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1 Survey Information and Objectives

Apache Energy PTY Ltd. of Australia agreed with **Multiwave** to utilize the m/v Pacific Titan as a shooting vessel for under-shooting 2 rigs on their 3D survey in block VIC/P58 outside Gippsland, Victoria, Australia.

The survey area was located south west of Lake Entrance on the Ninety Mile Beach.

The water depth in the area was logged to be around 40 metres.

The Pacific Titan is owned by Swire Pacific Offshore and operated by Multiwave.

As a recording boat was used the Western Trident operated by WesternGeco.

Pacific Titan met with Western Trident on the 12th of February in the survey area. Western Trident was assigned as the master boat with Pacific Titan as a slave vessel. Pacific Titan was located on the side of Western Trident as required by the instrument room onboard there.

Production on the prospect started on the 14th of February 2005 after some communication problems between the 2 vessels.

The survey was completed on the 17th of February and a total of 282 sail kilometres were acquired.

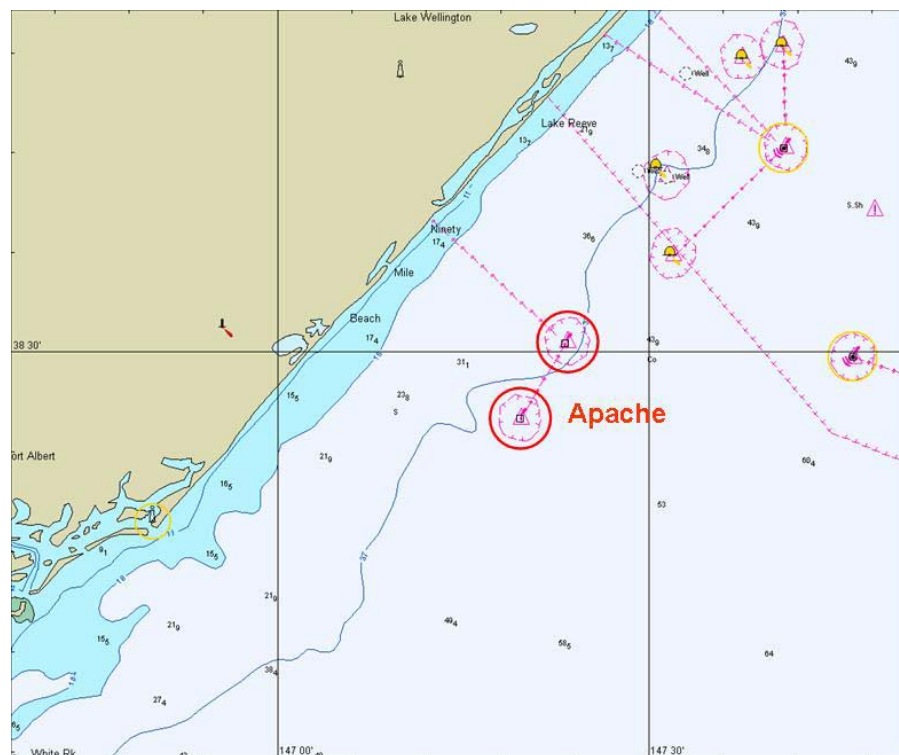
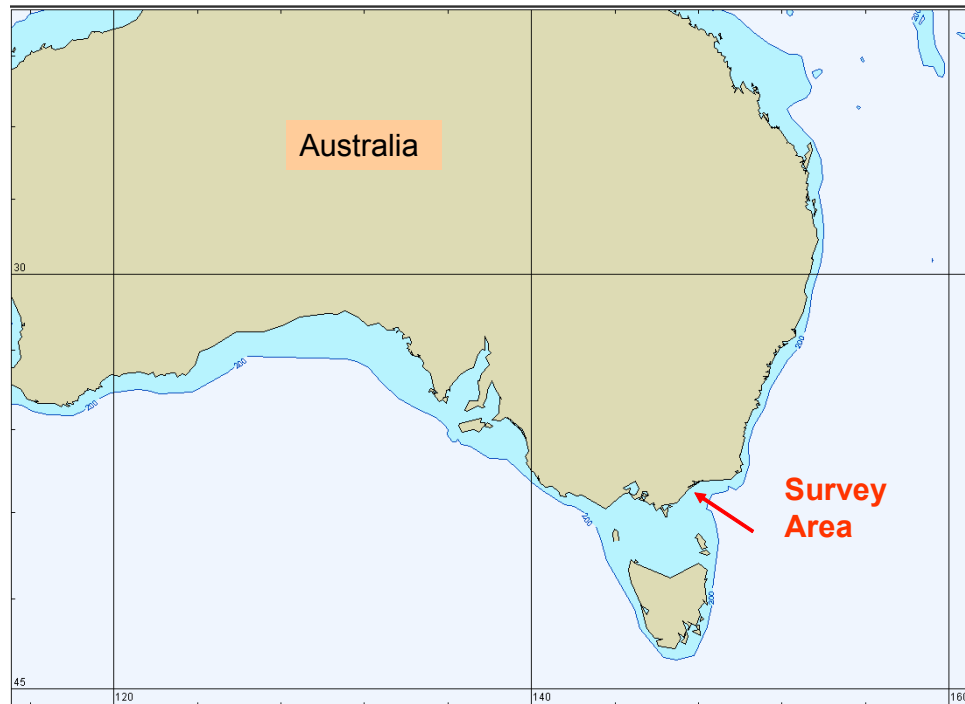
After completion the Pacific Titan sailed to Eden, New South Wales for demobilisation.

The gun controller data was the only data recorded onboard the Pacific Titan. These data were shipped off to Apache via the agent in Eden on the 18th of February.

There were no accidents or severe incidents during the survey.

2 Survey Area

2.1 Location of Survey



3 Contract Work Order



CONTRACT WORK ORDER

CONTRACT	
Client:	Apache Energy Limited
Vessel(s):	Pacific Titan
Job number:	6217
Bid number	
Client contract number/ref:	Sue 3D contract plan rev-02 and CPSP-6217 ver-01
Name	SUE 3D MSS Undershoot with Western Trident
Area:	VIC L 15 & 17, Gippsland Basin, Australia
Type of survey:	Source vessel-Undershoot
Area, or total kms:	TBA
Line heading:	TBA
Number of lines:	TBA
Line length:	Variable
Acquisition method:	single source
Estimated start date:	12-Feb-05
Estimated duration:	3-4 days
QHSE checklists completed	
STREAMER	
Type of streamer	N/A
Number of streamers	N/A
Separation	N/A
Streamer length	N/A
No. of channels	N/A
Group interval	N/A
Streamer depth	N/A
Water Depth	N/A
RECORDING	
Instrument type	
Record length	
Sample rate	
Recording filter: Hi-cut	
Recording filter: Lo-cut	
Filter type	
Pre-Amplifier Gain	
Tape format	Seg D Rev.1
Recording media	3590 Tape
Tape Copy	
SOURCE	
Source type	Bolt long-life Airguns
Source controller	GunLink 2000
Number of sources	1
Source separation	n/a
Volume per source	3040 cu/in
Source depth	7 metres average
Source pressure	2000 psi / 138 Bar
Source length	14.7 m
Number of sub-arrays per source	3
Sub-array separation	10
Flip/Flop	n/a
Shot point interval per shot	18.75 m
Shot point location	
Near fields to be recorded?	yes
Source firing specifications	+/- 1.0 ms
<div style="text-align: right;"> Signed: </div>	

4 Vessel Description

4.1 Vessel Specifications – Pacific Titan

The M/V Pacific Titan is capable of doing both 2D and 3D seismic data acquisition surveys. For 2D operations the vessel can tow a 12 000 meters streamer. For 3D work the vessel can do a dual source/dual streamer (2X8000m) or a 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, acoustic streamer positioning and onboard navigation. The following are general specifications for the vessel and seismic equipment on board.



Section 1: General Information

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
ton's 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: Kelvin Hughes Nucleus 6000A
ARPA
Secondary Radar: JRC JMA 3210 Daylight
GPS: Furuno GP 30
Echo Sounder: Simrad ED-162
Communications: G.M.D.S.S. Skanti
SSB,VHF,Inmarsat C 456304540 /
456304550
Weather Fax: Furuno 207
Satcom B: NERA Inmarsat phone/fax
Tel (874) 356 304 510
Vsat: Instrumentroom +47 51 40 76 11
Party Chief +47 51 40 76 12
Chiefs office +47 51 40 76 13
Fax +47 51 40 76 14
High Speed data link: NERA Inmarsat system:
Tel (873) 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 helicopter deck.
P.A. System
Stainless steel gun deck.
Helicopter deck rated for Bell 212 or equivalent with lights.

4.2 Seismic Particulars

4.2.1 Source and Mechanical Department Details

item	description	type	amount	remark
Guns	Long Life	Bolt		6 gun positions per sub-array 8 guns per sub-array
Hanging Plates	Multiwave design	Multiwave		
Chambers	40 – 300 cu.in.			
Cluster	2-gun cluster	Bolt	12	2 clusters on per 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 3000	Seamap		32 guns, expandable
Solenoid Power Supply	Gunlink 3000	Seamap		25 ms fire pulse width
Deflector	Multiwave	6 foils	2	
Gun Winches		Dual/single	2 * 3	Slip-ring, Air
Streamer Winches		Single	4	Each 9000 m (50 mm)
Spooling Device	Marine Project Development	Linear	4	Spooling on each streamer winch individually
Tow Points	ODIM	Flexible	3	
Winch Control	ODIM		2	Hydraulic remote

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1 List of Key Personnel

1.1 Onboard Personnel

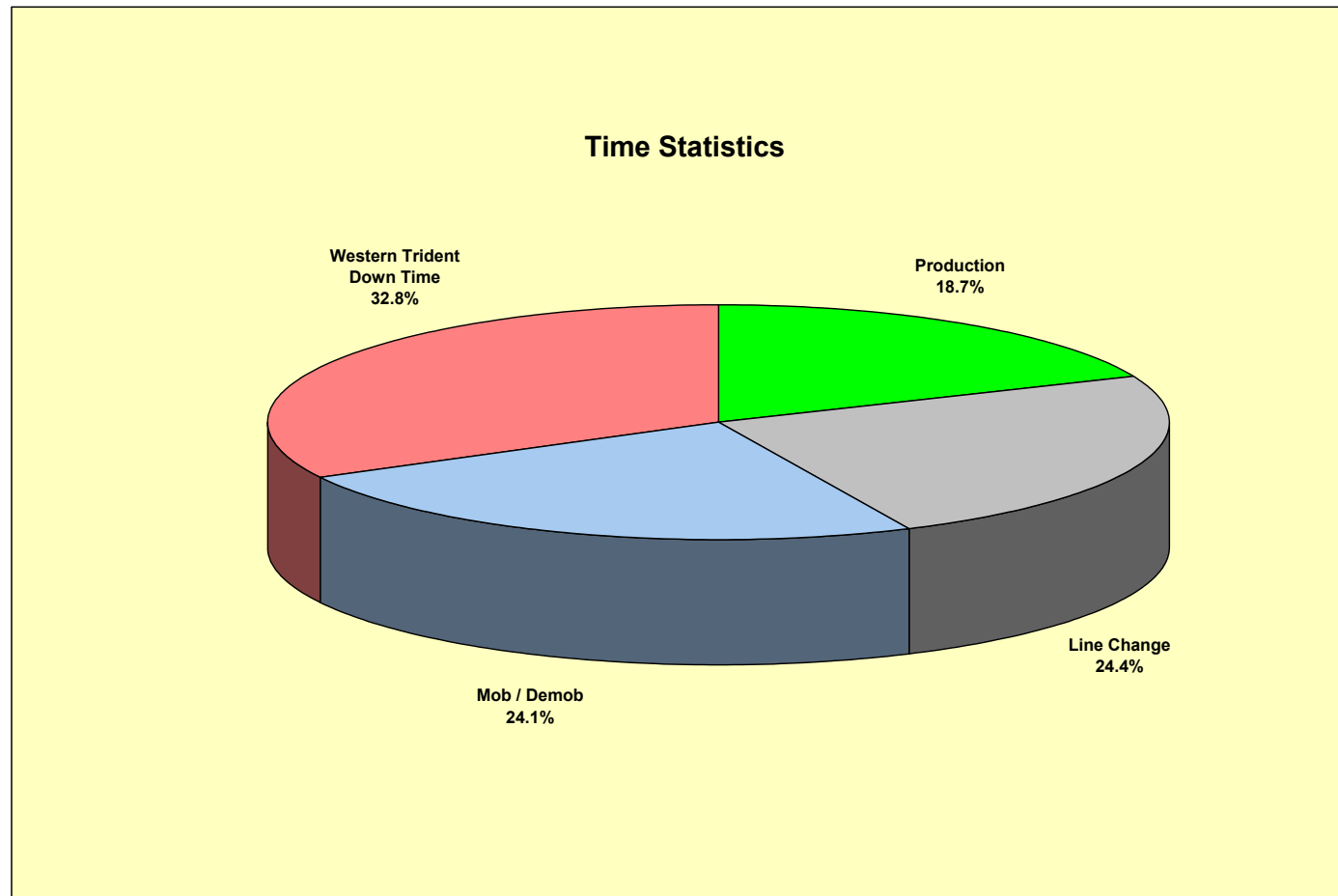
POSITION	CREW 2
Party Chief	Ketil Glimsjø
Captain	Michael Huler
Chief Engineer	Tommy Boughton
Chief Observer	Haydn Brook
Shift leader Observer	Cliff Gobitt
Chief Navigator	John Evans
Shift leader Navigation	Mark Smith
Chief Mechanic	Markus Rahm
Shift leader Mechanic	Alex Gastador
QC leader	Emma Buckingham
Client Representative	Drew Murray

1.2 Office Support Personnel

POSITION	NAME
Operation Manager	Atle Jacobsen
Operation Supervisor	Terje Kristiansen
Instrument support	Franck Andersen
Navigation support	Willy Forland
Mechanic support	Eivind Haavik
QC support	Christophe Massacand

2 Survey Information

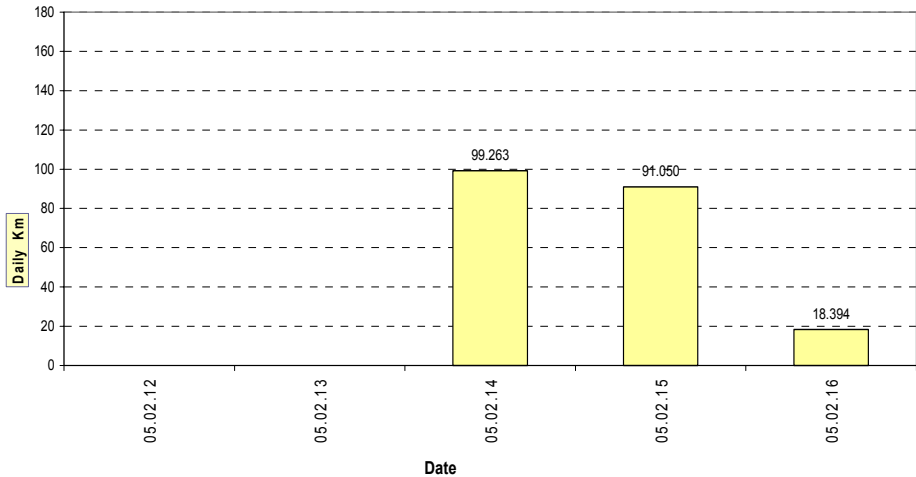
2.1 Production Statistics



Section 2: Operation Summary

Hours	JOB TOTAL	
120.53	Total Time	100.0%
22.58	Prime lines	18.7%
29.41	Linechanges	24.4%
0.00	Technical downtime	0.0%
29.01	Mob/Demob	24.1%
0.00	Weather	0.0%
39.53	Western Trident	32.8%
0.00	Swire DT	0.0%
0.00	Run-Out	0.0%

Daily Production Gippsland,
VIC/P 58 - Apache Energy
Job 6217



3 Production Log

PRODUCTION LOG

Apache Energy Victoria Vic P/58 -Job 6217								Total KM 208.706				
PACIFIC TITAN		All lines prefixed GAP04B										
Date	Line	Seq	Hdg.	FSP	LSP	SP	Kilometers					Comments
05.02.14	163201U1	091	224	2630	959	1672	31.350					Complete
05.02.14	1744U1	092	044	1103	2210	1108	20.775					Complete
05.02.14	1632U1	093	224	2630	1175	1456	27.300					Complete
05.02.14	1744U2094	094	044	1103	2160	1058	19.838					Complete
05.02.15	1632U3095	095	224	2630	1202	1429	26.794					Complete
05.02.15	1744U3096	096	044	1103	2250	1148	21.525					Complete
05.02.15	1632U4097	097	224	2630	1250	1381	25.894					Complete
05.02.15	1744U4098	098	044	1103	2000	898	16.838					Complete
05.02.16	1632U5099	099	224	2530	1550	981	18.394					Complete
							208.706					

3.1 Daily Summary

12th February 2005

HSE Activity:

3 toolbox meetings at handover/shift change. 3 departments.
2 observation cards received.

Daily Summary:

Mobilised for Apache Energy. At prospect area waiting for Western Trident and the two-boat link to be installed. At 23:00 the link was up and running. Working to solve problems with gun controller communication.

13th February 2005

HSE Activity:

6 toolbox meetings at handover/shift change. 3 departments, 2 shifts.
1 toolbox meeting prior to Western Trident FRC personnel transfer.

Daily Summary:

Shot a line passing north of obstruction Dolphin, but no recording took place onboard the Western Trident. Problems with time break on gun timing onboard the "Trident" side. The WesternGeco field service engineer was transferred back from Pacific Titan to Western Trident in the afternoon. At 13:00 UTC, midnight local, both vessels in shooting position. Navigation system on the Titan controlled from Trident, but frozen. Still timing problems on Trident. At 14:00 UTC - 01:00 local - run-in aborted. Further troubleshooting required on the Trident. At 20:00 UTC - 07:00 local - heading back towards line. Spectra on Titan running as single boat. System not 100%, but in a state where recording possibly could take place. At 22:37 UTC - 09:37 local - began soft start.

14th February 2005

HSE Activity:

6 toolbox meetings at handover/shift change. 3 departments, 2 shifts.

Daily Summary:

Steady production throughout the day : 99.263 Km.

15th February 2005

HSE Activity:

6 toolbox meetings at handover/shift change. 3 departments, 2 shifts.
1 TB meeting between Capt.. and PC regarding port call.

Daily Summary:

Steady production throughout the day : 91.050 Km. Closest pass to a platform was 75m on seq. 095. Temporarily lost one engine on line change between seq. 096 and 097. No time lost. Also on same line change, the generator fuel pump broke, making it impossible to run compressor under load. The fuel pump was replaced while the compressor was running on idle and it was brought back together before sol. No time lost.

Western Trident FRC on visit after seq. 098 to pick up a "True Time Unit", a part of their two-boat link.

Section 2: Operation Summary

16th February 2005

HSE Activity:

6 toolbox meetings at handover/shift change. 3 departments, 2 shifts.

1 TB meeting prior to retrieving source.

2 observation cards received.

Daily Summary:

Shot the last line in marginal weather. Retrieved the source and headed for port in Eden, NSW.

17th February 2005

HSE Activity:

Nothing to report.

Daily Summary:

Arrived in Eden at 05:30 and unloaded shipment.

End of demob at 06:30.

Two crew members and client representative departed.

3.2 Field Information and Encountered Problems

3.2.1 Obstructions / Installations in the Field

There were two field installations in the Prospect Area. The purpose of the survey was to acquire data underneath these installations by undershooting the platforms using 2 survey vessels.

3.2.2 Traffic / Shipping Lanes

No traffic was observed in the area throughout the Survey, no commercial nor leisure traffic.

3.2.3 Fishing Activity

No fishing activity observed in the prospect area during the survey.

3.2.4 Seismic Interference and Time Share

The Pacific Titan worked in the prospect as a shooting boat only, and as such no seismic interference could be discovered onboard.

3.2.5 Environmental Obstacles

Seals were observed on and nearby the obstructions.

3.2.6 Operational Observations

The weather was fine during the survey except from the last line which was shot in marginal weather conditions.

4 HSE Summary

A marine HSE Audit was carried out by GSR in mid November. All the findings from this audit were entered into the Pacific Titan Remedial Action Plan and dealt with.

There was no accident or incidents during the Nexus Survey.
Mr. Drew Murray was the Nexus QHSE representative onboard.

4.1 QHSE Statistics during the Survey

4.1.1 Observation Cards reported during the Survey

Date	Location	Observer	Type	Description	Immediate Action	Corrective Action	Status Description	Suggestions for preventing reoccurrence
13.02.05	Galley	Chief Cook	Housekeeping	Tools, boots, torch lying in doorway to mess room. Trip hazard	Spoke to person and removed objects		Closed.	
16.02.05	Bridge	I.R.	Housekeeping	Dirty cups left on bridge	Employ a night steward	Rinse cups and place in dish washer	Closed	
16.02.05	Accommodation	Sl. Observer	Housekeeping	Water on floor outside cabin 15 - And emergency exit, fwd access door.	Dried it up with paper towels and looked for cause. Possible Air Con condensation	?	Brought forward to captain	

6 Crew List

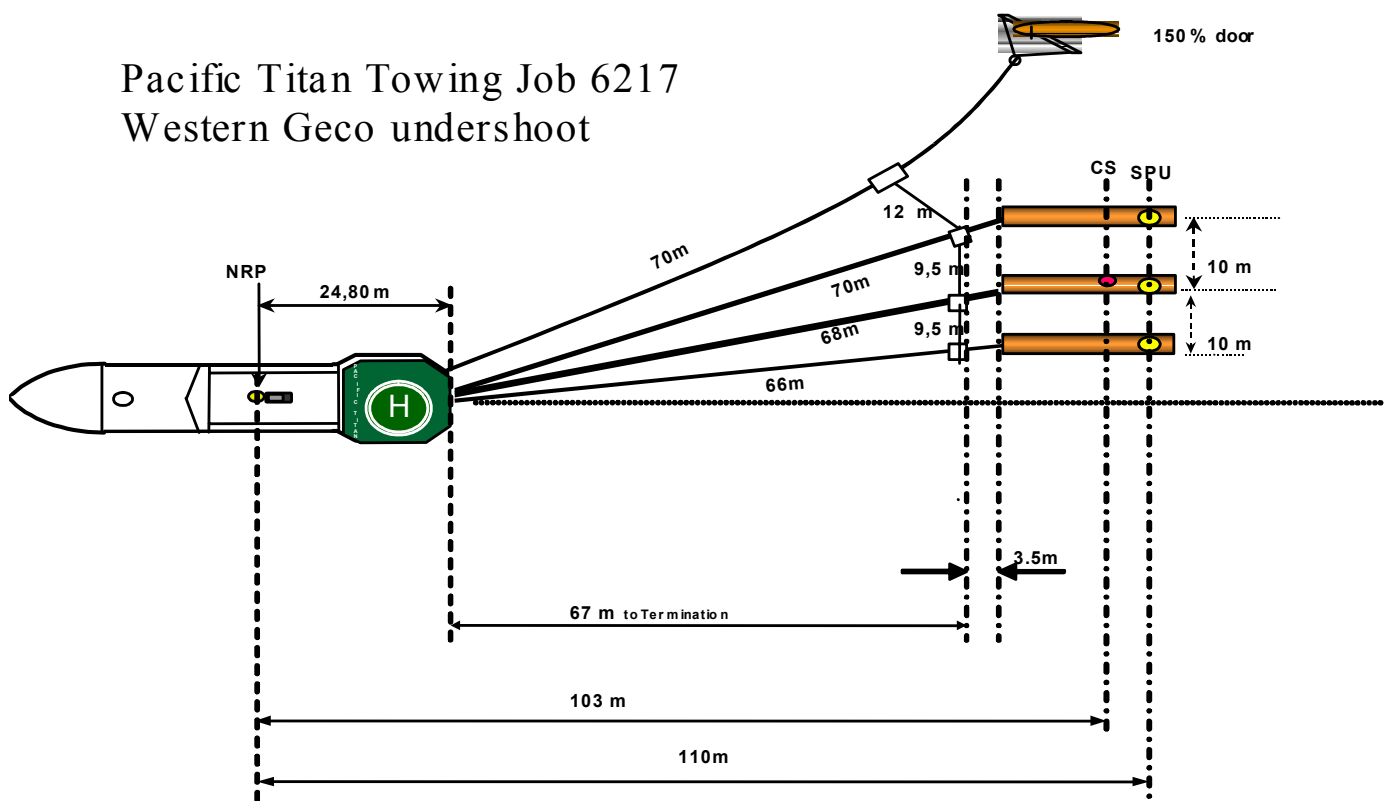
No	Name	Rank	Citizen
1	Michael Huler	Captain	Australian
2	Craig Loudon	Chief Officer	Australian
3	James Riley	2nd Officer	Australian
4	Tommy Boughton	Chief Engineer	Australian
5	Michael Kaye	1st Engineer	Australian
6	Michael D. N. Weeks	IR	Australian
7	Louis George Jacomos	IR	Australian
8	Johannes L. Van Drunick	IR	Australian
9	Matthew Barrett	IR	Australian
10	Barry Holland	Chief Cook	Australian
11	John Harding	2nd Cook	Australian
12	John Terry Harding	Steward	Australian
13	David Butler	Boiler maker	Australian
14	David Billington	Comp.mech	British
15	Kenneth Rupert Stephens	Comp.mech	Australian
16	Ketil Glimsjø	Party Chief	Norwegian
17	Haydn Brook	Chief Obs	Australian
18	Cliff Gobitt	Sl. Obs	British
19	Allan Beattie	Observer	British
20	John Evans	Chief Nav	British
21	Mark Alexander Smith	Navigator	Australian
22	Markus Rahm	Ch. Mechanic	Swiss
23	Alex Gastador	Sl. Mechanic	Filipino
24	Ronaldo Morales	Mechanic	Filipino
25	Emma Buckingham	QC	British
26	Drew Murray	Client rep	Australian
27	Chidiebere Ofor	WG field serv.	Nigerian

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1. Towing Configuration

1.1. Towing System Layout

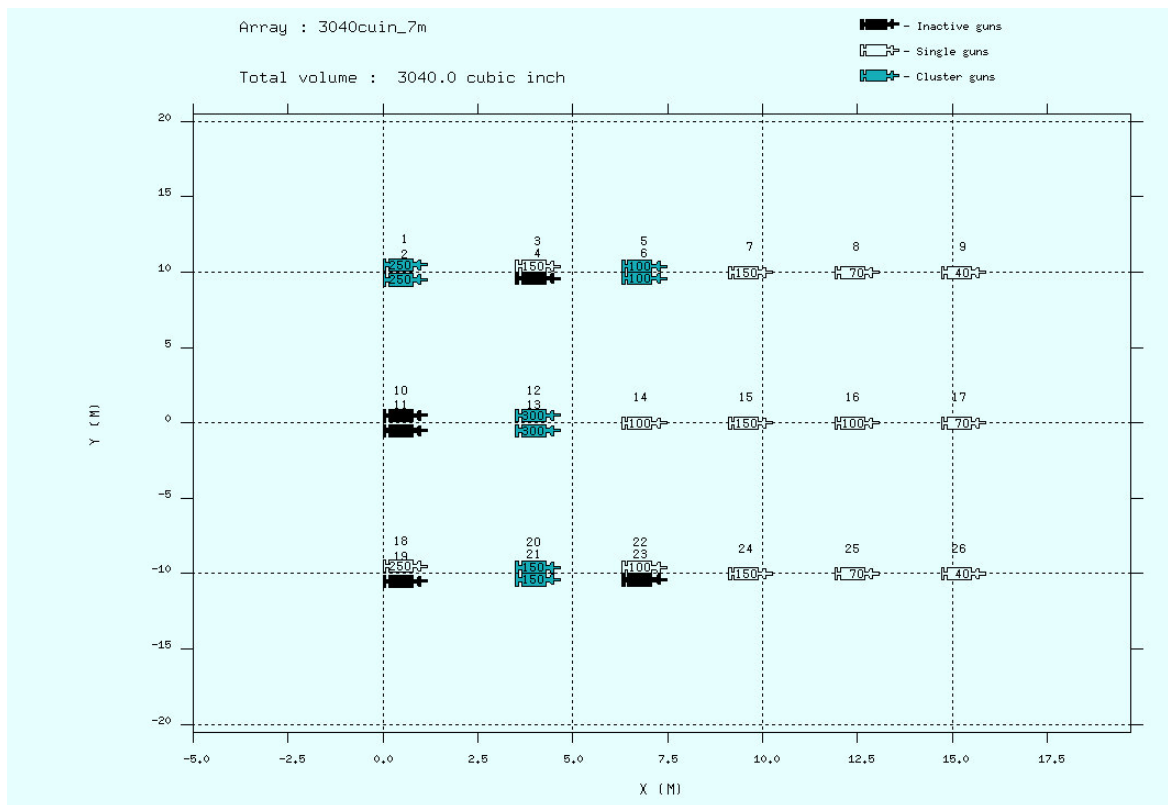
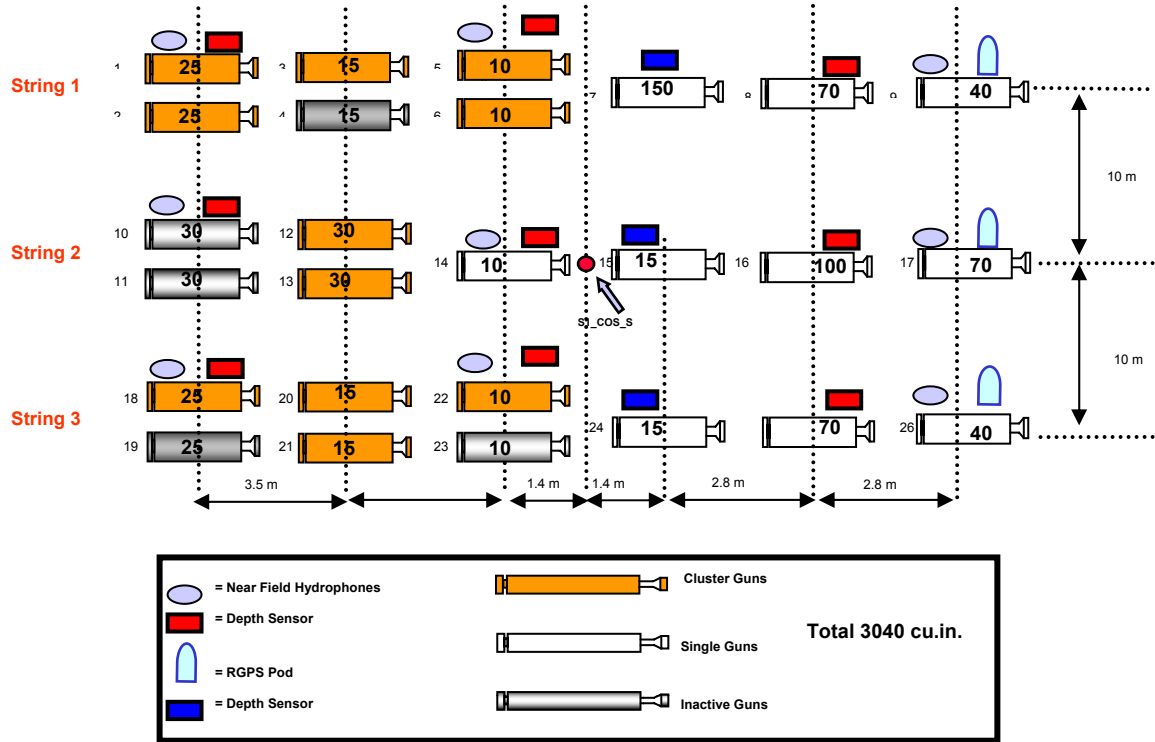


2. Source Configuration

2.1. Source System Description

Source Parameters	
Number of Sources	1
Number of Sub-arrays per Source	3
Array Length	14.7 m
Sub-array Separation	10 m
Source Width	20 m
Source Separation	N/A
Source Volume	3040 Cubic inches
Number of Hydrophones per Source	3*3
Number of Depth Transducers per Source	3*3
Number of Guns per Source	Sub-array 1 & 3 : 9 guns Sub-array 2 : 8 guns
Number of Clusters per Source	Sub-array 1 & 3 : 3 clusters Sub-array 2 : 2 clusters
Airgun Type	Bolt, 1500 & 1900 Long Life
Operating Pressure	2000 PSI
Depth of Guns	7.0 m
Peak-to-Peak Amplitude	69.8 barm
Primary-to-Bubble Ratio	13.6

2.2. Source Layout



2.3. Pulse Response

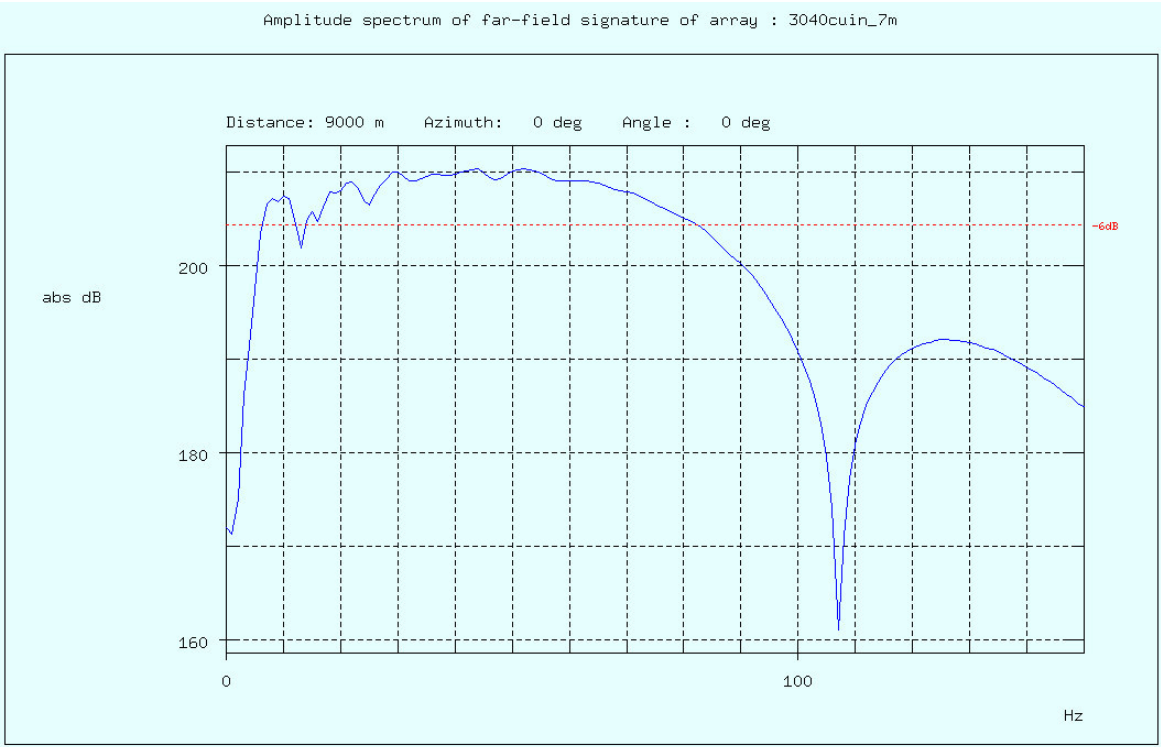
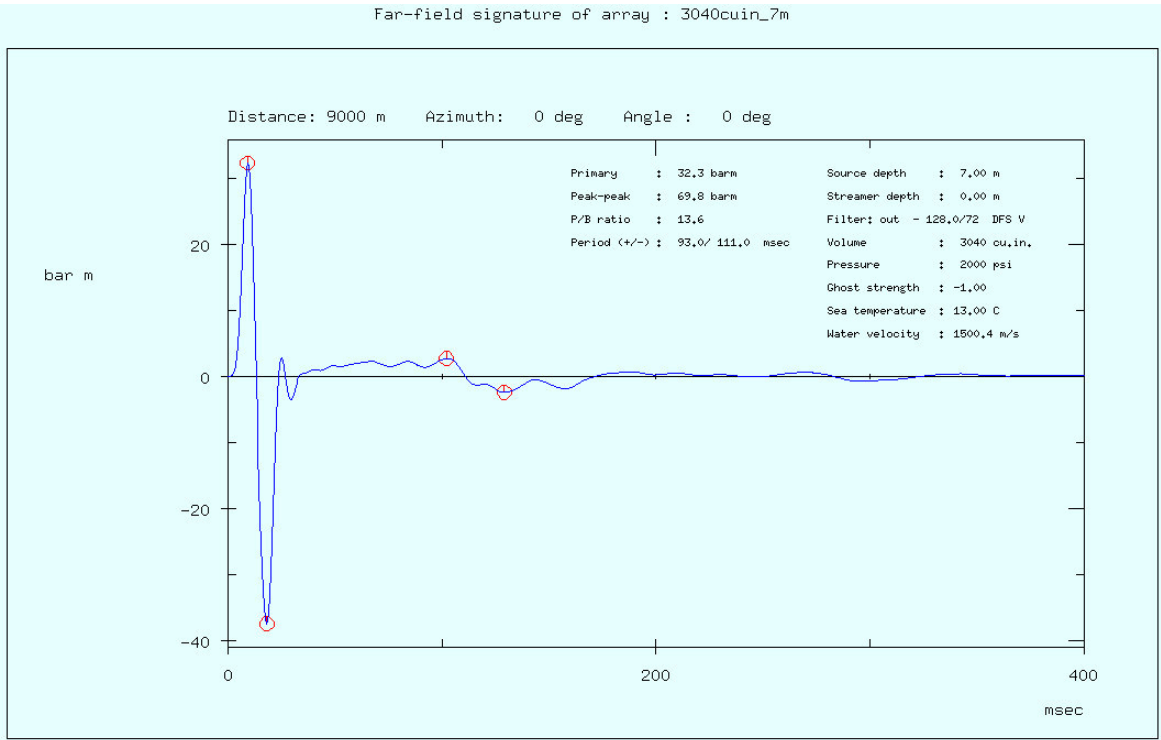


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1 Navigation and Positioning System Description

1.1 System Configuration

1.1.1 Navigation Hardware and Software

System	Hardware (Type and Serial No.)	Software version
CONCEPT Spectra	RTN μ (30/207P & 30/208P)	Spectra 9.8.06
	Linux Workstations	Red Hat 7.3
External Header	N/A	Gcs90v2
Acoustic System	N/A	
TS-meter	Saiv AS STD/CTD model SD204	
Echo Sounder	SIMRAD EA600	

1.1.2 System Timing

TRINAV issued a closure to the TrueTime master box at 1500ms before shot time. This signal was time stamped and transferred to the TrueTime slave box on the Pacific Titan. The slave TrueTime box was configured to issue a TTL signal out to the gun control system, GunLink, at a specified delay after the time stamp. The GunLink controller then utilized its own internal GPS clock to count down until the shot time at which point the guns would fire and a time break pulse was issued to the slave TrueTime box. This (remote) FTB was time stamped and a message returned to the master TrueTime box with the time of the remote FTB. Both TrueTime boxes are synchronised to GPS time via an onboard GPS clock.

Unfortunately, as a result of failure of the third TrueTime box, it was not possible to start the recording system referenced to this same closure. As a result, the TRINAV used another closure relay to send a signal at shot time to the MSX recording system. This signal was also sent in parallel to the master TrueTime box to act as the (local) FTB and was time stamped upon its arrival. The three times (initial closure, local FTB and remote FTB) were output as an ASCII string on each shot and recorded in a file along with any timing difference between the two FTB signals.

Because of the nature of relays, there was a different, and random, small delay on each relay between the time that the relay was signalled and the time that the relay actually closed. This resulted in a variable difference in the two FTB signals of +/-20ms. Applying the difference between the two FTB signals to the recorded seismic data in data processing resolved this issue.

1.2 Survey Positioning Method Used

Positioning of the vessel was by Single frequency differential GPS with delivery of differential correction data in RTCM 104 format.

The source was positioned relative to the vessel using a network consisting of rGPS units mounted on sub-arrays 1, 2 & 3 (strings 1, 2 and 3 were in use only).

1.3 Surface Positioning

1.3.1 Vessel Navigation

Summary

System 1:

Fugro MRDGPS Version 3.03.02

Differential correction delivery SkyFix Spotbeam and Inmarsat B.

Differential

Correction

Systems:

Fugro SkyFix Standard via Spot Beam (109E-Sat) satellite and Inmarsat (IOR).

Fugro MRDGPS is a multiple reference station DGPS system tailored for the specific needs of seismic surveying. State-of-the art 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 two 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.

1.3.2 Float Navigation

Float (both tail buoy and source) 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 Streamer and Source Positioning

1.3.3 Gyro Compass

The gyrocompasses used during the survey were:

Gyro 1 - Simrad HS50 GPS

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

Gyro 1 - plus 1.48 degrees

1.4 Auxilliary Navigation Sensors

1.4.1 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. Depth data was recorded throughout the survey using a dual transducer/dual frequency (12 kHz, 200 kHz) Simrad EA600 Echo sounder.

2 Navigation Systems Verification and Monitoring

2.1 Echo Sounder Verification

A verification was performed, alongside in Hobart. This was done using a lead-line, and also TS-Dip readings.

- **The Echo sounder verification results are given in Appendix 3.**

2.2 Gyro Monitoring

Dockside verification was performed in two opposite directions at Loyang Shipyard, Singapore on 16th July 2004.

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

2.3 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**

2.4 RGPS Health Checks

Health checks were carried out during a mobilization in Pebelokan, to verify installation and operational settings were satisfactory.

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

3 Observations

3.1 Navigation Summary

All systems performed very well throughout the survey, however note comments under 3.1.4 RGPS.

3.1.1 DGPS Systems

MRDGPS performed well during this survey.

3.1.2 Echo Sounder

The 12 kHz and 200 kHz transducer worked well throughout the survey. Depth data was not transmitted across or logged on the Western Trident

3.1.3 Gyro

The Primary gyro performed well during the survey.

3.1.4 RGPS

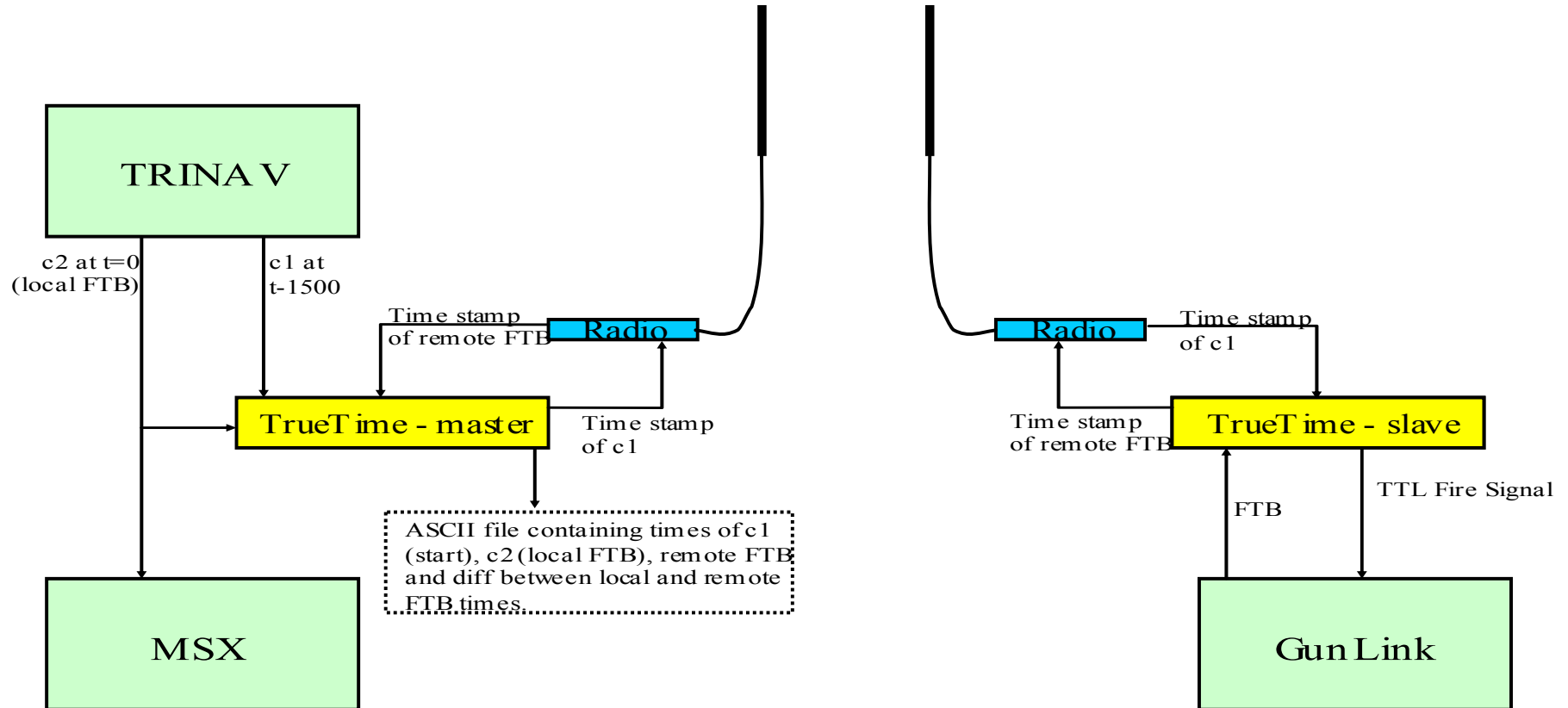
During the survey all pods except that on gun string sub-array no.2 performed well. Gunpod 2 was slightly noisy due to intermittent satellite dropouts. The pod on sub-array no.1 was unusable for a period during sequence 097.

Appendix 1 Navigation Systems

DGPS Reference Stations

V2G1		WGS84		
Ref. St. Name	No.	Latitude	Longitude	Height (m)
Adelaide	355	032° 07' 03.054"S	133° 41' 22.838" E	07.26
Melbourne	385	037° 48' 29.010"S	144° 57' 48.028" E	82.05
Sydney	336	033° 25' 46.884"S	149° 34' 01.967" E	756.65

System Timing Setup



Appendix 3 Calibrations and Tests

Introduction

Swift Survey Pte Ltd was appointed by Multiwave, to carry out the following survey work on MV Pacific Titan at Singapore Offshore Supply Base, Loyang.

- Gyro calibration in North-North-West (NNW) and South-South-East (SSE) direction. There are two gyros onboard. One is called the NMEA Gyro (Gyro 1) and the other is the Ship's Gyro.
- GPS verification. There are two positioning systems onboard. They are: S1_GPS1 and S1_GPS2.
- Tail buoy verification. There are four tail buoys with serial number 1322, 1251, 1249, 1183.

Summary of Results

<u>System</u>	<u>Computed</u>	<u>Observed</u>	<u>C-O</u>
NMEA Gyro in NNW direction	339.013 deg.	337.480 deg.	+1.533 deg
Ship Gyro in NNW direction	339.013 deg.	339.033 deg.	-0.021 deg
NMEA Gyro in SSE direction	159.816 deg.	157.920 deg.	+1.896 deg
Ship Gyro in NNW direction	159.816 deg.	159.640 deg.	+0.176 deg

	<u>Computed - Observed</u>	
	<u>Easting</u>	<u>Northing</u>
S1_GPS1 in NNW direction	-0.299m	+0.595m
S1_GPS2 in NNW direction	-0.280m	+0.678m
S1_GPS1 in SSE direction	-0.001m	-0.793m
S1_GPS2 in SSE direction	-0.073m	-0.801m

	<u>Computed - Observed</u>	
	<u>Bearing</u>	<u>Distance</u>
Tail Buoy (Serial No. 1322)	+0.443 deg	+1.271m
Tail Buoy (Serial No. 1251)	+0.821 deg	-0.339m
Tail Buoy (Serial No. 1249)	-0.776 deg	-0.055m
Tail Buoy (Serial No. 1183)	+1.310 deg	-0.471m

Method of Calibration

Gyro Calibration

A built-line (i.e. center-line of the vessel) was first established onboard the MV Pacific Titan. In this case the built-line was the foremast at the bow of the vessel and the stern light mast of the vessel.

One reflector was sited at the stern mast and another reflector was installed at the foremast of the vessel.

Three points on Loyang Jetty, stations GPS 83, GPS 81 and GR19 were used during the gyro calibration. The True bearing from GPS81 to GPS80 was established by sun-shots. This bearing was transferred to station GPS81 and GPS83.

For gyro calibration in NNW direction, a Total Station was set up at station GR 19 and a reference station set up at station GPS83. True bearings and horizontal distances were observed to the reflectors at the stern and bow of the vessel.

For gyro calibration in SSE direction, a Total Station was set up at station GPS 83 and a reference station set up at station GR 19. True bearings and horizontal distances were observed to the reflectors at the stern and bow of the vessel.

During each observation, readings from the ship's gyro were simultaneously logged. A total of 30 sets of reading were logged with the vessel in the NNW and SSE directions.

The gyro calibrations were carried out on 16th July 2004.

GPS Verification

GPS verification was carried out on 16th July 2004.

A single reflector was attached to the GPS antenna. For GPS verification in the NNW and SSE directions, a Total Station was set up at station GPS 83 and a reflector on tripod was set up at station GR 19.

Using station GR 19 as a reference bearing, the Total Station observed 30 sets of bearings and horizontal distances to the reflector at the GPS antenna. Readings were taken at 30 seconds interval. Simultaneously, the vessel also recorded the GPS positions.

The coordinates of the GPS antennae were computed and these were compared to the ship's printout to derive the difference in their Eastings and Northings.

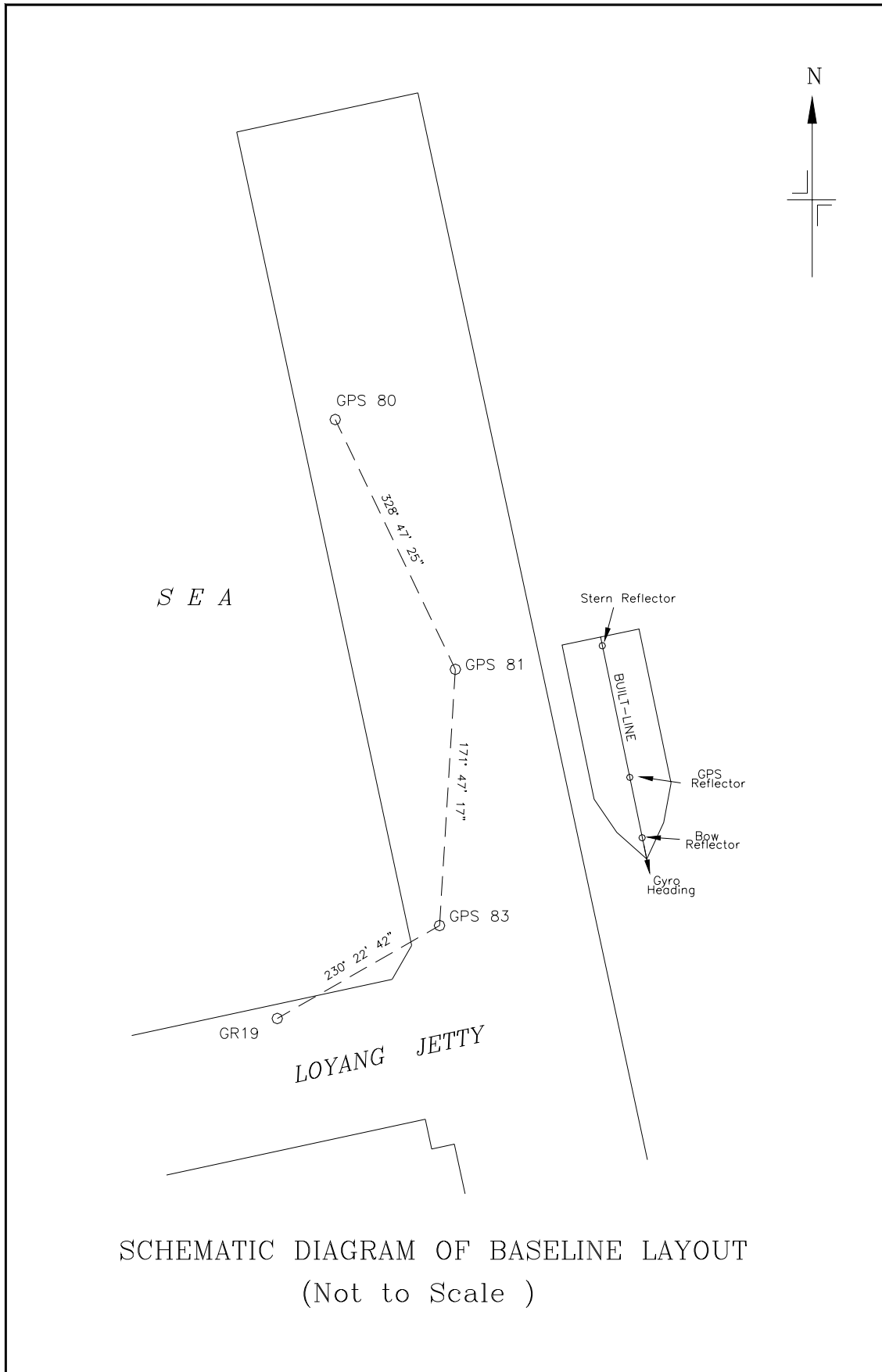
Tail Buoy Verification

Tail buoy verification was carried on the same day. Four tail buoys were placed on the jetty. The coordinates of these four tail buoys were determined using a total station deployed at station GPS 83.

Thirty sets of readings were observed to the GPS antenna (S1_GPS1) at 30 seconds interval. Simultaneously, bearings and distances from the GPS antenna to the four tail buoys were logged on the ship's computer. The four tail buoys were 1322,1251,1249 and 1183.

The computed bearing and horizontal distances using total station were compared against the ship's readings to derive the differences in bearings and distances for each tail buoy. The distances from the Total Station were converted to slant distances before comparison.

Section 4: Navigation



Section 4: Navigation

RGPS Verification

The last RGPS verification was held at the Island of Pebelokan on the 7th of September 2004. The following were the results for all Pods:

RGPS HEALTH CHECK

Location Pablokan

07-Sep-04

Survey Position: *Testpoint @ Pablokan North Jetty*

Bessel 1841 - Batavia	
TM Origin 108°E	
scale 0.9996	
Easting	321707.710
Northing	9394433.980

WGS84	005.4768828S
	106.3920667E
Convergence	0.15358398

Verification Summary:

<i>Pod</i>	<i>Mean Easting</i>	<i>Mean Northing</i>	<i>C-O (E)</i>	<i>C-O (N)</i>	<i>SD (E)</i>	<i>SD (N)</i>
322	321708.82	9394436.47	1.11	2.49	0.65	0.49
948	321708.66	9394436.05	0.95	2.07	0.42	0.32
320	321708.79	9394434.24	1.08	0.26	0.42	0.39
335	321708.09	9394435.47	0.38	1.49	0.46	0.43
183	321706.87	9394436.23	-0.84	2.25	0.46	0.37
252	321708.26	9394436.24	0.55	2.26	0.47	0.23
182	321707.67	9394436.95	-0.04	2.97	0.35	0.37
249	321708.18	9394436.59	-0.04	2.61	0.86	0.73
225	321709.30	9394435.35	1.59	1.37	0.43	0.54
340	321707.84	9394433.61	0.13	-0.37	0.42	0.58

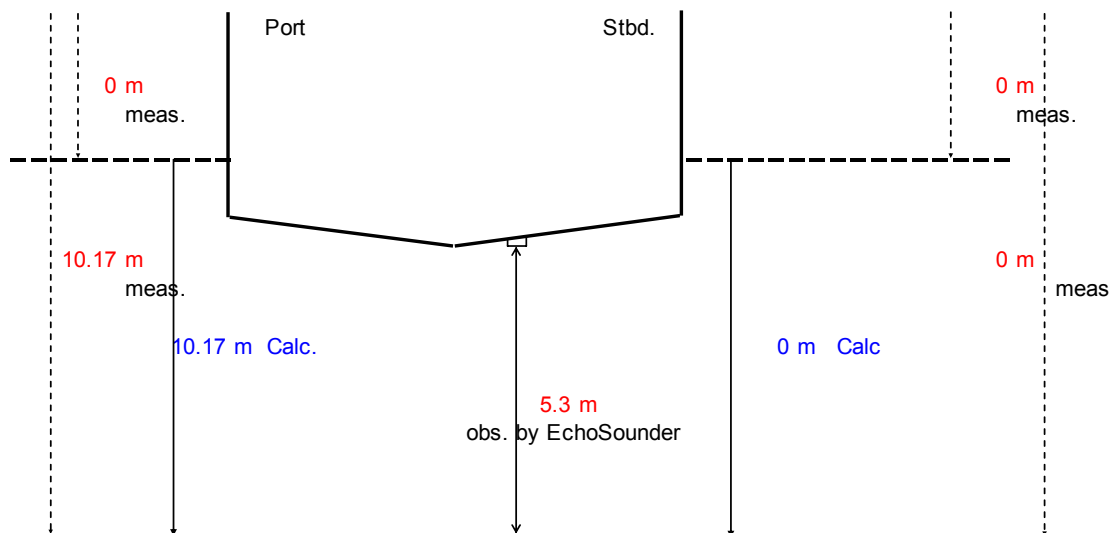
Section 4: Navigation

Echo Sounder Verification

ECHOSOUNDER CALIBRATION - m/v. PACIFIC TITAN

Alongside:- **Hobart**
Date: **31st Jan 2005**
Time: **00:32** GMT
Taken in Port for Mobilization
Job: **6211**
Client: **SANTOS**

Measurements taken:-	metres	EchouSounder Reading	
Port Freeboard	10.17	Time	5.3
Port TSDip		08:32	
Stbd Freeboard		Stbd Draught marks:	4.9
Stbd TSDip		Port Draught marks:	5



Draft Marks:

Port : **5 m**
Stbd : **4.9 m** Theoretical Draft = 4.95 m

Electronic Depth + Theoret. Draft 10.25 m

True Measured Water depth = 10.17 m

Difference = 0.08

TEXT = Measured

TEXT = Calculated

TEXT = Observed

TEXT = Results