FINAL FIELD OPERATION REPORT
MARINE SEISMIC REFLECTION SURVEY

Bass Strait Oil Company Ltd.
Vic-P/42
Gippsland Basin

WesternGeco Job No. 9226

ACQUIRED BY

Geco Beta

From July 28th to August 8th 2002

Report Compiled by Party Chief

The Survey Parameters and Job Configuration details listed in this report are for the purpose of reporting General information and should not be used for Data Processing Purpose.

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1. Survey Information and Objectives

The survey focused on the northeast of Block Vic/P42 and included seismic migration operators in adjacent areas L7, L8, L13 & L14, (Bream and Kingfish production licenses) and application area VO1-4.

The vessel was the M.V. Geco Beta, designed and built for worldwide seismic exploration. The M.V. Geco Beta has a purpose built back deck, where all work involved in the deployment and retrieval of streamers and energy sources was carried out, a dedicated instrument room, where all instrumentation required for the survey was housed, and living accommodation to house the normal complement of approximately 50 crew. M.V. Geco Beta is built to DNV+1A1-EO-HELIDK classification and conforms to the rules and regulation of Solas 1974. International load line requirements are according to international loadline convention of 1966. The vessel is also equipped with a jet powered fast rescue craft as well as a workboat for maintenance of the in-sea equipment.

The support vessel for the operation was the Total Voyager operated and owned by Total Marine. The Total Voyager was used to divert shipping and fishing vessels away from the towed equipment and act as a standby vessel during small boat operations.

The survey target objectives for the north of the survey area were to image
(and determine seismic velocities of):

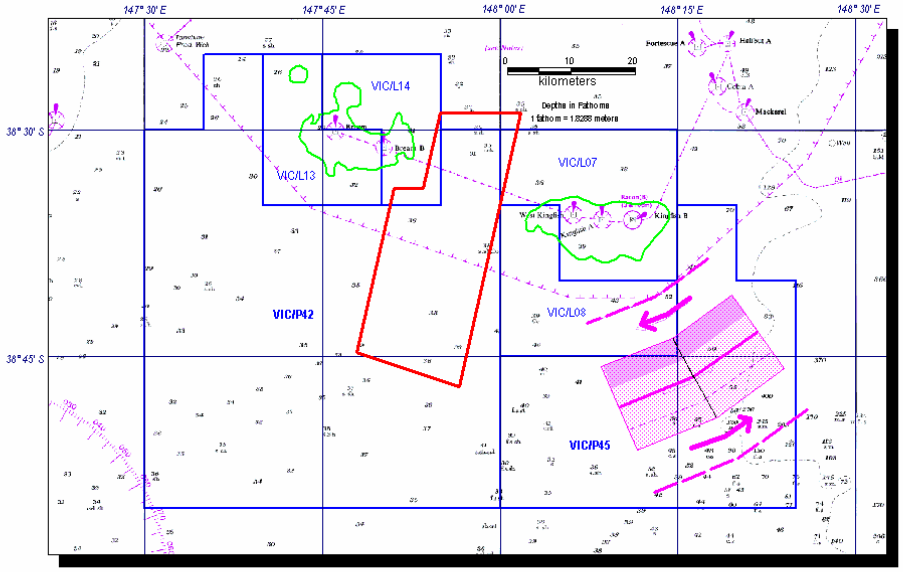
- High and low velocity carbonate channels at depths from 500 to 1500 (TWT 700-1100msec) carbonates
- Top Latrobe reservoir objectives at depths from 2100 - 2300m ss (TWT 1650-1700msec) clastics
- Intra Latrobe reservoir objectives at depths from 2200-3000m ss (TWT 1680 - 2000msec) clastics

For the southern half of the survey the objective was to image the Hemingway Prospect and determine occurrence of any DHI's:

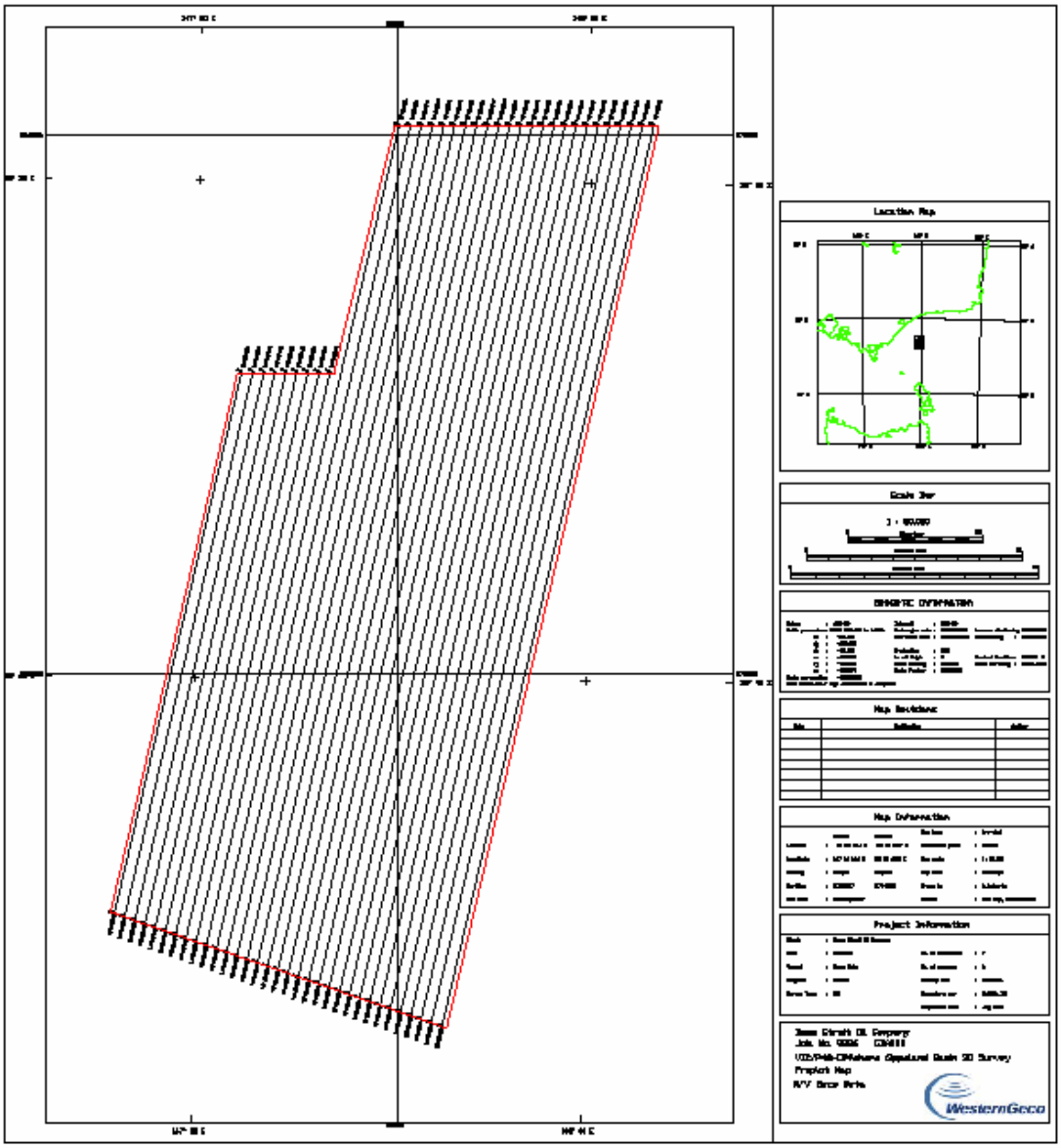
- Top Latrobe objective at depths from 1900-2100m ss (TWT 1500-1600msec) clastics

2. Area Map

Location Map
Bass Strait Oil Company
3D Survey Program, VIC/P42 & VIC/P45



3. Program Map



4. Job Book

Client:	Bass Strait Oil Company
Area:	Vic/P42
Job Number:	9226
Date:	24th July 2002
Version:	5

Project Geo:	Name Tim Brice

Acquisition Parameters

General

Client	Bass Strait Oil Company Ltd.
Vessel	Geco Beta
Job Number	9226
Client Contract Number	GBA02B
Location	Vic/P42, Gippsland Basin
Type of Survey (2D or 3D)	3D
Area or Total km	422.53 sq.km.
Average Line Length	29.7 km
Heading	193.254 / 013.254 deg
Estimated Start Date	28th July 2002
Estimated Duration	2 weeks
SuperVISION required	No

Streamer Parameters

Cable type	Nessie 4 (Nessie 3 Bubbles)
Number of streamers	8
Group length	16.12 m
Group interval	12.5 m
Hydrophone sensitivity	20 V/Bar
Streamer length	4600 m
Streamer depth	8m
Streamer separation	100 m
Number of groups per streamer	368
Streamer tracking	SIPS 1 & Trinav rGPS
Requested source to receiver offset	Approx. 150m

Recording

Recording system	Triacq 2.0
Recording format	SEGD **8015 rev 2**
Record length	6 sec
Sample rate	2ms
Recording filter (Hi-Cut)	180Hz @ 72dB/Octave
Recording filter (Low-Cut)	3Hz @ 18dB/Oct
Filter type	N3

Recording system delay	Nil
Recording media	IBM 3590
Dual recording / Tape copies	Yes

Source Parameters

Source	Bolt Long Life Air Guns
Number of sources	2
Source separation	50m
Shotpoint interval per shot	18.75m
Array volume / source	3542 cu in
Operating pressure	2000 psi
Source depth	7m
Number of subarrays per source	3
Subarray separation	8.0 m
Number of Airguns per Subarray	8
Sub array length	15.0 m
Gun Timing Specification	+/- 1 mili secs
Alternatively fired sources (flip-flop)	Yes
Source control system	Trisor

Client:	Bass Strait Oil Company
Area:	Vic/P42
Job Number:	9226
Date:	24th July 2002
Version:	3

Project Geo:	Name Kumara Krishnasamy

Positioning

Acquisition Geodetic Parameters

Spheroid	ANS
Semi Major Axis	6378160
Inverse Flattening	298.250000
Work Datum	AGD-84
Datum Transformation	**From WGS84 to Work Datum** ***Bursa Wolf Convention***
dX (m)	116.000 (Plus)
dY (m)	50.470 (Plus))
dZ (m)	-141.690 (Minus)
rX (arc secs)	-0.230 (Minus)
rY (arc secs)	-0.390 (Minus)
rZ (arc secs)	-0.3440 (Minus)
Scale (ppm)	-0.09830 (Minus)
Projection	UTM South
Zone if UTM	55
Central Meridian	147 E
Scale Factor	0.9996
False Easting (m)	500000 m

False Northing (m)	10 000 000 m
Latitude of Origin	0

Datum Transformation & Test Point

Transformation from Datum	WGS84
Transformation to Datum	AGD84
Latitude in WGS 84	38° 36' 06.799" S
Longitude in WGS 84	147° 54' 20.960" E
Latitude in Local Datum	38° 36' 12.308" S
Longitude in Local Datum	147° 54' 16.291" E
Northing in Local Projection	5,726,828.18m
Easting in Local Projection	578,760.78m

Post Processing Geodetic Parameters (List only if different from acquisition parameters)

Spheroid	Same as acquisition parameters
Semi Major Axis	NA
Inverse Flattening	NA
Work Datum	NA
Datum Transformation	**From WGS84 to Work Datum** ***Bursa Wolf Convention***
dX (m)	NA
dY (m)	NA
dZ (m)	NA
rX (arc secs)	NA
rY (arc secs)	NA
rZ (arc secs)	NA
Scale (ppm)	NA
Projection	NA
Zone if UTM	NA
Central Meridian	NA
Scale Factor	NA
False Easting (m)	NA
False Northing (m)	NA
Latitude of Origin	NA

Magnetic Variation & Geoidal Height

Location of Prospect Centre: Lat	38 36 12.308 S (AGD-84)
Location of Prospect Centre: Lon	147 54 16.290 E (AGD-84)
Magnetic Variation Data	Plus 13° 8' (Variation) Plus 1'/year (Annual Variation)

Source of Variation Data	IGRF 2000
Geoidal Height Data	EGM96 Model
Date for which values calculated	20th July 2002

Vessel Positioning

1. Integrated Navigation System (Navigation/Binning/QC)

Trinav INS 2.6

1. Primary Navigation System

Navigation System	TRINAV GPS
RTCM Delivery System	Thales Skyfix/ CNav
DGPS Reference Stations	Adelaide, Melbourne & Sydney
Survey & Differential Company	Thales Geo-Solutions/C&C Technologies
Contact Person	Norman.Mackay@thales-geosolutions.com rick.shannon@cctechnol.com

1. Secondary Navigation System

Navigation System	Multifix 3
RTCM Delivery System	Thales Skyfix
DGPS Reference Stations	Adelaide, Melbourne & Sydney
Survey & Differential Company	Norman.Mackay@thales-geosolutions.com
Contact Person	Norman MAckay, Norman.Mackay@thales-geosolutions.com

1. Secondary Navigation System

Navigation System	CNAV
RTCM Delivery System	Wordlwide Satellite Orbital corrections via INmarsat
DGPS Reference Stations	
Survey & Differential Company	C&C Technologies (www.cctechnol.com)
Contact Person	Rick Shannon, rick.shannon@cctechnol.com

Streamer

Positioning	
Source Surface Positioning	Seatrack 330
Front-Net In-Sea Positioning	Sonardyne SIPS 1
Mid-Streamer In-Sea Positioning	Sonardyne SIPS 1
Tailbuoy Surface Positioning	Seatrack 220

Tail-Net In-Sea Positioning	Sonardyne SIPS 1
Compass Bird Type	DigiCOURSE 5011
Compass Birds Per Streamer	Every 300m
Line & Shotpoint Numbering	
Line Prefix	VP42
Line Name Format: Prime	VP421001P
Line Name Format: Reshoot	VP421001A,B,C,....
Line Name Format: Infill	VP421001J,K,L,...
Line Name EXAMPLE	VP421234B023 Second reshoot of Line 1234 shot on seq23
First Shotpoint Number: Prime	1001
First Shotpoint Number: Reshoot	SP to remain the same
First Shotpoint Number: Infill	SP to remain the same
Incrementing/Decrementing	Yes
Source Firing on Even Numbers	Port (Even), Stb (Odds)

Preferred Shooting Plan

Race track

Known Obstructions

Bream Platform (6km to north west) and Kingfish platform (10km to east)

3D Parameters

Steering Point	To be decided onboard
Survey Grid Rotation	193.254 deg

Water Depth & Processing

Maximum & Minimum Water Depth	50m - 75m
Echosounder Standard Settings	VP=1500ms, Draft=0
Vertical Datum	MSL
Apply Tidal Corrections in Processing?	Yes
Apply Velocity Corrections in Processing?	Yes
Apply Draft Corrections in Processing?	Yes
Tidal Corrections Source	Data to be provided by client

5. Vessel Description

Vessel Particulars

MAIN PARTICULARS

SHIPS NAME	**GECO BETA**
CALL SIGN	HP-7674
INTERNATIONAL MARITIME ORG. (IMO) No.	7909853
OWNER	WesternGeco Seismic Shipping Inc.
PREVIOUS NAME	None.
FLAG STATE & PORT OF REGISTRY	Panama/Panama
PANAMA OFFICIAL No.	21461-94-CH
DATE OF BUILD	1980
YARD No. AND TYPE OF VESSEL	130/Seis. Reasearch vessel/"Trosvik-Class"
YARD BUILT	Trosvik Verksted A/S , Brevik Norway
DATE CONVERTED / POWER UPGRADED	March 1995 / June 2000
YARD CONVERTED	Mjellem & Karlsen, Bergen
CLASSIFICATION SOCIETY AND CLASS	Det Norske Veritas/DNV+ 1A1 EO Helideck
CLASS ID No.	12505
CLASSIFICATION MACHINERY SYSTEM	Planned Maintenance System (PMS)
CLASS APPROVED MAINTENANCE SYSTEM	1 of Electronic plan/rec.Rast OM 3.81
INTERNATIONAL SAFETY MANAGEMENT, (ISM) CODE COMPLIANCE	In compliance with the code. Interim Safety Management Certificate Dated 18.04.01
SAFE MANNING CERTIFICATE (MINIMUM)	11 Maritime crew members (Galley dep. Not included)

PRINCIPAL PARTICULARS

GROSS TONNAGE (GRT)	4404 metric ton.
(GRT) NATIONAL & INTERNATIONAL	4404 metric ton.
GROSS TONNAGE (GRT) SUEZ CANAL	4777.86 metric ton
NET. REG.TON (NRT) PANAMA CANAL	1322 metric ton
(NRT) NATIONAL & INTERNATIONAL	1322 metric ton
NET. REG. TON (NRT) SUEZ CANAL	3670.51 metric ton
LIGHTSHIP DISPLACEMENT	2995 metric ton
DEAD WEIGHT	
LENGTH OVER ALL (LOA)	92.3 MTRS
LENGTH BETWEEN PERPENDICULARS	83.75 MTRS
BREADTH (MOULDED)	19.6 MTRS
BREADTH (EXTREME)	22.5 MTRS
DEPTH (MOULDED)	8.59 MTRS
DRAFT (MAX)	7.2 MTRS
DRAFT (MEAN)	6.4 MTRS
AIR DRAFT (TO HIGEST ANTENNA)	27 MTRS
HELICOPTER DECK RATING	Sikorsky S-61 and Super Puma
HELICOPTER DECK DIAMETER (D-VALUE)	22.2 MTRS
HELICOPTER DECK MARKINGS STANDARD	CAA/ Helicopter Service

6. List of Key Personnel

6.1. Onboard Personnel

POSITION	CREW 1	CREW 2
Party Manager	Mike Martin	Alan Gladding
Captain	Robert Wilson	Richard Westwood
Chief Engineer	Gordon Sanders	Tim McRae
Acq. Supervisor	Arlen Roldan	Donny Isdaryanto
Acq. Shiftleader	Alasdair Fleming Larry DeGuzman	Andrew Stagg
Pos. Supervisor	Thomas Copeland	Johnny Olsen
Pos. Shiftleader	Joel Pederick Stuart Flowers	Paul Farrell Annas Jaafar
Handling Supervisor	Marcus Kay	Oskar Rosvoll
Shiftleader Mechanic	Andy Burrell Aldrin Flores	Paul Hollingsworth Ian Hunter
Trilogy QC Leader	Andrew McMahon	Justine Rouse
OBP Group Leader		

6.2. Office Support Personnel

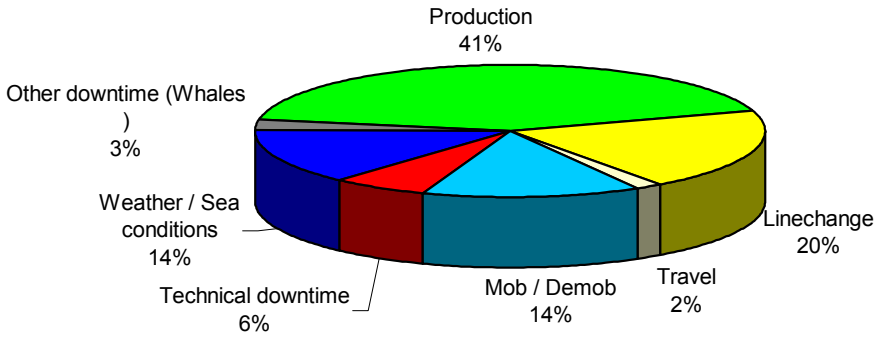
POSITION	NAME	OFFICE
Operation Manager	Jeff Mayville	Kuala Lumpur
Operation Supervisor	Terry Leighton	Perth
Maritime Superint.	Bo Hansen	Oslo
Instrument Support	PDN, Global Operations Support	Oslo
Navigation Support	PDN, Global Operations Support	Oslo
Mechanical Support	PDN, Global Operations Support	Oslo
Trilogy QC Support	PDN, Global Operations Support	Oslo
OBP Supervisor	Allen Rodeghiero	Kuala Lumpur

7. Field Information and Observations

7.1. Production Statistics

PRODUCTION (Km)		
Prime Production	1056.3188 Km	
Infill Production	138.5813 Km	(13.1 %)
Total Production	1194.9000 Km	

TIME DISTRIBUTION (Hours)		
Production	145.4160 Hours	(42.1 %)
Linechange	69.6990 Hours	(20.2 %)
Travel	6.0000 Hours	(1.7 %)
Mob / Demob	47.9670 Hours	(13.9 %)
Technical downtime	20.9330 Hours	(6.1 %)
Weather / Sea conditions	46.6500 Hours	(13.5 %)
Other downtime (Whales)	8.6830 Hours	(2.5 %)
Total Survey time	345.3480 Hours	(100 %)



7.2. Daily Summary

Time zone GMT +10:00hrs. Introspection PC Log in GMT.
Day starts 10:00 local time.

July 23rd
09:00-10:00 local, Bass Strait Oil start-up meeting

July 24th
The following busy schedule of meeting and tours were completed. (Times local)

09:00-10:15 Bass Strait Oil start-up meeting
10:30-12:15 BHP Start-up Meeting.
13:00 BHP General Meeting and briefing for all crew in Mess room.
14:00 BHP visitors group Tour of vessel
14:15-15:00 Technical meeting.
15:00 Bass Strait Oil visitor's tour of vessel.
16:00 Visitors tour of vessel, Visean Online, DNRE employees and personnel from Essential Petroleum.
Approximately 67 visitors were given a tour of the vessel.

Loading of stores and was provisions completed.
Maritime engine service work completed.
Seismic department maintenance work and repair completed.
Unpacking of stores in progress.
OBP installation for BHP completed. Instrument room powered down for OBP to be connected to USP.

Departure from Melbourne, scheduled for 22:00 local was the postponed due to problems with the lifeboat fall release mechanism. The lifeboat was lifted ashore by crane this evening for the fall auto-release mechanism to be freed. The release cable has parted and new cable is required.

July 25th.
The lifeboat fall auto-release mechanism was freed and release cable replaced with a locally sourced cable. After successful lowering and release tests the boat was stored in the davit and preparation for sailing made.

Beta departed Melbourne at 12:45 local.

02:45z End of port calls Melbourne.

At 16:30local OBP Peter Carver joined by Pilot boat. Peter was a late joiner as he had had flown to Sydney to pick up a fall release cable for the lifeboat.

16:50 local time, 06:50z Pilot away.

Vessel increased speed to head for deployment area. Beta steamed to the south of Wilson Promontory, crossed the shipping lane at right angles and slowed down for deployment from a position south of Seal Islands. The plan for deployment is to head 055degrees keeping in the shelter of the coast.

18:00z End of Transit to deployment area.
Tailbouy 1 was launched at 04:00local. The start of equipment deployment and mobilization agreed with Client.

Key deployment timing for the day;
UTC Local

18:00	4:00	Tailbuoy 1 deployed. Commence deployment of streamer 1
22:30	8:30	Tailbuoy 8 deployed. Commence deployment of streamer 8.
23:00	9:00	Monowing 1 deployed. Streamer 1 fully deployed.
23:40	9:40	Tailbuoy 2 deployed. Commence deployment of streamer 2.

Serious problems were encountered today booting-up Trinav. Network changes necessary for the installation of the OBP equipment to increase the number of IP's address were made. Initial report is that Oslo logged in to change the necessary address and host files for all Trilogy systems onboard. This caused boot up and network problems for all departments. Triacq and Trisor have been restarted. However the navigators had serious problems booting Trinav. Support was sourced via Intouch and by phone and good progress towards restarting the system made at the end of the UTC day.

July 26th

Dual streamer deployment continued in good weather. Maintenance work completed as required. The fourth mono-wing was deployed at 13:30z and with streamers 1, 2, 7 and 8 fully deployed the vessel was able to turn and head SSW back toward the prospect. Streamer 6 was fully deployed at 22:20z. Deployment of Streamer 4 continues and preparations for deployment of tailbuoy number 5, the last to be deployed, were in progress at the end of the day.

The network communication problems that caused the boot-up failure of Trinav VME and Trilogy systems were overcome at the start of the day. The tribulations resulted from changes made to the network files to incorporate the new the OBP installation. No time was lost as deployment continued through the fault-finding process. A debugging tool, a program that can capture network packets has now been installed to monitor the network traffic and identify any conflicts.

July 27th

Streamer deployment was completed at 09:00z. As the port lead-ins were deployed, lead-in 5 was examined and maintenance carried out. The chief mechanic was satisfied that the condition of the armoring did not required the lead-in to be changed. Following a depth calibration of the gun arrays were fully deployed at 16:10z and the vessel lined up for eastern most line 1008 heading south.

Slow intermittent update of the source positioning materialised once the arrays were deployed. QC systems and plotter did not function. Attempts to solve the network conflicts were made on the run-in to line but as the vessel passed DA zero at 17:58z the line attempt was aborted. Mobilisation was considered completed and down time for "local network systems" was logged from 17:58 to 24:00z.

The changes to the network configuration made for on board processing included the Trisor insea net. With the assistance of shore support different solutions were attempted to configure the net to a workable system without success. The decision was therefore made to go back to the original configuration. Ole Kristian Gregersen remote logged in at 22:30z to make the changes to the Ciso router, re-create a static route for the wet net and shut down the port used for the processing network.

At the end of the day Navigation and acquisition were changing configurations back to original settings as the vessel turned for the next line across the shipping lane.

July 28th

Traverse 109.06875 km

A strong 1.5kt head current was encountered today reducing the vessel speed. Feathers were large at times, up to 14 deg, but as the current is tidal and shooting plan is roughly in a tidal sequence feather matching is reasonable. Sea state was good, a long SE'ly swell at the start of the day. The onboard rep did request the RPM change. The RPM agreed with the Captain of 125rev reduces the propeller noise but was noted that this will also reduce vessel speed. It should be noted that the recommended RPM is 137rev and the vessel will have to increase to this for safe operation of the propulsion motors when the weather deteriorates.

Over 2hrs was lost at the start of the day reversing back to the original net configuration to solve the network routing problem that caused the loss of data between Trinav and Trisor. Shore support Ole Kristian Gregersen logged in to make the changes to the Cisco router and re-created the static route for the wet net. The navigation and Acquisition department then changed back and restarted systems. TriaqcQC was unavailable for the first three sequences but the QC can be produced from tape.

The last line of the day had to be aborted due to an auto-fire. The cause was found to be a cracked shuttle. As the guns were recovered the workboat was deployed and at the end of the day the crew were busy replacing malfunctioning bird and acoustic units.

The medic held two sessions on nutrition.

July 29th
Traverse 114.7125 km
The day commenced with array 2 on deck for repair of an auto-firing gun, (cracked shuttle) the workboat was out changing malfunctioning birds and acoustic units. The vessel continued down line to remain in a tidal sequence. Guns were redeployed at 0'08 but rather than leave a part line section which would require the vessel transiting the block at a later date the final part of the line was not resumed and boat crew continued the changes. To complicate matters the wind increased and vessel had to turn off line to create a lee for the boat. Prime line production resumed at 03:32z. A strong current is continuing to run and the Client accepted increased RPM whilst running into the current to try and increase the ground speed.

July 30th
Traverse 120.95625 km
Prime line production continued in good weather. Line 1184, sequence 9, had to be terminated due to a whale sighting. The whale dived and was not observed again and production on the same line, sequence 10, resumed after 1.5hrs.

Line changes are increasing in time after half teardrop turns are required for production to concentrate on the priority area. Currents are still strong but feather matching has been reasonable. Inner tailbuoy separations have been affected by vessel wake with larger separations between tailbuoys 4 and 5 observed. Tailbuoy 4 died today.

July 31st
Traverse 141.20625 km
Prime line production continued in good weather. With the forecast looking good the shooting plan reverted back to normal linechanges buffering up adjacent lines and working west. Another Whale sighting caused line sequence 13 to be terminated and last 5km was lost.

The normal linechanges were utilized for gun array inspect, service check, adjustment to ropes and fault finding on source positioning units.

A general safety meeting was held in the mess room.

August 1st
Traverse 145.3875 km
Prime line production continued in good weather. The last line of the day was called infill due to buffering up for coverage on the adjacent lines. Currents continue to be strong although feather matching is reasonable. In the calm conditions occasional mono-wing wash affecting streamer depth control was observed.

A Safety Committee meeting, Operations meeting was held.

August 2nd
Traverse 142.33125 km

At 1105 (0105z) on 02.08.02 the Geco Beta received a call from fishing vessel "Christine Claire" reporting a man with a badly lacerated hand. The MOB boat with medic was launched and the medic reported that the man in question had almost severed his thumb. A medivac procedure through the flying ambulance service was instigated and at 1408 the patient was lifted off the Geco Beta to hospital in Melbourne.

August 3rd
Traverse 103.6875 km
Two further helicopter operations were completed resulting in the completion of a full WesternGeco crew change. The linechange after sequence 26 was extended due to an ultrabox failure on position 1 array 6. Sequence 29 was a reshoot of sequence 1 caused by the incorrect setup of the network. This was followed by two further reshoots due to whale sightings. The weather conditions slowly deteriorated throughout the day as the wind and sea increased from the southwest.

August 4th
Traverse 108.43125 km
Sequence 32, a reshoot due to Trinav, was acquired. After this 3 complete prime line runs were made. At the end of the day acquisition continued on an infill run to the north. The Weather slowly improved once again with good sea conditions eventually prevailing. A lifeboat drill was held followed by group instructions. A general QHSE meeting was held attended by all available crewmembers.

August 5th
Traverse 114.150 km
Continued with prime and infill acquisition in the west of the survey area. The workboat was launched on one occasion in order to change out two faulty birds. Weather conditions took a turn for the worse as the next low pressure system approaches from the southwest.

August 6th
Traverse 0.000 km
Sequence 41 was aborted due to worsening weather conditions. As the seas began building from the west it was decided to recover the guns and head towards the shore for shelter. The weather conditions were monitored closely throughout the day to ensure the vessel was ready to turn back towards the prospect with any improvement in sea conditions. At the end of the day the vessel was approximately 17 NM from the coast heading 055 degrees waiting on the weather to improve.

August 7th
Traverse 0.000 km
The weather conditions remained poor for most of the day with gale force winds from the southwest prevailing. An improvement in the seastate occurred late in the day and the vessel headed back out to the prospect area. The helicopter scheduled to arrive with spare parts for the incinerator was cancelled due to the poor weather. At the end of the day all guns were deployed and the vessel running towards line.

August 8th
Traverse 94.96875 km
Acquisition commenced at 0120 UTC with sequence 42. Weather conditions remained good until completion of the survey at 2121 UTC. The vessel then commenced a transit east to the BHP survey. A helicopter arrived at 0750 UTC with spare parts for the incinerator and fresh provisions.

Bass Strait Oil Survey Complete 2121 UTC.

7.3. Field Information and Encountered Problems

7.3.1. Obstructions / Installations on the Field

There were no platforms or obstruction on the prospect. The platforms adjacent to the survey area, namely Bream, Bream B, West Kingfish, Kingfish A and B were sufficiently distant to cause no hazard.

7.3.2. Traffic / Shipping Lanes

A shipping lane, the main route for shipping traffic between Sydney and Melbourne was located south of the prospect in the vessels turning area. On a few occasions large merchant vessels had to be directed clear of the towed equipment.

7.3.3. Fishing Activity

Although shark fishing and trawling were apparent in the general area there were no conflicts or downtime recorded due to any type of fishing activity. On the 2nd of August UTC the Geco Beta provided assistance to the fishing vessel 'Christine Claire'. One of her seaman had severely lacerated his hand. On investigation by the Beta medic it was decided to instigate a medevac. An air ambulance was summoned and the casualty sent ashore for treatment.

7.3.4. Seismic Interference and Time Share

No seismic interference or time-share was required during the survey.

7.3.5. Environmental Obstacles

At the start of the survey the weather conditions were excellent enabling a good start to be made on the acquisition. On the 6th of August the weather deteriorated as a low-pressure system from the southwest arrived in the area. The Beta took shelter inshore towards Wilson's Promontory for the duration of the bad weather before heading back out to the prospect area. A total of 46.65 hours of weather downtime was recorded during this period. Currents were strong but with a tidal regime predominating it was possible to feather match adjacent lines with a reasonable accuracy thus minimizing on the required infill.

7.3.6. Operational Observations

It seems that the date for the survey was timely as the weather downtime was minimal. Consideration as to whale activity should be made for future surveys to minimise shutdowns due to sightings within the 3km zone. A total of 8.683 hours was logged as standby due to whale avoidance. The shipping lanes directly to the south of the survey posed little problems when the Beta was turning due to good communications being maintained at all times between vessels. Contact with the fishing cooperatives based out of Lakes Entrance should be of prime importance to any future surveys to enable a good relationship to be made with the local community.

8. HSE Summary

Reporting during the BSOC survey utilised the Westerngeco QUEST system. Below is a list of reports issued during the survey.

Description	Location	Event Date	Category
Fairing cord attached to hydraulic lever	3AMVBET	Jul 26, 2002	Hazardous Sit.
Hot Incinerator Ashes Placed in Waste Skip	3AMVBET	Jul 25, 2002	Accident/Failure
STOP: Improper disposal	3AMVBET	Jul 27, 2002	Hazardous Sit.
STOP. Cotterpin found in Washing machine	3AMVBET	Jul 26, 2002	Hazardous Sit.
Knife was left unsecure on Gun deck	3AMVBET	Jul 28, 2002	Hazardous Sit.
Sonardyne - Water ingress	3AMVBET	Jul 30, 2002	Accident/Failure
Diesel spill.	3AMVBET	Jul 31, 2002	Hazardous Sit.
LOCKED PIN at STBD Auxiliary winch UNLOCKED	3AMVBET	Jul 30, 2002	Hazardous Sit.
STOP - Inappropriate use of Internet	3AMVBET	Jul 31, 2002	Hazardous Sit.
Safe acts observe.	3AMVBET	Jul 25, 2002	Hazardous Sit.
Helideck netting badly corroded.	3AMVBET	Aug 01, 2002	Hazardous Sit.
Hammering near sleeping crew.	3AMVBET	Aug 01, 2002	Hazardous Sit.
Portable incinerator fabricated.	3AMVBET	Jul 30, 2002	Hazardous Sit.
Safe Act - Non-W-G Involved Medivac	3AMVBET	Aug 02, 2002	Hazardous Sit.
Safe Act - JSA Completed - Mooring	3AMVBET	Aug 03, 2002	Hazardous Sit.
Watertight door found open.	3AMVBET	Aug 04, 2002	Hazardous Sit.
Life jacket stored incorrectly	3AMVBET	Aug 04, 2002	Hazardous Sit.
Leaking life vest during blow test	3AMVBET	Aug 04, 2002	Hazardous Sit.
Steering failure on Total Voyager	3AMVBET	Aug 04, 2002	Hazardous Sit.
Medivac	3AMVBET	Aug 02, 2002	Hazardous Sit.
Safe work during boat trip	3AMVBET	Aug 05, 2002	Hazardous Sit.
STOP-Computer was found still on the log in postn.	3AMVBET	Aug 03, 2002	Hazardous Sit.

Stop - Loss of air conditioning to the OBP room.	3AMVBET	Aug 05, 2002	Hazardous Sit.
Corrupted file registering in eng. control PC	3AMVBET	Aug 06, 2002	Hazardous Sit.
JSA completed. Leadin Replacement	3AMVBET	Aug 06, 2002	Hazardous Sit.
Stop: Fire door found open	3AMVBET	Aug 07, 2002	Hazardous Sit.

QHSE Activity Summary.
Risk Indentification Reports 27
Helicopter Operations 5
Small Boat Launches 4
QHSE Meetings 3
Management Inspection 1

9. Shipment List

BET-02114AD-PER 6 boxes Seismic + Navigation Data. Destination Perth. Mike Giles
BET-02115AD-MEL 2 boxes. Support Documents. Destination Melbourne. M.Hartley
BET-02120AD-MEL 7 boxes. Copy Seis and Nav Data. Destination Melbourne. I Reid

10. Logs

Tape Report Survey 9226 OutputStream-1/3590

Client	BSOC	First Sequence	0001 SOL at 02:41:19utc 28-Jul-2002
Area	Gippsland	Last Sequence	0045 EOL at 21:21:01utc 08-Aug-2002
Vessel	Geco Beta		
JobNumber	9226		
Survey Type	3D		

Tape List [1]

Seq	Reel	FSP-LSP	FFILE-LFILE	OS	Dev	Media	Box	Remark	Missing shots
1	3	02315-01886	02315-01886	1	1	3590	1		
	4	01885-01456	01885-01456	1	2	3590	1		
	5	01455-01026	01455-01026	1	1	3590	1		
	6	01025-00930	01025-00930	1	2	3590	1		
	5	01455-01026	01455-01026	2	3	3590	1		
2	7	00969-01398	00969-01396	1	2	3590	1		
	8	01399-01828	01399-01828	1	1	3590	1		
	9	01829-02258	01829-02258	1	2	3590	1		
	10	02259-02688	02259-02688	1	1	3590	1		
	11	02689-02926	02689-02926	1	2	3590	1		
3	12	02839-02410	02839-02410	1	1	3590	1		
	13	02409-01980	02409-01980	1	2	3590	1		
	14	01979-01550	01979-01550	1	2	3590	1		
	15	01549-01120	01549-01120	1	1	3590	1		
	16	01119-00948	01119-00948	1	4	3590	1		
4	17	00975-01404	00975-01404	1	1	3590	1		
	18	01405-02960	01405-02960	1	2	3590	1		
5	19	02836-02407	02836-02407	1	1	3590	1		
	20	02406-01977	02406-01977	1	2	3590	1		
	21	01976-01547	01976-01547	1	1	3590	1		
	22	01546-01117	01546-01117	1	2	3590	1		
	23	01116-	01116-	1	1	3590	1		

		00952	00952				
6	24	01591-02020	01591-02020	1	2	3590	1
	25	02021-02450	02021-02450	1	1	3590	1
	26	02451-02880	02451-02880	1	1	3590	1
	27	02881-02959	02881-02959	1	1	3590	1
7	28	02843-02414	02843-02414	1	2	3590	1
	29	02413-01984	02413-01984	1	1	3590	1
	30	01983-01554	01983-01554	1	2	3590	1
	31	01553-01124	01553-01124	1	1	3590	1
	32	01123-00937	01123-00937	1	2	3590	1
8	33	00980-01409	00980-01409	1	2	3590	2
	34	01410-01839	01410-01839	1	1	3590	2
	35	01840-02269	01840-02269	1	2	3590	2
	36	02270-02699	02270-02699	1	1	3590	2
	37	02700-02958	02700-02958	1	2	3590	2
9	38	02845-02500	02845-02500	1	1	3590	2
10	39	02180-01751	02180-01751	1	2	3590	2
	40	01750-01321	01750-01321	1	1	3590	2
	41	01320-00934	01320-00934	1	2	3590	2
11	42	00985-01414	00985-01414	1	1	3590	2
	43	01415-01844	01415-01844	1	1	3590	2
	44	01845-02274	01845-02274	1	1	3590	2
	45	02275-02704	02275-02704	1	1	3590	2
	46	02705-02955	02705-02955	1	1	3590	2
12	47	02847-02418	02847-02418	1	1	3590	2
	48	02417-01988	02417-01988	1	1	3590	2
	49	01987-01558	01987-01558	1	1	3590	2
	50	01557-01128	01557-01128	1	1	3590	2
	51	01127-00928	01127-00928	1	1	3590	2
13	52	00990-01419	00990-01419	1	2	3590	2
	53	01420-01849	01420-01849	1	1	3590	2
	54	01850-02279	01850-02279	1	2	3590	2
	55	02280-02953	02280-02953	1	1	3590	2
14	56	02834-02405	02834-02405	1	2	3590	2
	57	02404-01975	02404-01975	1	1	3590	2
	58	01974-01545	01974-01545	1	2	3590	2
	59	01544-01115	01544-01115	1	1	3590	2

	60	01114-00957	01114-00957	1	2	3590	2
15	61	00995-01424	00995-01424	1	1	3590	2
	62	01425-01854	01425-01854	1	2	3590	2
	63	01855-02284	01855-02284	1	2	3590	3
	64	02285-02714	02285-02714	1	1	3590	3
	65	02715-02951	02715-02951	1	2	3590	3
16	66	02832-02403	02832-02403	1	1	3590	3
	67	02402-01973	02402-01973	1	2	3590	3
	68	01972-01543	01972-01543	1	1	3590	3
	69	01542-01113	01542-01113	1	2	3590	3
	70	01112-00962	01112-00962	1	1	3590	3
17	71	01000-01429	01000-01429	1	2	3590	3
	72	01430-01859	01430-01859	1	1	3590	3
	73	01860-02289	01860-02289	1	2	3590	3
	74	02290-02719	02290-02719	1	1	3590	3
	75	02720-02949	02720-02949	1	2	3590	3
18	76	02830-02401	02830-02401	1	1	3590	3
	77	02400-01971	02400-01971	1	2	3590	3
	78	01970-01541	01970-01541	1	1	3590	3
	79	01540-01111	01540-01111	1	2	3590	3
	80	01110-00967	01110-00967	1	1	3590	3
19	81	01005-01434	01005-01434	1	2	3590	3
	82	01435-01864	01435-01864	1	1	3590	3
	83	01865-02294	01865-02294	1	2	3590	3
	84	02295-02724	02295-02724	1	1	3590	3
	85	02725-02947	02725-02947	1	2	3590	3
20	86	02828-02399	02828-02399	1	2	3590	3
	87	02398-01969	02398-01969	1	1	3590	3
	88	01968-01539	01968-01539	1	2	3590	3
	89	01538-01109	01538-01109	1	1	3590	3
	90	01108-00972	01108-00972	1	2	3590	3
21	91	01005-01434	01005-01434	1	1	3590	3
	92	01435-01864	01435-01864	1	2	3590	3
	93	01865-02294	01865-02294	1	1	3590	4
	94	02295-02724	02295-02724	1	2	3590	4
	95	02725-02947	02725-02947	1	1	3590	4

22	96	02826-02397	02826-02397	1	2	3590	4
	97	02396-02034	02396-02034	1	1	3590	4
23	98	01780-01351	01780-01351	1	2	3590	4
	99	01350-00969	01350-00969	1	1	3590	4
24	100	01010-01439	01010-01439	1	2	3590	4
	101	01440-01869	01440-01869	1	1	3590	4
	102	01870-02299	01870-02299	1	2	3590	4
	103	02300-02729	02300-02729	1	1	3590	4
	104	02730-02945	02730-02945	1	2	3590	4
25	105	02824-02395	02824-02395	1	1	3590	4
	106	02394-01965	02394-01965	1	2	3590	4
	107	01964-01535	01964-01535	1	1	3590	4
	108	01534-01105	01534-01105	1	2	3590	4
	109	01104-00983	01104-00983	1	1	3590	4
26	110	01015-01444	01015-01444	1	2	3590	4
	111	01445-01874	01445-01874	1	1	3590	4
	112	01875-02304	01875-02304	1	2	3590	4
	113	02305-02734	02305-02734	1	1	3590	4
	114	02735-02942	02735-02942	1	2	3590	4
27	115	02801-02372	02801-02372	1	1	3590	4
	116	02371-01942	02371-01942	1	2	3590	4
	117	01941-01512	01941-01512	1	1	3590	4
	118	01511-01082	01511-01082	1	2	3590	4
	119	01081-00987	01081-00987	1	1	3590	4
28	120	01035-01464	01035-01464	1	1	3590	4
	121	01465-01894	01465-01894	1	2	3590	4
	122	01895-02324	01895-02324	1	1	3590	4
	123	02325-02754	02325-02754	1	2	3590	5
	124	02755-02942	02755-02942	1	1	3590	5
29	125	02821-02392	02821-02392	1	2	3590	5
	126	02391-02306	02391-02306	1	1	3590	5
30	127	02626-02953	02626-02953	1	1	3590	5
31	128	02522-02171	02522-02171	1	2	3590	5
32	129	02057-01768	02057-01768	1	1	3590	5
33	130	01653-02082	01653-02082	1	1	3590	5
	131	02083-02512	02083-02512	1	2	3590	5

	132	02513-02893	02513-02893	1	1	3590	5
34	133	02799-02370	02799-02370	1	1	3590	5
	134	02369-01940	02369-01940	1	2	3590	5
	135	01939-01510	01939-01510	1	1	3590	5
	136	01509-01080	01509-01080	1	2	3590	5
	137	01079-00993	01079-00993	1	1	3590	5
35	138	01648-02077	01648-02077	1	1	3590	5
	139	02078-02507	02078-02507	1	2	3590	5
	140	02508-02895	02508-02895	1	1	3590	5
36	141	02799-02370	02799-02370	1	2	3590	5
	142	02369-01940	02369-01940	1	1	3590	5
	143	01939-01510	01939-01510	1	2	3590	5
	144	01509-01080	01509-01080	1	1	3590	5
	145	01079-00994	01079-00994	1	2	3590	5
37	146	01643-02072	01643-02072	1	1	3590	5
	147	02073-02502	02073-02502	1	2	3590	5
	148	02503-02897	02503-02897	1	1	3590	5
38	149	02799-02370	02799-02370	1	1	3590	5
	150	02369-01940	02369-01940	1	2	3590	5
	151	01939-01510	01939-01510	1	2	3590	5
	152	01509-01080	01509-01080	1	1	3590	5
	153	01079-00993	01079-00993	1	1	3590	6
39	154	01638-02067	01638-02067	1	2	3590	6
	155	02068-02497	02068-02497	1	1	3590	6
	156	02498-02901	02498-02901	1	2	3590	6
40	157	02797-02368	02797-02368	1	2	3590	6
	158	02367-01938	02367-01938	1	1	3590	6
	159	01937-01508	01937-01508	1	1	3590	6
	160	01507-01502	01507-01502	1	2	3590	6
41	161	01633-02062	01633-02062	1	1	3590	6
	162	02063-02901	02063-02901	1	2	3590	6
42	163	02795-02366	02795-02366	1	1	3590	6
	164	02365-01936	02365-01936	1	2	3590	6
	165	01935-01506	01935-01506	1	1	3590	6
43	166	01633-02062	01633-02062	1	2	3590	6
	167	02063-02492	02063-02492	1	1	3590	6

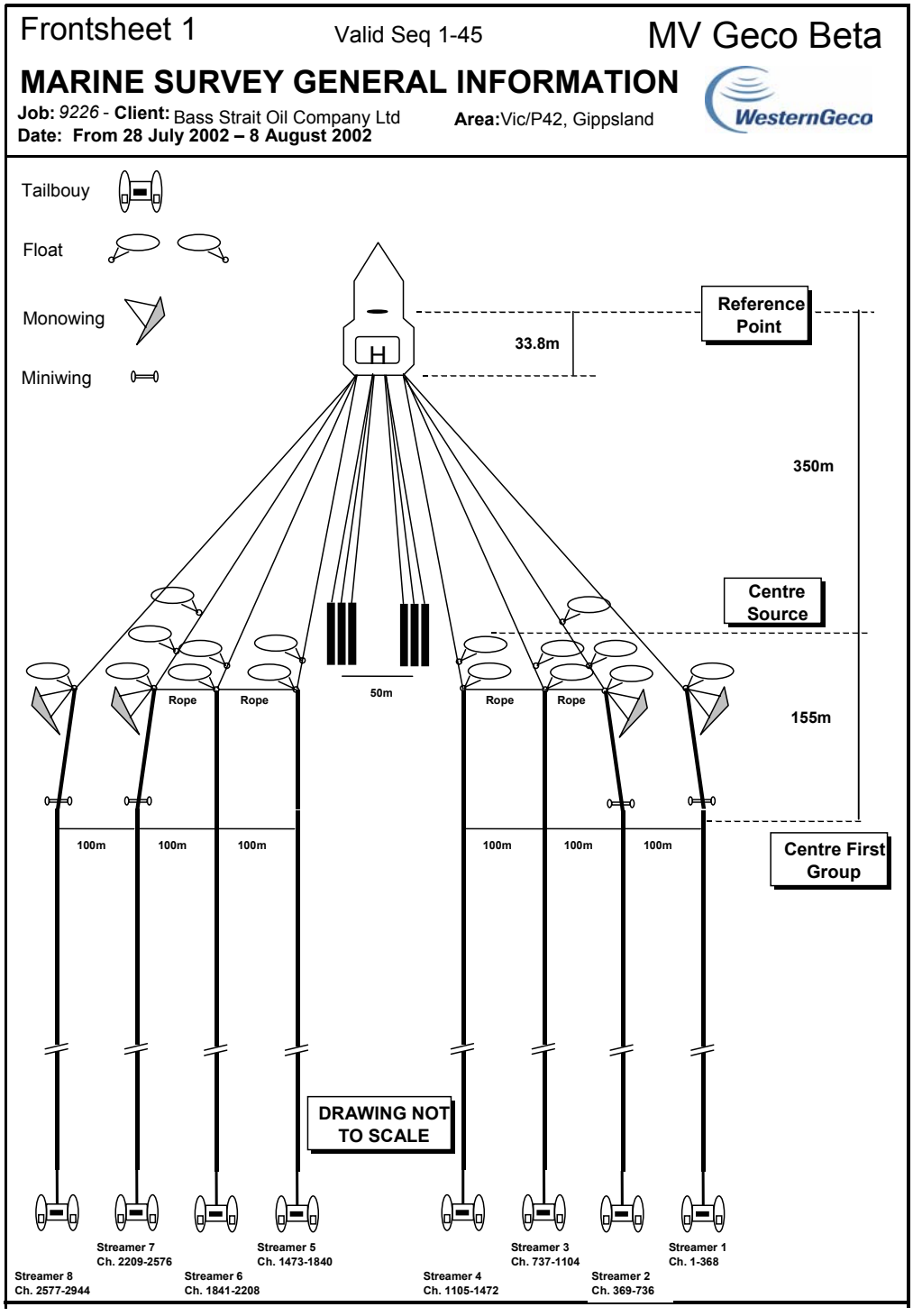
	168	02493-02901	02493-02901	1	2	3590	6
44	169	02793-02364	02793-02364	1	2	3590	6
	170	02363-01934	02363-01934	1	1	3590	6
	171	01933-01512	01933-01512	1	2	3590	6
45	172	01628-02057	01628-02057	1	1	3590	6
	173	02058-02487	02058-02487	1	2	3590	6
	174	02488-02904	02488-02904	1	1	3590	6

Note [1] : OS = outputstream, Dev = Device id, FFILE-LFILE = first/last file, FSP/LSP = first/last shotpoint

TRILOGY INFORMATION MANAGER - TAPE REPORT - GENERATED 11:08:00utc 09-Aug-2002

11. Towing Configuration

11.1. Towing System Layout



12. Streamer Configuration

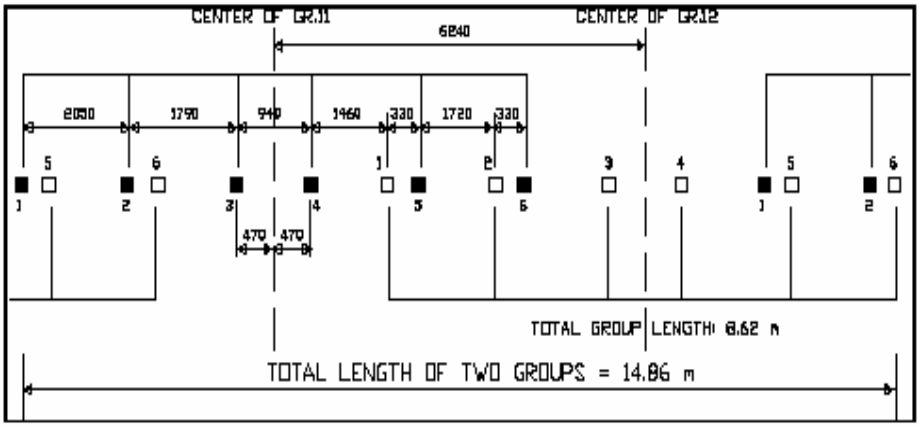
12.1. Streamer System Description

Streamer System Parameters	
Number of Streamers	8
Type of streamer	Digital NIII ASSI / NIV Sections
Streamer length	4600m
Groups per streamer	368
Group intervals	12.5 m
Outside diameter	54mm
Jacket (type-thickness)	Polyurethane, 3.5 mm
Breaking strength	90 kN
Ballast fluid (fluid-quantity)	Isopar M, 125 liters
Connectors (diameter-length)	Max. Dia 68 mm, length 251 mm
Channels per module	16
Data transmission link	Differential twisted pair
Power	60 – 300 V AC
Leakage	> 1 Mohm
Active group lengths	14.86 m
Nearest offset available	150 m
Streamer depth	8 m
Streamer separation	100 m
Number of stretch sections	
in front of each streamer	2
end of each streamer	1
No of compasses per streamer	18
No of depth transducers per streamer	18

Trace allocation (example for 8 treamers)	**Location**	**Near**	**Far**
Streamer 1	Starboard Outer	1	368
Streamer 2	Stbd Middle (outermost)	369	736
Streamer 3	Stbd Middle (innermost)	737	1104
Streamer 4	Starboard Inner	1105	1472
Streamer 5	Port Inner	1473	1840
Streamer 6	Port Middle (innermost)	1841	2208
Streamer 7	Port Middle (outermost)	2209	2576
Streamer 8	Port Outer	2577	2944

Hydrophone Parameters	
Detector type	Benthos Geopoint, I/O

Group interval	12.5m
Detectors per group	12
Group length	14.86 m
No of groups per section	8
Hydrophones spacing	See diagram
Operating temperature range	0-49 °C
Displacement	0.49 cu.in
Mechanical resonance	Lowest in oil: 4.2 kHz
Maximum operating depth	1000 feet
Group sensitivity (at 7m depth)	20 V/bar



12.2. Streamer Layout

Frontsheet 1 — MV Geco Beta

MARINE SURVEY GENERAL INFORMATION

Job: 9226 - **Client:** Bass Strait Oil Company Ltd **Area :** Vic/P42
Date: Jul 2002 – Aug 2002

Description	Bird #	Channel #	Length	
Lead in				
Optical adapter			1.2	(Streamers 1 & 8 only)
Optical bubble			0.52	(Streamers 1 & 8 only)
Monowing adaptor			16m	(Streamers 1,2,7 & 8 only)
Tow adaptor			1.2m	
Stretch section			23m	
Repeater bubble			0.52m	
Stretch section			50m	
Miniwing adaptor			1.2m	(Streamers 1,2,7 & 8 only)
1/2 group		1	15m	
Active 1	Bird 1	1 - 8	100m	
Bubble 1			0.52m	
Active 2	Bird 2	9 - 16	100m	
Active 3		17 - 24	100m	
Bubble 2			0.52m	
Active 4		25 - 32	100m	
Active 5	Bird 3	33 - 40	100m	
Bubble 3			0.52m	
Active 6		41 - 48	100m	
Active 7		49 - 56	100m	
Bubble 4			0.52	
Active 8	Bird 4	57 - 64	100m	
Active 9		65 - 72	100m	
Bubble 5			0.52m	
Active 10		73 - 80	100m	
Active 11	Bird 5	81 - 88	100m	
Bubble 6			0.52m	
Active 12		89 - 96	100m	
Active 13		97 - 104	100m	
Bubble 7			0.52m	
Active 14	Bird 6	105 - 112	100m	
Active 15		113 - 120	100m	
Bubble 8			0.52m	
Active 16		121 - 128	100m	
Active 17	Bird 7	129 - 136	100m	
Bubble 9			0.52m	
Active 18		137 - 144	100m	
Active 19		145 - 152	100m	
Bubble 10			0.52m	
Active 20	Bird 8	153 - 160	100m	
Active 21		161 - 168	100m	
Bubble 11			0.52m	
Active 22		169 - 176	100m	
Active 23	Bird 9	177 - 184	100m	
Bubble 12			0.52m	
Active 24		185 - 192	100m	
Active 25		193 - 200	100m	
Bubble 13			0.52	
Active 26	Bird 10	201 - 208	100m	

continued….

continued….

Description	Bird #	Channel #	Length
Active 27		209 - 216	100m
Bubble 14			0.52m
Active 28		217 - 224	100m
Active 29	Bird 11	225 - 232	100m
Bubble 15			0.52m
Active 30		233 - 240	100m
Active 31		241 - 248	100m
Bubble 16			0.52
Active 32	Bird 12	249 - 256	100m
Active 33		257 - 264	100m
Bubble 17			0.52m
Active 34		265 - 272	100m
Active 35	Bird 13	273 - 280	100m
Bubble 18			0.52m
Active 36		281 - 288	100m
Active 37		289 - 296	100m
Bubble 19			0.52
Active 38	Bird 14	297 - 304	100m
Active 39		305 - 312	100m
Bubble 20			0.52m
Active 40		313 - 320	100m
Active 41	Bird 15	321 - 328	100m
Bubble 21			0.52m
Active 42		329 - 336	100m
Active 43		337 - 344	100m
Bubble 22			0.52
Active 44	Bird 16	345 - 352	100m
Active 45		353 - 360	100m
Bubble 23			0.52m
Active 46	Bird 17	361 - 368	100m
Power bubble			0.52m
Tail stretch	Bird 18		75m
Tailbuot adpt.			12m

13. Source Configuration

13.1. Source System Description

Source Parameters	
Number of source arrays	2
Array separation	50 m
Array length	15 m
Array width	16 m
Number of strings/array	3
Separation from center track	25 m
Source volume	3542 cubic inches
Number of hydrophones per array	6
Number of depth transducers per array	6
Number of guns per array	24
Number of clusters per array	6
Airgun type	Bolt 1900 LL & 1500 LL
Operating pressure	2000 psi
Depth of guns	7 m
Peak to Peak amplitude	104 bar/m
Primary to Bubble ratio	32.3

13.2. Source Layout

Frontsheet 1 Valid Seq 001-045 — MV Geco Beta

MARINE SURVEY GENERAL INFORMATION

Job: *9226* - **Client:** Bass Strait Oil Company Ltd **Area:** Vic/P42
Date: *Jul 2002 - Aug 2002*

Information

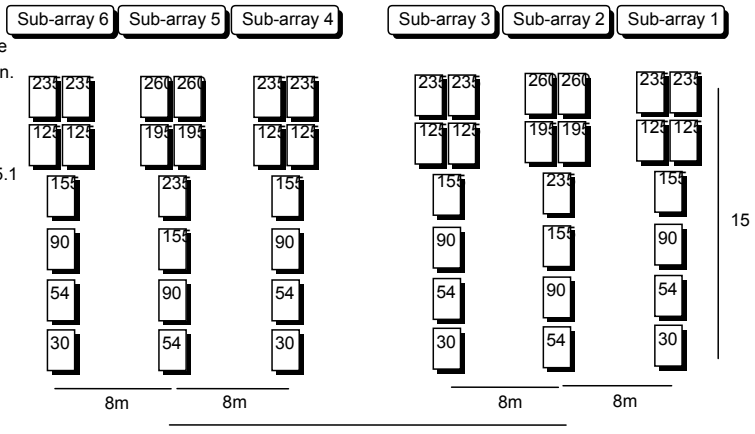
Guns:	Bolt Long Life
Volume:	2 x 3542 cu.in.
Depth:	7 m
Pressure:	2000 psi
Controller:	Trisor ver 1.5.1

Separation

CS to CS:	50 m
Subarray	8 m

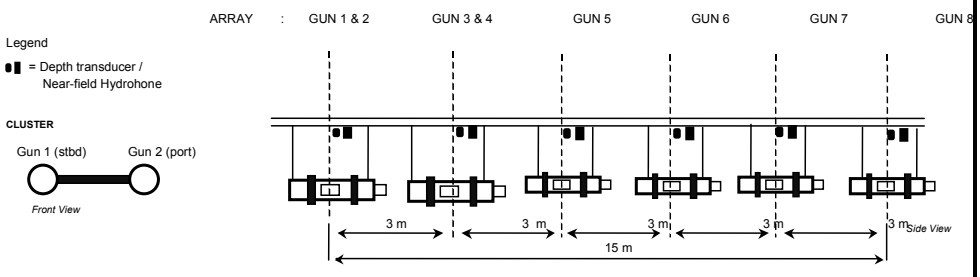
Offset

Ref to CS	350 m
CS to CFG	155 m



Source volume: 3542 cu.in.

Trisor	*Gun Model*	*Gun Volume*	*Ext.Hdr*	*Trisor*	*Gun Model*	*Gun Volume*	*Ext.Hdr*
Subarray 1, gun 1	Bolt 1500LL	235 cu.in.	Gun 1-1	Subarray 4, gun 1	Bolt 1500LL	235 cu.in.	Gun 4-1
Subarray 1, gun 2	Bolt 1500LL	235 cu.in.	Gun 1-2	Subarray 4, gun 2	Bolt 1500LL	235 cu.in.	Gun 4-2
Subarray 1, gun 3	Bolt 1900LL	125 cu.in.	Gun 1-3	Subarray 4, gun 3	Bolt 1900LL	125 cu.in.	Gun 4-3
Subarray 1, gun 4	Bolt 1900LL	125 cu.in.	Gun 1-4	Subarray 4, gun 4	Bolt 1900LL	125 cu.in.	Gun 4-4
Subarray 1, gun 5	Bolt 1500LL	155 cu.in.	Gun 1-5	Subarray 4, gun 5	Bolt 1500LL	155 cu.in.	Gun 4-5
Subarray 1, gun 6	Bolt 1900LL	90 cu.in.	Gun 1-6	Subarray 4, gun 6	Bolt 1900LL	90 cu.in.	Gun 4-6
Subarray 1, gun 7	Bolt 1900LL	54 cu.in.	Gun 1-7	Subarray 4, gun 7	Bolt 1900LL	54 cu.in.	Gun 4-7
Subarray 1, gun 8	Bolt 1900LL	30 cu.in.	Gun 1-8	Subarray 4, gun 8	Bolt 1900LL	30 cu.in.	Gun 4-8
Subarray 2, gun 1	Bolt 1500LL	260 cu.in.	Gun 2-1	Subarray 5, gun 1	Bolt 1500LL	260 cu.in.	Gun 5-1
Subarray 2, gun 2	Bolt 1500LL	260 cu.in.	Gun 2-2	Subarray 5, gun 2	Bolt 1500LL	260 cu.in.	Gun 5-2
Subarray 2, gun 3	Bolt 1500LL	195 cu.in.	Gun 2-3	Subarray 5, gun 3	Bolt 1500LL	195 cu.in.	Gun 5-3
Subarray 2, gun 4	Bolt 1500LL	195 cu.in.	Gun 2-4	Subarray 5, gun 4	Bolt 1500LL	195 cu.in.	Gun 5-4
Subarray 2, gun 5	Bolt 1500LL	235 cu.in.	Gun 2-5	Subarray 5, gun 5	Bolt 1500LL	235 cu.in.	Gun 5-5
Subarray 2, gun 6	Bolt 1500LL	155 cu.in.	Gun 2-6	Subarray 5, gun 6	Bolt 1500LL	155 cu.in.	Gun 5-6
Subarray 2, gun 7	Bolt 1900LL	90 cu.in.	Gun 2-7	Subarray 5, gun 7	Bolt 1900LL	90 cu.in.	Gun 5-7
Subarray 2, gun 8	Bolt 1900LL	54 cu.in.	Gun 2-8	Subarray 5, gun 8	Bolt 1900LL	54 cu.in.	Gun 5-8
Subarray 3, gun 1	Bolt 1500LL	235 cu.in.	Gun 3-1	Subarray 6, gun 1	Bolt 1500LL	235 cu.in.	Gun 6-1
Subarray 3, gun 2	Bolt 1500LL	235 cu.in.	Gun 3-2	Subarray 6, gun 2	Bolt 1500LL	235 cu.in.	Gun 6-2
Subarray 3, gun 3	Bolt 1900LL	125 cu.in.	Gun 3-3	Subarray 6, gun 3	Bolt 1900LL	125 cu.in.	Gun 6-3
Subarray 3, gun 4	Bolt 1900LL	125 cu.in.	Gun 3-4	Subarray 6, gun 4	Bolt 1900LL	125 cu.in.	Gun 6-4
Subarray 3, gun 5	Bolt 1500LL	155 cu.in.	Gun 3-5	Subarray 6, gun 5	Bolt 1500LL	155 cu.in.	Gun 6-5
Subarray 3, gun 6	Bolt 1900LL	90 cu.in.	Gun 3-6	Subarray 6, gun 6	Bolt 1900LL	90 cu.in.	Gun 6-6
Subarray 3, gun 7	Bolt 1900LL	54 cu.in.	Gun 3-7	Subarray 6, gun 7	Bolt 1900LL	54 cu.in.	Gun 6-7
Subarray 3, gun 8	Bolt 1900LL	30 cu.in.	Gun 3-8	Subarray 6, gun 8	Bolt 1900LL	30 cu.in.	Gun 6-8



13.3. Pulse Response

Frontsheet MV Geco Beta

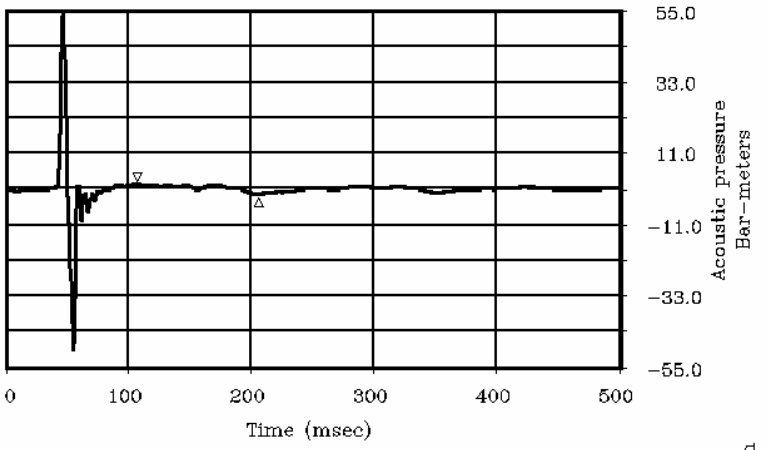
MARINE SURVEY GENERAL INFORMATION

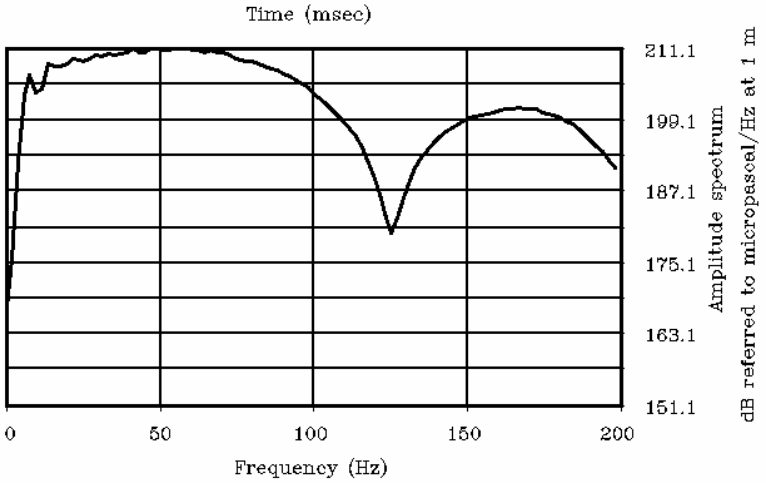
Job: *9226* - **Client:** Bass Strait Oil Company Ltd. **Area:** Vic/P42

Date: *Jul 2002 – Aug 2002*

Modelled Gun signature of 3542 cu in Array at 6.0m

	Peak Amplitude	54.4 Bar-m
ne3-003-180.filt	Peak-to-Peak Amplitude	104.0 Bar-m
Depth: 6.0 m	Primary-to-Bubble Ratio	32.3
File name:sig3542ex.f	Energy flux	51.4 kj/m**2





14. Instrumentation Room System Diagram

Frontsheet

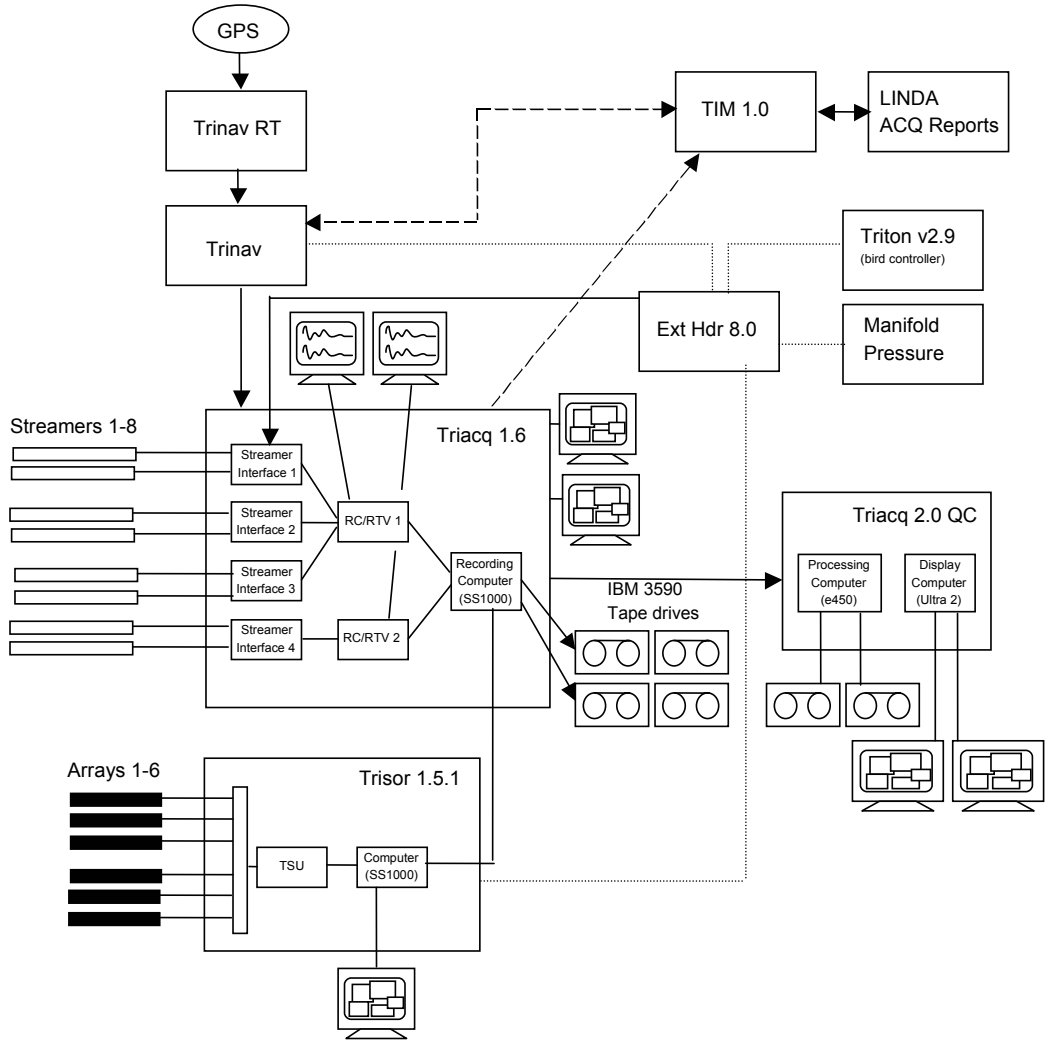
MV Geco Beta

MARINE SURVEY GENERAL INFORMATION

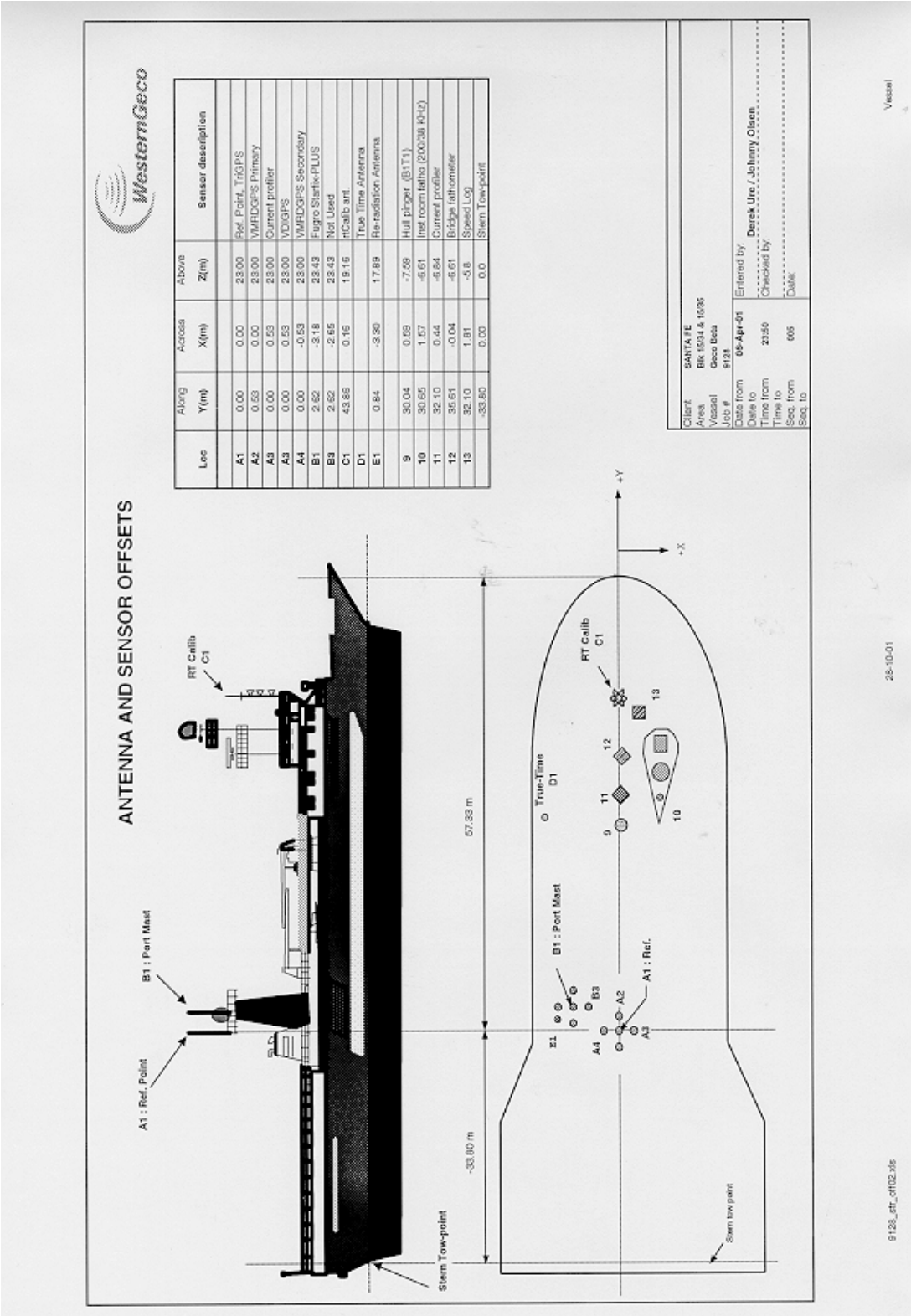
Job: *9226* - **Client:** Bass Strait Oil Company Ltd **Area:** Vic/P42

Date: *Jul 2002 – Aug 2002*

ACQUISITION INSTRUMENTATION SCHEMATIC



15. Equipment Offset Diagrams



16. Navigation and Positioning System Description

16.1. System Configuration

16.1.1. Navigation Hardware and Software

System	Hardware (Type and Serial No.)	Software Version
TRINAV	TRINAV RT	Version 2.6.0 Patch Level 19
External Header	EXT HDR	Ver. 7.9
Acoustic System	SIPS 1	Version 7.00.7-T
TS-meter	Valeport TS Meter Series 600 MK II Probe S/N 5619	
Echo Sounder	Simrad EA500 S/N 226	
Current Meter	RDI Narrowband (300 KHz)	Ver 1.11

16.1.2. System Timing

TRINAV issued closures to the recording/source firing system 640 milliseconds before the predicted time of peak pressure. All TRINAV system positions are at the time of predicted peak pressure.

16.2. Survey Positioning Method Used

This 3D survey was carried out using WesternGeco's standard mode of operation for 8 streamers and dual source surveys.

Positioning of the vessel was by differential GPS, utilizing TRINAV GPS, Thales MULTIFIX 3 and C&C Technologys' C-NAV system using Wide area Correction Transform (WCT) correction service. Delivery of differential correction data to TRINAV GPS and MULTIFIX 3 in RTCM SC104 format was by Thales SKYFIX.

The centre near group of each streamer and the sources were positioned relative to the vessel using a network consisting of 6 rGPS system units mounted on each source (10 units total), 132 SIPS 1acoustic ranges and 8 compass azimuths.

The center last group of each streamer was positioned using a network consisting of 8 TRINAV GPS tailbuoy mounted rGPS system units, streamer mounted compass heading units and SIPS 1 acoustics.

The mid streamer network consisted of 104 ranges between 8 acoustic transceivers mounted 2162.82 and 2262.01 meters from the center first group of each streamer.

The streamer shape was modelled by 144 Digicourse/Syntron series 5000 combined streamer depth control and magnetic compass units.

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

16.3. Surface Positioning

16.3.1. Vessel Navigation

System 1: TRINAV GPS
RTCM Delivery Systems
Thales Skyfix SF via Inmarsat-B (POR)
DGPS Stations: Adelaide (205), Sydney (206), Melbourne (208)

System 2: Thales Multifix 3 (VMFIX3A)
RTCM Delivery Systems
Thales Skyfix SF via Inmarsat-B (POR)
DGPS Stations: Adelaide (205), Sydney (206), Melbourne (208)

System 3: C&C Technolgy C-NAV dual frequency system using Wide area Correction Transform (WCT) Australia correction service.

System 4: C&C Technolgy C-NAV dual frequency system using Real Time Gypsy (RTG) Global correction service.

System 5: Trimble 4000DS receiver with Direct Injection of RTCM
Thales Skyfix (SF) corrections from Melbourne (208)

Primary vessel positioning was provided by TRINAV GPS.

TRINAV GPS is a multiple reference station DGPS system with the capability to be used in dual frequency mode when required, and 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 an exclusive 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.

Pseudo-range observations undergo comprehensive checks of validity and consistency before they are used in the fix algorithm. Carrier smoothing reduces the random noise effects on the pseudo ranges, and aids in multipath detection.

Integrity checking is a fundamental part of the processing philosophy: a Fault Detection, Isolation and Correction (FDIC) algorithm checks the consistency of the fix, detects and rejects any outliers, and re-computes the solution. W-testing and F-testing are used to give the best protection against erroneous observations.

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).

Secondary vessel positioning was provided by the third party multi-reference positioning product, Thales Multifix 3.

The independent sources of corrections were transmitted to and received onboard the vessel by independent means thereby providing a high degree of redundancy to ensure continuous vessel positioning.

- **Further information about these systems is given in Navigation Exhibit 1.**

Although Selective Availability was turned off in May 2000 differential corrections are still

required to provide a continuous high quality vessel position. Less frequent updates are required however.

16.3.2. Float Navigation

Float (both tailbuoy and source) surface navigation was provided by TRINAV GPS. The in-sea units incorporated a GPS receiver and interfacing for direct data transmission of the raw satellite pseudo-range data through the seismic streamer, the source cabling or by conventional UHF telemetry radio.

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

16.4. Streamer and Source Positioning

16.4.1. Acoustics

Acoustic data in the front, mid and tail networks was provided by Sonardyne's **S**eismic **I**ntegrated **P**ositioning **S**ystem (SIPS 1). This system comprises a rack mounted Controller, Processor and Graphical Display Unit which are located in the instrument room. HGPS (Hull and Gun Positioning System) transceivers mounted on the hull and on each source provide vessel relative source positioning. XSRS (Cross Streamer Ranging System) transceivers mounted on the streamer and tailbuoys provide vessel and tailbuoy relative streamer positioning.

16.4.2. Streamer Compasses

18 series 5000 Digibird combined magnetic compass and streamer depth controllers were attached to each streamer.

Compass Sampling Rate	=	1 second
Averaging constant	=	7 seconds

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

16.4.3. Gyro Compass

The gyrocompasses used during the survey were:

Instrument Room Gyro	- Gyro 1: Arma Brown MK10, S/N 3890
Ships Gyro	- Gyro 2: SG Brown, S/N 1029

The gyro correction values as computed by RTCalib from previous surveys were as follows:

Instrument Room Gyro	- Plus 0.42 degrees
Ships Gyro	- Plus 0.57 degrees

16.4.4. Velocity of Sound in Water

The following type of TS-meter has been used to determine the speed of sound in water.

- **Type: Valeport Series 600 MKII**

Valeport Series 600 MKII is a direct Reading Meter temperature / salinity probe which outputs measurements of depth/pressure, salinity/conductivity and temperature to a control display unit. Measurements are manually recorded when the probe is deployed at each depth. The user computes the speed of sound from the readings taken.

16.4.5. Echo Sounder

The echo sounder speed of sound was set to 1500 m/s. A draught correction of zero was entered in the echo sounder. The speed of sound for the total water column was derived on the prospect area using the temperature salinity device. The computed speed of sound, draught value, draught measurements taken during the survey and tide corrections were used to produce water depth corrected P190s.

16.5. Auxiliary Navigation Sensors

16.5.1. Current Meter

Data from an Acoustic Doppler Current Profiler, or Current Meter, was acquired throughout the survey. This data was used to assist the survey planning throughout the operation and so reduce the infill. The sensor used was a RDI Narrow Band Acoustic Doppler Current Profiler operating at 300 Hz.

16.5.2. Gravity

Gravity acquisition was not a requirement for this survey.

17. Navigation Systems Verification and Monitoring

17.1. Echo Sounder Verification

The calibration was carried out to determine the draught of the transducer in use and to compute a correction for the scale error. This verification was undertaken at Wharf 24, Victoria Docks, Melbourne on the 22nd of July 2002.

- **The calibration results are in Navigation Exhibit 2**

17.2. Gyro Monitoring

Continuous monitoring of the vessel gyros was performed using TRINAV's rtCalib utility program and a GPS baseline.

The gyro correction estimates provided by this program have been monitored and compared with previous dockside verification values and previous surveys.

Single side dockside verification was performed in one direction only at Wharf 24, Victoria Docks, and Melbourne on the 22nd of July 2002.

- **The gyro verification results are in Navigation Exhibit 3**

17.3. GPS Monitoring

Continuous monitoring using the Integrity Monitor was carried out offshore to verify that the installation was satisfactorily operational (data reception, transmission, processing and logging were verified) and that the operational settings were correct**.** Each system to be used, including duplicates, was verified.

rGPS Health Check was carried out with the use of TRINAV GPS's Re-Radiation kit.

- **The TRINAV GPS Integrity Monitor station in use is described in Exhibit 1.**
- **The Health Check results are in Exhibit 3**

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.

DGPS Health check onshore using the Integrity Monitor was carried out.

DGPS Health Check using Shore Control was carried out to verify datum shift parameters and antenna offsets were correctly entered in TRINAV. Satisfactory performance of the hardware was also verified.

- **The onshore Health Check results are in Navigation Exhibit 3.**

17.4. Current Meter Monitoring

To confirm that the Acoustic Doppler Current Profiler ADCP is operating correctly, with optimum configuration and, in so doing, providing a high quality data set for real-time and post-survey use, a test data set was sent weekly to an external contractor, Fugro GEOS. This process provided the onboard operation with a high level of confidence in the validity of the data being gathered, thereby increasing its value for survey planning.

18. Navigation Processing

18.1. The TRINAV System

TRINAV consists of a network of SUN SPARC workstations, external mass-data storage and hard-copy facilities running WesternGeco proprietary software on the UNIX operating system. Positioning sensors are interfaced to TRINAV through two VME sub systems.

The positions for each vessel/float are passed through a Kalman filter, where they may be integrated with speed and heading inputs. The output of the primary vessel Kalman filter is used for predicting the time when the first CMP position will be at the required distance along the preplot line. Relays are closed a fixed time prior to the estimated time of peak pressure. The raw, decoded data strings, and computed positions are stored to disk/tape.

The raw sensor data and Kalman filtered surface positions are passed from the Real Time acquisition system (TRINAV RT) to a near real time source and receiver positioning system (TRINAV QCPR). TRINAV QCPR computes positions online and provides facilities for any post processing required.

The data received by QCPR is immediately stored in a Techra relational database with directories for raw, filtered and processed data. Front, middle and tail networks are solved by least square adjustment at every shot-point. In-sea measurements are ‘clipped’ to remove large spikes. Statistical models are used to test the results of the adjustment, by detection of outliers. If the first iteration fails then the adjustment is repeated after the largest outlier has been removed. This routine is repeated until a satisfactory adjustment is achieved.

The quality of the data is then evaluated with the TRINAV application Diagnostics, against a set of standard criteria. WesternGeco's PAC, or **P**osition **A**cceptance **C**riteria, comprises a set of tolerances on specified statistics, which allow this objective assessment of the positioning quality to be made.

The resulting node positions are then smoothed using Kalman filters. From the source node, the center of source position is computed. The streamer cable shapes are computed from filtered compass data in order to establish positions for all the receiver groups. Wherever possible, the results of the real-time source and receiver positioning were used to make the final positioning data set. When the results from the online solution exceed the PAC additional processing was carried out on the ‘off-line’ system.

Final and raw navigation data in UKOOA standard formats was generated directly from the database on the off-line system. Available media are 3480 cartridges, 3590 cartridges and 8mm Exabyte cartridges.

The technique for these is described in **WesternGeco's Navigation systems – a Technical Introduction,** which is available upon demand.

18.1.1. Shot Editor

The Shot Editor was available for use on all lines as follows:

- Editing of non-production shot-points at the start and end of each line.
- Interpolation of missing shot-points.

18.1.2. Gun Editor

The Gun Editor was available for use on all lines as follows:

- The Gun Editor was used on shot-points interpolated by the Shot Editor to generate the missing gun mask. The gun mask is normally relayed to TRINAV via the External Header.
- The Gun Editor was used to change the status of the sources to non-firing for any NTBP sections of the lines.

18.1.3. Recompute

The vessel system position was computed and the positions saved at one second intervals to disk/tape by TRINAV RT. The positions of all objects at the predicted time of peak pressure were passed to TRINAV QCPR and stored in the database online.

Diagnostics was used on each line to decide if the real time Kalman filtered positions were acceptable. If the positions were not acceptable, the Recompute program was used to select different positions for each object or to merge different DGPS systems for parts of the line.

If new positions were selected in the Recompute these were Kalman filtered in the Smoother program using a forward backward Kalman filter.

The following plots were available for examination and comparison of the positioning systems:

- User selected track plot display of color-coded positions.
- Inline and Crossline time series shot to shot plots for selected positions.
- Inline and Crossline time series difference plot between selected positions and a reference position.
- Time series plots giving stochastic analysis of position quality for selected positions.

18.1.4. Smoother

The Smoother program is used for smoothing of surface positions offline and for smoothing of tracking nodes both online and offline.

When QCPR is acquiring data online the tracking node positions are smoothed using a forward Kalman filter. If the tracking node positions exceeded the PAC tolerances, they were re-smoothed offline using a Forward-Backward Kalman Filter. If new positions were selected in the Recompute program these were smoothed and time adjusted to shot time using the Kalman Forward-Backward filter.

- **Kalman filter**

This filter assumes that between any two shot points there will be zero average acceleration but some oscillation (noise) around the average.

- **Forward-Backward (FB) Kalman Filter**

All smoothing in post processing was performed using a Forward-Backward Kalman filter. This is essentially the weighted average of the raw data and two individual Kalman filters running in opposite directions through the data set.

This filter has the same acceleration parameters as the online Kalman filter but has separate rejection window parameters (for X and Y) thus enabling the user to model the expected motions independently. The FB Kalman filter for surface positions works in the area relative co-ordinate frame, while the FB Kalman and Kalman filters applied to the tracking nodes work in a vessel relative coordinate frame.

The quality of the smoothing was checked using the following difference plots:

- Difference between smoothed and un-smoothed data was checked to see the effect of the filter settings applied.
- Velocity cross-line and in-line plots indicate the amount of noise in the smoothed position.
- Variance Factor plot indicates the fit between the predicted and raw positions.

18.1.5. Filtering

❑ **Compass Processing**

The compasses were filtered online using two successive Kalman filters to avoid introducing any lag in the data. The difference between the predicted compass reading and the actual compass reading is tested at each shot. If the residual exceeds twice the standard deviation for two successive shots the online compass filtering was flagged as requiring post processing. If the online compass filtering failed, the data was analyzed by viewing time-series plots of raw and filtered data. Filter parameters were chosen to remove spikes and noise from the compasses. In the first instance the Kalman filter parameters were tuned to match the specific data set. If this did not achieve the desired result the following filters were used: -
For front compasses a median filter or a combination of median and mean filters.
Mid streamer and tail filters normally required a longer median depending on noise and movement.

Thirty additional shots are included at the start and ten at the end of the line to ensure that the compass filters were stable for the first and last chargeable shot points.

❑ **Gyro Filtering**

No gyro filtering was carried out.

❑ **Acoustic Filtering**

The acoustic networks were designed with maximum redundancy to ensure that positioning specifications could be maintained in case of range dropouts due to mechanical or electrical failure, noise or interference. All acoustic data was investigated using time-series plots.

The survey program is designed to identify by means of statistical testing where spikes and reflected ranges are corrupting the data as long as there is sufficient redundancy. On occasions it was necessary to apply clipping filters to remove large spikes, which tended to degrade the solution of the tracking nodes.

18.1.6. Reprocessing

The source and receiver position computation is divided into a number of discrete steps. These steps are executed automatically online. If post processing is required the operator is able to change parameters and examine the output between steps.

The processes are:

1. Least Squares solution of front and tail networks.
2. Kalman/Kalman FB smoothing of front and tail network tracking nodes
3. Computation of the streamer shape: receiver group lengths and sensor offsets are modified using a streamer tension model. Least squares condition equations are then used to compute corrections to the receiver group intervals and compasses in order to best fit the front and tail tracking nodes. The amount of stretch/compression permissible is user specified. The computation of positions and estimation of variances of the mid streamer network nodes is included in this process.
4. Least squares solution of the mid streamer network
5. Smoothing of the mid streamer tracking nodes
6. Step (3) is repeated using the front, middle and tail tracking nodes.

The least squares solutions include statistical testing and automatic rejection of outliers on a shot by shot basis.

18.2. Quality Control

Navigation post-processing was carried out on-board through to UKOOA P1/90 and P2/94 tape production.

18.2.1. First Line Test Data

After the first line was shot and processed, a test line was sent electronically to an external contractor, ECL. The data sent comprised:

1. All offset diagrams (vessel, streamer, source and float)
2. Offset spreadsheets
3. Velocity Profile Spreadsheet,
4. 100 shot points of P1 and P2 data
5. ASCII file of Diagnostics for this line
6. ASCII file of LAF for this line
7. ASCII files of Surface and Insea Survey Definitions
8. Job Book (as supplied from the supporting office)
9. Minutes from Start-up meeting (if relevant)
10. PFM Magnetic Variation Spreadsheet

A thorough QC of this test line was undertaken. The following checks were carried out:

- Strict compliance with published UKOOA P1 and P2 header and data format and generation of Format Check Reports.
- Graphical display of source and receiver towing geometry and comparison with WesternGeco office and vessel generated diagrams/documentation.
- Full vessel Configuration Report, as defined in the P2 header.
- Check P2 header defined Tow Points, Geodetic Parameters, etc. against WesternGeco Job Book and/or published values.
- List P2 header differences from a prior line sequence (if required).
- Raw data display and analysis
- Automated and manual (if required) data conditioning.
- Data processing to independently resolve vessel, source and receiver co-ordinates.
- Full position comparison report with WesternGeco P1/90 co-ordinates.
- Investigation of unacceptable position comparison results.
- Data Check and Statistics Report for compliance testing with survey contractual standards and specifications.
- Generation of statistics, error reports, test results, displays etc. as deemed necessary to highlight problem areas.
- Generation of QCPro P1/90 file, if desired.
- Check P2 file compliance with WesternGeco standard survey definition naming conventions.
- Check P1/90 and P2 file data compliance with WesternGeco standard numbering conventions.
- Comparison of vessel survey definitions with supplied offset spreadsheet and diagrams.
- Conduct Parameter Confirmation following the Parameter Confirmation Check Lists, MWWD/F012 and MWWD/F013.
- Other Survey Start-Up tests and checks as required and directed by WesternGeco.

When all the checks were performed a feedback report was published on ECL's secure web site. Any corrections required were made by the vessel. The Supporting Office and ECL then received a confirmation from the vessel that all updates had been completed.

18.2.2. Initial QC

The post-processing procedures included the following checks:

- QC checks on all survey parameters.
- Generation of correct survey definitions.
- Completion of shot point edits.
- P2/94 production.
- Completion of gun edits.
- QC of system position and recomputes if required.
- Smoothing of the vessel and buoy positions if required.
- Selective check and filtering if required, of the observations including:
  - Acoustic ranges.
  - Compass bearings.
  - Gyro heading.
- Least squares adjustment of front and tail network if required.
- Smoothing of source/streamer tracking nodes if required.
- Cable shaping to determine final source/receiver positions if required.
- Final QC of all lines
- P1/90 production.

The following documentation was produced for onboard QC:

- Navigation reports detailing information about the survey parameters, calibrations and continuing daily logs.
- A series of statistics and plots from on-line data acquisition:
  - Navigation line logs detailing performance and parameters used for the surface positioning, acoustics and compasses for each line.
  - Seismic observer's logs detailing gun information.
  - Edits list from the seismic observers detailing gun information.

18.2.3. Final QC

The post network solution QC plots and statistical printouts detailed in the previous section were examined and compared to WesternGeco specifications. In addition, trend analysis plots were created and analyzed every 20 lines to ensure consistency throughout the data set.

18.3. Water Depth Processing

Water depth processing was done on the raw water depth data onboard the vessel.

The water depth data was reduced to Mean Sea Level and then:

- corrected for draught
- filtered to de-spike and interpolate missing data
- corrected for tide
- corrected for measured sound velocity in water

The tidal predictions from d3d Bass Strait model were supplied by Client

- **The C-O values used are contained in the Job Book located in Section 1 of the Final Field Operations Report.**

The final data was dispatched on 3590 tapes direct from the vessel.

19. Observations

19.1. Navigation Summary

All systems performed well, however during acquisition the below systems required further detail.

19.1.1. TRINAV RT/QCPR

Trip 1 – Crew 2
August 2nd Trinav online database crashed while in production on sequence 022. A new database was created and line continued after 45 minutes or so. A reason for crash was not found. No further incidents during the survey

Trip 2 – Crew 1
No problems were experienced for the duration of the trip

19.1.2. TRINAV GPS (Primary)

Trip 1 – Crew 2
No problems were experienced for the duration of the trip
Trip 2 – Crew 1
No problems were experienced for the duration of the trip

19.1.3. Thales MULTIFIX 3 (Secondary)

Trip 1 – Crew 2
No problems were experienced for the duration of the trip
Trip 2 – Crew 1
No problems were experienced for the duration of the trip

19.1.4. C&C Technology C-NAV (Tertiary)

Trip 1 – Crew 2
The WCT system input to the Primary Estimator performed without fault for the duration of the trip. The standby RTG system was not used in real time.
Trip 2 – Crew 1
The WCT system input to the Primary Estimator performed without fault for the duration of the trip. The standby RTG system was not used in real time

19.1.5. DIGPS (Tertiary)

Trip 1 – Crew 2
The direct injection system was interfaced using Thales SF station Melbourne (208). As the station was approximately 300 kilometres away, data was somewhat noisier but acceptable as only a single reference station. As an average the DIGPS position was within 2m of the other systems used
Trip 2 – Crew 1

The direct injection system was interfaced using Thales SF station Melbourne (208). As the station was approximately 300 kilometres away, data was somewhat noisier but acceptable as

only a single reference station. As an average the DIGPS position was within 2m of the other systems used

19.1.6. TRINAV GPS Integrity Monitor

Trip 1 – Crew 2
The Integrity Monitor station at SALE was operational for the duration of the trip. As IM data was not a contract obligation for this prospect, the station was only monitored during line changes in order to build a historical reference of performance
Trip 2 – Crew 1
The Integrity Monitor station at SALE was operational for the duration of the trip. As IM data was not a contract obligation for this prospect, the station was only monitored during line changes in order to build a historical reference of performance

19.1.7. rGPS (Tailbuoys and Source Mounted)

Trip 1 – Crew 2
No major problems seen with tailbuoy or source-mounted rGPS for the duration of the trip.
Trip 2 – Crew 1
F004 GPS was dead upon arriving onboard. Weather prevented any fault finding or changes during the remainder of the job. Problem is suspected to be power related

19.1.8. Acoustics

Trip 1 – Crew 2
During the initial deployment all acoustic units were tested as they were put on the cables and all worked well. However several tail network XSRS units were changed out shortly after production commenced due damage caused by water ingress.
Trip 2 – Crew 1
S7T3 was intermittent on some sequences, no other problems

Due to following currents some lines had parts with acoustic ranges only be achieved every second shot.

19.1.9. Compasses

Trip 1 – Crew 2
Several individual compasses were seen to be bad during online acquisition. These units were set passive and changed out for good units when logistically possible.

Trip 2 – Crew 1
Several individual compasses were seen to be bad during online acquisition. These units were set passive and changed out for good units when logistically possible

19.1.10. Gyro

Trip 1 – Crew 2
The gyros performed without incident throughout the survey. The Instrument room gyro was the only one used during the survey for computing antenna laybacks and the layback to the stern tow point.
Trip 2 – Crew 1

Gyro 1 performed without any incidents during the remainder of the survey. A gyro plot was checked upon arriving onboard and it was then noticed that Gyro2 was showing a calibration value well below what was in use. See calibration report at the end of this report.

19.1.11. Echo Sounder

Trip 1 – Crew 2
The average depth over the survey area was ~70m. No problems were experienced with the echo sounder during the trip
Trip 2 – Crew 1
The average depth over the survey area was ~70m. No problems were experienced with the echo sounder during the trip

19.1.12. Current Meter

Trip 1 – Crew 2
No data for independent checking was rendered during the trip, but observed current was seen to correlate quite closely with predicted tidal stream data.
Trip 2 – Crew 1
No data for independent checking was rendered during the trip, but observed current was seen to correlate quite closely with predicted tidal stream data

19.2. Processing and QC Summary

Trip 1 – Crew 2
An external QC was carried out by ECL Ltd as per WesternGeco procedures on sequence 002. No major problem was encountered during this QC of the data set.
Trip 2 – Crew 1
No external QC was carried out on crew change as only a few sequences were left of the prospect. However, a full onboard parameter confirmation was done. Nothing was found during this check.

19.3. Conclusions

The job went very well without any incidents.

The current meter again proved very valuable for determining shooting plans and warnings about rip currents.

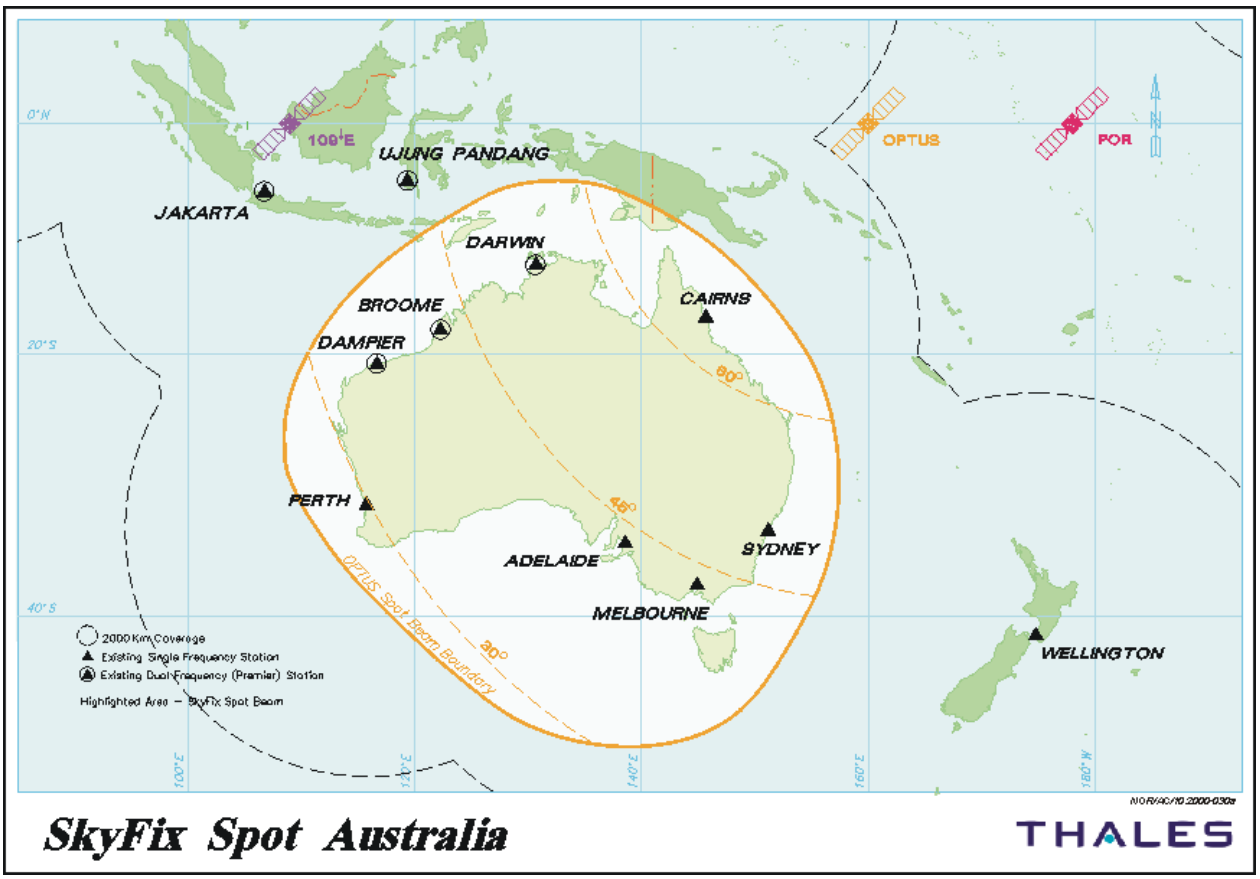
In addition we were supplied with Bass Strait predicted currents from the client for the duration of the survey. Logged currents agreed closely to predicted, except when the weather detoriated.

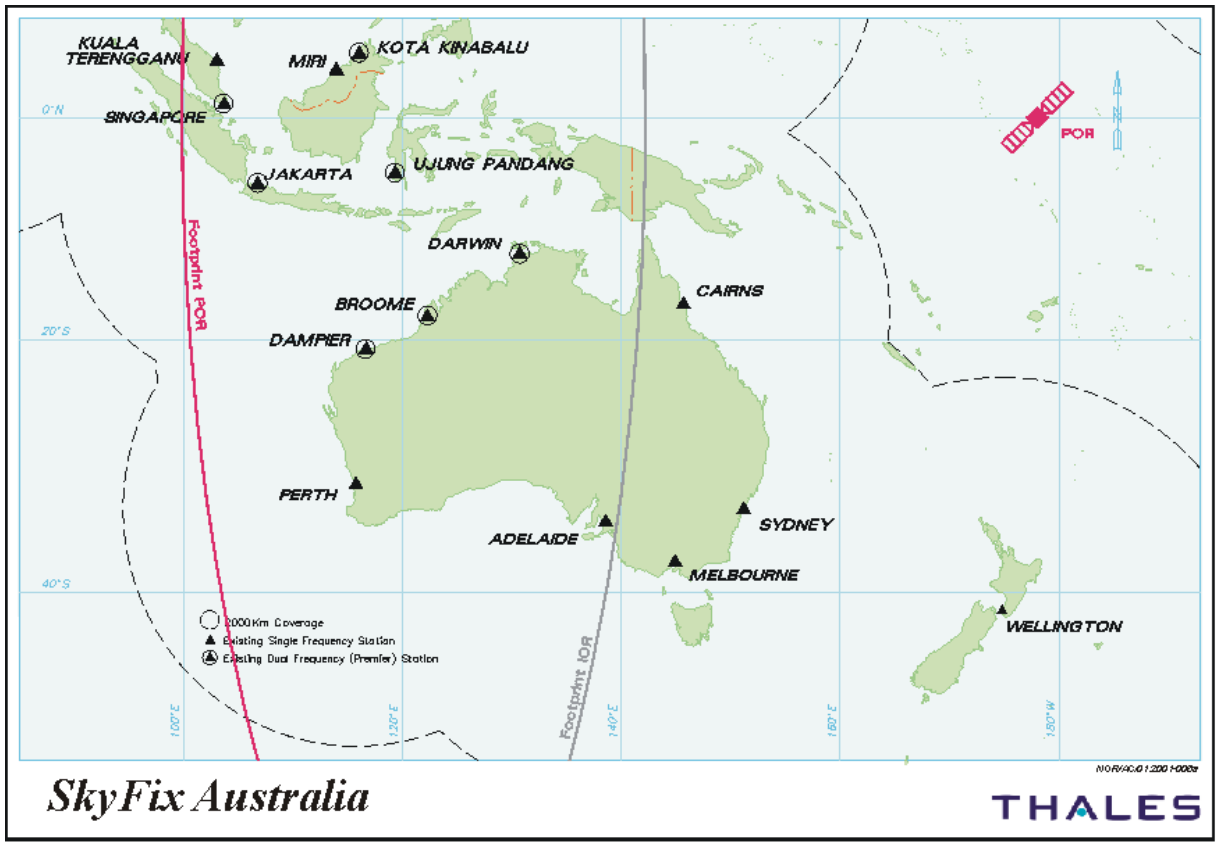
Due to the job being shot at 18.75m shot interval acoustics at times were limited to every second shots. This was caused by following currents pushing the vessel speed above the time needed for acquisition of ranges every shot. However, the acoustic solution was solid even on these lines.

20. Navigation Exhibits

Exhibit 1 : **Navigation System**

- **DGPS Coverage Maps for RTCM Sources**




KUALA TERENGGANU
MIRI
KOTA KINABALU
SINGAPORE
JAKARTA
UJUNG PANDANG
DARWIN
BROOME
DAMPIER
CAIRNS
PERTH
ADELAIDE
SYDNEY
MELBOURNE
WELLINGTON
POR
Footprint POR
Footprint IOR
0°N
20°S
40°S
100°E
120°E
140°E
160°E
180°W
2000Km Coverage
Existing Single Frequency Station
Existing Dual Frequency (Premier) Station
SkyFix Australia
THALES

❑

GPS System Installation Forms

VESSEL: Geco Beta	SHEET: 1 OF 1
	DATE: 24Jul 2002

GPS		VESSEL UNIT	SPARE UNIT	RTCALIB UNIT
GPS receiver	type	Novatel Millenium	Novatel Millenium	Leica MX 9400
	serial no.	NGY00250012	NGY00250005	585
	no. channels	12	12	12
	software version	4.503	4.503	1.59A
	firmware version	N/A	N/A	N/A
GPS Antenna	type	Novatel GPS 600	Novatel GPS 600	Sensor Systems
	serial No.	TPM00250028	TPM00250026	
	Clear of obstructions Y/N	Yes	Not Mounted	Yes
	location/type of obstruction		N/A	
Checked for p otential multipath problems Y/N		Yes	N/A	Yes
Cables	max length recommended	100	N/A	
	actual length	90	N/A	
	type	Andrews Cable	N/A	RG-213
	line amps installed (type)	Yes	N/A	No
	splitters installed (type)	No	N/A	Yes
	joints checked	Yes	N/A	Yes
Visual inspection of installation Y/N		Yes		Yes
TRINAV GPS Software version		Trinav 2.60 Patch 19		
Manuals onboard or access to WWW Y/N		Yes		

Radio Links – Satel		
Antennas have vertical separation	Y/N	Yes
ODUs mounted securely	Y/N	Yes
ODUs close to radio	Y/N	Yes < 2 metres
Frequencies separated	Y/N	Yes
Frequencies Used	Link 1	458.975 MHZ
	Link 2	458.775 MHz
	Link 3	458.600 MHz
	Link 4	N/A

ReRadiation Antenna		
Split from vessel antenna	Y/N	No, Dual Frequency antennas are not compatible with otherGPS equipment.
Mounted to minimise multipath effects	Y/N	No, slight obstruction from Norsat Dome.
Voltage observed at reradiation antenna		5.5 volts

	Name (Print)	Signature
Installed by:	Joel Pederick	_____
Positioning Supervisor:	Tom Copeland	_____

VESSEL: Geco Beta	SHEET: 1 OF 1
DGPS SYSTEM: Thales Multifix 3	
DATE: 01-10-01	

CHECK		ACTIVE UNIT	SPARE UNIT
GPS receiver	type	Trimble 4000DS	Trimble 4000DS
	serial no.	3325A03365	3308A02629
	no. channels	9	9
	software	Nav Ver: 7.29	Nav Ver: 7.29
GPS Antenna	type	Sensor Systems Low Gain	Sensor Systems Low Gain
	serial no.		
Cables	max. recommended length	100 m	100 m
	actual length	approx 90 metres	approx 90 metres
	type	Heliax Andrews Cable	Heliax Andrews Cable
	line amps installed Y/N	No	No
	joints checked Y/N	Yes	Yes
Satellite link	Correct Inmarsat antenna splitter used Y/N	Yes	No
Satellite link	Optus Antenna	No	Yes (Digital)
	demodulator serial number	802	4203
	demodulator frequency	75.10 MHz	78.525 MHz
Radio link	frequency	No	No
Raydome blind spots relative to ship's head		No	No
Contractor computer	type	Dell Optiplex GX110	Dell Optiplex GX110
	serial no.	9QB131S	BDJH11S
	Program version	Windows NT	Windows NT
Virus Check	Y/N	No	No
	program version	-	-
	result	-	-
Visual inspection installation	Y/N	Yes	Yes
Units securely mounted	Y/N	Yes	Yes
Power on check	Y/N	Yes	Yes
DGPS Software version		Multifix 3, Ver 1.25, 28 Mar 2001	Multifix 3, Ver 1.25, 28 Mar 2001
Manuals onboard	Y/N	Yes	Yes
Data output format to RT		Geco UKOAA	Geco UKOAA
Interfaced to RT		Yes	Yes
Satellite selection mode		All in view	All in view
Position calculation mode fixed/constrained		Height aiding	Height aiding
Antenna height above MSL		23.00 m	23.00 m
PDOP limit		No (set to 10)	No (set to 10)
Elevation mask		10 deg	10 deg
SV Sync time		1 sec	1 sec
Max age corrections		150 sec	150 sec

	Name (Print)	Signature
Installed by:	Thales/ Derek Ure	
Company	Thales Singapore	
Positioning Supervisor:	Derek Ure	

VESSEL: BETA	SHEET: 1 OF 1
DGPS SYSTEM: C-NAV	
DATE: 20/07/02	

CHECK		ACTIVE UNIT	SPARE UNIT
GPS display unit	type	C-NAV	C-NAV
	serial no.	042202-02	042202-09
	no. channels	10	10
	software	V12	V12
	firmware	V1.2	V1.2
GPS	type Antenna/Receiver	C-NAV	C-NAV
	serial no.	264050	264058
Cables	max. recommended length	100 feet (without RS244)	100 feet (without RS422)
	actual length	100 feet with RS 422	100 feet with RS422
	type	8 core comms cable	8 core comms cable
	line amps installed Y/N	Y	Y
	joints checked Y/N	Y	Y
Satellite link	Correct Inmarsat antenna splitter used Y/N	N/a	N/a
	demodulator serial number	N/a	N/a
	demodulator frequency	N/a	N/a
	demodulator expiry date	N/a	N/a
Radio link	frequency	N/a	N/a
Raydome blind spots relative to ship's head		N/a	N/a
Contractor computer	type	N/a	N/a
	serial no.	N/a	N/a
	program version	N/a	N/a
Virus Check	Y/N	N/a	N/a
	program version	N/a	N/a
	result	N/a	N/a
Visual inspection installation	Y/N	Y	Y
Units securely mounted	Y/N	Y	Y
Power on check	Y/N	Y	Y
Manuals onboard	Y/N	Y	Y
DGPS software	name, version	N/a	N/a
Data output format to RT		NEMEA (WCT Corrns)	NEMA (RTG Corrns)
Interfaced to RT		Y	Y
Satellite selection mode		All in view	All in view
Position calculation mode fixed/constrained		Auto	Auto
Antenna height above MSL		23.0m	23.0m
Geoid-spheroid separation		N/a	N/a
Std dev of antenna height input		N/a	N/a
PDOP limit		20	20
Elevation mask		8 deg	8 deg
SV Sync time		1 sec	1 sec
Max age corrections		150 sec	150 sec

	Name (Print)	Signature
Installed by:	Stefan Simpson_____	_____
Company	WG_____	
Positioning Supervisor:	Tom Copeland_____	_____

- **TRINAV GPS Integrity Monitor Station Description**

GPS INTEGRITY MONITOR		
Country: **Australia**	**Area/Region:** **South East Asia / ASA**	**Station name:** **SALE**
Telephone connection: Not available **SINET connection : Yes**		
Co-ordinates:		
Ellipsoid: Semi Major axis: Inverse flattening: Datum:	WGS-84 6378137.0 m 1/298.257 223 563 WGS-84	
Latitude: Longitude:	38° 06' 06.273" S 147° 05' 21.199" E	
Ellipsoidal height:	21.44m	
Description of station: The Station is located at the Schlumberger OFS Office at Raglan Street, Sale, Victoria AUSTRALIA		
Antenna: The antenna in use is a Model 502 L1/L2 GPS Dual Frequency Antenna from Novatel. The antenna is mounted on a pole giving a height above ground of approximately 10m.		
Receiver unit: The unit in use at the Integrity Monitor is a Novatel Power Pak II dual frequency receiver. Installation was on the 10 May 2002		
Observation and Processing method: The Antenna Position was Surveyed by Kluge Jackson consultants using standard survey methods. Height was derived through measurement in AHD (15.64m) and addition of AUSGEOID98 Model Geoidal Separation value (5.8m).		
Date of survey: 10th May 2002		
Please contact Matthew Boyall for technical issues.		

Exhibit 2 : **Echo Sounder Calibration**

Echo Sounder Check (In Port)

Vessel:	M/V "Geco Beta"	**Date :**	28-09-02
Client:	bhpBP	**Check started (GMT):**	16:45
Job no.	9227	**Check ended (GMT):**	17:00
Location:	Wharf 24, Victoria Quay, Melbourne	**E/S draught:**	6.61 m
E/S type:	Simrad EA500	**Vertical offset keel to E/S:**	0.00 m
Serial no:	145	**Bridge E/S reading**	xx.xx

Observed

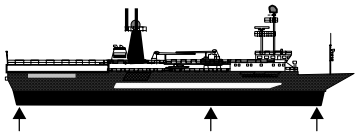
Draught (m)			Lead Line Depth (m)	
Bow	Mid-ships	Stern	Stbd (1)	Port (2)
3.80		7.90	10.76	11.70
Draught at E/S		**4.84**	LL Depth at E/S	**11.23**

Echo Sounder Readings

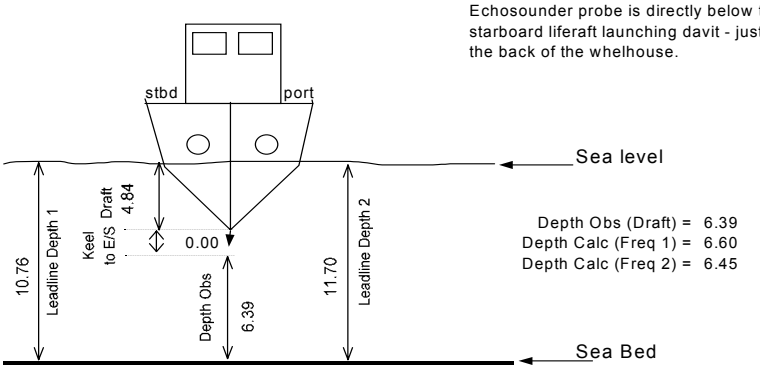
Freq 1 (m) 38 MHz	Freq 2 (m) 200MHz
6.60	6.40
6.60	6.40
6.60	6.40
6.60	6.60
Average =	**6.60**	**6.45**
+ vertical offset keel to E/S transducer	0.00	0.00
+ draught (keel to sea surface)	4.84	4.84
Total water depth (m)	**11.44**	**11.29**

Observed - Echo Sounder = -0.21 m Freq 1
Observed - Echo Sounder = -0.06 m Freq 2

Sounder Settings Check:	**Factory Defaults (from manual)**	**Check**
RangeA	xx.xx	
Absorption coefficient	10 dB	
Transmit power	2000 U	
Transducer Depth	0.00	
Speed of sound	1500 m/s	
two way beam angle	-20.6 dB	
Transducer gain	26.5 dB	
Sample distance	0.10m	



Offsets above are relative to VRP
Echosounder probe is directly below the starboard liferaft launching davit - just behind the back of the whelhouse.



Depth Obs (Draft) = 6.39
Depth Calc (Freq 1) = 6.60
Depth Calc (Freq 2) = 6.45

Exhibit 3 **: GPS and Gyro Calibration**

- **Offshore Calibration Report**

OFFSHORE CALIBRATION REPORT

Table of Contents

I. Introduction and Abstract of Results

During the seismic survey undertaken by M/V Geco Beta for Bass Strait Oil from 27th July 2002 to 8th August 2002 on the Vic/P42, Bass Strait, Australia prospect (WesternGeco job number 9226), the DGPS, rGPS and Gyro positioning systems were monitored continuously throughout acquisition. This allowed C-O values to be computed, monitored and modified, if necessary, whilst offshore. These offshore calibration techniques have been developed by WesternGeco – the principal components comprise:

- The Integrity Monitor, one of several shore reference stations where a GPS receiver and data link are established at a known coordinated point allowing comparisons of the vessel GPS receiver performance against the reference receiver.
- The Re-radiation Kit, which enables rGPS systems to be fed the same GPS signal as the vessel receiver, thus allowing performance evaluation to be undertaken by means of a zero baseline test.
- The RT Calib system that uses the Primary vessel GPS together with a second GPS installation at a predetermined point on the vessel to determine a heading vector against which the vessels Gyros may be calibrated.

The technique for these is described in **WesternGeco's Navigation systems – a Technical Introduction,** which is available upon demand.

The report presents the observations and results from these offshore calibrations.

Abstract of Results

Value	C-O	SD
Gyro 1 (mean)	0.50	0.17

Gyro 2 (mean)		-.53	0.19
GPS Integrity Monitor Results	Delta Easting		
	Delta Northing		
TRIGPS vs. SYSTEM	Radial	.44	.13
MFIX3A vs SYSTEM	Radial	.49	.08
VCNAVWCT vs SYSTEM	Radial	.76	.15
VCNAVRTG vs SYSTEM	Radial	.95	.23

A table of the values are presented above

II. Differential GPS Verification

M/V Geco Beta utilised the following DGPS systems throughout the survey: a Leica MX9400/Novatel Millennium Dual Frequency GPS receiver providing raw pseudo range data to WesternGeco's TRINAV GPS 2.6 for Primary vessel positioning with Trinav GPS.
RTCM corrections delivered by Skyfix Inmarsat, and Skyfix Optus.

Secondary vessel positioning was provided by Thales Multifix with Skyfix corrections delivered via Inmarsat and Optus.

Third vessel positioning was provided by CNAV system with the CNAVWCT system

Tertiary vessel positioning was provided by CNAV system with CNAVRTG system.

Tertiary vessel positioning was provided by a Trimble 4000 DGPS with direct injection of Skyfix RTCM corrections delivered by Thales via Inmarsat. Melbourne was used for this

Data transfer between the vessel and the Integrity Monitor Receiver was achieved using the vessel's Norsat C satellite data link.

Method used

Refer to **WesternGeco's Navigation systems – a Technical Introduction**, DGPS Calibrations Integrity Monitor section.

Results

Chapter VI contains a summary of the statistics taken from the diagnostics files and derived from the data logged by rtDisplay.

Chapter VII contains numerical data from rtcalib for the integrity monitor.

Figure 1 shows the average misclosure of the integrity monitor station in graphical form (separated into northing and easting misclosures) for all the sequences acquired. For ease of interpretation, separate displays are also included to allow any line heading dependency of the GPS positioning to be ascertained.

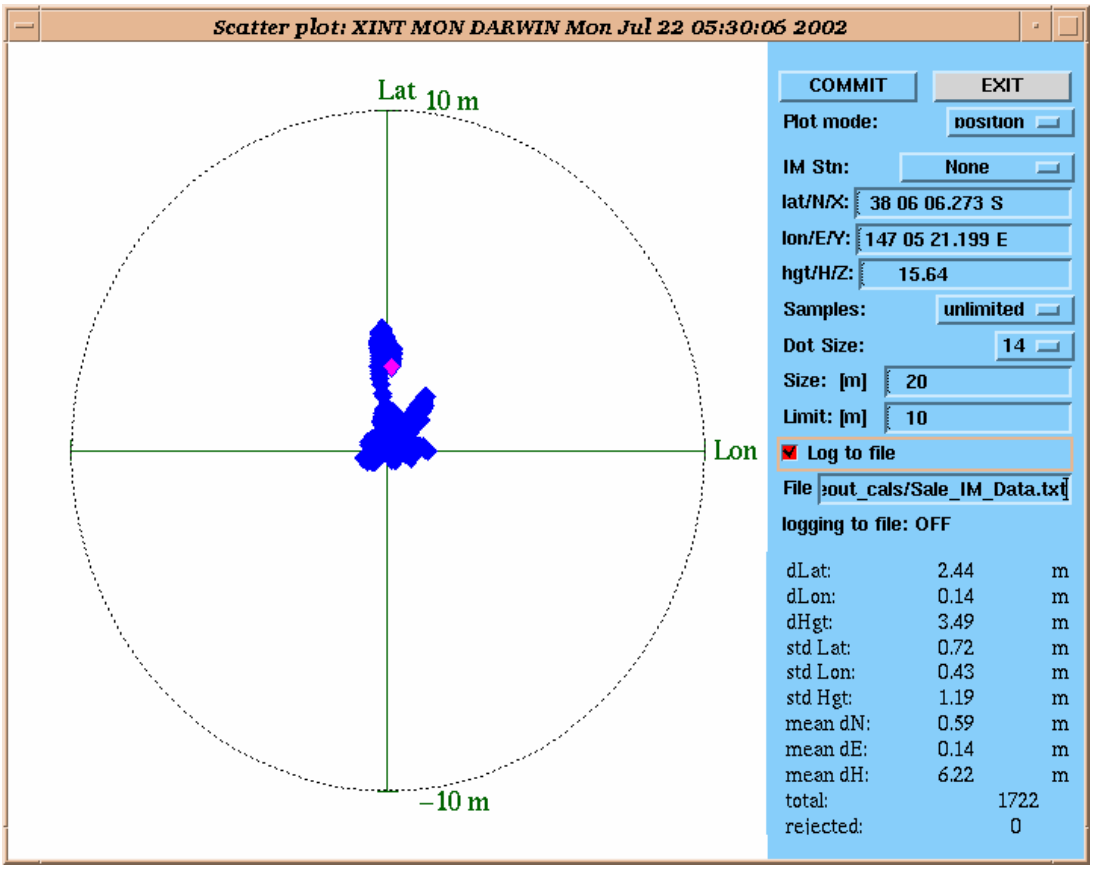


Figure 1: Integrity Monitor Plot Trends to demonstrate GPS quality during the calibrations. This plot is from the calibration done in Melbourne the 22nd of July. Due to hardcoded in Trinav it is referred to as Darwin, but is actually Sale.

III. rGPS Verification

M/V Geco Beta utilised WesternGeco's TRINAV GPS 2.6 rGPS system throughout this survey for Float and Source positioning. The GPS signal received by the main TRINAV GPS vessel receiver is split using a purpose designed GPS splitter from WR systems inc. It is then used by both the main vessel receiver and transferred to a re-radiating antenna on the back deck, allowing use of a near identical GPS signal by float and vessel receivers simultaneously.

Method used

Refer to **WesternGeco's Navigation systems – a Technical Introduction**, rGPS Calibrations section.

Results

The table below shows a summary of the statistics taken from plots within TRINAV GPS for all float units. This table contains collated data from the re-radiation tests done at the start and end of the survey.

9226 Bass Strait Oil - Pre/Post Survey rGPS Re-Rad Checks
RGPS Re-radiation Verification

System	Unit	Date	Obs	mean dN	mean dE	mean dH	StdN	StdE	StdH
Float	F002	24-Jul-02	6415	0.17	1.13	2.54	1.99	1.30	2.59
Float	F006	24-Jul-02	6501	0.24	0.80	4.81	1.28	1.12	2.28
Float	F001	24-Jul-02	104	0.20	-0.44	-0.44	0.59	1.01	1.48
Float	F002	24-Jul-02	204	0.81	0.10	-1.05	0.86	0.82	2.09
Float	F003	24-Jul-02	228	0.88	-0.34	-0.61	1.44	0.64	2.27
Float	F004	24-Jul-02	112	-0.41	-0.59	3.26	0.72	0.61	1.87
Float	F005	24-Jul-02	329	-0.29	0.26	-0.50	0.91	0.68	2.26
Float	F006	24-Jul-02	250	0.39	-0.73	5.50	1.35	0.64	1.60
Float	F007	24-Jul-02	201	0.55	0.19	-0.91	1.27	0.99	2.05
Float	F008	24-Jul-02	323	-0.35	0.17	-0.54	0.92	1.25	2.79
Gun1	SE_02	25-Jul-02	896	-0.33	1.08	-6.82	1.70	1.17	3.05
Gun2	SE_03	25-Jul-02	628	-1.27	1.07	-5.62	0.62	1.04	2.30
	SE_04	25-Jul-02	672	-0.13	0.16	-4.45	1.92	1.46	3.40
Gun3	SE_05	25-Jul-02	728	0.17	0.92	-3.12	1.40	1.28	3.06
	SE_06	25-Jul-02	685	-0.58	-0.69	-1.75	2.13	1.30	3.88
Gun4	SE_07								
	SE_08								
Gun5	SE_09								
	SE_10	25-Jul-02	628	0.85	0.13	-7.44	0.92	0.85	0.83
Gun6	SE_12								
	Averages			**0.06**	**0.20**	**-1.07**	**1.25**	**1.01**	**2.36**

Table 1: rGPS verification test data from re-radiation tests

IV. Gyro Calibration

M/V Geco Beta is fitted with two gyrocompasses, a main survey gyro of type Arma Brown MK10 and a secondary gyro of type SG Brown for comparison and backup use. TRINAV GPS is used to determine the heading vector, for comparison with the Gyro headings. This utilises the standard vessel receiver as described above and a second receiver, of the Leica MX9400 type. The second receiver's antenna is mounted 43.86m ahead of the primary receiver's, with the minimum practicable difference in height. The positions of all antennas used in the Gyro calibration process are determined during a high precision Offset Measurement Survey, performed by an independent contractor, whilst the Vessel is in dock or alongside.

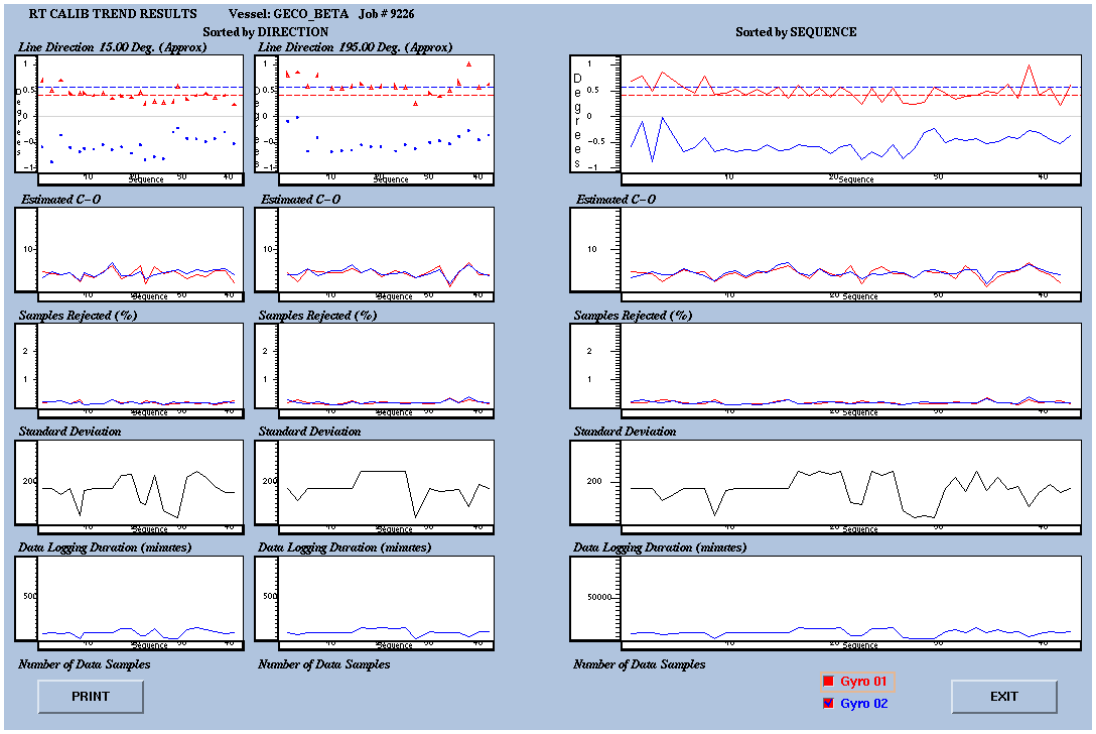
Method used

Refer to **WesternGeco's Navigation systems – a Technical Introduction**, Gyro Calibrations section.

Results

Results from RT Calib are available in several formats, both graphical and tabular. Figure 2 shows the average C-O for each of the gyros in graphical form for all the sequences acquired. For ease of interpretation, separate displays are also included to allow any line heading dependency of the gyro performance to be ascertained. The earlier TRINAV GPS Integrity Monitor trend plot (Figure 1) is useful to confirm the GPS positioning when the gyro quality shows interesting trends.

Numerical results for RT Calib are shown in chapter VII.



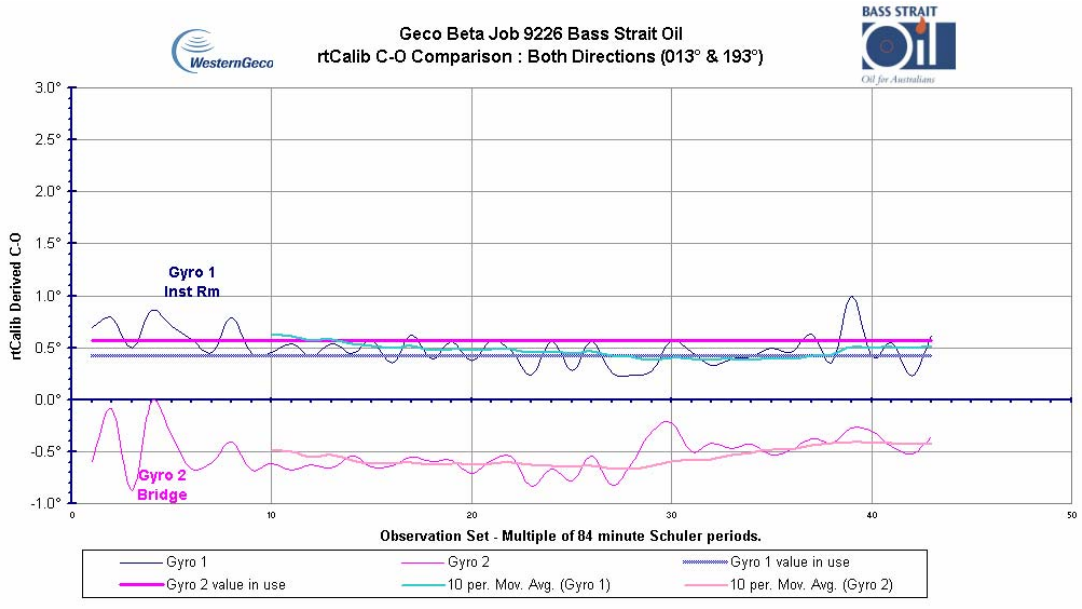


Figure 2: Gyro Calib Trends

Geco Beta Job 9226 Bass Strait Oil
rtCalib C-O Comparison : Both Directions (013° & 193°)

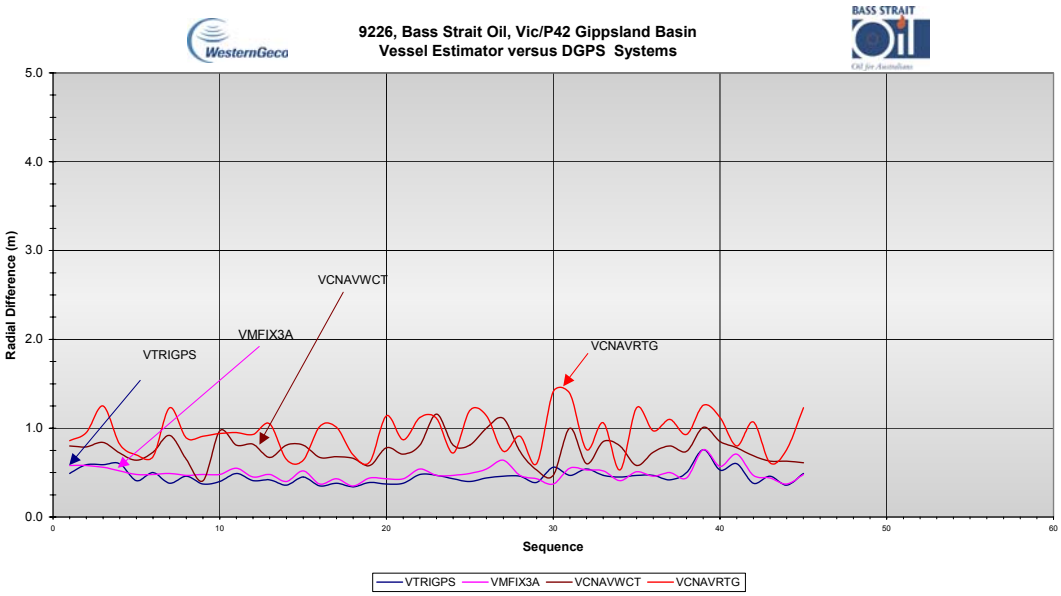
	Obs	Minutes	Start	End	Name	C-O	Std	No.	Percent	Name	C-O	Std	No.	Percent
Line Name	Set	Used	Hdg	Hdg		[deg]	[deg]	samp.	Rejected		[deg]	[deg]	samp	Rejected
VP421216P001	001	168	18	12	GY01	0.69	0.20	8346	4.8	GY02	-0.59	0.25	8346	3.3
VP421008P002	002	168	205	189	GY01	0.79	0.19	9919	4.7	GY02	-0.09	0.31	9919	4.2
VP421232P003	003	168	17	2	GY01	0.50	0.22	9970	4.4	GY02	-0.88	0.23	9970	4.9
VP421024P004	004	113	199	199	GY01	0.86	0.31	6713	2.5	GY02	-0.01	0.19	6713	4.2
VP421248P005	005	140	17	2	GY01	0.70	0.28	8273	4.0	GY02	-0.36	0.28	8273	4.0
VP421024A006	006	168	205	191	GY01	0.58	0.19	9959	5.3	GY02	-0.67	0.17	9959	5.5
VP421200P007	007	168	13	6	GY01	0.45	0.16	9983	4.5	GY02	-0.60	0.15	9983	4.7
VP421040P008	008	168	200	187	GY01	0.79	0.17	9956	4.8	GY02	-0.41	0.25	9956	3.8
VP421184P009	009	041	17	17	GY01	0.44	0.29	2460	2.5	GY02	-0.68	0.25	2460	2.8
VP421184A010	010	161	13	354	GY01	0.45	0.13	9570	4.1	GY02	-0.62	0.14	9569	4.7
VP421056P011	011	168	199	182	GY01	0.54	0.13	9963	4.6	GY02	-0.68	0.12	9963	5.1
VP421168P012	012	168	17	8	GY01	0.41	0.16	9895	3.3	GY02	-0.63	0.16	9895	3.7
VP421072P013	013	168	197	186	GY01	0.54	0.15	9969	4.5	GY02	-0.66	0.12	9969	5.0
VP421264P014	014	168	13	7	GY01	0.44	0.17	9907	4.8	GY02	-0.54	0.15	9905	4.6
VP421088P015	015	168	200	183	GY01	0.57	0.28	9836	5.6	GY02	-0.65	0.22	9836	6.4
VP421280P016	016	168	18	7	GY01	0.35	0.31	9953	6.2	GY02	-0.64	0.29	9953	7.0
VP421104P017	017	252	199	188	GY01	0.62	0.15	14913	4.5	GY02	-0.55	0.15	14913	4.6
VP421296P018	018	231	20	9	GY01	0.33	0.20	13660	3.1	GY02	-0.53	0.17	13660	3.8
VP421120P019	019	252	203	185	GY01	0.56	0.17	14685	5.5	GY02	-0.58	0.22	14685	5.5
VP421312P020	020	236	24	10	GY01	0.37	0.22	13995	4.3	GY02	-0.71	0.24	13995	3.9
VP421120J021	021	252	199	188	GY01	0.57	0.24	14881	3.7	GY02	-0.58	0.21	14878	4.1
VP421328A023	022	104	19	14	GY01	0.46	0.15	6126	6.3	GY02	-0.55	0.16	6126	4.9
VP421344P025	023	093	21	17	GY01	0.24	0.26	5465	2.0	GY02	-0.83	0.21	5465	3.2
VP421152P026	024	249	194	196	GY01	0.56	0.19	14724	5.1	GY02	-0.67	0.18	14724	4.4
VP421360P027	025	230	17	15	GY01	0.28	0.19	13656	6.0	GY02	-0.78	0.22	13656	4.2
VP421152J028	026	252	198	194	GY01	0.56	0.18	14923	4.4	GY02	-0.54	0.16	14923	4.8
VP421216A029	027	063	21	20	GY01	0.26	0.11	3701	4.3	GY02	-0.82	0.13	3701	4.7
VP421072A030	028	034	195	202	GY01	0.24	0.18	2021	3.5	GY02	-0.62	0.19	2021	3.4
VP421184B031	029	041	4	4	GY01	0.28	0.16	2447	5.0	GY02	-0.30	0.24	2447	5.1
VP421328B032	030	030	1	5	GY01	0.57	0.16	1788	4.7	GY02	-0.22	0.21	1788	5.4
VP421520P033	031	170	199	192	GY01	0.45	0.17	10076	4.8	GY02	-0.50	0.20	10076	4.4
VP421376P034	032	220	11	8	GY01	0.33	0.23	13001	3.1	GY02	-0.42	0.21	13001	4.3
VP421504P035	033	156	190	185	GY01	0.39	0.20	9281	6.2	GY02	-0.47	0.18	9281	5.2
VP421376J036	034	252	15	10	GY01	0.41	0.16	14913	4.2	GY02	-0.43	0.20	14913	5.4
VP421488P037	035	161	197	190	GY01	0.50	0.37	9491	1.2	GY02	-0.53	0.33	9491	2.0
VP421376K038	036	224	17	11	GY01	0.45	0.21	13263	3.6	GY02	-0.48	0.18	13263	4.8
VP421472P039	037	164	195	187	GY01	0.63	0.19	9732	4.6	GY02	-0.38	0.21	9732	4.9
VP421392P040	038	178	16	1	GY01	0.36	0.14	10539	5.1	GY02	-0.42	0.17	10531	5.3
VP421456P041	039	083	218	212	GY01	1.00	0.31	4938	6.9	GY02	-0.27	0.40	4938	6.5
VP421408P042	040	149	7	360	GY01	0.41	0.18	8807	5.0	GY02	-0.30	0.22	8813	5.5
VP421456A043	041	188	203	195	GY01	0.55	0.25	11116	4.0	GY02	-0.45	0.22	11116	4.7
VP421424P044	042	150	8	1	GY01	0.23	0.28	8902	2.1	GY02	-0.52	0.20	8903	4.2
VP421440P045	043	170	199	190	GY01	0.62	0.16	10059	4.2	GY02	-0.36	0.20	10059	3.8
						0.50					-0.53			
						0.17					0.19			

V. Conclusions and Comments on Data Quality

All systems performed well throughout the survey. However, Gyro 2 calibration value was seen to be –0.5. This was most likely due to power loss before the survey started and the repeater was not realigned. Gyro2 was never used during the survey, it is secondary and to be used for backup only. However, the calibration values for Gyro 2 were stable around –0.5 and could have been used if needed.

VI. Secondary & Tertiary DGPS System Differences to System

The following table contains a summary of the statistics taken from the diagnostics files and derived from the data logged by rtDisplay.



		Diff Vessel Position versus GPS - Radial Difference (m)			
Line	Seq	Primary system VTRIGPS	Secondary system VMFIX3A	Tertiary system VCNAVWCT	Tertiary System VCNAVRTG
Line: VP421216P001	1	0.49	0.58	0.80	0.86
Line: VP421008P002	2	0.59	0.58	0.79	0.95
Line: VP421232P003	3	0.59	0.56	0.84	1.25
Line: VP421024P004	4	0.60	0.52	0.72	0.82
Line: VP421248P005	5	0.41	0.48	0.64	0.70
Line: VP421024A006	6	0.50	0.48	0.73	0.68
Line: VP421200P007	7	0.38	0.49	0.92	1.23
Line: VP421040P008	8	0.46	0.47	0.65	0.89
Line: VP421184P009	9	0.37	0.48	0.41	0.91
Line: VP421184A010	10	0.40	0.48	0.97	0.94
Line: VP421056P011	11	0.49	0.55	0.81	0.95
Line: VP421168P012	12	0.41	0.45	0.82	0.93
Line: VP421072P013	13	0.42	0.48	0.67	1.05
Line: VP421264P014	14	0.36	0.40	0.81	0.65
Line: VP421088P015	15	0.45	0.52	0.81	0.64
Line: VP421280P016	16	0.35	0.37	0.67	1.02
Line: VP421104P017	17	0.38	0.43	0.68	1.01
Line: VP421296P018	18	0.34	0.35	0.66	0.70
Line: VP421120P019	19	0.39	0.44	0.58	0.62
Line: VP421312P020	20	0.37	0.43	0.78	1.14
Line: VP421120J021	21	0.38	0.43	0.71	0.87
Line: VP421328P022	22	0.48	0.54	0.81	1.12
Line: VP421328A023	23	0.47	0.47	1.16	1.11
Line: VP421136P024	24	0.43	0.47	0.81	0.72
Line: VP421344P025	25	0.40	0.49	0.81	1.20
Line: VP421152P026	26	0.44	0.54	1.00	1.14
Line: VP421360P027	27	0.46	0.64	1.11	0.74
Line: VP421152J028	28	0.46	0.47	0.74	0.91

Line: VP421216A029	29	0.39	0.43	0.53	0.60
Line: VP421072A030	30	0.56	0.37	0.47	1.41
Line: VP421184B031	31	0.47	0.55	1.00	1.39
Line: VP421328B032	32	0.54	0.53	0.60	0.76
Line: VP421520P033	33	0.47	0.52	0.85	1.06
Line: VP421376P034	34	0.45	0.41	0.80	0.53
Line: VP421504P035	35	0.47	0.51	0.58	1.23
Line: VP421376J036	36	0.47	0.46	0.73	0.97
Line: VP421488P037	37	0.42	0.50	0.80	1.10
Line: VP421376K038	38	0.50	0.44	0.74	0.93
Line: VP421472P039	39	0.76	0.76	1.01	1.26
Line: VP421392P040	40	0.53	0.57	0.85	1.12
Line: VP421456P041	41	0.60	0.71	0.78	0.80
Line: VP421408P042	42	0.00	0.47	0.69	1.07
Line: VP421456A043	43	0.00	0.44	0.63	0.61
Line: VP421424P044	44	0.38	0.37	0.63	0.76
Line: VP421440P045	45	0.46	0.48	0.61	1.23

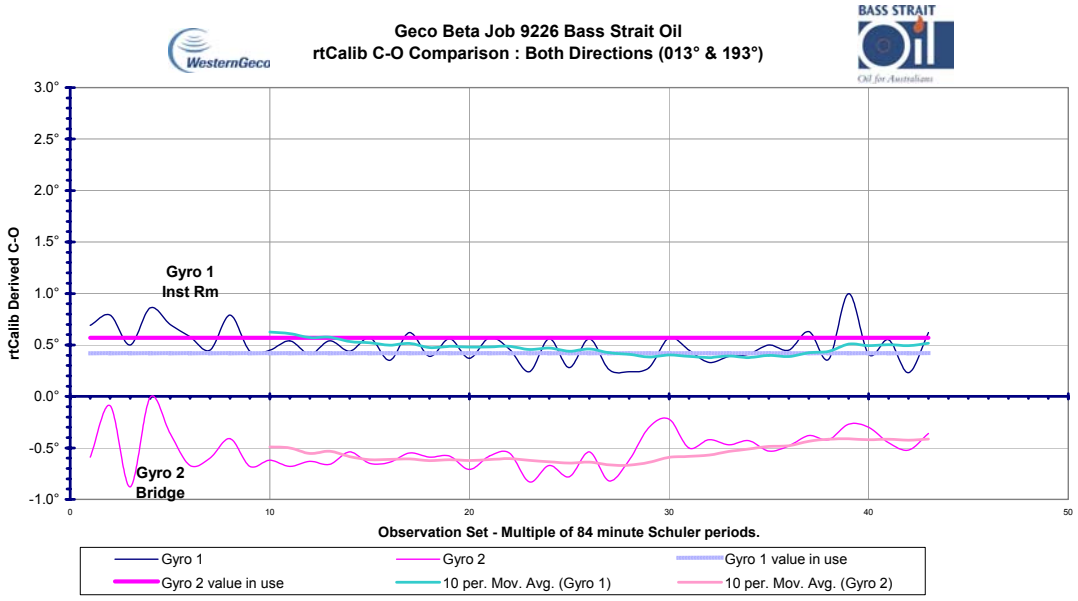
VII. Line by Line Results from RT Calib for Gyros and Integrity Monitor

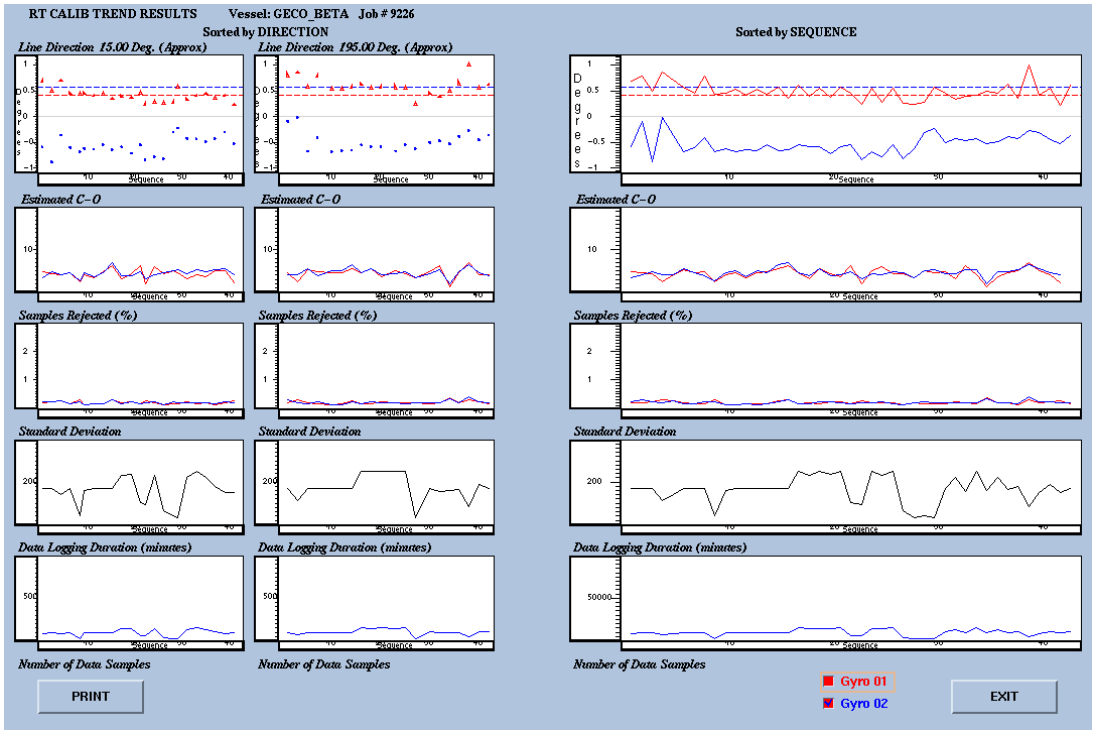
Available Gyros: GY01 Surveydef Corr: 0.42 deg

GY02 Surveydef Corr: 0.65 deg

Gyro Calibration Results:

Line Name	Obs Set	Minutes Used	Start Hdg	End Hdg	Name	C-O [deg]	Std [deg]	No. samp.	Percent Rejected	Name	C-O [deg]	Std [deg]	No. samp	Percent Rejected
VP421216P001	001	168	18	12	GY01	0.69	0.20	8346	4.8	GY02	-0.59	0.25	8346	3.3
VP421008P002	002	168	205	189	GY01	0.79	0.19	9919	4.7	GY02	-0.09	0.31	9919	4.2
VP421232P003	003	168	17	2	GY01	0.50	0.22	9970	4.4	GY02	-0.88	0.23	9970	4.9
VP421024P004	004	113	199	199	GY01	0.86	0.31	6713	2.5	GY02	-0.01	0.19	6713	4.2
VP421248P005	005	140	17	2	GY01	0.70	0.28	8273	4.0	GY02	-0.36	0.28	8273	4.0
VP421024A006	006	168	205	191	GY01	0.58	0.19	9959	5.3	GY02	-0.67	0.17	9959	5.5
VP421200P007	007	168	13	6	GY01	0.45	0.16	9983	4.5	GY02	-0.60	0.15	9983	4.7
VP421040P008	008	168	200	187	GY01	0.79	0.17	9956	4.8	GY02	-0.41	0.25	9956	3.8
VP421184P009	009	041	17	17	GY01	0.44	0.29	2460	2.5	GY02	-0.68	0.25	2460	2.8
VP421184A010	010	161	13	354	GY01	0.45	0.13	9570	4.1	GY02	-0.62	0.14	9569	4.7
VP421056P011	011	168	199	182	GY01	0.54	0.13	9963	4.6	GY02	-0.68	0.12	9963	5.1
VP421168P012	012	168	17	8	GY01	0.41	0.16	9895	3.3	GY02	-0.63	0.16	9895	3.7
VP421072P013	013	168	197	186	GY01	0.54	0.15	9969	4.5	GY02	-0.66	0.12	9969	5.0
VP421264P014	014	168	13	7	GY01	0.44	0.17	9907	4.8	GY02	-0.54	0.15	9905	4.6
VP421088P015	015	168	200	183	GY01	0.57	0.28	9836	5.6	GY02	-0.65	0.22	9836	6.4
VP421280P016	016	168	18	7	GY01	0.35	0.31	9953	6.2	GY02	-0.64	0.29	9953	7.0
VP421104P017	017	252	199	188	GY01	0.62	0.15	14913	4.5	GY02	-0.55	0.15	14913	4.6
VP421296P018	018	231	20	9	GY01	0.39	0.20	13660	3.1	GY02	-0.59	0.17	13660	3.8
VP421120P019	019	252	203	185	GY01	0.56	0.17	14685	5.5	GY02	-0.58	0.22	14685	5.5
VP421312P020	020	236	24	10	GY01	0.37	0.22	13995	4.3	GY02	-0.71	0.24	13995	3.9
VP421120J021	021	252	199	188	GY01	0.57	0.24	14881	3.7	GY02	-0.58	0.21	14878	4.1
VP421328A023	022	104	19	14	GY01	0.46	0.15	6126	6.3	GY02	-0.55	0.16	6126	4.9
VP421344P025	023	093	21	17	GY01	0.24	0.26	5465	2.0	GY02	-0.83	0.21	5465	3.2
VP421152P026	024	249	194	196	GY01	0.56	0.19	14724	5.1	GY02	-0.67	0.18	14724	4.4
VP421360P027	025	230	17	15	GY01	0.28	0.19	13656	6.0	GY02	-0.78	0.22	13656	4.2
VP421152J028	026	252	198	194	GY01	0.56	0.18	14923	4.4	GY02	-0.54	0.16	14923	4.8
VP421216A029	027	063	21	20	GY01	0.26	0.11	3701	4.3	GY02	-0.82	0.13	3701	4.7
VP421072A030	028	034	195	202	GY01	0.24	0.18	2021	3.5	GY02	-0.62	0.19	2021	3.4
VP421184B031	029	041	4	4	GY01	0.28	0.16	2447	5.0	GY02	-0.30	0.24	2447	5.1
VP421328B032	030	030	1	5	GY01	0.57	0.16	1788	4.7	GY02	-0.22	0.21	1788	5.4
VP421520P033	031	170	199	192	GY01	0.45	0.17	10076	4.8	GY02	-0.50	0.20	10076	4.4
VP421376P034	032	220	11	8	GY01	0.33	0.23	13001	3.1	GY02	-0.42	0.21	13001	4.3
VP421504P035	033	156	190	185	GY01	0.39	0.20	9281	6.2	GY02	-0.47	0.18	9281	5.2
VP421376J036	034	252	15	10	GY01	0.41	0.16	14913	4.2	GY02	-0.43	0.20	14913	5.4
VP421488P037	035	161	197	190	GY01	0.50	0.37	9491	1.2	GY02	-0.53	0.33	9491	2.0
VP421376K038	036	224	17	11	GY01	0.45	0.21	13263	3.6	GY02	-0.48	0.18	13263	4.8
VP421472P039	037	164	195	187	GY01	0.63	0.19	9732	4.6	GY02	-0.38	0.21	9732	4.9
VP421392P040	038	178	16	1	GY01	0.36	0.14	10539	5.1	GY02	-0.42	0.17	10531	5.3
VP421456P041	039	083	218	212	GY01	1.00	0.31	4938	6.9	GY02	-0.27	0.40	4938	6.5
VP421408P042	040	149	7	360	GY01	0.41	0.18	8807	5.0	GY02	-0.30	0.22	8813	5.5
VP421456A043	041	188	203	195	GY01	0.55	0.25	11116	4.0	GY02	-0.45	0.22	11116	4.7
VP421424P044	042	150	8	1	GY01	0.23	0.28	8902	2.1	GY02	-0.52	0.20	8903	4.2
VP421440P045	043	170	199	190	GY01	0.62	0.16	10059	4.2	GY02	-0.36	0.20	10059	3.8





GPS Integrity Monitor Results:

- **Results from Onshore Gyro Calibration and GPS Health Check**

Client: **WesternGeco**
Date: **22 July 2002**
Job No.: **3397A4.1**
Location: **Victoria Dock 24, Melbourne**

INTRODUCTION

Surveying services were provided by Thales Geosolutions (Australasia) Limited (Thales) for calibration of two gyrocompasses and confirmation of Differential GPS positioning onboard the Geco Beta for WesternGeco. Services were provided whilst the Geco Beta was moored alongside the Victoria Dock 24, Melbourne 21 July and 22 July 2002.

The results of the checks and calibrations are summarised below:

A. Gyrocompass Calibration Results

Gyrocompass Number 1 C-O	*:*	*+0.0°*
Gyrocompass Number 2 C-O	*:*	*+1.0°*

B. Differential GPS Checks Results

		Observation Set 1	***Observation Set 2***
Thales Multifix3A (Primary Position)	*:*	*0.89m*	*0.72m*
WesternGeco VTRIGPS	*:*	*0.68m*	*0.50m*
VCNAV	*:*	*1.18m*	*1.10m*

C. Control Point for Tailbuoy Check

Datum: WGS84

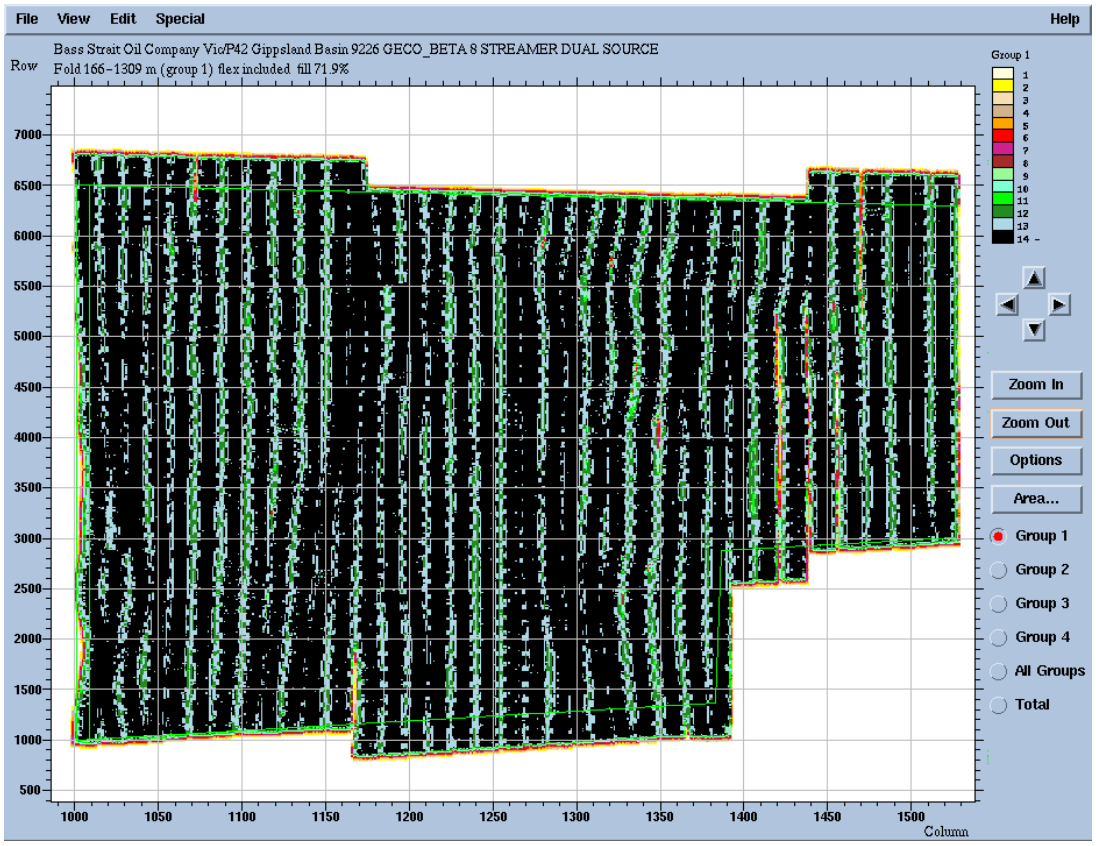
Latitude: *37° 49' 04.480" South*
Longtitude: *144° 55' 42.158" East*

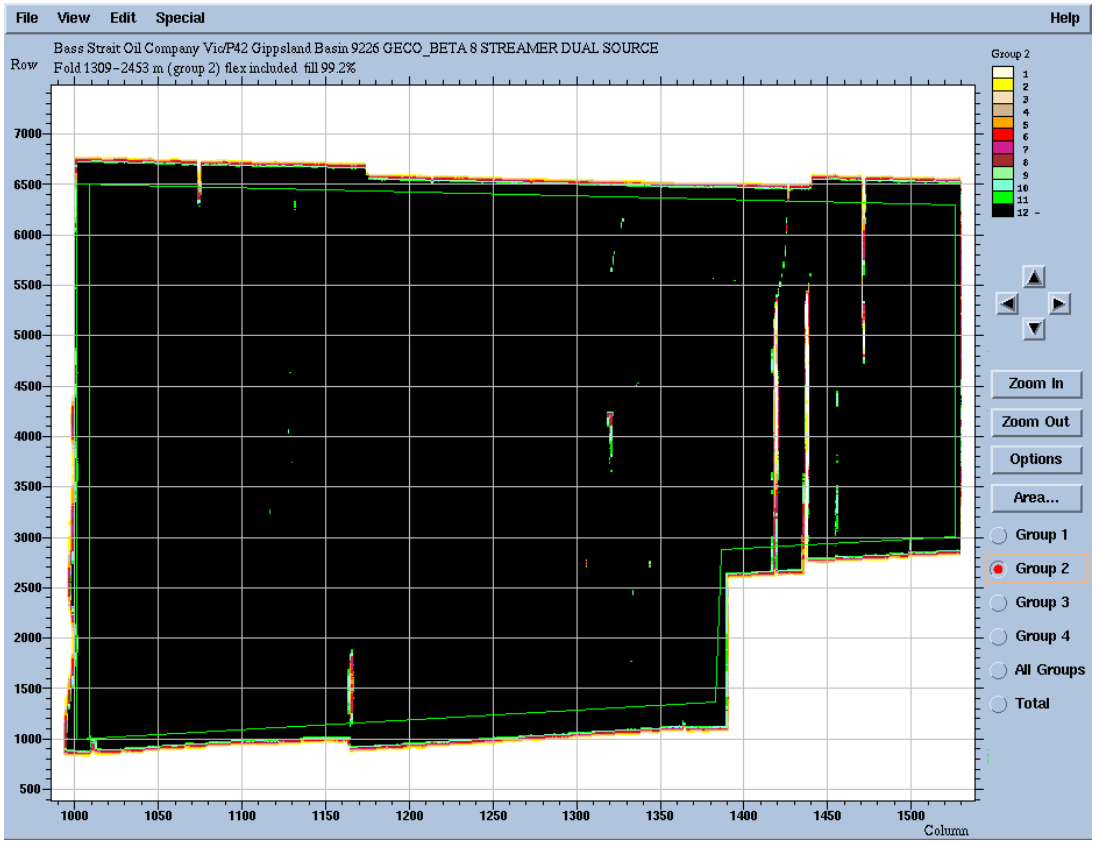
Projection: UTM Zone 55 South, C.M. 147° East

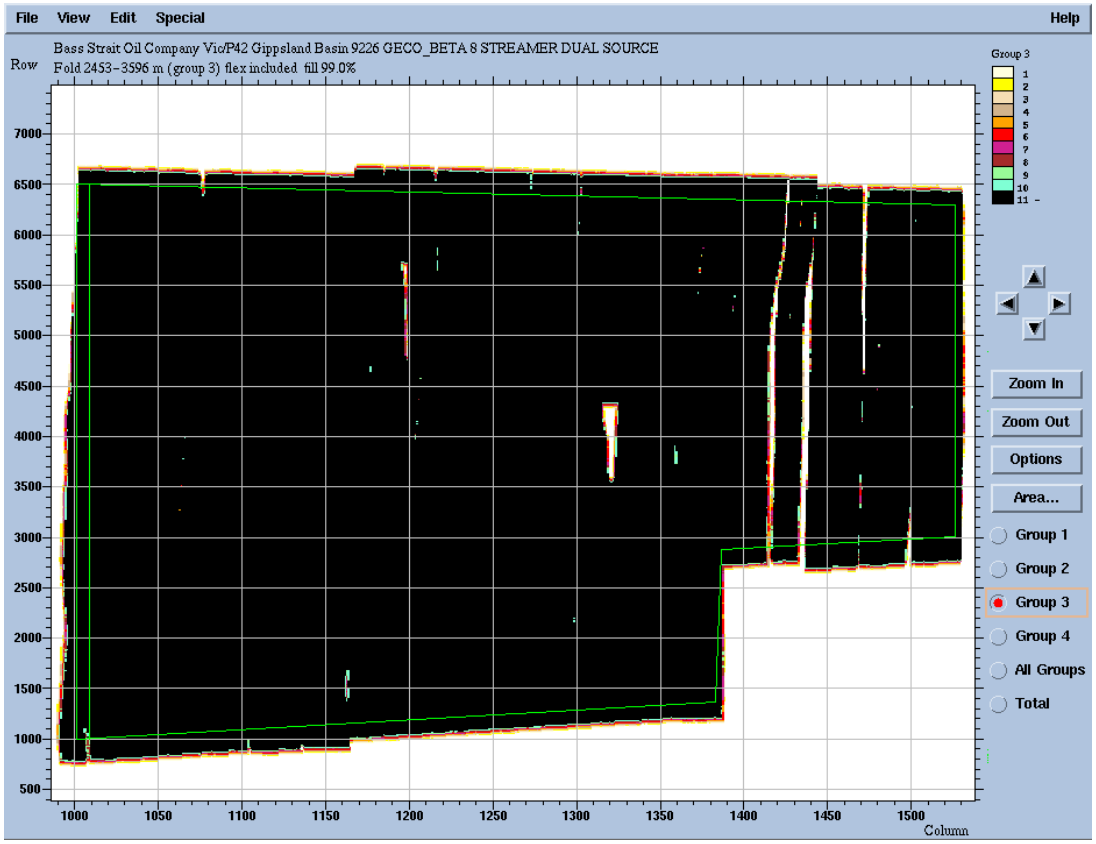
Easting: *317 658.29m*
Northing: *5 812 366.08m*

Exhibit 4 **: Coverage Maps**

Group 1 – 4, total, and all groups flexed




File
View
Edit
Special
Help
Bass Strait Oil Company Vic/P42 Gippsland Basin 9226 GECO_BETA 8 STREAMER DUAL SOURCE
Fold 1309-2453 m (group 2) flex included fill 99.2%
Row
Column
Group 2
Zoom In
Zoom Out
Options
Area...
Group 1
Group 2
Group 3
Group 4
All Groups
Total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View
Edit
Special
Help
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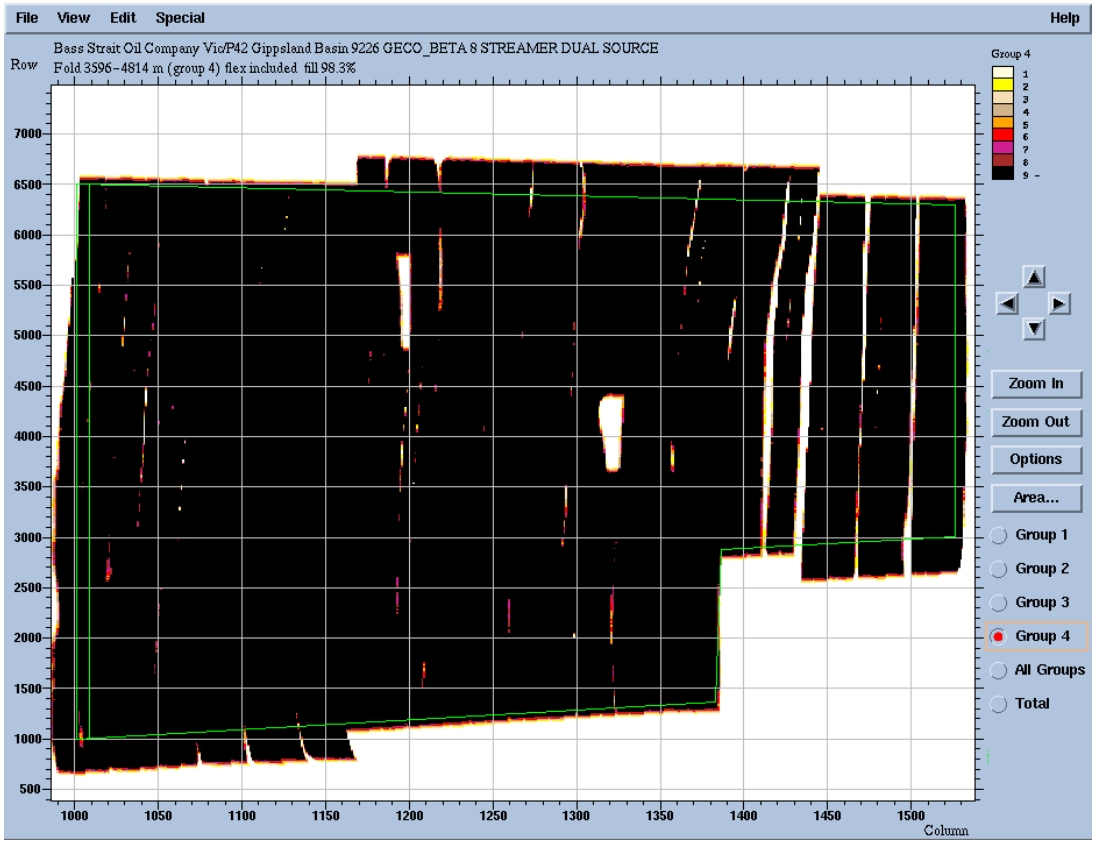
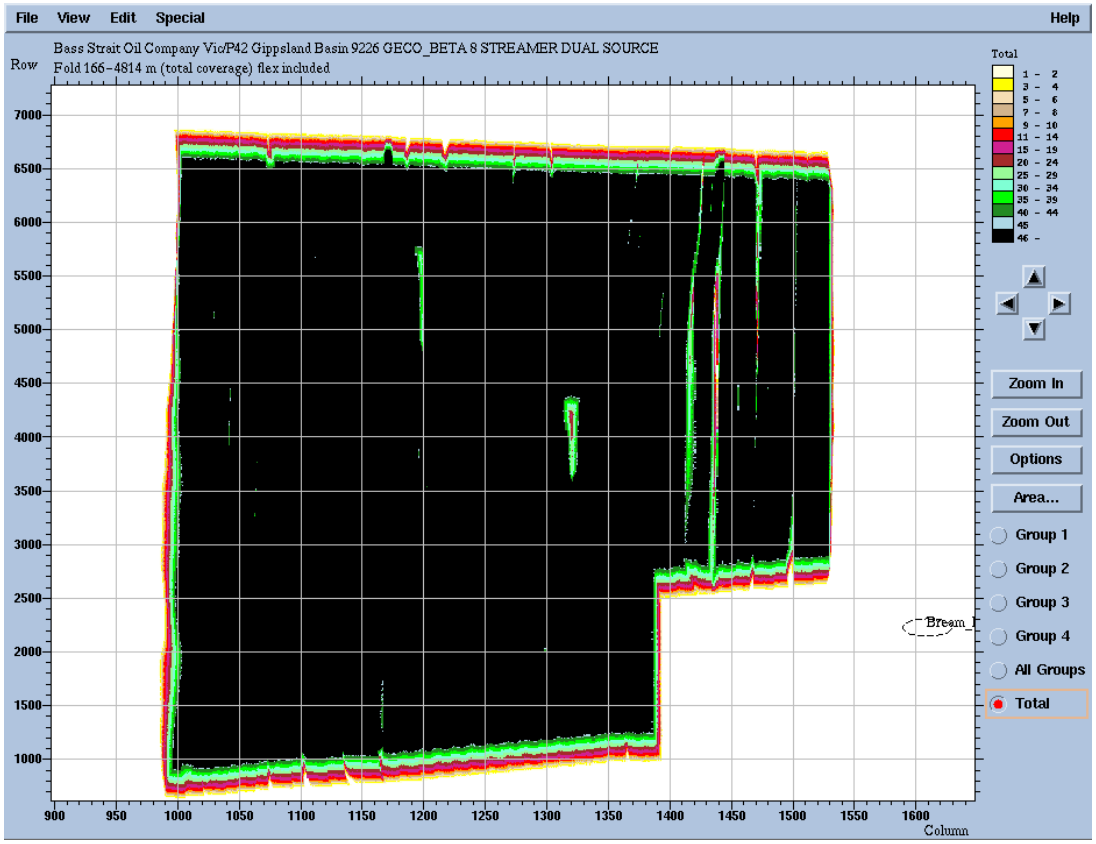
Row
Column
Group 3
Zoom In
Zoom Out
Options
Area...
Group 1
Group 2
Group 3
Group 4
All Groups
Total


File
View
Edit
Special
Help
Bass Strait Oil Company Vic/P42 Gippsland Basin 9226 GECO_BETA 8 STREAMER DUAL SOURCE
Fold 3596-4814 m (group 4) flex included fill 98.3%
Row
Column
Group 4
Zoom In
Zoom Out
Options
Area...
Group 1
Group 2
Group 3
Group 4
All Groups
Total


File
View
Edit
Special
Help
Bass Strait Oil Company Vic/P42 Gippsland Basin 9226 GECO_BETA 8 STREAMER DUAL SOURCE
Fold 166-4814 m (total coverage) flex included
Row
Column
Total
1 - 2
3 - 4
5 - 6
7 - 8
9 - 10
11 - 14
15 - 19
20 - 24
25 - 29
30 - 34
35 - 39
40 - 44
45
46 -
Zoom In
Zoom Out
Options
Area...
Group 1
Group 2
Group 3
Group 4
All Groups
Total
Bream

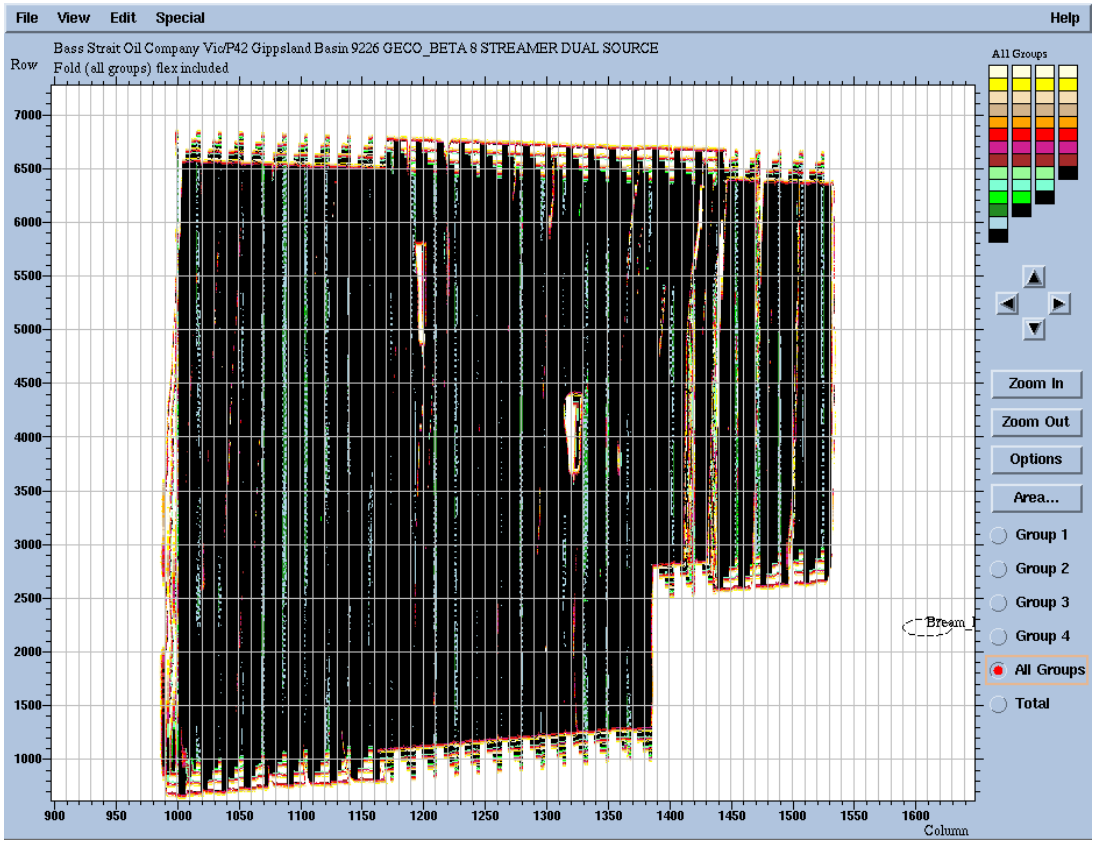
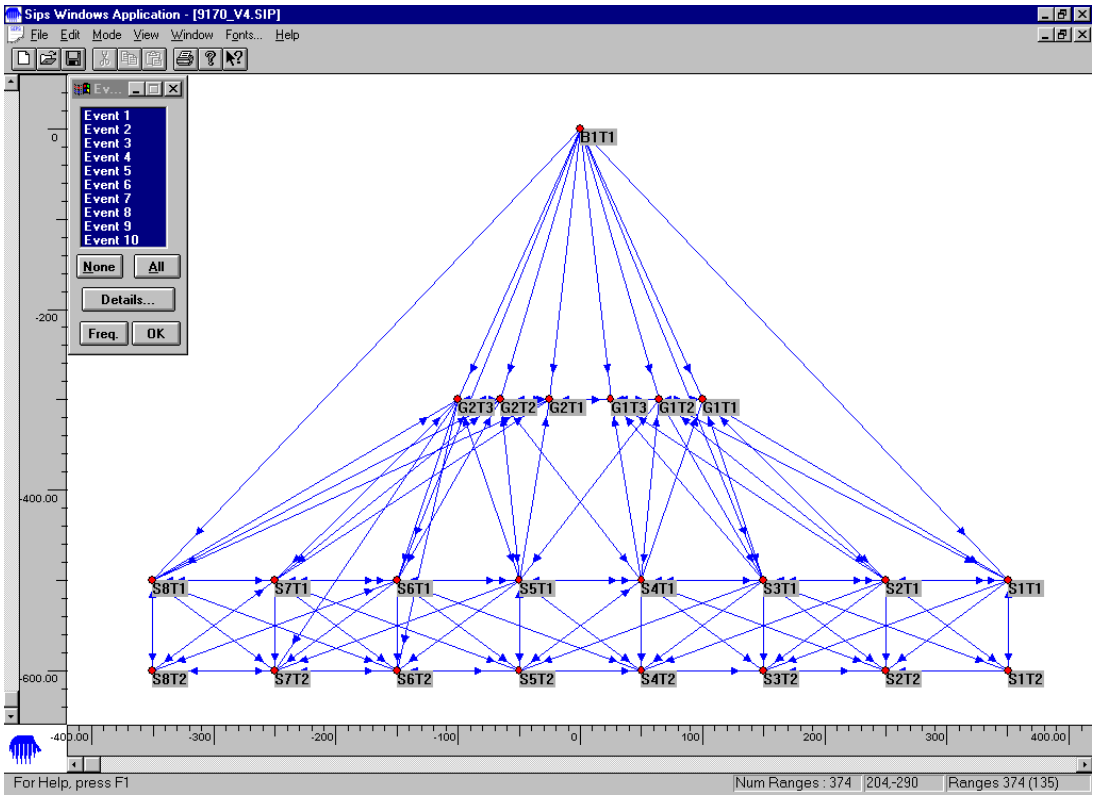
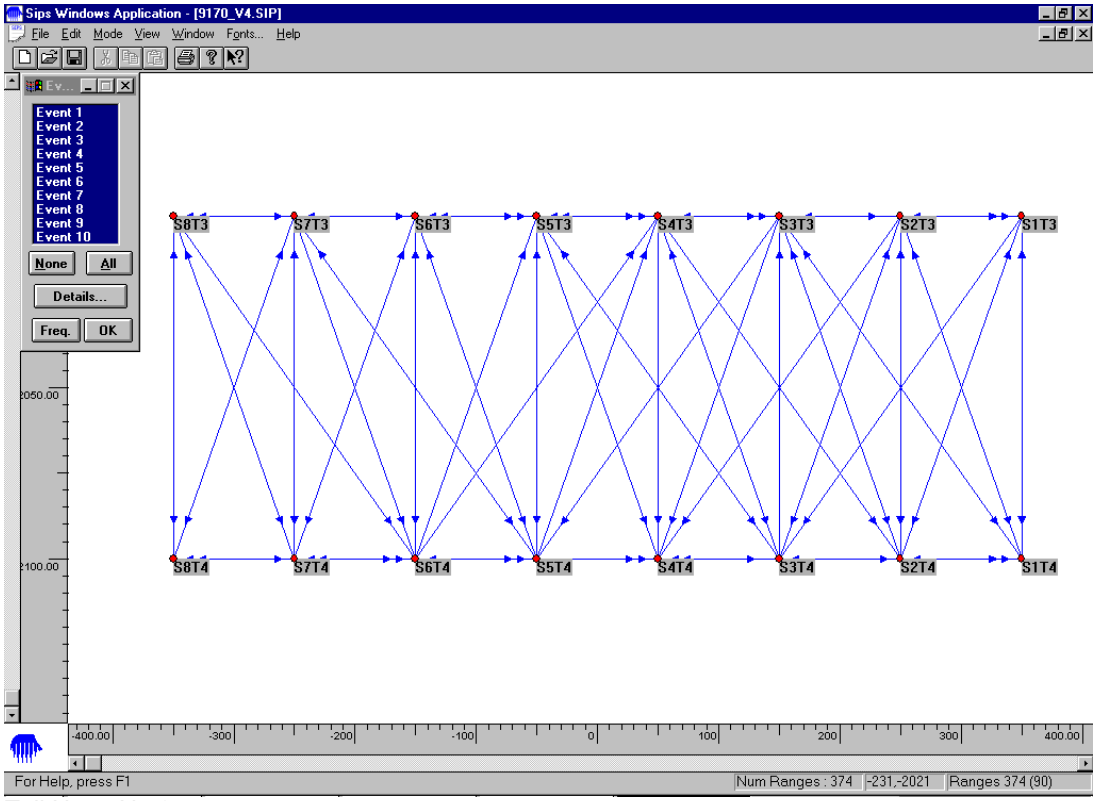


Exhibit 5 **: Acoustic Range System**

Front Net Net1



Mid Net – Net3



Tail Net – Net2

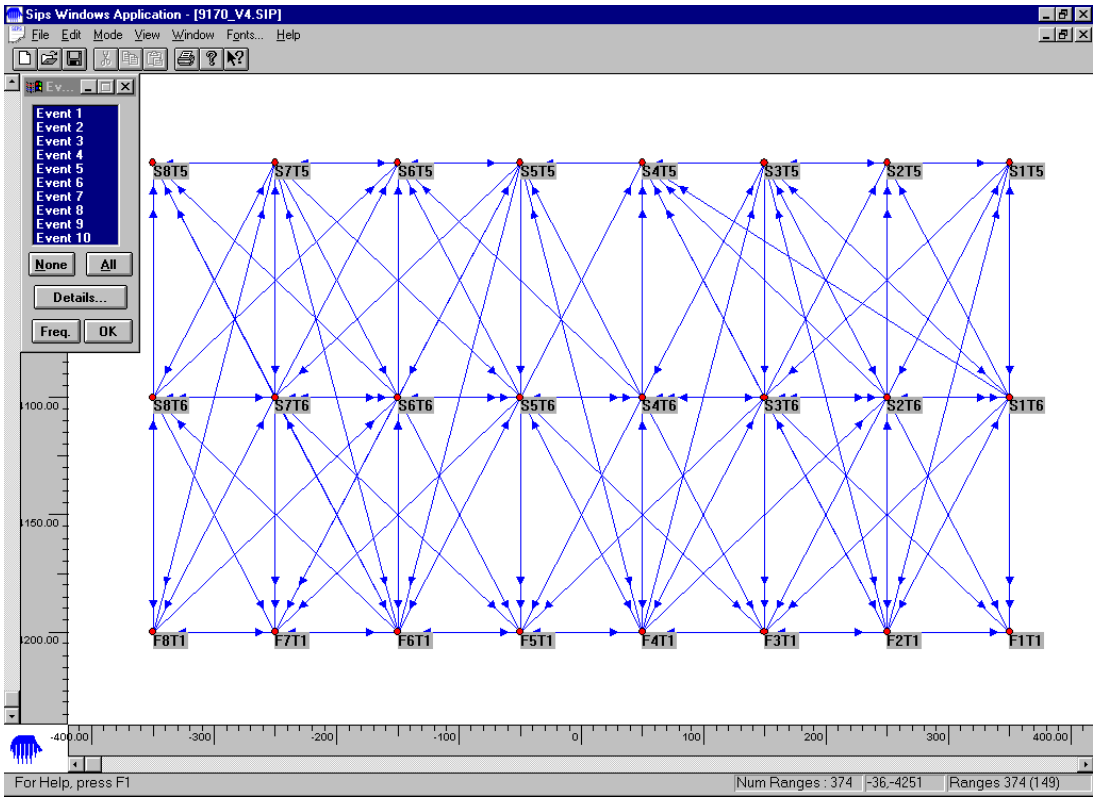
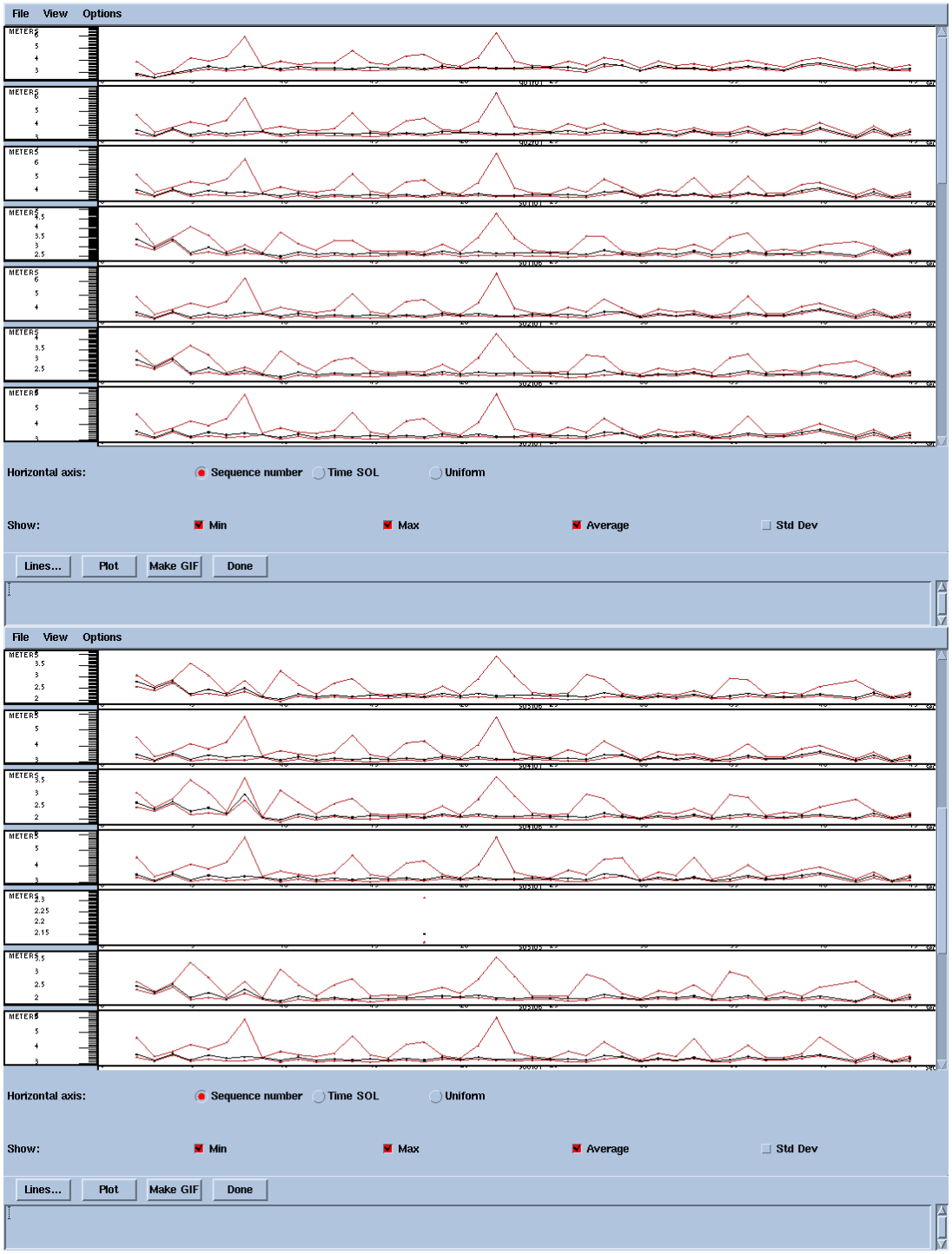

Sips Windows Application - [9170_V4.SIP]
File Edit Mode View Window Fonts... Help
Event 1
Event 2
Event 3
Event 4
Event 5
Event 6
Event 7
Event 8
Event 9
Event 10
None
All
Details...
Freq.
OK
S8T5 S7T5 S6T5 S5T5 S4T5 S3T5 S2T5 S1T5
S8T6 S7T6 S6T6 S5T6 S4T6 S3T6 S2T6 S1T6
F8T1 F7T1 F6T1 F5T1 F4T1 F3T1 F2T1 F1T1
-400.00 -300 -200 -100 0 100 200 300 400.00
For Help, press F1
Num Ranges : 374
-36,-4251
Ranges 374 (149)

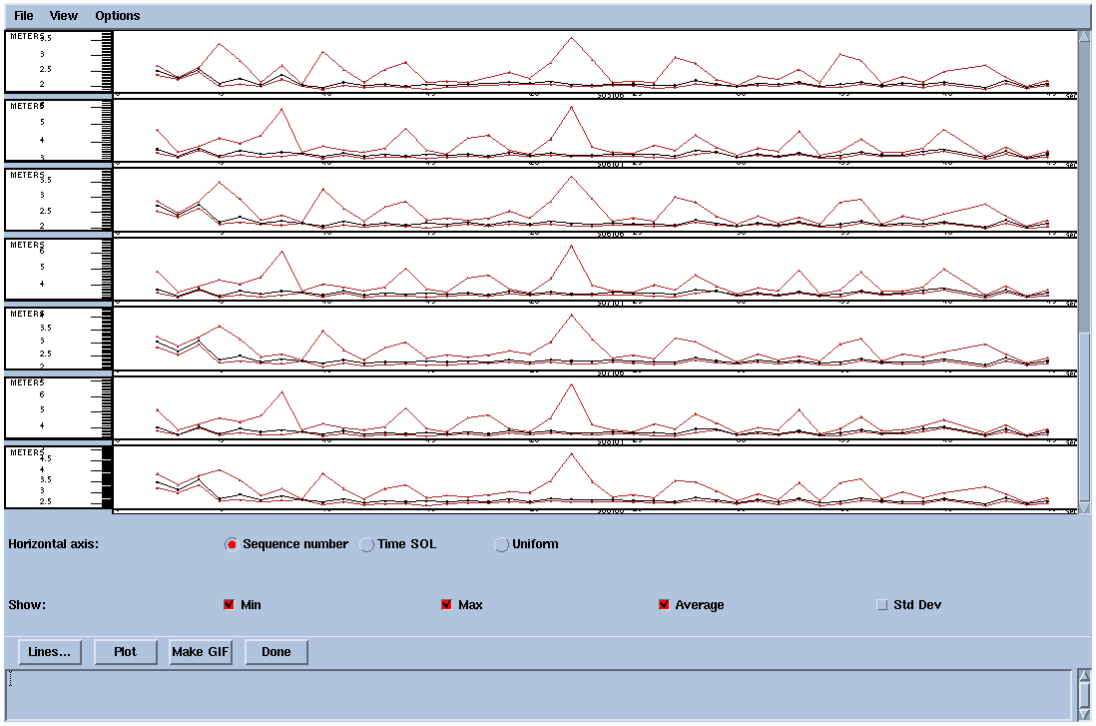
Exhibit 6 : **Survey Definition Changes Summary**

Date	Surdef in use	From Seq	To ***Seq***	Offset ***Database***	Description
27 July 02	mas9226_01	001	004	9226_off01	Start of Survey
29 July 02	mas9226_02	005	007	9226_off01	New BCU S1C7 WAS 12594 NOW 11383 New BCU S6C12 WAS 9402 NOW 18578 New BCU S8C4 WAS 13484 NOW 18016 New F2T1 – s/n was 3451 now 2747 New F8T1 – s/n was 1524 now 1462
29-07-02	mas9226_03	008	008	9226_off01	New SIPS job – Reduced from 9 to 8 Events to decrease Cycle Time
30-07-02	mas9226_04	009	10	9226_off01	New BCU S3C16 WAS 10513 NOW 14390. New pinger S6T6 s/n was 4556 now 2646, new S6T5 s/n was 1527 now 4556, new S4T6 s/n was 1747 now 2156, new S4T5 s/n was 1101 now 1747. new F4T1 s/n was 2524 now 1142.
30-07-02	mas9226_05	011	015	9226_off01	Spare pinger S1T1 s/n 3243 in use. new off-set entered in Surdef New ranges added in SIPS – G1T1 to G1T2. G1T1 to G1T3. G2T3 to G2T2. G2T3 to G2T1
31-07-02	mas9226_06	016	016	9226_off01	FLQC changes.
31-07-02	mas9226_07	017	023	9226_off01	More FLQC changes.
02-08-02	mas9226_08	024	036	9226_off01	New value for speed of sound in water. 1501.54 TS_DIP_02
	mas9226_09	037	45	9226_off01	new S3C17 s/n was 20421 now 12542 new S3C14 s/n was 20157 now 12594
					End of Survey

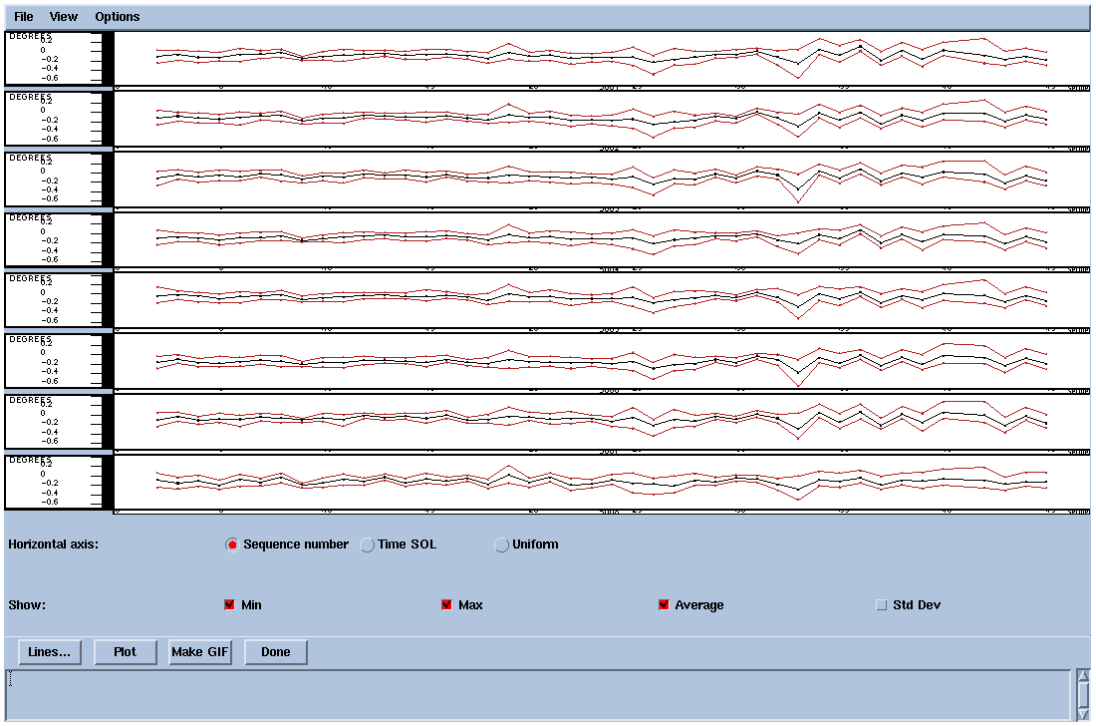
Exhibit 7 : **Trend Analysis**

- **Tracking Node Error Ellipse Semi-major Axis (95%)**

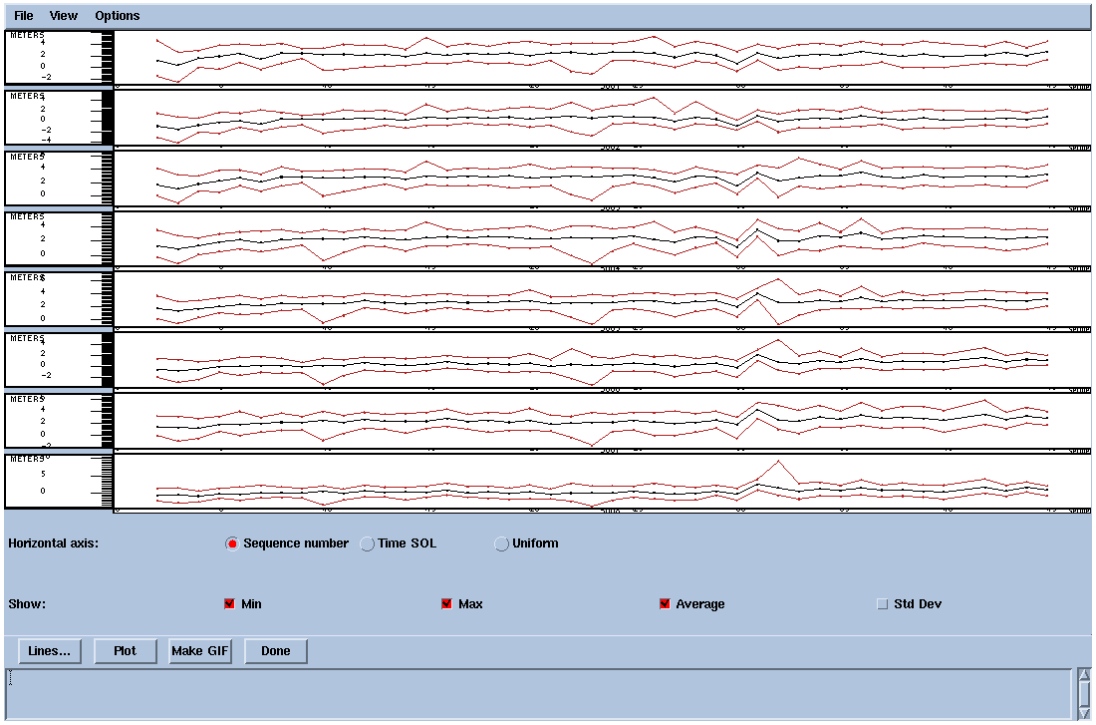




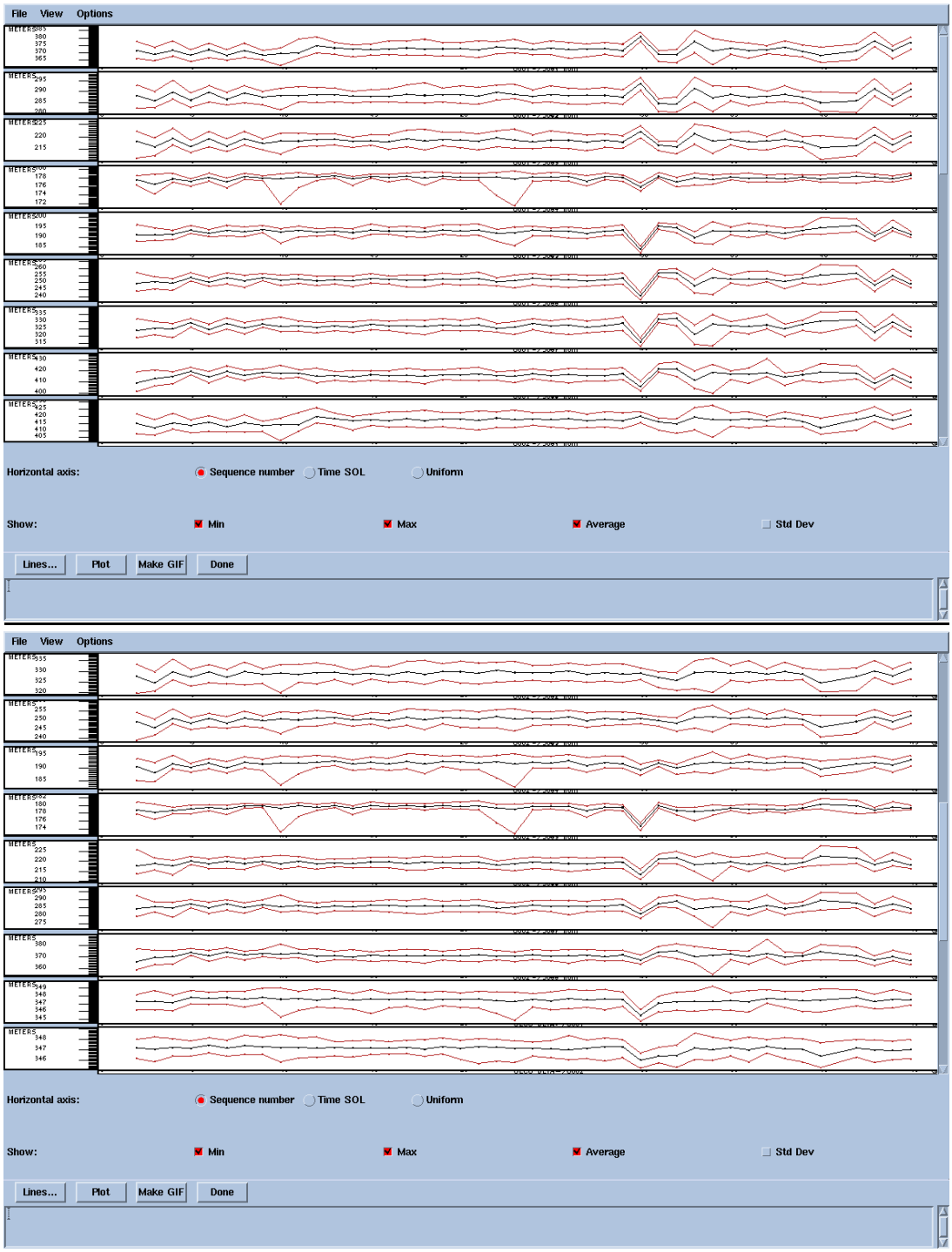
❑ Estimated Rotation Bias

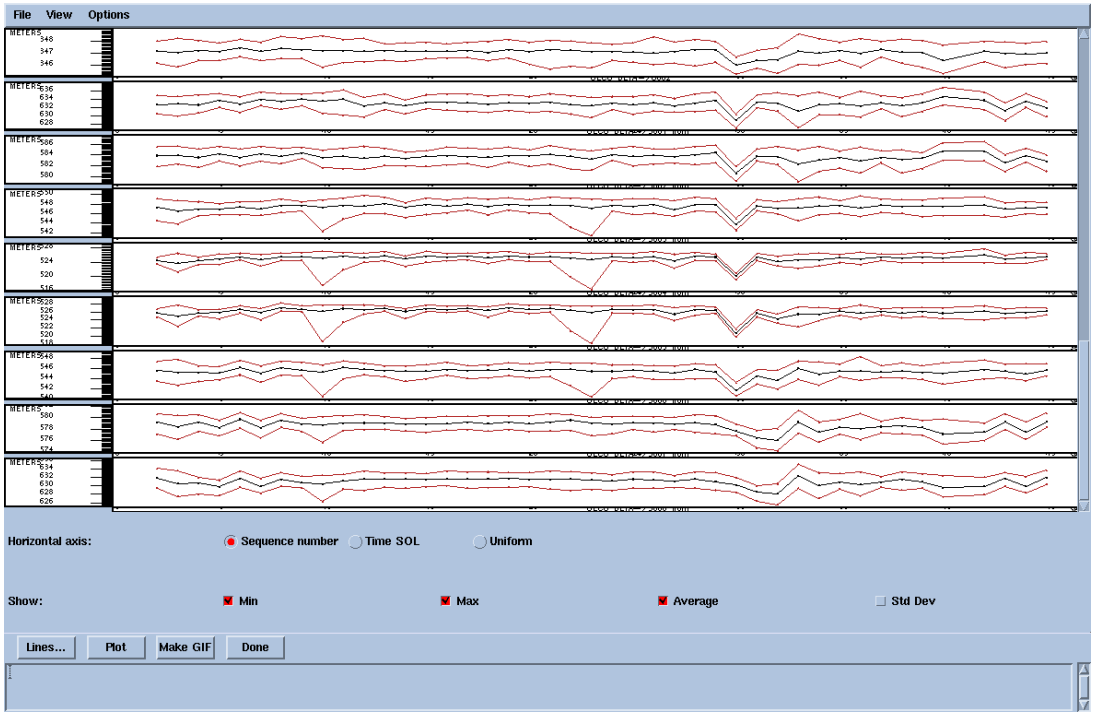


❑ Tail Tracking Node Misclosure Along

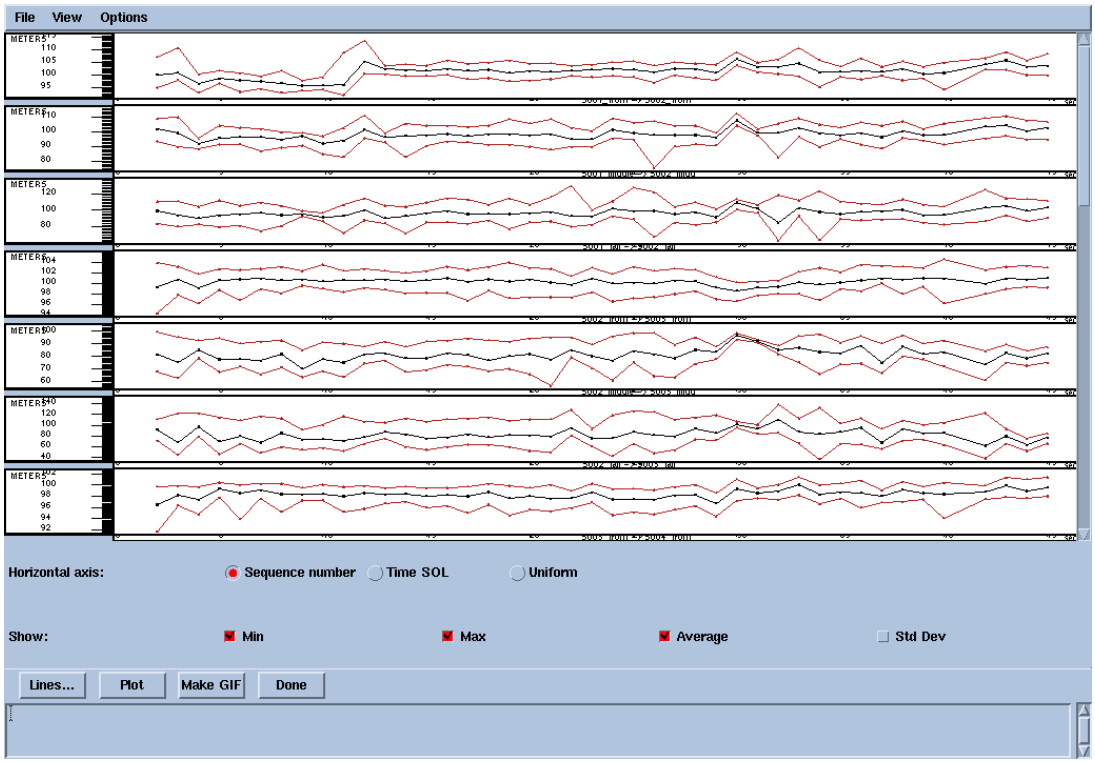


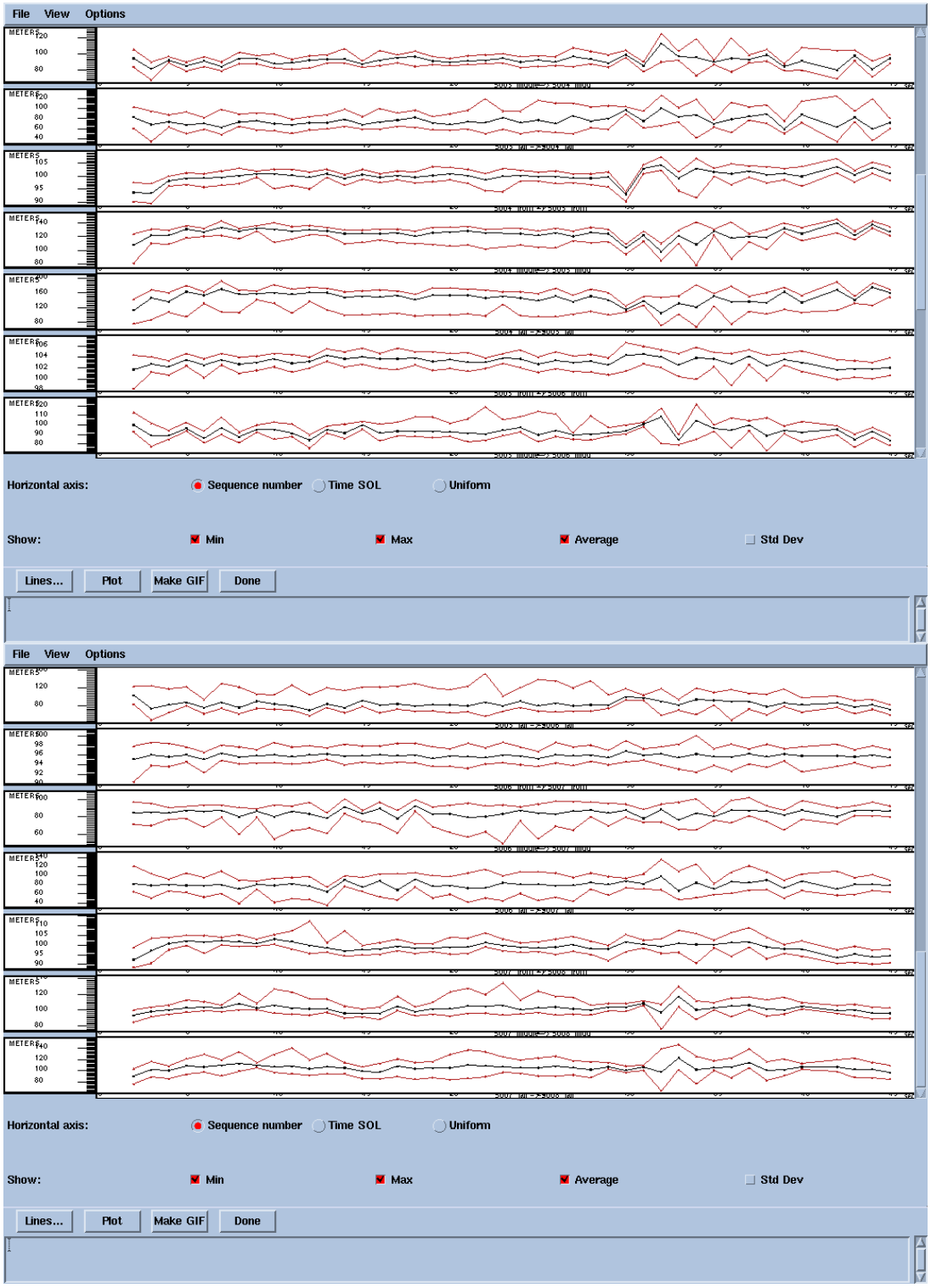
Radial Separation (Vessel to all streamers and sources)


File View Options
Horizontal axis:
Sequence number
Time SOL
Uniform
Show:
Min
Max
Average
Std Dev
Lines...
Plot
Make GIF
Done
File View Options
Horizontal axis:
Sequence number
Time SOL
Uniform
Show:
Min
Max
Average
Std Dev
Lines...
Plot
Make GIF
Done

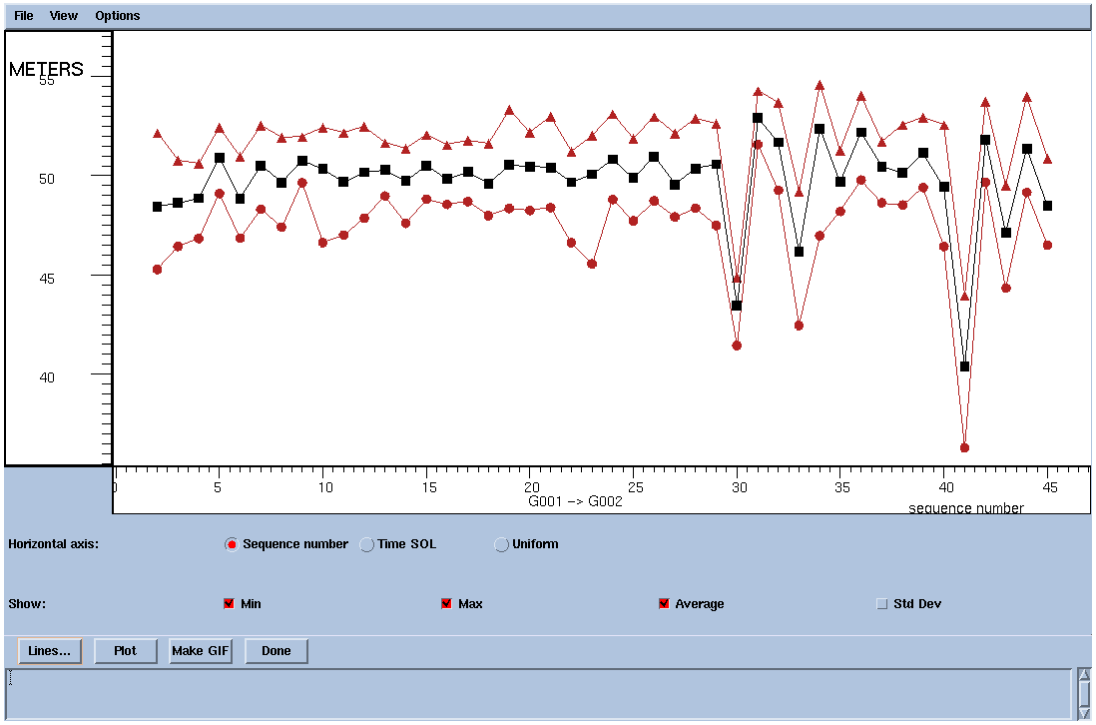


❑ Cross Separation (All streamers to front, middle and tail)

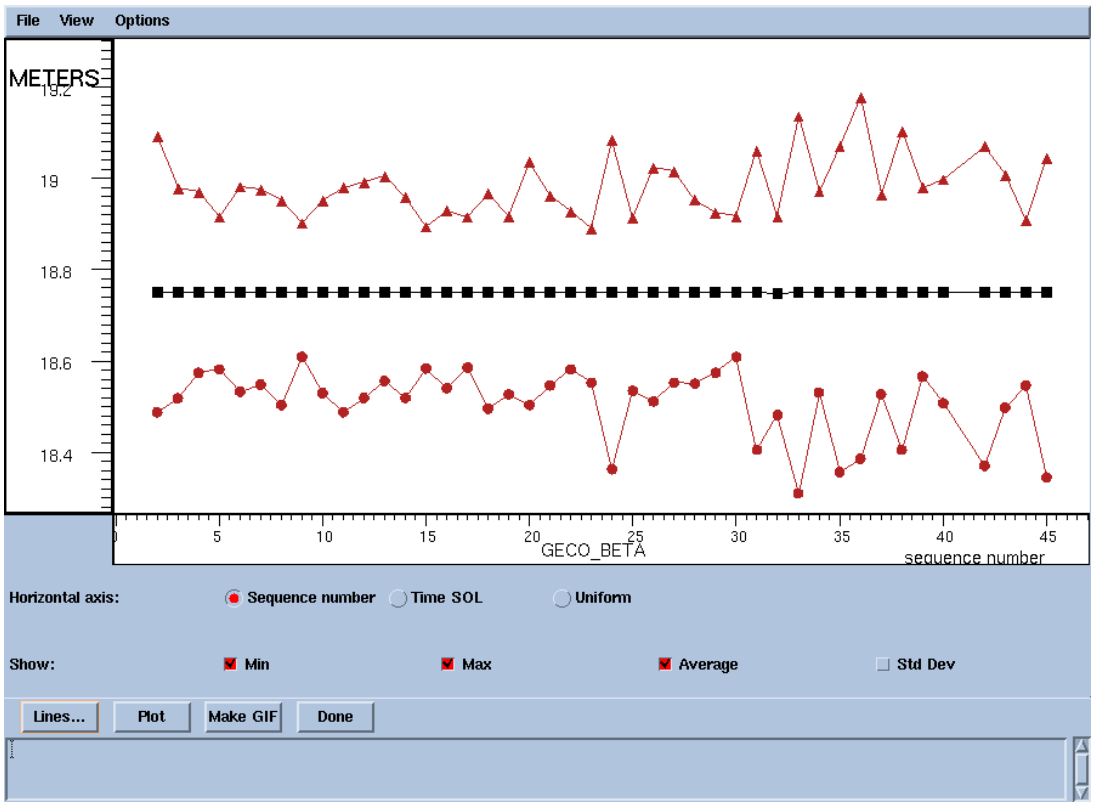




- **Cross Separation (Sources)**



- Shotpoint interval distance



21. Instrumentation and QC System Description

System	Hardware	Software
Recording	Triacq Recording System: SS1000E, 6 CPU's, 60MHz, 1GB RAM.	TRIACQ Version 1.6c
Tape drives	4 IBM 3590 drives.	
Plotter	1 OYO 22" GS-622 Plotter.	
Onboard QC	TQC machine 1 Sun Ultra Enterprise 450: 4 x 300 MHz CPU's, 2GB RAM 16 x 18Gbyte internal hard disks 2 x 36Gbyte internal hard disks TQC Display host 1 Sun Ultra 60 Creator 3D: 2 x 360 MHz CPU's, 1,5GB RAM 2 x 9 GB hard disks 2 Creator3D video cards	TQC Version 2.1
Tape drives	2 x Exabyte drives, 1 CD-ROM drive 2 IBM 3590 drives	
Plotter	1 OYO 22" GS-622 Plotter	
Trilogy Information Manager (TIM)	TIM host 1 Sun Ultra 2: Sun Ultra 2, 2 x 300MHz	TIM Version 1.0
Source Controller	Trisor Gun Controller: Sun Ultra-2, 2 x 300MHz CPU's, 256 MB RAM 2 x 4.2 GB internal hard disks 9 GB external hard disk Exabyte and CD-ROM drives	TRISOR Version 1.5
External Header		Version 8.0
Tension Monitor	STM	Version 4.7
Bird Controller	Triton Bird Controller.	Version 2.8

22. Instrumentation and QC Tests

22.1. Start-up Tests

The daily test was performed on the 29 July 2002; the result showed 23 random traces failed on the noise analysis test.

22.2. Additional Client Tests

There was no additional test performed during this job.

22.3. Daily and Monthly Tests

The daily test will produce 10 files and the Monthly test 28 files.
Abbreviations used for test names in the test sequence tables:

- NA Noise Analysis
- PS Preamplifier Sensitivity
- PR Pulse Response
- CF Cross Feed
- HD Harmonic Distortion
- NC Noise with Calibration line
- CS Current Setting indicates that the current survey definition setting will be used for this parameter.

❑ **Daily Test**

Date	Accepted by Client	Comment
29.7.2002		23 chns. Failed on RMS
31.7.2002		61 chns. Failed on RMS
2.8.2002		6 chns. Failed on RMS, Trc 220 fail THD (file-6) -69dB (spec= -70dB)
3.8.2002		38 chns. Fail on RMS, Trc 220 fail THD (file-6) -69dB (spec= -70dB)
5.8.2002		50 chns. Failed on RMS
7.8.2002		10 chns. Failed on RMS
8.8.2002		44 chns. Failed on RMS

22.4. End of Job Test

❑ **Monthly Test**

Date	NA	PS	PR	CF	HD
8.8.2002	760 & 2576			30 (-84dB) (spec= -85dB)	File 22: 220 (-69 dB (Spec = -70dB)) File 30: 404, 1078 (-63/62 dB (Spec = -64dB))

					File 31: 1078 (-53 dB (Spec = -54dB))

23. QC Products and Processing Sequence

23.1. Online Brute Stack

For each sail line a different source-streamer combination was used to generate a brute stack for one subsurface cmp line. Paper plots of the raw and filtered stacks were produced at the end of the line. Due to unforeseen difficulties with the vessel network at the start of the survey the QC of the first 10 sequences was delayed by approximately 36 hours.

- **Processing sequence:**

Input 1 cmp line per sail line:	368 traces
Data reduction:	Resample to 4ms sample rate
Velocities applied:	Velocity function supplied by Client
Gain recovery:	Spherical divergence correction plus exponential gain of 2.0 dB/s, 0-6000ms
Normal moveout correction	
Pre-stack mute with offset/time pairs:	410,0 425,200 475,300 775,700 3175,2300 4800,3500
Stack Root N scaling:	60 fold
Output:	To disk file

- **Raw Brute Stack**
  - Select every second CMP
  - Constant amplitude scaling
  - Display: Scale 1: 25,000 7 cm/sec

- **AGC Brute Stack**
  - Select every 2nd CMP
  - AGC Scaling, 1000ms window, 500ms move up, output amplitude 0.5
  - Display at 1:25000, 7 cm/sec

23.2. Shots and FK Spectral Analysis

Every shot from the chosen subsurface line was displayed online in the shot and FK domain. This helped to identify noise sources, and to QC data outside the windows used for attribute analysis. The FK analysis was performed over every 41st full raw shot record and the result was output to disk for offline visual inspection in InDA.

23.3. RMS Online Analysis

23.3.1. Ambient RMS Window

An overview of the ambient noise distribution during a line was produced by calculating average RMS values above the first break (from trace 100 to 368 for each streamer) in a time window from 0 to 500 ms.

- **Processing Sequence**

Data Input:	All shots, last 268 traces of each streamer, window 0-500ms
Scaling:	By 1000 to convert amplitudes to microbars.
RMS analysis:	One trace was output for each shot containing the RMS amplitude over the given window for each channel. An average RMS value for each streamer, and for the whole shot, is also calculated. These values are appended to the each trace.
Output:	To Aqua Database
Online display:	Using Pro and ATV display package.

23.3.2. Deep RMS Window

RMS values from the last 500 ms of the record were calculated for every trace, each shot. These values were displayed online for identification of noise sources and noisy traces. Average RMS values for each cable and each shot were also calculated. Applying a bandpass filter prior to the RMS calculation produced filtered shot vs. trace RMS values, which were also stored in the Aqua database and displayed in Pro.

- **Processing Sequence**

Data Input:	All shots, all channels, window 5500-6000 ms.
Scaling:	By 1000 to convert amplitudes to microbars.
RMS Analysis:	One trace was output for each shot containing the RMS amplitude over the window for each channel.
Output:	To Aqua Database.
Online display:	Using Pro and ATV display package.
Bandpass Filter:	5 - 60 Hz
RMS analysis:	One trace was output for each shot containing the RMS amplitude over the given window for each channel, for each filter band.
Output:	To Aqua Database.
Online display:	Using Pro and ATV display package.

23.4. Navigation QC Displays

Near trace data from all streamers and both sources (all combinations) were displayed and annotated with direct arrival times calculated from processed navigation offsets at the end of each line. This allowed direct comparison of recorded and calculated direct arrival times and acted as navigation QC prior to the production of the near trace cube.

- **Processing sequence:**

Store near traces online:	Based on common offset.
Merge seismic data with processed navigation data:	Use the centre-source to centre-first-group range from the navigation data to calculate a theoretical time for the direct arrival using a water velocity of 1500 m/s.

Display:	Window 150 - 250 ms (outer streamers) 100 - 200 ms (mid streamers) 60 – 160 ms (inner streamers) Horizontal scale 10 traces/cm, Vertical scale 20 cm/sec

23.5. Attributes, Online Analysis

23.5.1. Header Information

The seismic header information for every shot was transferred to Triacq QC Aqua Database. The following Header attributes were used for online QC:

• Streamer depth:	Min, mean and max value for each streamer
• Water depth:	
• Parity error count:	For each streamer
• Gyro Heading of the Vessel:	
• Individual Gun timing errors:	For both sources
• Individual Gun depths:	For both sources, all arrays
• Gun manifold pressure:	
• RMS source comparison:	Average RMS of first 15 traces of inner streamers for each source.
• Average RMS of all streamers:	Split into frequencies, high, mid, low, and total background noise, and ambient noise
• Average RMS values:	For individual streamers

Values were displayed versus shot point online, and GIF files were posted on the SuperVision web site for QC and archiving purposes.

23.6. Seismic Cubes

All cubes are referenced to the following grid origin (center cell 1,1):

X = 618348.7165
Y = 5752865.8908

23.6.1. Near Trace Cube

Near traces from each streamer were collected online to produce a near trace cube. The seismic and navigation data were merged with the near traces after final navigation data was available. The x / y source and receiver positions were written to the trace headers. This information was then used to grid the near traces and assign true offsets for each near trace.

A velocity function provided by the Client was used for NMO correction over the entire cube. The main purpose of this QC tool was to check for erroneous positioning. Some slight shifts at the water bottom can be seen but these are attributed to the fact that no tidal statics were applied.

- **Parameters**

Inlines	: 980 - 1550	Incr: 1
Crosslines	: 850 - 3000	Incr: 1
Cell Size	: 25.00 x 18.75	
Rotation	: 600285600	
Data Input	: Based on common radial offset 400 – 440 m	
Data Length	: 2000ms	
Sample Rate	: 2ms	

Inlines were equivalent to CMP lines, and crosslines were equivalent to shot point number.

- **Processing Sequence**

Input - Edit bad traces:	Input traces. (as above)
Merge with processed navigation data:	Merge based on time of day
NMO:	Using supplied velocity function.
Scale:	Data independent scaling
Output:	Data written to Charisma cube.

24. Data Quality / Observations

24.1. Quality Control Summary

The RMS values, shot and External Header data were displayed online versus shot point using the Pro display tool. The RMS and shot attribute displays, when used in conjunction with the online brute-stack and the RMS shot versus trace display allowed rapid and accurate delineation of noise types and their associated effects on data quality.

The RMS values, shot and SSE attributes and the External Header data could also be viewed in an areal sense, using the ATV display tool. This method of displaying the data was very useful for visualizing trends in both the in-line and cross-line directions.

The predominant noise types during the survey were swell-noise, and occasional monowing wash. The majority of data acquired, however, suffered from very little interference from external noise.

24.1.1. Noise Types Encountered

- **Swell Noise**

Low frequency, high amplitude swell noise was the most common type of noise encountered.

- **Monowing Wash**

Monowing wash was observed on some sequences, but usually only affected a range of about 25 shots and between 50 and 100 traces per streamer, and mainly on the outer

streamers i.e. streamers 1,2 & 7,8. The affected traces were logged and placed as warnings in the Acquisition Report.

The noise from monowing wash was generally high amplitude but low frequency (less than 10hz). Associated with this was the loss of depth control in the same area. If a bird changed depth by more than 3 metres, for more than 5 consecutive shots, traces before and after the particular bird were marked as an edit.

- **Cable bend noise**

Several SOL noise records contained cable bend noise in the last half of the streamer. This because the SOL noise tests were run around 1.5km prior to line start – when the cables were sometime still partially bent due to tight line changes. After line start however the cables had straightened with no bend noise affecting the data.

24.1.2. Observation on the QC Products

The Raw RMS areal map showed all external noise events, and was used as the basis for the noise analysis of the survey. All the noise events observed in this map are catalogued in Table 1. See Acquisition Reports for further details.

Table 1: noise events observed in raw RMS areal-map

Seq name	*Type of noise observed*
020	Monowing wash
021	Monowing wash
022	Monowing wash
023	Monowing wash
027	Monowing wash
028	Monowing wash
030	Slight swell noise
031	Moderate swell noise
032	Moderate swell noise
033	Moderate swell noise decreasing along line
034	Mild swell noise
035	Mild swell noise
036	Mild swell noise, monowing wash
038	Monowing wash
042	Moderate swell noise
044	Very slight swell noise

24.2. Instrument Summary

NESSIE 3/4 Streamer and Triacq recording

Faulty channels due to spiking, noise, weak or dead were annotated in the individual Acquisition Reports. These traces however were few and condition of the streamer was quite good.

Types of noise appearing on individual line sequences were noted down on the observer logs. Summaries were listed on the data quality assurance section.

TRISOR Source

The dual trisor source performed well. Generally the gun timing was well within the specified ± 1.0ms. Necessary source repairs and maintenances were carried out at regular intervals.