

**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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REVISION	DATE	DESCRIPTION	ORIGINATOR	CHECKED	APPROVED	CLIENT APPR
<b>Report Title:</b>						
<b>GYRO CALIBRATION/DGPS/TAILBUOY SYSTEM'S VERIFICATION ON MV PACIFIC TITAN AT LOYANG JETTY, SINGAPORE ON 6 &amp; 11 FEBRUARY, 2008</b>						
<b>Report No: AB-V-RP-00936</b>			<b>File Ref: MV Pacific Titan Main Report</b>			

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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	<b>0.27 deg</b>	<b>0.05</b>
Gyro HS 50	<b>1.40 deg</b>	<b>0.35</b>

### b) DGPS System's verification – 6 February 2008

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

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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

## 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

### 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 6<sup>th</sup> 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

### 3.1 PRISM INSTALLATION

On 6<sup>th</sup> 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.

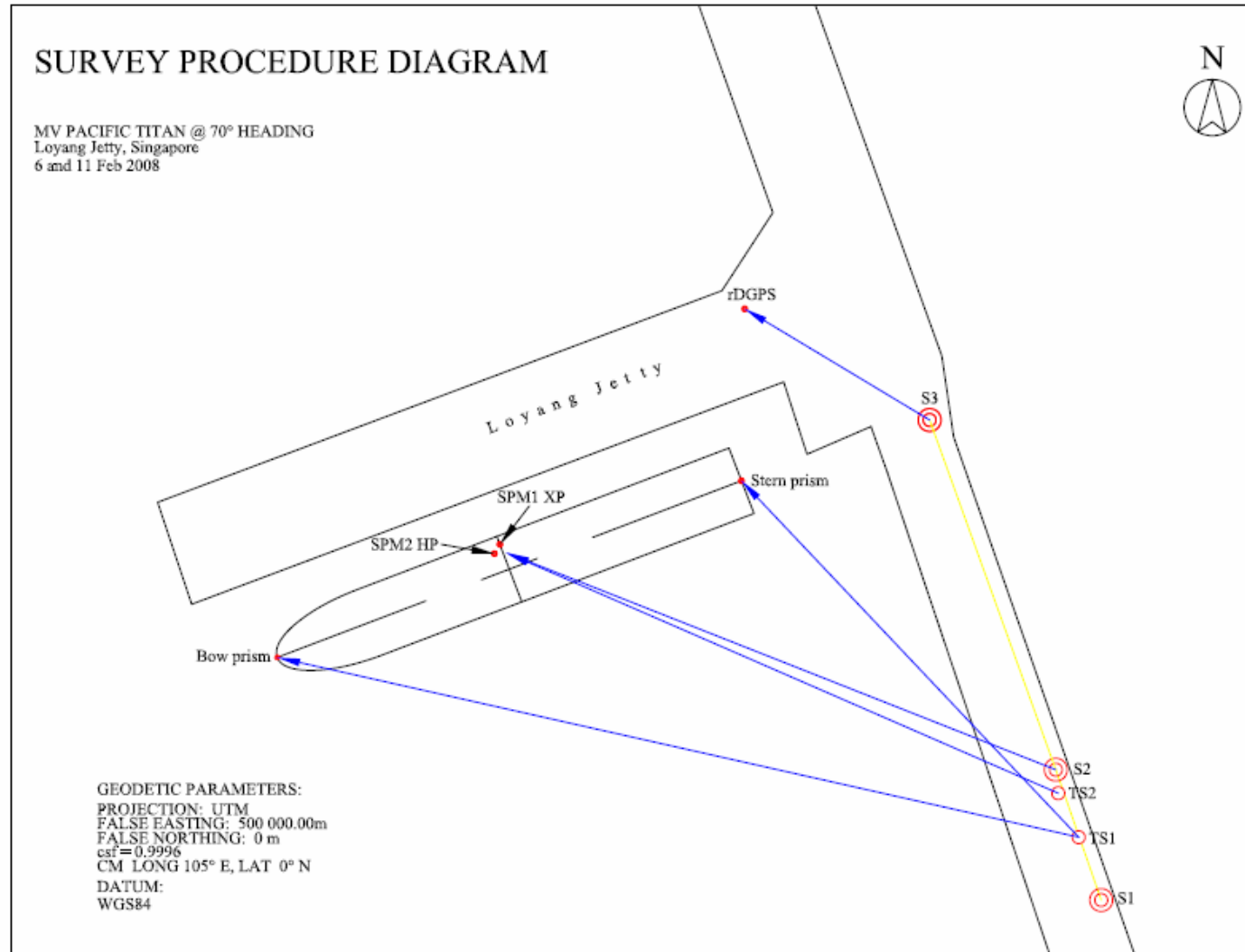
3-second interval readings were then logged from the vessel while observations from total station were being carried out.

On 11<sup>th</sup> 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.

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

## 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												RESULTS																					
OBSERVATION DATA												RESULTS																					
No.	06-Feb-07 (UTC)	BOW			STERN			Dist. (m)	Obs. Gyro Hdng (T)		No.	Bow		Stern		dE	dN	Bow-Stern Computed Distance	Comp. Brg (G)	Bow-Stern Computed Grid	Bow-Stern True Bearing	C-O											
		Bearing (Grid) d	Bearing (Grid) m	Bearing (Grid) s	Bearing (Grid) d	Bearing (Grid) m	Bearing (Grid) s		AD 100 deg	HS 50 deg		E	N	E	N							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	152989.02	385048.90	153010.91	-58.706	-21.889	62.65	-110.45	249.55	249.52	0.22	1.42									
2	07:41:39	303	32	15	118.65	331	39	47	76.36	249.3	247.8	2	384990.19	152989.99	385048.90	153010.92	-58.710	-21.933	62.67	-110.49	249.51	249.48	0.18	1.68									
3	07:42:53	303	32	29	118.64	331	39	44	76.36	249.3	248.3	3	384990.20	152989.00	385048.90	153010.92	-58.704	-21.926	62.66	-110.48	249.52	249.49	0.19	1.19									
4	07:45:36	303	31	58	118.64	331	39	26	76.36	249.3	247.7	3	384990.20	152989.98	385048.90	153010.92	-58.697	-21.940	62.66	-110.50	249.50	249.47	0.17	1.77									
6	07:46:27	303	32	0	118.63	331	40	4	76.36	249.3	248.6	6	384990.20	152989.98	385048.90	153010.93	-58.702	-21.952	62.67	-110.50	249.50	249.47	0.17	0.87									
7	07:53:01	303	32	15	118.62	331	40	21	76.36	249.2	247.5	4	384990.21	152989.99	385048.91	153010.94	-58.692	-21.952	62.66	-110.51	249.49	249.46	0.26	1.96									
8	07:55:20	303	32	5	118.61	331	40	52	76.37	249.2	247.7	8	384990.23	152989.98	385048.91	153010.95	-58.683	-21.974	62.66	-110.53	249.47	249.44	0.24	1.74									
9	07:56:45	303	31	35	118.61	331	41	1	76.37	249.2	248.1	5	384990.22	152989.96	385048.91	153010.95	-58.689	-21.995	62.67	-110.54	249.46	249.43	0.23	1.33									
10	07:58:01	303	31	36	118.61	331	41	1	76.37	249.1	248.5	10	384990.22	152989.96	385048.91	153010.95	-58.693	-21.992	62.68	-110.54	249.46	249.43	0.33	0.93									
11	07:59:00	303	31	39	118.60	331	40	38	76.37	249.1	248.2	6	384990.23	152989.96	385048.91	153010.95	-58.680	-21.985	62.66	-110.54	249.46	249.43	0.33	1.23									
12	08:00:00	303	31	39	118.60	331	40	11	76.37	249.1	248.2	12	384990.23	152989.96	385048.90	153010.94	-58.669	-21.979	62.65	-110.54	249.46	249.43	0.33	1.23									
13	08:00:30	303	31	16	118.60	331	40	11	76.37	249.1	248.1	7	384990.22	152989.95	385048.90	153010.94	-58.675	-21.991	62.66	-110.55	249.45	249.42	0.32	1.32									
14	08:01:33	303	31	24	118.59	331	40	3	76.37	249.1	247.5	14	384990.23	152989.95	385048.90	153010.94	-58.663	-21.987	62.65	-110.55	249.45	249.42	0.32	1.92									
15	08:02:30	303	31	12	118.60	331	40	44	76.37	249.1	248.2	8	384990.23	152989.94	385048.91	153010.95	-58.673	-22.007	62.66	-110.56	249.44	249.41	0.31	1.21									
16	08:03:45	303	31	11	118.60	331	40	7	76.37	249.1	247.5	16	384990.23	152989.94	385048.90	153010.94	-58.667	-21.995	62.65	-110.55	249.45	249.42	0.32	1.92									
17	08:04:30	303	31	1	118.60	331	40	8	76.37	249.1	247.9	9	384990.23	152989.94	385048.90	153010.94	-58.669	-22.001	62.66	-110.56	249.44	249.41	0.31	1.51									
18	08:07:20	303	31	13	118.59	331	40	46	76.37	249.1	248.1	18	384990.24	152989.94	385048.91	153010.95	-58.671	-22.007	62.66	-110.56	249.44	249.41	0.31	1.31									
19	08:07:34	303	31	13	118.59	331	40	45	76.37	249.1	248.6	10	384990.24	152989.94	385048.91	153010.95	-58.669	-22.007	62.66	-110.56	249.44	249.41	0.31	0.81									
20	08:09:04	303	30	48	118.58	331	40	47	76.37	249.1	248.3	20	384990.24	152989.93	385048.90	153010.95	-58.660	-22.027	62.66	-110.58	249.42	249.39	0.29	1.09									
21	08:09:44	303	31	6	118.59	331	40	42	76.38	249.1	248.5	11	384990.24	152989.94	385048.90	153010.95	-58.664	-22.013	62.66	-110.57	249.43	249.40	0.30	0.90									
22	08:10:45	303	30	51	118.58	331	40	42	76.37	249.1	247.7	22	384990.24	152989.93	385048.90	153010.95	-58.660	-22.023	62.66	-110.58	249.42	249.39	0.29	1.69									
23	08:11:22	303	30	26	118.58	331	40	56	76.37	249.1	247.7	12	384990.24	152989.91	385048.91	153010.96	-58.668	-22.041	62.67	-110.59	249.41	249.38	0.28	1.68									
												Mean										62.66		-110.54		249.46		249.43		0.27		1.40	
												Max										62.68		-110.45		249.55		249.52		0.33		1.96	
												Min										62.65		-110.59		249.41		249.38		0.17		0.81	
												Std dev										0.01		0.04		0.04		0.04		0.05		0.35	





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#### 5.4 DGPS SYSTEM'S VERIFICATION (11<sup>TH</sup> 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							SPM1_HP					SPM1_XP					
No.	Time (UTC)	Bearing (grid)			Dist. (m)	Observed		Logged on Vsl		de	dn	Observed		Logged on Vsl		de	dn
		d	m	s		E	N	E	N			E	N	E	N		
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
										<b>Mean</b>	<b>0.47</b>	<b>-0.30</b>			<b>Mean</b>	<b>-0.31</b>	<b>-0.06</b>
										<b>Min</b>	<b>0.55</b>	<b>-0.22</b>			<b>Min</b>	<b>-0.30</b>	<b>-0.05</b>
										<b>Max</b>	<b>0.43</b>	<b>-0.34</b>			<b>Max</b>	<b>-0.36</b>	<b>-0.08</b>
										<b>Std Dev</b>	<b>0.05</b>	<b>0.05</b>			<b>Std Dev</b>	<b>0.02</b>	<b>0.01</b>

5.5 TAILBUOY SYSTEM'S VERIFICATION – MV PACIFIC TITAN

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

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

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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

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## APPENDIX IV.

DPR FOR 6 & 11 FEB, 2008

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## APPENDIX V.

REPORT CD