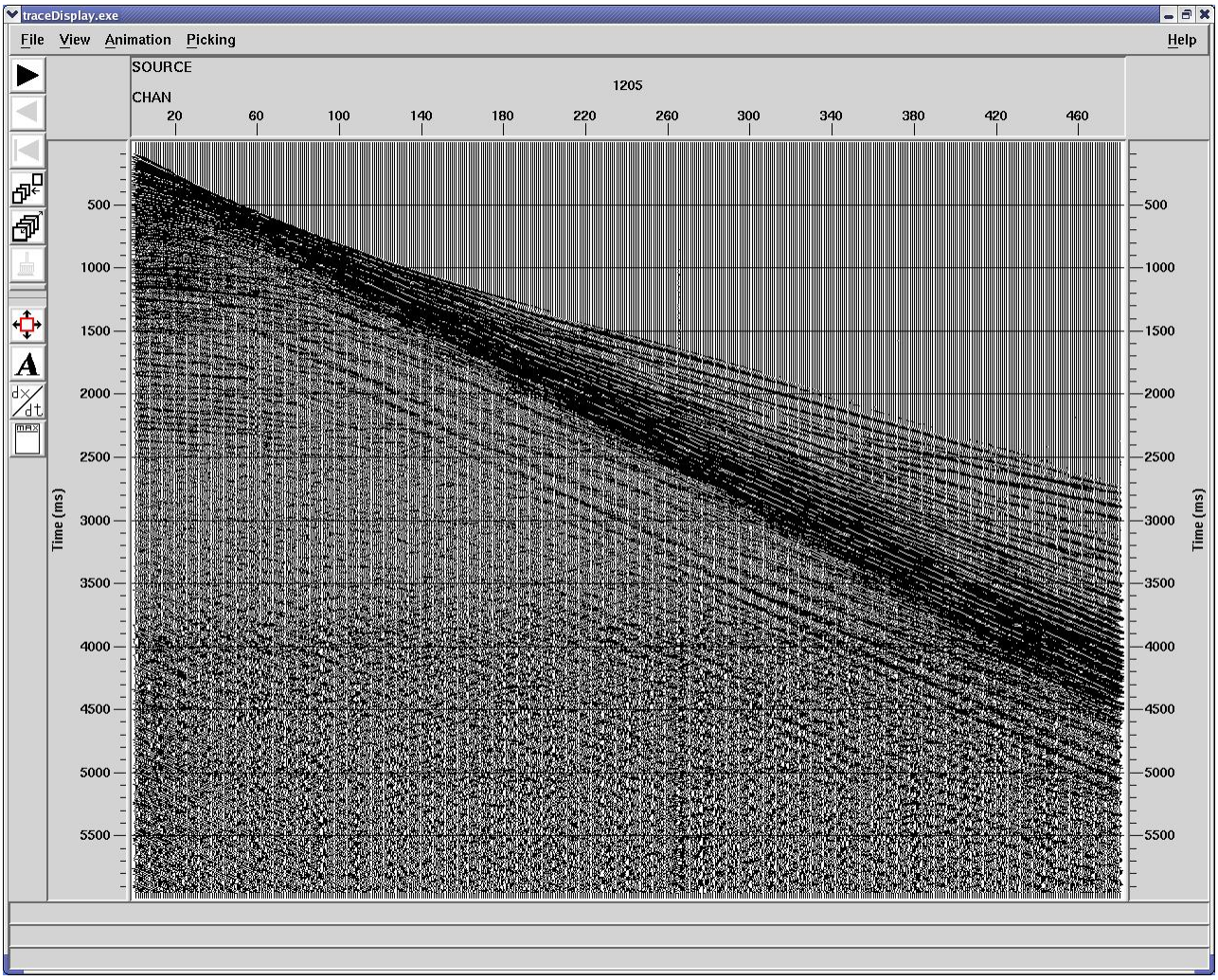


Figure 21-12: Raw shots display, SP 1205, seq. 002. Note strong refraction multiples from the seabed on the longer offsets and noise on channel 265.

21.13. Navigation Processing

In order to QC the navigation data, the final processed P190 navigation files were merged with the near traces for each line. The predicted first break time was computed using the water velocity. This was displayed overlaid on the near trace as seen below (in red), to enable QC of the consistency between the predicted and the recorded first breaks.

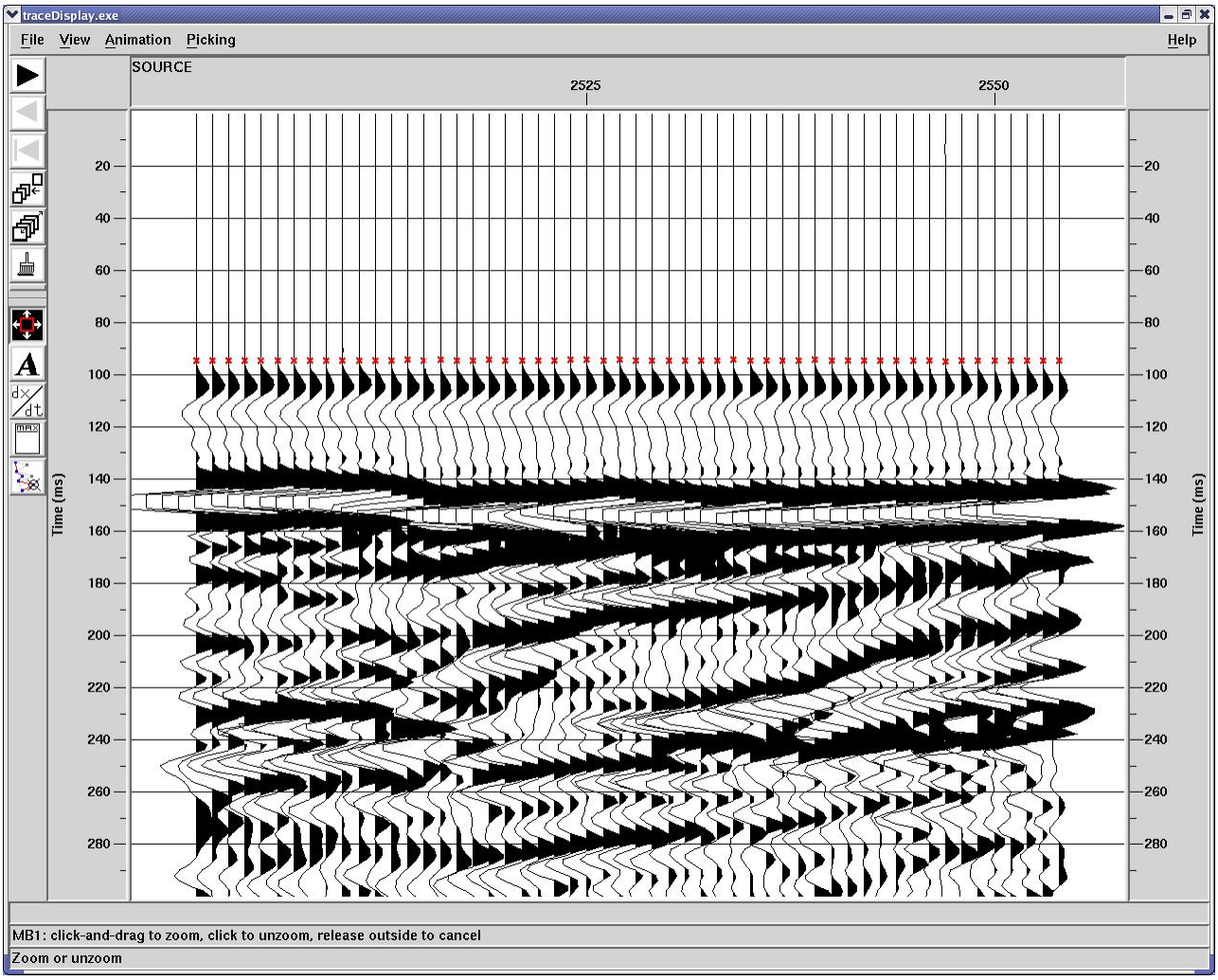


Figure 21-13: Navigation QC display.

22. Encountered problems

22.1. Swell noise

Weather conditions over the survey period were varied. In general, the weather was good, with swell heights less than 2m.

Swell bursts were seen on the raw shot records, typically affecting less than 10% of the traces, usually at a level below 25ub. Because of the high fold of coverage, this noise invariably stacked out, even with no noise attenuation processes applied to the data.

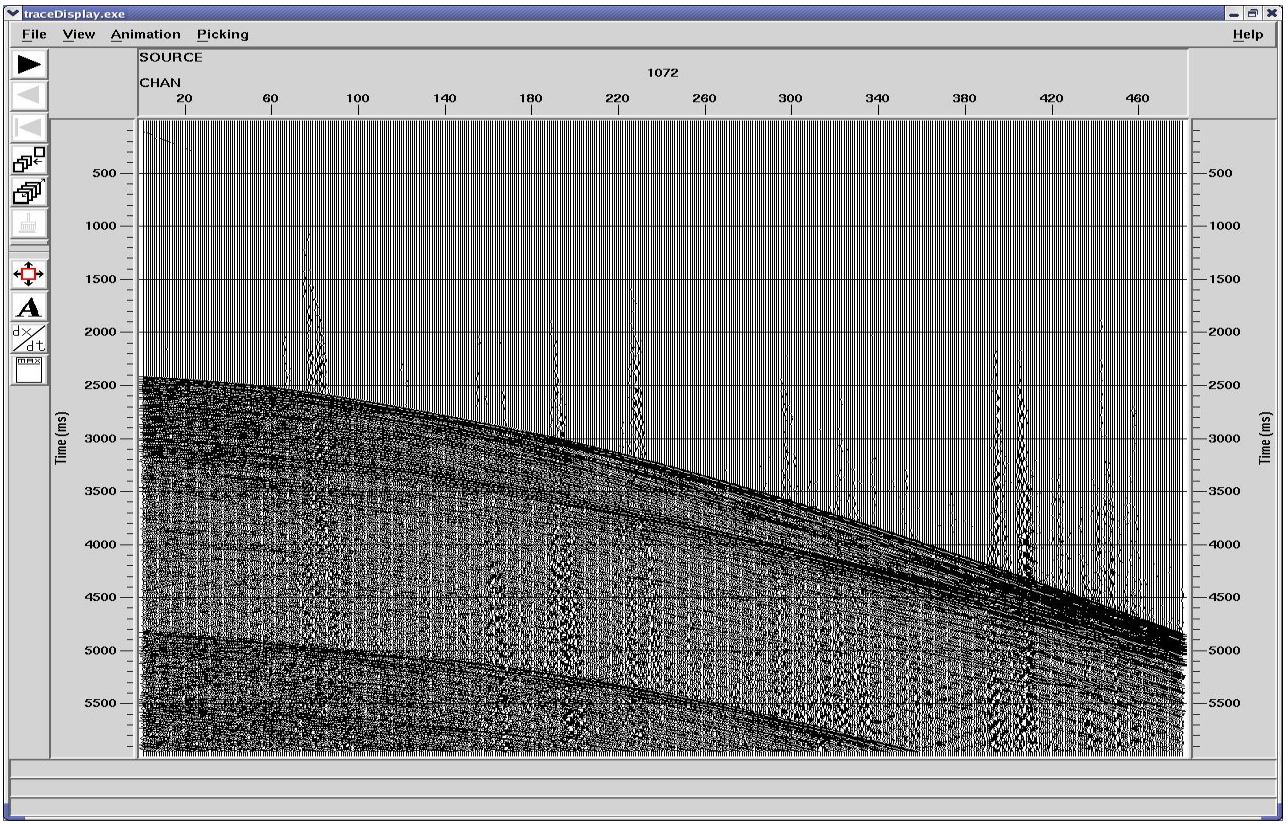


Figure 22-1: Shot gather of SP 1072 for seq. 019. Swell noise affecting approx 10% of traces is evident.

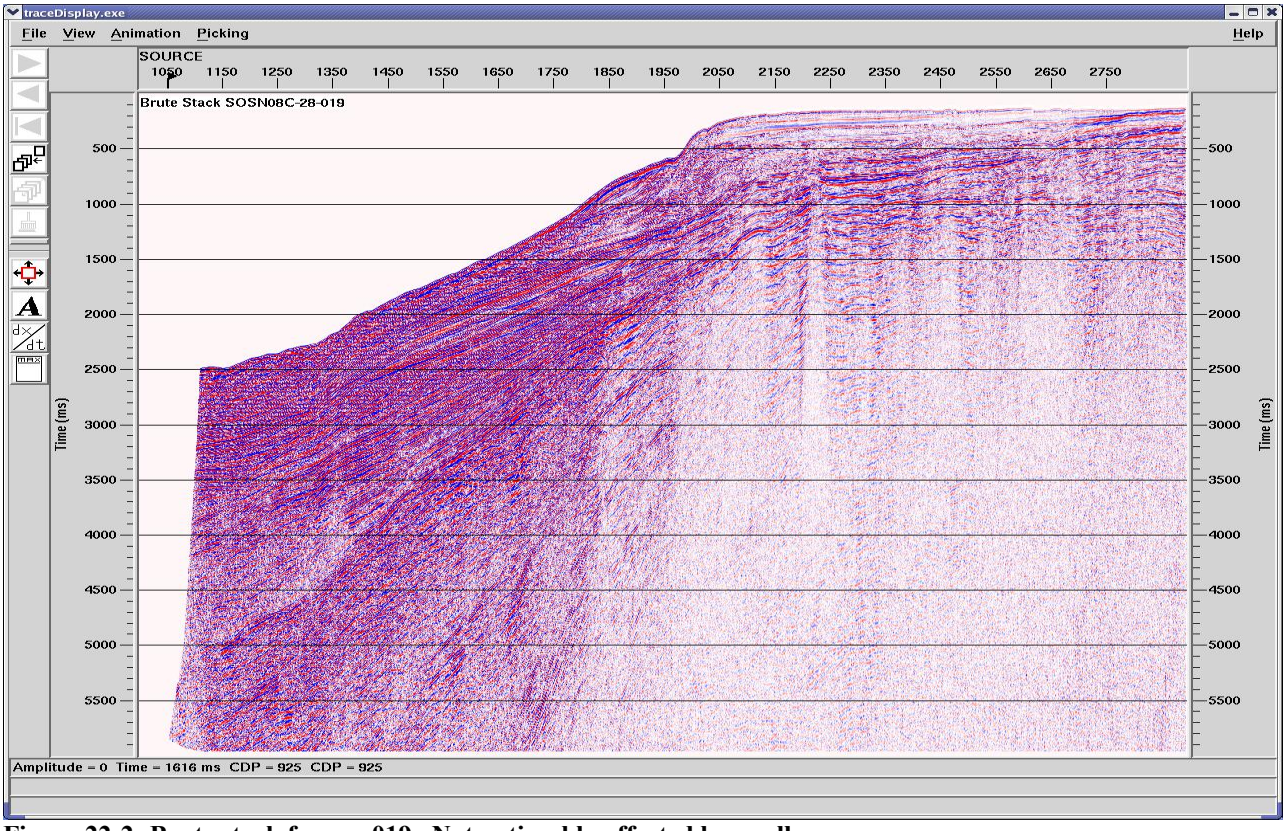


Figure 22-2: Brute stack for seq 019. Not noticeably affected by swell.

22.2. Autofires/misfires

Overall, the guns performed well during the period of acquisition. Processing QC confirmed the guns' performance. Autofires, misfires and air pressures were closely monitored. Ocassionally gunlink flagged shots with uncomplete or missing headers as autofires, which was closely investigated to ensure correctness. Gun delta errors, missing headers etc were marked both in the Observer Logs and in the QC logs.

The QC procedures in place to check for autofires and other gun problems are descibed in section 21.11.

Seq	Line	Bad Shots: MSP - missed SP (not fired); REC - not recorded SP or bad due to recording system; GAF - gun autofire; GTE - gun timing error >1.5ms; NOR - noise on record out of specs; NAV - nav error or missing nav header; SE - spread error
1	SOSN08C-01-001	INC HEADER: 1543,1550,1580,2680 MSP: 2002,2009 SE: 2185,2186,2187 GTE: 2194,2195
2	SOSN08C-03-002	NO HEADER: 1744,1951,2482,2770 SE: 1744,1951,2117,2118,2770
3	SOSN08C-05-003	NO HEADER: 1983,2017
4	SOSN08C-07-004	MSP: 1512,1517,1519,1520,1521,1534,1535,1536,1537 SE: 1538,1539,1540
5	SOSN08C-09-005	NO HEADER: 1887
6	SOSN08C-11-006	MSP: 1231 NO HEADER: 1643,2050,2263
7	SOSN08C-13-007	NO HEADER: 1192, 2238
8	SOSN08C-15-008	NO HEADER: 1350,1659,1928
9	SOSN08C-17-009	INC HEADER: 1044,1468,1538,1774
10	SOSN08C-19-010	NO HEADER: 1118
11	SOSN08C-21-011	NO HEADER: 1325,1923,1994,2340,2491,2503
12	SOSN08C-23-012	
13	SOSN08C-23-013	
14	SOSN08C-23-014	
15	SOSN08C-23-015	
16	SOSN08C-23-016	NONE
17	SOSN08C-23-017	NO HEADER: 1425,1747
18	SOSN08C-27-018	NO HEADER: 1453,1721,1904
19	SOSN08C-25-019	NO HEADER: 1151,1818,2190 MSP: 1447
20	SOSN08C-02-020	NO HEADER: 1171,1449,1876,2274,3427,3432,3487,3498
21	SOSN08C-04-021	NO HEADER: 1441,2119,2473,2595,2980 MSP: 3443
22	SOSN08C-06-022	NO HEADER: 1207,1558,2460,3903,4041,4093,4132,4676,4991,5437, MSP: 4462

Figure 22-3: Shot edits section of the QC log listing bad shots.

22.3. Turn noise

On occasion the streamer was still in turn when the SOL noise files were recorded, due to the line run-in being constrained by safe navigation areas, with associated noise up to 150ub. Notes regarding the sequences affected can be found in the QC logs.

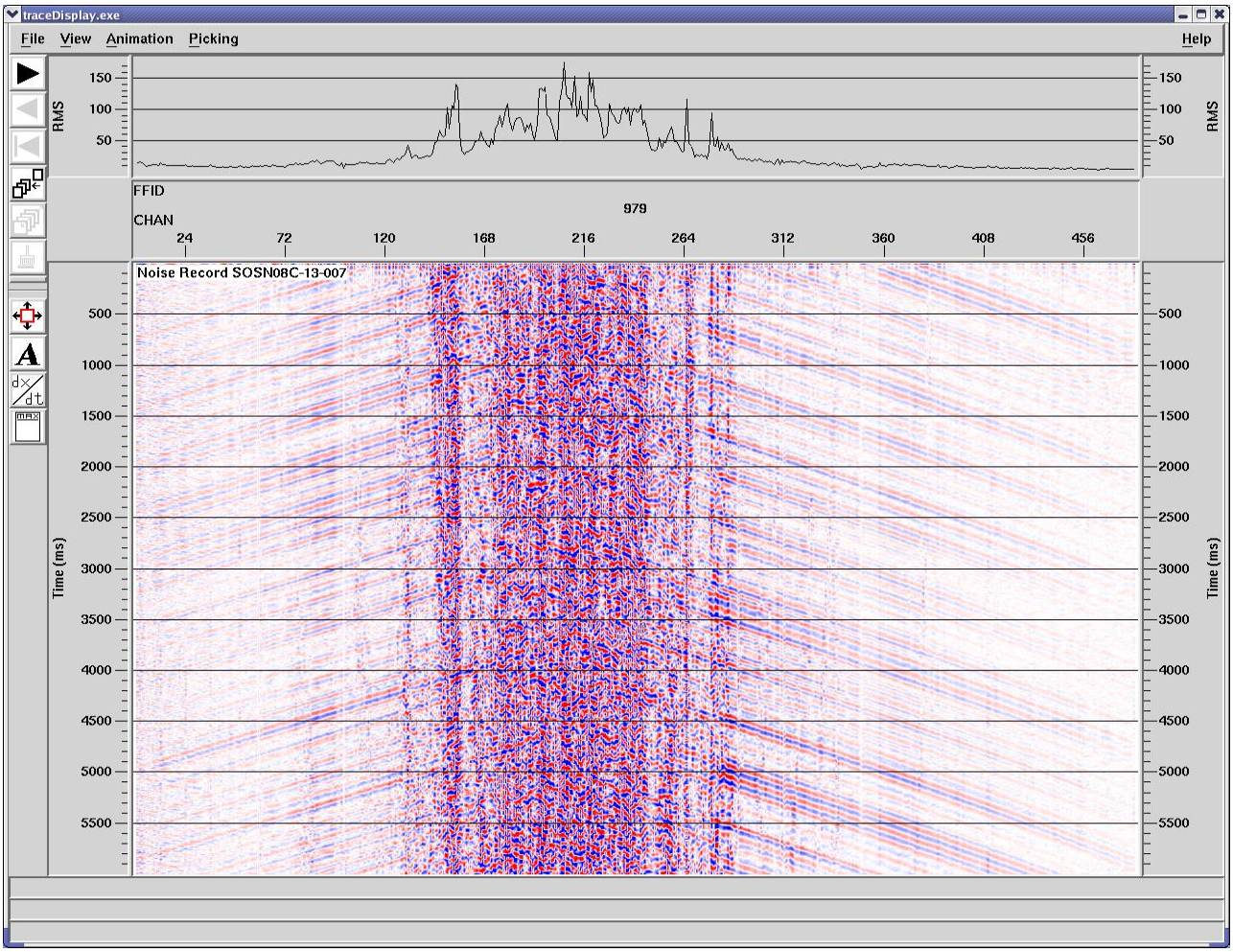


Figure 22-4: SOL noise display of sequence 007. Streamer still in turn while SOL noise records were taken.

22.4. Reflection energy

In the prospect area residual energy extending into the next shot was occasionally observed. This resulted in increased RMS.

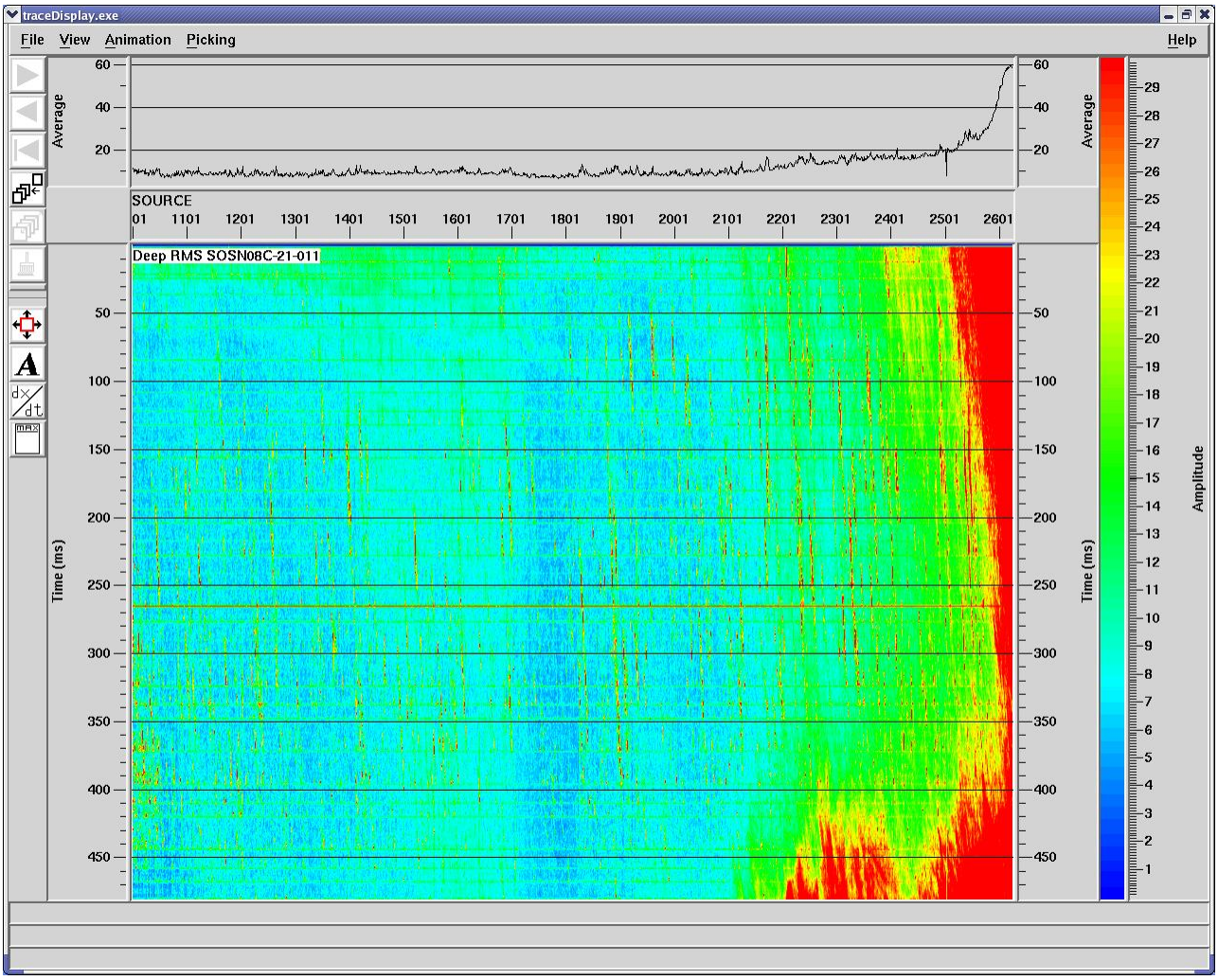


Figure 22-5: Residual reflection's energy on deep RMS shot vs. channel screen display of sequence 011.

22.5. Spiky Channels

The number of bad channels was less than 1.5% for the entire survey. Only one channel was strongly spiky.

reversed polarity
fails instrumentation tests
noisy
spiking

for more detailed info, see OBSERVER LINE LOGS

	channel																Q
seq001	21	59			181		242	265	277	337							7
seq002	21	59			181		242	265	277	337							7
seq003	21	59			181		242	265	277	337							7
seq004	21	59			181			265	277	337							6
seq005	21	59			181			265	277	337							6
seq006	21	59			181			265	277	337							6
seq007	21	59			181			265	277	337							6
seq008	21	59			181	190		265	277	337							7
seq009	21	59			181	190		265	277	337							7
seq010	21	59			181	190		265	277	337							7
seq011	21	59			181	190		265	277	337							7
seq012																	
seq013																	
seq014																	
seq015																	
seq016	21	59	91	150						337							5
seq017	21	59	91	150						337							5
seq018	21	59	91	150						337							5
seq019	21	59	91	150						337							5
seq020	21	59	91	150						337							5
seq021	21	59	91	150			242			337							6
seq022	21	59	91	150			242			337							6

Figure 22-6: Channel edits section of QC log listing bad channels.

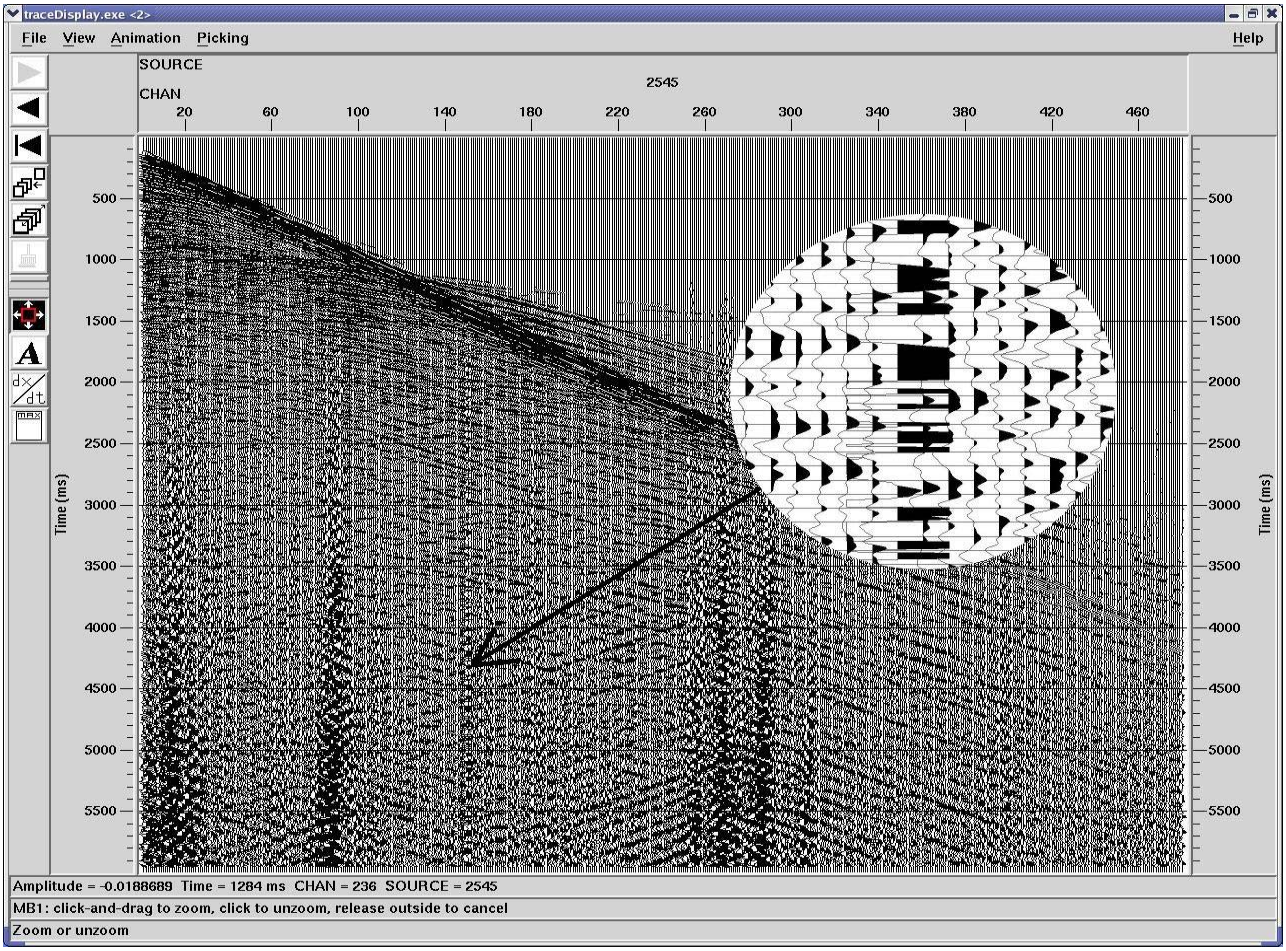


Figure 22-7: Shot gather of SP 2545 for seq. 017. Note spiky channel 150.

22.6. Noise history display

The following display shows the noise record history for all sequences, calculated from the SOL and EOL noise files.

All channels for each noise record have been stacked together to a single trace, and these average channel values are annotated above the display.

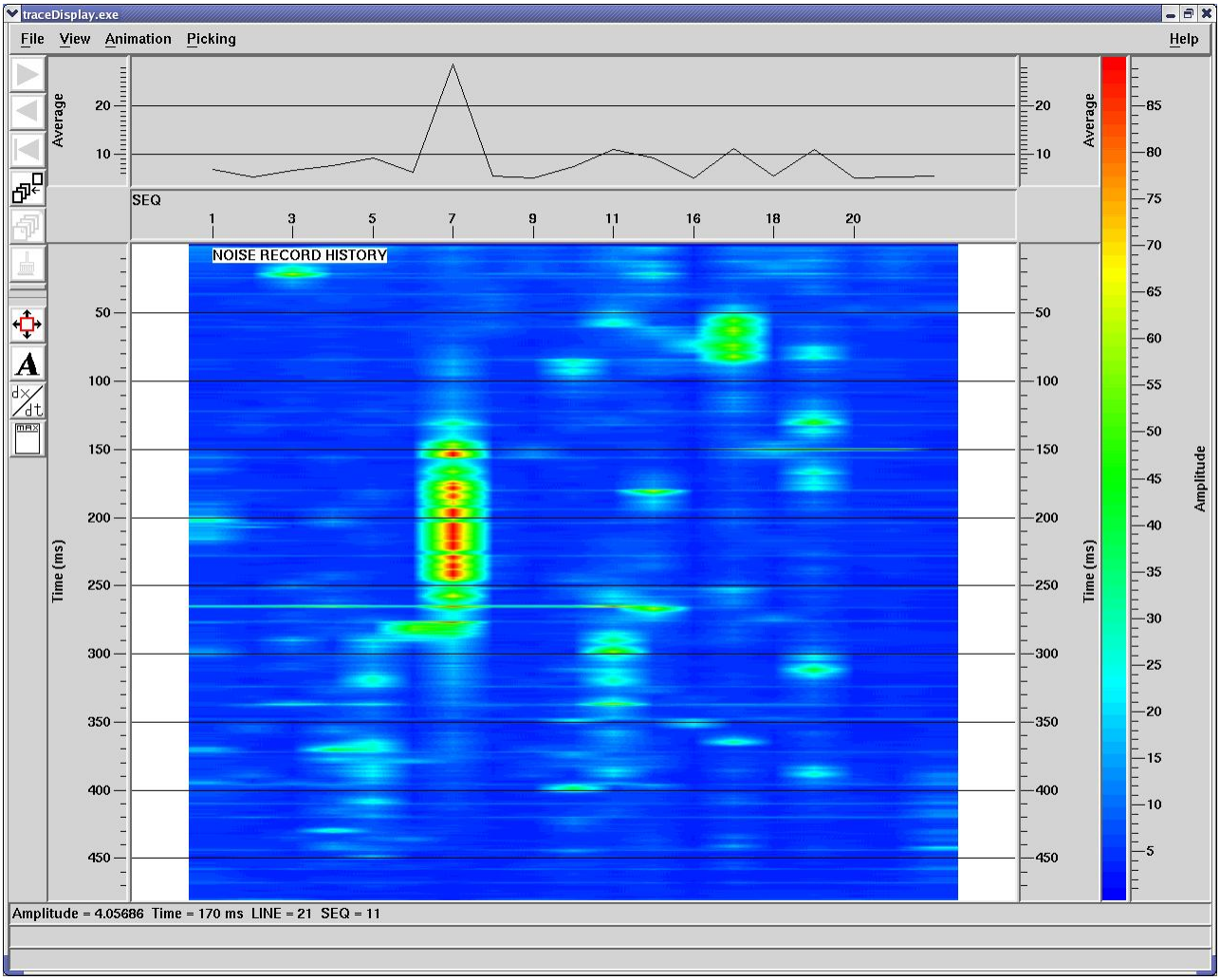


Figure 22-8 : Noise history display for Sequences 001 to 022.

22.7. RMS history displays

The following display shows the line average RMS for each individual channel on the streamer for Sequences 001 to 022, calculated from the shallow RMS window at 50 to 500 ms.

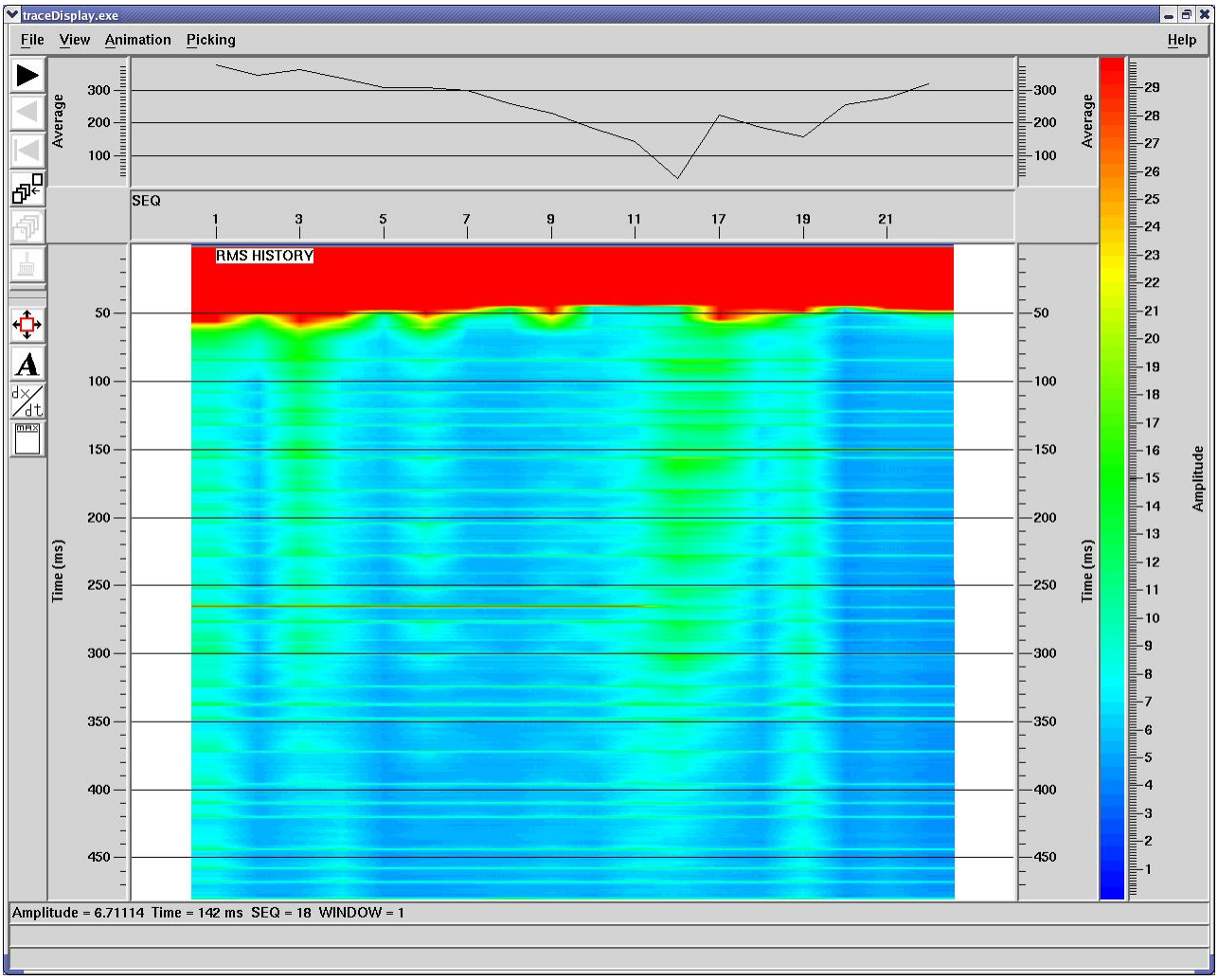


Figure 22-9: Shallow RMS history display for sequences 001 to 022. Showing some sequences affected by low amplitude swell noise and the first 50 channels dominated by direct arrival energy.

The following display shows the line average RMS for each individual channel on the streamer for Sequences 001 to 022, calculated from the deep RMS window at 5450 to 5950 ms

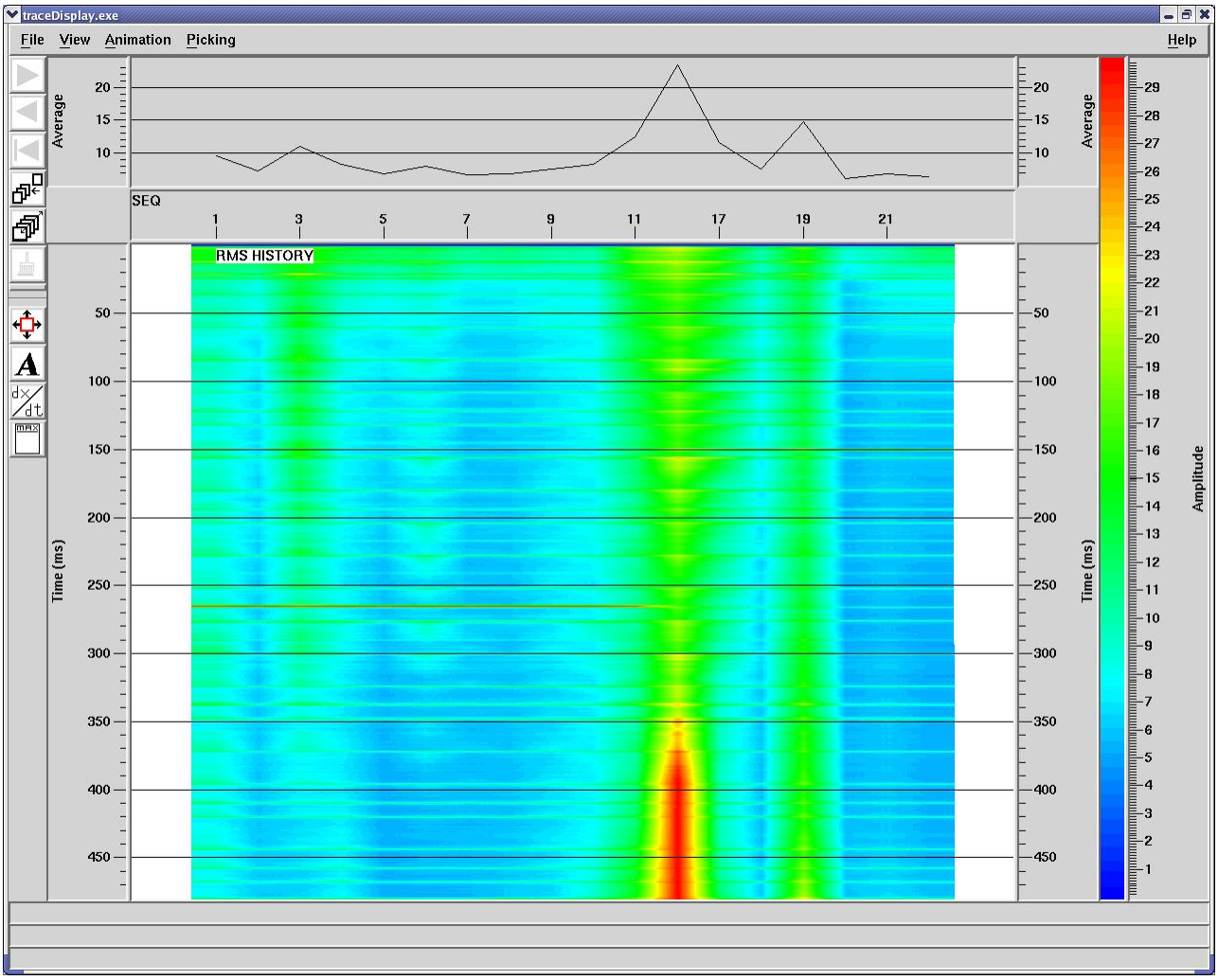


Figure 22-10 History of deep RMS window. Showing some sequences affected by low amplitude swell noise and residual energy.

.

23. Conclusion

Overall the data recorded on this survey was of good quality, helped by good acquisition conditions with low extraneous noise levels.

A total of 22 sequences were shot, all of good quality.

Some swell noise was evident, although of low amplitude and affecting few traces. This noise did not affect the brute stacks significantly.

The number of bad channels was less than 1.5% for the entire survey.

The brute stacks showed good data quality and contained dipping surfaces, diffractions and multiples and good evidence of the captured geology including anticline structures and faulting planes.

Signal penetration was good for the top half of the record, but poor beyond this, probably as a result of the high reflectivity of the intermediate layers. Strong multiples were observed.

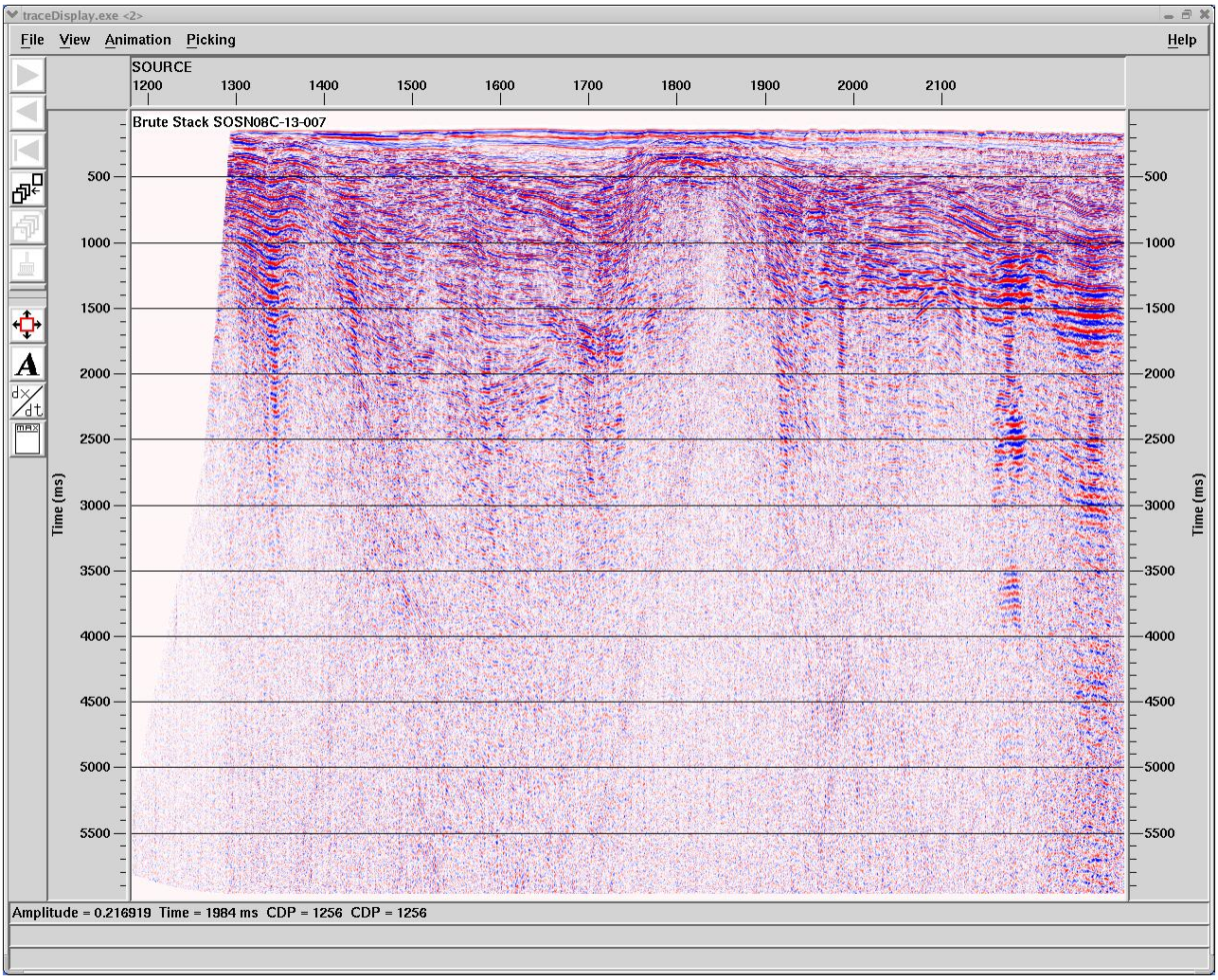


Figure 23-1: Brute stack of sequence 007.

A QC log in Excel format detailing quality control analysis of each line was delivered to the client at the completion of the survey.

Seq	Line	SHOTS	STACK
1	SOSN08C-01-001	Av. Ambient RMS: 6.9µb	Good clean stack
2	SOSN08C-03-002	Av. Ambient RMS: 5.4µb	Good clean stack
3	SOSN08C-05-003	Av. Ambient RMS: 8.4µb	Good clean stack
4	SOSN08C-07-004	Av. Ambient RMS: 7.1µb	Good clean stack
5	SOSN08C-09-005	Av. Ambient RMS: 7.7µb	Good clean stack
6	SOSN08C-11-006	Av. Ambient RMS: 6.3µb	Good clean stack
7	SOSN08C-13-007	Bend noise exceeding 150µb in mid-cable SOL. Av. Ambient RMS: 20.6µb	Good clean stack
8	SOSN08C-15-008	Av. Ambient RMS: 5.8µb	Good clean stack
9	SOSN08C-17-009	Av. Ambient RMS: 5.7µb	Good clean stack
10	SOSN08C-19-010	Av. Ambient RMS: 6.9µb	Good clean stack
11	SOSN08C-21-011	Bend noise up to 100µb in mid-cable SOL. Average ambient RMS of 9.8µb.	Good clean stack
12	SOSN08C-23-012	NTBP	NTBP
13	SOSN08C-23-013	NTBP	
14	SOSN08C-23-014	NTBP	
15	SOSN08C-23-015	NTBP	
16	SOSN08C-23-016	Av. Ambient RMS: 6.3µb	Good clean stack
17	SOSN08C-23-017	Av. Ambient RMS: 5.8µb	Good clean stack
18	SOSN08C-27-018	Av. Ambient RMS: 9.0µb	Good clean stack
19	SOSN08C-25-019	Av. Ambient RMS: 8.5µb. Swell noise up to 20µb affects the line from SOL to SP 1600.	Good clean stack
20	SOSN08C-02-020	Av. Ambient RMS: 5.7µb	Good clean stack
21	SOSN08C-04-021	Av. Ambient RMS: 5.4µb	Good clean stack
22	SOSN08C-06-022	Av. Ambient RMS: 5.5µb	Good clean stack

Figure 23-2: Quality section of QC log.

24. Appendices

24.1. SEGY Brute Stack Headers

The following SEGY Stacks EBDIC header template was used. Items marked in **bold** differ from line to line.

C 1 CLIENT: SEBOA CONSORTIUM COMPANY: CGG VERITAS
C 2 SURVEY: GROUP SHOOT 2D AREA: EAST BASIN, OFFSHORE AUSTRALIA
C 3 **SOSN08C-xx-xxx** SP: **xxxx-xxxx** CDP: **xxxx-xxxx**
C 4 DATA TRACES/STREAMER: 480 AUXILIARY TRACES/RECORD: 30
C 5 SAMPLE RATE: 2MS RECORD LENGTH: 6000ms
C 6 RECORDING FORMAT: SEG-D 8058 REV 100 FILTERS: DIGITAL LOW CUT: ON
C 7 ANALOG LOW CUT: 3 HZ 6 DB/OCTAVE HIGH CUT: 200 HZ 370 DB/OCTAVE
C 8 STREAMER: SERCEL SEAL SOLID ACTIVE LENGTH: 6000 M
C 9 GROUP INTERVAL: 12.5 M DEPTH: 8 M
C10 SOURCE TYPE: BOLT AIRGUN VOLUME: 2130 CU IN
C11 NO OF SUB ARRAY/SOURCE: 3 SUB ARRAY SEPARATION: 10 M
C12 ARRAY PRESSURE: 2000 PSI ARRAY DEPTH: 6 M
C13
C14 SEGY HEADER BYTES
C15 Water Depth 185-188
C16 Line Number 189-192
C17 Cable 193-194
C18 Gun Sequence 195-196
C19
C20 SP ANNOTATED AT NEAR TRACE CDP
C21
C22 PROCESSING:
C23
C24 REFORMAT - SEGD TO PROMAX FORMAT
C25 INSTRUMENT DELAY -50ms
C26 SHOT AND CHANNEL EDITS BASED ON OBSERVER LOGS
C27 BANDPASS FILTER, ORMSBY 6-8-90-120 HZ
C28 RESAMPLE 2ms TO 4ms. HIGH FIDELITY ANTIALIAS FILTER
C29 TRACE DECIMATION, 2:1, USING SINGLE NMO FUNCTION
C30 TAR - T**2 CORRECTION
C31 NMO, VELOCITIES PICKED AT 4 KM INTERVALS
C32 CDP STACK, STRAIGHT MEAN SQUARE ROOT NORMALIZATION
C33 GUN & CABLE STATIC 9ms
C34
C35 CDP INTERVAL 12.5 METRES
C36
C37
C38 MARCH 2008

24.2. Shipments

QC deliverables were included in the Primary and Copy Tape Shipments. The following QC products were shipped to the client at the end of the survey:

Shipment No: PT-2008-021

Date: 2nd. April 2008

Contents cover Sequences: 1 to 22

1 x CD containing SEG-Y Stack files (CGM format), various QC screen displays (JPG format), velocities (ASCII format) and ambient noise (ASCII format) files.

Shipped to:

Fugro Seismic Imaging
69 Outram Street
West Perth
WA, 6005
Australia

Attn: Phil Cook

Shipment No: PT-2008-022

Date: 2nd. April 2008

Contents cover Sequences: 1 to 22

1 x CD containing SEG-Y Stack files (CGM format), various QC screen displays (JPG format), velocities (ASCII format) and ambient noise (ASCII format) files.

Shipped to:

Operations Geophysics
Santos Ltd
c/- Toll Priority
Basement, 191 Pultney Street
Adelaide, SA, 5000
Australia
Attn: Nick Papanicolaou

24.3. QC Line log

A QC log was maintained for the duration of the project to keep track of the workflows being run, shot edits, problems encountered and any processing comments. This log file has been written to DVD, and was included in the final data shipment to the client.

Client: SEBOA Consortium Members **ProMAX QC Log**

Project: SEBOA 2D **Area: East Basin, Offshore Australia** **Start Date: 03 March 2008**

Seq	Line	Date	Dir	FCSP	LCSP	no. of SPs	no. of CDPs	SEG-D Input	Noise Records	Raw Shot Display	Auxiliary QC	RMS Display Shallow	RMS Display Deep	2D Geometry	Pick WB Times	Database	Near Trace QC	Trace Decimation	Stack RMS	Velocity Analysis	Channel Stack	Shot Stack	NMO QC	Brute Stack	Plot Stack	Archive Stack & Vel	Vels to Ascii	RMS Archive	SEG-Y Stack	FTP P190	P190 merge / QC	FTP JPGs	Notes
001	SOSN08C-01-001	4-Mar	238°	1001	3049	2049	4336	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	6/3	5/3	5/3	6/3	6/3	6/3	6/3	6/3	5/3	6/3	5/3	5/3	6/3	Complete, LCSP changed from 3169 after QC finished, hydrophone 26 dead, 27, 30 reversed
002	SOSN08C-03-002	5-Mar	058°	1001	2884	1884	4006	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	6/3	6/3	6/3	6/3	5/3	6/3	5/3	5/3	6/3	Complete, LCSP changed from 3004 after QC finished, hydrophone 26, 27 dead
003	SOSN08C-05-003	5-Mar	238°	1001	2492	1492	3222	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	5/3	6/3	5/3	5/3	6/3	6/3	6/3	6/3	6/3	5/3	6/3	6/3	6/3	6/3	Complete, LCSP changed from 2612 after QC finished, hydrophone 26 dead
004	SOSN08C-07-004	5-Mar	058°	1001	2440	1440	3118	5/3	6/3	5/3	5/3	6/3	6/3	5/3	5/3	5/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	Complete, LCSP changed from 2560 after QC finished, hydrophone 26 dead
005	SOSN08C-09-005	5-Mar	239°	1001	2211	1211	2660	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	Complete, LCSP changed from 2331 after QC finished, hydrophone 26 dead
006	SOSN08C-11-006	6-Mar	062°	1001	2310	1310	2858	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	Complete, LCSP changed from 2310 after QC finished, hydrophone 26 dead
007	SOSN08C-13-007	6-Mar	242°	1183	2186	1004	2246	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	7/3	Complete, hydrophone 26 dead
008	SOSN08C-15-008	6-Mar	065°	1001	2016	1016	2270	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	7/3	6/3	6/3	7/3	Complete, hydrophone 26 dead
009	SOSN08C-17-009	6-Mar	245°	1001	1979	979	2196	6/3	7/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	6/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	Complete, hydrophone 26 dead
010	SOSN08C-19-010	7-Mar	065°	1001	1975	975	2188	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	Complete, hydrophone 26 dead
011	SOSN08C-21-011	7-Mar	245°	1001	2624	1624	3486	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	7/3	Complete, hydrophone 26 dead
012	SOSN08C-23-012																																NTBP
013	SOSN08C-23-013																																NTBP
014	SOSN08C-23-014																																NTBP
015	SOSN08C-23-015																																NTBP
016	SOSN08C-23-016	9-Mar	062°	1001	1371	371	980	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	Incomplete, line aborted early d/t whale sighting
017	SOSN08C-23-017	9-Mar	062°	1372	2554	1183	2604	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	this line only: hydrophones 25-30 are gunstr 2, gunstr 3 no hydrophone data available
018	SOSN08C-27-018	9-Mar	245°	1001	1979	979	2196	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	9/3	hydrophone 19 suspected leakage, 20, 21 no signal, 27, 29 killd d/t leakage
019	SOSN08C-25-019	10-Mar	062°	1001	2774	1774	3786	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	Complete, hydrophone 20,21 no signal
020	SOSN08C-02-020	10-Mar	328°	1001	3596	2596	5430	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	10/3	11/3	10/3	10/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	Complete, hydrophone 20,21 no signal
021	SOSN08C-04-021	10-Mar	147°	1001	3554	2554	5346	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	Complete, hydrophone 20,21 no signal
022	SOSN08C-06-022	11-Mar	337°	1001	5723	4723	9684	11/3	12/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	11/3	12/3	12/3	12/3	12/3	12/3	12/3	12/3	12/3	12/3	12/3	12/3	12/3	12/3	12/3	Complete, hydrophone 20,21 no signal

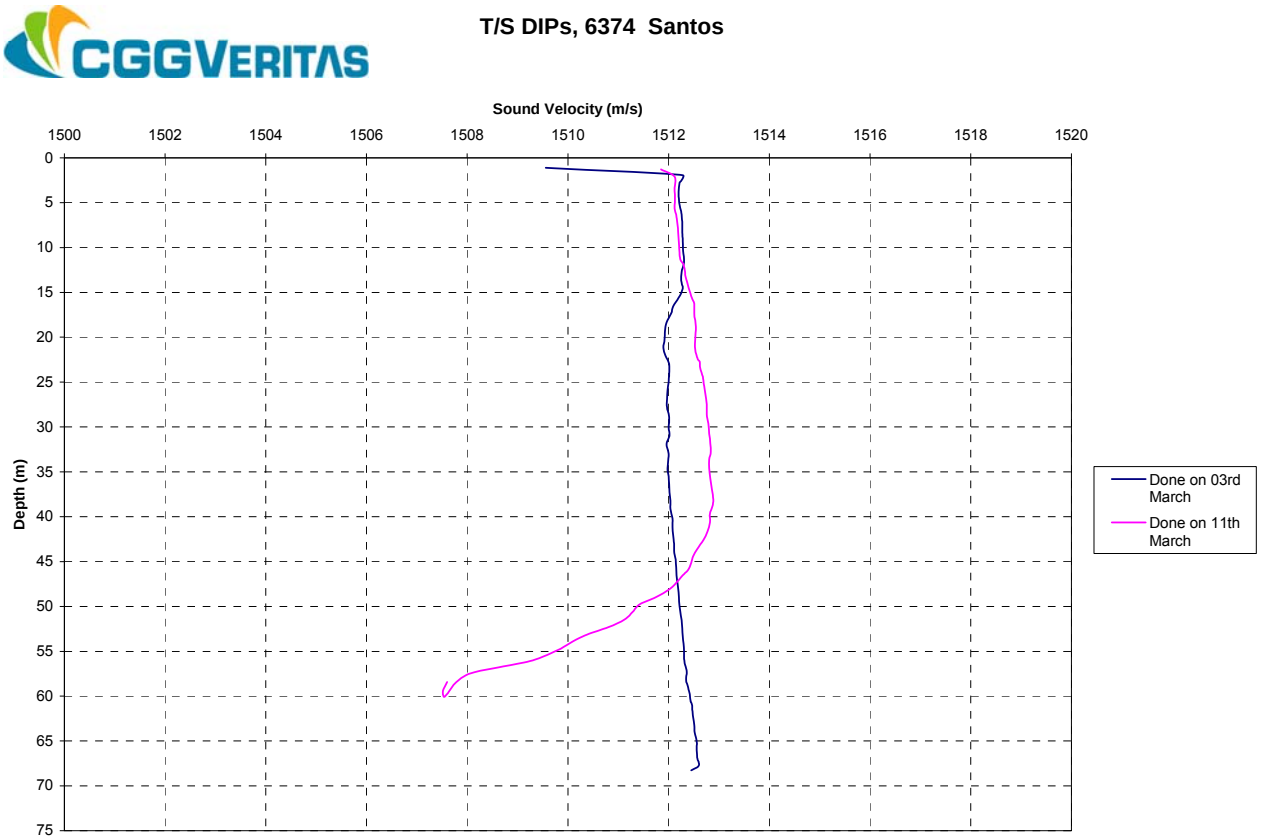
Figure 24-1: QC processing part of the QC log detailing processing applied on a line-by-line basis.

Appendix 0 Hydrographical Data Graph

Conductivity, pressure and temperature profiles are gathered using a (TS) Dips. Data and location information are included in the Supporting Documents section of the CDROM.
Data from the Temperature and Salinity (TS) Dips are used to verify the water speed, which is continuously measured while recording data. Two TS Dip measurements were taken during the survey.

Position	
Lat	040° 33' 44" S
Long	144° 20' 10" E
Date:	03rd March 08
Time:	16:55 GMT
	03:55 Local Time
1512.16	Mean Velocity on deploy
1512.20	Mean Velocity on recovery
1512.18	Mean Velocity

Position	
Lat	040° 42' 30" S
Long	143° 54' 06" E
Date:	11th March 08
Time:	11:16 GMT
	22:16 Local Time
1511.73	Mean Velocity on deploy
1512.09	Mean Velocity on recovery
1511.91	Mean Velocity

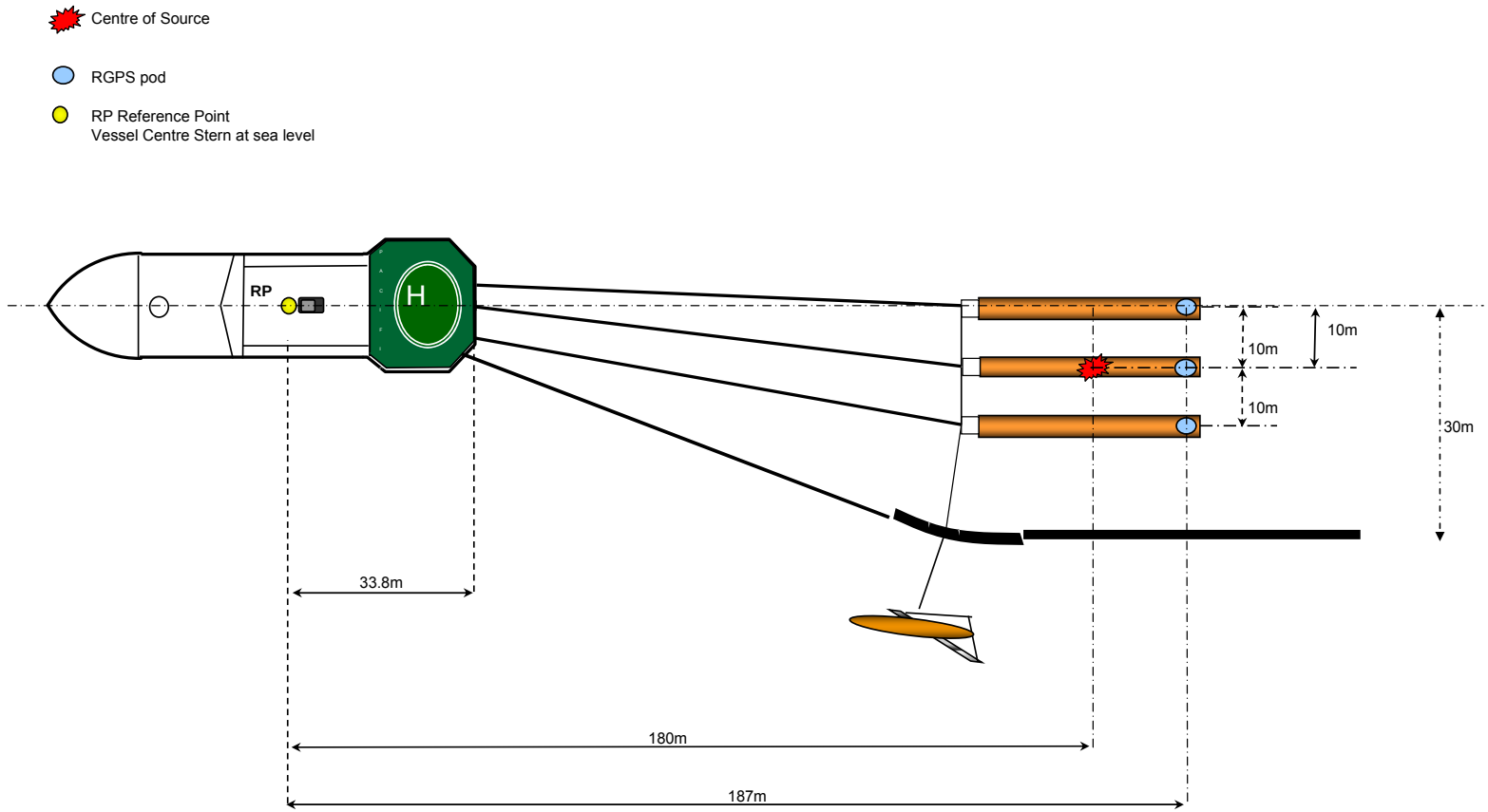


Appendix 1 Navigation Systems & Diagrams

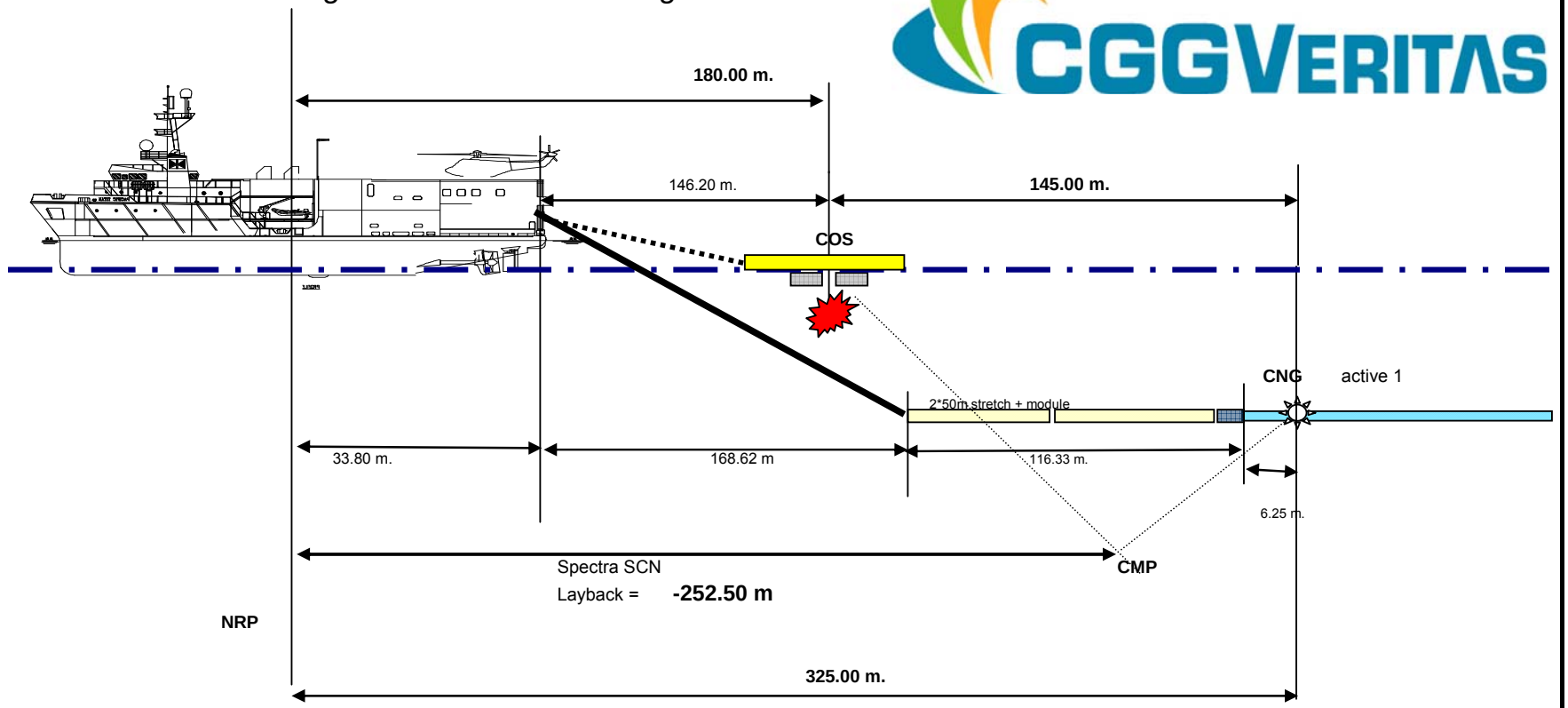
DGPS Reference Stations

WGS84				
Ref. St. Name	**No.**	**Latitude**	**Longitude**	**Height (m)**
Brisbane	275	027° 28’ 38.488’’S	153° 01’ 37.352 ’’E	93.14
Bathurst	336	033° 25’ 46.879’’S	149° 34’ 01.969’’E	756.66
Ceduna	355	032° 07’ 03.049” S	133°41’22.851 “ E	7.27
Corbar	316	031° 29’ 57.430’’S	145° 50’ 20.346 ’’E	270.17
Melbourne	385	037° 47’ 59.264“ S	144° 57’ 39.311” E	67.33

Pacific Titan
General Towing arrangement



M/V Pacific Titan Towing Dimensions/Offset Diagram

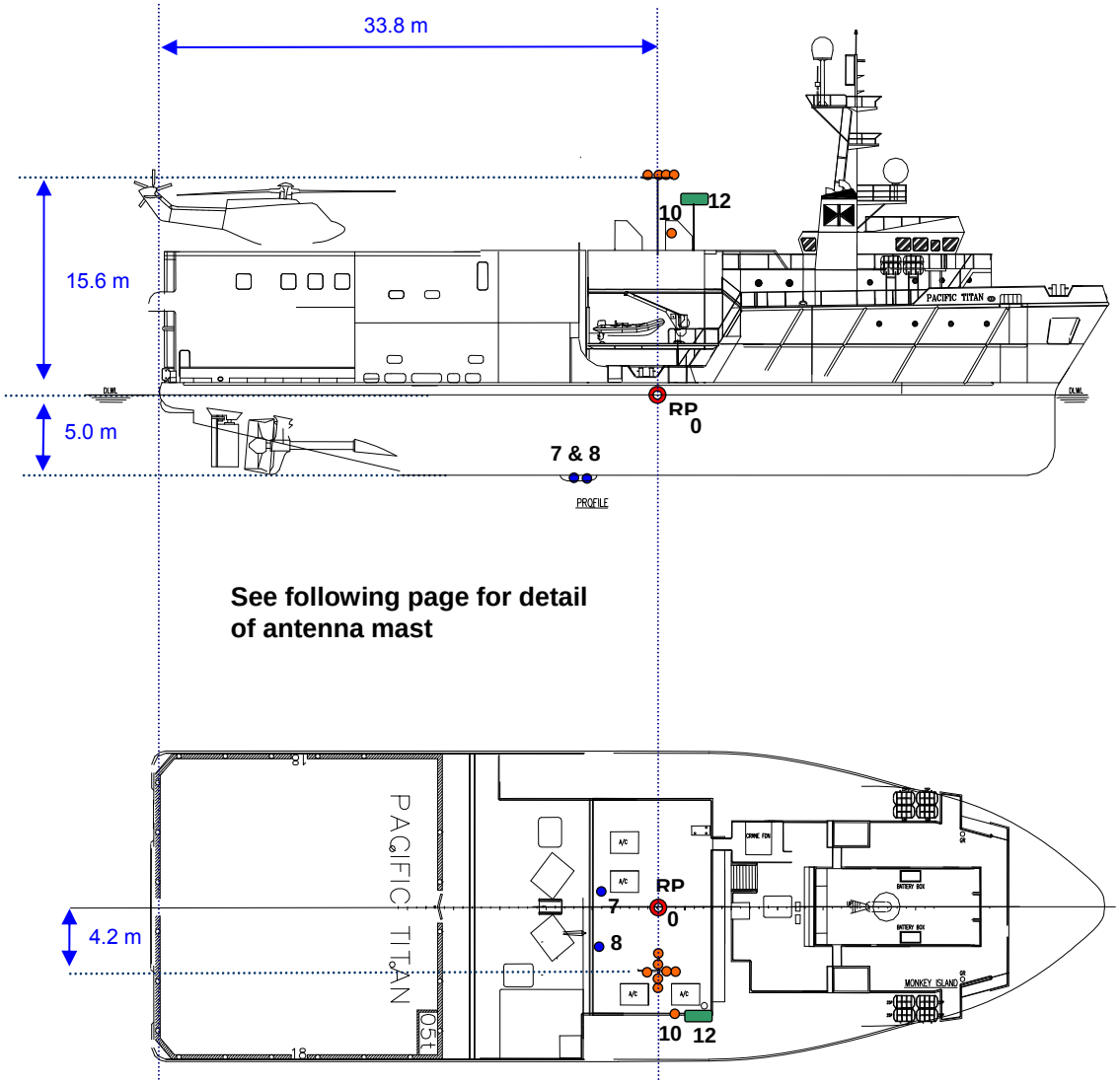


Principal Distances:			Principal Offsets:		Used as:
NRP-Stern	33.80 m.		COS-CNG	145.00 m.	
Stern-COS	146.20 m.		**NRP-CMP**	**-252.50 m**	**Spectra SCN Layback**
Stern-CNG	291.20 m.				
NRP-COS	**180.00 m.**		**NRP-CNG**	**325.00 m.**	**Offset from NRP**

Centre near group derived from Seal manuals = 6.25m from coupling

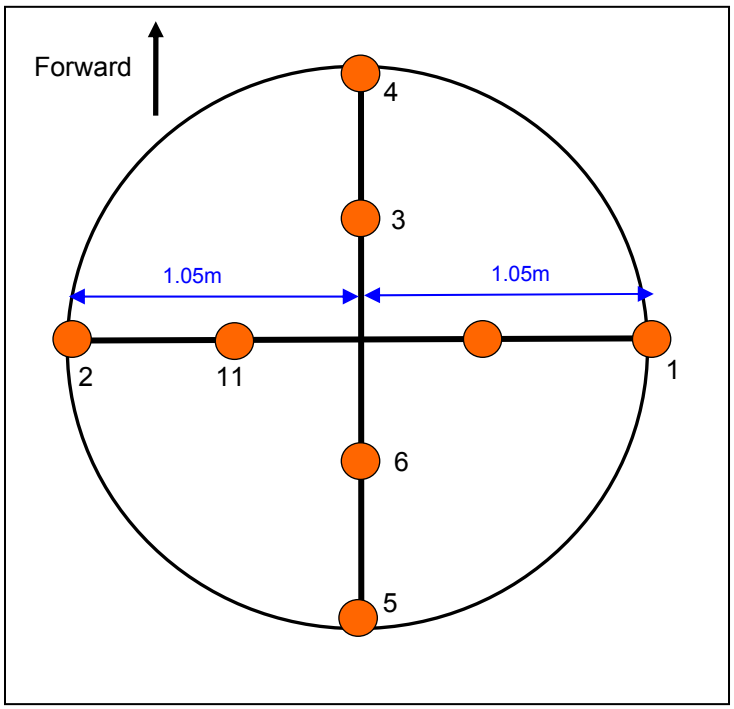
Key:	
NRP	Navgation reference point (centre of mast @ sea level)
COS	Centre of source
CNG	**Centre of near group (Trace # 001)**
CDP	Common depth point
NTRP	Near trace reflection point

Antenna Offsets



No	Spectra ID	X	Y	Z	Description	Cable Id
0	**V1**	0	0	0	Vessel ref point	
		0	-33.8	0	Vessel centre Stern from ref point	
1	**V1G1,V1G5**	5.25	0	15.6	SPM1 XP,HP. Alison 940D	2 Red Rings
2		3.15	0	15.6	Alison 940D	5 Red Rings
3					motorola UHF Radio antenna	
4	**V1G2, V1G3, V1G4**	4.2	**1.05**	15.6	SPM2 XP,HP Multifix. Alison 940D	3 Red Rings
5					Seatex Yagi VCU, UHF antenna	4 Red Rings
6					Seatex Omni VCU, UHF antenna	1 Red Ring
7	**V1E1**	-1.3	-5.8	-5	Simrad EA 600, 200kHz tranceducer	
8	**V1E2**	1.5	-6.1	-5	Simrad EA 600, 12kHz tranceducer	
9	**Speedlan**					
10	**Runt 1**				Trimble Bullet	
11					sailor VHF Antenna	2 Green Rings
12	**V1GY1**				Simrad GPS Gyro	

Detail of Antenna Mast



Appendix 2 Navigation Processing Log

CGGVERITAS

Navigation Processing Log

Client: Santos
Job: 6374
Area: Bass Strait, Australia T48P

Line Name	Seq	FOSP	FCSP	LSP	LOSP	Line Status	Processing Comments
SOSN08C-01-001	1		1001	3169		Complete	SP 1543, 2680 No E33 Record
SOSN08C-03-002	2		1001	3004		Complete	1744, 1951, 2482, 2770 No E33 records
SOSN08C-05-003	3		1001	2612		Complete	shot 1983 & 2017 No E33 record
SOSN08C-07-004	4		1001	2560		Complete	WARNING: shot 1172,1913,1983 No E33 record
SOSN08C-09-005	5		1001	2331		Complete	shot 1887 NO E33 record
SOSN08C-11-006	6		1001	2310		Complete	Warnings: shots 1231,1643,2050,2263 NO E33 record
SOSN08C-13-007	7		1183	2306		Complete	
SOSN08C-15-008	8		1001	2136		Complete	shot 1001,1350,1659,1928 No E33 record
SOSN08C-17-009	9		1001	2099		Complete	shot 1044, 1468, 1538, 1774 No E33 record
SOSN08C-19-010	10		1001	2095		Complete	WARNING: shot 1118 No E33 record
SOSN08C-21-011	11		1001	2744		Complete	WARNING: shot 1325 No E33 record WARNING: shot 1923 No E33 record WARNING: shot 1994 No E33 record WARNING: shot 2340 No E33 record WARNING: shot 2491 No E33 record WARNING: shot 2503 No E33 record
SOSN08C-23-012	12		1001	1342		NTBP	LINE DNP (8.5k of line was shot)
SOSN08C-23-013	13		1001	1349		NTBP	LINE DNP (8.5k of line was shot)
SOSN08C-23-014	14		1001	2674		NTBP	WARNING: shot 1174 No E33 record WARNING: shot 1645 No E33 record WARNING: shot 1929 No E33 record WARNING: shot 2034 No E33 record WARNING: shot 2567 No E33 record DGPS systems 2,3 and 4 KO'd in processing d/t a gap in data reception for 2 minutes. DGPS systems 1 and 5 uneffected and remained good
SOSN08C-23-015	15		1001	1263		NTBP	LINE DNP only 6.5K on line was shot
SOSN08C-23-016	16		1001	1371		Complete	WARNING: shot 1372 No E33 record

SOSN08C-23-017	17	1252	1372	2674	Complete	shot 1289, 1425, 1747 No E33 record
SOSN08C-027-018	18		1001	2099	Complete	shot 1453, 1721, 1904 No E33 record
SOSN08C-25-019	19		1001	2894	Complete	WARNING: shot 1151 No E33 record WARNING: shot 1447 No E33 record WARNING: shot 1818 No E33 record WARNING: shot 2190 No E33 record
SOSN08C-02-020	20		1001	3716	Complete	shot 1171, 1449, 1876, 2274, 3427, 3432, 3487, 3498 No E33 record
SOSN08C-04-021	21		1001	3674	Complete	WARNING: shot 1441 No E33 record WARNING: shot 2119 No E33 record WARNING: shot 2472 No E33 record WARNING: shot 2595 No E33 record WARNING: shot 2980 No E33 record WARNING: shot 3443 No E33 record
SOSN08C-06-022	22		1001	5843	Complete	shot 981,1207, 1558, 2460, 3903, 4041, 4093, 4132, 4466, 4991, 5437 No E33 record

Appendix 3 Calibrations and tests

Summary of Results for the Singapore Calibration Feb 2008-03-08

INTRODUCTION

Subsea 7 (Singapore) Pte Ltd was appointed by CGG Veritas to carry out the following services for their vessel, MV Pacific Titan at Loyang Jetty, Singapore on 6 & 11 February, 2008:

- Gyro Calibration
- DGPS System's Verification
- Tail Buoy System's Verification

The results are summarized as follow:

a) Gyro Calibration – 6 February 2008

Heading @ 134 deg		
System	C-O	Std Dev
Gyro AD 100	0.27 deg	0.05
Gyro HS 50	1.40 deg	0.35

b) DGPS System's verification – 6 February 2008

	Easting		Northing	
System	C-O	Std Dev	C-O	Std Dev
SPM1 XP	-0.57	0.05	-0.16	0.05
SPM2 HP	1.29	0.11	-0.14	0.05

c) DGPS' System's verification (re-carried out) – 11 Feb 2008

	Easting		Northing	
System	C-O	Std Dev	C-O	Std Dev
DG_V_XP_EXP	-0.48	0.03	0.26	0.04
SPM1_XP	-0.31	0.02	-0.06	0.01
SPM1_HP	0.47	0.05	-0.30	0.05
SPM2_XP	-0.50	0.05	0.28	0.05
SPM2_HP	1.26	0.09	-0.23	0.06

d) Tailbuoy System's verification – 6 Feb 2008

	Easting		Northing	
TB SERIAL #	C-O	Std Dev	C-O	Std Dev
1314	-0.70	0.73	-2.70	0.65
1411	-2.72	2.10	-0.27	1.34
2320	-1.67	1.13	-0.67	0.93
0869	-1.04	1.20	-0.17	0.93
1511	-1.23	1.49	-1.04	1.53
1320	-2.61	1.12	1.22	1.08

PROJECT DETAILS Client : CGG Veritas – Asia Pacific
9 Serangoon North Ave. 5
CGGVeritas Hub
Singapore 554531
Tel: +65 6723 5630
Fax: +65 6723 5552
Cell: +65 9186 3619

Contractor : Subsea 7 (Singapore) Pte Ltd
No 39 Tampines Street 92,
#02-00 2E Capital Building
Singapore 528883
Tel (Direct): +(65)-6785 4396 (Ext. 101) Tel (Mobile): +(65)-9146 1432 and
+(60) 12 7238452 Fax: +(65)-6260 4465

Project :
Gyro Calibration
DGPS System's Verification
Tail Buoy System's Verification
Vessel : MV Pacific Titan
Location : Laying Jetty, Singapore
Equipment : Nikon DTM-552 Total station
Personnel : Rolando Paguio (Surveyor)
Rostam Rosli
Date : 6 & 11 February 2008

3. SURVEY PROCEDURES

Survey origin at Loyang Jetty, Singapore
Three geodetic control stations were established on 21 December 2006 by Subsea7 (Singapore) Pte Ltd for the purpose of carrying out survey works for the vessel berthed at Loyang Jetty, Singapore .

The stations are:

Station	Easting	Northing	EL	Description
S1	385 112.540	152 940.435	4.694	nail
S2	385 104.607	152 963.277	4.714	nail
S3	385 082.549	153 024.532	4.676	nail

These stations were identified on the ground and their relative bearings and distances were checked prior to usage.

Current Survey

For this calibration, temporary stations TS1 and TS2 were established. TS1 was used as instrument station for carrying out DGPS/Tail Buoy system's verification while TS2 was used as instrument station for Gyro calibration on 6th Feb 2008.
Coordinates of stations TS1 and TS2 are as follow:

Station	Easting	Northing
TS1	385 108.610	152 951.442
TS2	385 105.024	152 959.150

Calibration Preliminaries

Prior to the calibration, the following were carried out:
- All mooring lines were tightened
- There was no heavy loading on the vessel
- The surveyor's time piece was synchronized with the vessel computer time
- All C-O were removed from the vessel's computers (i.e. logged raw data only)
- Advised the navigators to log onto the correct differential stations
- Advised the navigators to monitor the vessel's data when calibration is on-going

3.1 PRISM INSTALLATION

On 6th February 2008, the vessel's heading was 250º. At this direction, Gyro calibration, DGPS/Tail Buoy system's verification were carried out.
For gyro calibration, the bow and stern reflector was set up at the foremost part of the bow and stern of the vessel. Reflectors were also set up at SPM1 XP and SPM2 HP antennas for DGPS system's verification.

3.2 CALIBRATION/VERIFICATION PROCEDURES

Gyro Calibration

For Gyro calibration at 250º heading, total station was set up at temporary station TS2, and S3 was used as reference station. Grid bearings and horizontal distances were observed to the reflectors set up at the bow and stern of the vessel.
Simultaneously, a 3-second interval readings were being logged from the vessel's gyro while observations from total station were being carried out.

DGPS System's Verification

The total station was set up at temporary station TS1, and S3 was used as reference station. Grid bearings and horizontal distances were observed to the prism set up at SPM1 XP and SPM2 HP antennas.
3-second interval readings were then logged from the vessel while observations from total station were being carried out.
On 11th of February 2008, DGPS systems verifications were re-carried out. Same procedure was applied, but observations were done at different instrument station and reference bearing such as S2 and S3. Positions from XP EXP, SPM1 XP, SPM1 HP, SPM2 XP and SPM2 HP were simultaneously logged from the vessel while reflectors set up at DGPS antennas were being observed.

Tailbuoy System's Verification

Tail Buoy system's verification was carried out simultaneously with the DGPS verification. A known position was established using total station and from this position, 6 x rDGPS pods were set up and ranges and bearings relative to SPM1 XP antenna were logged at 3-second interval.

4. GEODETIC PARAMETERS

The survey work was computed based on the following geodetic and projection system.

Geodetic Reference System

Datum	WGS 84
Spheroid	WGS 84
Semi-major axis	6 378 137.0000 metres
Semi-minor axis	6 356 752.3142 metres
Inverse flattening	298.257 223 563 metres
Eccentricity	0.006 694 380

Projection Parameters

Grid	Universal Transverse Mercator (UTM)
Projection type	Transverse Mercator
Central Meridian	105º E
Latitude of origin	0º (Equator)
False Easting	500 000 metres
False Northing	0 metres
Scale factor on CM	0.9996

5. RESULTS

Gyro Calibration

The grid bearings derived from the observation of bow and stern reflectors were converted to true bearings. These were then compared with the ship's print out for AD 100 and HS 50 gyros to obtain the C-O corrections for 250º heading of the vessel.
The convergence at Station TS2 and S3 was computed to be minus 0.03 deg.
True Bearing = Grid Bearing Minus 0.03 º
All observed distances were converted to grid distances. The scale factor used was 0.9998798.

DGPS System's Verification

The observed grid bearings and distances from the reflectors set up at DGPS antennas were converted to easting and northing. These computed coordinates were then compared to the vessel's XP EXP, SPM1 XP, SPM1 HP, SPM2 XP and SPM2 HP easting and northing print outs to derive the C-O corrections.

Tailbuoy System's Verification

The observed ranges and bearings relative to SPM1 XP antenna were converted to easting and northing. The mean coordinates of each rDGPS pod were then compared to known established position to derive the C-O corrections for easting and northing.

Calibration undertaken in Balikpapan, Indonesia

1. ABSTRACT

Fugro Survey Pte Ltd through its subsidiary in Indonesia, PT Fugro Indonesia was contracted by Fugro Survey AS to carry out the following services for their survey vessel MV Pacific Titan at Semayang Wharf, Balikpapan, Indonesia on 07 up to 08th August 2007.

- DGPS System Verification
- Gyro Calibration
- Tail Buoys Verification

All co-ordinates quoted within this report are in metres and referred to WGS 1984 Spheroid and Datum

1.1 Summary of Results

The results are summarized and tabulated as follows:

a) DGPS System Verification

	Easting (m)		Northing (m)	
System	C - O	Std Dev.	C - O	Std Dev.
Port GPS Antenna	-1.4	0.4	1.6	0.2
Stbd GPS Antenna (Primary)	-1.4	0.4	1.6	0.1

b) Gyro Calibration

		Gyro 1 HS 50		Gyro 2 AD 100	
Cal. #	Heading	C - O	Std Dev.	C - O	Std Dev.
August 7	15.3	1.1	0.8	2.2	0.2
August 8	191.9	1.6	0.8	2.2	0.6
Mean		1.35	0.8	2.2	0.4

c) Tail Buoys System Verification

	Degrees °		*Distance (m)*	
System	Mean	Std Dev.	Mean	Std Dev.
Pod1260	3.19	1.76	-0.55	2.10
Pod1314	1.49	1.08	2.05	1.05
Pod1411	1.45	4.32	-1.96	0.98
Pod1503	-3.68	3.34	0.73	1.22
Pod1511	-0.56	4.07	1.91	2.85
Pod1518	0.82	0.33	0.32	0.38
Pod1575	1.33	1.69	1.14	0.71
Pod2041	-0.11	2.28	2.00	1.89

2. PROJECT DETAILS

Client	: Fugro Survey AS
Contractor	: FUGRO SURVEY Pte. Ltd.
Project	: Gyro Calibration, DGPS System and Tail Buoys Verification
Vessel / Barge	: MV Pacific Titan
Location	: Semayang Wharf, Balikpapan, Indonesia
Equipment	: Total Station – Sokkia SET4B
Personnel	: Anto Sinaga (Surveyor) Bambang Setiawan (Surveyor)
Date	: 07th – 08th August 2007

3. SURVEY PROCEDURES

3.1 Survey Stations

There are 2 reference survey station (2 numbers with WGS 1984 coordinates system) at Semayang Wharf Balikpapan, Indonesia. They are FUGRO 3 and FUGRO 4 (Refer to Appendix A). This point must be transferred due to far away from vessel. We make 2 help point near the vessel (P2 and P4) so that we could be shot prism on the vessel easily. P4 was used as instrument set-up location and P2 as the backsight (prism target). Details position of reference point and help point above as follows:

No.	Point_Name	Coordinates			
		Geodetic Coordinates		Grid Coordinates	
		Latitude	Longitude	Easting (m)	Northing (m)
1	FUGRO 3	01°16'14.2952 S	116°48'24.2996 E	478501.312	9859555.337
2	FUGRO 4	01°16'13.6253 S	116°48'24.9706 E	478522.046	9859575.907
3	P2	01°16'21.3263 S	116°48'19.9359 E	478366.480	9859339.450
4	P4	01°16'23.5496 S	116°48'19.7757 E	478361.536	9859271.189

3.2 Position of Target Prism

On board the barge, four prisms were installed with masking tape, one at port GPS Antenna, one at starboard GPS Antenna (DGPS system and tailbuoys verification), and two at along starboard side of the vessel (Gyro calibration). The starboard GPS antenna was used as primary GPS antenna.

3.3 Calibration Procedures

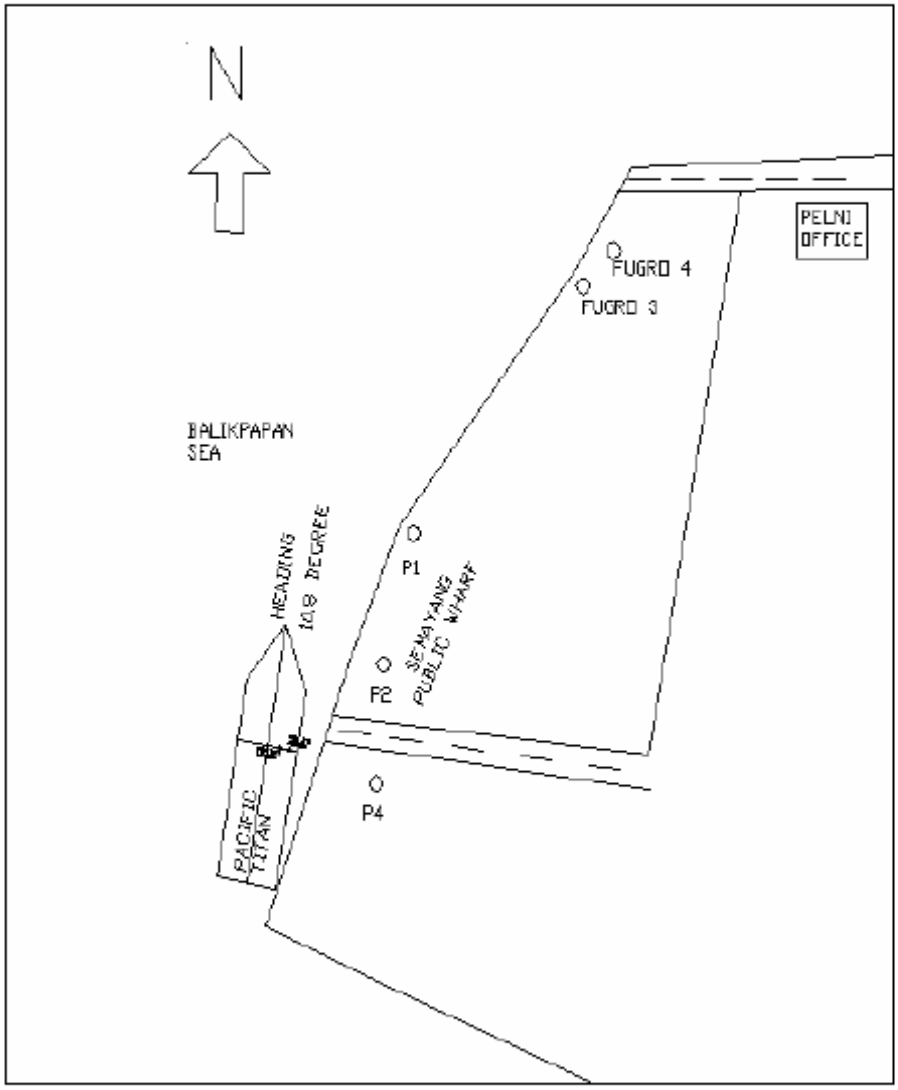
The DGPS verification checks and gyro calibrations were conducted in difference time. The Total Station was set up at P4 and referenced to P2 as backsight (Refer to Appendix C). Range and bearing measurements were observed to the prisms installed on board the barge, same survey procedure was used for both gyro calibration and DGPS verification checks. At the same times, DGPS antenna positions and the gyro readings were logged by vessel chief navigator.

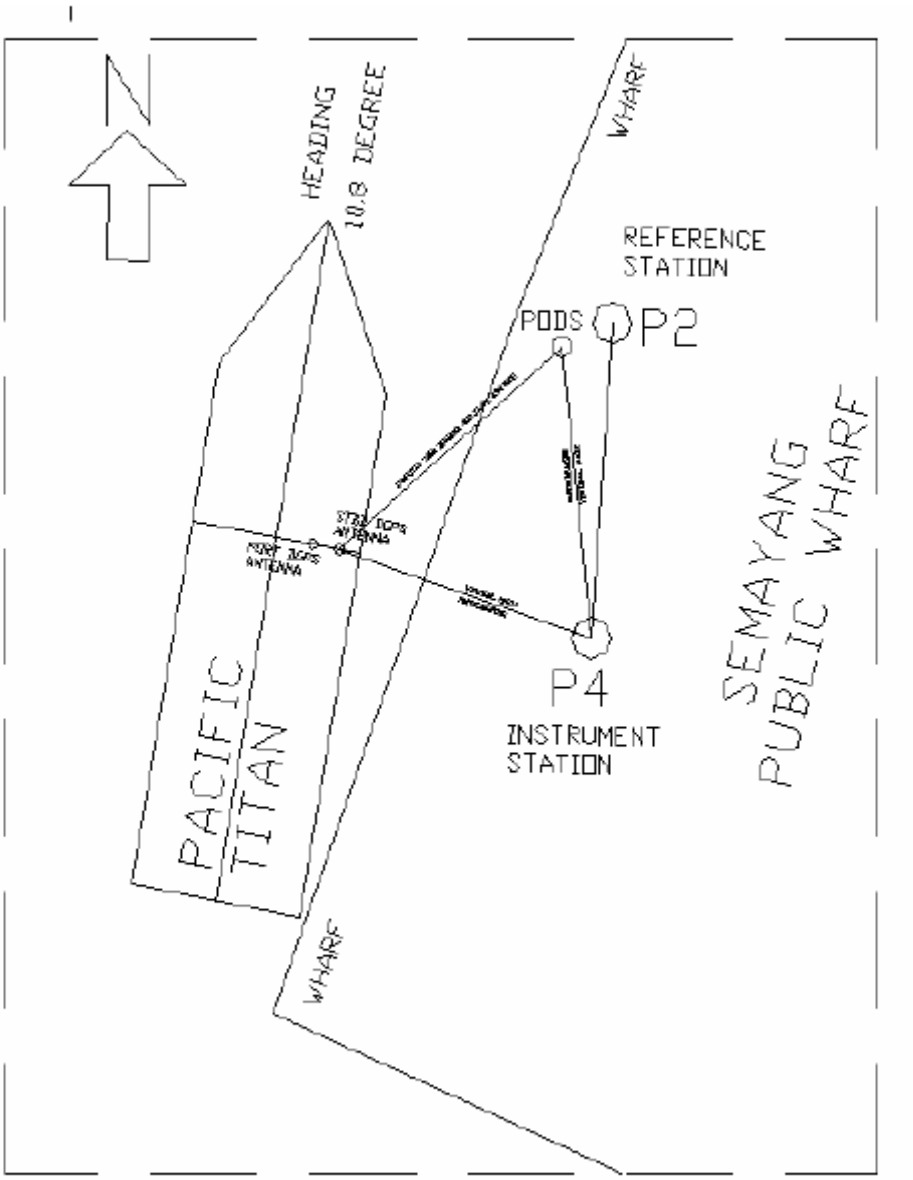
4. GEODETIC PARAMETERS

The survey work was defined and computed in the following Geodetic and Projection system:

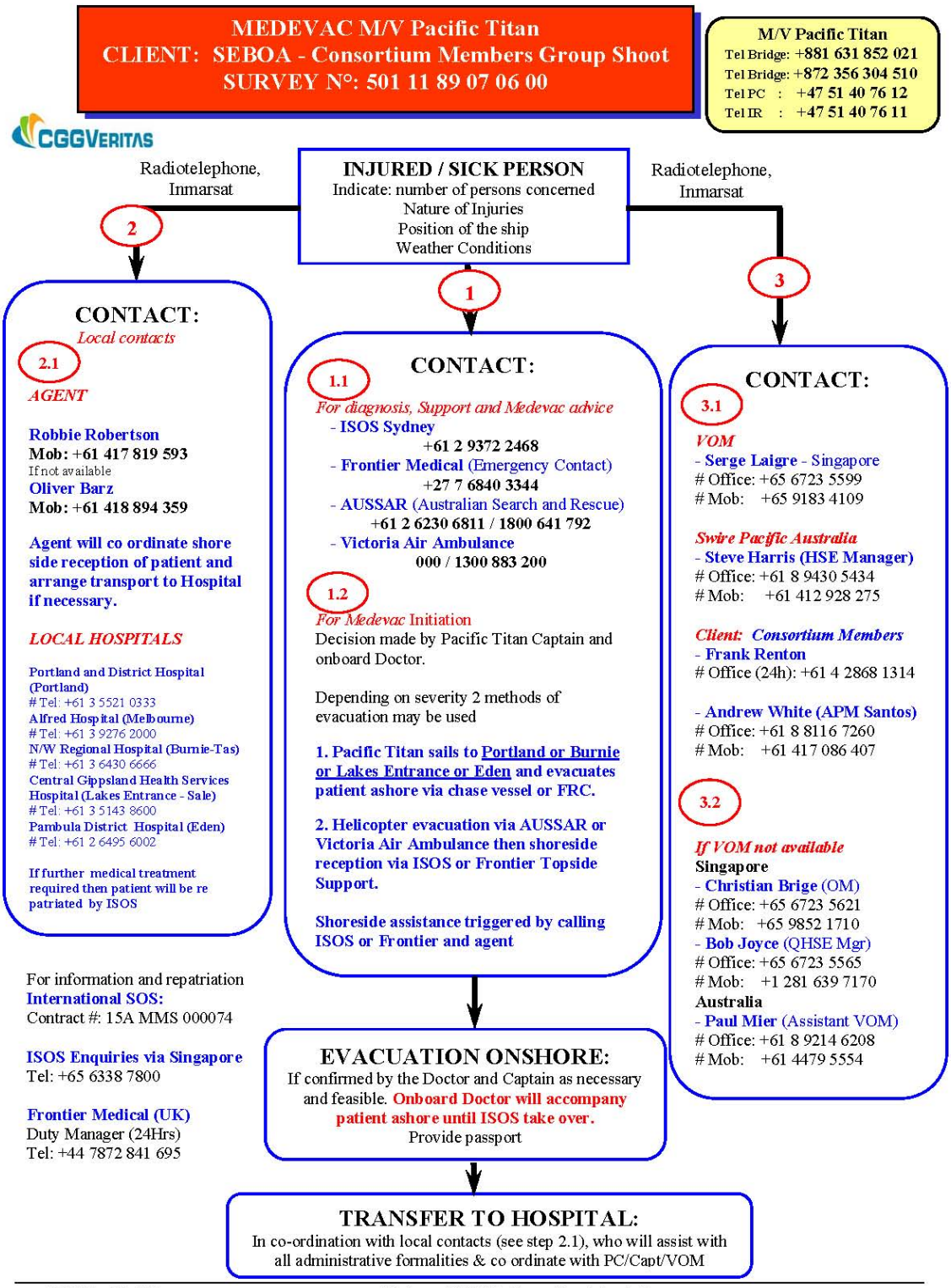
Global Positioning System Geodetic Parameters	
Spheroid:	World Geodetic System 1984
Datum:	World Geodetic System 1984
Semi major axis:	a = 6 378 137.000 m
Inverse Flattening:	$1/f$ = 298.257 223 563
Project Projection Parameters	
Grid Projection:	Universal Transverse Mercator
UTM Zone:	50 S
Central Meridian:	117° 00' 00" E
Latitude of Origin:	0° 00' 00" N
False Easting:	500 000 m
False Northing:	0 m
Scale factor on Central Meridian:	0.9996
Units:	metre

C FIELD DIAGRAM




N
HEADING
10.8 DEGREE
WHARF
REFERENCE
STATION
PODS
P2
SEMAYANG
PUBLIC WHARF
P4
INSTRUMENT
STATION
PACIFIC
TITAN
WHARF

Appendix 4 Medevac Plan



Appendix 5 Contact List

CONTACT LIST: CGGVeritas - Marine 2D Seismic Acquisition Services for South East Basin, Offshore Australia - M/V Pacific Titan
March 2008 - July 2008

Address	Location	Name	Mobile	Phone	Fax	E-mail
Pacific Titan		**Bridge**		Phone: +881 631 852 021 (Iridium)		E-mail: pacific.titan@swireships.com
Seismic Survey Vessel				Phone: +872 356 304 510 (Inmarsat B)	Fax: +872 335 385 513 (Inmarsat B)	
				Phone: +47 51 40 76 14 (VSAT)		
		Party Chief (Office)		Phone: +47 51 40 76 12 (VSAT)		E-mail: om.titan@cggveritas.com (Party Chief)
		Haydn Brook	Mob: +61 437 952 303			E-mail: chnav.titan@cggveritas.com (Nav Dept)
		Sigurd Osterrud	Mob: +65 9232 7329			
	Singapore	**Instruments Room**		Phone: +47 51 40 76 11 (VSAT)		E-mail: chobs.titan@cggveritas.com (Record.Dept)
						E-mail: seisqc.titan@cggveritas.com (Processor Dept)
						E-mail: chmech.titan@cggveritas.com (Source Dept)
						E-mail: hse.titan@cggveritas.com (HSE Advisor)
		Client (office)		Phone: +47 51 40 76 13 (VSAT)		
CGGVeritas APAC		**Office**		Phone: +65 6723 5500	Fax: +65 6723 5552	
9 Serangoon North Ave 5		**Serge LAIGRE** (Pacific Titan Operations Manager)	Mob: +65 9183 4109	Phone: +65 6723 5599		E-mail: serge.laigre@cggveritas.com
CGGVeritas Hub		**Rollin Delzer (Senior VP Marine)**	Mob: +65 8200 5907	Phone: +65 6723 5604		E-mail: rollin.delzer@cggveritas.com
Singapore 554 531		**Michelle Tay** (Marine Secretary)	Mob: +65 8263 0010	Phone: +65 6723 5584		E-mail: Michelle.Tay@cggveritas.com
		Christian Brige (Marine Operations Manager)	Mob: +65 9852 1710	Phone: +65 6723 5621		E-mail: christian.brige@cggveritas.com
		Chewy Chua (Navigation Analyst)	Mob: +65 9756 3204	Phone: +65 6723 5618		E-mail: Chewy.Chua@cggveritas.com
		Tony Nash (Navigation Analyst)	Mob: +65 8113 5118	Phone: +65 6723 5645		E-mail: Anthony.Nash@cggveritas.com
		Fabrice Mandroux (ATG Geophysist)	Mob: +65 9385 9041	Phone: +65 6723 5619		E-mail: fabrice.mandroux@cggveritas.com
		Dominique Bottier (Sales & Marketing Manager)	Mob: +65 9182 4984	Phone: +65 6723 5608		E-mail: dominique.bottier@cggveritas.com
	Singapore	**Emmanuel Haget** (Marine Resources Manager)	Mob: +65 9105 2358	Phone: +65 6723 5642		E-mail: emmanuel.haget@cggveritas.com
		William Jee (Regional Logistics Supervisor)	Mob: +65 9040 2200	Phone: +65 6723 5617		E-mail: william.jee@cggveritas.com
		Graham Knight (Instrument Manager)	Mob: +65 9628 8428	Phone: +65 6723 5616		E-mail: Graham.Knight@cggveritas.com
		Jeff Cleland (ATG Regional Supervisor)	Mob: +65 9186 3619	Phone: +65 6723 5630		E-mail: Jeff.Cleland@cggveritas.com
		Bob Joyce (GHSE Manager)	Mob: +1 281 639 7170	Phone: +65 6723 5565		E-mail: Bob.Joyce@cggveritas.com
		Richard John Watson (Maritime Technical Manager)	Mob: +65 9105 2403	Phone: +65 6723 5611		E-mail: RichardJohn.Watson@cggveritas.com
		Mark Plummer (OS Equipment - Mechanics)	Mob: +65 8222 9699	Phone: +65 6723 5543		E-mail: mark.plummer@cggveritas.com
		Tay Kar Hong (Asst Maritime Technical Manager)	Mob: +65 9644 4631	Phone: +65 6723 5649		E-mail: KarHong.Tay@cggveritas.com
		Didier Eledut (Crew Manager Singapore)	Mob: +65 8201 2748	Phone: +65 6723 5649		E-mail: didier.eledut@cggveritas.com
		Francois Monchy (HR Manager - France)	Mob: +33 6 8368 9082	Phone: +33 1 6447 3090		E-mail: francois.monchy@cggveritas.cm
Swire Pacific Offshore		**Office**		Phone: +65 6496 8280	Fax: +65 6496 8270	E-mail: survey.services@swire.com.sg
Survey Services Division (SSD)		**Ramoo Selvam** (Chief Operating Officer / Marketing)	Mob: +65 9191 2222	Phone: +65 6496 8282		E-mail: ramoo.selvam@swire.com.sg
1 Loyang Way 4		**Yvon F. Koster** (General Manager)	Mob: +65 8181 8882	Phone: +65 6496 8283		E-mail: yvon.koster@swire.com.sg
Singapore 507028		**Teddy Tan** (Accounting Manager)	Mob: +65 9635 0047	Phone: +65 6496 8285		E-mail: teddy.tan@swire.com.sg
		Lee Lee Chin (Jr. Accountant)	Mob: +65 9748 4223	Phone: +65 6496 8291		E-mail: lee.leechin@swire.com.sg
	Singapore	**Allan Wank** (Technical Manager)	Mob: +65 8333 3163	Phone: +65 6496 8284		E-mail: allan.wank@swire.com.sg
		Ian Mbd Samli (GHSE)	Mob: +65 9191 8080	Phone: +65 6496 8288		E-mail: ian.abdullahsamli@swire.com.sg
		Michelle Chin (Purchasing & Logistics)	Mob: +65 9780 7851	Phone: +65 6496 8293		E-mail: michelle.chin@swire.com.sg
		Joyce Tan (Buyer)	Mob: +65 9136 0262	Phone: +65 6496 8292		E-mail: joyce.tan@swire.com.sg
		Jancy Lee (Crew Administrator)	Mob: +65 9618 0262	Phone: +65 6496 8286		E-mail: jancy.lee@swire.com.sg
		Susan Teo (Administrator)	Mob: +65 9690 4838	Phone: +65 6496 8207		E-mail: susan.teo@swire.com.sg
2nd Floor Queensgate Centre		**Steve Harris** (Operations & HSE Manager)	Mob: +61 412 928 275	Phone: +61 8 9430 5434	Fax: +61 9430 7849	E-mail: sharris@spopty.com.au
cnr William & Newman Streets	Australia	**Nigel Gribble** (Secretary)		Phone: +61 8 9430 5434		E-mail: ngribble@spopty.com.au
Fremantle , WA 6160, Australia		**Malcolm Hearnden** (Manager)	Mob: + 61 412 505 434	Phone: +61 8 9430 5434		E-mail: mhearnden@spopty.com.au
		Simone Osten (Crewing)		Phone: +61 8 9430 5434		E-mail: sosten@spopty.com.au
Monsoon	Philippines	**Diosdado G. Ramos** (General Manager)	Mob: +63 917 5212 897	Phone: +63 2 5223 181	Fax: +63 2 5254 852	E-mail: dgramos@monsoon.com.ph
		Mae (Crewing operation)		Phone: +63 2 5253 051		E-mail: operations@monsoon.com.ph
Telstart Travels Agency	Singapore	**Shamim**	Mob: +65 9824 4530	Phone: +65 6726 9012		E-mail: shamim@telstartravels.com
	India	**Sujeet**	Mob: +91 9820 042 116			E-mail: tlplmar@telstartravels.com
		Farida	Mob: +91 9821 510 062			E-mail: farida@telstartravels.com
MARITIME AGENT:						E-mail: nts.a@ntshipping.com.au
NT Shipping Agencies		**Robbie Robertson** (Operations Manager)	Mob: +61 4 1781 9593	Phone: +61 8 8947 2570	Fax: +61 8 8947 2640	E-mail: robbie@ntshipping.com.au
East Arm Wharf	Singapore	**Oliver Barz**	Mob: +61 4 1889 4359			
Berrimah Road		**Christie Beeson** (Crew Logistic)				E-mail: Christie@ntshipping.com.au
Berrimah NT 0828						
General Medical/Rescue Advice		**ISOS Sydney**		Phone: +61 2 9372 2468	Fax: +61 2 9372 2455	
		ISOS Singapore		Phone: +65 6338 7800		
		AusSAR 24 hr contact		Phone: +61 2 6230 6811		
		- Aviation Rescue		Phone: 1800 815 257		
		- Maritime Emergency		Phone: 1800 641 792		
		Victoria Air Ambulance		Phone: 1300 883 200		Email: air.ambulance@mas.vic.gov.au
Consortium Members		**Frank Renton**		Phone: +61 4 1868 1314	Fax:	Email: FJRenton@enquest.com.au
SANTOS		Mike Giles (Project Manager)	Mob: +61 437 816 312	Phone: +61 8 8116 7952	Fax: +61 8 8116 7258	
		Andrew White (APM)	Mob: +61 417 086 407	Phone: +61 8 8116 7260		Email: Andrew.White@santos.com
				Phone: +61 8 8332 2949		
		Stuart Brew	Mob: +61 412 552 055	Phone: +61 8 8116 7625		
			Mob:	Phone: +61 8 8278 7515		
		Nick Fox (HSE Manager)	Mob: +61 407 395 815	Phone: +61 8 8116 5151		
				Phone: +61 8 8327 1594		
		Allan Jones (alternate)	Mob: +61 427 520 773	Phone: +61 8 8116 7303		
				Phone: +61 8 8357 6212		
		Phillip Galley (alternate)		Phone: +61 8 8116 7946		
				Phone: +61 8 8271 7532		
Duty Incident Manager		Roger Kennett	Mob: +61 419 180 935	Phone: +61 8 8116 7846	Fax: +61 8 8116 7965	
		Nick Lagonik	Mob: +61 400 383 020	Phone: +61 8 8116 7349	Fax: +61 8 8116 7113	
		Mark McFarlane	Mob: +61 438 788 138	Phone: +61 8 8116 5269	Fax: +61 8 8116 7113	
		Colin Cruickshank	Mob: +61 419 169 254	Phone: + 61 8 8116 7855	Fax: + 61 8 8116 7755	
		Dennis Vale	Mob: +61 437 653 905	Phone: +61 8 8116 7651	Fax: +61 8 8116 7113	
Fishing Vessel – SANTOS (M/V Shandara)		Jonathan (Jono) Hammond	Mob: +61 427 366 529	+61 145 115 342	VHF & UHF	
		(Distinguishing mark: RDX2)			(Call sign VNM 4671)	
		John Hammond	Mob: +61 429 130 238		VHF & UHF	
		(Distinguishing mark: UX9)	Mob: +61 428 130 238		(Call sign VJT 3639)	
3D Oil Contact		**Jon Keall**	Mob: +61 439 038 054	Phone: +61 3 9650 9866		E-mail: jkeall@3doil.com.au
				Phone: +61 3 5341 3669		
Bass Straits Oil Company Contact		**Keith Jackson**	Mob: +61 402 109 715	Phone: +61 3 9027 3000		E-mail: keithjackson@bassoil.com.au
				Phone: +61 3 9439 3552		
Cue Energy Resources Contact		**Desmond Leech**	Mob: +61 422 981 139	Phone: +61 3 96708668		E-mail: desJeech@cuenrg.com.au
				Phone: +61 422 981 139		
Eagle Bay Resources Contact		**Ian R Barr**	Mob: +61 415 271 299	Phone: +61 8 9481 3322		E-mail: ianbarr@eaglebayresources.com.au
				Phone: +61 8 9381 1181		
Exoil Contact		James Willis	Mob: +61 404 078 292	Phone: +61 3 8610 4711		E-mail: james.willis@allensgroup.com
Fishing Vessel – Exoil (M/V)				Phone: +61 3 9699 7439		

Tap Oil Contact		Emergency contact number			Phone:	+61 (0)8 9226 7836 (24 Hrs)			
		Blaine Ulmer	Mob:	+61 409 483 932	Phone:	+61 8 9226 7813			E-mail: blaine.ulmer@tapoil.com.au
					Phone:	+61 8 9271 4046			
		Denise Long	Mob:	+61 409 684 079	Phone:	+61 8 9226 7809			E-mail: denise.long@tapoil.com.au
					Phone:	+61 8 9367 7583			
		John Thornton	Mob:	+61 404 830 788					E-mail: john.thornton@tapoil.com.au
Agent & shore support in Australia		**Robbie Robertson** (Assistant Manager)	Mob:	+61 417 819 593	Phone:	+61 8 8947 2570			E-mail: robbie@ntshipping.com.au
N.T. Shipping Agencies Pty. Ltd.		**Oliver Barz** (Alternative Contact)	Mob:	+61 418 894 359					
Melbourne Hospital									
Alfred Hospital					Phone:	+61 3 9276 2000 / +61 03 9840 3500 (Switchboard)	Fax:	+61 3 9276 2255 / +61 3 9840 3547	
Commercial Road, Prahran, Melbourne, Australia									
Austin & Repatriation Medical Center					Phone:	+61 3 9276 2000 / +61 3 9840 3500	Fax:	+61 3 9276 2255	
Studley Road, Heidelberg, Melbourne, Australia 3084									
Burnie (Tasmania) Hospital									
North West Regional Hospital					Phone:	+61 3 6430 6666 / +61 3 6430 6524			
Brickport Road, Burnie, TAS 7320, Australia									
Portland Hospital									
Portland and District Hospital					Phone:	+61 3 5521 0333	Fax:	+61 3 55 210 358	
Bentinck Street, PORTLAND, Victoria 3305									
Lakes Entrance – Sale Hospital									
Central Gippsland Health Services Hospital					Phone:	+61 3 5143 8600		+61 3 5143 8633	
Guthridge Parade, Sale 3850									
Eden Hospital									
Pambula District hospital					Phone:	+61 2 6495 6002			
Merimbula rd, Pambula NSW 2549									
Australian Federal Authorities									
NOPSA					Phone:	+61 3 8866 5700			
24 hr Incident Notification									
Department of Agriculture, Fisheries & Forestry (Switchboard)					Phone:	+61 2 6272 3933			
Department of Industry, Tourism & Resources (Switchboard)					Phone:	+61 2 6213 6000			
Victoria Police Centre					Phone:	+61 3 9247 6666			
Victoria Police Centre, 37 Flinders Street, Melbourne, VIC, 3005									
Air Wing (Victoria Police)					Phone:	+61 3 9374 1311	Fax:	+61 3 9374 1929	
Victoria Police									
Hanger 104, Essendon Airport, VIC, 3041									
Burnie Police Headquarters					Phone:	+61 3 6434 5211			
88 Wilson Street, Burnie TAS 7320					Phone:	+61 3 6230 2700			
Onshore									
Police		**Police Emergency**			Phone:	0			
		Police Non urgent			Phone:	131 444			
Ambulance		**Ambulance Emergency**			Phone:	0			
		Air Ambulance (Victoria)			Phone:	+61 3 9945 9911			
Hospitals – Public Victoria		**Royal Melbourne Hospital**			Phone:	03 9342 7000 (Ph)			
Hospitals – Public Tasmania		**Royal Hobart Hospital (Public)**			Phone:	03 6222 8308 (Ph)			
		Launceston General Hospital			Phone:	03 6348 7111 (Ph)			
		North West Regional Hospital (Burnie)			Phone:	03 6430 6666 (Ph)			
Medical Advice		**International SOS Medical Support Singapore**			Phone:	+65 6338 7000 (24 hrs)			
Airport		**Melbourne**			Phone:	03 9297 1600 (Ph - Administration)			
		Hobart			Phone:	03 6212 1600 (Ph - Administration)			
		Launceston			Phone:	03 6391 6222 (Ph - Administration)			
Australian Search and Rescue (ASAR)					Phone:	1800 641 792 (Ph within Australia)			
					Phone:	+61 2 6230 6811 (Ph Outside Aust.)			
					Phone:	+61 2 6279 5719 (Ph Outside Aust.)			
					Phone:	+61 2 6279 5712 (Ph Outside Aust.)			
					Phone:	08 9478 3388 (Ph)			
Australian Maritime Safety Organization					Phone:	08 9430 2121 (Fax)			
Minerals Resources Tasmania Petroleum Emergency Contact		**Hobart**			Phone:	Carol Bacon			
					Phone:	03 6233 8326 (Ph Bus Hrs)			
					Phone:	03 6239 1409 (Ph after hours)			
					Phone:	Chris Boron			
					Phone:	03 6233 8362 (Ph Bus Hrs)			
					Phone:	03 6272 4862 (Ph after hours)			
Maritime Rescue Coordination Centre					Phone:	02 6230 6811 (Ph)			
					Phone:	02 6230 6868 (Fax)			
Yolla A Platform		**Mark Sanford**			Phone:	+65 3 5654 9124			Email: Mark.Sanford@originenergy.com.au
Origin Energy Bass Gas Operations									