

# FINAL SURVEY REPORT



CGGVeritas



## VESSEL: M/V PACIFIC TITAN

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

LOCATION	:	AUSTRALIA
AREA	:	BASS BASIN - AUSTRALIA
SURVEY	:	T42/43P - TARGA 2D SURVEY
CLIENT	:	BASS STRAIT OIL COMPANY LTD
DURATION	:	04 <sup>th</sup> May 2008 - 01 <sup>st</sup> June 2008
C.G.G.V. SURVEY N°	:	501 11 89 07 06 00 (JOB N°: 6374)
CONTRACT N°	:	859832



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# 1. Survey Information and Objectives

Bass Strait agreed to enter into a service contract for the purpose of acquisition of a marine seismic 2D survey with 17 sail lines of approximately 1140 total sail kilometres.

The survey area was located approximately 100 kilometres North of George Town, Tasmania within the blocks T42P and T43P in the Bass Strait of Australia.

Water depth in the survey area varied from 35m to around 75.3m over the survey.

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 6000 m, towed at a depth of 8 m.

Recording length was 6 sec.

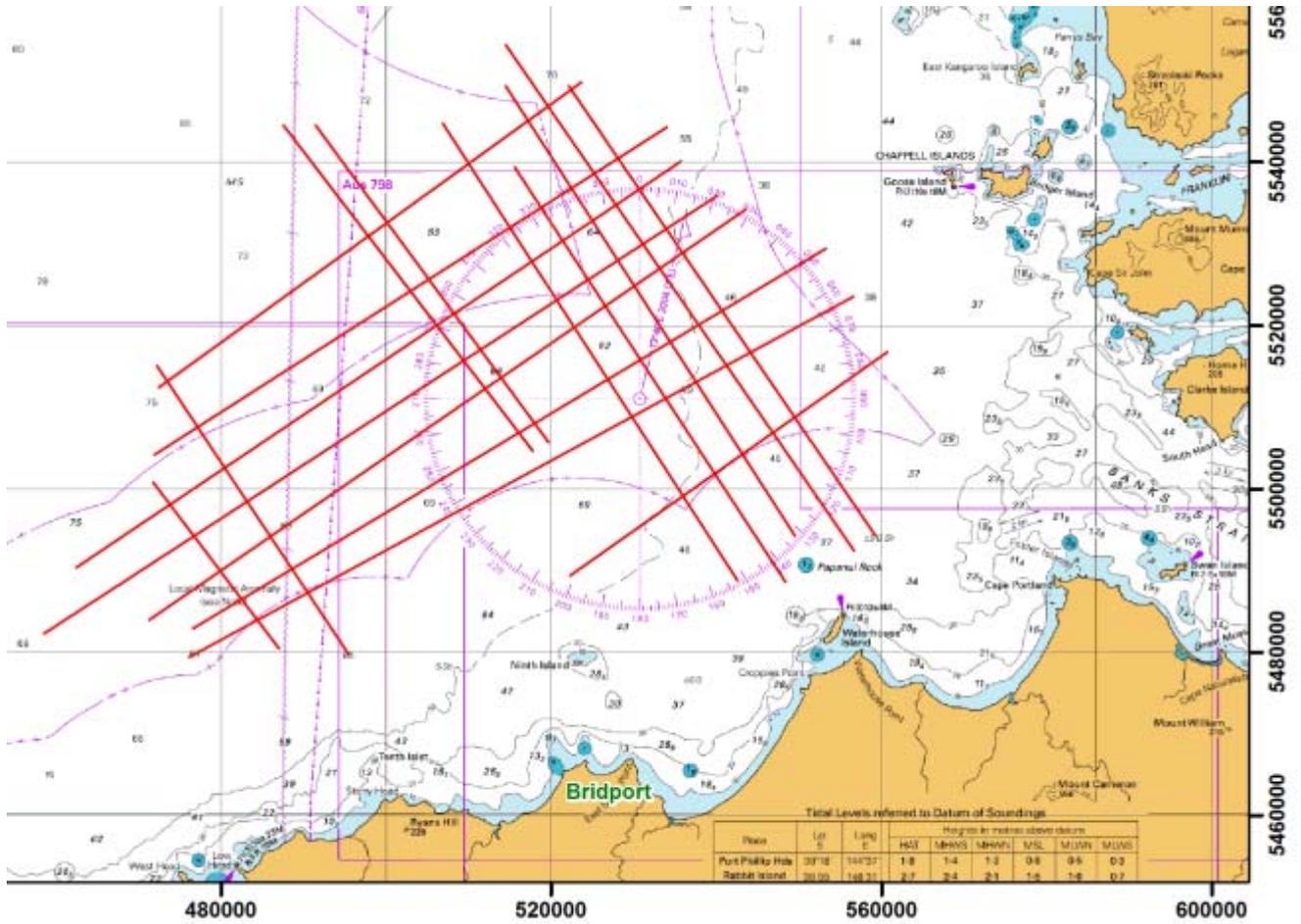
Chargeable production was in two different time periods. The first three lines were shot from the 4<sup>th</sup> May at 13:59 GMT (23:59 local) until 13:28 GMT (23:38 local) on the 5<sup>th</sup> May. At this point there was crew change and then the vessel went off to do the Exoil survey before returning on the 24<sup>th</sup> of May. Production then again started at 00:12 GMT (10:12 local) on the 25<sup>th</sup> May and completed 31<sup>st</sup> May at 04:53 GMT (14:53 local).

All lines were pre-fixed with BOBS08. 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 and field tapes started at 1.

Upon survey completion, Pacific Titan departed the area to transit to the Bass Strait Vic survey.



## 2.2. Blocks T42P and T43P



## 2.3. Postplot Map T42P and T43P

### 3. Contract Work Order

#### CONTRACT

Client: Bass Strait  
Vessel(s): Pacific Titan  
Job number: 6734  
Bid number:  
Client contract number/ref:  
Name:  
Area: T42P & T43P Bass Strait, Australia  
Type of survey: 2D Towed streamer  
Area or total km's: 1140  
Line heading: Variable  
Number of lines: 17  
Line Length: Variable  
Acquisition method: 2D Single Streamer, Single Source

#### 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: 70 to 90 metres

#### 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 (effectively 4.7Hz)  
Filter type: Butterworth  
Pre-amplifier gain: 0dB, (1600mV)  
Tape format: SEG D 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 (2X6000m) 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, 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 3.2Ghz	1	
Terminals		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

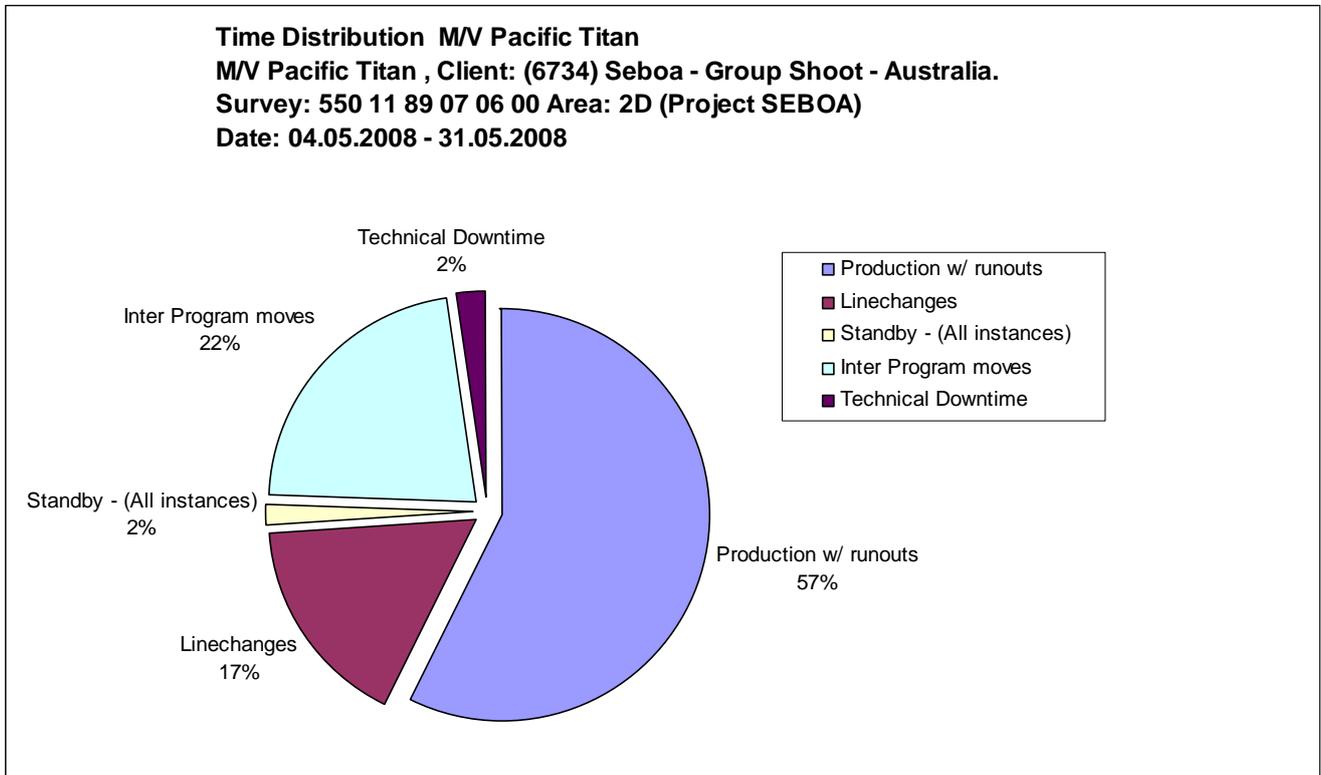
<b>POSITION</b>	<b>Crew 1</b>
<b>Party Chief</b>	Sigurd Østerud
<b>Captain</b>	Theodore Strockyj
<b>Chief Engineer</b>	Carl Sayers
<b>Chief Observer</b>	Allan Beatie
<b>Shift Leader Observer</b>	Jun Lamabas
<b>Chief Navigator</b>	Paul Stafford
<b>Shift Leader Navigation</b>	Christopher Hernandez
<b>Chief Mechanic</b>	Markus Rahm
<b>Shift Leader Mechanic</b>	Ronaldo Morales
<b>QC leader</b>	Steffi Schwarz
<b>Client Representative</b>	Drew Murray

### 5.2. Office Support Personnel

<b>POSITION</b>	<b>NAME</b>
<b>Vice President Operation</b>	Christian Brige
<b>Operation Manager</b>	Serge Laigre
<b>Instrument Manager</b>	Graham Knight
<b>Navigation Manager</b>	Rafael Bouraly
<b>Mechanic Manager</b>	Mark Plummer
<b>QC support</b>	Fabrice Mandroux

## 6. Field Information and Observations

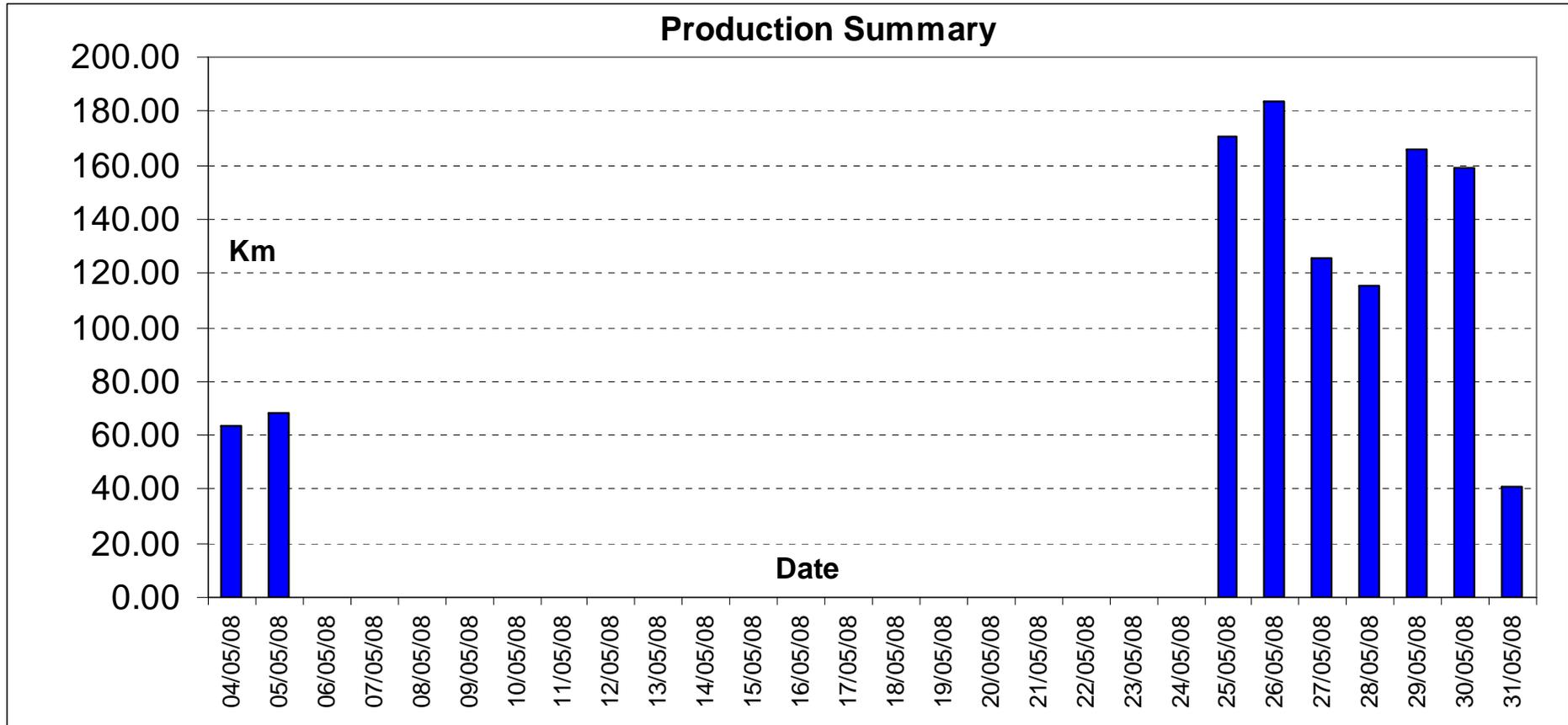
### 6.1. Time Statistics (part 1 & part 2 combined)



### 6.2. Production Statistics Bass Strait T42P & T43P part of Group Shoot

<b>Production w/ runouts</b>	<b>129.88 Hours</b>
<b>Linechanges</b>	<b>38.02 Hours</b>
<b>Standby - (All instances)</b>	<b>3.58 Hours</b>
<b>Technical Down Time</b>	<b>5.33 Hours</b>
<b>Inter Program moves</b>	<b>50.23 Hours</b>

### 6.3. Production Summary (part 1 & part 2 combined)



## 6.4. Daily Summary (Reverse chronological order)

### All daily logs are in GMT time.

#### **Sat, 31 May 2008, week 22**

We finished the southerly Bass Strait prospect at 04:53 and finished recovery of the gear at 09:00 GMT. During the recovery we found one retriever that was pulled off the cable and gone. This most likely occurred when we caught the octopus trap.

Currently we are transiting to the Vic Bass Strait prospect. Expect to start deploying at 11:15 local time 1st of June.

Weather; very nice and hardly any swell

Midnight fuel balance 681.664 cubic M, Consumed 13.535 cubic M

HSE

Total personnel onboard: 33 (16 Maritime, 15 Seismic, 2 client)

11 x toolbox meetings (8 x Dept. Handovers, 1 x recover guns, 1 x recover door, 1 x recover streamer)

2 x Observation Card

#### **Fri, 30 May 2008, week 22**

Good production today with 165 km. Line change between line 13 and 11 was close to the coast and we had to start 11 with cable in a turn. The first chargeable shot is 1001 but first solvable from navigation was 1120.

At the end of the day GMT we are on the last line of the southerly Bass Strait prospect. We expect to finish at around 15:00 local time. Picking up the gear will be around 6 hours and then approximately a 20 hour transit to the next Bass Strait prospect. We will

require a two hour observation period in daylight before we can commence production again.

Weather; windy with some choppy seas.

Midnight fuel balance 695.199 cubic M, Consumed 13.446 cubic M

HSE

Total personnel onboard: 33 (16 Maritime, 15 Seismic, 2 client)

8 x toolbox meetings (8 x Dept. Handovers)

1 x Observation Card

#### **Thu, 29 May 2008, week 22**

Good production today with 172 km. Not much to say today. We brought on gun string 1 for an electrical problem between seq 15 and 16. One more day and we should finish up this prospect.

Weather; Overcast but very nice

Midnight fuel balance 708.645 cubic M, Consumed 13.543 cubic M

HSE

Total personnel onboard: 33 (16 Maritime, 15 Seismic, 2 client)

10 x toolbox meetings (8 x Dept. Handovers, 1 x gun recovery, 1 x gun deploy)

0 x Observation Card

1 x CSV

#### **Wed, 28 May 2008, week 22**

We had fairly good production today with 125 km. We had a octopus trap caught between door and lead-in and this feel off as we picked up the gear. This operation caused some standby time today.

This along with the long transit after sequence 12 produced

lower production figures for the day.

Weather; Overcast but good

Midnight fuel balance 722.188 cubic M, Consumed 12.790 cubic M

HSE

Total personnel onboard: 33 (16 Maritime, 15 Seismic, 2 client)

14 x toolbox meetings (8 x Dept. Handovers, 2 x gun recovery, 2 x gun deploy, 1 x door recovery, 1 x door deploy)

1 x Observation Card

1 x MSV

1 x CSV  
1 x General Safety meeting  
ver2 to test new SOLID version and added 1 safety meeting

### **Tue, 27 May 2008, week 22**

We had very good production today with 181 km. We had something catch on bird 23 during sequence 10 (line 5). This pulled the bird deep and out of spec for around 40 SPs. Also during sequence 11 the door float began to go completely under water and the first two birds began riding a bit deeper. We believe there is some sea weed or other object caught between door and lead-in. The plan is to bring this area in for a look on line change after sequence 11.

Weather; Sunny and very good

Midnight fuel balance 734.978 cubic M, Consumed 13.085 cubic M

HSE

Total personnel onboard: 33 (16 Maritime, 15 Seismic, 2 client)

8 x toolbox meetings (8 x Dept. Handovers)

1 x Observation Card

1 x MSV

1 x CSV

1 x PRM

### **Mon, 26 May 2008, week 22**

We had very good production today with 189 km. Continuing on the East-West lines. No problems today.

Weather; Good

Midnight fuel balance 748.063 cubic M, Consumed 14.293 cubic M

HSE

Total personnel onboard: 33 (16 Maritime, 15 Seismic, 2 client)

8 x toolbox meetings (8 x Dept. Handovers)

1 x Observation Card

1 x Drill (General Muster)

### **Sun, 25 May 2008, week 22**

We had good production today with 176 km. Shooting the East-West lines. No real problems today. One gun down on sequence 5 and repaired on line change. All within spec.

Weather; A front expected to pass over today. No significant swell.

Midnight fuel balance 762.356 cubic M, Consumed 10.130 cubic M

HSE

Total personnel onboard: 33 (16 Maritime, 15 Seismic, 2 client)

10 x toolbox meetings (8 x Dept. Handovers, 1 x gun recovery, 1 x gun deployment)

2 x Observation Card

2 x medical training for cold injuries

ver2 Changed the standby of the first 12 minutes to line change

### **Sat, 24 May 2008, week 21**

We finished deployment of gear. The 2 hour MMO observation was completed in daylight before starting any guns. Started firing whale gun at 23:10 GMT and production started shortly after midnight GMT.

Weather; cold with fairly strong winds but no significant swell.

Midnight fuel balance 772.486 cubic M, Consumed 13.336 cubic M

HSE

Total personnel onboard: 33 (16 Maritime, 15 Seismic, 2 client)

11 x toolbox meetings (8 x Dept. Handovers, 1 x streamer deployment, 1 x gun deployment, 1 x door deployment)

1 x Observation Card

ver3 Changed charge code back to Bass Strait and took away the environmental standby.

### **Fri, 23 May 2008, week 21**

We stopped by the Portland port to drop off the two extra MMO's and cray pot before continuing our transit to the Bass Strait. We passed the halfway point between prospects at 17:45 GMT and have slowed down at 23:30 GMT. This due to the fact we have to

do two hours MMO observation in daylight again before starting any guns. The plan is to begin deployment at 0300 local time in the morning.

Weather outlook looks good for the near future.

Midnight fuel balance 785.822 cubic M, Consumed 13.627 cubic M

HSE

Total personnel onboard: 35 (16 Maritime, 15 Seismic, 4 client)

12 x toolbox meetings (8 x Dept. Handovers, 1 x streamer retrieval, 1 x gun retrieval, 1 x door recovery, 1 x personnel transfer)

2 x Observation Card

1 x Department cross-audit

1 x PRM

1 x personnel transfer

vers3 After another meeting with Split, charges between Exoil and Bass Strait again

### **Tue, 06 May 2008, week 19**

No km acquired today due to being in Burnie for Crew change.

Berth into Burnie around 1 hour later than expected due to Bow thruster problems (fuel). Once rectified vessel berthed and the port call work list commenced.

Faulty Umbilical offloaded, new umbilical loaded, Vessel bunkered, Sludge offloaded, Water loaded.

Midnight fuel balance 977.034 cubic M, Consumed 6.4, Received onboard 497.922 cubic M.

HSE

Total personnel onboard: 34 (16 Maritime, 16 Seismic, 2 client)

11 x toolbox meetings (8 x Dept. Handovers, 3 x umbilical operation)

0 x Observation card

### **Mon, 05 May 2008, week 19**

74.025 km acquired today.

Vessel circled because of an air leak (another top housing liner) soon after starting Seq 002.

Shooting plan was revised after the circle in preparation for crew change.

Two North/south lines to the West end of the prospect were acquired before recovering the gear for crew change. A TS Dip was performed once all trailing equipment is onboard.

Weather had increased on prospect soon after the streamer is onboard due to a low front passing, around 35 knots evident with choppy sea conditions.

Vessel is currently just off Burnie and the Pilot is soon to board.

No tailbuoy GPS through the day (on investigation appears to be the jumper from the streamer to the FUPE box)

Midnight fuel balance 485.512 cubic M, Consumed 14.8 cubic M

HSE

Total personnel onboard: 34 (16 Maritime, 16 Seismic, 2 client)

14 x toolbox meetings (8 x Dept. Handovers, 1 x gun deployment, 2 x gun recovery, 1 x Para vane recovery, 1 x streamer recovery, 1 x TS Dip)

0 x Observation card

### **Sun, 04 May 2008, week 19**

133.075 km acquired today.

3D Oil survey completed today. Bass Strait Started.

On completion of 3D Oil the vessel then proceeded to Bass Strait prospect. Along the way gun string 3 and 1 recovered for maintenance. On deployment of the gun arrays string 1 and 2 became entangled. This resulted in an extended interchange program move

whilst time is spent to separate the arrays. Once the gun arrays are no longer tangled and are back in position array 2 had to be recovered due to an air leak. Wind conditions at the time were not great with 30+ knots on location.

Streamer set to 9m for the first line of Bass strait due strong winds on prospect (40 knots). Wind eased off to 20knots by the end of the line. Speed fluctuated throughout the line due to the sea conditions. Currently have trouble reading the first tape in Promax, still working on the situation trying a few different options.

Gun string 1 recovered at the EOL due to No-fires on gun no.8.

No Tailbuoy GPS through the day.

Midnight fuel balance 500.312 cubic M, Consumed 15.2 cubic M

HSE

Total personnel onboard: 34 (16 Maritime, 16 Seismic, 2 client)  
14 x toolbox meetings (8 x Dept. Handovers, 3 x gun deployment, 3 x gun recovery)

## **6.5. Field Information and Encountered Problems**

### **6.5.1. Obstructions / Installations in the Field**

The only obstructions encountered within the Survey location was one Octopus trap which caught on the door-deflector and lead-in connection. After it released it also caused some us to loose a retriever (cable recovery float device).

### **6.5.2. Traffic / Shipping Lanes**

There was very little shipping traffic through the prospect area observed during the duration of the survey. No problems encountered and all ships communicated and cooperated nicely with us.

### **6.5.3. Fishing Activity**

There were a few vessels around on our first line on the second part of the survey, but they caused no problems. We had one occasion with some downtime for a octopus trap caught on the gear as described above under Obstructions.

### **6.5.4. Environmental Obstacles**

No reportable obstacles during the survey.

### **6.5.5. Operational Observations**

The survey was shot in two different time frames with the first started on the 4<sup>th</sup> of May. After 3 lines were completed the vessel went for crew change in Burnie. After that it was decided to do the ExOil prospect before finishing the rest of this prospect. On the 24<sup>th</sup> of May we continued with the survey and its start was delayed slightly due to the MMO observation in daylight rules. The survey was completed on the 31<sup>st</sup> with no technical or weather downtime during the second part. The data quality was excellent and the weather and streamer feathering helped ensure this. When the prospect was finished we picked up all gear for the transit to the second Bass Strait prospect in VICP41 area.

## 7. HSE Summary

No environment incidents during the survey.

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.

We had no HSE incidents during this survey.

HSE summary stats from the 4<sup>th</sup> - 5<sup>th</sup> and 24<sup>th</sup> - 31<sup>st</sup> of May 08

### QHSE Stats

Personnel Breakdown for the above period (Master Vessel)		Total man-days for Master Vessel		HSE Breakdown for the period	
Marine	<b>128</b>			induction tour seismic	<b>0</b>
CGG	<b>121</b>		<b>265</b>	induction tour marine	<b>0</b>
Sub Contract	<b>0</b>	Total Exposure hrs		HSE Committee Meeting	<b>0</b>
Client	<b>16</b>		<b>6360</b>	<b>HSE Crew Meeting</b>	<b>1</b>
		<b>Total man-days for chase</b>		Department Meeting	<b>0</b>
			<b>0</b>	PRM	<b>1</b>
		<b>Total Chase Exposure hrs</b>		OGP_FMM HSE training	<b>2</b>
			<b>0</b>	Small Boat Sortie	<b>0</b>
				External Audits	<b>0</b>
				X department Audit	<b>0</b>
				CSV	<b>3</b>
				MSV	<b>2</b>
				NC	<b>0</b>
				OFI	<b>0</b>
				<b>JSA:</b>	<b>0</b>
				<b>Observation cards</b>	<b>9</b>
				<b>Tool Box meetings:</b>	<b>80</b>
				Drills	<b>1</b>
				<b>Incident</b>	<b>0</b>
<b>Total Exposure hrs All</b>			<b>6360</b>		



## 7.2. Production-Log

																
Production Log:		Bass Strait Oil Company Ltd - Survey T42/43P														
M/V Pacific Titan		(6734) Seboia - Group Shoot - Australia										Area: 2D (Project SEBOA)				
Date:	04.05.2008	Date:	05.05.2008 <th>Survey:</th> <td>550 11 89 07 06 00 <th colspan="8"></th> <th colspan="3"></th> </td>	Survey:	550 11 89 07 06 00 <th colspan="8"></th> <th colspan="3"></th>											
Date:	23.05.2008 <th>Date:</th> <td>31.05.2008 <th>Survey:</th> <td>550 11 89 07 06 00 <th colspan="8"></th> <th colspan="3"></th> </td></td>	Date:	31.05.2008 <th>Survey:</th> <td>550 11 89 07 06 00 <th colspan="8"></th> <th colspan="3"></th> </td>	Survey:	550 11 89 07 06 00 <th colspan="8"></th> <th colspan="3"></th>											
Date	Line	Time	Total Time	Dir	FSP	LSP	TOT SPS	Chargeable CMP kans	Primary	Secondary	Comments	Standby per Instance	Date (Local)	Time (Local)	Time (Local)	
04-May-08		08:40 - 11:20	2.67						Technical D/T	Inter-move	Standby on clients request: Interprogram move: Bass Strait		04-May-08	18:40	21:20	
04-May-08		11:20 - 13:59	2.65						Technical D/T	MEC	Mechanical, backdeck, source handling: Array 1 and 2 tangled.		04-May-08	21:20	23:59	
04-May-08	BOBS08-02-001	13:59 - 21:33	7.57	233	3537	1001	2537	63.425	Recording	Production	Production 2D Line		04 & 05-May-08	23:59	07:33	
04-May-08	BOBS08-02-001	21:33 - 21:52	0.32	233	1000	881	120	3	Recording	Production	Production Runout		05-May-08	07:33	07:52	
04-May-08		21:52 - 00:00	2.13						Line Change	Linechange	Linechange, nominal		05-May-08	07:52	10:00	
05-May-08		00:00 - 00:08	0.13						Line Change	Linechange	Linechange, nominal		05-May-08	10:00	10:08	
05-May-08		00:08 - 00:27	0.32						Technical D/T	MEC	NTBP due to: Mechanical, source, gun: Air leak: Top housing liner		05-May-08	10:08	10:27	
05-May-08	BOBS08-04-002	00:27 - 02:49	2.37	57	1001	1110	110		Technical D/T	MEC	Mechanical, source, gun		05-May-08	10:27	12:49	
05-May-08	BOBS08-01-003	02:49 - 05:35	2.77	143	2022	1001	1022	25.55	Recording	Production	Production 2D Line		05-May-08	12:49	15:35	
05-May-08	BOBS08-01-003	05:35 - 05:55	0.33	143	1000	881	120	3	Recording	Production	Production Runout		05-May-08	15:35	15:55	
05-May-08		05:55 - 08:17	2.37						Line Change	Linechange	Linechange, nominal		05-May-08	15:55	18:17	
05-May-08	BOBS08-03-004	08:17 - 13:08	4.85	326	1001	2698	1698	42.45	Recording	Production	Production 2D Line		05-May-08	18:17	23:08	
05-May-08	BOBS08-03-004	13:08 - 13:28	0.33	326	2699	2818	120	3	Recording	Production	Production Runout		05-May-08	23:08	23:38	
23-May-08		17:45 - 00:00	6.25						Technical D/T	Inter-move	Standby on clients request, Inter Program move to start Bass Strait again, charged to Bass Strait		23 & 24-May-08	03:45	10:00	
24-May-08		00:00 - 22:12	22.20						Technical D/T	Inter-move	Standby on clients request, inter program move and deployment, Bass Strait charged		24 & 25-May-08	10:00	08:12	
24-May-08		22:12 - 00:00	1.80						Line Change	Linechange	Linechange, nominal		25-May-08	08:12	10:00	
25-May-08		00:00 - 00:12	0.20						Line Change	Linechange	Linechange, nominal		25-May-08	10:00	10:12	
25-May-08	BOBS08-04-005	00:12 - 08:23	8.18	57	1001	3960	2960	74	Recording	Production	Production 2D Line		25-May-08	10:12	18:23	
25-May-08	BOBS08-04-005	08:23 - 08:43	0.33	57	3961	4080	120	3	Recording	Production	Production Runout		25-May-08	18:23	18:43	
25-May-08		08:43 - 10:52	2.15						Line Change	Linechange	Linechange, nominal		25-May-08	18:43	20:52	
25-May-08	BOBS08-06-006	10:52 - 20:16	9.40	235	4545	1001	3545	88.625	Recording	Production	Production 2D Line		25 & 26-May-08	20:52	06:16	
25-May-08	BOBS08-06-006	20:16 - 20:35	0.32	235	1000	881	120	3	Recording	Production	Production Runout		26-May-08	06:16	06:35	
25-May-08		20:35 - 23:09	2.57						Line Change	Linechange	Linechange, nominal		26-May-08	06:35	09:09	
25-May-08	BOBS08-12-007	23:09 - 00:00	0.85	59	1001	1318	318	7.95	Recording	Production	Production 2D Line		26-May-08	09:09	10:00	
26-May-08	BOBS08-12-007	00:00 - 08:58	8.97	59	1319	4591	3273	81.825	Recording	Production	Production 2D Line		26-May-08	10:00	18:58	
26-May-08	BOBS08-12-007	08:58 - 09:17	0.32	59	4592	4711	120	3	Recording	Production	Production Runout		26-May-08	18:58	19:17	
26-May-08		09:17 - 11:24	2.12						Line Change	Linechange	Linechange, nominal		26-May-08	19:17	21:24	
26-May-08	BOBS08-10-008	11:24 - 20:40	9.27	235	4526	1001	3526	88.15	Recording	Production	Production 2D Line		26 & 27-May-08	21:24	06:40	
26-May-08	BOBS08-10-008	20:40 - 21:00	0.33	235	1000	881	120	3	Recording	Production	Production Runout		27-May-08	06:40	07:00	
26-May-08		21:00 - 22:36	1.60						Line Change	Linechange	Linechange, nominal		27-May-08	07:00	08:36	
26-May-08	BOBS08-14-009	22:36 - 00:00	1.40	61	1001	1534	534	13.35	Recording	Production	Production 2D Line		27-May-08	08:36	10:00	
27-May-08	BOBS08-14-009	00:00 - 08:42	8.70	61	1535	4674	3140	78.5	Recording	Production	Production 2D Line		27-May-08	10:00	18:42	
27-May-08	BOBS08-14-009	08:42 - 09:01	0.32	61	4675	4794	120	3	Recording	Production	Production Runout		27-May-08	18:42	19:01	
27-May-08		09:01 - 10:48	1.78						Line Change	Linechange	Linechange, nominal		27-May-08	19:01	20:48	
27-May-08	BOBS08-16-010	10:48 - 15:52	5.07	235	2890	1001	1890	47.25	Recording	Production	Production 2D Line		27 & 28-May-08	20:48	01:52	
27-May-08	BOBS08-16-010	15:52 - 16:10	0.30	235	1000	881	120	3	Recording	Production	Production Runout		28-May-08	01:52	02:10	
27-May-08	BOBS08-05-011	16:10 - 18:43	2.55	322	1001	2958	1958	48.95	Line Change	Linechange	Linechange, nominal		28-May-08	02:10	04:43	
27-May-08		18:43 - 00:00	5.26						Recording	Production	Production 2D Line		28-May-08	04:43	10:00	
28-May-08	BOBS08-05-011	00:00 - 00:07	0.12	322	2959	3003	45	1.125	Recording	Production	Production 2D Line		28-May-08	10:00	10:07	
28-May-08	BOBS08-05-011	00:07 - 00:26	0.32	322	3004	3123	120	3	Recording	Production	Production Runout		28-May-08	10:07	10:26	
28-May-08		00:26 - 02:26	2.00						Line Change	Linechange	Linechange, nominal		28-May-08	10:26	12:26	
28-May-08		02:26 - 06:01	3.58						Regional D/T	Standby	Environmental, fishing activities, Octopus trap caught on door/ lead-in		28-May-08	12:26	16:01	
28-May-08	BOBS08-07-012	06:01 - 11:12	5.18	142	2921	1001	1921	48.025	Recording	Production	Production 2D Line		28-May-08	16:01	21:12	
28-May-08	BOBS08-07-012	11:12 - 11:32	0.33	142	1000	881	120	3	Recording	Production	Production Runout		28-May-08	21:12	21:32	
28-May-08		11:32 - 15:53	4.35						Line Change	Linechange	Linechange, nominal		28 & 29-May-08	21:32	01:53	
28-May-08	BOBS08-09-013	15:53 - 23:05	7.20	327	1001	3659	2659	66.475	Recording	Production	Production 2D Line		29-May-08	01:53	09:05	
28-May-08	BOBS08-09-013	23:05 - 23:24	0.32	327	3660	3779	120	3	Recording	Production	Production Runout		29-May-08	09:05	09:24	
28-May-08		23:24 - 00:00	0.60						Line Change	Linechange	Linechange, nominal		29-May-08	09:24	10:00	
29-May-08		00:00 - 01:35	1.58						Line Change	Linechange	Linechange, nominal		29-May-08	10:00	11:35	
29-May-08	BOBS08-15-014	01:35 - 09:40	8.08	147	4002	1001	3002	75.05	Recording	Production	Production 2D Line		29-May-08	11:35	19:40	
29-May-08	BOBS08-15-014	09:40 - 09:59	0.32	147	1000	881	120	3	Recording	Production	Production Runout		29-May-08	19:40	19:59	
29-May-08		09:59 - 11:38	1.65						Line Change	Linechange	Linechange, nominal		29-May-08	19:59	21:38	
29-May-08	BOBS08-17-015	11:38 - 18:45	7.12	326	1001	3661	2661	66.525	Recording	Production	Production 2D Line		29 & 30-May-08	21:38	04:45	
29-May-08	BOBS08-17-015	18:45 - 19:04	0.32	326	3662	3781	120	3	Recording	Production	Production Runout		30-May-08	04:45	05:04	
29-May-08		19:04 - 21:23	2.32						Line Change	Linechange	Linechange, nominal		30-May-08	05:04	07:23	
29-May-08	BOBS08-13-016	21:23 - 00:00	2.62	326	3612	2650	963	24.075	Recording	Production	Production 2D Line		30-May-08	07:23	10:00	
30-May-08	BOBS08-13-016	00:00 - 04:33	4.55	147	2649	1001	1649	41.225	Recording	Production	Production 2D Line		30-May-08	10:00	14:33	
30-May-08	BOBS08-13-016	04:33 - 04:54	0.35	174	1000	881	120	3	Recording	Production	Production Runout		30-May-08	14:33	14:54	
30-May-08		04:54 - 06:12	1.30						Line Change	Linechange	Linechange, nominal		30-May-08	14:54	16:12	
30-May-08	BOBS08-11-017	06:12 - 12:47	6.58	326	1001	3423	2423	60.575	Recording	Production	Production 2D Line		30-May-08	16:12	22:47	
30-May-08	BOBS08-11-017	12:47 - 13:07	0.33	326	3424	3543	120	3	Recording	Production	Production Runout		30-May-08	22:47	23:07	
30-May-08		13:07 - 17:56	4.82						Line Change	Linechange	Linechange, nominal		30 & 31-May-08	23:07	03:56	
31-May-08	BOBS08-08-018	17:56 - 00:00	6.07	236	4906	2629	2278	56.95	Recording	Production	Production 2D Line		31-May-08	03:56	10:00	
31-May-08	BOBS08-08-018	00:00 - 04:33	4.55	236	2628	1001	1628	40.7	Recording	Production	Production 2D Line		31-May-08	10:00	14:33	
31-May-08	BOBS08-08-018	04:33 - 04:53	0.33	236	1000	881	120	3	Recording	Production	Production Runout		31-May-08	14:33	14:53	
31-May-08		04:53 - 00:00	19.12						Technical D/T	Inter-move	Standby on clients request, transit to the Vic Bass Strait prospect		31-May & 01-June-08	14:53	10:00	





PT-2008-041

Date: 31-May-08

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

**Consignee:**  
**Bass Strait Oil Company**  
 Level 1, 99 William Street  
 Melbourne  
 Victoria 3000  
 Australia  
 Attn: Keith Jacks on  
 Ph: +61 (0) 3 9927 3004  
 Fax: +61 (0) 3 9614 6533

Type of freight: Air	Comments: SEBOA Group Shoot, Bass Strait Oil, T42/43P, Copy Data (Seq 1 - 18)
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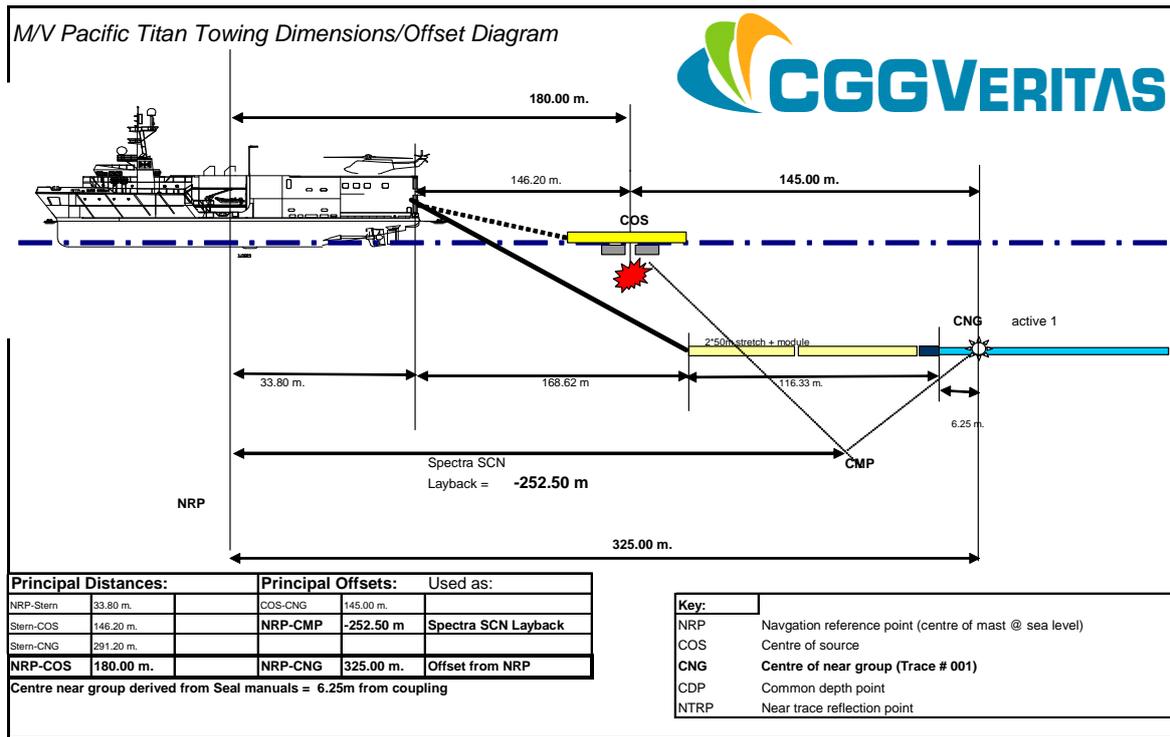
Box	Item	General description of content	Weight(kg)	Value(USD)
1	1	3590 Data tape containing Start of Job Tests (Tape 1)	0.2	3
	2-30	3590 Data tapes containing seismic data (Tapes 2 - 30) (sequence 1 - 13)	6.8	97
2	1-12	3590 Data tapes containing seismic data (Tapes 31 - 42) (sequence 14 - 18)	3	40
	13	3590 Data tape containing Interim & End of Job Tests (Tape 43)	0.2	3
		<b>Observers' data</b>		
	14	1 x CD containing Observers/Source/Tape Logs/Timing Diagram, Shipping Profoma	0.1	10
		<b>Nav data</b>		
	15	1 x DVD Navigation Data containing: Final P1/90, RawP294, Production/Processing Log	0.1	10
		<b>QC data</b>		
	16	1 x DVD containing QC Deliverable Data	0.1	10
		Please confirm receipt of goods to chobs.titan@cggveritas.com		

Total boxes 2 10.5  
 Total value: 173

Certified true and correct  
 CGG Veritas  
 M/V Pacific Titan

Sign Allan Beattie  
Chief Observer

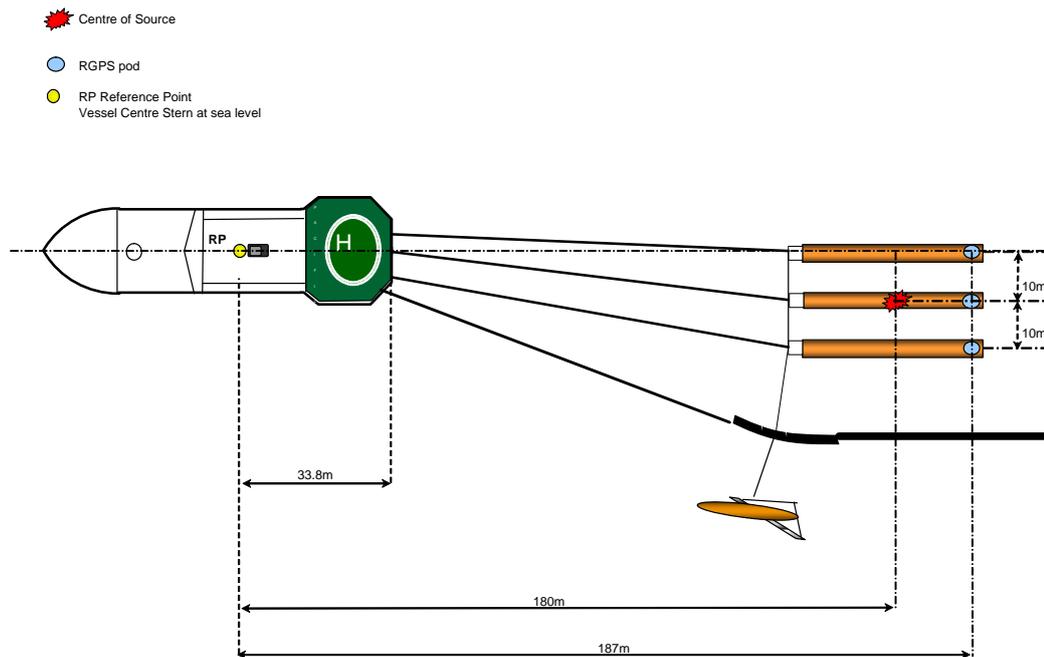
# 10. Towing Configuration



## 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 AXCUC)			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							
<b>PORT AFT REEL</b>							
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	96.8barm
Primary to Bubble Ratio	22.9

### 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.

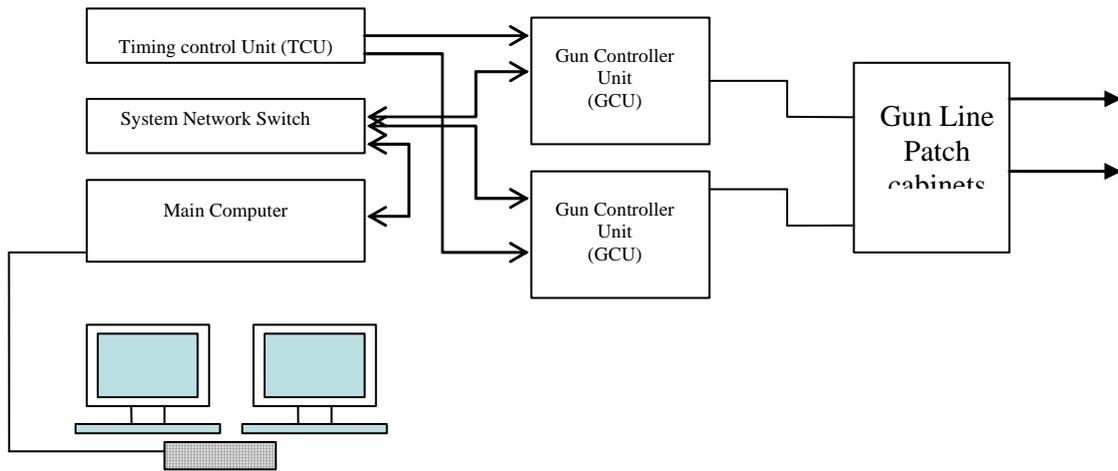
The system uses the latest high speed micro processors to provide onboard firing control and sensor timing monitoring, continuous monitoring of near field phones and interrogation of depth and pressure sensors.

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.

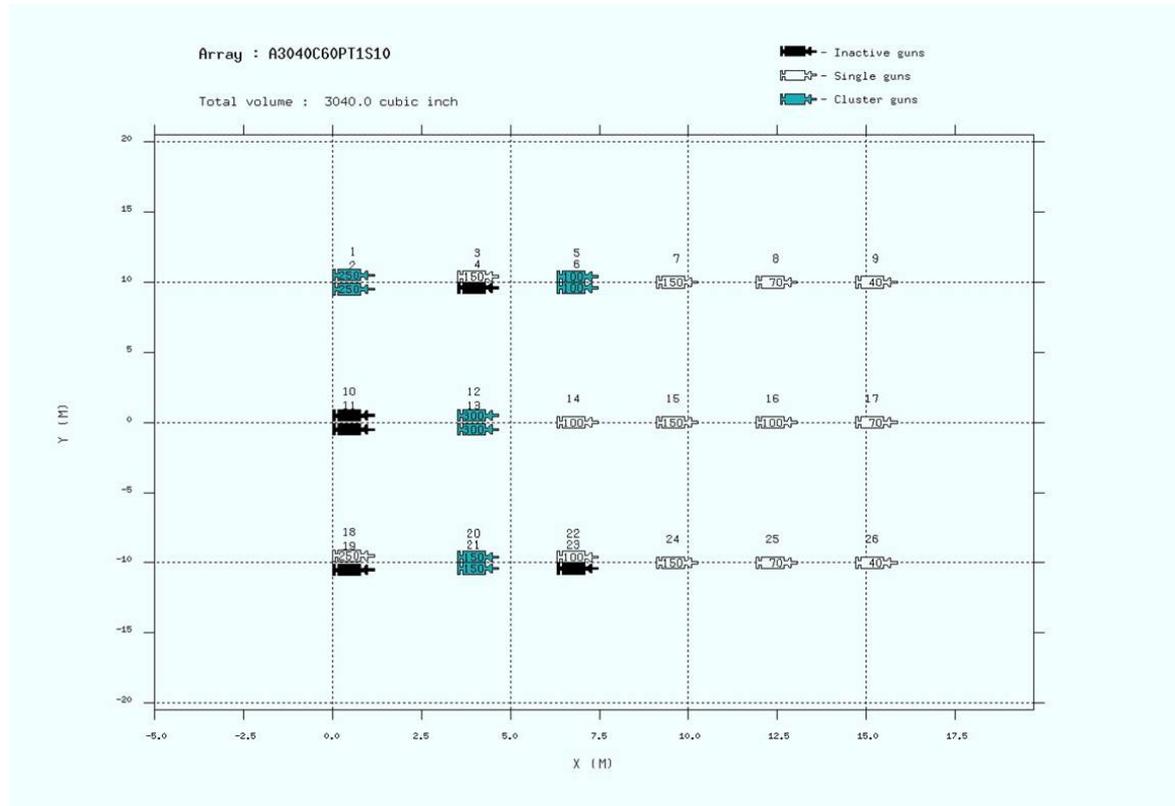
To further reduce operator fatigue, the system draws the operator's attention to gun misfires, auto-fires and other faults by use of voice alerts issued from the system speakers.



### 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

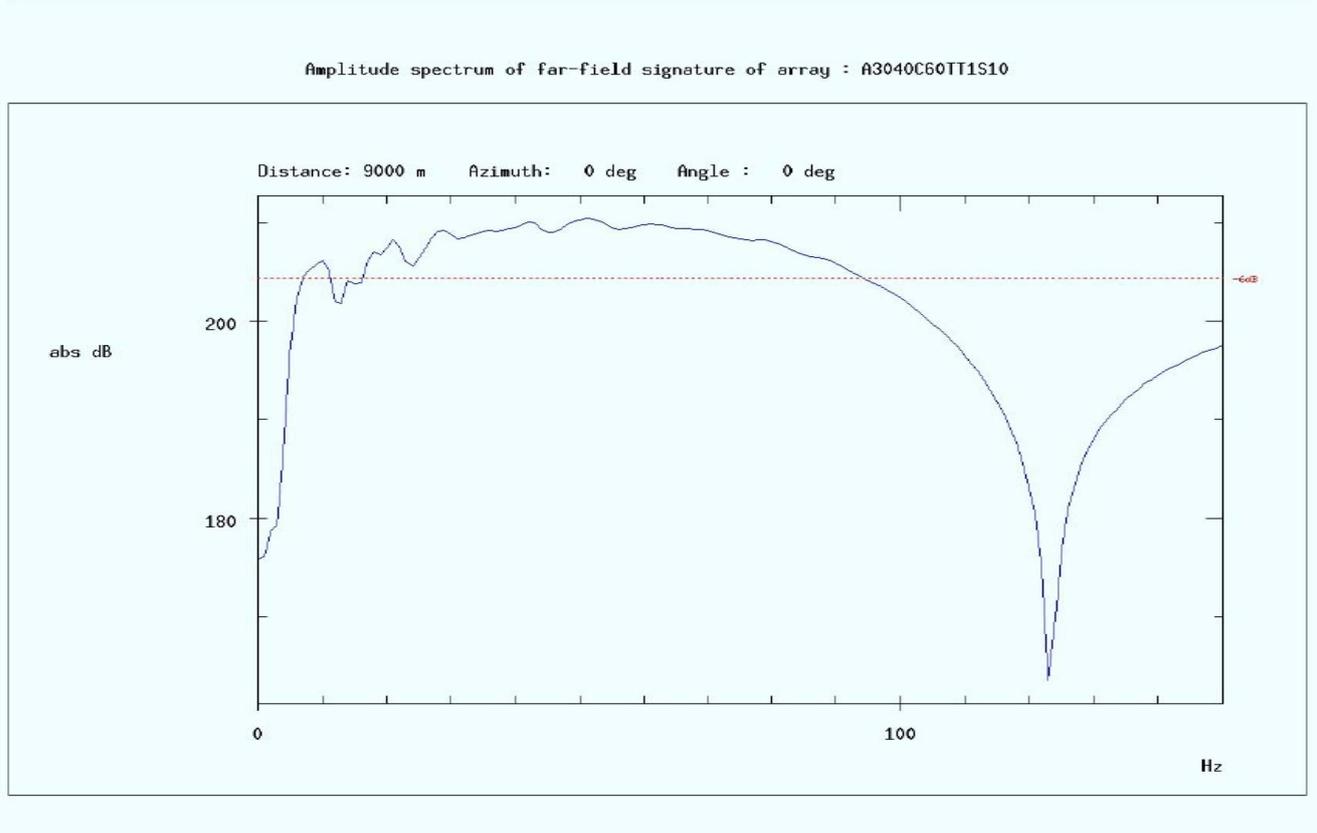
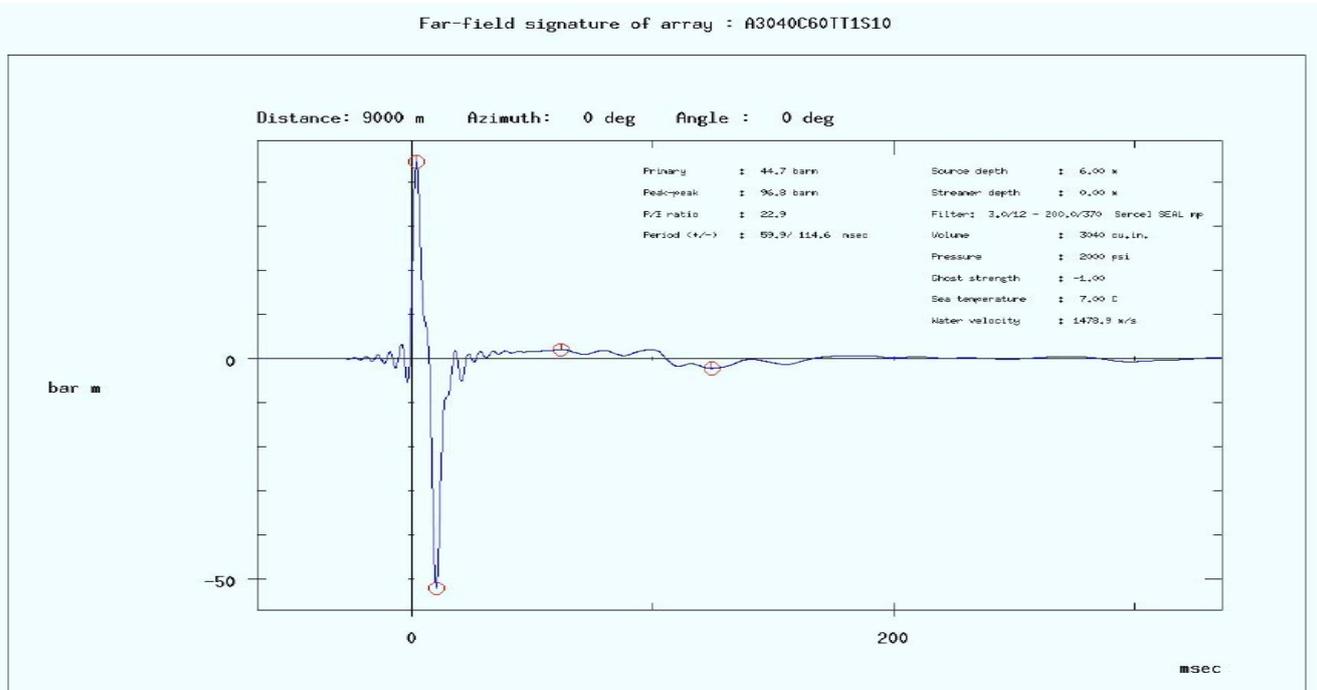
Total active volume: 3040 in<sup>3</sup>

Nominal pressure 2000 psi.

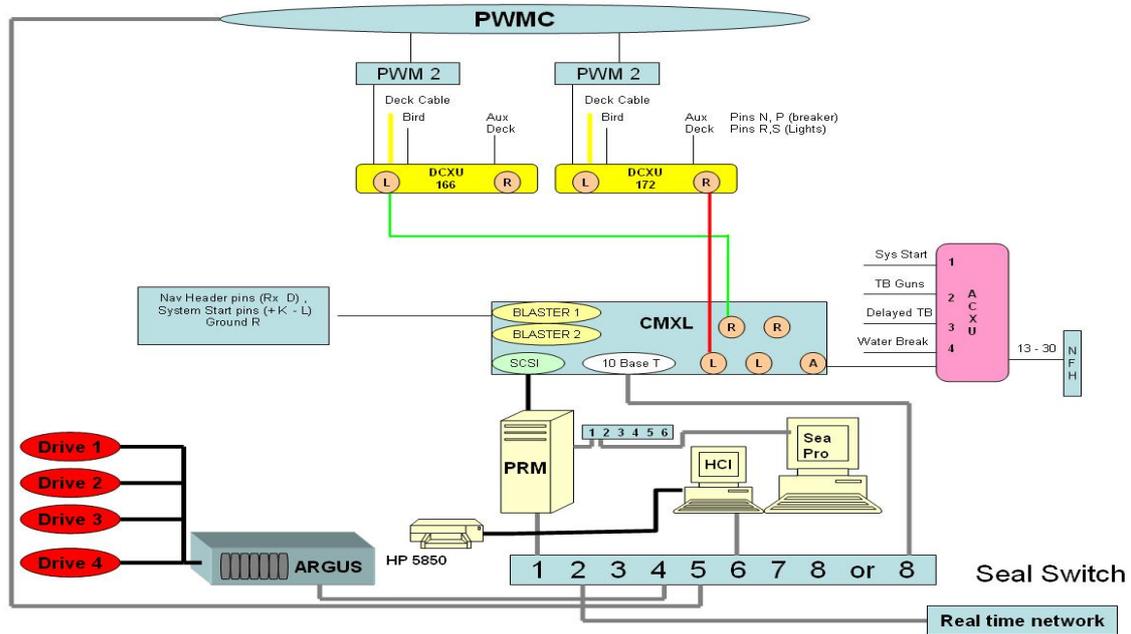
GUN#	GUN TYPE	Dist X (m)	Dist Y (m)	Dist Z (m)	Volume	Active / Spare	Sub-array #
1	1500LL	0	10.5	6	250	Active	1
2	1500LL	0	9.5	6	250	Active	1
3	1900LLX	3.5	10.5	6	150	Active	1
4	1900LLX	3.5	9.5	6	150	Spare	1
5	1900LLX	6.3	10.5	6	100	Active	1
6	1900LLX	6.3	9.5	6	100	Active	1
7	1900LLX	9.1	10	6	150	Active	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	RTN $\mu$ (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 gyrocompass used during the survey was:

Gyro 1 - Simrad HS50 GPS

Second gyro was for standby purposes only. This gyro was overhauled prior to the survey and was installed back in place without dual sided calibration.

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. The 200khz transducer was set to master transducer due depths of 80m encountered during the survey.

## 14. Survey Pre-plots

### 14.1. Geodetics

#### Satellite/Survey Datum

**Datum Name:** GDA94  
**Spheroid Name:** GRS80  
**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

No transformation from WGS 84 to GDA94

### 14.2. Preplot

H0100Survey Area T42P T43P 2D  
H0101General Survey Details  
H0200Date of Survey N/A  
H0201Date of Issue 17 Mar 2008  
H0202Tape Version P1/90  
H0203Line Prefix  
H0300Client Bass Strait  
H0400Geophysical Contractor CGGVeritas  
H0500Positioning Contractor  
H0600Position Processing  
H0800Co-ordinate Location Preplot Sail Line Locations  
H1100Receiver Groups per Shot 0  
H1400Surveyed Datum GDA94 GRS80 6378137.000 298.2572221  
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 1140.32 kilometres  
H2600AVG. LINE LENGTH 67.08 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 BOBS08-01 1 1001 2022 323.196 025525.0  
H2600 BOBS08-03 1 1001 2698 146.851 042425.0  
H2600 BOBS08-05 1 1001 3003 142.908 050050.0  
H2600 BOBS08-07 1 1001 2921 144.023 048000.0  
H2600 BOBS08-09 1 1001 3659 147.413 066450.0  
H2600 BOBS08-11 1 1001 3423 147.044 060550.0  
H2600 BOBS08-13 1 1001 3612 147.435 065275.0  
H2600 BOBS08-15 1 1001 4002 145.627 075025.0  
H2600 BOBS08-17 1 1001 3661 145.855 066500.0  
H2600 BOBS08-02 1 1001 3537 054.020 063400.0  
H2600 BOBS08-04 1 1001 3960 057.317 073975.0  
H2600 BOBS08-06 1 1001 4545 056.100 088600.0  
H2600 BOBS08-08 1 1001 4906 056.991 097625.0  
H2600 BOBS08-10 1 1001 4526 055.382 088125.0  
H2600 BOBS08-12 1 1001 4591 058.913 089750.0  
H2600 BOBS08-14 1 1001 4674 061.436 091825.0  
H2600 BOBS08-16 1 1001 2890 054.337 047225.0

H2600

SBOBS08-01 1001404937.20S1465046.68E 487039.85480435.8  
SBOBS08-01 2022403834.15S1463955.88E 471718.55500838.4  
SBOBS08-03 1001403052.55S1464017.23E 472166.95515073.0  
SBOBS08-03 2698405002.90S1465647.38E 495488.85479653.5  
SBOBS08-05 1001401459.69S1465111.16E 487506.55544493.8  
SBOBS08-05 3003403632.02S1471235.17E 517745.85504636.6  
SBOBS08-07 1001401458.94S1465355.84E 491397.05544522.5  
SBOBS08-07 2921403556.55S1471355.14E 519627.85505725.8  
SBOBS08-09 1001401450.79S1470448.99E 506827.65544775.5  
SBOBS08-09 3659404503.14S1473014.60E 542551.15488775.7  
SBOBS08-11 1001401743.56S1471057.42E 515520.85539435.9  
SBOBS08-11 3423404508.32S1473421.57E 548341.55488580.4  
SBOBS08-13 1001401223.26S1471012.03E 514468.15549313.5  
SBOBS08-13 3612404204.07S1473508.63E 549482.95494254.4  
SBOBS08-15 1001400938.39S1471011.62E 514468.15554396.5  
SBOBS08-15 4002404302.08S1474016.31E 556689.45492414.2  
SBOBS08-17 1001401221.20S1471534.75E 522097.15549358.5  
SBOBS08-17 3661404202.45S1474204.67E 559246.45494232.8  
SBOBS08-02 1001403219.83S1464029.04E 472454.85512383.1  
SBOBS08-02 3537401206.58S1471638.33E 523601.55549804.7  
SBOBS08-04 1001403646.44S1464004.39E 471906.05504160.3  
SBOBS08-04 3960401503.03S1472358.92E 533993.05544324.6  
SBOBS08-06 1001404413.11S1463318.02E 462426.95490345.2  
SBOBS08-06 4545401719.38S1472511.43E 535686.35540112.9  
SBOBS08-08 1001404834.55S1463030.64E 458546.35482263.0  
SBOBS08-08 4906401935.86S1472818.56E 540082.15535882.5  
SBOBS08-10 1001404742.12S1463933.50E 471258.55483940.1  
SBOBS08-10 4526402027.69S1473046.27E 543558.55534265.1  
SBOBS08-12 1001404818.38S1464318.26E 476529.15482840.3  
SBOBS08-12 4591402303.21S1473736.88E 553211.95529407.6  
SBOBS08-14 1001405010.43S1464259.43E 476099.05479383.9  
SBOBS08-14 4674402612.94S1474001.33E 556573.65523532.5  
SBOBS08-16 1001404447.08S1471548.45E 522242.05489359.7  
SBOBS08-16 2890402951.29S1474257.86E 560678.15516767.5

## **15. Navigation Systems Verification and Monitoring**

### **15.1. Gyro Monitoring**

Dockside verification was performed in Balikpapan, Indonesia over 07-08<sup>th</sup> 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 Singapore and onboard using a zero base line technique.

Previously verifications took place at Semayang Wharf, Balikpapan, Indonesia over the 07-08<sup>th</sup> 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 and speed of sound. All 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-**

The Spot beam demodulator failed for around 1 day. This was swapped out with the spare.

#### **17.1.2. Echo Sounder**

The echo sounder performed consistently well throughout the survey.

#### **17.1.3. Gyro**

The primary and secondary gyro performed well during the survey.

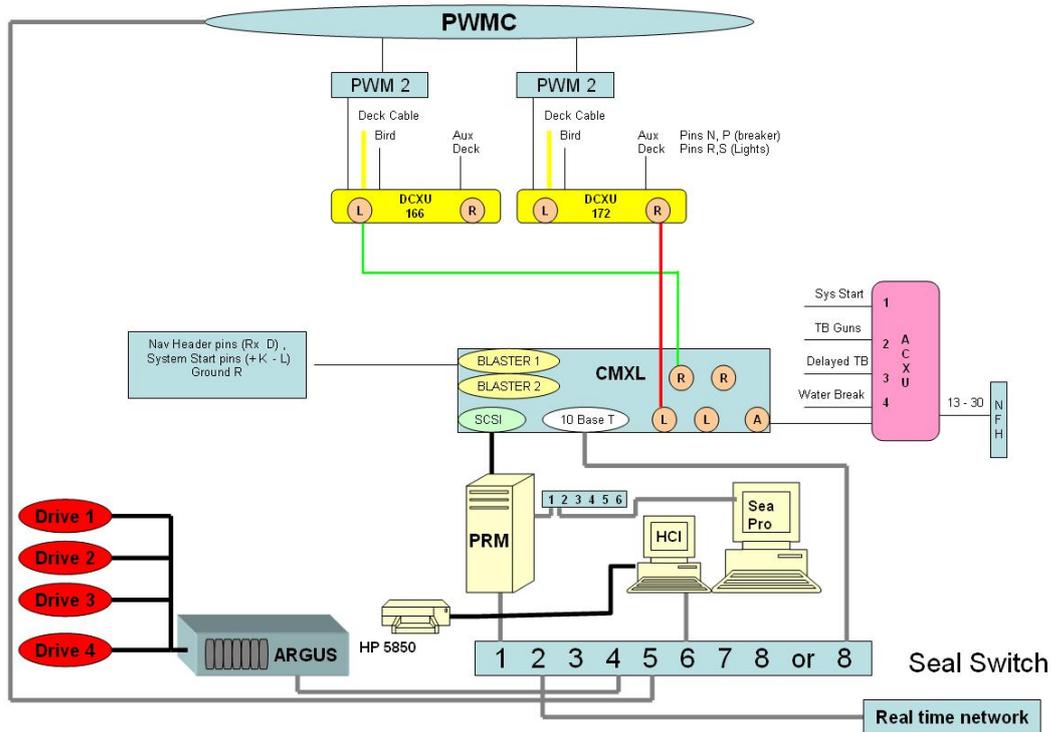
#### **17.1.4. RGPS**

RGPS worked well throughout the survey with no significant drop outs.

### **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 2.5.2
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 85 & 337 failing Capacitance, Channel 452 failing Low Frequency Cut-off and Channels 242 & 452 failing Hydrophone Leakage.

Due to a break in the acquisition of this block, after Sequence 4, a further set of tests were performed as above and sent to the processing centre together with the seismic data. The results of the tests from recommencement of production were: Channel 337 failing Capacitance, channels 51, 242 & 252 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 until Sequence 4. From Sequence 5 to EOJ no channels 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

Date Local	System tests						Sensor tests			Remarks
	HD	Sys noise	CMRR	Gain err	X talk odd	X talk even	Cap	LF cut-off	Leakage	
04-May-08	ok	ok	ok	ok	ok	ok	2	1	2	SOJ TEST: Chs. 85, 337 failed Capacitance. Ch. 452 failed Cutoff, Ch. 242 & 452 failed Leakage.
05-May-08	ok	ok	ok	ok	ok	ok	2	1	2	Chs. 85, 337 failed Capacitance. Ch. 452 failed Cutoff, Ch. 242 & 452 failed Leakage.
-	-	-	-	-	-	-	-	-	-	No Tests recorded for period 6th May to 23rd May due to vessel not on survey.
24-May-08	ok	ok	ok	ok	ok	ok	1	0	3	Ch 337 fails Capacitance, Ch 51, 242, 252 failed Leakage
25-May-08	ok	ok	ok	ok	ok	ok	1	0	3	Ch 337 fails Capacitance, Ch 51, 242, 252 failed Leakage
26-May-08	ok	ok	ok	ok	ok	ok	1	0	2	Ch 337 fails Capacitance, Ch 51, 242 failed Leakage
27-May-08	ok	ok	ok	ok	ok	ok	1	0	2	Ch 337 fails Capacitance, Ch 51, 242 failed Leakage
28-May-08	ok	ok	ok	ok	ok	ok	1	0	2	Ch 337 fails Capacitance, Ch 51, 242 failed Leakage
29-May-08	ok	ok	ok	ok	ok	ok	1	0	2	Ch 337 fails Capacitance, Ch 51, 242 failed Leakage
30-May-08	ok	ok	ok	ok	ok	ok	2	0	2	Ch 85, 337 fails Capacitance, Ch 51, 242 failed Leakage
31-May-08	ok	ok	ok	ok	ok	ok	3	0	2	Ch 85, 91, 337 fails Capacitance, Ch 51, 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: Channels 85, 91 & 337 failed Capacitance. Channels 51 & 242 failed Leakage.



# 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

## DGPS Reference Guide

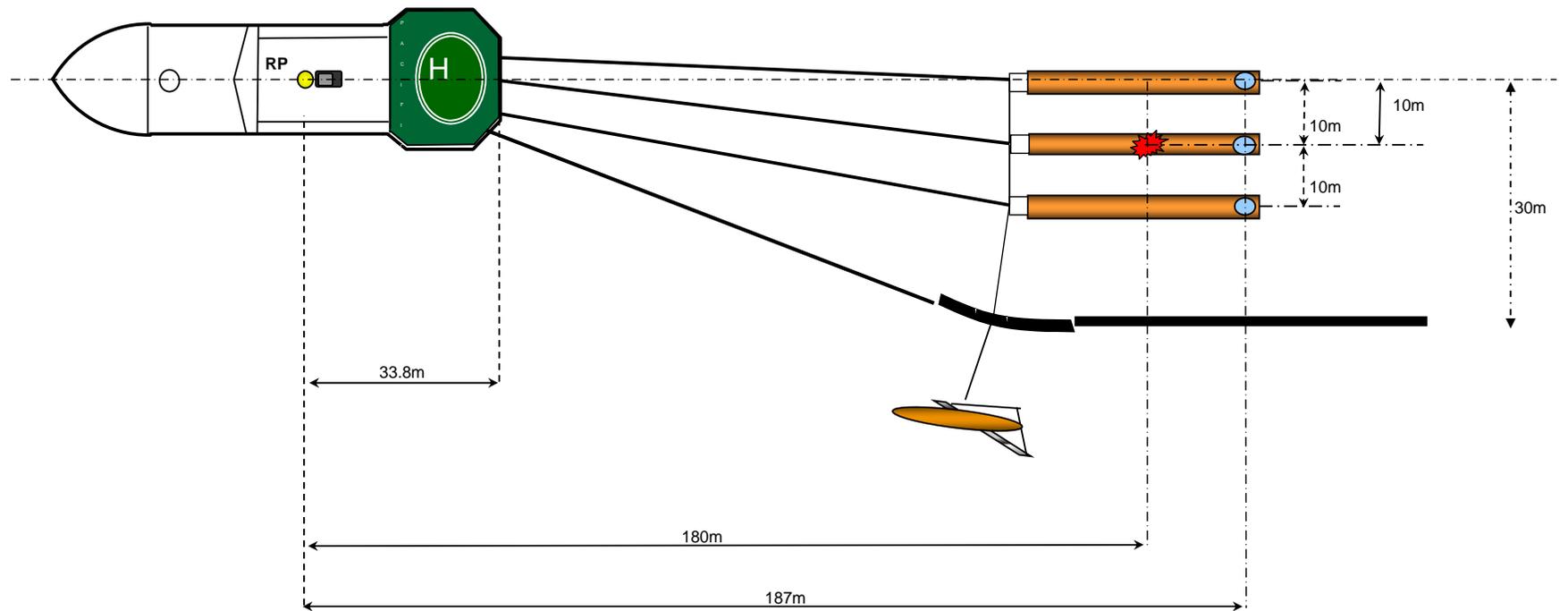
<i>Spectra Name</i>	<i>GPS Feed</i>	<i>Position Type</i>
V1G1	SPM1	SPM 5.16 XP
V1G2	SPM2	SPM 5.16 HP
V1G3	SPM2	Mulifix 5 XP
V1G4	SPM2	SPM 5.16 XP
V1G5	SPM1	SPM 5.16 HP

## RGPS Reference Guide

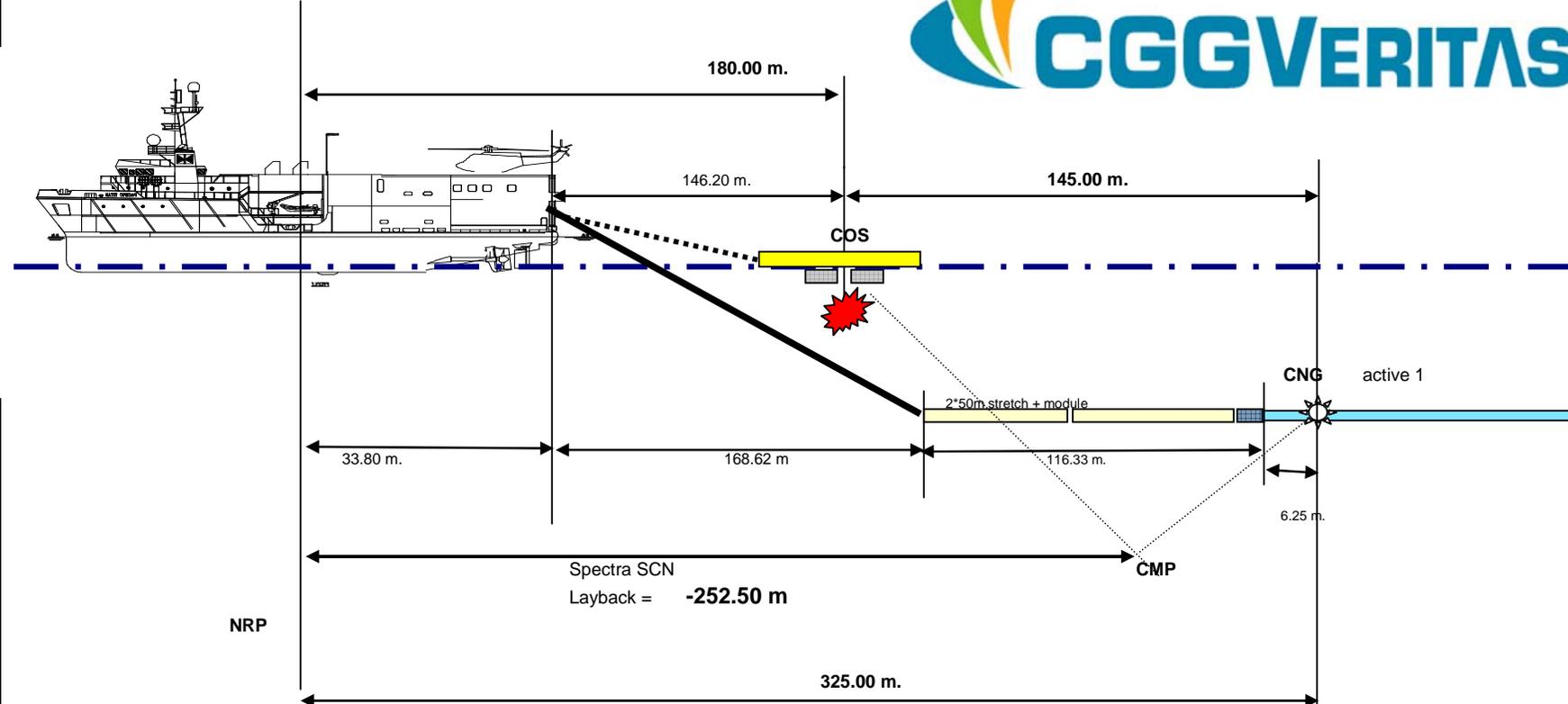
<i>RGPS System</i>	<i>GPS Reference</i>	<i>Spectra Node</i>	<i>Position</i>
V1R1 (RGPS1)	SPM1	G1R1	Gun String 1
		G1R3	Gun String 2
		G1R5	Gun String 3
		TB1R1	Tailbuoy
V1R2 (RGPS2)	SPM2	G1R2	Gun String 1
		G1R4	Gun String 2
		G1R6	Gun String 3
		TB1R2	Tailbuoy

# Pacific Titan General Towing arrangement

-  Centre of Source
-  RGPS pod
-  RP Reference Point  
Vessel Centre Stern at sea level



# M/V Pacific Titan Towing Dimensions/Offset Diagram

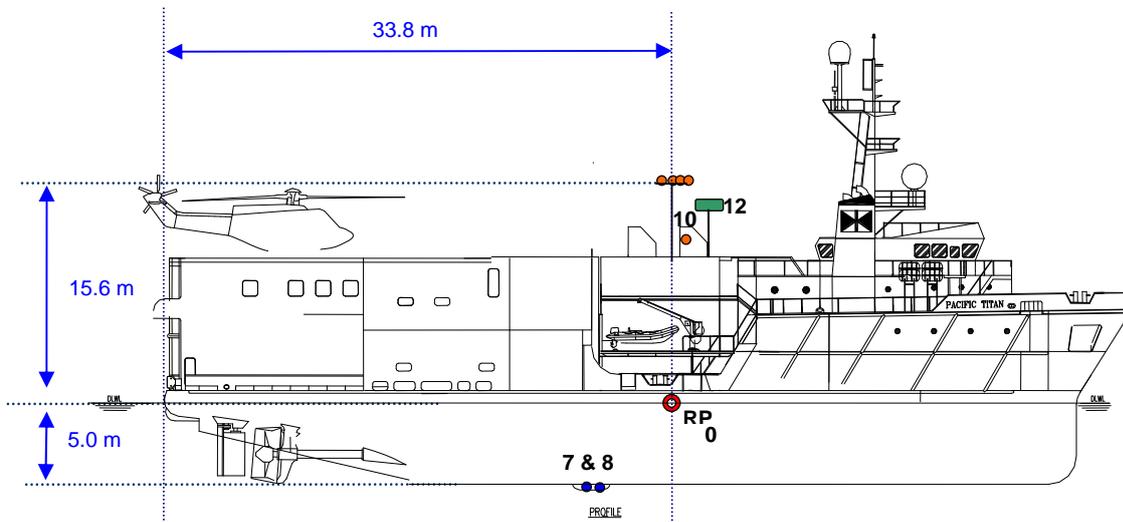


Principal Distances:		Principal Offsets:		Used as:
NRP-Stern	33.80 m.	COS-CNG	145.00 m.	
Stern-COS	146.20 m.	<b>NRP-CMP</b>	<b>-252.50 m</b>	<b>Spectra SCN Layback</b>
Stern-CNG	291.20 m.			
<b>NRP-COS</b>	<b>180.00 m.</b>	<b>NRP-CNG</b>	<b>325.00 m.</b>	<b>Offset from NRP</b>

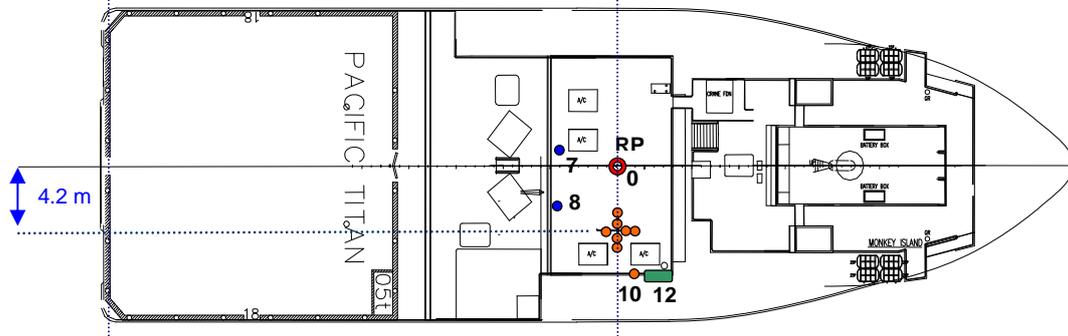
Centre near group derived from Seal manuals = 6.25m from coupling

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

# Antenna Offsets

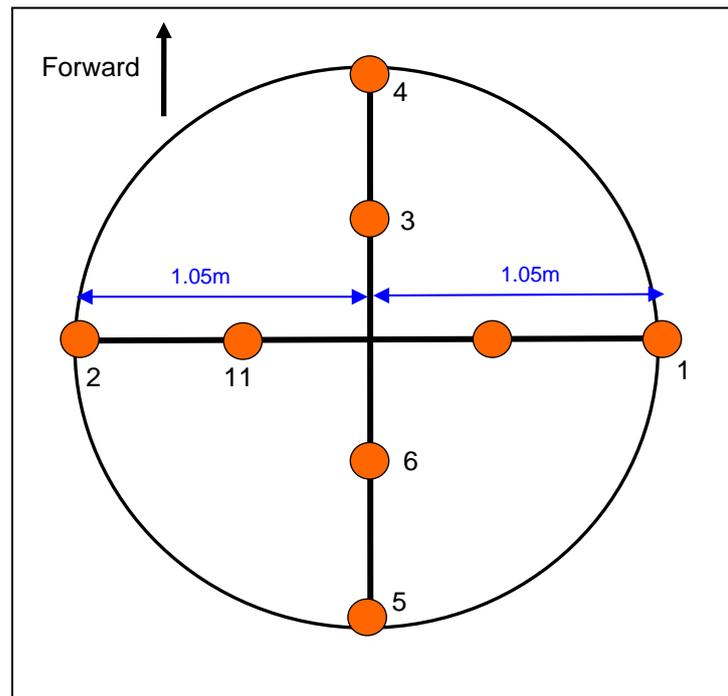


See following page for detail of antenna mast



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



### Navigation Processing Log

Client: **Bass Strait**

Job: **6374**

Area: **T42P T43P**

Line Name	Seq	FOSP	FCSP	LSP	LOSP	Line Status	Processing Comments
BOBS08-02-001	1		3537	881		Complete	Tailbuoy Dead Compass Bias S1C8 No E33 record for Sps 3242,2734,1367,1275,894
BOBS08-04-002	2		1001	4080		NTBP	
BOBS08-01-003	3		2022	881		Complete	Tailbuoy Dead No E33 record for Sps 1667, 992 Compass Bias S1C9 fail
BOBS08-03-004	4		1001	2818		Complete	Tailbuoy Dead No E33 record for Sps 1993,2690 High Gun separations causing high UV from Sp 2470
BOBS08-04-005	5		1001	4080		Complete	shot 1284 No E33 record shot 1890 No E33 record
BOBS08-06-006	6		4545	881		Complete	WARNING: shot 4347 , 4081, 3649, 3256, 2777, 2453, 2287, 1708, 1529, 1474, 1378, 1133 No E33 records
BOBS08-12-007	7		1001	4711		Complete	shots 1007 1339 1420 2575 2659 2782 3554 3641 3765 3769 4461 No E33 records
BOBS08-10-008	8		4526	881		Complete	WARNING: shot 4228 4065 4031 3720 3419 2847 2532 1744 1080 No E33 record
BOBS08-14-009	9		1001	4794		Complete	shot 1175 No E33 record shot 1562 No E33 record shot 2256 No E33 record shot 2547 No E33 record shot 3099 No E33 record shot 3426 No E33 record shot 4433 No E33 record
BOBS08-16-010	10		2890	881		Complete	WARNING: shot 2350 No E33 record WARNING: shot 1868 No E33 record WARNING: shot 1625 No E33 record WARNING: shot 1420 No E33 record WARNING: shot 1148 No E33 record SP 2750 to 2710. Streamer stretch extended by 14m max
BOBS08-05-011	11		1001	3123		Complete	WARNING: shot 2127 No E33 record WARNING: shot 2194 No E33 record WARNING: shot 2804 No E33 record WARNING: shot 2934 No E33 record Compass 2 KO from processed solution

BOBS08-07-012	12	2921	881	Complete	shot 2531 No E33 record shot 2111 No E33 record shot 1602 No E33 record TB1R1 globally rejected
BOBS08-09-013	13	1001	3779	Complete	WARNING: shot 1122 No E33 record
BOBS08-15-014	14	4002	881	Complete	shot 3801 No E33 record shot 1990 No E33 record shot 1952 No E33 record shot 1906 No E33 record shot 1861 No E33 record shot 1368 No E33 record shot 1117 No E33 record
BOBS08-17-015	15	1001	3781	Complete	WARNING: shot 1455 No E33 record WARNING: shot 2492 No E33 record WARNING: shot 2542 No E33 record WARNING: shot 3219 No E33 record
BOBS08-13-016	16	3612	881	Complete	shot 2879 No E33 record shot 1973 No E33 record shot 1662 No E33 record VIG2N Globally rejected
BOBS08-11-017	17	1001	3543	Complete	WARNING: shot 995 No E33 record WARNING: shot 1322 No E33 record WARNING: shot 1599 No E33 record WARNING: shot 1895 No E33 record WARNING: shot 3196 No E33 record WARNING: shot 3380 No E33 record
BOBS08-08-018	18	4906	881	Complete	shot 4692 No E33 record shot 4029 No E33 record shot 3089 No E33 record shot 2995 No E33 record shot 2847 No E33 record shot 2704 No E33 record shot 1926 No E33 record shot 1714 No E33 record shot 1145 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

System	Easting		Northing	
	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

System	Easting		Northing	
	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

TB SERIAL #	Easting		Northing	
	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 6<sup>th</sup> 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 6<sup>th</sup> February 2008, the vessel's heading was 250°. 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 250° 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 11<sup>th</sup> 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	105° E
Latitude of origin	0° (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 250° 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 °

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

FUGRO SURVEY AS  
Report on Gyro Calibration, Tailbuoys and DGPS Verification on M.V. Pacific Titan  
At Semayang Wharf, 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 08<sup>th</sup> 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

System	Easting (m)		Northing (m)	
	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

Cal. #	Heading	Gyro 1 HS 50		Gyro 2 AD 100	
		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

System	Degrees °		Distance (m)	
	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 – 08<sup>th</sup> 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:

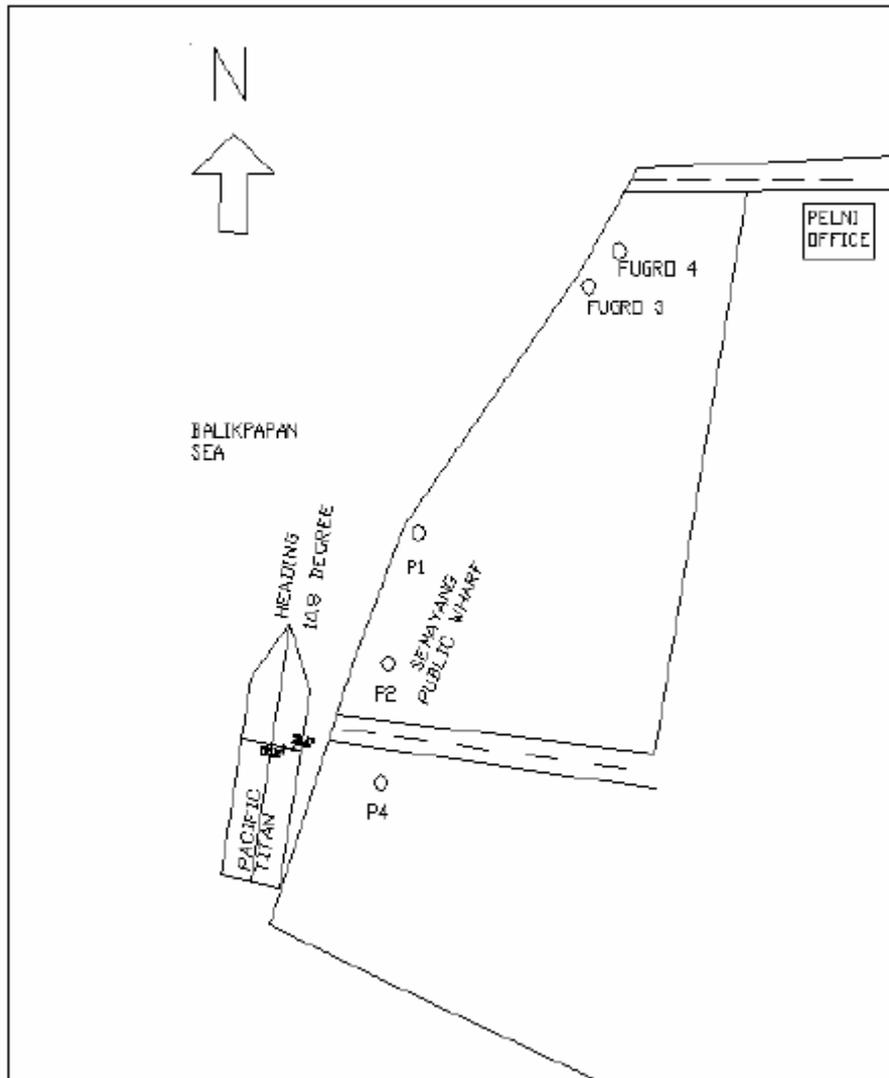
Global Positioning System Geodetic Parameters	
Spheroid:	World Geodetic System 1984
Datum:	World Geodetic System 1984
Semi major axis:	a = 6 378 137.000 m
Inverse Flattening:	$\frac{1}{f} = 298.257\ 223\ 563$
Project Projection Parameters	
Grid Projection:	Universal Transverse Mercator
UTM Zone:	50 S
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

**FUGRO SURVEY AS**

Report on Gyro Calibration, Tailsbuoys and DGPS Verification on M.V. Pacific Titan  
At Semayang Wharf, Balikpapan, Indonesia



**C FIELD DIAGRAM**





## Appendix 4 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. Four TS Dip measurements were taken during the survey.

<b>Position</b> <b>Lat</b> 040° 18' 39" S <b>Long</b> 146° 05' 01" E  <b>Date:</b> 01 April 2008 <b>Time:</b> 09:27 GMT 20:17 Local Time	<b>Position</b> <b>Lat</b> 040° 01' 01" S <b>Long</b> 145° 21' 21" E  <b>Date:</b> 05 May 2008 <b>Time:</b> 20:15 GMT 07:15 Local Time
1514.19 Mean Velocity on deploy 1514.03 Mean Velocity on recovery  1514.11 <u>Mean Velocity</u>	1510.02 Mean Velocity on deploy 1510.36 Mean Velocity on recovery  1510.19 <u>Mean Velocity</u>
<b>Position</b> <b>Lat</b> 040° 25' 51" S <b>Long</b> 146° 05' 55" E  <b>Date:</b> 24 May 2008 <b>Time:</b> 16:45 GMT 02:45 Local Time	<b>Position</b> <b>Lat</b> 040° 41' 17" S <b>Long</b> 146° 32' 24" E  <b>Date:</b> 31 May 2008 <b>Time:</b> 09:14 GMT 19:14 Local Time
1510.23 Mean Velocity on deploy 1510.11 Mean Velocity on recovery  1510.17 <u>Mean Velocity</u>	1509.09 Mean Velocity on deploy 1509.06 Mean Velocity on recovery  1509.08 <u>Mean Velocity</u>

- TS DIP on 01st April 2008
- TS DIP on 05th May 2008
- TS DIP on 24th May 2008
- TS DIP on 31st May 2008

