

**SURVEY REPORT  
FOR THE  
OCEAN BOUNTY RIG MOVE TO  
THE THYLACINE-2 LOCATION**

**HY15597-33**

**Client** : Woodside Energy Limited  
1 Adelaide Terrace  
PERTH WA 6001

**Date of Survey** : 3<sup>rd</sup> August – 28<sup>th</sup> August 2001

**Date of Report** : 7<sup>th</sup> September 2001

**Checked** :

**Authorised** : \_\_\_\_\_

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## ABSTRACT

*Between 3<sup>rd</sup> and 28<sup>th</sup> August 2001, Fugro Survey provided equipment and personnel for the MODU Ocean Bounty rig move to the Thylacine-2 location in exploration permit T/30P, in the Otway Basin, Australia.*

*Surface positioning was achieved utilising Fugro Survey's Multi-Reference Differential GPS and Starfix Seis Navigation Software.*

*The final position for the drill stem derived from DGPS observations at the Thylacine-2 location was:*

<b>Location Name:</b>	<b>THYLACINE-2</b>
<b>Easting:</b>	<b>659 564.5 m</b>
<b>Northing:</b>	<b>5 656 220.4 m</b>
<b>Latitude:</b>	<b>39° 13' 42.675" S</b>
<b>Longitude:</b>	<b>142° 50' 55.000" E</b>
<b>Rig Heading:</b>	<b>249.77° True</b>

**TABLE 1 : FINAL POSITION – DRILL STEM**

*This position is **1.7m** on a bearing of **248°** (G) from the proposed Thylacine-2 location.*

*All co-ordinates in this report are quoted in AGD84 datum and UTM Zone 54 (CM 141°) projection unless otherwise stated.*

## **1.0 INTRODUCTION**

Fugro Survey Pty Ltd (Fugro) was contracted by Woodside Energy Limited (Woodside) to provide positioning services for the mobile offshore drilling unit (MODU) Ocean Bounty move to the Thylacine-2 location in exploration permit T/30P in the Otway Basin, Australia.

A general location diagram is shown as Figure 1.

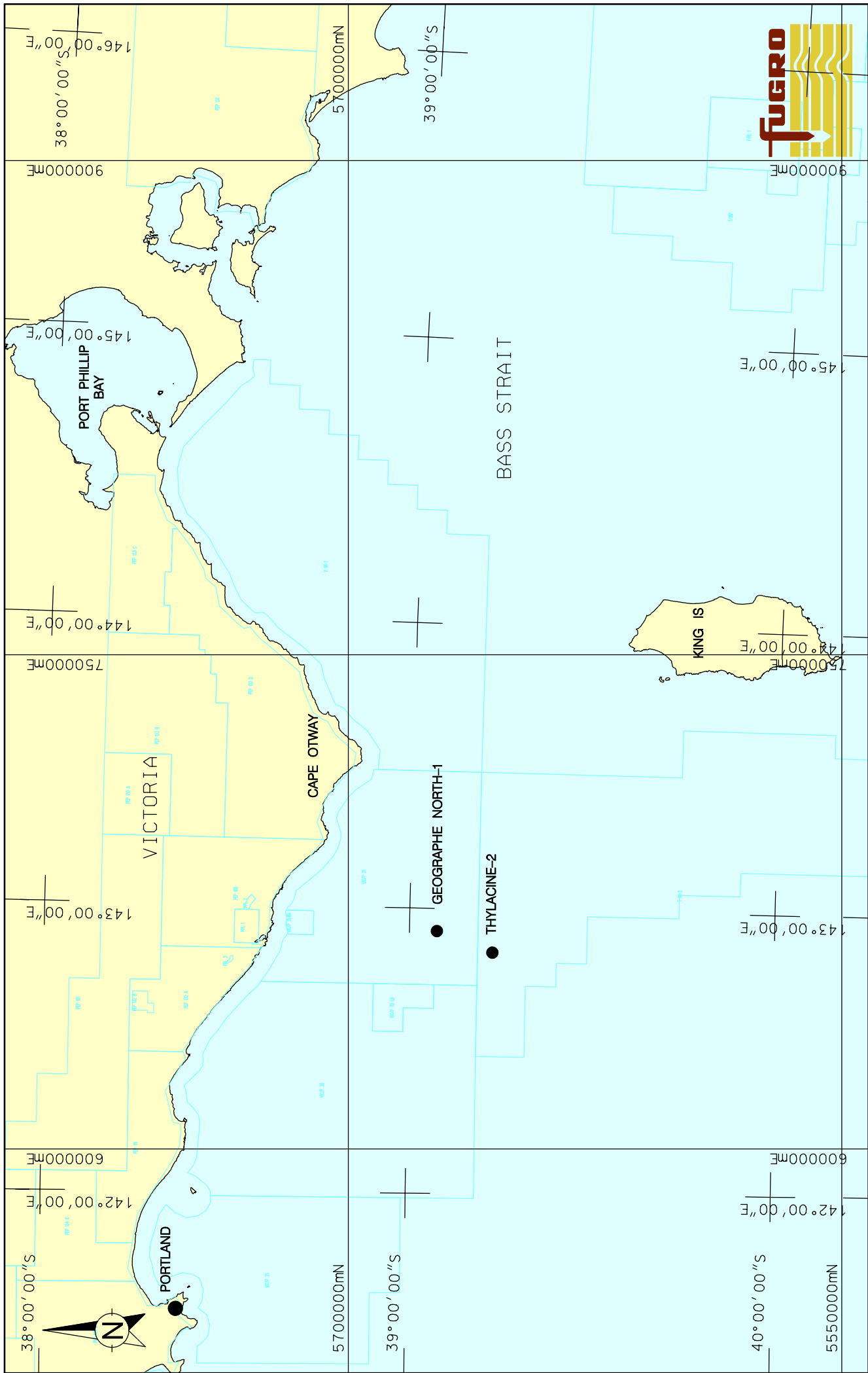
This report details equipment used, survey parameters adopted, procedures employed, and the results achieved. Safety is included in Section 7.0 of this report.

### **1.1 Scope of Work**

Personnel and equipment were to be provided on a 24-hour per day basis for:

- Surface navigation for the Ocean Bounty using Fugro's Starfix-Spot Differential GPS (Optus and Apsat satellites) and Multi Reference Differential Solution.
- Surface navigation for two AHV's and barge management system to send tow route and anchor locations from the survey computer to the AHV's.
- Final rig position calculation for the Thylacine-2 location using DGPS observations.
- Logging of GPS Phase Data

Woodside provided co-ordinates for the proposed Thylacine-2 location and Diamond Offshore supplied the proposed anchor pattern. These co-ordinates are located in Appendix B.



GENERAL LOCATION DIAGRAM

FIGURE 1

## 1.2 Sequence of Events

3 <sup>rd</sup> August 2001	H. Gilmour travels to Melbourne, overnight at Melbourne Hilton.
4 <sup>th</sup> August 2001	H. Gilmour departs Melbourne Hilton and transfers to Barry's Beach Marine terminal. Mobilises Pacific Sentinel and checks into Toora Lodge.
5 <sup>th</sup> August 2001	H. Gilmour standing by in Toora awaiting arrival of Pacific Conqueror for mobilisation. A. Sarolea travels to Melbourne, overnight at Melbourne Hilton.
6 <sup>th</sup> August 2001	H. Gilmour standing by in Toora awaiting arrival of Pacific Conqueror for mobilisation. A. Sarolea transfers to Ocean Bounty via Longford Heliport. Commence mobilisation of Ocean Bounty.
7 <sup>th</sup> August 2001	H. Gilmour standing by in Toora awaiting arrival of Pacific Conqueror for mobilisation. Complete Mobilisation of Ocean Bounty, A. Sarolea attends pre-rig move meeting, Sun azimuth observations for gyro calibration and DGPS verification data collected. A. Sarolea attends weekly safety meeting.
8 <sup>th</sup> August 2001	H. Gilmour mobilises Pacific Conqueror, transfers to Sale awaiting transfer to Ocean Bounty. Awaiting anchor recovery at East Pilchard-1. Pacific Conqueror called to assist Maersk Tacoma.
9 <sup>th</sup> August 2001	Awaiting anchor recovery at East Pilchard-1. H. Gilmour transfers to Ocean Bounty. Pacific Conqueror assisting Maersk Tacoma.
10 <sup>th</sup> August 2001	Awaiting anchor recovery at East Pilchard-1. Pacific Conqueror assisting Maersk Tacoma.
11 <sup>th</sup> August 2001	Awaiting anchor recovery at East Pilchard-1. Pacific Conqueror assisting Maersk Tacoma.

12 <sup>th</sup> August 2001	Awaiting anchor recovery at East Pilchard-1. Pacific Conqueror assisting Maersk Tacoma. Personnel attend fire and abandon rig drill.
13 <sup>th</sup> August 2001	Commence recovery of anchors. Anchor recovery completed. Commence tow to Thylacine-2 location.
14 <sup>th</sup> August 2001	Rig on tow to Thylacine-2 location. Fugro personnel attend weekly safety meeting.
15 <sup>h</sup> August 2001	Rig on tow to Thylacine-2 location.
16 <sup>th</sup> August 2001	Rig on tow to Thylacine-2 location. Due to deteriorating weather conditions and similar forecasts, the decision was made to commence ballasting the Ocean Bounty down to survival draft of 60ft.
17 <sup>th</sup> August 2001	Rig on tow to Thylacine-2 location. Pacific Sentinel parted tow wire. Lower #3 anchor to prevent rate of static tow drift. Monitoring rig position at anchor. Waiting on weather.
18 <sup>th</sup> August 2001	Waiting on Weather. Monitoring rig position at anchor.
19 <sup>th</sup> August 2001	Waiting on Weather. Monitoring rig position at anchor.
20 <sup>th</sup> August 2001	Waiting on Weather. Monitoring rig position at anchor. H. Gilmour departs rig for Melbourne.
21 <sup>st</sup> August 2001	Waiting on Weather. Monitoring rig position at anchor. H. Gilmour standing by in Melbourne awaiting transfer to Ocean Bounty.
22 <sup>nd</sup> August 2001	Waiting on Weather. Monitoring rig position at anchor. H. Gilmour returns to rig from Melbourne.
23 <sup>rd</sup> August 2001	Waiting on Weather. Monitoring rig position at anchor. Commence tow wire recovery at storm location.



24 <sup>th</sup> August 2001	Recommence tow to Thylacine-2. Commence anchor deployment at Thylacine-2 location.
25 <sup>th</sup> August 2001	Anchor deployment continuing at Thylacine-2 location
26 <sup>th</sup> August 2001	Anchor deployment and pre-tensioning completed.
27 <sup>th</sup> August 2001	H. Gilmour departs rig and return to Perth. Commence logging final position. Commence logging GPS Phase measurements. Rig position field report issued to client. End logging of GPS Phase measurements.
28 <sup>th</sup> August 2001	End logging of GPS Phase measurements. A. Sarolea departs rig and return to Perth.

Full details of Fugro involvement in the rig move are presented in the Daily Operations Reports included in Appendix A.

## 2.0 SURVEY PARAMETERS

All co-ordinates supplied in this report are referenced to the Australian Geodetic Datum 1984 (AGD84). The GPS is in reference to the World Geodetic System 1984 (WGS84).

### 2.1 Geodetic Parameters

<b>Datum</b>	:	<b>WGS84</b>
Reference Spheroid	:	World Geodetic Spheroid 1984
Semi-major Axis	:	6 378 137 m
Inverse flattening (1/f)	:	298.257223563

The proposed drilling location and all project co-ordinates are in terms of:

<b>Datum</b>	:	<b>AGD 1984</b>
Reference Spheroid	:	Australian National Spheroid (ANS)
Semi-major Axis	:	6 378 160 m
Inverse flattening (1/f)	:	298.25

<b>Projection</b>	:	<b>UTM</b>
False Easting	:	500 000 m
False Northing	:	10 000 000 m
Latitude of Origin	:	0.0°
Central Meridian (CM)	:	141° East
UTM Zone	:	54
Scale Factor on CM	:	0.9996
Units	:	International Metres

#### Datum Transformation

The transformation parameters used for conversion from WGS 84 co-ordinates, generated by the Differential GPS system, to AGD 84 are listed below. Fugro follow the DMA convention for datum transformations.

X Shift (metres)	=	+116.0000	Rotation X (secs)	=	+0.2300
Y Shift (metres)	=	+50.4700	Rotation Y (secs)	=	+0.3900
Z Shift (metres)	=	-141.6900	Rotation Z (secs)	=	+0.3440
Scale (ppm)	=	-0.0983			

## 2.2 Differential GPS Reference Stations

The reference stations listed in the table below were used in the computation of the Multi Reference DGPS position.

Description	Site ID	Latitude (S)	Longitude (E)	Height (m)	Datum
Melbourne	385	38° 27' 53.375"	144° 54' 46.909"	144.9	WGS84
Bathurst	336	33° 25' 46.902"	149° 34' 01.960"	756.8	WGS84
Pt Augusta	326	32° 29' 55.166"	137° 46' 31.459"	19.0	WGS84

**TABLE 2 : DIFFERENTIAL GPS REFERENCE STATIONS**

## 2.3 Project Co-ordinates and Tolerances

Woodside supplied the proposed target co-ordinates for the Thylacine-2 location.

THYLACINE-2	Easting	Northing
Proposed Wellhead	659 566m	5 656 221m

**TABLE 3 : PROJECT COORDINATES**

The tolerance for the final drill rig position, as specified by Woodside was to be within a 25-metre radius of the design location, with a rig heading of 250°(T).

Please refer to Appendix B for the full listing.

## 3.0 EQUIPMENT AND PERSONNEL

### 3.1 Equipment Listing

#### **Ocean Bounty**

- 2 x Starfix Seis navigation computers and monitors
- 2 x Starfix-Spot (Optus) DGPS System c/w antennae, cabling and interfaces
- 2 x Starfix-Spot (APsat) DGPS System c/w antennae, cabling and interfaces
- 2 x Trimble 4000 series GPS Receivers c/w antennae, cabling and interfaces
- 2 x Tokimec GM20/21 Gyro Compass
- 1 x PCTug computer and monitor (Spare)
- 2 x Remote Tug Tracking Telemetry Systems (radio/modem & antenna)
- 1 x Theodolite and tripod
- 1 x DeskJet Printer

#### **Pacific Conqueror and Pacific Sentinel (Anchor Handling Vessels)**

- 1 x PCTug navigation computer and monitor
- 1 x OmniSTAR<sup>plus</sup> Enhanced Differential System (EDS) unit c/w associated antenna, cabling and interfaces
- 1 x Remote Tug Tracking Telemetry System (radio/modem & antenna)
- 1 x Fluxgate Compass

Please refer overleaf for equipment flow diagrams shown as Figures 2 and 3.

### 3.2 Vessels

The vessels used for anchor handling and towing of the Ocean Bounty were the Pacific Conqueror and Pacific Sentinel.

Refer to Figures 4, 5 and 6 overleaf for vessel offset diagrams.

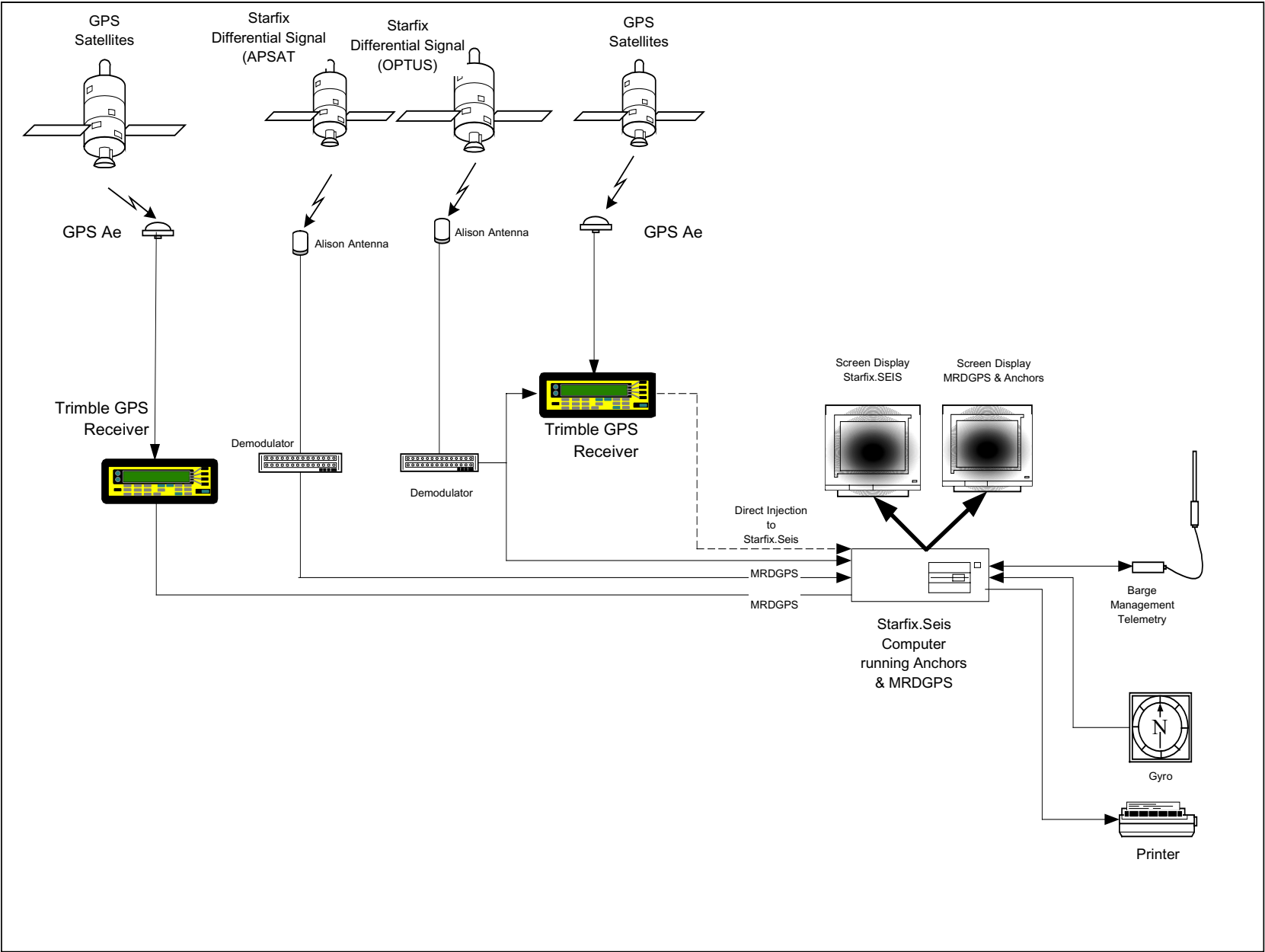


FIGURE 2 : EQUIPMENT FLOW DIAGRAM - OCEAN BOUNTY

**FIGURE 3 : EQUIPMENT FLOW DIAGRAM - AHV'S**

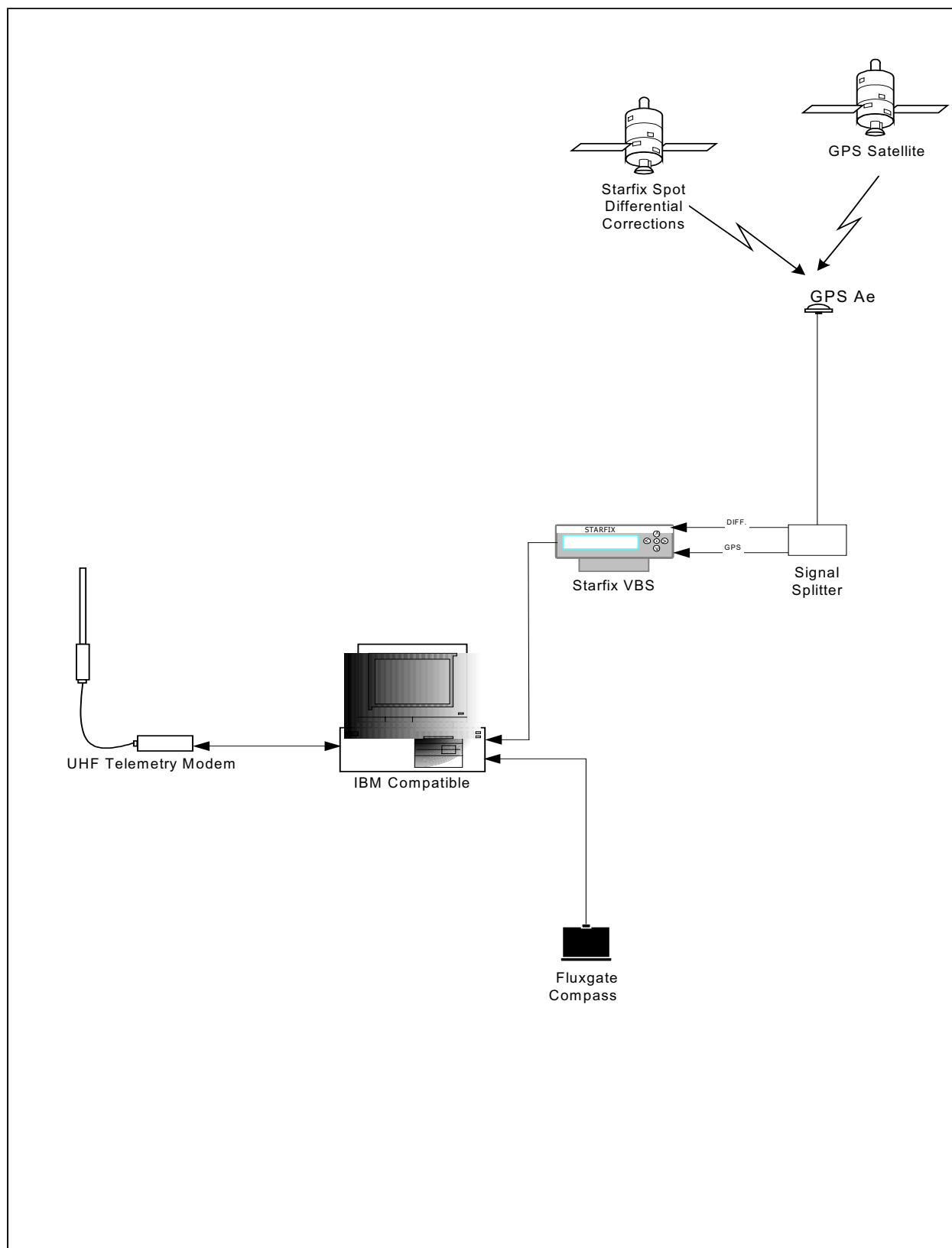


FIGURE 4 : VESSEL OFFSET DIAGRAM - OCEAN BOUNTY

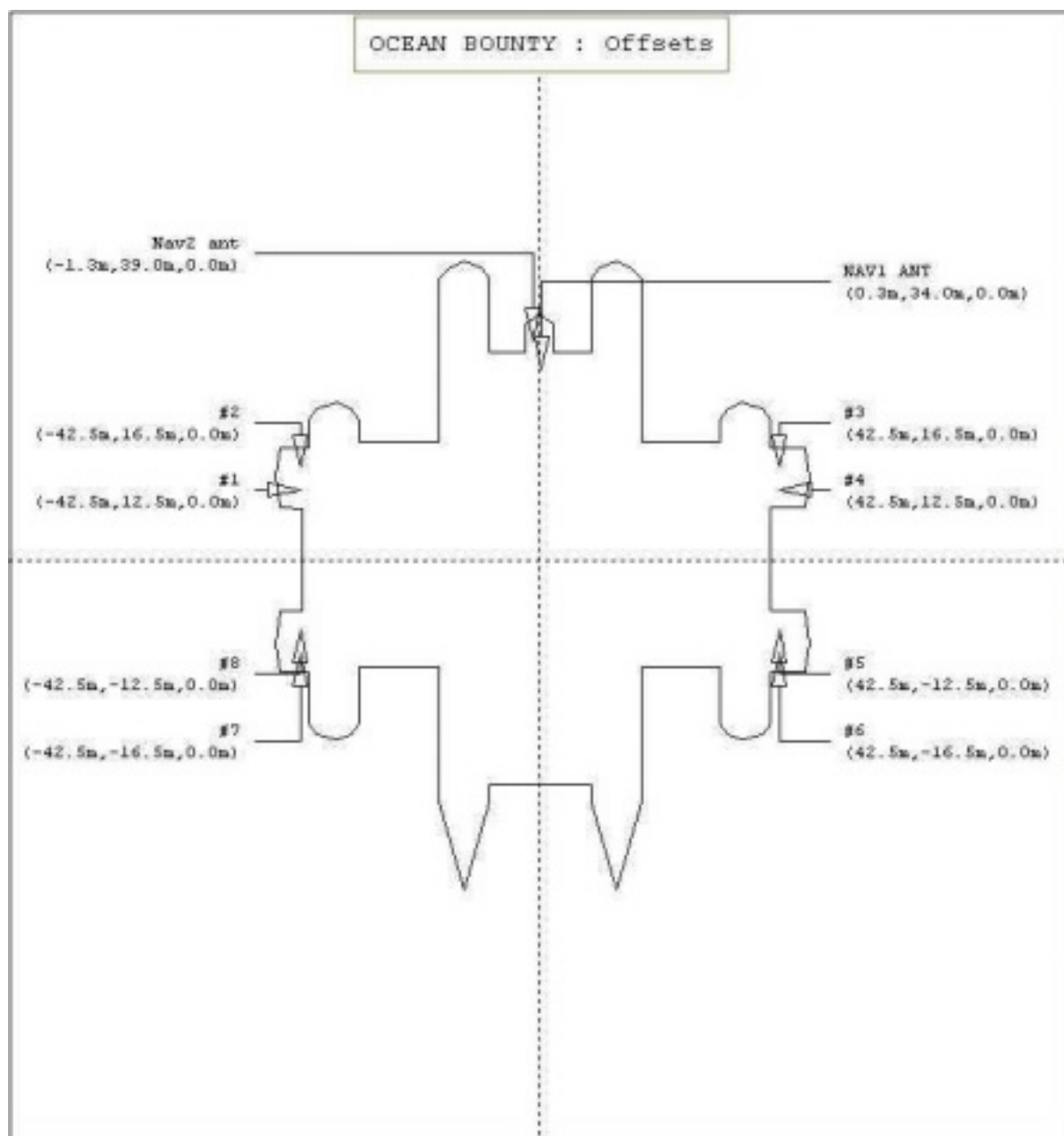
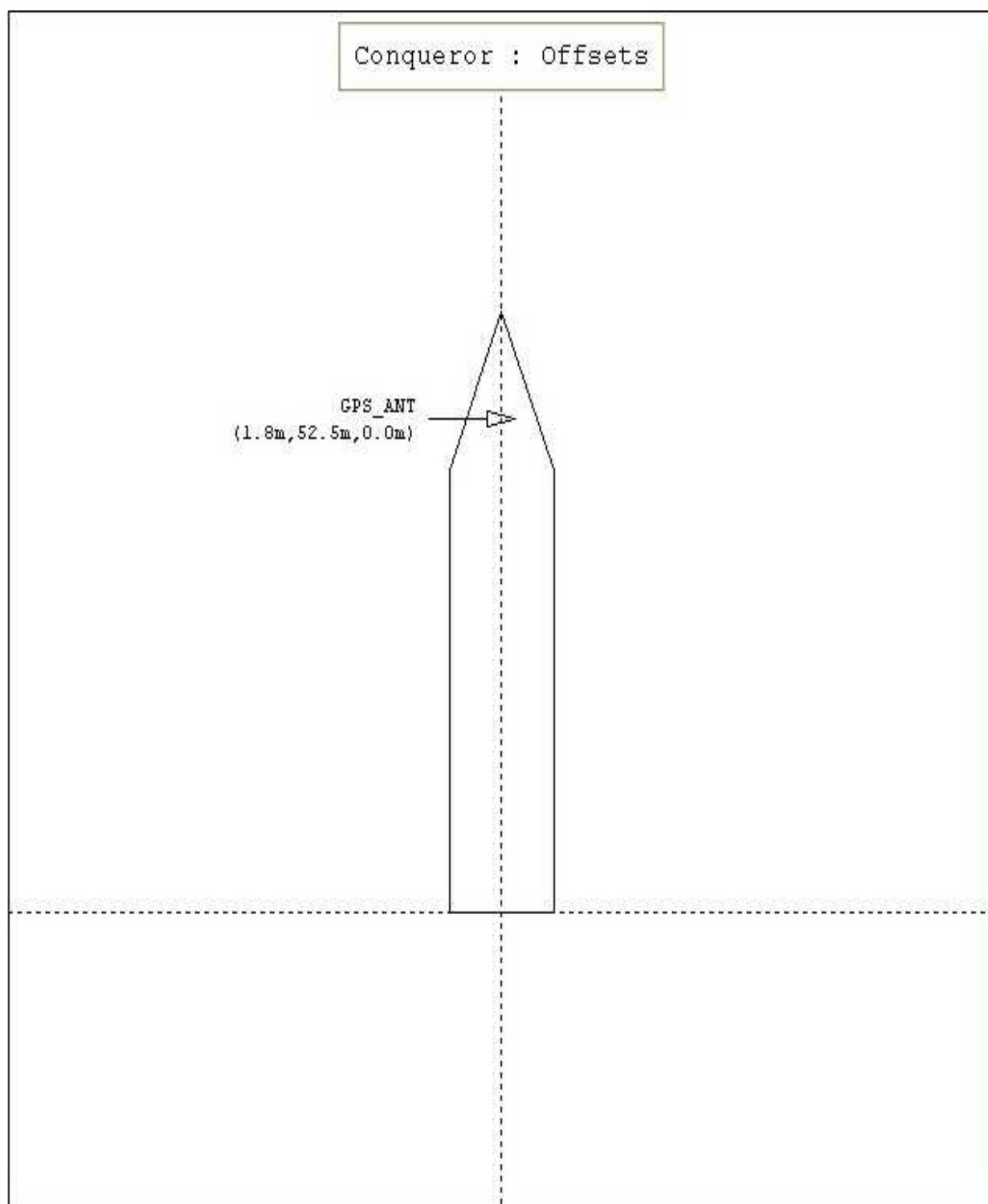
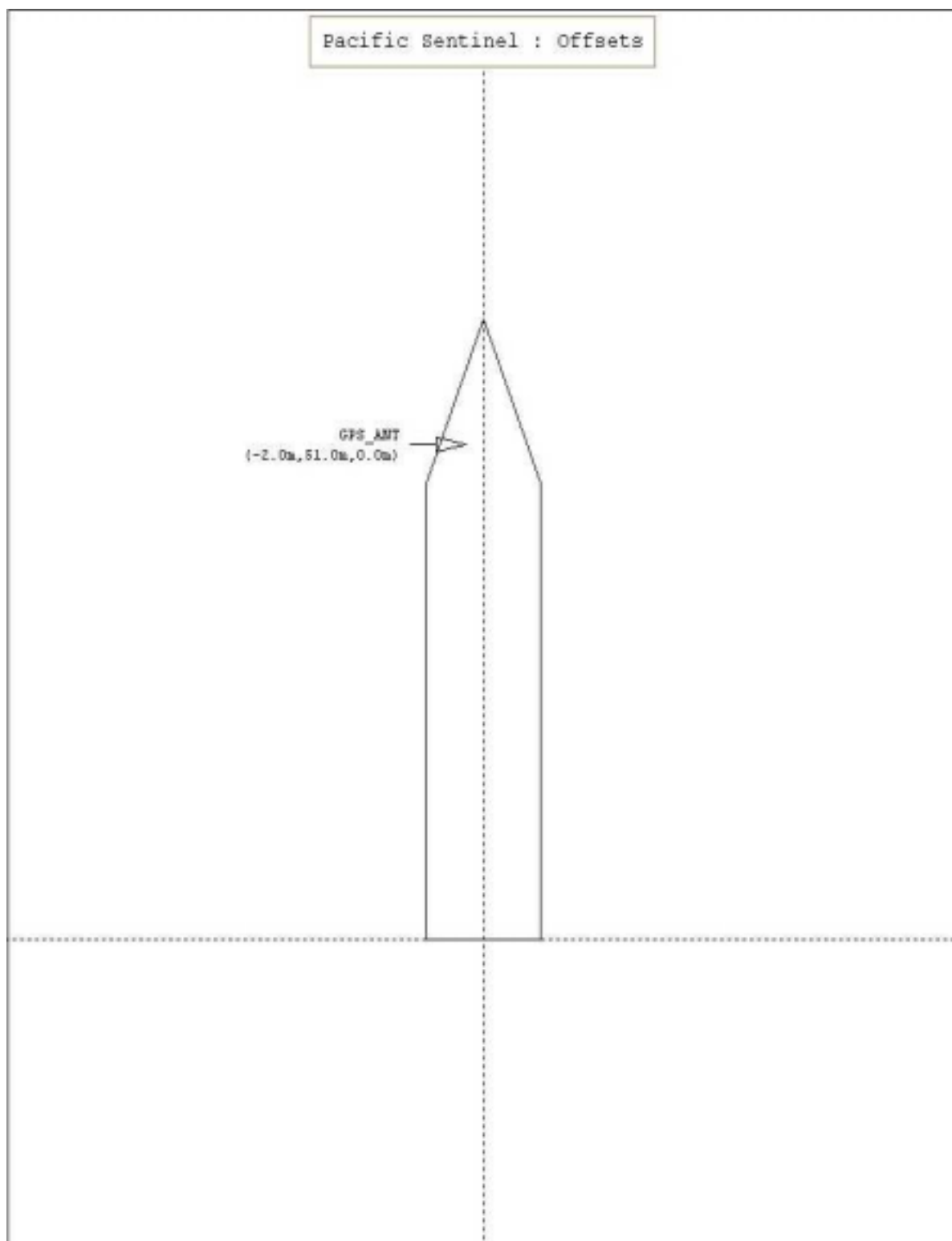


FIGURE 5 : VESSEL OFFSET DIAGRAM - PACIFIC CONQUEROR





**FIGURE 6 : VESSEL OFFSET DIAGRAM - PACIFIC SENTINEL**



### **3.3 Personnel**

Fugro personnel involved in this project were as follows:

A. Sarolea	Party Chief/Surveyor	5 <sup>th</sup> to 28 <sup>th</sup> August 2001
H. Gilmour	Survey Technician	3 <sup>rd</sup> to 27 <sup>th</sup> August 2001

Woodside were represented during the rig move by:

A. Sellers	QC Surveyor	5 <sup>th</sup> to 28 <sup>th</sup> August 2001
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## 4.0 EQUIPMENT CALIBRATIONS

### 4.1 DGPS Navigation Integrity Check

The primary navigation system comprised a Trimble GPS receiver and the Fugro Survey Multi Reference Differential GPS (MRDGPS) utilising reference stations at Melbourne, Bathurst and Pt Augusta. The secondary navigation system comprised of a Trimble GPS receiver with single base station direct-injection RTCM corrections, from the reference station at Melbourne.

With the rig stationary and fully anchored over the East Pilchard-1 location on 7<sup>th</sup> August 2001, the calculated datum position (drill stem) was logged for approximately thirty minutes. The calculated datum position from the primary and secondary positioning systems were then compared to each other. The two systems were found to be in good agreement. Please refer to the two tables below.

**Note: East Pilchard-1 Geodesy: AGD66 (Bass Strait) UTM, CM 147°East**

Established Position Comparison	Easting (m)	Northing (m)
Established Co-ordinates(East Pilchard-1)	636 764.6	5 771 005.8
Observed Co-ordinates (primary navigation)	636 762.3	5 771 004.1
Differences (Established – Observed)	2.3 m	1.7 m

**TABLE 4 : ESTABLISHED POSITION COMPARISON**

Primary/Secondary Comparison	Easting (m)	Northing (m)
Primary navigation(MRDGPS)	636 762.26	5 771 004.10
Secondary navigation(Direct Injection)	636 762.07	5 771 003.77
Differences	0.19	0.33

**TABLE 5 : PRIMARY/SECONDARY COMPARISON**

Please refer to Appendix C for DGPS check.

A positioning checklist was completed to ensure that correct antenna offsets, transformation parameters and UTM central meridian were being used in all calculations. The geodetic calculations with both the online Starfix Seis navigation program and the off line GEO geodetic calculations program were also carried out.

## **4.2 Gyro Compass Check**

The calibration of the survey gyro compass was checked by Sun observations on 7<sup>th</sup> August 2001, while the rig was anchored at East Pilchard-1 location.

A series of observations were made to the sun which the rig heading was calculated. The calculated values were then compared to the observed gyro compass values logged in Starfix Seis. A mean C-O value of  $-0.46^{\circ}$  was determined and added to the existing correction of  $+200.00^{\circ}$  giving a final correction of  $+199.54^{\circ}$  applied as a correction in Starfix Seis.

Details of the observations and gyro calibration reduction results are enclosed in Appendix C.

## **5.0 SURVEY PROCEDURES**

### **5.1 Mobilisation**

Fugro Survey personnel mobilised to Melbourne from Perth on 3<sup>rd</sup> August 2001 whilst the rig was fully anchored over the East Pilchard-1 location.

The AHV's equipment was mobilised onto the Pacific Sentinel on 4<sup>th</sup> August and Pacific Conqueror on the 8<sup>th</sup> August 2001 whilst they were alongside the Barry's Beach Marine Terminal, Victoria.

The Rig's Survey equipment was mobilised on the 7<sup>th</sup> August 2001 with all systems operational at 1430 hrs the same day.

Antenna offset measurement checks and the gyro calibration were completed on 7 August 2001, while the rig was fully anchored at the East Pilchard-1 location.

### **5.2 General Survey Procedures**

Anchor recovery at East Pilchard-1 location began on 13<sup>th</sup> August 2001. Runlines were sent to each of the vessels, via the Starfix Seis system, to assist them in chasing out the PCCs along the chains and recover the anchors. The last anchor was recovered at 2300 hrs on 13<sup>th</sup> August 2001 and the Ocean Bounty commenced tow to the Thylacine-2 location.

During the tow to the Thylacine-2 location, the rig experienced deteriorating weather conditions and with similar forecasts, the decision was made to commence ballasting the Ocean Bounty down to survival draft of 60ft. The rig then encountered storm force winds and large swells which prevented the rig from advancing and deploying its anchors. During the morning of 17<sup>th</sup> August the main tow bridle connected to the Pacific Sentinel parted and the rig's rate of drift increased to approximately two knots in an Easterly direction away from the intended Thylacine-2 location. The decision was made to deploy the rig's #3 anchor, this was deployed on the afternoon of the 17<sup>th</sup> August 2001. The rig then held on this anchor until the afternoon of 23<sup>rd</sup> August 2001. The tow recommenced at 0020 hrs on 24<sup>th</sup> August 2001 with both the Pacific Conqueror and Pacific Sentinel towing the rig from the #2 and #3 anchor chains.

After arriving at location at 1550 hrs on 24<sup>th</sup> August 2001, the rig deployed the #6 anchor and the Pacific Conqueror ran the #2 anchor. After the Pacific Conqueror ran the #2 anchor, the Pacific Sentinel then ran the #3 anchor. The remaining five anchors were deployed with the last anchor in place at 1319 hrs on 25<sup>th</sup> August 2001. The #3 anchor had to be rerun due to the AHV being unable to strip back the PCC to the rig.

For each anchor, the AHV's were given a waypoint with the corresponding runline through the PCTug system. The AHV's would then run out the anchor chain along this line until the desired amount of chain, as determined by the winch's cable counter, had been paid out from the rig. The anchor chain was then stretched out and the anchor lowered to the seabed with the vessel then stripping the chain chaser back to the rig.

After deployment of the anchor spread, anchors were storm tensioned and the rig's moon pool location was positioned over the proposed Thylacine-2 location. To facilitate positioning operations, the rig's drill stem position relative to the required location was displayed on the navigation monitor, which displayed the bearing and distance from the intended location both graphically and numerically.

The Ocean Bounty was positioned over the Thylacine-2 location and all anchoring and pre-tensioning completed by 2330hrs on 26<sup>th</sup> August 2001. Final position data was logged between 2142 hrs and 2342 hrs on 27<sup>th</sup> August 2001. A field report was issued to the Woodside Survey Representative and the Woodside Wellsite Manager on 27<sup>th</sup> August 2001.

### **5.3 Demobilisation**

All navigation systems onboard the Ocean Bounty, Pacific Conqueror and Pacific Sentinel were powered down and left mobilised ready for the next rig move.

Fugro personnel departed the rig on 27<sup>th</sup> and 28<sup>th</sup> August 2001.

## 6.0 RESULTS

### 6.1 Final Position

The final position of the Ocean Bounty drill-stem was established by calculating the mean position from two hours of differential GPS data between 2142 hrs and 2342 hrs on 27<sup>th</sup> August 2001. During this period calculated drill-stem co-ordinates from both the primary and secondary positioning systems were logged at one second intervals in Starfix Seis. Data from the primary positioning system was used for the final position calculation.

Differential corrections for the GPS positioning system were derived using a multi reference solution with base station data from Melbourne, Pt Augusta and Bathurst.

AGD84 geographical positions for the Thylacine-2 location are as follows:

Position	Method	Latitude	Longitude
Drill Stem @ Surface	DGPS	39° 13' 42.675" S	142° 50' 55.000" E
Proposed Location		39° 13' 42.654" S	142° 50' 55.063" E

**TABLE 6 : AGD84 GEOGRAPHICAL POSITIONS FOR THYLACINE-2**

AGD84 grid co-ordinates (CM 141° E) for the Thylacine-2 location are as follows:

Position	Method	Easting	Northing	No. Of Obs	S. Dev.
Drill Stem @ Surface	DGPS	659 564.5	5 656 220.4	7190	± 0.45
Proposed Location		659 566.0	5 656 221.0		

**TABLE 7 : AGD84 GRID CO-ORDINATES FOR THYLACINE-2**

This position is **1.7m** at a bearing of **248°** (Grid) from the proposed Thylacine-2 location.

The rig position field report and final position fix data are enclosed in Appendix D.

## 6.2 Rig Heading

The heading of the Ocean Bounty was established by calculating the average heading from two hours of gyro compass data between 2142 hrs and 2342 hrs on 27<sup>th</sup> August 2001. During this period gyro readings were logged at one second intervals in Starfix Seis.

The Ocean Bounty rig heading is as follows:

Description	Method	True	Grid	No. Of Obs	S.Dev
Rig Heading	Gyro	249.77°	250.94°	7190	± 0.54°
Proposed Heading		250°			

**TABLE 8 : RIG HEADING**

## 6.3 Anchor Positions

The approximate locations of the Ocean Bounty anchors are shown below. These positions are derived from a position fix on the stern of the AHV at the time of anchor deployment on the seabed. The bearing from the fairlead along each anchor leg to the AHV's stern position, was correlated with final chain lengths payed out from each anchor winch and applied tension to calculate catenary and corrected horizontal distances to each anchor buried in the seabed.

Anchor	Easting	Northing	Bearing(T)	Deployed by
1	659 294	5 654 846	190°	Pacific Conqueror
2	658 660	5 655 142	220°	Pacific Conqueror
3	658 209	5 656 450	277°	Pacific Sentinel
4	658 540	5 657 174	311°	Pacific Sentinel
5	659 823	5 657 635	010°	Pacific Conqueror
6	660 383	5 657 258	038°	Ocean Bounty
7	660 959	5 655 926	100°	Pacific Conqueror
8	660 604	5 655 282	131°	Pacific Conqueror

**TABLE 9 : ANCHOR POSITIONS**



## **7.0 SAFETY**

All work undertaken by Fugro personnel during the project was conducted within the guidelines of Fugro Survey's Safety Policy as defined in Fugro Survey's Safety Manual (FSSM01) and Offshore Survey Safety Practices (FSSM06).

Fugro personnel worked within project safety guidelines and plans adopted by Diamond Offshore and Woodside.

Personal safety equipment was worn throughout the project as required.

No injuries involving Fugro personnel were reported during the project.

A Sarolea and H. Gilmour participated in a fire and abandon rig drill on 12<sup>th</sup> August 2001. A. Sarolea also attended a weekly safety meeting on 7<sup>th</sup>, 14<sup>th</sup> and 22<sup>nd</sup> August 2001. With H. Gilmour attending a weekly safety meeting on 14<sup>th</sup> and 22<sup>nd</sup> August 2001.

## **8.0 CONCLUSIONS**

On reviewing the Rig Move operations undertaken by Fugro Survey for the Ocean Bounty, the following conclusions have been reached:

The Ocean Bounty was successfully positioned on location within required tolerances.

The #3 anchor had to be rerun as the AHV was not able to return the PCC to the rig.