

**GYRO CALIBRATION/ DGPS/TAILBUOY SYSTEM'S
VERIFICATION ON MV PACIFIC TITAN AT LOYANG JETTY,
SINGAPORE ON 6 & 11 FEBRUARY, 2008**

FOR : CGG/VERITAS

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Report Title:

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Report No: AB-V-RP-00936	File Ref: MV Pacific Titan Main Report

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1. INTRODUCTION

Subsea 7 (Singapore) Pte Ltd was appointed by CGG Veritas to carry out the following services for their vessel, MV Pacific Titan at Loyang Jetty, Singapore on 6 & 11 February, 2008:

- Gyro Calibration
- DGPS System's Verification
- Tail Buoy System's Verification

The results are summarized as follow:

a) Gyro Calibration – 6 February 2008

Heading @ 134 deg		
System	C-O	Std Dev
Gyro AD 100	0.27 deg	0.05
Gyro HS 50	1.40 deg	0.35

b) DGPS System's verification – 6 February 2008

System	Easting		Northing	
	C-O	Std Dev	C-O	Std Dev
SPM1 XP	-0.57	0.05	-0.16	0.05
SPM2 HP	1.29	0.11	-0.14	0.05

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c) DGPS' System's verification (re-carried out) – 11 Feb 2008

System	Easting		Northing	
	C-O	Std Dev	C-O	Std Dev
DG_V_XP_EXP	-0.48	0.03	0.26	0.04
SPM1_XP	-0.31	0.02	-0.06	0.01
SPM1_HP	0.47	0.05	-0.30	0.05
SPM2_XP	-0.50	0.05	0.28	0.05
SPM2_HP	1.26	0.09	-0.23	0.06

d) Tailbuoy System's verification – 6 Feb 2008

TB SERIAL #	Easting		Northing	
	C-O	Std Dev	C-O	Std Dev
1314	-0.70	0.73	-2.70	0.65
1411	-2.72	2.10	-0.27	1.34
2320	-1.67	1.13	-0.67	0.93
0869	-1.04	1.20	-0.17	0.93
1511	-1.23	1.49	-1.04	1.53
1320	-2.61	1.12	1.22	1.08

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2. PROJECT DETAILS

Client : CGG Veritas – Asia Pacific
9 Serangoon North Ave. 5
CGGVeritas Hub
Singapore 554531
Tel: +65 6723 5630
Fax: +65 6723 5552
Cell: +65 9186 3619

Contractor : Subsea 7 (Singapore) Pte Ltd
No 39 Tampines Street 92,
#02-00 2E Capital Building
Singapore 528883
Tel (Direct): +(65)-6785 4396 (Ext. 101)
Tel (Mobile): +(65)-9146 1432 and
+(60) 12 7238452
Fax: +(65)-6260 4465

Project : Gyro Calibration
DGPS System's Verification
Tail Buoy System's Verification

Vessel : MV Pacific Titan

Location : Laying Jetty, Singapore

Equipment : Nikon DTM-552 Total station

Personnel : Rolando Paguio (Surveyor)
Rostam Rosli

Date : 6 & 11 February 2008

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3. SURVEY PROCEDURES

Survey origin at Loyang Jetty, Singapore

Three geodetic control stations were established on 21 December 2006 by Subsea7 (Singapore) Pte Ltd for the purpose of carrying out survey works for the vessel berthed at Loyang Jetty, Singapore . The stations are:

Station	Easting	Northing	EL	Description
S1	385 112.540	152 940.435	4.694	nail
S2	385 104.607	152 963.277	4.714	nail
S3	385 082.549	153 024.532	4.676	nail

These stations were identified on the ground and their relative bearings and distances were checked prior to usage.

Current Survey

For this calibration, temporary stations TS1 and TS2 were established. TS1 was used as instrument station for carrying out DGPS/Tail Buoy system's verification while TS2 was used as instrument station for Gyro calibration on 6th Feb 2008. Coordinates of stations TS1 and TS2 are as follow:

Station	Easting	Northing
TS1	385 108.610	152 951.442
TS2	385 105.024	152 959.150

Calibration Preliminaries

Prior to the calibration, the following were carried out:

- All mooring lines were tightened
- There was no heavy loading on the vessel
- The surveyor's time piece was synchronized with the vessel computer time
- All C-O were removed from the vessel's computers (i.e. logged raw data only)
- Advised the navigators to log onto the correct differential stations
- Advised the navigators to monitor the vessel's data when calibration is on-going

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3.1 PRISM INSTALLATION

On 6th February 2008, the vessel's heading was 250°. At this direction, Gyro calibration, DGPS/Tail Buoy system's verification were carried out.

For gyro calibration, the bow and stern reflector was set up at the foremost part of the bow and stern of the vessel. Reflectors were also set up at SPM1 XP and SPM2 HP antennas for DGPS system's verification.

3.2 CALIBRATION/VERIFICATION PROCEDURES

Gyro Calibration

For Gyro calibration at 250° heading, total station was set up at temporary station TS2, and S3 was used as reference station. Grid bearings and horizontal distances were observed to the reflectors set up at the bow and stern of the vessel.

Simultaneously, a 3-second interval readings were being logged from the vessel's gyro while observations from total station were being carried out.

DGPS System's Verification

The total station was set up at temporary station TS1, and S3 was used as reference station. Grid bearings and horizontal distances were observed to the prism set up at SPM1 XP and SPM2 HP antennas.

3-second interval readings were then logged from the vessel while observations from total station were being carried out.

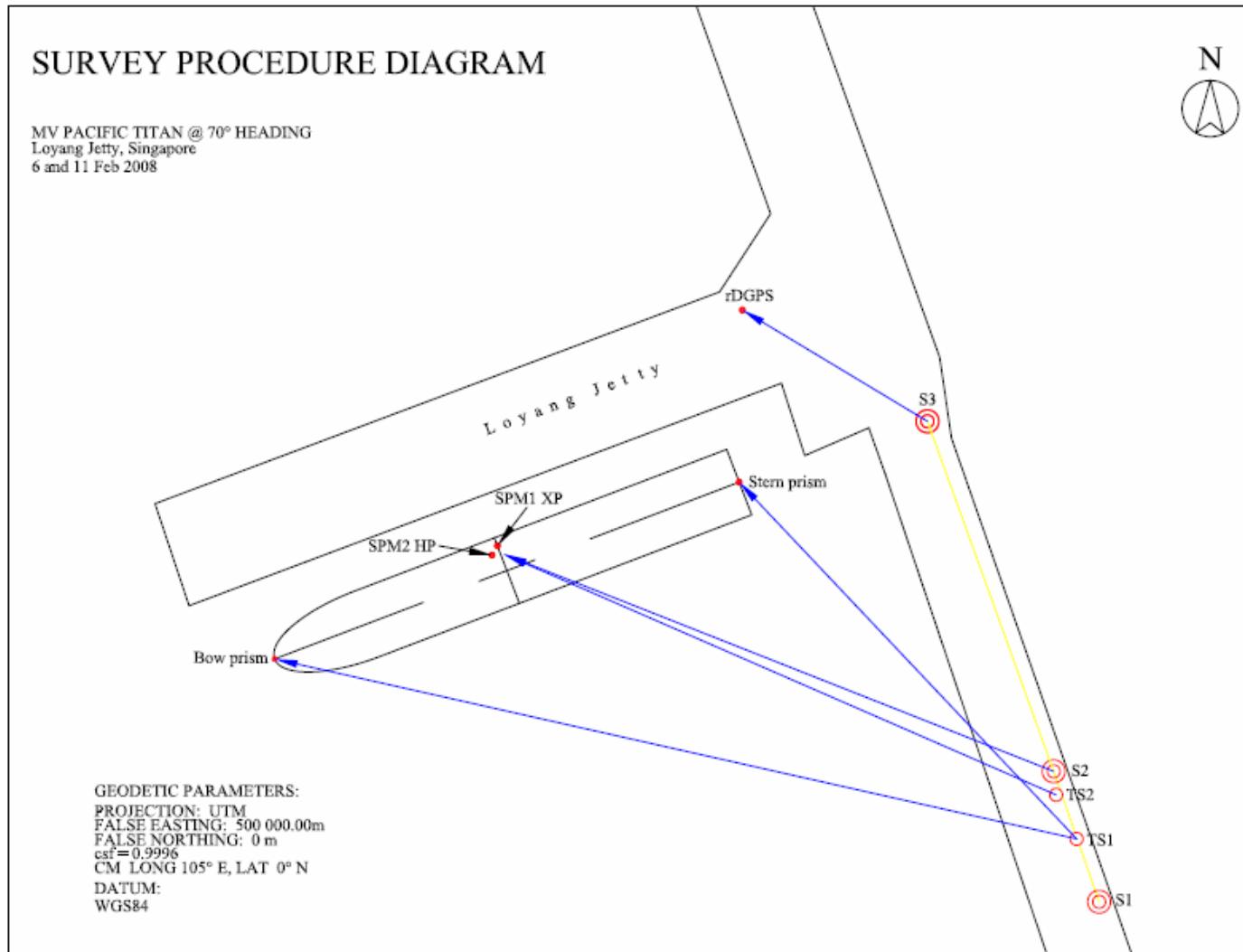
On 11th of February 2008, DGPS systems verifications were re-carried out. Same procedure was applied, but observations were done at different instrument station and reference bearing such as S2 and S3. Positions from XP EXP, SPM1 XP, SPM1 HP, SPM2 XP and SPM2 HP were simultaneously logged from the vessel while reflectors set up at DGPS antennas were being observed.

Tailbuoy System's Verification

Tail Buoy system's verification was carried out simultaneously with the DGPS verification. A known position was established using total station and from this position, 6 x rDGPS pods were set up and ranges and bearings relative to SPM1 XP antenna were logged at 3-second interval.

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3.3 SURVEY PROCEDURE DIAGRAM @ 250° HEADING



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4. GEODETIC PARAMETERS

The survey work was computed based on the following geodetic and projection system.

Geodetic Reference System

Datum	WGS 84
Spheroid	WGS 84
Semi-major axis	6 378 137.0000 metres
Semi-minor axis	6 356 752.3142 metres
Inverse flattening	298.257 223 563 metres
Eccentricity	0.006 694 380

Projection Parameters

Grid	Universal Transverse Mercator (UTM)
Projection type	Transverse Mercator
Central Meridian	105° E
Latitude of origin	0° (Equator)
False Easting	500 000 metres
False Northing	0 metres
Scale factor on CM	0.9996

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5. RESULTS

Gyro Calibration

The grid bearings derived from the observation of bow and stern reflectors were converted to true bearings. These were then compared with the ship's print out for AD 100 and HS 50 gyros to obtain the C-O corrections for 250° heading of the vessel.

The convergence at Station TS2 and S3 was computed to be minus 0.03 deg.
True Bearing = Grid Bearing Minus 0.03 °

All observed distances were converted to grid distances. The scale factor used was 0.9998798.

DGPS System's Verification

The observed grid bearings and distances from the reflectors set up at DGPS antennas were converted to easting and northing. These computed coordinates were then compared to the vessel's XP EXP, SPM1 XP, SPM1 HP, SPM2 XP and SPM2 HP easting and northing print outs to derive the C-O corrections.

Tailbuoy System's Verification

The observed ranges and bearings relative to SPM1 XP antenna were converted to easting and northing. The mean coordinates of each rDGPS pod were then compared to known established position to derive the C-O corrections for easting and northing.

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5.1 GYRO CALIBRATION @ 250° HEADING – MV PACIFIC TITAN

GYRO CALIBRATION SHEET														
Date of Calibration:	06-Feb-07	Location:	LOYANG JETTY, SINGAPORE											
Vessel:	PACIFIC TITAN													
Client :	CGG VERITAS													
Model and Serial No.														
At heading :	250°													
for Bow														
Inst. Station :	TS2	E =	385105.024	N =	152959.150									
R.O. station :	S3	E =	385082.549	N =	153024.532									
Inst. to R.O : Ref. bearing (Grid) =	341.029641	deg	=	341	1	47	(d m s)							
Convergence (Grid to True) :	-0.03	deg												
Note : RO was set to Zero instead of bearing														
OBSERVATION DATA														
No.		06-Feb-07 (UTC)		Bearing (Grid)		Dist.		Bearing (Grid)		Dist.		Obs. Gyro Hdg (T)		
		d	m	s	(m)	d	m	s	(m)	deg	deg	AD 100	HS 50	
1	07:37:40	303	33	11	118.65	331	39	18	76.35	249.3	248.1	1	384990.19	
2	07:41:39	303	32	15	118.65	331	39	47	76.36	249.3	247.8	2	384990.19	
3	07:42:53	303	32	29	118.64	331	39	44	76.36	249.3	248.3	3	384990.20	
4	07:46:36	303	31	58	118.64	331	39	26	76.36	249.3	247.7	4	384990.20	
6	07:46:27	303	32	0	118.63	331	40	4	76.36	249.3	248.6	6	384990.20	
7	07:53:01	303	32	15	118.62	331	40	21	76.36	249.2	247.5	7	384990.20	
8	07:55:20	303	32	5	118.61	331	40	52	76.37	249.2	247.7	8	384990.20	
9	07:56:45	303	31	35	118.61	331	41	1	76.37	249.2	248.1	5	384990.22	
10	07:58:01	303	31	36	118.61	331	41	1	76.37	249.1	248.5	10	384990.22	
11	07:59:00	303	31	39	118.60	331	40	38	76.37	249.1	248.2	6	384990.23	
12	08:00:00	303	31	39	118.60	331	40	11	76.37	249.1	248.2	12	384990.23	
13	08:00:30	303	31	16	118.60	331	40	11	76.37	249.1	248.1	7	384990.22	
14	08:01:33	303	31	24	118.59	331	40	3	76.37	249.1	247.5	14	384990.23	
15	08:02:30	303	31	12	118.60	331	40	44	76.37	249.1	248.2	8	384990.23	
16	08:03:45	303	31	11	118.60	331	40	7	76.37	249.1	247.5	16	384990.23	
17	08:04:30	303	31	1	118.60	331	40	8	76.37	249.1	247.9	9	384990.23	
18	08:07:20	303	31	13	118.59	331	40	46	76.37	249.1	248.1	18	384990.24	
19	08:07:34	303	31	13	118.59	331	40	45	76.37	249.1	248.6	10	384990.24	
20	08:09:04	303	30	48	118.58	331	40	47	76.37	249.1	248.3	20	384990.24	
21	08:09:44	303	31	8	118.59	331	40	42	76.38	249.1	248.5	11	384990.24	
22	08:10:45	303	30	51	118.58	331	40	42	76.37	249.1	247.7	22	384990.24	
23	08:11:22	303	30	26	118.58	331	40	56	76.37	249.1	247.7	12	384990.24	

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5.2 DGPS SYSTEM'S VERIFICATION (6TH FEBRUARY 2008) – MV PACIFIC TITAN

DGPS SYSTEM VERIFICATION SHEET																														
Date of Calibration:	06-Feb-07		Location:		LOYANG JETTY, SINGAPORE																									
Vessel:	PACIFIC TITAN		Client:		CGG VERITAS																									
Inst. station:	T81	E =	385108.610	Note: RO was set to Zero	N =	152951.442																								
R.O. station:	S3	E =	385082.549																											
Inst. to R.O.: Ref. bearing (Grid) =	340° 37.57783 deg																													
	= 340° 22' 33" (d m s)																													
OBSERVATION DATA																														
TOTAL STATION OBSERVATION																														
To PRSM target																														
SPM1 XP																														
No.	Time (UTC)	Bearing (grid)	d	m	s	Dist. (m)	E	N	Observed	Logged on Vsl	E	N	Observed	Logged on Vsl	E	N	de	dn												
2	03:43:05	319	44	19	106.20	385016.75	153004.72	385017.26	153004.79	-0.51	-0.07	385016.10	153003.38	385014.93	153003.58	1.17	-0.19													
3	03:43:16	319	44	2	106.21	385016.73	153004.72	385017.26	153004.79	-0.53	-0.07	385016.08	153003.38	385014.93	153003.58	1.16	-0.20													
4	03:43:30	319	44	21	106.21	385016.73	153004.73	385017.26	153004.79	-0.53	-0.06	385016.08	153003.39	385014.93	153003.58	1.16	-0.18													
5	03:43:40	319	44	9	106.21	385016.74	153004.72	385017.26	153004.90	-0.53	-0.18	385016.09	153003.38	385014.93	153003.58	1.16	-0.19													
6	03:43:52	319	43	46	106.20	385016.73	153004.71	385017.26	153004.79	-0.53	-0.08	385016.08	153003.37	385014.93	153003.47	1.16	-0.10													
7	03:44:05	319	44	21	106.21	385016.74	153004.73	385017.26	153004.90	-0.53	-0.17	385016.09	153003.39	385014.93	153003.58	1.16	-0.19													
8	03:44:23	319	43	56	106.21	385016.73	153004.72	385017.26	153004.79	-0.53	-0.07	385016.08	153003.38	385014.93	153003.58	1.16	-0.20													
9	03:44:39	319	44	14	106.21	385016.74	153004.73	385017.26	153004.79	-0.53	-0.07	385016.09	153003.39	385014.93	153003.58	1.16	-0.19													
10	03:44:53	319	43	58	106.20	385016.74	153004.72	385017.26	153004.79	-0.53	-0.08	385016.09	153003.38	385014.93	153003.58	1.16	-0.20													
11	03:45:07	319	44	27	106.21	385016.74	153004.73	385017.26	153004.90	-0.53	-0.17	385016.09	153003.39	385014.93	153003.58	1.16	-0.18													
12	03:45:17	319	44	1	106.21	385016.73	153004.72	385017.26	153004.90	-0.53	-0.18	385016.08	153003.38	385014.81	153003.58	1.27	-0.20													
13	03:45:28	319	44	4	106.21	385016.73	153004.72	385017.26	153004.79	-0.53	-0.07	385016.08	153003.38	385014.81	153003.58	1.27	-0.19													
14	03:45:39	319	44	3	106.21	385016.73	153004.72	385017.26	153004.90	-0.53	-0.18	385016.08	153003.38	385014.93	153003.47	1.15	-0.08													
15	03:45:49	319	43	57	106.21	385016.73	153004.72	385017.26	153004.90	-0.53	-0.07	385016.08	153003.38	385014.93	153003.58	1.16	-0.20													
16	03:45:59	319	44	9	106.20	385016.74	153004.72	385017.37	153004.90	-0.63	-0.18	385016.09	153003.38	385014.93	153003.47	1.17	-0.09													
17	03:46:07	319	44	2	106.21	385016.73	153004.72	385017.26	153004.79	-0.64	-0.18	385016.08	153003.38	385014.93	153003.58	1.15	-0.19													
18	03:46:19	319	44	6	106.21	385016.73	153004.72	385017.26	153004.79	-0.53	-0.07	385016.08	153003.38	385014.81	153003.47	1.27	-0.08													
19	03:46:30	319	44	9	106.21	385016.73	153004.73	385017.26	153004.79	-0.53	-0.18	385016.08	153003.39	385014.81	153003.47	1.27	-0.08													
20	03:46:43	319	44	17	106.21	385016.73	153004.73	385017.37	153004.90	-0.64	-0.17	385016.08	153003.39	385014.81	153003.58	1.27	-0.19													
21	03:46:53	319	44	6	106.21	385016.73	153004.72	385017.26	153004.90	-0.53	-0.18	385016.08	153003.38	385014.81	153003.47	1.27	-0.08													
22	03:47:05	319	44	5	106.21	385016.73	153004.72	385017.26	153004.79	-0.53	-0.07	385016.08	153003.38	385014.81	153003.47	1.27	-0.08													
23	03:47:16	319	44	2	106.21	385016.73	153004.72	385017.37	153004.90	-0.64	-0.18	385016.08	153003.38	385014.81	153003.58	1.27	-0.20													
24	03:47:29	319	43	45	106.21	385016.73	153004.71	385017.26	153004.90	-0.53	-0.19	385016.08	153003.37	385014.81	153003.58	1.26	-0.20													
25	03:47:39	319	44	3	106.20	385016.74	153004.72	385017.26	153004.75	-0.52	-0.07	385016.08	153003.38	385014.81	153003.47	1.27	-0.09													
26	03:47:49	319	44	2	106.21	385016.73	153004.72	385017.26	153004.90	-0.53	-0.18	385016.08	153003.38	385014.81	153003.58	1.27	-0.20													
27	03:47:59	319	43	44	106.21	385016.73	153004.72	385017.26	153004.90	-0.54	-0.19	385016.07	153003.38	385014.81	153003.58	1.26	-0.20													
28	03:48:09	319	43	34	106.21	385016.73	153004.71	385017.26	153004.90	-0.54	-0.20	385016.07	153003.37	385014.81	153003.58	1.26	-0.21													
29	03:48:19	319	43	54	106.20	385016.74	153004.71	385017.37	153004.90	-0.64	-0.19	385016.09	153003.37	385014.81	153003.58	1.27	-0.20													
30	03:48:29	319	43	5	106.21	385016.72	153004.72	385017.26	153004.90	-0.55	-0.21	385016.07	153003.36	385014.81	153003.58	1.25	-0.22													
31	03:48:41	319	43	53	106.20	385016.74	153004.71	385017.26	153004.90	-0.52	-0.19	385016.09	153003.37	385014.81	153003.58	1.27	-0.20													
32	03:48:55	319	43	55	106.20	385016.74	153004.71	385017.26	153004.90	-0.52	-0.19	385016.09	153003.37	385014.81	153003.58	1.26	-0.20													
33	03:49:05	319	43	42	106.20	385016.73	153004.71	385017.26	153004.90	-0.53	-0.19	385016.08	153003.37	385014.81	153003.47	1.27	-0.10													
34	03:49:15	319	43	47	106.21	385016.74	153004.72	385017.37	153004.90	-0.64	-0.19	385016.08	153003.37	385014.81	153003.47	1.27	-0.09													
35	03:49:27	319	43	56	106.20	385016.74	153004.72	385017.37	153004.90	-0.64	-0.19	385016.09	153003.38	385014.81	153003.58	1.27	-0.20													
36	03:49:37	319	43	53	106.20	385016.74	153004.71	385017.37	153004.90	-0.64	-0.19	385016.09	153003.37	385014.81	153003.58	1.27	-0.20													
37	03:49:48	319	43	45	106.20	385016.74	153004.71	385017.37	153004.90	-0.64	-0.19	385016.09	153003.37	385014.81	153003.47	1.27	-0.10													
38	03:49:58	319	43	37	106.20	385016.73	153004.71	385017.37	153004.90	-0.64	-0.20	385016.08	153003.38	385014.81	153003.58	1.27	-0.21													
39	03:50:08	319	43	58	106.19	385016.74	153004.71	385017.37	153004.90	-0.63	-0.19	385016.09	153003.37	385014.70	153003.47	1.39	-0.09													
40	03:50:18	319	43	39	106.20	385016.73	153004.71	385017.37	153004.90	-0.64	-0.20	385016.08	153003.37	385014.70	153003.47	1.38	-0.10													
41	03:50:29	319	43	36	106.20	385016.74	153004.71	385017.37	153004.90	-0.64	-0.20	385016.08	153003.37	385014.70	153003.47	1.38	-0.10													
42	03:50:51	319	43	5	106.20	385016.72	153004.69	385017.26	153004.90	-0.65	-0.21	385016.07	153003.35	385014.70	153003.47	1.37	-0.11													
43	03:51:04	319	43	34	106.20	385016.73	153004.71	385017.26	153004.90	-0.64	-0.20	385016.07	153003.37	385014.70	153003.47	1.38	-0.10													
44	03:51:16	319	43	29	106.21	385016.73	153004.71	385017.26	153004.90	-0.54	-0.20	385016.																		

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5.3 DGPS SYSTEM'S VERIFICATION (11TH FEBRUARY 2008) – MV PACIFIC TITAN

DGPS SYSTEM VERIFICATION SHEET																							
Date of Calibration:	11-Feb-07																						
Location:	LOYANG JETTY, SINGAPORE																						
Vessel:	PACIFIC TITAN																						
Client :	CGG VERITAS																						
Inst. station :	S2	E =	385104.607																				
Note: RO was set to Zero		N =	152963.277																				
R.O. station :	S3	E =	385082.549																				
		N =	153024.532																				
Inst. to R.O.: Ref. bearing (Grid) =	340.1958999	deg																					
	= 340° 11' 46" (d m s)																						
OBSERVATION DATA																							
TOTAL STATION OBSERVATION																							
To PRISM target																							
No.	Time (UTC)	Bearing (grid)	Dist. (m)	Observed	Logged on Vsl	Observed	Logged on Vsl	Observed	Logged on Vsl	Observed	Logged on Vsl	Observed	Logged on Vsl	RESULTS									
		d	m	s	E	N	E	N	E	N	E	N	E	RESULTS									
1	06:00:22	314	28	41	97.13	385016.34	153003.83	385016.93	153003.58	-0.58	0.25	385016.34	153003.83	385015.04	153003.98	1.31	-0.16	385016.34	153003.83	385016.93	153003.58	-0.58	0.25
2	06:00:56	314	28	4	97.13	385016.34	153003.81	385016.82	153003.58	-0.48	0.23	385016.34	153003.81	385015.04	153003.98	1.30	-0.18	385016.34	153003.81	385016.93	153003.58	-0.59	0.23
3	06:01:29	314	28	31	97.13	385016.34	153003.82	385016.93	153003.58	-0.58	0.24	385016.34	153003.82	385015.04	153003.98	1.31	-0.16	385016.34	153003.82	385016.93	153003.47	-0.58	0.35
4	06:01:38	314	28	29	97.13	385016.34	153003.82	385016.82	153003.58	-0.47	0.24	385016.34	153003.82	385015.04	153003.98	1.31	-0.16	385016.34	153003.82	385016.93	153003.58	-0.58	0.24
5	06:02:22	314	28	43	97.13	385016.35	153003.83	385016.82	153003.58	-0.47	0.25	385016.35	153003.83	385015.04	153003.98	1.31	-0.16	385016.35	153003.83	385016.82	153003.58	-0.47	0.25
6	06:02:31	314	28	41	97.13	385016.35	153003.82	385016.82	153003.58	-0.47	0.25	385016.35	153003.82	385015.04	153004.09	1.31	-0.27	385016.35	153003.82	385016.82	153003.58	-0.47	0.25
7	06:03:37	314	28	3	97.13	385016.33	153003.81	385016.82	153003.58	-0.48	0.23	385016.33	153003.81	385015.04	153003.98	1.30	-0.17	385016.33	153003.81	385016.82	153003.58	-0.48	0.23
8	06:03:46	314	28	34	97.13	385016.35	153003.82	385016.82	153003.58	-0.47	0.24	385016.35	153003.82	385015.04	153003.98	1.31	-0.16	385016.35	153003.82	385016.82	153003.58	-0.47	0.24
9	06:04:29	314	28	34	97.13	385016.34	153003.82	385016.82	153003.58	-0.47	0.24	385016.34	153003.82	385015.04	153003.98	1.31	-0.16	385016.34	153003.82	385016.93	153003.58	-0.58	0.24
10	06:04:46	314	28	4	97.13	385016.34	153003.81	385016.82	153003.58	-0.48	0.23	385016.34	153003.81	385015.04	153003.98	1.30	-0.18	385016.34	153003.81	385016.82	153003.58	-0.48	0.23
11	06:05:25	314	28	34	97.13	385016.34	153003.82	385016.82	153003.58	-0.48	0.25	385016.34	153003.82	385015.04	153004.09	1.30	-0.27	385016.34	153003.82	385016.82	153003.58	-0.48	0.25
12	06:05:34	314	28	43	97.13	385016.34	153003.83	385016.82	153003.58	-0.47	0.25	385016.34	153003.83	385015.04	153004.09	1.31	-0.27	385016.34	153003.83	385016.82	153003.58	-0.47	0.25
13	06:06:26	314	28	53	97.14	385016.34	153003.83	385016.82	153003.58	-0.47	0.25	385016.34	153003.83	385015.04	153004.09	1.31	-0.26	385016.34	153003.83	385016.82	153003.58	-0.47	0.25
14	06:06:34	314	28	5	97.14	385016.33	153003.81	385016.82	153003.58	-0.48	0.23	385016.33	153003.81	385015.04	153004.09	1.30	-0.28	385016.33	153003.81	385016.82	153003.58	-0.48	0.23
15	06:07:16	314	28	39	97.13	385016.34	153003.83	385016.82	153003.58	-0.48	0.25	385016.34	153003.83	385015.04	153004.09	1.30	-0.27	385016.34	153003.83	385016.82	153003.58	-0.48	0.25
16	06:08:05	314	28	56	97.13	385016.34	153003.83	385016.82	153003.58	-0.47	0.26	385016.34	153003.82	385015.04	153004.09	1.31	-0.26	385016.34	153003.83	385016.82	153003.58	-0.47	0.26
17	06:08:14	314	29	8	97.13	385016.35	153003.84	385016.82	153003.58	-0.47	0.26	385016.35	153003.84	385015.04	153004.09	1.31	-0.26	385016.35	153003.84	385016.82	153003.58	-0.47	0.26
18	06:09:01	314	29	0	97.13	385016.35	153003.83	385016.82	153003.58	-0.47	0.25	385016.35	153003.83	385015.04	153004.09	1.31	-0.26	385016.35	153003.83	385016.82	153003.58	-0.47	0.25
19	06:09:10	314	28	54	97.13	385016.35	153003.83	385016.82	153003.58	-0.47	0.25	385016.35	153003.83	385015.04	153004.09	1.31	-0.26	385016.35	153003.83	385016.82	153003.47	-0.47	0.36
20	06:10:02	314	28	59	97.13	385016.35	153003.83	385016.82	153003.58	-0.47	0.26	385016.35	153003.83	385015.04	153004.09	1.31	-0.26	385016.35	153003.83	385016.82	153003.47	-0.47	0.37
21	06:10:43	314	28	37	97.13	385016.35	153003.82	385016.82	153003.58	-0.47	0.24	385016.35	153003.82	385015.04	153004.09	1.31	-0.27	385016.35	153003.82	385016.82	153003.58	-0.47	0.24
22	06:10:56	314	28	34	97.13	385016.35	153003.82	385016.82	153003.58	-0.47	0.24	385016.35	153003.82	385015.04	153004.09	1.31	-0.27	385016.35	153003.82	385016.82	153003.58	-0.47	0.24
23	06:11:41	314	28	25	97.13	385016.34	153003.83	385016.82	153003.58	-0.47	0.24	385016.34	153003.82	385015.04	153004.09	1.31	-0.28	385016.34	153003.82	385016.82	153003.58	-0.47	0.24
24	06:11:50	314	28	32	97.13	385016.35	153003.82	385016.82	153003.58	-0.47	0.24	385016.35	153003.82	385015.04	153004.09	1.31	-0.28	385016.35	153003.82	385016.82	153003.58	-0.47	0.24
25	06:15:50	314	28	11	97.12	385016.35	153003.81	385016.82	153003.47	-0.47	0.34	385016.35	153003.81	385015.15	153004.09	1.20	-0.29	385016.35	153003.81	385016.93	153003.47	-0.58	0.34
26	06:17:19	314	28	18	97.12	385016.35	153003.81	385016.82	153003.47	-0.47	0.35	385016.35	153003.81	385015.15	153004.09	1.20	-0.28	385016.35	153003.81	385016.93	153003.47	-0.58	0.35
27	06:18:34	314	28	17	97.12	385016.35	153003.81	385016.82	153003.58	-0.47	0.23	385016.35	153003.81	385015.15	153004.09	1.20	-0.17	385016.35	153003.81	385016.93	153003.47	-0.58	0.35
28	06:19:55	314	28	43	97.12	385016.35	153003.82	385016.82	153003.58	-0.46	0.24	385016.35	153003.82	385015.15	153004.09	1.20	-0.27	385016.35	153003.82	385016.82	153003.47	-0.46	0.36
29	06:20:55	314	28	3	97.12	385016.34	153003.81	385016.82	153003.47	-0.47	0.34	385016.34	153003.81	385015.15	153004.09	1.20	-0.29	385016.34	153003.81	385016.82	153003.47	-0.47	0.34
30	06:22:01	314	28	23	97.12	385016.35	153003.81	385016.82	153003.47	-0.46	0.35	385016.35	153003.81	385015.26	153004.09	1.09	-0.28	385016.35	153003.81	385016.82	153003.47	-0.46	0.35
31	06:22:56	314	28	32	97.12	385016.36	153003.82	385016.82	153003.58	-0.46	0.24	385016.36	153003.82	385015.26	153004.09	1.10	-0.28	385016.36	153003.82	385016.82	153003.47	-0.46	0.35
32	06:24:10	314	28	24	97.12	385016.35	153003.81	385016.82	153003.58	-0.47	0.24	385016.35	153003.81	385015.26	153004.09	1.09	-0.28	385016.35	153003.81	385016.82	153003.47	-0.4	

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5.4 DGPS SYSTEM'S VERIFICATION (11TH FEBRUARY 2008) – MV PACIFIC TITAN

DGPS SYSTEM VERIFICATION SHEET																		
Date of Calibration:		11-Feb-07																
Location:		LOYANG JETTY, SINGAPORE																
Vessel:		PACIFIC TITAN																
Client :		CGG VERITAS																
Inst. station :	S2	E =	385104.607															
Note: RO was set to Zero		N =	152963.277															
R.O. station :	S3	E =	385082.549															
		N =	153024.532															
Inst. to R.O.: Ref. bearing (Grid) =		340.1959899	deg															
		= 340	11	46	(d m s)													
OBSERVATION DATA						RESULTS						RESULTS						
		TOTAL STATION OBSERVATION				RESULTS						RESULTS						
No.	Time (UTC)	To PRISM target			SPM1_HP						SPM1_XP							
		Bearing (grid) d	m	s	Dist. (m)	Observed E	N	Logged on Vsl E	N	de	dn	Observed E	N	Logged on Vsl E	N	de	dn	
1	06:00:02	315	18	52	97.17	385016.91	153005.12	385016.37	153005.35	0.54	-0.22	385016.91	153005.12	385017.22	153005.18	-0.31	-0.06	
2	06:00:43	315	18	53	97.16	385016.92	153005.12	385016.37	153005.35	0.55	-0.23	385016.92	153005.12	385017.22	153005.18	-0.30	-0.06	
3	06:01:11	315	18	58	97.16	385016.92	153005.12	385016.48	153005.35	0.44	-0.22	385016.92	153005.12	385017.22	153005.18	-0.30	-0.06	
4	06:01:53	315	18	36	97.16	385016.92	153005.11	385016.48	153005.35	0.43	-0.23	385016.92	153005.11	385017.22	153005.18	-0.30	-0.07	
5	06:02:47	315	18	53	97.16	385016.92	153005.12	385016.48	153005.35	0.43	-0.22	385016.92	153005.12	385017.22	153005.18	-0.30	-0.06	
6	06:03:22	315	18	39	97.16	385016.92	153005.12	385016.48	153005.35	0.43	-0.23	385016.92	153005.12	385017.22	153005.18	-0.30	-0.07	
7	06:04:04	315	18	44	97.16	385016.91	153005.12	385016.48	153005.46	0.43	-0.34	385016.91	153005.12	385017.22	153005.18	-0.30	-0.06	
8	06:04:14	315	18	43	97.16	385016.92	153005.12	385016.48	153005.46	0.43	-0.34	385016.92	153005.12	385017.22	153005.18	-0.30	-0.07	
9	06:05:10	315	18	38	97.16	385016.91	153005.12	385016.48	153005.46	0.43	-0.34	385016.91	153005.12	385017.22	153005.18	-0.31	-0.07	
10	06:05:56	315	18	52	97.16	385016.92	153005.12	385016.48	153005.35	0.44	-0.22	385016.92	153005.12	385017.22	153005.18	-0.30	-0.06	
11	06:06:07	315	18	59	97.16	385016.92	153005.12	385016.48	153005.46	0.44	-0.33	385016.92	153005.12	385017.22	153005.18	-0.30	-0.06	
12	06:06:53	315	19	12	97.17	385016.92	153005.13	385016.48	153005.46	0.43	-0.32	385016.92	153005.13	385017.22	153005.18	-0.30	-0.05	
13	06:07:01	315	18	59	97.16	385016.92	153005.13	385016.48	153005.46	0.43	-0.33	385016.92	153005.13	385017.22	153005.18	-0.30	-0.06	
14	06:07:41	315	19	16	97.16	385016.92	153005.13	385016.48	153005.46	0.44	-0.32	385016.92	153005.13	385017.22	153005.18	-0.30	-0.05	
15	06:07:50	315	19	5	97.17	385016.92	153005.13	385016.48	153005.46	0.43	-0.33	385016.92	153005.13	385017.22	153005.18	-0.30	-0.05	
16	06:08:31	315	19	14	97.17	385016.92	153005.13	385016.48	153005.46	0.43	-0.32	385016.92	153005.13	385017.22	153005.18	-0.30	-0.05	
17	06:08:43	315	19	4	97.16	385016.92	153005.13	385016.48	153005.46	0.43	-0.33	385016.92	153005.13	385017.22	153005.18	-0.30	-0.06	
18	06:09:29	315	19	11	97.16	385016.92	153005.13	385016.48	153005.46	0.44	-0.33	385016.92	153005.13	385017.22	153005.18	-0.30	-0.05	
19	06:09:38	315	19	18	97.16	385016.92	153005.13	385016.37	153005.46	0.55	-0.32	385016.92	153005.13	385017.22	153005.18	-0.30	-0.05	
20	06:10:17	315	19	13	97.16	385016.92	153005.13	385016.37	153005.46	0.55	-0.32	385016.92	153005.13	385017.28	153005.21	-0.36	-0.08	
21	06:10:29	315	19	18	97.16	385016.92	153005.13	385016.37	153005.46	0.55	-0.32	385016.92	153005.13	385017.28	153005.21	-0.36	-0.08	
22	06:11:14	315	18	41	97.16	385016.92	153005.12	385016.37	153005.46	0.54	-0.34	385016.92	153005.12	385017.23	153005.18	-0.31	-0.07	
23	06:11:23	315	18	41	97.16	385016.92	153005.12	385016.37	153005.46	0.55	-0.34	385016.92	153005.12	385017.23	153005.18	-0.31	-0.07	
24	06:15:07	315	18	42	97.15	385016.93	153005.11	385016.37	153005.46	0.55	-0.34	385016.93	153005.11	385017.23	153005.18	-0.30	-0.07	
										Mean	0.47	-0.30						
										Min	0.55	-0.22						
										Max	0.43	-0.34						
										Std Dev	0.05	0.05						
										Mean	0.47	-0.30						
										Min	0.55	-0.22						
										Max	0.43	-0.34						
										Std Dev	0.02	0.01						

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5.5 TAILBUOY SYSTEM'S VERIFICATION – MV PACIFIC TITAN

	S/N 1314		S/N 1411		S/N 2320	
	Easting	Northing	Easting	Northing	Easting	Northing
Computed	385050.23	153044.01	385050.23	153044.01	385050.23	153044.01
Observed	385050.93	153046.70	385052.94	153044.27	385051.90	153044.67
C-O	-0.70	-2.70	-2.72	-0.27	-1.67	-0.67
Std Dev	0.73	0.65	2.10	1.34	1.13	0.93

	S/N 0869		S/N 1511		S/N 1320	
	Easting	Northing	Easting	Northing	Easting	Northing
Computed	385050.23	153044.01	385050.23	153044.01	385050.23	153044.01
Observed	385051.27	153044.17	385051.45	153045.05	385052.84	153042.79
C-O	-1.04	-0.17	-1.23	-1.04	-2.61	1.22
Std Dev	1.2	0.93	1.49	1.53	1.12	1.08

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APPENDIX I.

GPS CONTROL STATIONS (S1, S2 AND S3) DESCRIPTION

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APPENDIX II.

EXTRACTED RAW DATA FROM THE VESSEL

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APPENDIX III.

PHOTOGRAPHS

Report Title: GYRO CALIBRATION/DGPS/TAILBUOY SYSTEM'S VERIFICATION ON MV PACIFIC TITAN AT LOYANG JETTY,
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APPENDIX IV.

DPR FOR 6 & 11 FEB, 2008

Report Title: GYRO CALIBRATION/DGPS/TAILBUOY SYSTEM'S VERIFICATION ON MV PACIFIC TITAN AT LOYANG JETTY,
Report No: SINGAPORE ON 6 AND 11 FEBRUARY 2008
AB-V-RP-00936

APPENDIX V.

REPORT CD