

# FINAL ACQUISITION REPORT

For the Undershoot Vessel on

## SUE 3D MARINE SEISMIC SURVEY (GAP04B)

Conducted By

# APACHE ENERGY LIMITED

In The Exploration Licence Area

## VIC/P58

SURVEY START DATE 12<sup>th</sup> FEBRUARY 2005

SURVEY COMPLETION DATE 16<sup>th</sup> FEBRUARY 2005



Compiled by Drew Murray

*The format, scope and content of this report were developed by ENQUEST Pty. Ltd. and, as such, remain the property of that company. No copies of this document shall be made without the explicit written permission of ENQUEST Pty. Ltd.*

**TABLE OF CONTENTS**

|          |                                                              |           |
|----------|--------------------------------------------------------------|-----------|
| <b>1</b> | <b>INTRODUCTION.....</b>                                     | <b>3</b>  |
| 1.1      | OBJECTIVES .....                                             | 3         |
| 1.2      | SURVEY PARAMETRES.....                                       | 3         |
| 1.3      | ACQUISITION PARAMETERS .....                                 | 3         |
| <b>2</b> | <b>SYNOPSIS.....</b>                                         | <b>5</b>  |
| 2.1      | OVERVIEW.....                                                | 5         |
| 2.2      | SURVEY PRODUCTION BY LINE.....                               | 6         |
| 2.3      | STATISTICAL SUMMARY .....                                    | 6         |
| 2.4      | TECHNICAL SUMMARY.....                                       | 7         |
| 2.5      | VESSEL.....                                                  | 7         |
| 2.6      | SAFETY SUMMARY .....                                         | 10        |
| 2.7      | RECOMMENDATIONS & CONCLUSION.....                            | 12        |
| <b>3</b> | <b>NAVIGATION.....</b>                                       | <b>13</b> |
| 3.1      | NAVIGATION HARDWARE AND SOFTWARE.....                        | 13        |
| 3.2      | SURVEY POSITIONING METHOD USED .....                         | 13        |
| 3.3      | ECHO SOUNDER.....                                            | 15        |
| 3.4      | INTEGRATED NAVIGATION SYSTEM .....                           | 15        |
| <b>4</b> | <b>ENVIRONMENT.....</b>                                      | <b>16</b> |
| 4.1      | WEATHER.....                                                 | 16        |
| 4.2      | TIDES, CURRENT AND FEATHER .....                             | 16        |
| 4.3      | NAVIGATION HAZARDS.....                                      | 16        |
| 4.4      | ENVIRONMENTAL.....                                           | 17        |
| 4.5      | CETACEAN REPORTING.....                                      | 17        |
| 4.6      | FISHING .....                                                | 17        |
| 4.7      | CORAL REEFS .....                                            | 17        |
| 4.8      | CONCLUSION.....                                              | 17        |
| <b>5</b> | <b>DIARY .....</b>                                           | <b>18</b> |
| <b>6</b> | <b>MEASUREMENTS.....</b>                                     | <b>19</b> |
| 6.1      | GPS ANTENNAE POSITIONS.....                                  | 19        |
| 6.2      | TOWING SYSTEM .....                                          | 20        |
| <b>7</b> | <b>ECHOSOUNDER CALIBRATION JANUARY 31<sup>ST</sup> .....</b> | <b>21</b> |

## 1 INTRODUCTION

### 1.1 OBJECTIVES

To carry out a High Quality 3D seismic undershoot survey in conjunction with the Western Trident as part of the SUE 3D survey so as to provide subsurface coverage under the Perch and Dolphin Monopods. The location was in the Bass Strait Oil Fields area south east of Lakes Entrance on the Victorian Coast. The survey being acquired on behalf of APACHE Energy Ltd.

The seismic source vessel was the Pacific Titan owned and operated by Swire Pacific Offshore Operations (Pte) Ltd who provided the marine crew. The vessel was on lease by Multiwave Geophysical Company ASA, who supplied the seismic personnel, data processing and logistics.

### 1.2 SURVEY PARAMETRES

The following is a summary of the survey parameters:

|                       |                                              |
|-----------------------|----------------------------------------------|
| Survey type           | : 3D Undershoot                              |
| Client                | : Apache Energy.                             |
| Survey name           | : Sue 3D MSS Undershoot                      |
| SP int                | : 18.75                                      |
| Source                | : 3040 in <sup>3</sup> . Sleeve guns         |
| Positioning           |                                              |
| Primary               | : Fugro Starfix MRDGPS SPOT & Dual Frequency |
| Secondary             | : Fugro Starfix MN8 dGPS                     |
| Port of supply        | : Hobart, Tasmania                           |
| Contractor            | : Multiwave Geophysical Company ASA          |
| Vessel                | : Pacific Titan                              |
| Client Representation | : Enquest Pty. Limited                       |

### 1.3 ACQUISITION PARAMETERS

|                      |                         |
|----------------------|-------------------------|
| Recording System     | : na                    |
| Number of Channels   | : na                    |
| Record Length        | : na                    |
| Sample Interval      | : na                    |
| Low Cut Filter       | : na                    |
| High Cut Filter      | : na                    |
| Tape Format          | : na                    |
| Digital Filter Delay | : off                   |
| Energy Source Type   | : Bolt 1500LL and 1900C |
| Total Capacity       | : 3040 cubic inches     |
| Number of Arrays     | : 1                     |
| Number of sub-arrays | : 3                     |
| Array Length         | : 14.7m                 |

|                                       |                                                                                         |
|---------------------------------------|-----------------------------------------------------------------------------------------|
| Sub Array Separation                  | : 10.0m                                                                                 |
| Total Number of Guns                  | : 26                                                                                    |
| Capacity of each Sub-Array            | : 1110 in <sup>3</sup> starboard, 1020 in <sup>3</sup> inner, 910 in <sup>3</sup> port. |
| Typical Output                        | : 88.0 bar/metres pk-pk                                                                 |
| Primary / bubble ratio                | : 25.0                                                                                  |
| Pressure                              | : 2000psi +/- 10%                                                                       |
| Depth                                 | : 7.0 metres                                                                            |
| Firing Delay from Time Zero           | : 50ms                                                                                  |
| Shot Interval                         | : 18.75 metres                                                                          |
| Coverage                              | : na                                                                                    |
| Number Of Groups                      | : na                                                                                    |
| Group Length                          | : na                                                                                    |
| Group Interval                        | : na                                                                                    |
| Group Sensitivity                     | : na                                                                                    |
| Hydrophones per Group                 | : na                                                                                    |
| Streamer depth                        | : na                                                                                    |
| Typical Noise                         | : na                                                                                    |
| Offset (In-line)                      | : na                                                                                    |
| Nav Ref.-Cent. Source                 | : 166.00m                                                                               |
| Primary Navigation                    | : Thales Multifix 4 Version 1.3                                                         |
| Secondary Navigation                  | : Thales Multifix 4 Version 1.3                                                         |
| Integrated Navigation System: SPECTRA |                                                                                         |
| Coverage Binning System               | : na                                                                                    |
| Echo Sounder                          | : Kongsberg-Simrad EA600, 12 kHz                                                        |

## 2 SYNOPSIS

### 2.1 OVERVIEW

The survey was undertaken using the Pacific Titan as a source vessel and the Western Trident as the Recording vessel.

The Pacific Titan had mobilised out of Hobart, Tasmania on January 31<sup>st</sup> 2005 after an extensive period in port repairing a large amount of engine room pipe work. The vessel had initially arrived in Hobart on the 21<sup>st</sup> of January 2005 the departure of the Pacific Titan was held up when the surveyor found the seawater inlet valve was illegally installed and did not meet specifications. Work continued through the 22<sup>nd</sup> to 24<sup>th</sup>. The Captain held a meeting on the Bridge at 10:30hrs of the 24<sup>th</sup> and advised the extent of the repairs would keep the Titan alongside till the 30<sup>th</sup> of January.

The surveys scheduled for the Pacific Titan prior to SUE were completed on February 12th at 12:39hrs. local. The Titan turned to starboard. All in water equipment was retrieved by 16:15 and the vessel arrived at Dolphin Platform at 19:30hrs local. The Western Trident asked for the Titan to move to position 38 22.8'S 147 30.7'E before deploying the source array. Source arrays were deployed by 21:20. Work on the necessary equipment to make the 2 vessel undershoot survey work had been carried out during the transit and the data link was up and running by 21:50. Problems were encountered with getting the shot timing working correctly and at the end of the day work was still being carried out to resolve these problems.

February 13th The Titan was on station and had all arrays in the towing position by 21:20 on the 12th of February. The WesternGeco field technician had all the necessary equipment up and running by 22:50 of the 12th and worked through the night set up communications between the Tridents system and the Titan. There were some initial problems getting the navigation to work but these were overcome reasonably quickly. The major problem encountered was with the gunlink time break. Part of this problem required the replacement of a time and frequency receiver needed to synchronise both vessels systems. A spare unit was sent over from the Trident. The next hurdle was the drifting of the time break on the array timing. All indications pointed to the Tridents equipment and at 18:30 hours the Field Technician transferred over to the Trident to try and resolve the problem. At midnight no significant progress had been made. During this set up period of some 24+ hours the Western Geco field technician had been working with out a break or sleep.

February 14th The Titan was in shooting position at 01:00hrs next to the Western Trident running towards Perch Platform. The Trident was still having timing problems, and was also reconfiguring the navigation system. The Spectra display on the Titan was locked at this point in time because the Trident was not sending the Titan data. As it went the attempt at a pass on Perch was terminated and both vessels steered away from the platform for further tests At 04:15 the Trident was still having problems with FTB. Tests onboard the Titan using the seal system look ok and at 07:00hrs both vessels headed back for line 1632. Soft start commencing at 09:37. Two lines were completed, 1632 and 1744and at the end of the day both vessels were on a line change to make a pass on Dolphin Platform.

February 15th started with the Titan coming onto line sequence 093. Communications between the vessels improved and turns were synchronised. Requested minimum pass distances are being observed. Captain, Party Chief and Client Rep. Were on the bridge during platform passes. During the turn from sequence 096 to sequence 097 the Titan lost one engine, this slowed the vessel and the run in was reduced to 5500m to allow the Titan to catch up. At the end of the day both vessels were on the approach to GAP04B-1632U-4-097

February 16th The Trident workboat came alongside at 09:30hrs local to pick up the U/S True Time unit. Weather conditions were fast deteriorating, by 14:00hrs local wind was SW 30knts with a 3 metre sea. The Western Geco field Tech was still onboard the Trident. Poor weather conditions

made a safe transfer of personnel impracticable. With weather conditions halting recording the decision was taken to consider the survey complete, all equipment was secured and at the end of the day the Titan was headed for Eden on the NSW east coast to clear Immigration for departure out of Australian waters.

## 2.2 SURVEY PRODUCTION BY LINE

| Seq | Line           | Dir | FSP  | LSP  | KM       |
|-----|----------------|-----|------|------|----------|
| 091 | GAP04B-1632U-1 | 224 | 2630 | 959  | 31.35000 |
| 092 | GAP04B-1744U-1 | 044 | 1103 | 2210 | 20.77500 |
| 093 | GAP04B-1632U-2 | 224 | 2630 | 1175 | 27.30000 |
| 094 | GAP04B-1744U-2 | 044 | 1103 | 2160 | 19.83750 |
| 095 | GAP04B-1632U-3 | 224 | 2630 | 1202 | 26.79375 |
| 096 | GAP04B-1744U-3 | 044 | 1103 | 2250 | 21.52500 |
| 097 | GAP04B-1632U-4 | 224 | 2630 | 1250 | 25.89375 |
| 098 | GAP04B-1744U-4 | 044 | 1103 | 2000 | 16.83750 |
| 099 | GAP04B-1632U-5 | 044 | 2530 | 1550 | 18.39375 |

**SURVEY TOTAL**

**KM**

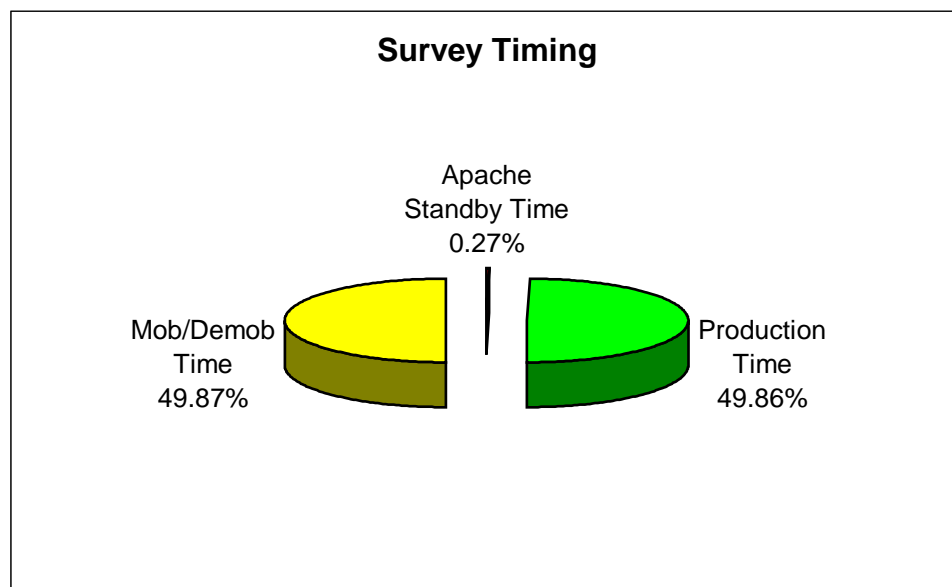
208.70625

## 2.3 STATISTICAL SUMMARY

### Total Survey Timing

| Category                        | Hours |
|---------------------------------|-------|
| Apache Standby Time             | 0.28  |
| Production Time                 | 51.70 |
| Mob/Demob Time                  | 51.72 |
| Total survey time: 103.70 hours |       |

The following graph shows the total survey time.



## 2.4 TECHNICAL SUMMARY

The following is a brief description of Seismic Equipment used on the Pacific Titan:

### Energy Source

Over the past few years the Pacific Titan was used primarily as a source vessel so the arrays and the attached infrastructure were in good condition. A Sealink 2000, onboard source controller and hydrophone data acquisition system was installed early 2004. A twin screen graphical interface allows for simple operator monitoring and control as well as showing deterioration of gun performance.

Gun timing could have been better but it is doubtful if the timing specifications need to be so stringent particularly for the larger source sizes over 150 in<sup>3</sup>. A rigorous maintenance schedule was maintained on the array strings and individual elements were replaced at the specified time regardless of their performance.

The three sub arrays were equipped with a total of 26 array elements. The lay out of the spare array elements provided for easy substitutions whilst maintaining the geometry of the array by creating a mirror image of the standard layout. The drop out spec was generated by MGC. Zero time was lost to the source arrays. A 3040 cu<sup>3</sup> inch array was used through out the survey with only occasional low volume shots when single guns failed to operate and when substitutions were made.

The Titan has three compressors. One compressor comfortably maintained air pressure with the other two being rotated through to allow maintenance to be carried out. The 25m recording interval was easily within the scope of the compressors and they performed reliably with zero time lost.

## 2.5 VESSEL



The Pacific Titan was built in Japan in 1982 and since that time has been through a number of transformations, from anchor handler to seismic boat, back to anchor handler before being refitted

once more as a seismic vessel. A major refit in Seattle in the 90's had the vessel widened and fitted out as a multi streamer 3D vessel.

Prior to this survey the Titan had completed surveys for Woodside Petroleum and a number of surveys managed by SANTOS. The vessel is set up as a 3D vessel. The 3D capacity means that it is possible to make use of active floats on the tailbuoy and sub arrays thus providing a higher degree of positioning accuracy than would normally be found on a 2D survey vessel. The vessel has been poorly maintained over the years and needs to have a general tidy up to be comfortable. For the size of the vessel the cabins for both seismic and marine crews are small and cramped. On the top deck of the seismic accommodation there is a constant musty odour and dampness. Conditions are reminiscent of 20 years ago. Extended surveys on this vessel could become a serious OHS issue. There are adequate numbers of showers and toilets available and the steward worked hard to keep them clean. The showers and toilets are in a poor state and need to be completely refitted to a standard fitting the current OHS standards expected of crews and vessels on the Australian coast. The same argument could be applied to the seismic crews quarters.

Swires supplied the vessel marine personnel. All seismic personnel were from various countries and contracted to Multiwave.

The instrument room while not large was well laid out with plenty of working space for all personnel. The back deck areas are split with the streamer reels above the array deck. Both areas were spacious with plenty of safe working space for both array mechanics and streamer handling. The gun deck became very wet in any thing but dead flat conditions.

The galley and mess areas were adequate. House keeping on the whole was good considering there was only one-steward, seismic cabins were left out of the cleaning cycle but the bathrooms were cleaned daily. There was also an inadequate supply of bed linen considering there was only one steward to take care of a crew of 28.

Communications are through Norsat and Inmarsat. The client has an office next to the instrument room with a network connection but no phone.

### **Vessel Specifications**

|                  |                                               |
|------------------|-----------------------------------------------|
| Name             | : M/V Pacific Titan                           |
| Owner            | : Swire Pacific Offshore Operations (Pte) Ltd |
| Port of Registry | : Singapore                                   |
| Date Built       | : 1981                                        |
| Date Refit       | : 2000                                        |
| IMO Number       | : 8208385                                     |
| Radio Call Sign  | : 9V5935                                      |

### **Classifications**

|             |                                    |
|-------------|------------------------------------|
| Flag        | : Singapore                        |
| Class       | : A1 (E) Seismic Research AMS ACCU |
| Designation | : Seismic Research Vessel          |

### **Dimensions**

|                 |                                          |
|-----------------|------------------------------------------|
| Length, overall | : 64.50 meters                           |
| Beam            | : 18.50 meters                           |
| Draft           | : 6.00 meters                            |
| GRT             | : 3211 tonnes (gross registered tonnage) |
| NRT             | : 963 tonnes (net registered tonnage)    |



**Machinery**

|              |                                                                                   |
|--------------|-----------------------------------------------------------------------------------|
| Main Engines | : 4 x 1600 bhp, 6Z-ST, total 6400 bhp @ 680 rpm                                   |
| Propulsion   | : 2 x variable pitch, in Kort Nozzles                                             |
| Bow Thruster | : Yanmar 6LAAL-DTN, 420 bhp, 5 tonnes thrust                                      |
| Generators   | : 3 x 280 kW, 440v, 60 Hz alternators, driven by Yanmar 6LAAL-DTN diesel engines. |

**Capacities**

|                          |                                                        |
|--------------------------|--------------------------------------------------------|
| Fuel Oil Capacity        | : 1300 cubic meters                                    |
| Lubricating Oil Capacity | : 5.0 cubic meters                                     |
| Cable Oil Capacity       | : 48.0 cubic meters                                    |
| Fresh Water Capacity     | : 154.0 cubic meters                                   |
| Water Maker              | : 2 x RO Machines, producing 20.0 cubic meters per day |

**Operating Capabilities**

|                  |                                           |
|------------------|-------------------------------------------|
| Speed            | : 12 knots (Maximum), 10 knots (Cruising) |
| Fuel Consumption | : 9.0 cubic meters per day (average)      |
| Endurance        | : 45 days, while conducting 2D survey     |

**Bridge Equipment**

|                      |                                                                  |
|----------------------|------------------------------------------------------------------|
| Radar                | : Kelvin Hughes Nucleus 6000A ARPA with slave in instrument room |
| Secondary Radar      | : JRC JMA 3210 Daylight                                          |
| Echo Sounder         | : Simrad ED-162                                                  |
| GPS                  | : Furuno GP 30                                                   |
| Communications       | : G.M.D.S.S. (Global Maritime Distress & Safety System)          |
|                      | : 1x Skanti SSB                                                  |
|                      | : 2 x VHF                                                        |
|                      | : 2 x Inmarsat C 456304540/456304550 with                        |
|                      | : Thrane and Thrane telex facility                               |
|                      | : 3 x VHF (portable GMDSS)                                       |
|                      | : 2 x SART                                                       |
|                      | : 1 x EPIRB                                                      |
|                      | : 1 x Navtex                                                     |
|                      | : 1 x Jotron TR-6102 Airband Transceiver                         |
| Satcom B             | : NERA Inmarsat phone / fax                                      |
|                      | : Tel: (874) 335 385 510                                         |
|                      | : Fax: (874) 335 385 513                                         |
| Satcom C             | : TeleNor C-Link phone / fax                                     |
| High Speed data link | : TeleNor C-Link                                                 |
| Weather Fax          | : Furuno 207                                                     |

**Safety Equipment**

Fire monitoring and detection to all accommodation, machinery and office spaces.

Foam deluge system covering streamer winches, streamer storage reels and helideck.

Six man inflatable Man overboard boat on quick release davit.

7.5 metre, 210hp. Rigid NorSafe Fast Rescue Boat Certified for 10 people.

LSA equipment for 45 persons excluding survival suits.



**Typical Breathing Apparatus**

## **2.6 SAFETY SUMMARY**

The vessel fully adheres to the health and safety requirements as set out by SOLAS. All machinery and seismic equipment is maintained on a computerised planned maintenance system. HSE audit recommendations are implemented through the IMG-CQHSE System which highlights deficiencies identified during audits and sets target dates for the completion of work along with whom or which department is responsible. Regular cross audits are held to improve and bring to attention any problems in operations or work practises. All emergency exits and routes to exits are adequately marked. A fully integrated alarm system is in place and is tested on a regular basis. Flashing lights are fitted to alert personnel when equipment on the gun deck is either being pressurised or test fired. Fire fighting equipment is positioned at all necessary locations about the vessel. The streamer reel is covered by a foam deluge system. The streamer reels are fitted with a 'save-all'. There is no obvious drainage to the waste kerosene tank. Nearly all-lifting equipment on the gun deck consists of stainless steel chains and shackles. Lifting points on deck heads were not used unless they had been rated. All certification is current. More than adequate abandonment equipment is carried on board.

Emergency procedures are laid down and prominently displayed about the vessel. Vessel plans showing emergency escape routes along with the location of all emergency equipment are also prominently displayed. Emergency fire/boat and man-overboard drills are held on a weekly basis. Current policy, hazards, near misses and topics arising are dealt with during the HSE meetings held for all crew.

Procedures for handling trailing gear during deployment and recovery were clearly laid down and followed closely. Procedures are under constant review as both the equipment and therefore the handling techniques change. Procedures are also in place for two-boat operations, helicopter operations and at-sea personnel transfers. Safety 'toolbox' meetings were held with all personnel involved prior to any operation. A Permit to Work system was in place for all hot work (burning, welding, and cutting), confined space entry, work aloft, work on high-pressure systems and electrical systems.

Comprehensive first aid and medical supplies are carried onboard. Medical advice was on hand through the Main Norwegian SAR (+47 51 51 70 00), Rogaland Radio (MEDICO), (47 51 68 36 01) and Haukaland Hospital (MEDICO) (47 55 97 50 00).

All seismic personnel have completed an offshore survival course, which covers survival at sea; fire fighting, first aid and helicopter underwater escape training. The Master, Chief Officer and some senior seismic personnel have undertaken advanced first aid and HSE management courses.

The waste management system in place onboard consisted of all food waste being separated prior to incineration. All glass and metal were separated for disposal ashore. Dirty oil, PVC and plastic refuse was also stored separately for disposal onshore in line with MARPOL regulations.

The standard of accommodation was adequate to poor. The general housekeeping was good.

#### HSE Details for Survey

| Incidents/Accidents     |            | Exposure Hours        |             |
|-------------------------|------------|-----------------------|-------------|
| Type                    | Cumulative | Group                 | Cumulative  |
| Fatality                | 0          | Client                | 104         |
| Lost Time Incident      | 0          | Maritime              | 1560        |
| Medical Treatment Case  | 0          | Seismic               | 1040        |
| First Aid Case          | 0          | 3rd Party             | 32          |
| Restricted Work Case    | 0          |                       |             |
| Material Loss or Damage | 0          |                       |             |
| Environmental Damage    | 0          |                       |             |
| Near Miss               | 0          |                       |             |
| Hazard                  | 0          |                       |             |
| Unsafe Act              | 0          |                       |             |
| <b>Total Incidents</b>  | <b>0</b>   | <b>Total Hours</b>    | <b>2736</b> |
|                         |            | <b>Total Man Days</b> | <b>114</b>  |



**Fast Rescue Boat**

## **2.7 RECOMMENDATIONS & CONCLUSION**

- Showers and toilets need replacing, they are in a very poor state and unhygienic
- The vessel needs two stewards not one as in the case of this survey. This is an OHS matter with regard to cleanliness of the vessel.
- The overall appearance of the vessel is poor, this reflects on both the contractor and the Company.
- With the over all OH&S performance expected of and delivered by both the Marine Crew and the Seismic Crew. The acceptance of a vessel in the Pacific Titans condition is lets down the hard work done by the crew in maintaining a safe and comfortable work environment.
- The level of seismic experience of the Bridge crew was negligible. The Captain had done one trip on Swires other seismic vessel
- More safety drills are required.

The over all performance of the seismic crew was excellent, the level of seismic experience was above average and work was carried out in a professional manner, any problems encountered were quickly brought to the client's attention.

Safety standards by both marine and seismic crew were high, closer cooperation during drills would be an advantage and improve teamwork.



### 3 NAVIGATION

#### 3.1 NAVIGATION HARDWARE AND SOFTWARE

Navigation was controlled from the Western Trident. The following information is supplied to show the normal Pacific Titan system.

| System                                                                                                                                      | Hardware (Type and Serial No.)                                                                                                                                                         | Software version                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| Concepts Spectra<br>Concepts Reflex<br>SeisPos<br>processing<br>External Header<br>Compass System<br>TS-meter<br>Echo Sounder<br>Multifix 4 | RTN $\mu$ (30/207P & 30/208P)<br>Linux Workstations<br>Windows Workstation<br><br>Digicourse System 3 5011 Birds<br>Saiv AS STD/CTD model SD204<br>SIMRAD EA600<br>Windows Workstation | Spectra v 9.8.06<br>Reflex v 1.9.4<br>Red Hat v 7.3<br>v 12.30<br>Gcs90v2<br>v 5.01<br>v 3.5.9.97<br>v 2.1.1.0<br>v 1.03 |

#### 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 500 milliseconds after time zero. This was sent to the recording system as a timing verification. The trigger was 5 milliseconds in duration.

#### 3.2 SURVEY POSITIONING METHOD USED

Positioning of the vessel was linked to the Western Trident and controlled from that vessel. The Pacific Titans positioning system of Single frequency differential DGPS with delivery of differential correction data in RTCM 104 format and recorded in the P2/94 files. was also run as a back up.

The source was positioned relative to the vessel using a network consisting of rGPS units mounted on all 3 sub-arrays.

#### SURFACE POSITIONING

##### General

All survey and positioning work was carried out using the GRS 80 Spheroid and GDA 94 datum. Grid co-ordinates were based on the Universal Transverse Mercator projection zone 55 south. Central Meridian for zone 55 is 147°E.

Common Offshore datum shift parameters between WGS84 and GDA 94 were as specified in the contract.

For GRS 80, the following parameters were entered into Spectra INS:

Semi-Major Axis: 6378137.000  
Inverse Flattening: 298.257222101

### Datum Shift Parameters

For transformation of WGS84 to GDA 94

| DX (m) | DY (m) | DZ (m) | Rot X (sec) | Rot Y (sec) | Rot Z (sec) | Scale (ppm) |
|--------|--------|--------|-------------|-------------|-------------|-------------|
| 0      | 0      | 0      | 0           | 0.000       | 0.000       | 0.000       |

| WGS84         |     |                  |                   |            |
|---------------|-----|------------------|-------------------|------------|
| Ref. St. Name | No. | Latitude         | Longitude         | Height (m) |
| Adelaide      | 355 | 032°07' 03.054"S | 133°41' 22.838"E  | 7.26       |
| 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     |

### Vessel Navigation

System 1: Fugro Multifix 4 Version 1.06  
Differential correction delivery: SkyFix Spotbeam and Inmarsat B.

System 2: Fugro Multifix 4 Version 1.06  
Differential correction delivery: SkyFix Spotbeam and Inmarsat B.

Differential  
Correction

Systems: Fugro SkyFix Standard via Inmarsat B (POR) and Spot Beam (SEAsia)

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

Fugro Multifix 4 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.

### DGPS Reference Stations

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.

## Float Navigation

Float (tailbuoy, headbuoy and source) surface navigation was provided by Kongsberg-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.

## Gyro Compass

The gyro compass used during the survey was:

Gyro 1 (NEMA)            - Simrad HS50 GPS

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

Gyro 1 - plus 1.46 degrees

## Magnetic Declination

Model: IGRF2005  
Date: 2005-01-31  
Position: 38°04'00.000"S 147°34'00.000"E  
Magnetic Declination: 12.82°E

## 3.3 ECHO SOUNDER

Primary Echosounder:                      Simrad Model EA600 200/12KHz

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.

## Echo Sounder Verification

A verification was performed, alongside in Hobart, Tasmania. This was done using a lead line, and also depth reading from the calibrated TS probe. All depths recorded are based on the position of the Fathometer's transducer on the vessel's Hull. Depths are NOT draught corrected.

## 3.4 INTEGRATED NAVIGATION SYSTEM

The integrated navigation system used for this survey was Spectra from Concept Systems Ltd. UK. Spectra is an integrated navigation and data management system designed to handle environments of multi-vessel operations such as under shooting of obstructions as rigs. Spectra delivers data management, positioning techniques and flexibility with the following key benefits:

- Navigation acquisition and validation with real-time source and streamer positioning for marine seismic surveys ranging from simple 2D and high resolution requirements to extensive 3D multi-streamer, multi-vessel configurations.
- Distributed data server provides simple connectivity to easily configure multi-vessel surveys.

- Real-time data acquisition units with integrated GPS receiver provide triggering to 50 micro-seconds, allowing remote synchronization of seismic and acoustic systems.
- Real-time binning, CMP and offset distribution with simultaneous bin expansion capabilities.
- Data logging to UKOOA P1/90 and P2/94 standards with full redundancy providing confidence in data integrity.
- Quality control process providing alarm and audit facilities meeting UKOOA guidelines. Extensive online graphical analysis facilities and end of line reporting facilities.
- Positioning using Kalman Filtering with advanced data snooping statistical testing techniques.
- DGPS and RGPS real-time recomputation.
- Autopilot interface controlled from instrument room leaving the navigator in charge of steering. This facility is fully integrated with a comprehensive turn planning utility providing optimum efficiency on line changes

Multiwave's implementation of Spectra runs on work stations based on the IBM Pentium-4 PC architecture, and on the LINUX operating system.

## **ECHO SOUNDER**

Echo Sounder data was generally good throughout the prospect. In the shallow water depths of the survey you would expect nothing less.

## **4 ENVIRONMENT**

### **4.1 WEATHER**

It was possible, via the 'World Wide Web', to access data about local environmental conditions from [www.weatherbuoy.com](http://www.weatherbuoy.com). Information was reported daily with a 7 day forecast. The Australian Bureau of Metrology also has a good website with reasonably accurate forecasts for the local area. Wind direction and weather forecasts were also available from the NavTex system. Further information such as tidal movements were available the admiralty pilot for the area.

This is an area of intense weather conditions with a predominant southwest swell through out the year driven by strong low-pressure systems in the southern ocean. Winter is considered the period for heavy swells and wind driven seas but as can be seen during this survey conditions of 5 to 7 metre seas can occur at any time. The weather in this area should be considered volatile and hard to accurately predict.

### **4.2 TIDES, CURRENT AND FEATHER**

There was very little tidal influence in the area. The pilot for the area indicated that tidal movement in the area is around 0.3 to 2.3 metres at Port Welshpool

### **4.3 NAVIGATION HAZARDS**

The survey was conducted in relatively open waters of around 40 metres depth. Very few vessels were seen during the survey and those that were, were readily contacted and kept clear of the survey area.



#### **4.4 ENVIRONMENTAL**

In keeping with modern survey practice environmental protection played an important role in the operating practices of Multiwave. Survey operations were carried out under procedures designed to minimise any environmental impact at all times.

There was no off shore refuelling during the survey.

Great care was taken to follow International Maritime Regulations with regard to the disposal of garbage and waste. The Pacific Titan was equipped with an incinerator so that where possible most of the waste could be burnt. Ash from the incinerator was stored for proper disposal ashore. Putrescibles were discharged over the side in compliance with MARPOL regulations. Garbage that was unsuitable for burning was segregated and stored on board the vessel for proper disposal ashore. In addition the ship operates a garbage separation scheme to separate plastics, glass and metal waste. Hazardous wastes such as lithium batteries and chemicals were stored for proper disposal under the manufacturer's guidelines.

The overall environmental performance of the crew was up to modern industry standards with no garbage disposal to the sea, the main areas for improvement would be to replace the fluid filled streamer with a modern solid streamer, which contains no fluid. And the installation of an industrial standard macerator.

#### **4.5 CETACEAN REPORTING**

The survey was carried out outside of the known whale migration period. There were no sightings of any cetaceans during the survey.

On all lines, the acoustic energy source was gradually brought up to maximum capacity over a 30-minute period (soft start) to give sufficient notice to any marine life that might have been in the area. A low volume array element was run during all line changes.

#### **4.6 FISHING**

Fishing activity was low in the area.

#### **4.7 CORAL REEFS**

No physical damage was caused to any reefs in the survey area.

#### **4.8 CONCLUSION**

The Pacific Titan and associated operations had no detrimental impact on the local environment during the seismic survey.

The only discharges into the sea were small quantities of food scraps and treated sewage waste, which fell within MARPOL guidelines.

**5 DIARY****February 12th 2005**

|       |    |                                                                                                                   |
|-------|----|-------------------------------------------------------------------------------------------------------------------|
| 16:18 | MO | Pacific Titan completed recovery of all in water equipment and heading for a rendezvous with the Western Trident. |
| 19:30 | MO | Pacific Titan transiting to 38 22.8'S, 147 30.7'E at the request of Western Trident.                              |
| 20:00 | MO | Deploying source array for undershoot.                                                                            |
| 21:20 | MO | Source arrays in place, technician working on establishing data link with the Trident.                            |

**February 13th 2005**

|       |    |                                                                                                                                                                                  |
|-------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 00:00 | MO | All systems have been installed. Vessels turning to run a test line.                                                                                                             |
| 03:00 | MO | Both vessels circling back due to problems in triggering the gun link. Fault finding on the array trigger in progress. Spectra configured and navigation appears to be working.  |
| 09:00 | MO | Waiting on a replacement Time and frequency receiver.                                                                                                                            |
| 10:30 | MO | Replacement, Time and frequency receiver in place. Communications between the vessels regarding the firing of the array on the Titan with the closure from the Trident resolved. |
| 12:00 | MO | Testing and fault finding continues. Problems have been encountered with the time break on the gun timing.                                                                       |
| 15:20 | MO | Testing and fault finding continues. Predict timing altered in the Tridents nav system. Nav system on the Trident being rebooted.                                                |
| 18:30 | MO | WesternGeco field technician transferred over to the Trident from the Titan. Titan standing by.                                                                                  |

**February 14th 2005**

|       |    |                                                                                                                                 |
|-------|----|---------------------------------------------------------------------------------------------------------------------------------|
| 00:00 | MO | Trident still testing her gear.                                                                                                 |
| 00:10 | MO | Titan in position running towards Perch platform. Trident still having timing problems and reconfiguring the navigation system. |
| 01:00 | MO | Terminated the attempt at Perch platform. Trident still having timing problems, conducting further tests.                       |
| 04:15 | MO | Testing continues on Trident, heading for line 1632.                                                                            |
| 07:00 | MO | All systems are looking good, heading for line 1632. Vessel offset 700 metres to gain far coverage.                             |
| 09:15 | MO | Heading for line 1632. Vessel offset 700 metres to gain far coverage. Soft start commenced at 09:37.                            |
| 11:02 | PR | Recording line GAP04B-1632U-01-091                                                                                              |
| 14:25 | PR | Line change.                                                                                                                    |
| 18:18 | PR | Recording line GAP04B-1744U-1-092                                                                                               |
| 20:10 | PR | Line change.                                                                                                                    |

**February 15th 2005**

|       |    |                                    |
|-------|----|------------------------------------|
| 00:00 | PR | Line change.                       |
| 00:21 | PR | Recording line GAP04B-1632U-2-093  |
| 03:12 | PR | Line change.                       |
| 06:20 | PR | Recording GAP04B-1744U-2-094       |
| 08:31 | PR | Line change.                       |
| 12:23 | PR | Recording line GAP04B-1632U-3-095. |
| 15:20 | PR | Line change.                       |

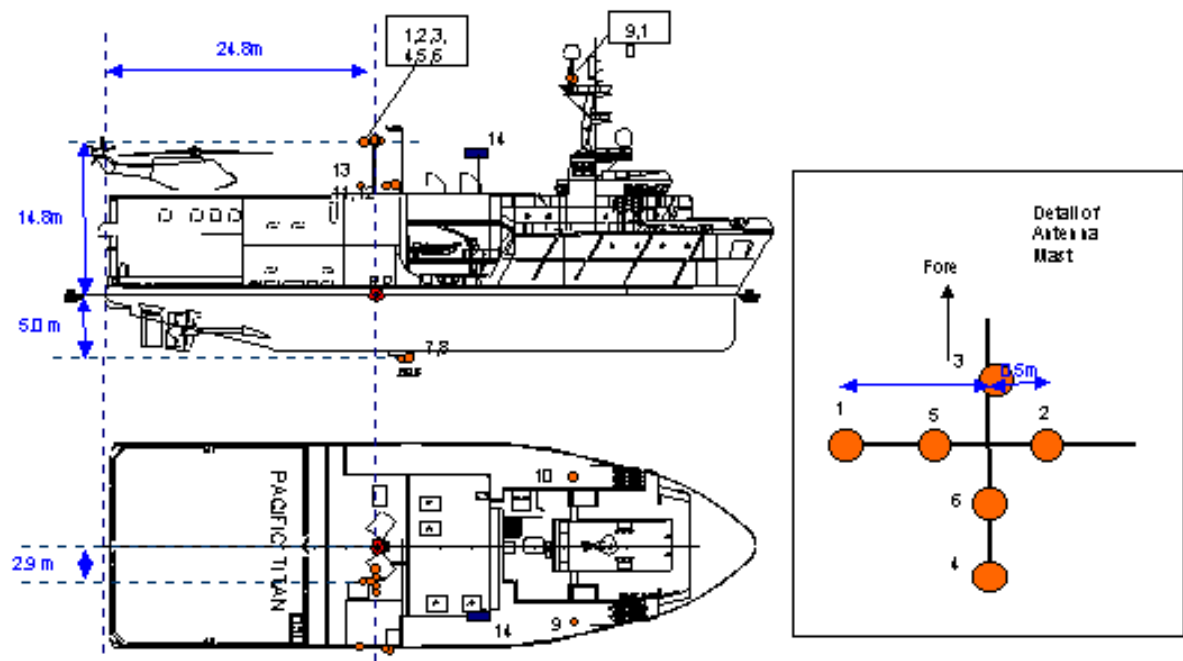
18:46 PR Recording line GAP04B-1744U-3-096.  
 21:06 SB Running test line at Tridents' request.  
 21:23 PR Line change.

## February 16th 2005

00:00 PR Line change.  
 01:01 PR Recording line GAP04B-1632U-4-097.  
 04:02 PR Line change.  
 07:07 PR Recording line GAP04B-1744U-4-098.  
 08:54 PR Line change.  
 12:48 PR Recording line GAP04B-1632U-5-099  
 15:01 MO All array equipment onboard and secure.  
 17:20 MO Titan heading to Eden on the NSW south coast to clear out of Australian Waters.

## 6 MEASUREMENTS

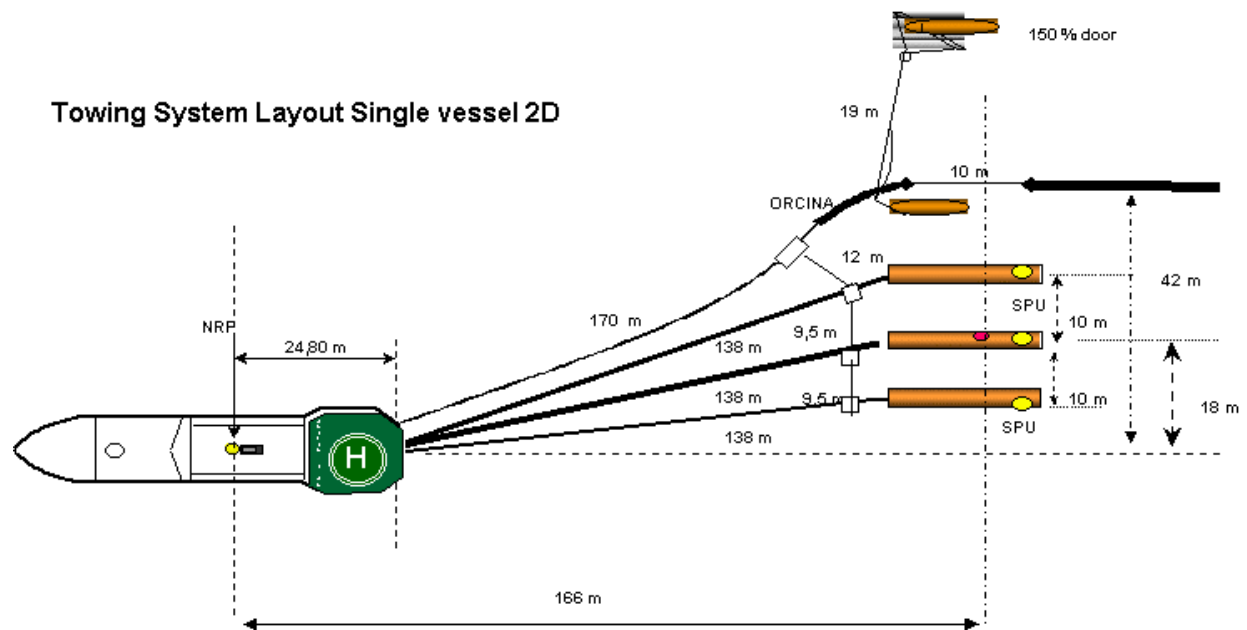
### 6.1 GPS ANTENNAE POSITIONS



|    |          |      |     |      |                                |        |
|----|----------|------|-----|------|--------------------------------|--------|
| 8  | V1E2     | -1.2 | 3.0 | -5.0 | Simrad EA600 200khz Transducer |        |
| 9  | Freewave |      |     |      | 900Mhz Antenna                 |        |
| 10 | Speedlan |      |     |      | 1.4Ghz Antenna                 |        |
| 11 | Runt 1   |      |     |      | Trimble Bullet III GPS Antenna |        |
| 12 |          |      |     |      | Spare Simrad VCU UHF Antenna   | No. 9  |
| 13 |          |      |     |      | Sailor VHF Radio Antenna       | No. 20 |
| 14 | V1GY1    |      |     |      | Simrad GPS Gyro                |        |

## 6.2 TOWING SYSTEM

Towing System Layout Single vessel 2D



7 ECHOSOUNDER CALIBRATION JANUARY 31<sup>ST</sup>ECHOSOUNDER CALIBRATION - m/v. PACIFIC TITAN

Alongside:- **Hobart**  
 Date: **31st Jan 2005**  
 Time: **0:32** GMT  
 Taken in Port for Mobilization  
 Job: **6211**  
 Client: **SANTOS**

## Measurements taken:-

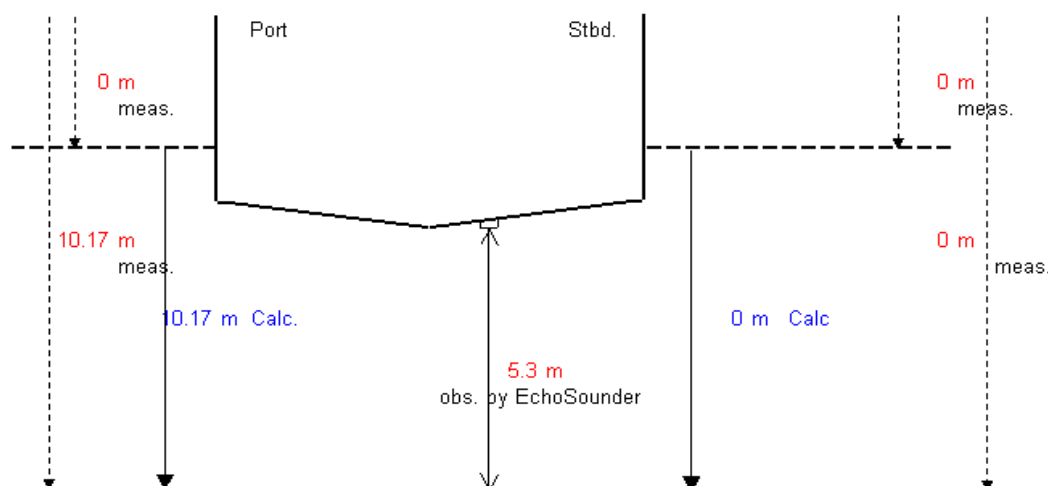
Port Freeboard  
 Port TSDip  
 Stbd Freeboard  
 Stbd TSDip

metres

10.17

EchouSounder Reading  
 Time  
 Stbd Draught marks:  
 Port Draught marks:

5.3  
 8:32  
 4.9  
 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