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File No. 8562-16286  
RDIMS #4710790

January 30, 2009

Ralph Wilhelm  
Fisheries and Oceans Canada, Canadian Coast Guard  
Marine Engineering  
520 Exmouth Street  
Sarnia, ON  
N7T 8B1

**RE: Approval of "TRAVERSE" Manual of Trim & Stability, Document Number 50214/9-01**

Dear Mr. Wilhelm,

Reference is made to your letter dated December 5, 2007, submitting four (4) copies of the following document for review and approval:

- 1) *Manual of Trim & Stability, Document Number: 50214/9-01 (Rev. 1)*

Headquarters granted your request for exemption from full compliance with the requirements of TP 7301, STAB 6 (*Policy Decision, RDIMS #4657067*). The noted submission was examined and is approved on this basis.

Please find enclosed one (1) stamped copy of the submitted document. An invoice will be issued from Headquarters for the document examination.

Best Regards,

Murray Hawe  
Senior Marine Safety Inspector

Enclosure

cc: Dianna Labine (letter & booklet) – AMSBA  
cc: Mike Dua (letter & booklet) – PMB–SAR

SUBJECT TO  
NOTATION IN  
RED

SOUS RÉSERVE  
DES ANNOTATIONS  
EN ROUGE

## 19.81M CCGS TRAVERSE

### Manual of Trim & Stability

November 2007  
Document Number: 50214/9-01 (Rev-1)

"SUBJECT TO THE OWNER, HIS SHIPBUILDER OR NAVAL ARCHITECT BEING RESPONSIBLE FOR THE OCCUPANCY OF THE DESIGN OPERATING CONDITIONS PRESENTED HEREIN AND OF THE BASIC DATA FROM WHICH SUCH CONDITIONS WERE DEVELOPED, IT SHALL BE THE RESPONSIBILITY OF THE OWNER AND MASTER TO ENSURE THAT A PROPER MEASURE OF STABILITY IS MAINTAINED FOR ALL CONDITIONS OF LOADING AND BALLASTING."

"SOUS RÉSERVE QUE LE PROPRIÉTAIRE, SON ARCHITECTE NAVAL OU LE CONSTRUCTEUR DES NAVIRES SON RESPONSABLES DE L'EXACTITUDE DES CONDITIONS D'EXPLOITATION SOUMISES DES DONNÉES DE BASES D'APRÈS LESQUELLES LES CONDITIONS SONT ÉLABORÉES. IL INCOMBE AU PROPRIÉTAIRE ET AU CAPITAINE DE MAINTENIR UN DEGRÉ APPROPRIÉ DE STABILITÉ DANS TOUTES LES CONDITIONS DE CHARGEMENT ET DE LESTAGE."

Prepared for



 Transport Canada  
Transports Canada  
**APPROVED — APPROUVÉ**

ON THE AUTHORITY OF THE CANADA SHIPPING ACT AND REGULATIONS MADE THEREUNDER.

EN VERTU DE LA LOI SUR LA MARINE MARCHANDE DU CANADA ET DES RÉGLEMENTS CONNEXES.

ON BEHALF OF THE BOARD OF STEAMSHIP INSPECTION, DEPARTMENT OF TRANSPORT.

POUR LE COMPTE DU BUREAU D'INSPECTION DES NAVIRES À VAPEUR, MINISTÈRE DES TRANSPORTS.

*Murray Howe*  
JANUARY 28, 2009

DATE

Integrated Technical Service Directorate  
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NOTE: APPROVAL OF THIS MANUAL IS BASED ON TCMS HEADQUARTERS' POLICY DECISION (RDIMS #4657167) EXEMPTING VESSEL FROM FULL COMPLIANCE WITH TP7301, STAB 6.

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## 1.0 GENERAL PARTICULARS

Ship's Name:	CCGS Traverse
Type of Vessel:	Aluminum Catamaran
Official Number:	821185
Port of Registry:	Kenora, Ontario
Number of Crew:	4 maximum
Number of Passengers:	0
Length at Waterline:	19.14 metres
Length of Hull	20.14 metres
Length Overall	21.478 metres
Breadth Moulded:	7.30 metres
Depth (to deck):	1.63 metres
Draft (mean):	0.662 metres
Lightship Displacement:	34.68 tonnes
Gross Tonnage:	70.66 tonnes
Net Tonnage:	53 tonnes
Class of Voyages:	Inland Waters II
Date Keel Laid:	1998
Builder's Name:	Metal Craft Marine, Kingston, Ontario
Owner's Name:	Department of Fisheries and Oceans

## 2.0 GENERAL ARRANGEMENT

The profile and plan view of the General Arrangement for this vessel is shown in Figure 2.1.

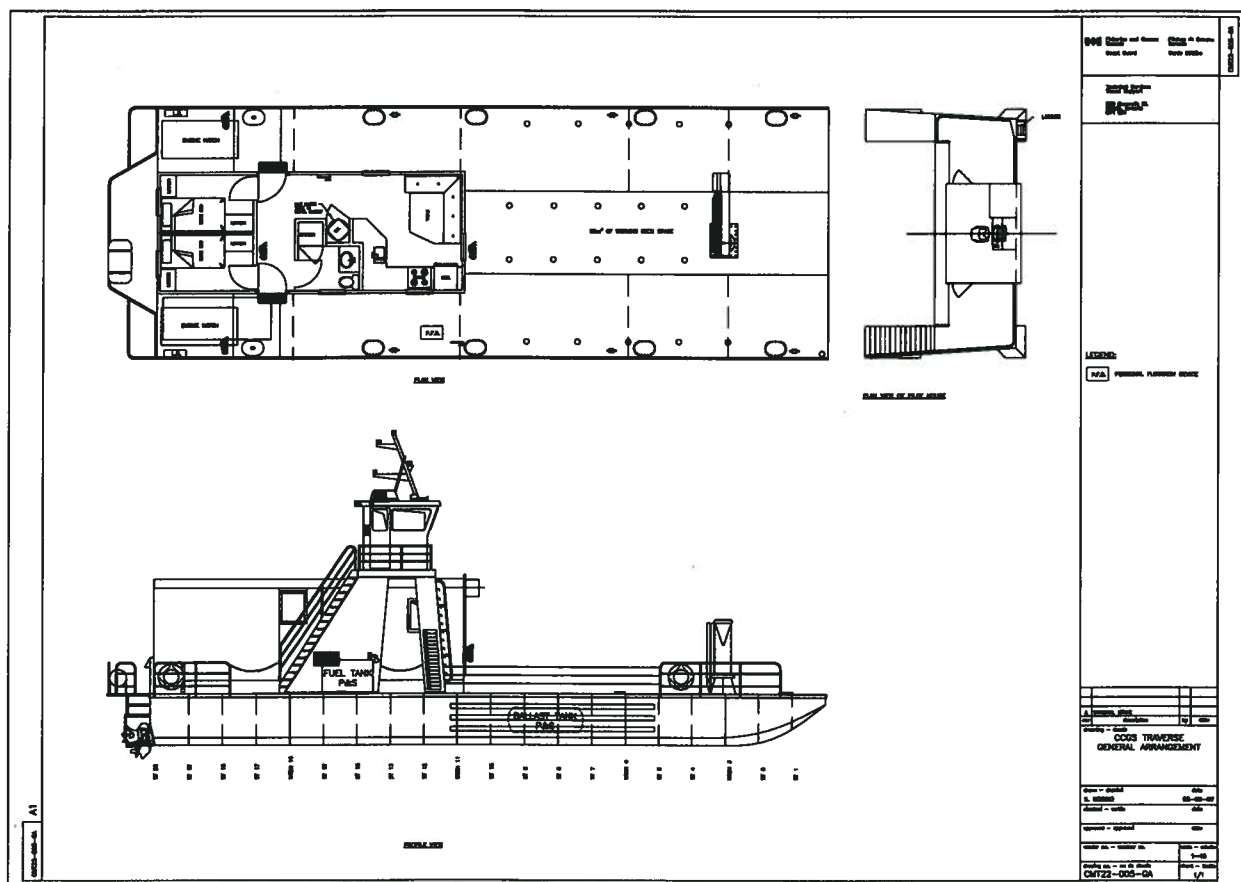


Figure 2.1: General Arrangement – Traverse

### 3.0 DATUM LINE DIAGRAM

The datum point on the vessel for all measurements contained in this manual is station 0, for LCG, the baseline for VCG and the vessel centreline for TCG as shown in figure 3.1. LCG is positive measured aft of the datum, positive above the datum and positive to starboard of the centreline.

The forward draft marks are located 3.13 metres aft of the origin and the after draft marks are located 19.785 metres aft of the origin as shown in figure 3.1.

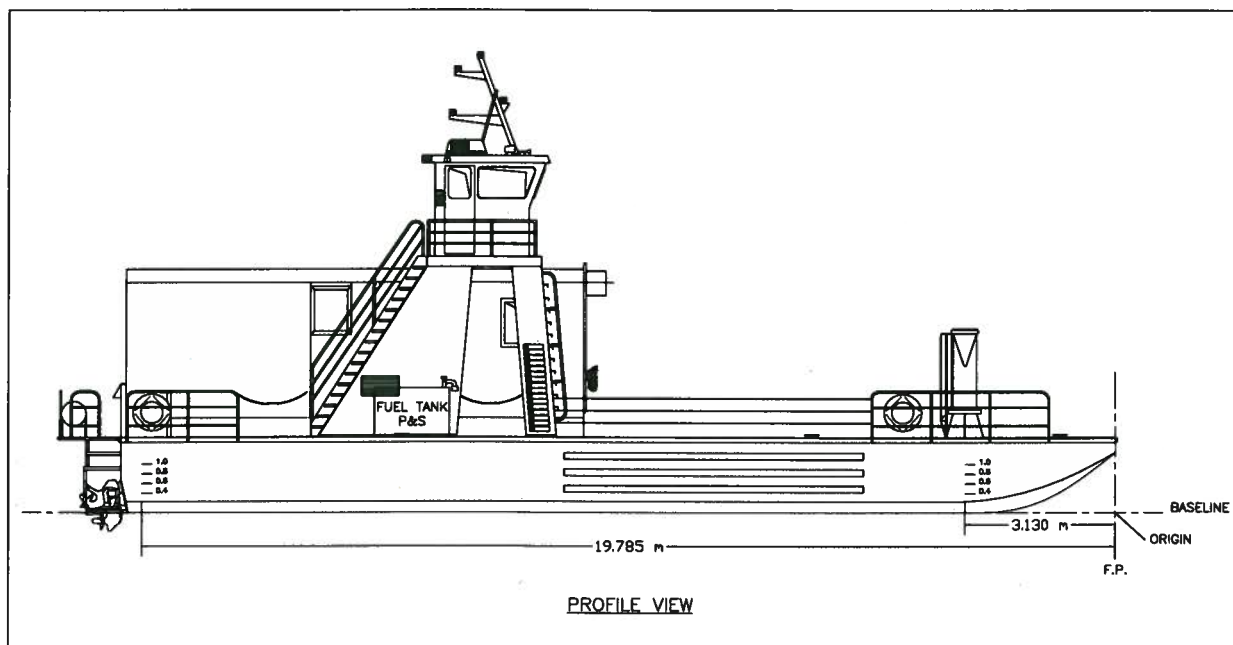


Figure 3.1: Datum Line Diagram – Traverse

## 4.0 INCLINING EXPERIMENT

The Inclining Experiment on CCGS Traverse was carried out in Kenora, Ontario on May 18 2007 and was conducted in accordance with TP7301E, Stab-2. The following persons were present: Mr. Robert Brown and Mr. Michael Follett from Fleetway, Mr. Murray Hawe from Transport Canada - Marine Safety and two personnel from the Canadian Coast Guard.

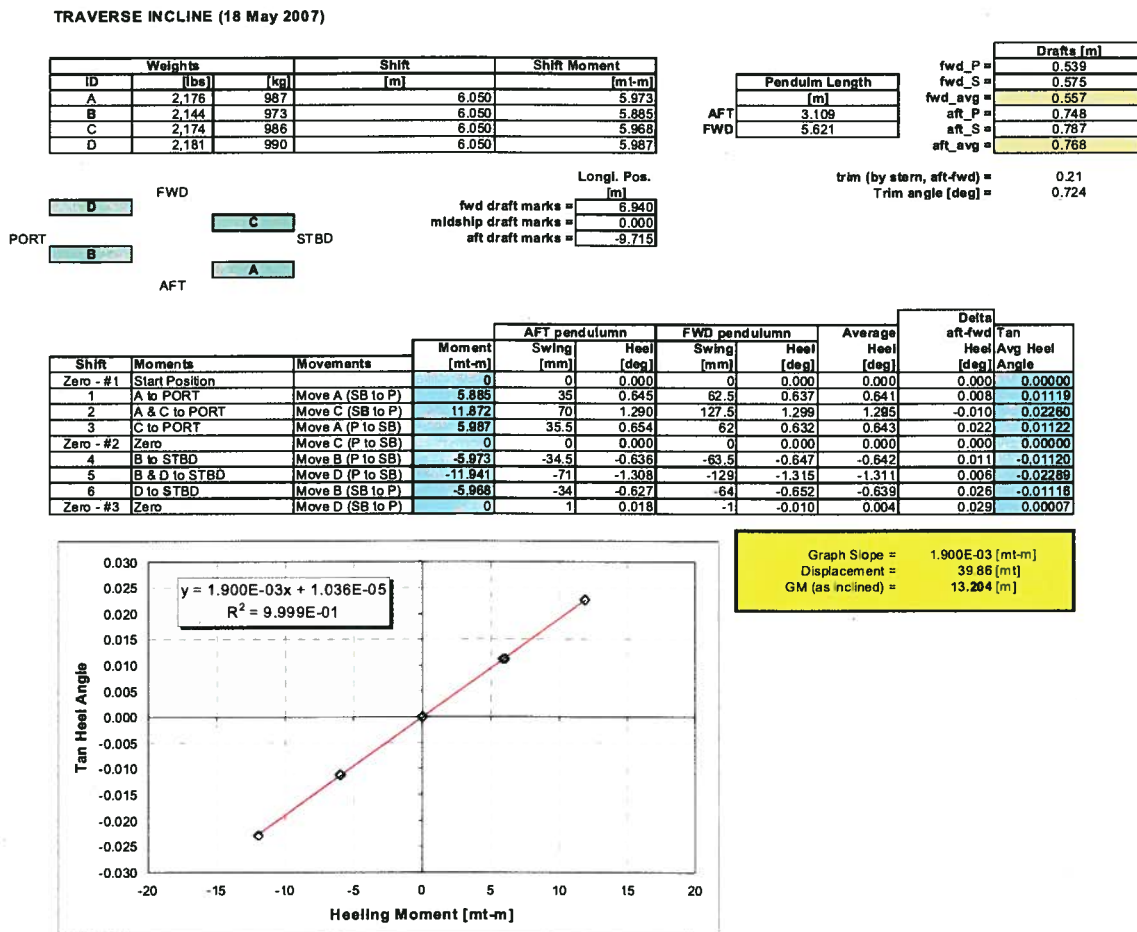
### 4.1 Account of Inclining

Weights used in the inclining experiment were weighed and located in four groups, two groups (B&D) to port of the vessel centreline and two groups (A&C) to starboard of the centreline as shown in figure 4.1.

Two pendulums were set up for the experiment, one located aft of the accommodation container at the stern and the second located forward of the wheelhouse. Pendulum lengths were recorded and are given in figure 4.1.

Drafts were taken at the fwd and after draft mark locations on both the port and starboard sides in order to capture any vessel heel angle.

Figure 4.1: Account of Inclining Results





#### 4.1.1 Details of GM Calculation Based on Results From Inclining Experiment

In-accordance-with TP7301E, Stab-2, eight (8) weight shifts were made during the experiment to derive the vessels as inclined Metacentric Height (GM). These weight shifts, the resulting pendulum readings and the moment / heel angle graph are shown in figure 4.1.

The resulting GM calculation in Figure 4.1 is based on the following formula:

$$HM = GM \times \Delta \times \tan(\phi),$$

HM – Heeling Moment (tonne metre),  
GM – Metacentric Height (metre),  
 $\Delta$  – Displacement (tonnes),  
 $\phi$  – Heel angle (deg).

Written with  $\tan(\phi)$  as a function of  $\Delta$ :

$$\tan(\phi) = 1/(GM \times \Delta) \times HM,$$

where  $1/(GM \times \Delta)$  represents the slope of the curve  $\tan(\phi)$  vs. HM. Value of the slope is obtained from the graph, and GM is the calculated value from the formula below:

$$GM = 1/(\text{'slope'} \times \Delta).$$

#### 4.1.2 Derivation of Lightship

The Lightship displacement and centre of gravity of the CCGS Traverse was derived from data obtained from the inclining experiment as discussed below.

The "As Inclined" displacement, position of the centre of buoyancy (LCB, TCB and VCB), as well as the position of the Metacentre (KM) were calculated using Creative Systems GHS software (v. 10.98A) based on the draft mark readings taken before and after the experiment. The Vertical Centre of Gravity (VCG) was calculated by subtracting GM (derived from inclining subsection 4.1.1) from KM ( $VCG = KM - GM$ ). The Longitudinal Centre of Gravity (LCG) is by definition equal to LCB and the Transverse Centre of Gravity (TCG) was calculated using the equation  $TCG = \tan(\phi) \times GM$  (here  $\tan(\phi)$  is equal to the "As Inclined" heel angle derived from the difference in the port and starboard draft mark readings).

Using the "As Inclined" displacement and centre of gravity as the baseline, the Lightship displacement and centre of gravity were derived by subtracting all non-lightship weights from the "As Inclined" condition and by adding weights that are normally part of lightship and were not there at the time of the experiment. Table 4.1 summarizes the details of the derivation.

Table 4.2.1: Lightship Derivation

Weight Description	Weight (t)	LCG (m)	L Mom (t-m)	TCG (m)	T Mom (t-m)	VCG (m)	V Mom (t-m)
boat (as inclined)	39.860	11.682	465.645	0.078	3.109	1.873	74.658
<b>weights to be subtracted</b>							
ballast group A	0.987	7.240	7.146	3.025	2.986	1.829	1.805
ballast group B	0.973	6.240	6.072	-3.025	-2.943	1.829	1.779
ballast group C	0.986	5.490	5.413	3.025	2.983	1.829	1.803
ballast group D	0.990	4.490	4.445	-3.025	-2.995	1.829	1.810
fuel tank stbd (93.5 %)	0.766	14.428	11.052	3.074	2.354	2.108	1.615
fuel tank port (93.5%)	0.766	14.428	11.052	-3.074	-2.354	2.108	1.615
Personnel #1 (Fwd Pen)	0.109	9.600	1.046	0.000	0.000	1.900	0.207
Personnel #2 (Aft Pen)	0.089	20.600	1.833	0.000	0.000	1.900	0.169
Personnel #3 (CCG x 2)	0.161	4.500	0.725	0.000	0.000	2.500	0.403
Personnel #4 (Ship Safety)	0.102	4.500	0.459	0.000	0.000	2.500	0.255
total	5.929	8.305	49.243	0.005	0.030	1.933	11.461
<b>weights to be added</b>							
small locker (#1)	0.159	6.909	1.097	3.010	0.478	1.900	0.302
large locker (#2 stbd)	0.304	4.064	1.235	3.010	0.915	2.000	0.608
large locker (#3 port)	0.289	4.026	1.161	-3.010	-0.868	2.000	0.577
			0.000		0.000		0.000
			0.000		0.000		0.000
total	0.751	4.651	3.493	0.698	0.524	1.979	1.486
<b>Lightship</b>	<b>34.682</b>	<b>12.107</b>	<b>419.895</b>	<b>0.104</b>	<b>3.603</b>	<b>1.865</b>	<b>64.684</b>
Note: Origin @ station 0 (bow, centerline, baseline); L (+) aft of bow, T (+) stbd, V (+) above baseline							

Boat (As inclined)	
BMt	14.658
VCB	0.419
GMt	13.204
VCG	1.873

## 5.0 NOTES REGARDING STABILITY AND LOADING OF THE VESSEL

This manual presents the results of the stability analysis for the CCGS Traverse, which is in service for the Canadian Coast Guard and currently (2007) operates out of Kenora, Ontario. The stability criteria against which the vessel has been analyzed is STAB 6 (TP 7301E – Stability, Subdivision, and Load Line Standards – Standard for Intact Stability of Non-Passenger Ships and Passenger Ships Carrying Not More than 12 Passengers). In addition to the STAB 6 requirements the stability of the vessel has also been assessed, in varying loading conditions, while lifting weights using its onboard crane.

### 5.1 Loading

At the beginning of the operating season the vessel's two water ballast tanks should be pressed full and should remain in this fully loaded condition until the vessel is laid up for the winter.

When loading deck cargo the master is to ensure that the load is distributed in such a manner as to minimize both heel and trim. Ideally both heel and trim should be as close to zero as possible.

### 5.2 Intact Stability

As is typical for a catamaran type vessel the CCGS Traverse has excellent initial stability, due to its very high GM, however due to this hull form the GZ curve reaches a maximum value very early, ranging between  $13^{\circ}$  and  $16^{\circ}$  for all loading cases. These values fail to satisfy the angle of maximum righting arm of  $25^{\circ}$  established in the STAB 6 regulations.

At higher heel angles, between  $28^{\circ}$  and  $34^{\circ}$ , depending on loading, the engine compartment air intakes become submerged and these compartments will flood. If the GZ curve is cut short at this point, as required by Stab 1 criteria, then the CCGS Traverse will fail to meet the STAB 6 criteria for area under the GZ curve between  $30^{\circ}$  and  $40^{\circ}$  under all defined loading conditions.

### 5.3 Lifting of Heavy Weights

The vessel's stability is influenced by the lifting of weights over the side or on the vessel's longitudinal axis. To analyse this loading scenario, a point load was taken to act under the tip of the extended crane boom. Two worst-case scenarios were reviewed; *high-lift* and *out-lift*. The *high-lift* phenomenon considers the extension, angle, and respective maximum operational load that would generate the greatest vertical moment. The *out-lift* scenario considers the extension, angle, and respective maximum operational load that would generate the greatest transverse moment. The operational load considered for both of these cases was 2760 lbs (1.25 tonnes), the recorded Safe Working Load of the crane. The tip of the extended crane boom at full extension for the *high-lift* situation is located 9.525m above baseline, and for the *out-lift* situation is 3.850m above baseline at a distance 6.190m to starboard. The impact on the vertical centre of gravity as well as the impact of a heeling moment generated by these lifting scenarios is not significant and does not jeopardize the stability of the vessel.

#### 5.4 Notes to Master

From the above it can be stated that under all specified loading conditions the vessel has good initial stability but does not fully meeting Stab 6 requirements at higher heel angles.

Notwithstanding the above, compliance with the stability criteria at low to moderate heel angles this **does not** ensure immunity against capsizing regardless of the circumstances, or absolve the vessel masters from their responsibilities.

Masters should therefore;

- Exercise prudence and good seamanship having regard to the season of the year, weather forecasts and the navigational zone.
- Take the appropriate action as to speed and course warranted by the prevailing circumstances.
- Prior to voyage, ensure pieces of equipment and cargo have been properly stowed and/or lashed so as to minimize the possibility of both longitudinal and lateral shifting while at sea, under the effect of acceleration caused by rolling or pitching.
- Ensure that the ballast tanks are pressed full for all operating conditions.
- Exercise due diligence and extreme caution in hoisting items with the crane while at extensions, and ensure that loads that do not exceed 1.25 MT.

## 6.0 TANK CHARACTERISTICS

### 6.1 Capacities, Centres of Gravity and Free Surface Moments

This vessel has two (2) fuel tanks, one Port and one Starboard, whose summary particulars are defined in Table 6.1. The complete fuel tank capacities are included in Appendix C.

Additionally, there are two (2) plastic water ballast tanks which are fitted within the hulls to correct the trim of the vessel. These tanks should always be full when the vessel is operating and are only to be emptied when the vessel is being stored. Summary particulars of these tanks are shown in Table 6.2

**Table 6.1: Fuel Tank Particulars**

<b>LOCATION:</b>	Above deck: 13.668 to 15.188 m from the bow. 2.769 to 3.379 m from centre line (P & S).		
<b>CAPACITIES:</b>	95% Full	0.77 MT	
	30% Full	0.24 MT	
	10% Full	0.08 MT	
<b>CENTRES OF GRAVITY (full):</b>	Vertical (above keel)	2.110 m	
	Longitudinal (aft of bow)	14.428 m	
	Transverse (P & S)	3.345 m	
<b>FREE SURFACE MOMENT:</b>	Negligible		
Typical fuel specific gravity for this vessel is 0.87 (Diesel) and the resulting weight and moment using this figure is given.			
NOTE: The weight and centres of gravity have been given for the tank at 100% full.			

**Table 6.2: Fresh Water Ballast Tank Particulars**

<b>LOCATION:</b>	Plastic tanks located below deck level in the third compartment aft in each hull (P & S). The compartment extents are from 6.0 to 11.0 m from the bow.		
<b>CAPACITIES:</b>	100% Full	1.100 m <sup>3</sup>	1.100 MT
<b>CENTRES OF GRAVITY:</b>	Vertical (above keel)	0.785 m	
	Longitudinal (aft of bow)	8.371 m	
	Transverse (P & S)	1.464 m	
<b>FREE SURFACE MOMENT:</b>	Negligible		
NOTE: These tanks are always full when the vessel is operating and are empty only when the vessel is being stored.			

### 6.2 Effect of Free Surface on Stability

The effect of the free surface in the fuel tanks was found to be negligible. They do not significantly effect the calculation of GM or GZ values presented in this booklet.

## **7.0 STABILITY ANALYSIS**

### **7.1 Intact Conditions**

The stability of the vessel has been evaluated for several loading conditions:

- Lightship Condition
- Light Load Condition
- Maximum Load Condition
- Arrival Condition

All conditions are evaluated against the criteria contained in STAB 6. The Loading Condition Sheets and Statistical Stability Curves for each of these cases are presented in Figures 7.1 through figures 7. 4. Additionally, Hydrostatic Properties and Cross Curves of Stability are presented in Appendices A and B respectively.

Note: The calculation of righting arm in the Cross Curves of Stability does not include the superstructure.

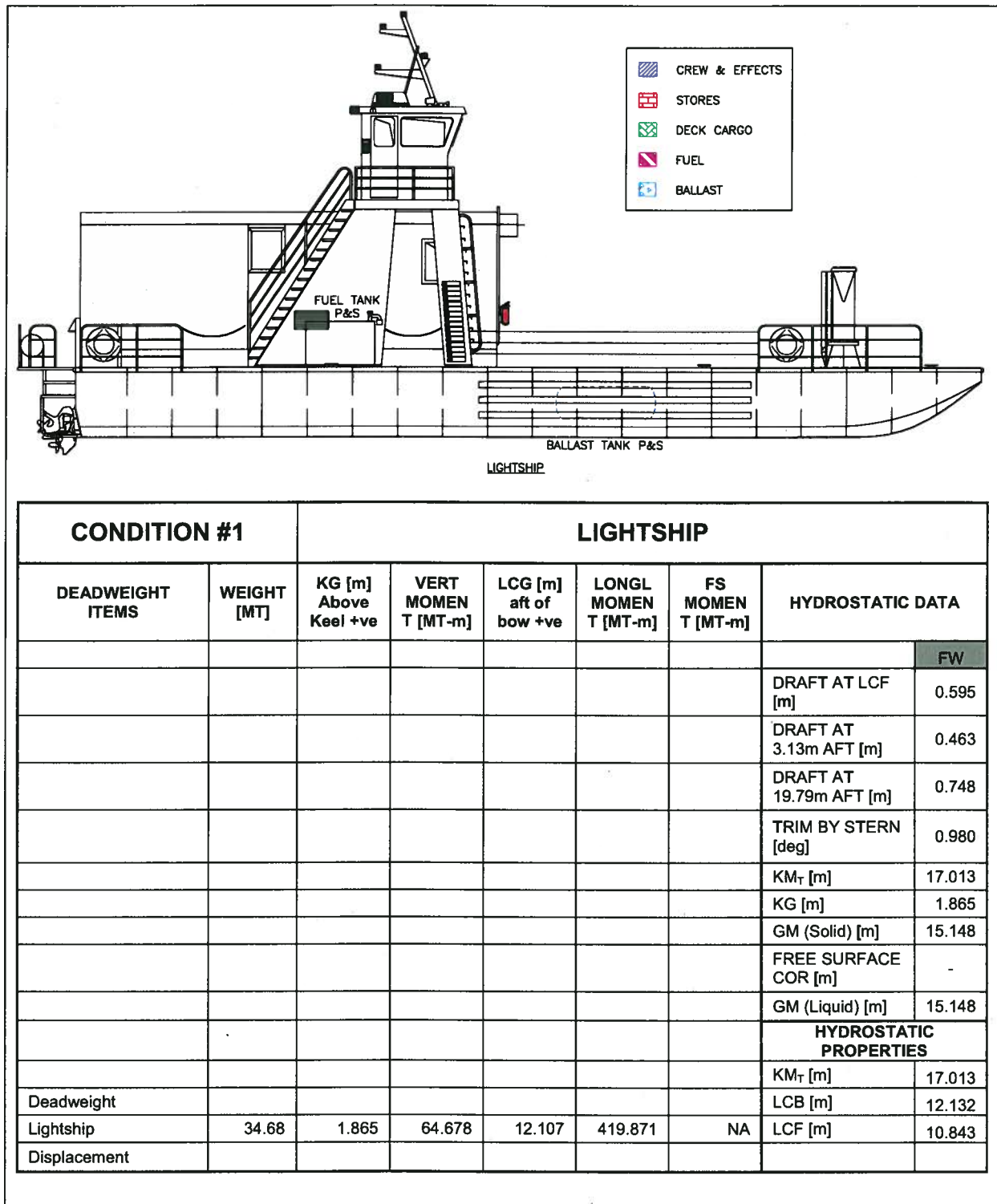
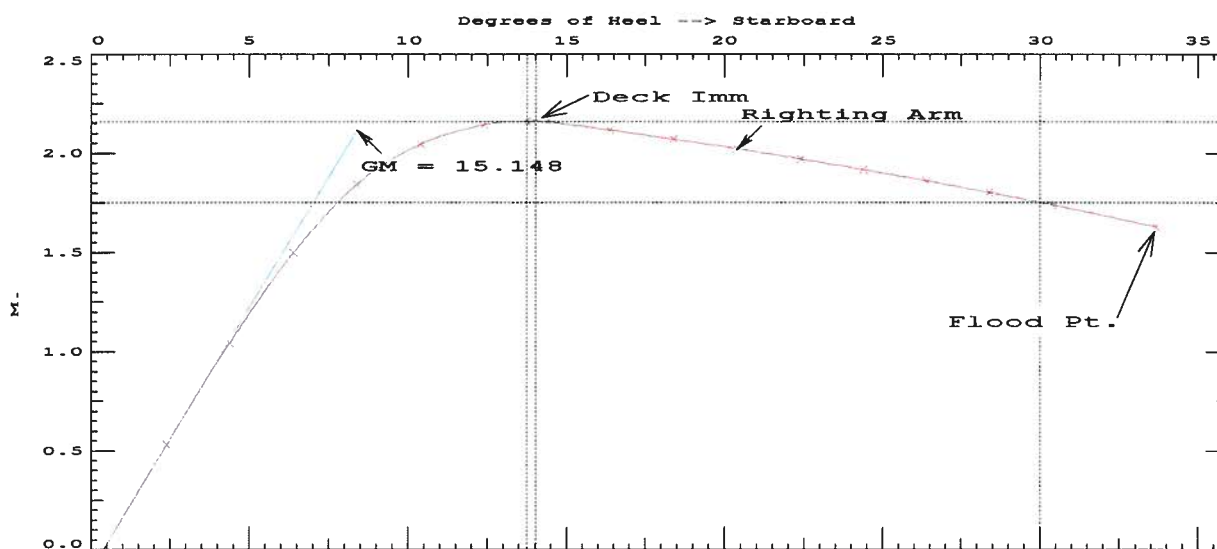


Figure 7.1.a: Lightship Condition

STABILITY REQUIREMENTS	RESULTS	COMPLIANCE
AREA UNDER CURVE UP TO 30° > 0.055 m-RADS	0.8915	Pass
AREA UNDER CURVE UP TO 40° OR DOWNFLOODING ANGLE > 0.09 m-RADS	0.9998	Pass
AREA BETWEEN 30° AND 40° OR DOWNFLOODING ANGLE > 0.03 m-RADS	0.1083	Pass
RIGHTING ARM, GZ AT 30° > 0.2 METRES	1.749	Pass
ANGLE FROM 0 deg to MAXIMUM GZ @ >25°	13.75	Fail
GM UPRIGHT > 0.150 METRES	15.148	Pass
ABSOLUTE ANGLE AT FLOOD > 0°	33.68	NA
ABSOLUTE ANGLE AT DECK IMMERSION > 0°	14.03	NA

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TRAVERSE INTACT ANALYSIS

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**Figure 7.1.b: Lightship Condition**



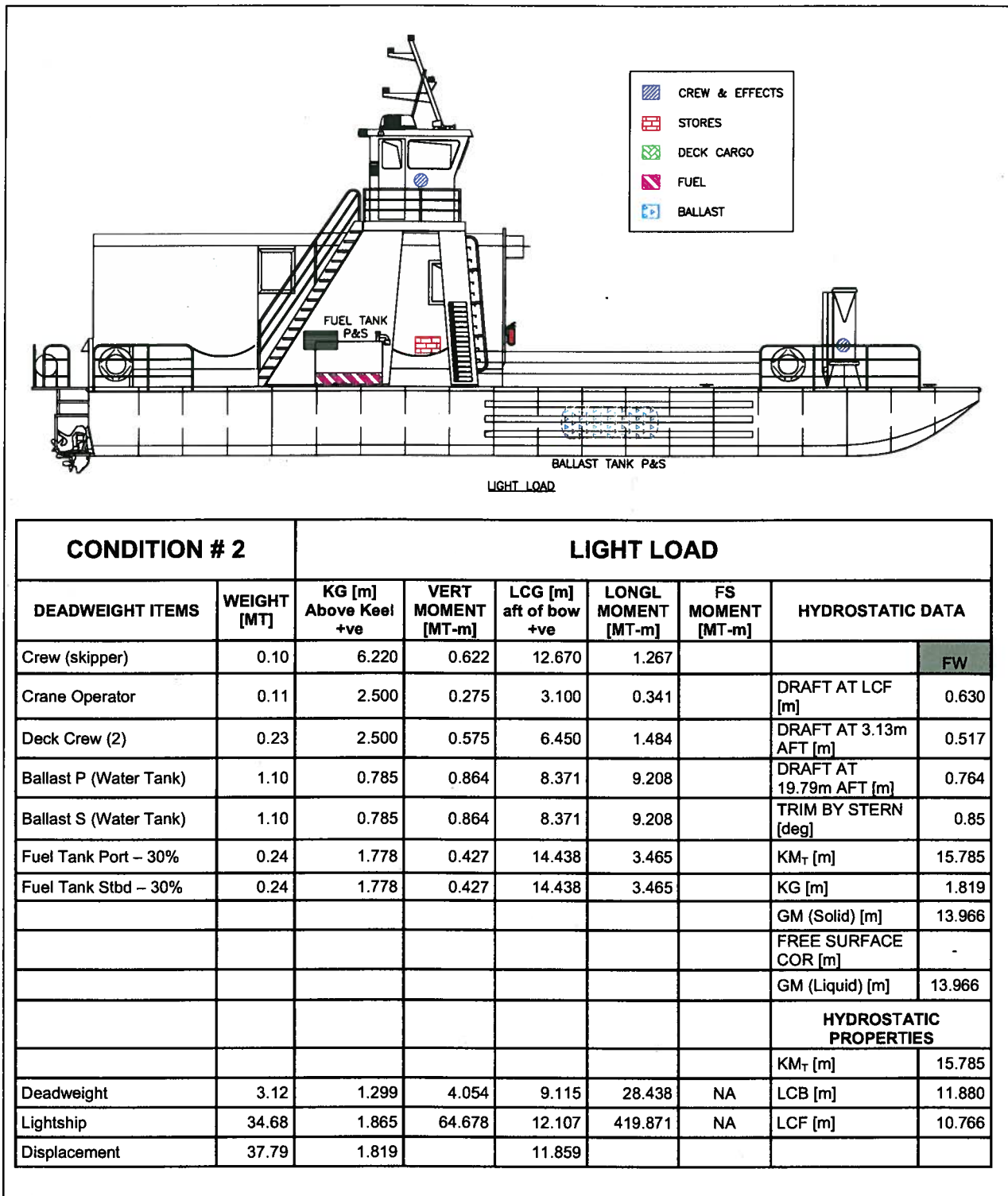


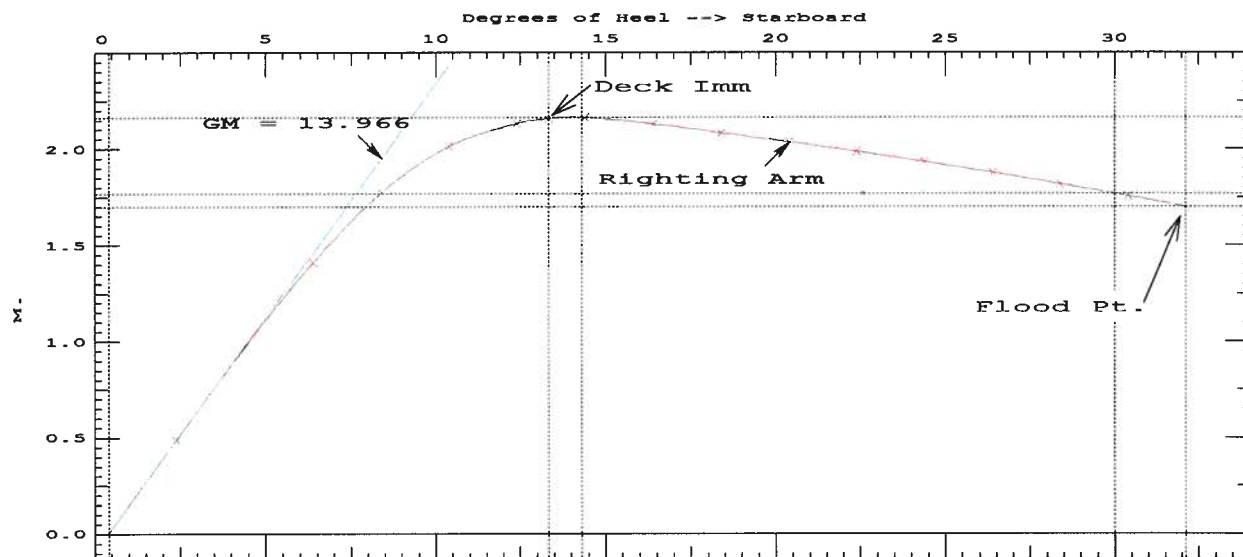
Figure 7.2a: Light Load Condition

STABILITY REQUIREMENTS	RESULTS	COMPLIANCE
AREA UNDER CURVE UP TO 30° > 0.055 m-RADS	0.8847	Pass
AREA UNDER CURVE UP TO 40° OR DOWNFLOODING ANGLE > 0.09 m-RADS	0.9492	Pass
AREA BETWEEN 30° AND 40° OR DOWNFLOODING ANGLE > 0.03 m-RADS	0.0645	Pass
RIGHTING ARM, GZ AT 30° > 0.2 METRES	1.767	Pass
ANGLE FROM 0 deg to MAXIMUM GZ @ >25°	14.13	Fail
GM UPRIGHT > 0.150 METRES	13.966	Pass
ABSOLUTE ANGLE AT FLOOD > 0°	32.13	NA
ABSOLUTE ANGLE AT DECK IMMERSION > 0°	13.33	NA

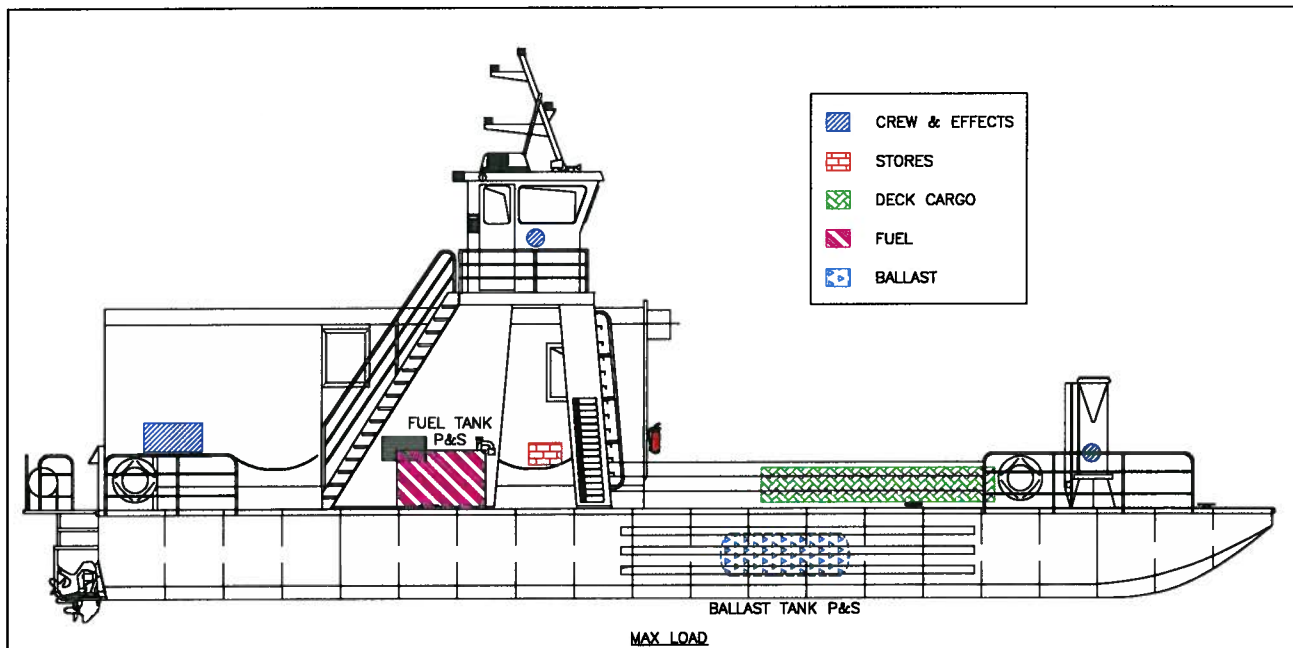
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**Figure 7.2.b: Light Load Condition**



CONDITION # 3		MAXIMUM LOAD					
DEADWEIGHT ITEMS	WEIGHT [MT]	KG [m] Above Keel +ve	VERT MOMENT [MT-m]	LCG [m] aft of bow +ve	LONG MOMENT [MT-m]	FS MOMENT [MT-m]	HYDROSTATIC DATA
Crew (skipper)	0.10	6.220	0.622	12.670	1.267		FW
Crane Operator	0.11	2.500	0.275	3.100	0.341		DRAFT AT LCF [m] 0.747
Deck Crew (2)	0.23	2.500	0.575	6.450	1.484		DRAFT AT 3.13m AFT [m] 0.722
Crew Effects (200 lbs)	0.09	2.800	0.252	18.870	1.698		DRAFT AT 19.79m AFT [m] 0.778
Stores (650 lbs)	0.30	2.500	0.75	12.500	3.750		TRIM BY STERN [deg] 0.19
Deck Cargo (20000 lbs)	9.07	1.900	17.233	6.784	61.531		KM <sub>T</sub> [m] 12.802
Ballast P (Water Tank)	1.10	0.785	0.864	8.371	9.208		KG [m] 1.849
Ballast S (Water Tank)	1.10	0.785	0.864	8.371	9.208		GM (Solid) [m] 10.953
Fuel Tank Port – 95%	0.74	2.099	1.553	14.429	10.677		FREE SURFACE COR [m] -
Fuel Tank Stbd – 95%	0.74	2.099	1.553	14.429	10.677		GM (Liquid) [m] 10.953
							<b>HYDROSTATIC PROPERTIES</b>
							KM <sub>T</sub> [m] 12.802
Deadweight	13.58	1.807	24.541	8.088	109.841	NA	LCB [m] 10.981
Lightship	34.68	1.865	64.678	12.107	419.871	NA	LCF [m] 10.535
Displacement	48.28	1.849		10.977			

Figure 7.3.a: Maximum Load Condition

STABILITY REQUIREMENTS	RESULTS	COMPLIANCE
AREA UNDER CURVE UP TO 30° > 0.055 m-RADS	0.8013	Pass
AREA UNDER CURVE UP TO 40° OR DOWNFLOODING ANGLE > 0.09 m-RADS	0.8013	Pass
AREA BETWEEN 30° AND 40° OR DOWNFLOODING ANGLE > 0.03 m-RADS	UNDEF	Fail
RIGHTING ARM, GZ AT 30° > 0.2 METRES	UNDEF	Fail
ANGLE FROM 0 deg to MAXIMUM GZ @ >25°	15.11	Fail
GM UPRIGHT > 0.150 METRES	10.953	Pass
ABSOLUTE ANGLE AT FLOOD > 0°	28.78	NA
ABSOLUTE ANGLE AT DECK IMMERSION > 0°	13.22	NA

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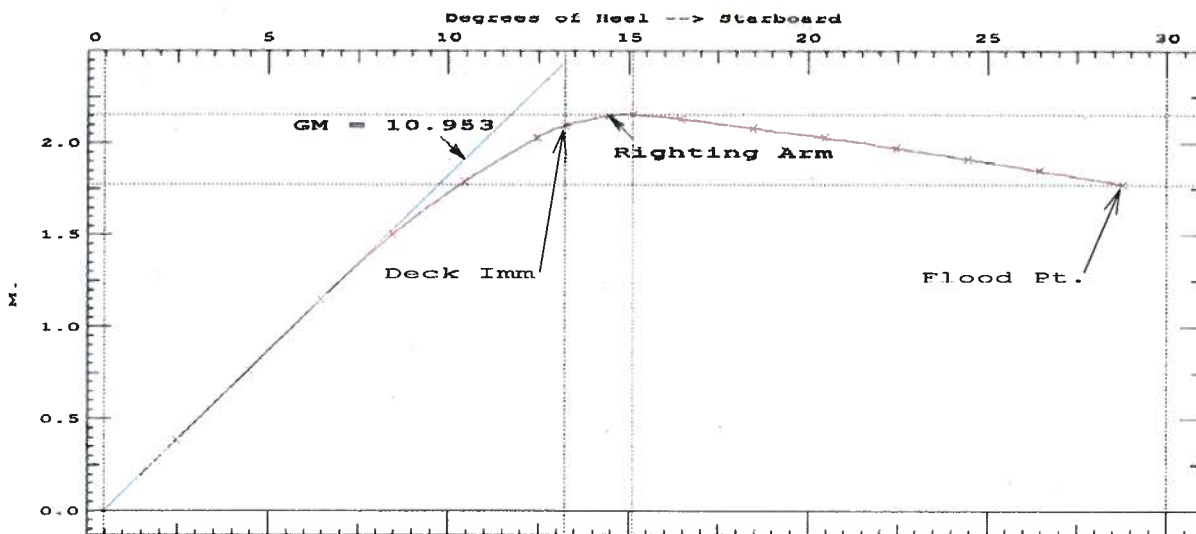


Figure 7.3.b: Maximum Load Condition

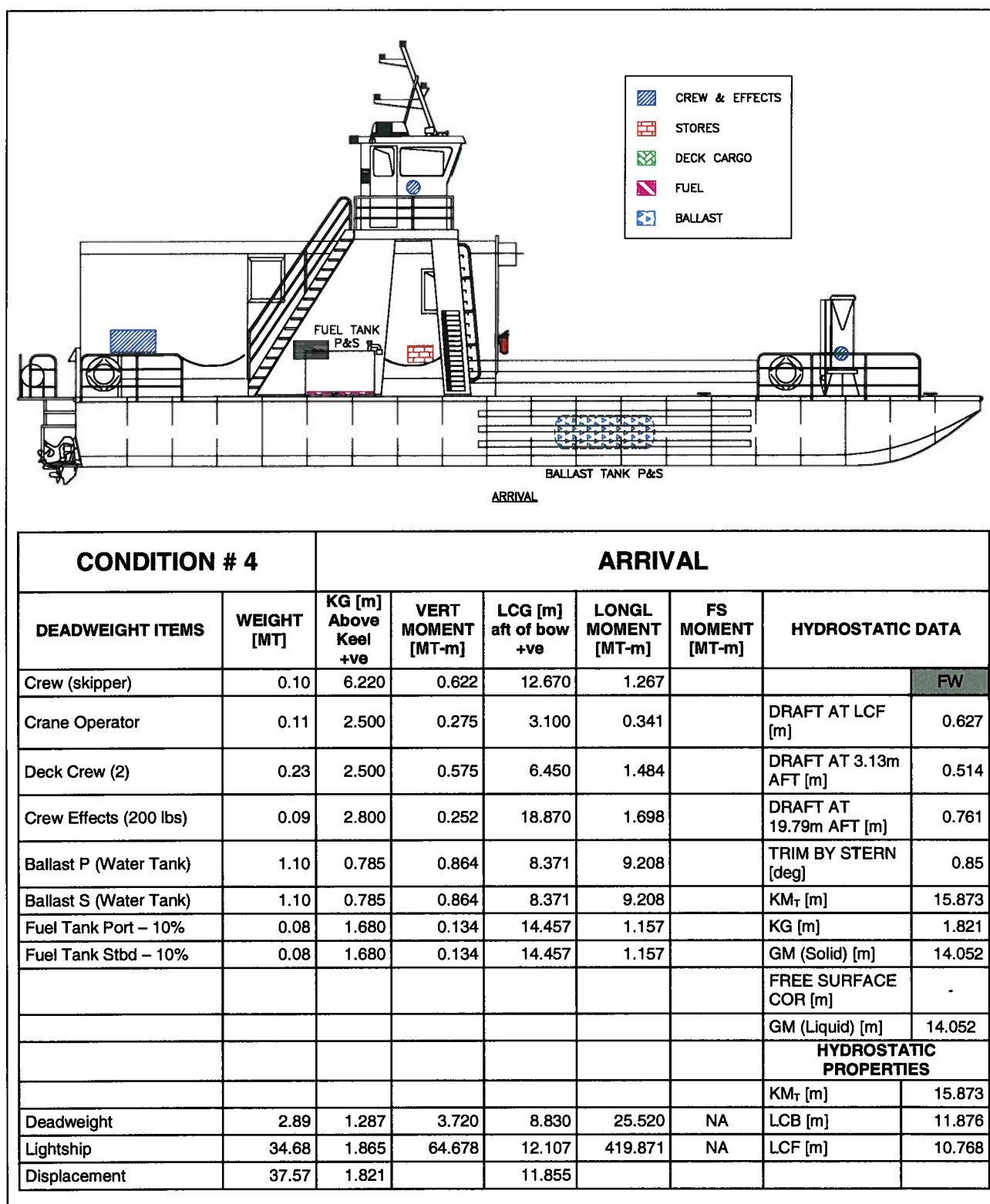
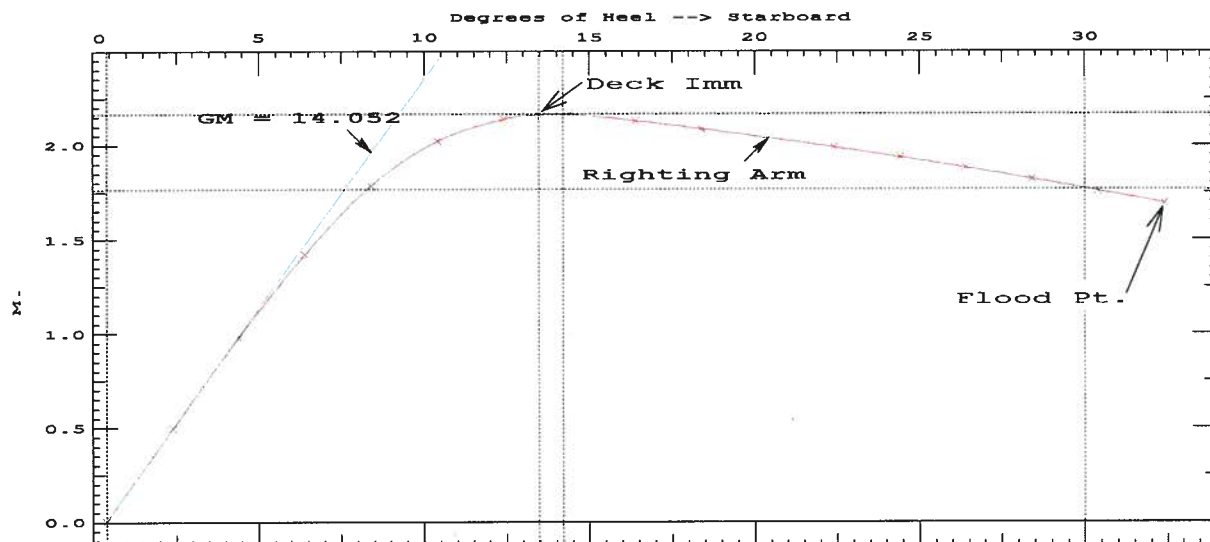


Figure 7.4.a: Arrival Condition

STABILITY REQUIREMENTS	RESULTS	COMPLIANCE
AREA UNDER CURVE UP TO 30° > 0.055 m-RADS	0.8856	Pass
AREA UNDER CURVE UP TO 40° OR DOWNFLOODING ANGLE > 0.09 m-RADS	0.9586	Pass
AREA BETWEEN 30° AND 40° OR DOWNFLOODING ANGLE > 0.03 m-RADS	0.0730	Pass
RIGHTING ARM, GZ AT 30° > 0.2 METRES	1.767	Pass
ANGLE FROM 0 deg to MAXIMUM GZ @ >25°	14.16	Fail
GM UPRIGHT > 0.150 METRES	14.052	Pass
ABSOLUTE ANGLE AT FLOOD > 0°	32.42	NA
ABSOLUTE ANGLE AT DECK IMMERSION > 0°	13.46	NA

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**Figure 7.4.b: Arrival Condition**

## 7.2 Lifting of Weights over the Side

Lifting weights over the side of the vessel has two impacts on vessel stability. The first is a significant impact on the vertical centre of gravity as the load is taken on the tip of the crane boom. The second is a heeling moment caused by lifting a weight some distance away from the vessel centreline.

On the Traverse, the crane is located 2.92 metres aft of the bow and 0.30 metres to starboard of the vessel centreline, as shown on Figure 7.5. The arc of coverage (5.89 metre radius), for the evaluated out-lift condition is displayed graphically also in Figure 7.5.

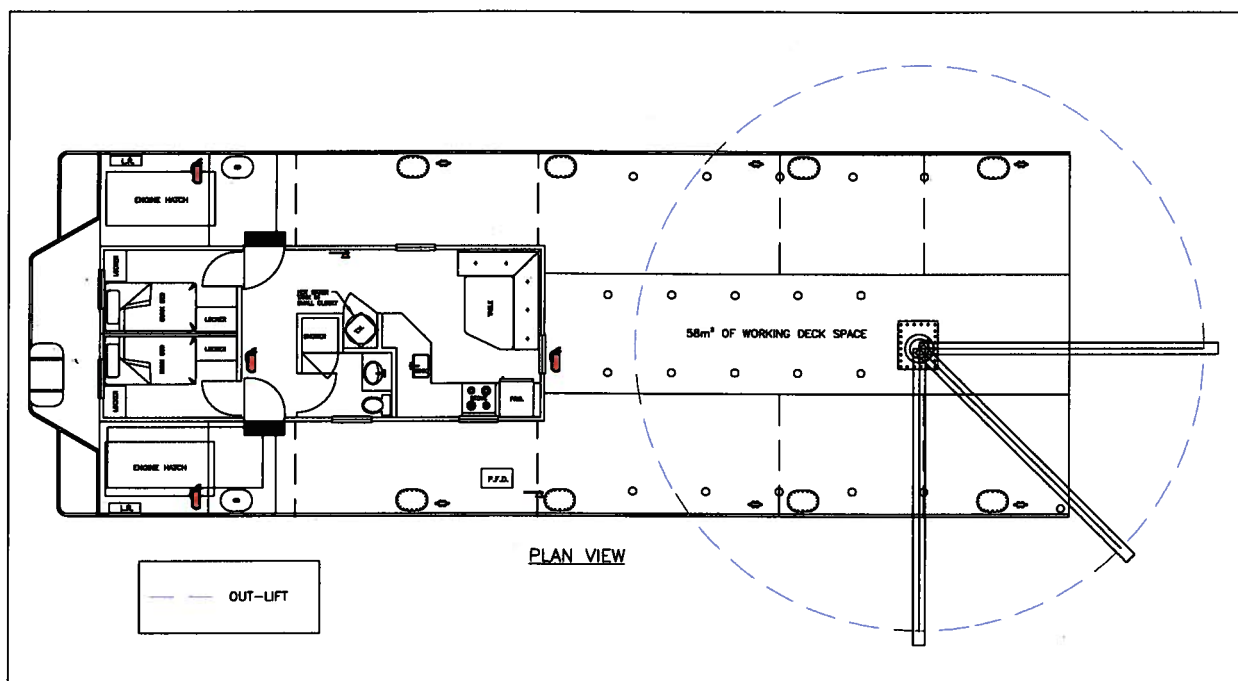


Figure 7.5: Crane Arc of Coverage

The crane model, Palfinger PK 8080, has a recorded Safe Working Load of 2760 lbs, which was used for the purpose of this analysis.

It was assumed that the crane was lifting to starboard, generating the greatest possible moment contributions. Two worst-case lifting scenarios were determined; *high-lift* and *out-lift*:

- The **high-lift** phenomenon considers the extension, angle, and respective maximum operational load that would generate the greatest **vertical** moment.
- The **out-lift** scenario considers the extension, angle, and respective maximum operational load that would generate the greatest **transverse** moment.

Due to a lack of vender information, CCG advised that the crane operational limitations were such that the tip of the extended crane boom at full extension for the *high-lift* scenario is located 9.525m above baseline at the cranes pivot point, and for the *out-lift* scenario is 3.850m above

baseline at a distance 4m to starboard. However for the following analysis an out-lift distance of 6.19m, corresponding to the crane arc of coverage and global location with respect to the origin (0.30m to starboard), was used.

These conditions assumed a stationary, "working" state at some point during voyage, with fuel and reserves at their departure maximum levels. The analysis involved only a maximum value of 20,000 lbs deck load, which was incorporated upon consultation of the local CCG operator.

From this analysis it was determined that the vessel's stability characteristics would not limit the crane in achieving its loading capacity of 2760 lbs.

The righting arm curves for these conditions are shown in Figures 7.6 and 7.7. The full stability analyses (GHS output) are presented in Appendix D.



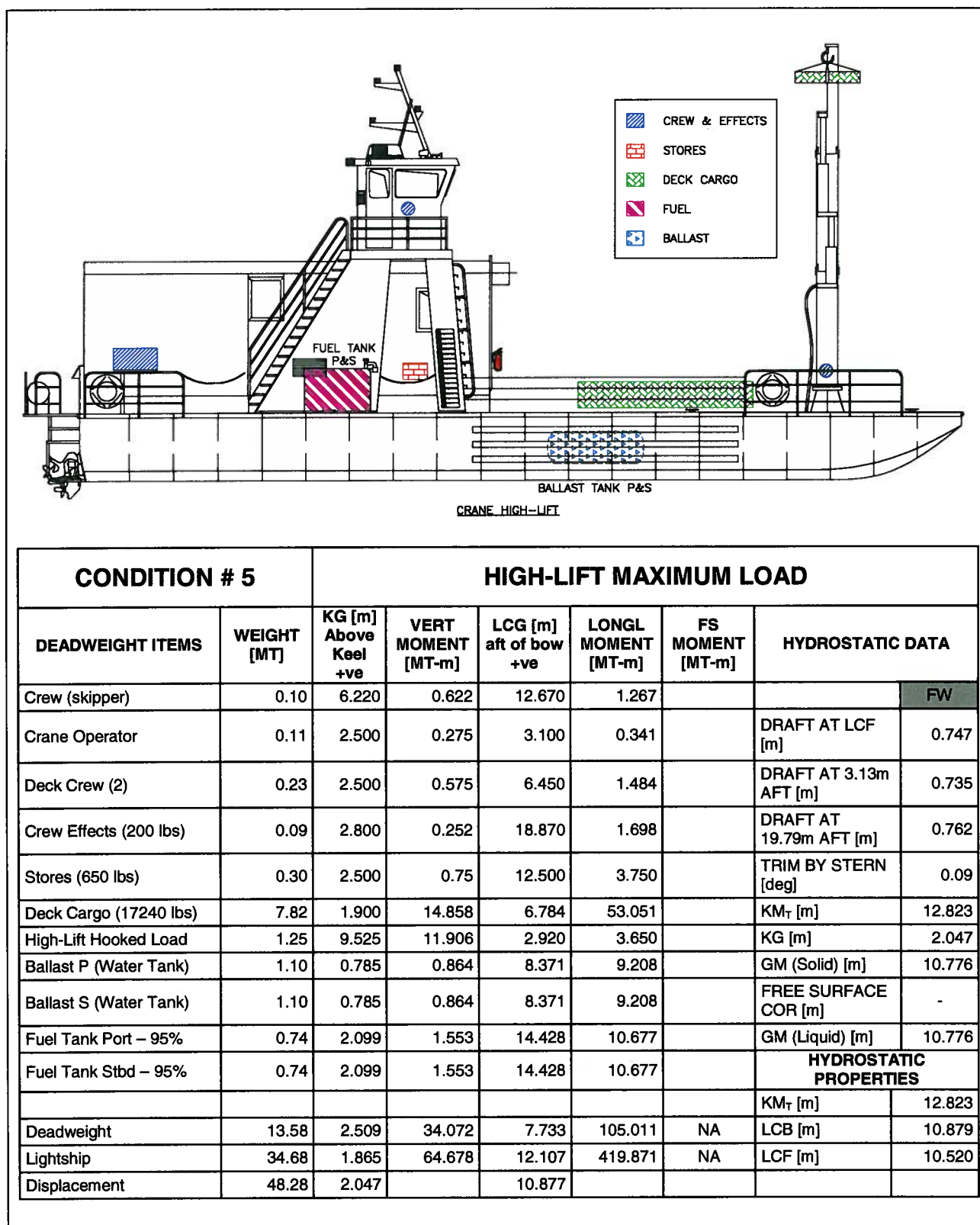
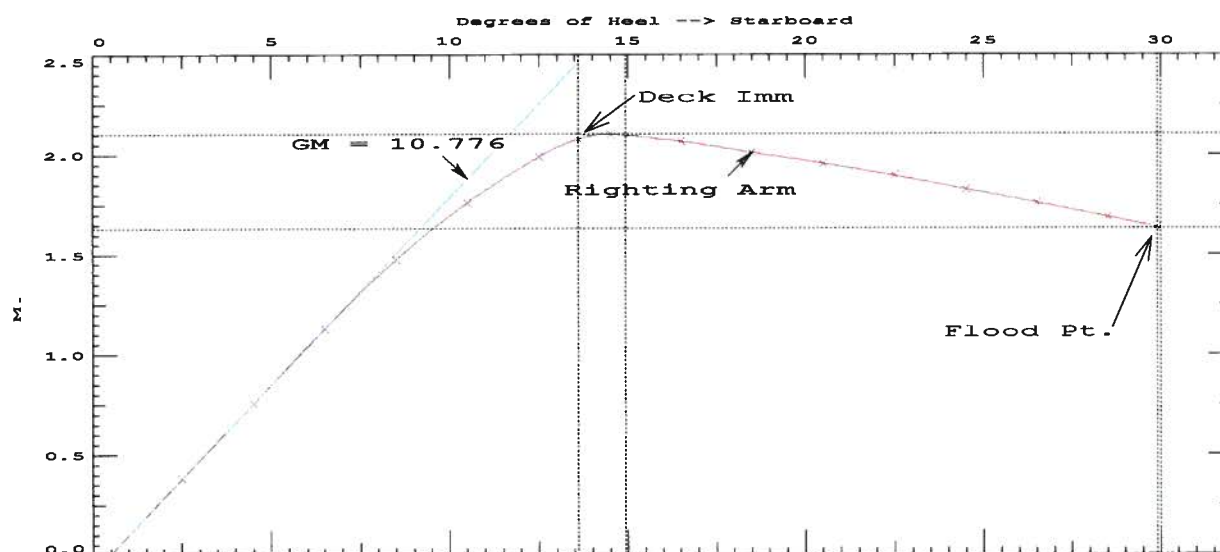


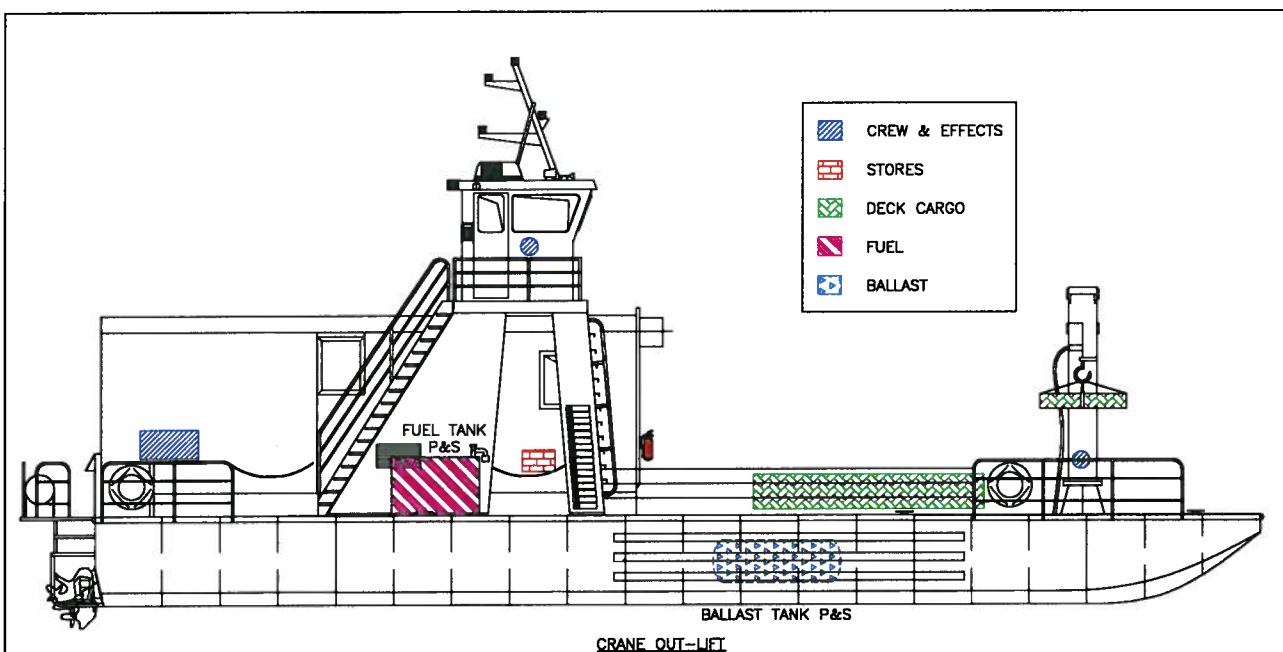
Figure 7.6.a: High-Lift Maximum Load Condition.

STABILITY REQUIREMENTS	RESULTS	COMPLIANCE
AREA UNDER CURVE UP TO 30° > 0.055 m-RADS	0.8071	Pass
AREA UNDER CURVE UP TO 40° OR DOWNFLOODING ANGLE > 0.09 m-RADS	0.8071	Pass
AREA BETWEEN 30° AND 40° OR DOWNFLOODING ANGLE > 0.03 m-RADS	UNDEF	Fail
RIGHTING ARM, GZ AT 30° > 0.2 METRES	UNDEF	Fail
ANGLE FROM 0 deg to MAXIMUM GZ @ >25°	14.49	Fail
GM UPRIGHT > 0.150 METRES	10.776	Pass
ABSOLUTE ANGLE AT FLOOD > 0°	29.90	NA
ABSOLUTE ANGLE AT DECK IMMERSION > 0°	13.61	NA

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**Figure 7.6.b: High-Lift Maximum Load Condition.**



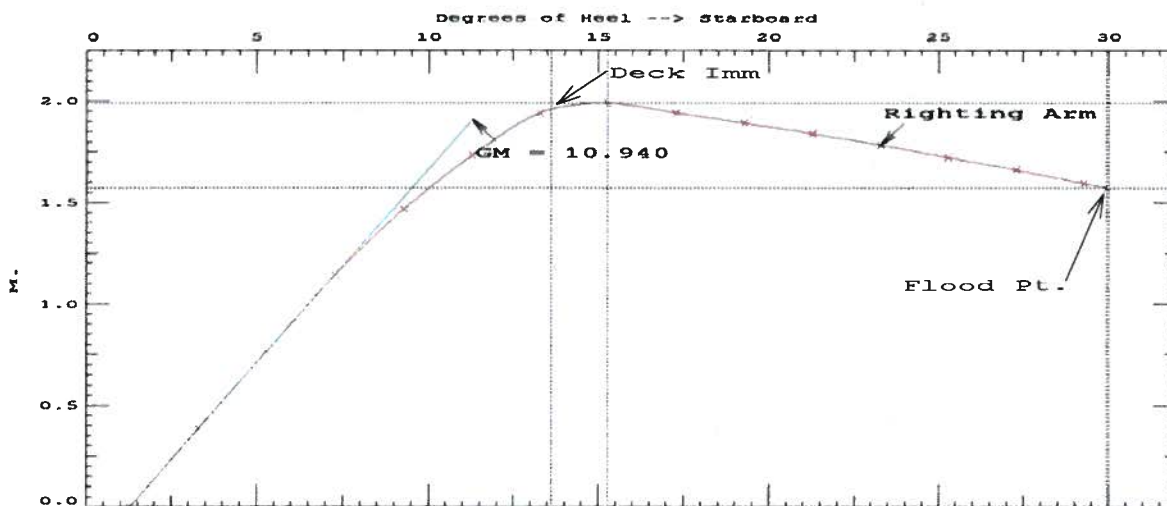
CONDITION # 5a		OUT-LIFT MAXIMUM LOAD						
DEADWEIGHT ITEMS	WEIGHT [MT]	KG [m] Above Keel +ve	VERT MOMENT [MT-m]	LCG [m] aft of bow +ve	LONGL MOMENT [MT-m]	FS MOMENT [MT-m]	HYDROSTATIC DATA	
Crew (skipper)	0.10	6.220	0.622	12.670	1.267			FW
Crane Operator	0.11	2.500	0.275	3.100	0.341		DRAFT AT LCF [m]	0.747
Deck Crew (2)	0.23	2.500	0.575	6.450	1.484		DRAFT AT 3.13m AFT [m]	0.735
Crew Effects (200 lbs)	0.09	2.800	0.252	18.870	1.698		DRAFT AT 19.79m AFT [m]	0.762
Stores (650 lbs)	0.30	2.500	0.75	12.500	3.750		TRIM BY STERN [deg]	0.09
Deck Cargo (17240 lbs)	7.82	1.900	14.858	6.784	53.051		KM <sub>T</sub> [m]	12.839
Out-Lift Hooked Load	1.25	3.850	4.813	2.92	3.65		KG [m]	1.899
Ballast P (Water Tank)	1.10	0.785	0.864	8.371	9.208		GM (Solid) [m]	10.940
Ballast S (Water Tank)	1.10	0.785	0.864	8.371	9.208		FREE SURFACE COR [m]	-
Fuel Tank Port – 95%	0.74	2.099	1.553	14.428	10.677		GM (Liquid) [m]	10.940
Fuel Tank Stbd – 95%	0.74	2.099	1.553	14.428	10.677		HYDROSTATIC PROPERTIES	
							KM <sub>T</sub> [m]	12.839
Deadweight	13.58	1.987	26.979	7.733	105.011	NA	LCB [m]	10.879
Lightship	34.68	1.865	64.678	12.107	419.871	NA	LCF [m]	10.515
Displacement	48.27	1.899		10.877				

Figure 7.7.a: Out-Lift Maximum Load Condition.

STABILITY REQUIREMENTS	RESULTS	COMPLIANCE
AREA UNDER CURVE UP TO 30° > 0.055 m-RADS	0.7538	Pass
AREA UNDER CURVE UP TO 40° OR DOWNFLOODING ANGLE > 0.09 m-RADS	0.7538	Pass
AREA BETWEEN 30° AND 40° OR DOWNFLOODING ANGLE > 0.03 m-RADS	UNDEF	Fail
RIGHTING ARM, GZ AT 30° > 0.2 METRES	UNDEF	Fail
ANGLE FROM 0 deg to MAXIMUM GZ @ >25°	14.81	Fail
GM UPRIGHT > 0.150 METRES	10.940	Pass
ABSOLUTE ANGLE AT FLOOD > 0°	29.93	NA
ABSOLUTE ANGLE AT DECK IMMERSION > 0°	13.61	NA

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**Figure 7.7.b: Out-Lift Maximum Load Condition.**

## **APPENDIX A**

### **HYDROSTATIC PROPERTIES**

Hydrostatics "As-Inclined"  
WEIGHT and DISPLACEMENT STATUS  
Baseline draft: 0.517 @ Origin

Trim: Aft 0.73 deg., Heel: Stbd 0.29 deg.

Part-----	Weight(MT)----	LCG-----	TCG-----	VCG
WEIGHT	39.86	11.682a	0.078s	0.000
	SpGr-----	Displ(MT)----	LCB-----	TCB-----
HULL	1.000	39.86	11.677a	0.076s
				VCB-----
				RefHt
				-0.517
-----				
Righting Arms:		0.000	0.000s	
Distances in METERS.-----				

HYDROSTATIC PROPERTIES

Trim: Aft 0.73 deg., Heel: Stbd 0.29 deg.

Origin	Displacement	Center of Buoyancy						
Depth-----	Weight(MT)----	LCB-----	TCB-----	VCB-----	WPA-----	LCF-----	BML-----	BMT
0.517	39.86	11.677a	0.076s	0.419	87.1	10.717a	64.71	14.658
Distances in METERS.-----Specific Gravity = 1.000.-----								

Hydrostatics "Even Keel"

HYDROSTATIC PROPERTIES

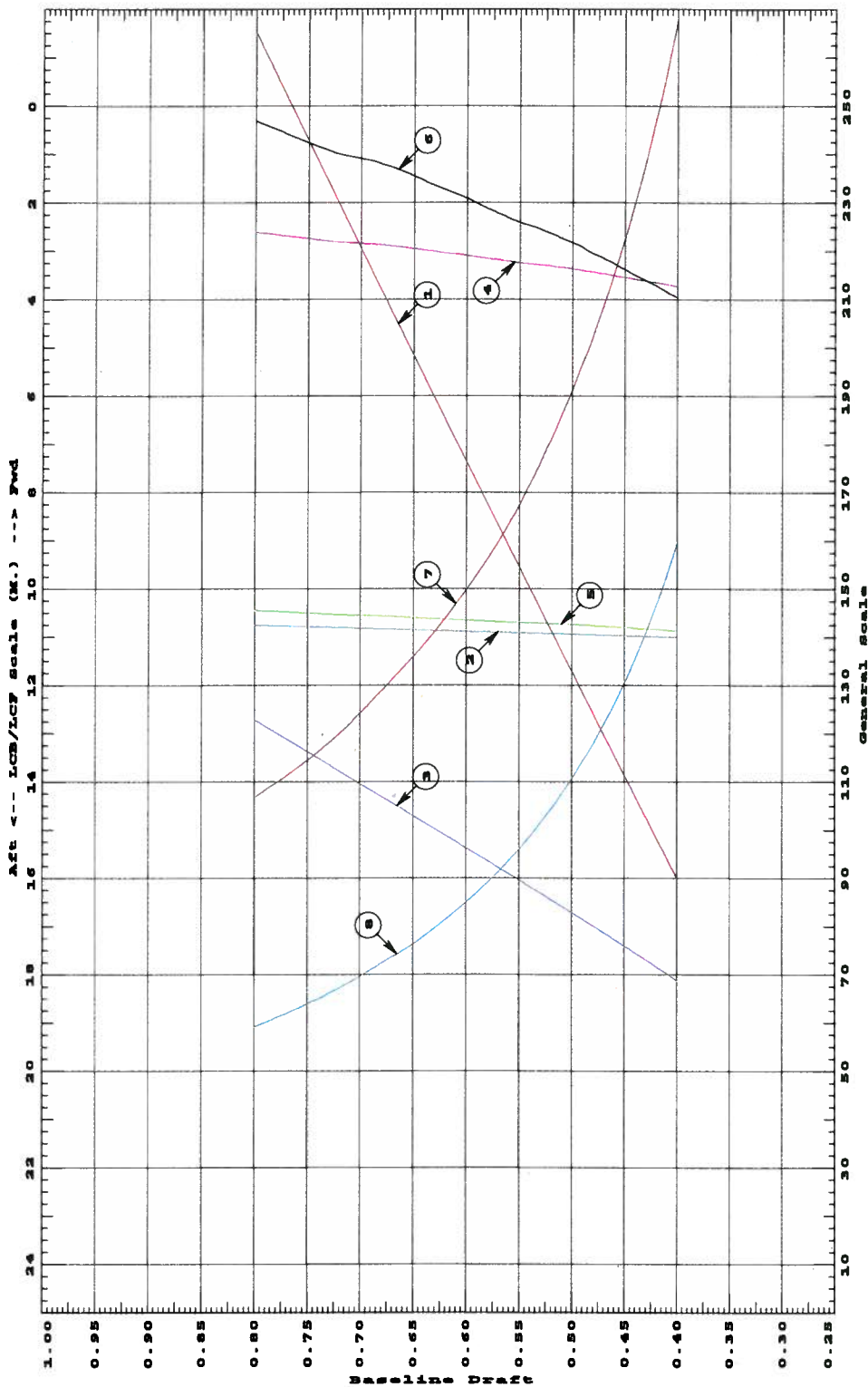
No Trim, No Heel, VCG = 0.000

Draft@	Displacement	Buoyancy-Ctr.		Weight/	Moment/			
11.458a----	Weight(MT)----	LCB-----	VCB-----	cm-----	LCF--	Deg trim----	KML-----	KMT
0.400	17.98	11.005a	0.275	0.85	10.871a	42.08	134.10	31.952
0.405	18.40	11.001a	0.278	0.85	10.864a	42.19	131.34	31.249
0.410	18.83	10.998a	0.281	0.85	10.857a	42.31	128.72	30.579
0.415	19.26	10.995a	0.284	0.85	10.849a	42.44	126.26	29.943
0.420	19.68	10.991a	0.287	0.85	10.841a	42.56	123.89	29.331
0.425	20.11	10.988a	0.289	0.85	10.835a	42.67	121.57	28.741
0.430	20.54	10.984a	0.292	0.86	10.828a	42.78	119.35	28.175
0.435	20.96	10.981a	0.295	0.86	10.821a	42.89	117.23	27.631
0.440	21.39	10.977a	0.298	0.86	10.814a	43.01	115.18	27.109
0.445	21.82	10.974a	0.301	0.86	10.807a	43.12	113.22	26.608
0.450	22.25	10.970a	0.304	0.86	10.800a	43.24	111.34	26.125
0.455	22.68	10.967a	0.306	0.86	10.793a	43.35	109.53	25.660
0.460	23.11	10.963a	0.309	0.86	10.786a	43.47	107.78	25.213
0.465	23.54	10.960a	0.312	0.86	10.779a	43.59	106.10	24.781
0.470	23.97	10.956a	0.315	0.86	10.772a	43.70	104.47	24.364
0.475	24.40	10.953a	0.318	0.86	10.767a	43.80	102.86	23.957
0.480	24.83	10.949a	0.320	0.86	10.761a	43.90	101.30	23.565
0.485	25.26	10.946a	0.323	0.86	10.755a	44.01	99.80	23.185
0.490	25.69	10.942a	0.326	0.86	10.746a	44.16	98.48	22.845
0.495	26.12	10.939a	0.329	0.86	10.740a	44.26	97.06	22.490
0.500	26.56	10.935a	0.331	0.87	10.735a	44.35	95.68	22.146
0.505	26.99	10.932a	0.334	0.87	10.730a	44.44	94.34	21.813
0.510	27.42	10.929a	0.337	0.87	10.725a	44.54	93.05	21.491
0.515	27.85	10.925a	0.340	0.87	10.720a	44.63	91.79	21.178
0.520	28.29	10.922a	0.342	0.87	10.715a	44.72	90.57	20.875
0.525	28.72	10.919a	0.345	0.87	10.709a	44.81	89.38	20.581
0.530	29.16	10.915a	0.348	0.87	10.704a	44.90	88.23	20.295
0.535	29.59	10.912a	0.351	0.87	10.700a	44.98	87.08	20.015

0.540	30.02	10.909a	0.353	0.87	10.697a	45.05	85.95	19.742
0.545	30.46	10.906a	0.356	0.87	10.694a	45.12	84.86	19.476
0.550	30.89	10.903a	0.359	0.87	10.690a	45.18	83.79	19.218
0.555	31.33	10.900a	0.361	0.87	10.686a	45.26	82.77	18.969
0.560	31.76	10.896a	0.364	0.87	10.681a	45.36	81.81	18.729
0.565	32.20	10.893a	0.367	0.87	10.676a	45.46	80.87	18.496
0.570	32.64	10.890a	0.369	0.87	10.670a	45.55	79.97	18.269
0.575	33.07	10.887a	0.372	0.87	10.665a	45.65	79.08	18.047
0.580	33.51	10.884a	0.375	0.87	10.659a	45.75	78.23	17.832
0.585	33.95	10.881a	0.377	0.87	10.654a	45.86	77.39	17.621
0.590	34.38	10.878a	0.380	0.88	10.648a	45.96	76.58	17.416
0.595	34.82	10.875a	0.383	0.88	10.642a	46.06	75.79	17.217
0.600	35.26	10.872a	0.385	0.88	10.636a	46.17	75.02	17.022
0.605	35.70	10.869a	0.388	0.88	10.631a	46.27	74.26	16.831
0.610	36.14	10.866a	0.391	0.88	10.626a	46.35	73.49	16.642
0.615	36.57	10.863a	0.393	0.88	10.622a	46.44	72.74	16.458
0.620	37.01	10.860a	0.396	0.88	10.618a	46.52	72.01	16.277
0.625	37.45	10.857a	0.399	0.88	10.614a	46.61	71.29	16.101
0.630	37.89	10.854a	0.401	0.88	10.609a	46.70	70.61	15.930
0.635	38.33	10.851a	0.404	0.88	10.604a	46.80	69.94	15.762
0.640	38.77	10.848a	0.407	0.88	10.598a	46.90	69.29	15.598
0.645	39.21	10.845a	0.409	0.88	10.593a	47.00	68.66	15.438
0.650	39.66	10.842a	0.412	0.88	10.588a	47.10	68.04	15.281
0.655	40.10	10.839a	0.415	0.88	10.582a	47.20	67.44	15.128
0.660	40.54	10.836a	0.417	0.88	10.577a	47.29	66.84	14.997
0.665	40.98	10.833a	0.420	0.88	10.573a	47.38	66.23	14.850
0.670	41.42	10.830a	0.422	0.88	10.569a	47.46	65.64	14.749
0.675	41.86	10.827a	0.425	0.88	10.564a	47.53	65.04	14.607
0.680	42.31	10.824a	0.428	0.89	10.560a	47.60	64.46	14.468
0.685	42.75	10.822a	0.430	0.89	10.555a	47.67	63.89	14.332
0.690	43.19	10.819a	0.433	0.89	10.551a	47.74	63.33	14.199
0.695	43.63	10.816a	0.436	0.89	10.548a	47.79	62.74	14.065
0.700	44.08	10.813a	0.438	0.89	10.546a	47.83	62.17	13.934
0.705	44.52	10.811a	0.441	0.89	10.543a	47.87	61.60	13.805
0.710	44.96	10.808a	0.444	0.89	10.540a	47.92	61.05	13.679
0.715	45.41	10.805a	0.446	0.89	10.538a	47.96	60.51	13.556
0.720	45.85	10.803a	0.449	0.89	10.535a	48.01	59.98	13.435
0.725	46.30	10.800a	0.452	0.89	10.531a	48.08	59.49	13.319
0.730	46.74	10.798a	0.454	0.89	10.526a	48.16	59.02	13.207
0.735	47.18	10.795a	0.457	0.89	10.521a	48.24	58.57	13.097
0.740	47.63	10.792a	0.459	0.89	10.516a	48.32	58.12	12.988
0.745	48.07	10.790a	0.462	0.89	10.511a	48.40	57.68	12.882
0.750	48.52	10.787a	0.465	0.89	10.505a	48.49	57.25	12.777
0.755	48.96	10.785a	0.467	0.89	10.500a	48.57	56.83	12.675
0.760	49.41	10.782a	0.470	0.89	10.494a	48.66	56.42	12.574
0.765	49.86	10.779a	0.473	0.89	10.489a	48.75	56.02	12.475
0.770	50.30	10.777a	0.475	0.89	10.483a	48.84	55.62	12.377
0.775	50.75	10.774a	0.478	0.89	10.478a	48.93	55.24	12.282
0.780	51.20	10.771a	0.480	0.89	10.472a	49.02	54.86	12.188
0.785	51.64	10.769a	0.483	0.89	10.466a	49.12	54.49	12.096
0.790	52.09	10.766a	0.486	0.89	10.460a	49.21	54.12	12.004
0.795	52.54	10.763a	0.488	0.89	10.455a	49.29	53.75	11.912
0.800	52.99	10.761a	0.491	0.90	10.450a	49.38	53.39	11.822

Distances in METERS.-----Specific Gravity = 1.000.-----Moment in m.-MT.  
Draft is from Baseline.

HYDROSTATIC PROPERTIES AT LEVEL TRIM



Specific Gravity = 1.000 Assumed KG = 0.00 M.  
"K" = base plane



## **APPENDIX B**

### **CROSS CURVES OF STABILITY**

Note: Superstructure is not included in these calculations of righting arm.

CROSS CURVES OF STABILITY

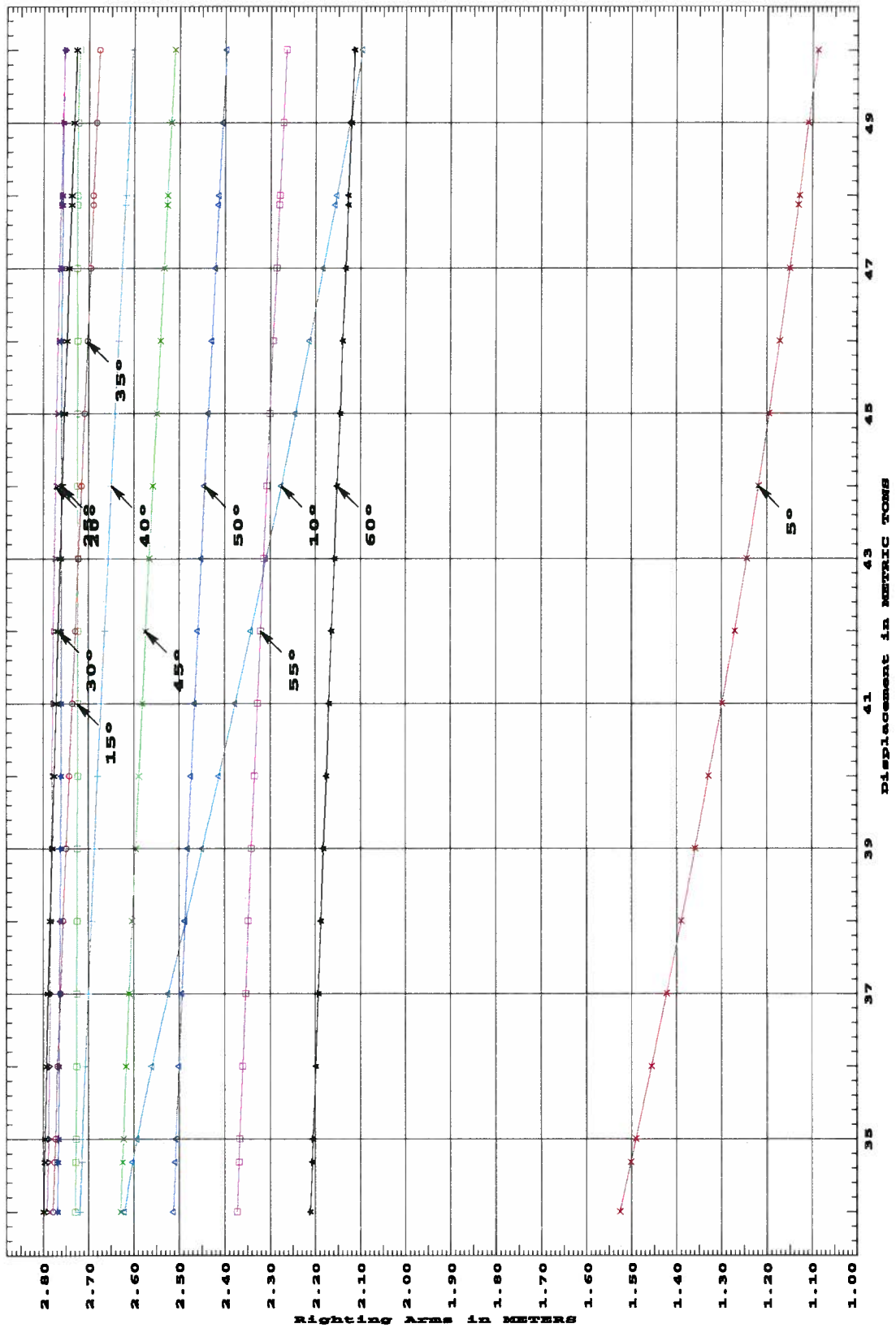
Showing righting arms in heel at VCG = 0.00

Trim: zero at zero heel (trim righting arm held at zero)

Displacement METRIC TONS	Heel Angles in Degrees					
	5.00s	10.00s	15.00s	20.00s	25.00s	30.00s
34.00	1.525s	2.619s	2.727s	2.766s	2.790s	2.798s
34.68	1.501s	2.601s	2.726s	2.765s	2.788s	2.796s
35.00	1.490s	2.592s	2.726s	2.765s	2.787s	2.795s
36.00	1.455s	2.559s	2.725s	2.763s	2.785s	2.791s
37.00	1.422s	2.522s	2.724s	2.762s	2.783s	2.787s
38.00	1.390s	2.485s	2.724s	2.761s	2.782s	2.783s
39.00	1.359s	2.447s	2.723s	2.760s	2.781s	2.779s
40.00	1.328s	2.411s	2.723s	2.759s	2.779s	2.775s
41.00	1.299s	2.376s	2.723s	2.759s	2.778s	2.771s
42.00	1.271s	2.341s	2.723s	2.759s	2.776s	2.766s
43.00	1.245s	2.308s	2.723s	2.759s	2.774s	2.762s
44.00	1.219s	2.275s	2.723s	2.759s	2.772s	2.757s
45.00	1.195s	2.243s	2.723s	2.759s	2.770s	2.752s
46.00	1.172s	2.212s	2.724s	2.758s	2.767s	2.747s
47.00	1.150s	2.182s	2.724s	2.758s	2.764s	2.742s
47.87	1.131s	2.156s	2.724s	2.757s	2.761s	2.737s
48.00	1.129s	2.152s	2.724s	2.757s	2.760s	2.737s
49.00	1.108s	2.124s	2.724s	2.755s	2.757s	2.731s
50.00	1.089s	2.096s	2.720s	2.753s	2.753s	2.726s
-----						
METRIC TONS	35.00s	40.00s	45.00s	50.00s	55.00s	60.00s
34.00	2.776s	2.718s	2.628s	2.512s	2.371s	2.210s
34.68	2.773s	2.714s	2.624s	2.507s	2.367s	2.206s
35.00	2.771s	2.712s	2.622s	2.505s	2.365s	2.204s
36.00	2.766s	2.706s	2.615s	2.499s	2.359s	2.199s
37.00	2.761s	2.699s	2.609s	2.492s	2.353s	2.193s
38.00	2.755s	2.693s	2.602s	2.486s	2.347s	2.187s
39.00	2.748s	2.686s	2.595s	2.479s	2.340s	2.181s
40.00	2.742s	2.679s	2.588s	2.472s	2.334s	2.175s
41.00	2.735s	2.671s	2.581s	2.465s	2.327s	2.169s
42.00	2.728s	2.664s	2.573s	2.458s	2.321s	2.163s
43.00	2.722s	2.656s	2.565s	2.450s	2.314s	2.157s
44.00	2.715s	2.648s	2.558s	2.443s	2.307s	2.151s
45.00	2.708s	2.641s	2.550s	2.436s	2.300s	2.145s
46.00	2.702s	2.633s	2.542s	2.428s	2.293s	2.139s
47.00	2.695s	2.625s	2.534s	2.420s	2.286s	2.133s
47.87	2.689s	2.619s	2.527s	2.414s	2.280s	2.127s
48.00	2.689s	2.618s	2.526s	2.413s	2.279s	2.127s
49.00	2.682s	2.611s	2.518s	2.405s	2.272s	2.120s
50.00	2.676s	2.603s	2.510s	2.397s	2.265s	2.114s

Distances in METERS.---Specific Gravity = 1.000.-----

CROSS CURVES OF STABILITY WITH - STBD HEEL  
at LEVEL TRIM (initial)



Specific Gravity = 1.000 Assumed KG = 0.00 M.  
"K" = base plane

## **APPENDIX C**

### **TANK CAPACITIES**

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Page 1

**TANK CHARACTERISTICS**

**No Trim, No Heel**

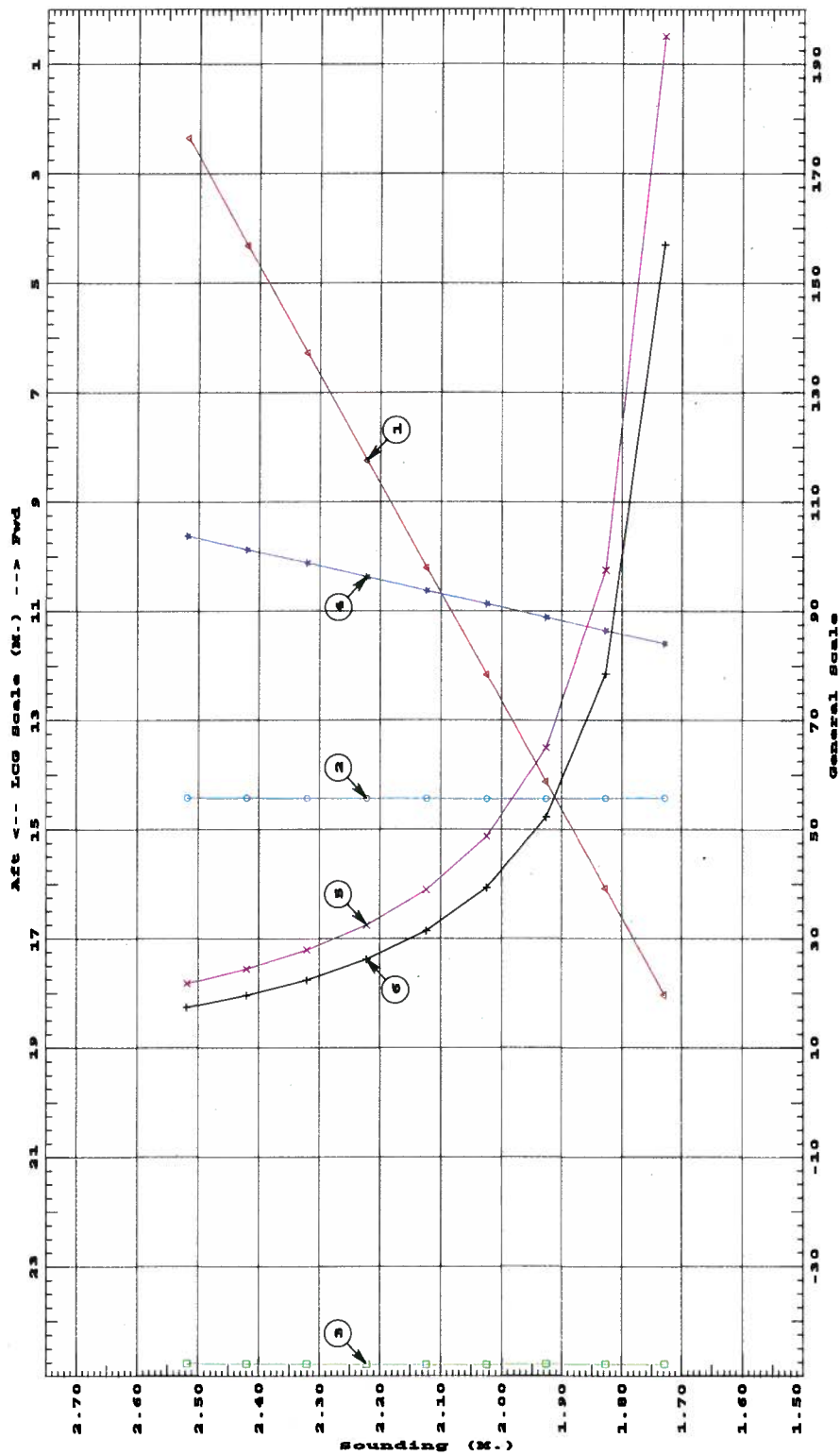
**Tank: FUEL.P, Contents: DIESEL OIL at 0.870 Specific Gravity**

Snding	Load	Weight	Center of Gravity			GML	GMT
		METRIC TON	LCG	TCG	VCG		
1729	.100	0.08	14.428a	3.345p	1.679	1.95	0.314
1827	.200	0.16	14.428a	3.345p	1.729	0.98	0.157
1926	.300	0.24	14.428a	3.345p	1.778	0.65	0.105
2025	.400	0.31	14.428a	3.345p	1.827	0.49	0.079
2124	.500	0.39	14.428a	3.345p	1.877	0.39	0.063
2222	.600	0.47	14.428a	3.345p	1.926	0.33	0.052
2321	.700	0.55	14.428a	3.345p	1.975	0.28	0.045
2420	.800	0.63	14.428a	3.345p	2.025	0.24	0.039
2518	.900	0.71	14.428a	3.345p	2.074	0.22	0.035
	1.000	0.78	14.428a	3.345p	2.124		

-----Distances in METERS.-----

FUEL.P Reference Point: Long.= 0.000 Trans.= 0.000 Vert.= 0.000

FUEL T  
TANK CHARACTERISTICS at LEVEL TRIM



- 1 Weight 1=0.004 MT
- 2 LCG (see top scale)
- 3 TCG 1=-.07 M.
- 4 VCG 1=-.02 M.
- 5 GML 1=-.01 M.
- 6 GMT 1=-.002 M.

DIESEL OIL Specific Gravity = 0.870

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**TANK CHARACTERISTICS**

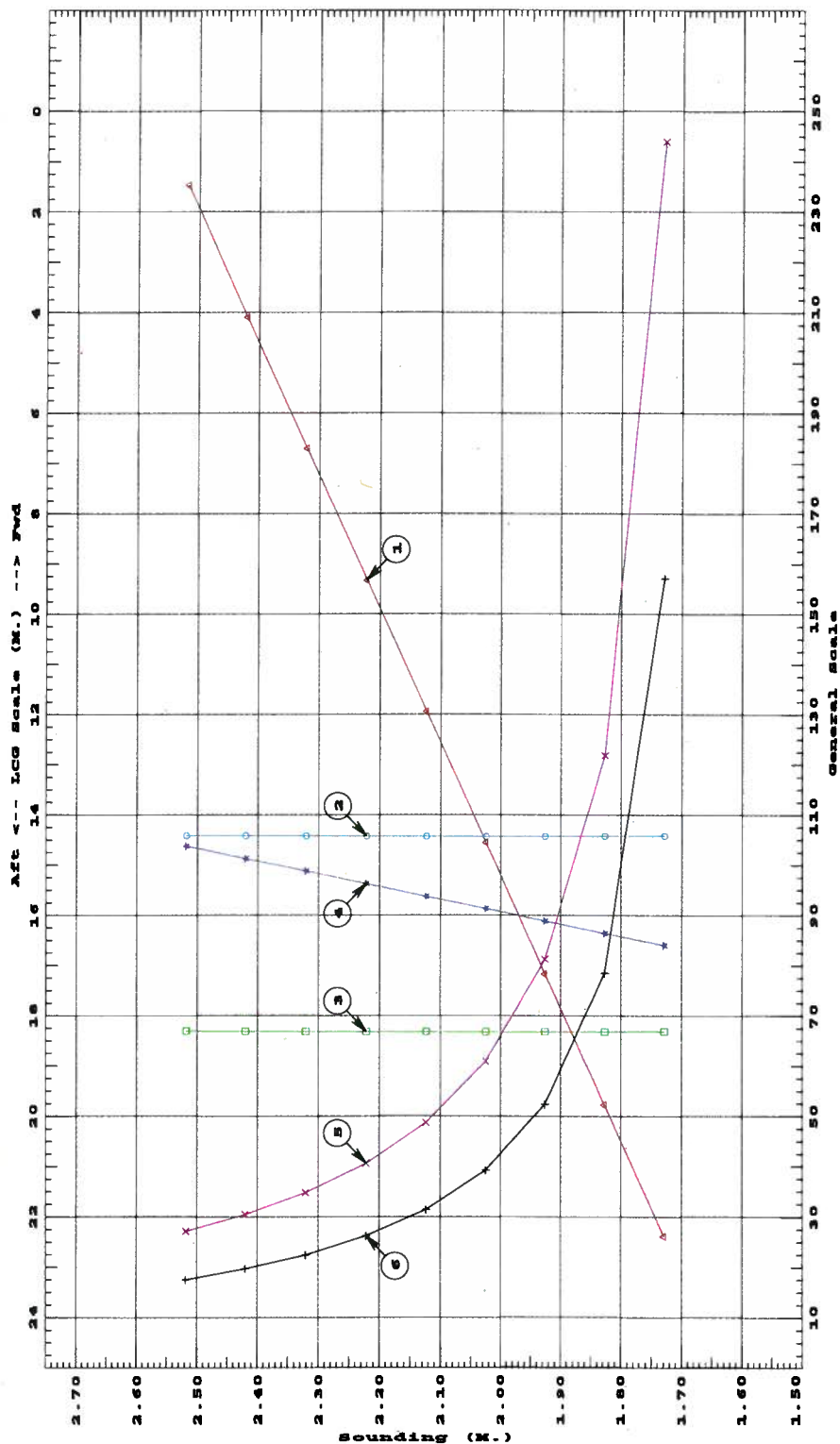
**No Trim, No Heel**

**Tank: FUEL.S, Contents: DIESEL OIL at 0.870 Specific Gravity**

Snding	Load	Weight		Center of Gravity			GML	GMT
		METRIC	TON	LCG	TCG	VCG		
1729	.100	0.08	14.428a	3.345s	1.679	1.95	0.314	
1827	.200	0.16	14.428a	3.345s	1.729	0.98	0.157	
1926	.300	0.24	14.428a	3.345s	1.778	0.65	0.105	
2025	.400	0.31	14.428a	3.345s	1.827	0.49	0.079	
2124	.500	0.39	14.428a	3.345s	1.877	0.39	0.063	
2222	.600	0.47	14.428a	3.345s	1.926	0.33	0.052	
2321	.700	0.55	14.428a	3.345s	1.975	0.28	0.045	
2420	.800	0.63	14.428a	3.345s	2.025	0.24	0.039	
2518	.900	0.71	14.428a	3.345s	2.074	0.22	0.035	
	1.000	0.78	14.428a	3.345s	2.124			

-----Distances in METERS-----  
FUEL.S Reference Point: Long.= 0.000 Trans.= 0.000 Vert.= 0.000

FUEL.S  
TANK CHARACTERISTICS AT LEVEL TRIM



- 1 Weight 1.003 MT
- 2 LCG (see top scale)
- 3 TCG 1.05 M.
- 4 VCG 1.02 M.
- 5 GML 1.008 M.
- 6 GMT 1.002 M.

DIESEL OIL Specific Gravity = 0.870



## **APPENDIX D**

### **STABILITY ANALYSIS – GHS OUTPUT**

CONDITION NUMBER 1

LIGHTSHIP

WEIGHT and DISPLACEMENT STATUS

Baseline draft: 0.410 @ Origin

Trim: Aft 0.98 deg., Heel: Stbd 0.39 deg.

Part-----	Weight(MT)-----	LCG-----	TCG-----	VCG-----	FSM-----
WEIGHT	34.68	12.107a	0.104s	1.865	
Load-----	SpGr-----	Weight(MT)-----	LCG-----	TCG-----	VCG-----
Total Tanks----->		0.00			0.00
		Displ(MT)-----	LCB-----	TCB-----	VCB-----
HULL	1.000	34.68	12.132a	0.114s	0.393

Righting Arms: 0.000 0.000s  
Distances in METERS-----Moments in m.-MT.

WEIGHT STATUS

Trim: Aft 0.98 deg., Heel: Stbd 0.39 deg.

Part-----	Weight(MT)-----	LCG-----	TCG-----	VCG-----
Total Tanks----->	0.00			

Distances in METERS-----

CRITICAL POINT STATUS

Baseline draft: 0.410 @ Origin

Trim: Aft 0.98 deg., Heel: Stbd 0.39 deg.

Critical Points-----	LCP-----	TCP-----	VCP-----	Height-----
(1) Engine Vent stern	FLOOD 20.100a	3.350s	2.138	1.362
(1) Engine Vent stern	FLOOD 20.100a	3.350p	2.138	1.407
(2) Engine Vent side	FLOOD 18.354a	3.660s	2.138	1.389
(2) Engine Vent side	FLOOD 18.354a	3.660p	2.138	1.439

Distances in METERS-----

HYDROSTATIC PROPERTIES

Trim: Aft 0.98 deg., Heel: Stbd 0.39 deg., VCG = 1.865

LCF	Displacement	Buoyancy-Ctr.	Weight/	Moment/
Draft-----	Weight(MT)-----	LCB-----	VCB-----	cm-----
0.595	34.68	12.132a	0.393	0.86
				10.843a
				42.36
				69.97
				15.148

Distances in METERS-----Specific Gravity = 1.000-----Moment in m.-MT.  
Draft is from Baseline.

RIGHTING ARMS vs HEEL ANGLE

LCG = 12.107a TCG = 0.104s VCG = 1.865

Origin	Degrees of	Displacement	Righting Arms	Flood Pt
Depth---Trim---	Heel---	Weight(MT)---	in Trim---in Heel---	Area --Height
0.410 0.98a	0.39s	34.68	0.000 0.000	0.0000 1.362(1)
0.406 0.99a	2.39s	34.68	0.000 0.530	0.0093 1.242(1)
0.390 1.05a	4.39s	34.68	0.000 1.041	0.0367 1.117(1)
0.353 1.17a	6.39s	34.68	0.000 1.495	0.0811 0.988(1)
0.283 1.38a	8.39s	34.68	0.000 1.840	0.1395 0.854(2)
0.175 1.68a	10.39s	34.68	0.000 2.044	0.2073 0.728(2)
0.055 1.95a	12.39s	34.67	0.000 2.140	0.2803 0.623(2)
-0.022 2.07a	13.75s	34.68	0.000 2.159	0.3313 0.567(2)
-0.037 2.08a	14.03s	34.68	0.000 2.159	0.3418 Deck Imm.

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## TRAVERSE INTACT ANALYSIS

LIGHTSHIP

-0.055	2.09a	14.39s	34.68	0.000	2.155	0.3555	0.546(2)
-0.149	2.09a	16.39s	34.68	0.000	2.113	0.4301	0.497(2)
-0.242	2.09a	18.39s	34.68	0.000	2.068	0.5031	0.447(2)
-0.337	2.09a	20.39s	34.68	0.000	2.019	0.5745	0.396(2)
-0.433	2.10a	22.39s	34.68	0.000	1.969	0.6441	0.343(2)
-0.530	2.12a	24.39s	34.68	0.000	1.915	0.7119	0.287(2)
-0.628	2.15a	26.39s	34.68	0.000	1.859	0.7778	0.229(2)
-0.728	2.18a	28.39s	34.68	0.000	1.799	0.8416	0.169(2)
-0.810	2.22a	30.00s	34.68	0.000	1.749	0.8915	0.119(2)
-0.830	2.23a	30.39s	34.68	0.000	1.737	0.9033	0.107(2)
-0.998	2.34a	33.68s	34.68	0.000	1.628	0.9998	0.000(2)

Distances in METERS.----Specific Gravity = 1.000.-----Area in m.-Rad.

## Critical Points-----LCP-----TCP-----VCP

(1) Engine Vent stern FLOOD 20.100a 3.350 2.138

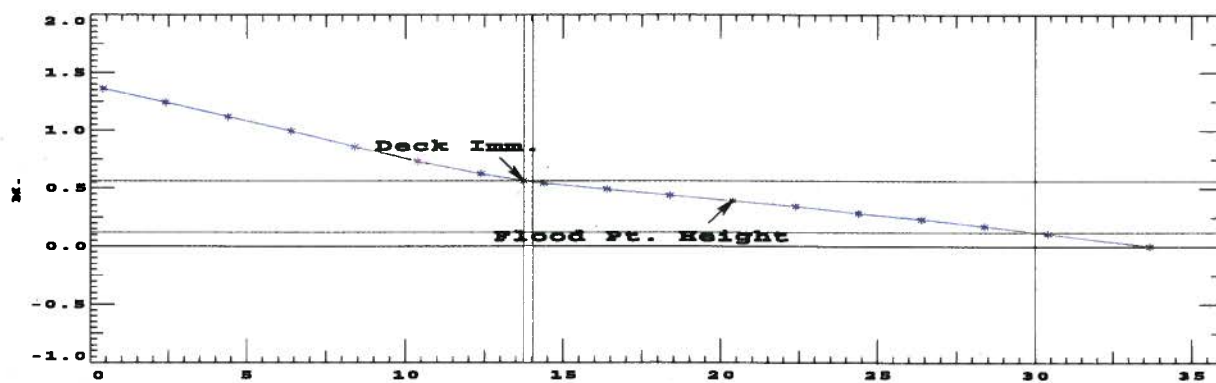
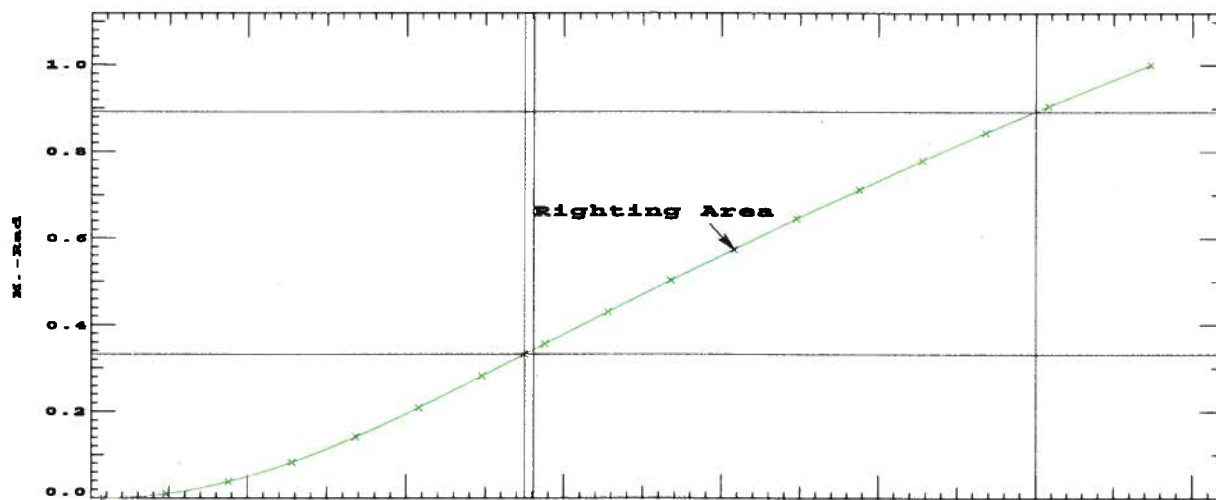
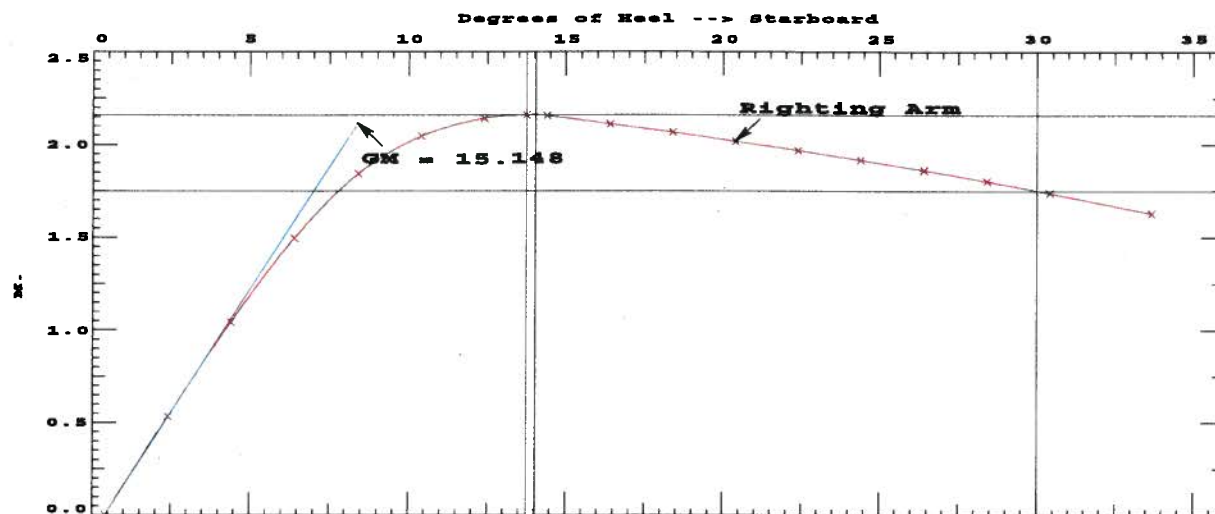
(2) Engine Vent side FLOOD 18.354a 3.660 2.138

LIM-----	STAB 6 CRITERION-----	Min/Max-----	Attained
(1) Area from Equilibrium to abs 30 deg	>	0.0550 m.-Rad	0.8915 P
(2) Area from Equilibrium to abs 40 deg	>	0.0900 m.-Rad	UNDEF
(3) Area from abs 30 deg to abs 40	>	0.0300 m.-Rad	UNDEF
(4) Righting Arm at abs 30 deg	>	0.200 m.	1.749 P
(5) Absolute Angle at MaxRA	>	25.00 deg	13.75 F
(6) GM at Equilibrium	>	0.150 m.	LARGE
(7) Absolute Angle at Flood	>	0.00 deg	33.68 P
(8) Absolute Angle at Deck Immersion	>	0.00 deg	14.03 P
(9) Area from Equilibrium to Flood	>	0.0900 m.-Rad	0.9998 P

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LIGHTSHIP

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LIGHT LOAD

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TRAVERSE INTACT ANALYSIS

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CONDITION NUMBER 2

LIGHT LOAD

WEIGHT and DISPLACEMENT STATUS

Baseline draft: 0.469 @ Origin

Trim: Aft 0.85 deg., Heel: Stbd 0.40 deg.

Part-----	Load-----	SpGr-----	Weight(MT)-----	LCG-----	TCG-----	VCG-----	FSM-----
LIGHT SHIP			34.68	12.107a	0.104s	1.865	
Crew (skipper)			0.10	12.670a	0.000	6.220	
Crane Operator			0.11	3.100a	1.060s	2.500	
Deck Crew (2)			0.23	6.450a	0.000	2.500	
Ballast P (Water Tank)			1.10	8.371a	1.464s	0.785	
Ballast S (Water Tank)			1.10	8.371a	1.464p	0.785	
Total Fixed----->			37.32	11.827a	0.100s	1.819	
FUEL.P	0.300	0.870	0.24	14.438a	3.344p	1.778	0.02
FUEL.S	0.300	0.870	0.24	14.438a	3.346s	1.778	0.02
Total Tanks----->			0.47	14.438a	0.001	1.778	0.05
Total Weight----->			37.79	11.859a	0.099s	1.819	
HULL	1.000		37.79	11.880a	0.109s	0.409	

Righting Arms: 0.000 0.000s  
Distances in METERS----- Moments in m.-MT.

TANK STATUS

Trim: Aft 0.85 deg., Heel: Stbd 0.40 deg.

Part-----	Load-----	SpGr-----	Weight(MT)-----	LCG-----	TCG-----	VCG-----	RefHt-----
FUEL.P	0.300	0.870	0.24	14.438a	3.344p	1.778	-1.734
FUEL.S	0.300	0.870	0.24	14.438a	3.346s	1.778	-1.687
Total Tanks----->			0.47	14.438a	0.001	1.778	

Distances in METERS-----

CRITICAL POINT STATUS

Baseline draft: 0.469 @ Origin

Trim: Aft 0.85 deg., Heel: Stbd 0.40 deg.

Critical Points-----	LCP-----	TCP-----	VCP-----	Height-----
(1) Engine Vent stern	FLOOD 20.100a	3.350s	2.138	1.345
(1) Engine Vent stern	FLOOD 20.100a	3.350p	2.138	1.392
(2) Engine Vent side	FLOOD 18.354a	3.660s	2.138	1.369
(2) Engine Vent side	FLOOD 18.354a	3.660p	2.138	1.420

Distances in METERS-----

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LIGHT LOAD

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TRAVERSE INTACT ANALYSIS

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HYDROSTATIC PROPERTIES

Trim: Aft 0.85 deg., Heel: Stbd 0.40 deg., VCG = 1.819

LCF	Displacement	Buoyancy-Ctr.	Weight/	Moment/
Draft----	Weight(MT)----	LCB-----	VCB-----	cm-----
LCF--Deg trim----	GML-----	GMT		
0.630	37.79	11.880a	0.409	0.87
10.766a	43.39	65.77	13.966	
Distances in METERS.-----Specific Gravity = 1.000.-----Moment in m.-MT.				
Draft is from Baseline. True Free Surface included.				

RIGHTING ARMS vs HEEL ANGLE

Fixed CG: LCG = 11.827a TCG = 0.100s VCG = 1.819

Origin	Degrees of	Displacement	Righting Arms	Flood Pt
Depth----	Trim----	Heel----	Weight(MT)----	in Trim--in Heel--> Area --Height
0.469	0.85a	0.40s	37.79	0.000 0.000 0.0000 1.345(1)
0.465	0.87a	2.40s	37.79	0.000 0.489 0.0085 1.225(1)
0.454	0.91a	4.40s	37.79	0.000 0.969 0.0340 1.102(1)
0.425	1.00a	6.40s	37.79	0.000 1.410 0.0756 0.969(2)
0.374	1.16a	8.40s	37.79	0.000 1.773 0.1313 0.836(2)
0.283	1.41a	10.40s	37.79	0.000 2.012 0.1974 0.707(2)
0.165	1.70a	12.40s	37.79	0.000 2.131 0.2697 0.594(2)
0.110	1.80a	13.33s	37.79	0.000 2.155 0.3044 Deck Imm.
0.065	1.86a	14.13s	37.79	0.000 2.163 0.3347 0.517(2)
0.050	1.88a	14.40s	37.79	0.000 2.163 0.3448 0.508(2)
-0.047	1.90a	16.40s	37.79	0.000 2.127 0.4199 0.455(2)
-0.141	1.90a	18.40s	37.79	0.000 2.082 0.4935 0.404(2)
-0.237	1.91a	20.40s	37.79	0.000 2.034 0.5653 0.353(2)
-0.334	1.93a	22.40s	37.79	0.000 1.984 0.6355 0.298(2)
-0.431	1.95a	24.40s	37.79	0.000 1.931 0.7038 0.241(2)
-0.530	1.98a	26.40s	37.79	0.000 1.875 0.7702 0.183(2)
-0.630	2.03a	28.40s	37.79	0.000 1.816 0.8347 0.121(2)
-0.711	2.07a	30.00s	37.79	0.000 1.767 0.8847 0.070(2)
-0.731	2.08a	30.40s	37.79	0.000 1.755 0.8970 0.057(2)
-0.819	2.13a	32.13s	37.79	0.000 1.699 0.9492 -0.000(2)
Distances in METERS.-----Specific Gravity = 1.000.-----Area in m.-Rad.				

Note: The Center of Gravity shown above is for the Fixed Weight of 37.32 MT. As the tank load centers shift with heel and trim, the total Center of Gravity varies. The righting arms shown above include the effect of the C.G. variation.

Critical Points-----	LCP-----	TCP-----	VCP
(1) Engine Vent stern	FLOOD 20.100a	3.350	2.138
(2) Engine Vent side	FLOOD 18.354a	3.660	2.138

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TRAVERSE INTACT ANALYSIS

LIGHT LOAD

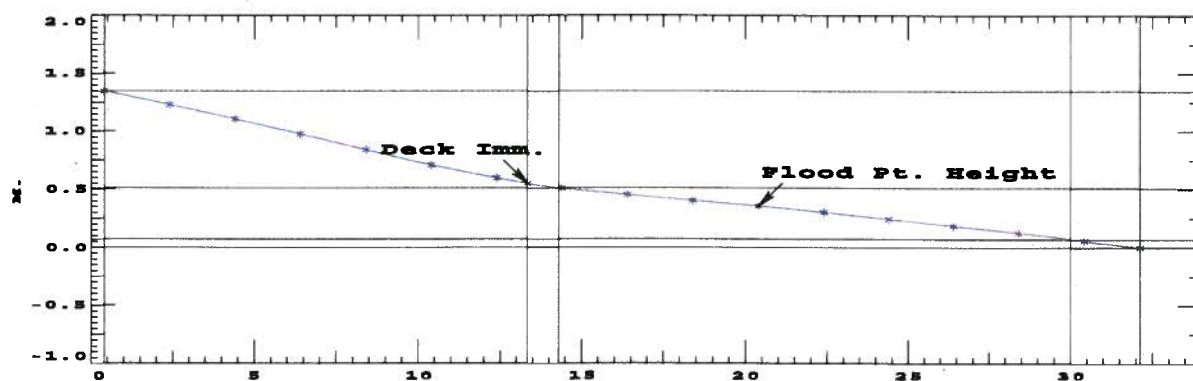
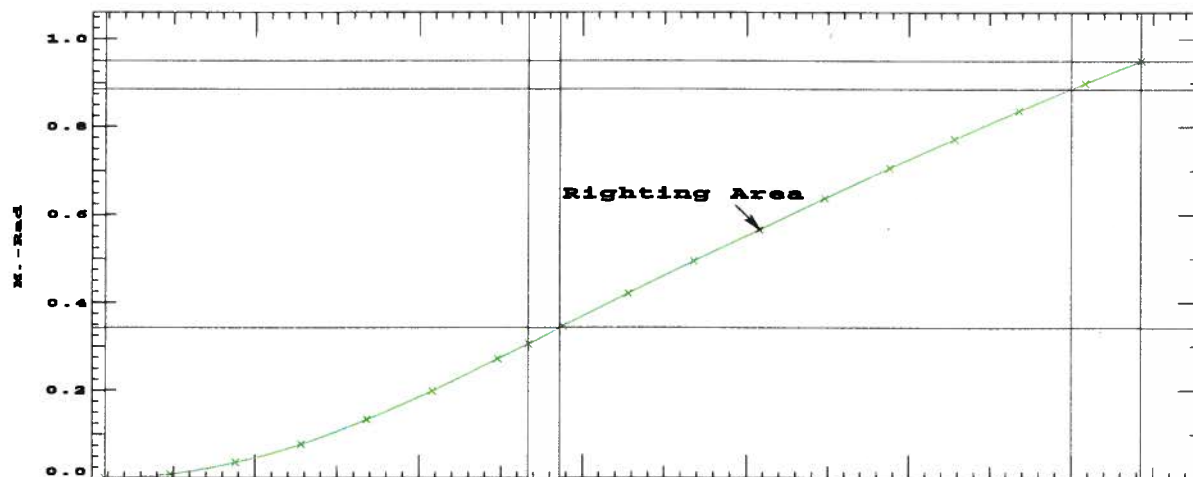
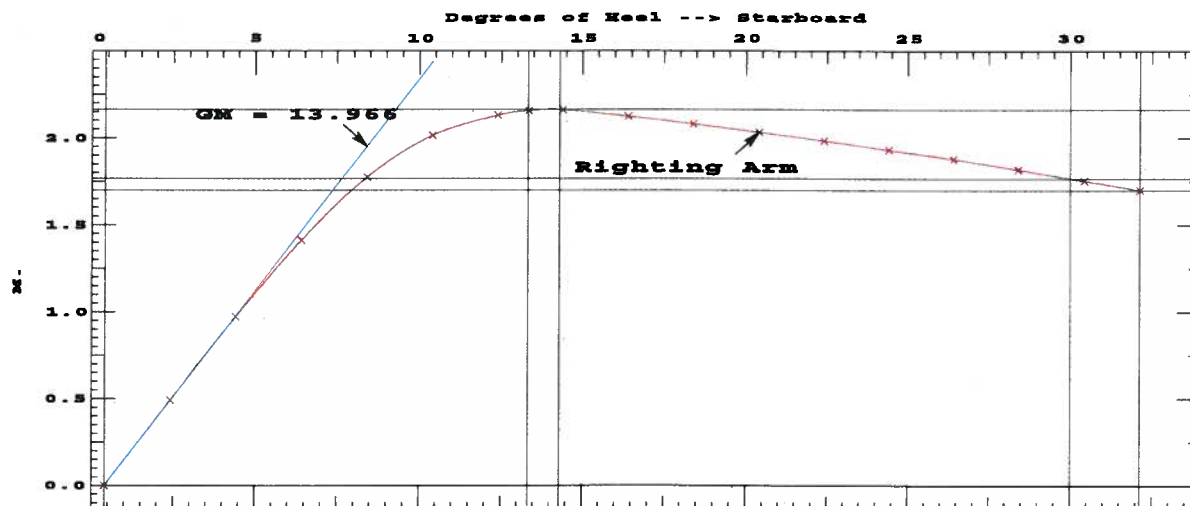
LIM-----	STAB 6 CRITERION-----	Min/Max-----	Attained
(1)	Area from Equilibrium to abs 30 deg	> 0.0550 m.-Rad	0.8847 P
(2)	Area from Equilibrium to abs 40 deg	> 0.0900 m.-Rad	UNDEF
(3)	Area from abs 30 deg to abs 40	> 0.0300 m.-Rad	UNDEF
(4)	Righting Arm at abs 30 deg	> 0.200 m.	1.767 P
(5)	Absolute Angle at MaxRA	> 25.00 deg	14.13 F
(6)	GM at Equilibrium	> 0.150 m.	13.966 P
(7)	Absolute Angle at Flood	> 0.00 deg	32.13 P
(8)	Absolute Angle at Deck Immersion	> 0.00 deg	13.33 P
(9)	Area from Equilibrium to Flood	> 0.0900 m.-Rad	0.9492 P

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LIGHT LOAD

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MAXIMUM LOAD

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TRAVERSE INTACT ANALYSIS

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CONDITION NUMBER 3

MAXIMUM LOAD

WEIGHT and DISPLACEMENT STATUS

Baseline draft: 0.711 @ Origin

Trim: Aft 0.19 deg., Heel: Stbd 0.45 deg.

Part-----	Weight(MT)-----	LCG-----	TCG-----	VCG-----			
LIGHT SHIP	34.68	12.107a	0.104s	1.865			
Crew (skipper)	0.10	12.670a	0.000	6.220			
Crane Operator	0.11	3.100a	1.060s	2.500			
Deck Crew (2)	0.23	6.450a	0.000	2.500			
Crew Effects (200lbs)	0.09	18.870a	0.000	2.800			
Stores (650lbs)	0.30	12.500a	1.400s	2.500			
Deck Cargo (20000lbs)	9.07	6.784a	0.000	1.900			
Ballast P (Water Tank)	1.10	8.371a	1.464s	0.785			
Ballast S (Water Tank)	1.10	8.371a	1.464p	0.785			
Total Fixed----->	46.79	10.867a	0.089s	1.841			
Load-----	SpGr-----	Weight(MT)-----	LCG-----	TCG-----	VCG-----	FSM-----	
FUEL.P	0.950	0.870	0.74	14.429a	3.345p	2.099	0.02
FUEL.S	0.950	0.870	0.74	14.429a	3.345s	2.099	0.02
Total Tanks----->			1.49	14.429a	0.000	2.099	0.05
Total Weight----->			48.28	10.977a	0.086s	1.849	
		Displ(MT)-----	LCB-----	TCB-----	VCB-----		
HULL	1.000	48.28	10.981a	0.097s	0.464		

Righting Arms:

0.000 0.000s

Distances in METERS-----Moments in m.-MT.

TANK STATUS

Trim: Aft 0.19 deg., Heel: Stbd 0.45 deg.

Part-----	Load-----	SpGr-----	Weight(MT)-----	LCG-----	TCG-----	VCG-----	RefHt-----
FUEL.P	0.950	0.870	0.74	14.429a	3.345p	2.099	-2.545
FUEL.S	0.950	0.870	0.74	14.429a	3.345s	2.099	-2.492
Total Tanks----->			1.49	14.429a	0.000	2.099	

Distances in METERS-----

CRITICAL POINT STATUS

Baseline draft: 0.711 @ Origin

Trim: Aft 0.19 deg., Heel: Stbd 0.45 deg.

Critical Points-----	LCP-----	TCP-----	VCP-----	Height-----
(1) Engine Vent stern	FLOOD 20.100a	3.350s	2.138	1.332
(1) Engine Vent stern	FLOOD 20.100a	3.350p	2.138	1.384
(2) Engine Vent side	FLOOD 18.354a	3.660s	2.138	1.336
(2) Engine Vent side	FLOOD 18.354a	3.660p	2.138	1.393

Distances in METERS-----

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MAXIMUM LOAD

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HYDROSTATIC PROPERTIES

Trim: Aft 0.19 deg., Heel: Stbd 0.45 deg., VCG = 1.849

LCF	Displacement	Buoyancy-Ctr.	Weight/	Moment/
Draft----	Weight(MT)----	LCB-----	VCB-----	cm-----
0.747	48.28	10.981a	0.464	0.89
		10.535a	46.49	55.17
				10.953

Distances in METERS.-----Specific Gravity = 1.000.-----Moment in m.-MT.  
Draft is from Baseline. True Free Surface included.

RIGHTING ARMS vs HEEL ANGLE

Fixed CG: LCG = 10.867a TCG = 0.089s VCG = 1.841

Origin	Degrees of	Displacement	Righting Arms	Flood Pt
Depth----	Trim----	Heel----	Weight(MT)----	in Trim--in Heel--> Area --Height
0.711	0.20a	0.45s	48.28	0.000 0.000 0.0000 1.332(1)
0.708	0.21a	2.45s	48.28	0.000 0.385 0.0067 1.206(2)
0.701	0.23a	4.45s	48.28	0.000 0.767 0.0268 1.074(2)
0.688	0.27a	6.45s	48.28	0.000 1.149 0.0603 0.939(2)
0.664	0.34a	8.45s	48.27	0.000 1.499 0.1065 0.805(2)
0.626	0.42a	10.45s	48.27	0.000 1.791 0.1640 0.678(2)
0.573	0.52a	12.45s	48.27	0.000 2.027 0.2306 0.558(2)
0.542	0.59a	13.22s	48.28	0.000 2.094 0.2584 Deck Imm.
0.473	0.74a	14.45s	48.27	0.000 2.146 0.3039 0.445(2)
0.434	0.82a	15.11s	48.27	0.000 2.152 0.3289 0.415(2)
0.365	0.86a	16.45s	48.28	0.000 2.129 0.3789 0.374(2)
0.265	0.89a	18.45s	48.28	0.000 2.080 0.4525 0.320(2)
0.164	0.93a	20.45s	48.28	0.000 2.028 0.5243 0.263(2)
0.064	0.97a	22.45s	48.28	0.000 1.972 0.5941 0.203(2)
-0.036	1.02a	24.45s	48.28	0.000 1.913 0.6619 0.141(2)
-0.134	1.07a	26.45s	48.28	0.000 1.851 0.7276 0.077(2)
-0.230	1.11a	28.45s	48.28	0.000 1.785 0.7911 0.011(2)
-0.246	1.12a	28.78s	48.28	0.000 1.774 0.8013 0.000(2)

Distances in METERS.-----Specific Gravity = 1.000.-----Area in m.-Rad.

Note: The Center of Gravity shown above is for the Fixed Weight of 46.79 MT. As the tank load centers shift with heel and trim, the total Center of Gravity varies. The righting arms shown above include the effect of the C.G. variation.

Critical Points-----	LCP-----	TCP-----	VCP
(1) Engine Vent stern	FLOOD 20.100a	3.350	2.138
(2) Engine Vent side	FLOOD 18.354a	3.660	2.138

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TRAVERSE INTACT ANALYSIS

MAXIMUM LOAD

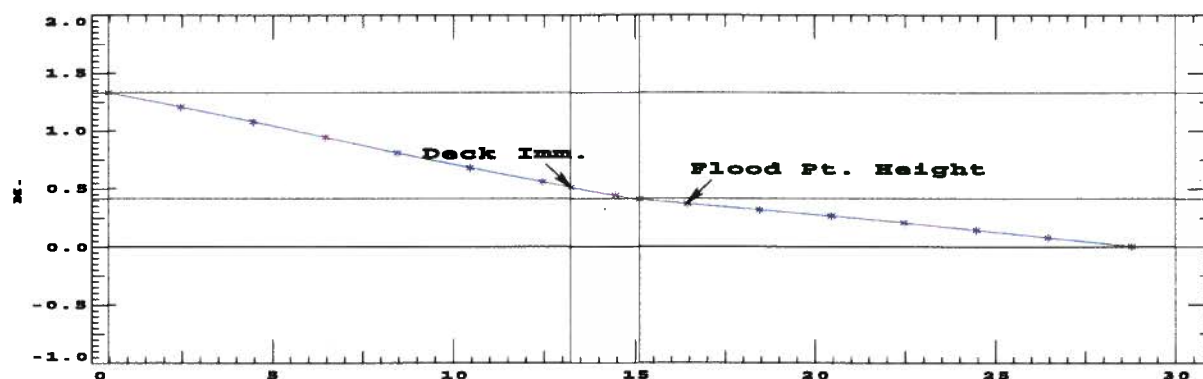
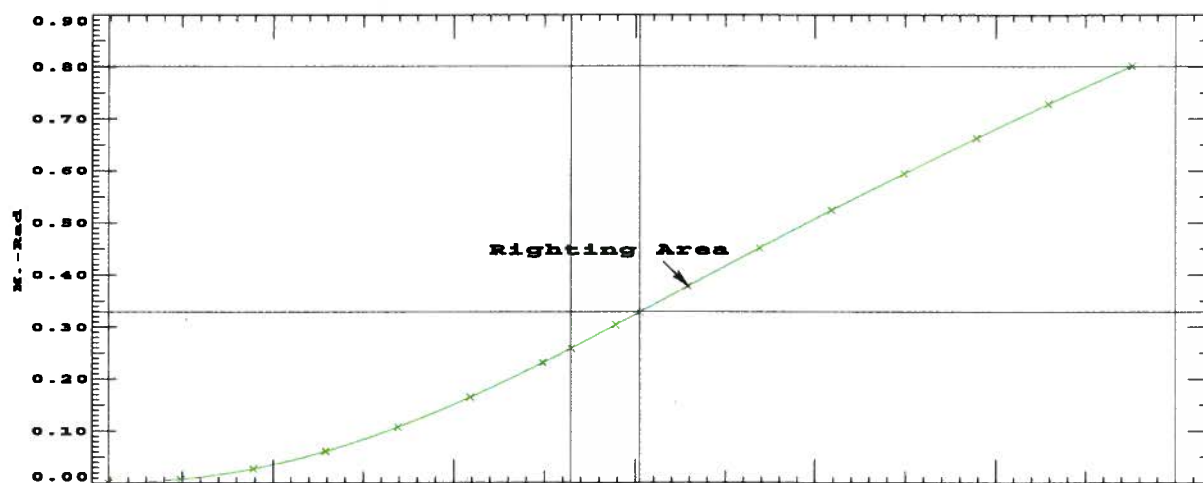
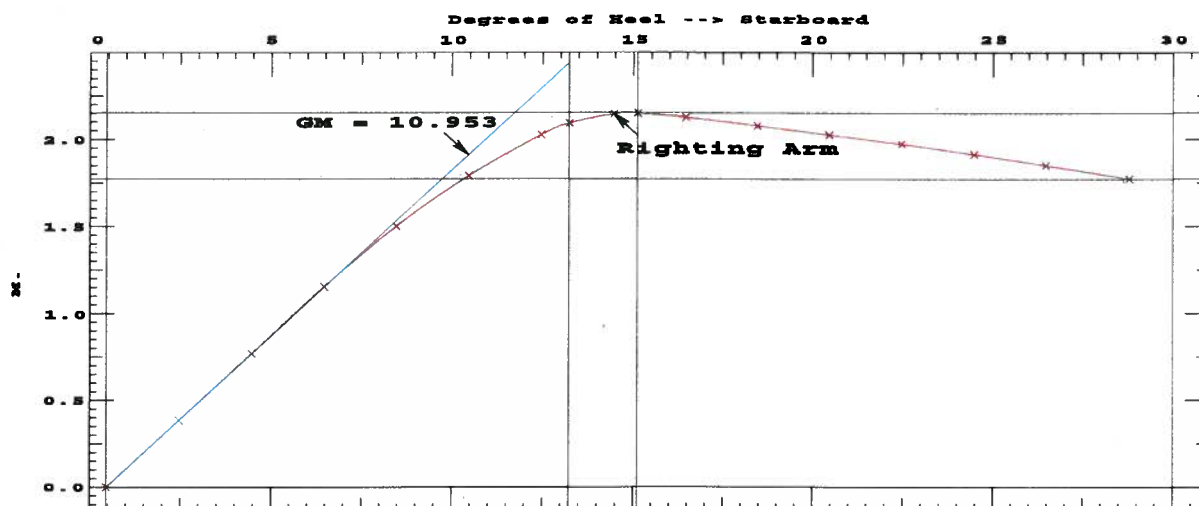
LIM-----	STAB 6 CRITERION-----	Min/Max-----	Attained
(1)	Area from Equilibrium to abs 30 deg	> 0.0550 m.-Rad	UNDEF
(2)	Area from Equilibrium to abs 40 deg	> 0.0900 m.-Rad	UNDEF
(3)	Area from abs 30 deg to abs 40	> 0.0300 m.-Rad	UNDEF
(4)	Righting Arm at abs 30 deg	> 0.200 m.	UNDEF
(5)	Absolute Angle at MaxRA	> 25.00 deg	15.11 F
(6)	GM at Equilibrium	> 0.150 m.	10.953 P
(7)	Absolute Angle at Flood	> 0.00 deg	28.78 P
(8)	Absolute Angle at Deck Immersion	> 0.00 deg	13.22 P
(9)	Area from Equilibrium to Flood	> 0.0900 m.-Rad	0.8013 P

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MAXIMUM LOAD

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ARRIVAL

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TRAVERSE INTACT ANALYSIS

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CONDITION NUMBER 4

ARRIVAL

WEIGHT and DISPLACEMENT STATUS

Baseline draft: 0.469 @ Origin

Trim: Aft 0.85 deg., Heel: Stbd 0.40 deg.

Part-----	Load-----	SpGr-----	Weight(MT)-----	LCG-----	TCG-----	VCG-----	FSM-----
LIGHT SHIP			34.68	12.107a	0.104s	1.865	
Crew (skipper)			0.10	12.670a	0.000	6.220	
Crane Operator			0.11	3.100a	1.060s	2.500	
Deck Crew (2)			0.23	6.450a	0.000	2.500	
Crew Effects (200lbs)			0.09	18.870a	0.000	2.800	
Ballast P (Water Tank)			1.10	8.371a	1.464s	0.785	
Ballast S (Water Tank)			1.10	8.371a	1.464p	0.785	
Total Fixed----->			37.41	11.844a	0.100s	1.821	
	0.100	0.870	0.08	14.457a	3.343p	1.680	0.02
FUEL.P			0.08	14.457a	3.347s	1.680	0.02
FUEL.S			0.16	14.457a	0.002s	1.680	0.05
Total Tanks----->			37.57	11.855a	0.099s	1.821	
Total Weight----->				Displ(MT)-----	LCB-----	TCB-----	VCB-----
HULL	1.000		37.57	11.876a	0.109s	0.407	

Righting Arms:

0.000 0.000s

Distances in METERS.-----Moments in m.-MT.

TANK STATUS

Trim: Aft 0.85 deg., Heel: Stbd 0.40 deg.

Part-----	Load-----	SpGr-----	Weight(MT)-----	LCG-----	TCG-----	VCG-----	RefHt-----
FUEL.P	0.100	0.870	0.08	14.457a	3.343p	1.680	-1.539
FUEL.S	0.100	0.870	0.08	14.457a	3.347s	1.680	-1.492
Total Tanks----->			0.16	14.457a	0.002s	1.680	

Distances in METERS.-----

CRITICAL POINT STATUS

Baseline draft: 0.469 @ Origin

Trim: Aft 0.85 deg., Heel: Stbd 0.40 deg.

Critical Points-----		LCP-----	TCP-----	VCP-----	Height-----
(1) Engine Vent stern	FLOOD	20.100a	3.350s	2.138	1.349
(1) Engine Vent stern	FLOOD	20.100a	3.350p	2.138	1.396
(2) Engine Vent side	FLOOD	18.354a	3.660s	2.138	1.373
(2) Engine Vent side	FLOOD	18.354a	3.660p	2.138	1.424

Distances in METERS.-----

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ARRIVAL

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TRAVERSE INTACT ANALYSIS

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HYDROSTATIC PROPERTIES

Trim: Aft 0.85 deg., Heel: Stbd 0.40 deg., VCG = 1.821

LCF	Displacement	Buoyancy-Ctr.	Weight/	Moment/
Draft----	Weight(MT)----	LCB-----	VCB-----	cm-----
LCF--Deg trim----	GML-----	GMT		
0.627	37.57	11.876a	0.407	0.87
10.768a	43.37	66.13	14.052	

Distances in METERS.-----Specific Gravity = 1.000.-----Moment in m.-MT.  
Draft is from Baseline. True Free Surface included.

RIGHTING ARMS vs HEEL ANGLE

Fixed CG: LCG = 11.844a TCG = 0.100s VCG = 1.821

Origin	Degrees of	Displacement	Righting Arms	Flood Pt
Depth----	Trim----	Heel----	Weight(MT)----	in Trim--in Heel--> Area --Height
0.469	0.85a	0.40s	37.57	0.000 0.000 0.0000 1.349(1)
0.465	0.86a	2.40s	37.57	0.000 0.492 0.0086 1.230(1)
0.453	0.90a	4.40s	37.57	0.000 0.975 0.0342 1.106(1)
0.424	1.00a	6.40s	37.57	0.000 1.417 0.0760 0.973(2)
0.373	1.15a	8.40s	37.57	0.000 1.780 0.1320 0.840(2)
0.280	1.41a	10.40s	37.57	0.000 2.018 0.1983 0.711(2)
0.163	1.69a	12.40s	37.56	0.000 2.134 0.2708 0.599(2)
0.100	1.80a	13.46s	37.57	0.000 2.160 0.3106 Deck Imm.
0.061	1.85a	14.16s	37.57	0.000 2.164 0.3369 0.523(2)
0.048	1.86a	14.40s	37.57	0.000 2.164 0.3460 0.514(2)
-0.048	1.88a	16.40s	37.57	0.000 2.126 0.4210 0.462(2)
-0.142	1.88a	18.40s	37.57	0.000 2.081 0.4945 0.412(2)
-0.238	1.89a	20.40s	37.57	0.000 2.034 0.5664 0.361(2)
-0.334	1.90a	22.40s	37.57	0.000 1.983 0.6365 0.306(2)
-0.432	1.92a	24.40s	37.57	0.000 1.930 0.7048 0.250(2)
-0.530	1.96a	26.40s	37.57	0.000 1.875 0.7712 0.191(2)
-0.630	2.00a	28.40s	37.57	0.000 1.816 0.8357 0.130(2)
-0.711	2.04a	30.00s	37.57	0.000 1.767 0.8856 0.079(2)
-0.731	2.05a	30.40s	37.57	0.000 1.754 0.8980 0.066(2)
-0.834	2.11a	32.42s	37.57	0.000 1.689 0.9586 0.000(2)

Distances in METERS.-----Specific Gravity = 1.000.-----Area in m.-Rad.

Note: The Center of Gravity shown above is for the Fixed Weight of 37.41 MT. As the tank load centers shift with heel and trim, the total Center of Gravity varies. The righting arms shown above include the effect of the C.G. variation.

Critical Points-----	LCP-----	TCP-----	VCP
(1) Engine Vent stern	FLOOD 20.100a	3.350	2.138
(2) Engine Vent side	FLOOD 18.354a	3.660	2.138

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TRAVERSE INTACT ANALYSIS

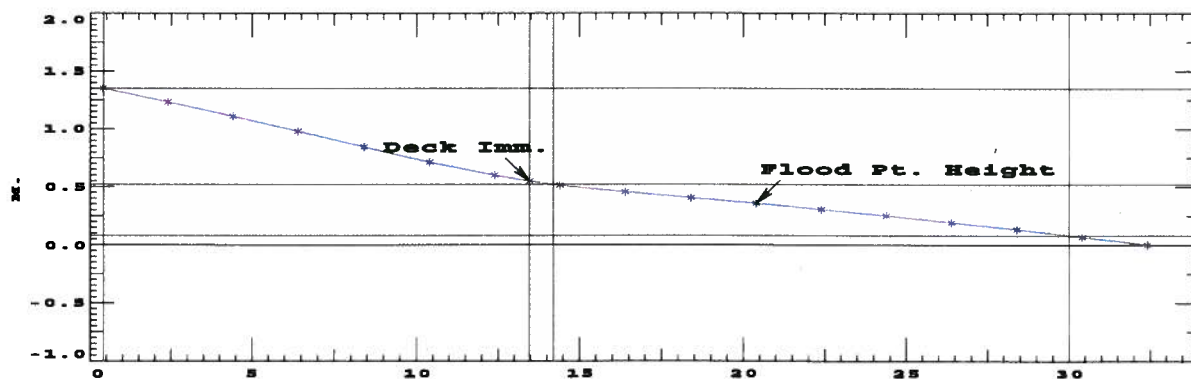
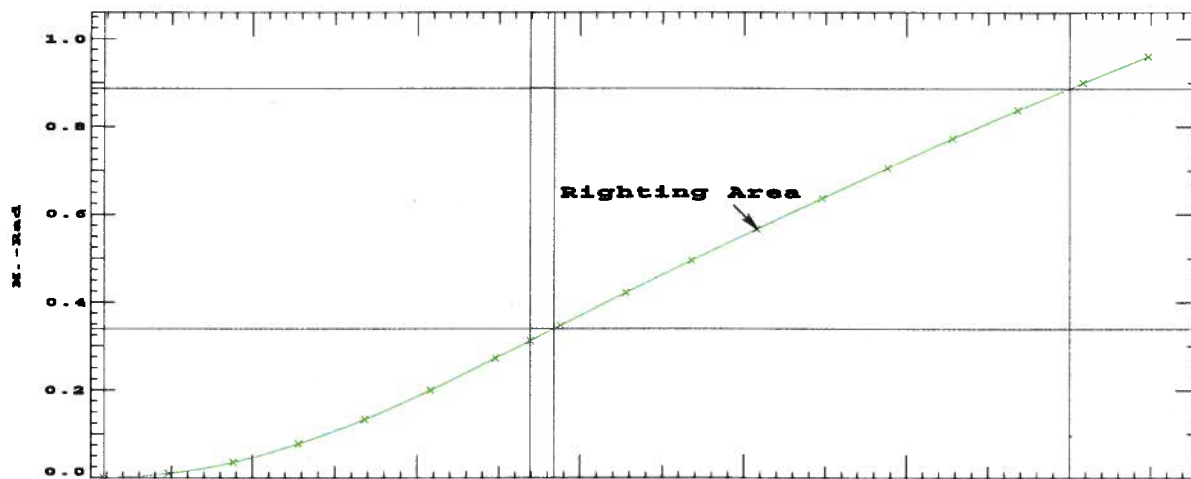
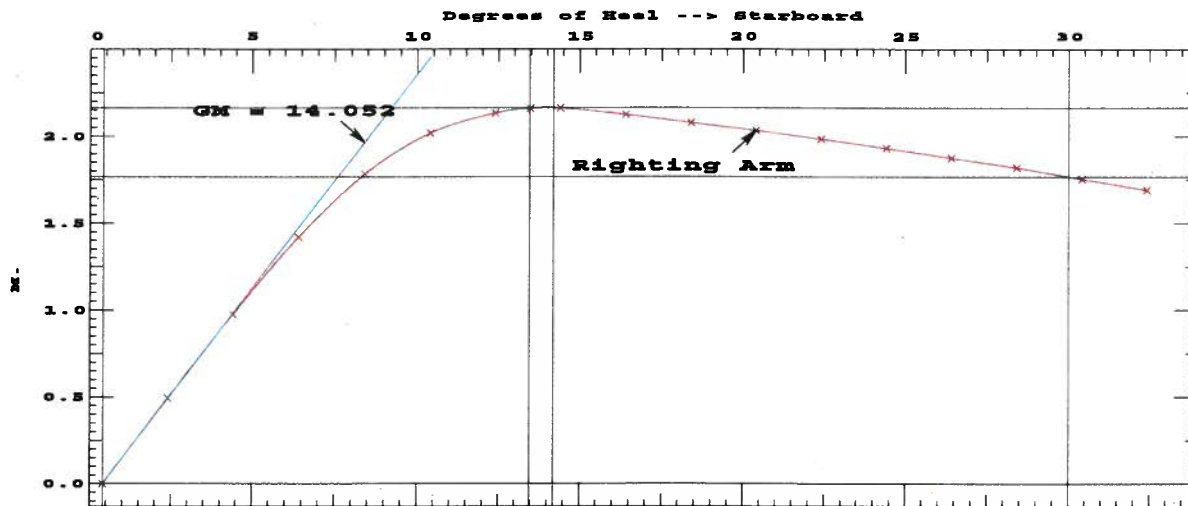
ARRIVAL

LIM-----	STAB 6 CRITERION-----	Min/Max-----	Attained
(1)	Area from Equilibrium to abs 30 deg	> 0.0550 m.-Rad	0.8856 P
(2)	Area from Equilibrium to abs 40 deg	> 0.0900 m.-Rad	UNDEF
(3)	Area from abs 30 deg to abs 40	> 0.0300 m.-Rad	UNDEF
(4)	Righting Arm at abs 30 deg	> 0.200 m.	1.767 P
(5)	Absolute Angle at MaxRA	> 25.00 deg	14.16 F
(6)	GM at Equilibrium	> 0.150 m.	14.052 P
(7)	Absolute Angle at Flood	> 0.00 deg	32.42 P
(8)	Absolute Angle at Deck Immersion	> 0.00 deg	13.46 P
(9)	Area from Equilibrium to Flood	> 0.0900 m.-Rad	0.9586 P

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ARRIVAL

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TRAVERSE INTACT ANALYSIS

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## TRAVERSE INTACT ANALYSIS

MAX LOAD WITH HIGH-LIFT HOOKED LOAD

## CONDITION NUMBER 5

## MAX LOAD WITH HIGH-LIFT HOOKED LOAD

## WEIGHT and DISPLACEMENT STATUS

Baseline draft: 0.730 @ Origin

Trim: Aft 0.09 deg., Heel: Stbd 0.49 deg.

Part-----	Weight(MT)-----	LCG-----	TCG-----	VCG-----			
LIGHT SHIP	34.68	12.107a	0.104s	1.865			
Crew (skipper)	0.10	12.670a	0.000	6.220			
Crane Operator	0.11	3.100a	1.060s	2.500			
Deck Crew (2)	0.23	6.450a	0.000	2.500			
Crew Effects (200lbs)	0.09	18.870a	0.000	2.800			
Stores (650lbs)	0.30	12.500a	1.400s	2.500			
Deck Cargo (17240lbs)	7.82	6.784a	0.000	1.900			
High-Lift Load (2760lbs)	1.25	2.920a	0.300s	9.525			
Ballast P (Water Tank)	1.10	8.371a	1.464s	0.785			
Ballast S (Water Tank)	1.10	8.371a	1.464p	0.785			
Total Fixed----->	46.79	10.764a	0.097s	2.045			
Load-----	SpGr-----	Weight(MT)-----	LCG-----	TCG-----	VCG-----	FSM-----	
FUEL.P	0.950	0.870	0.74	14.428a	3.345p	2.099	0.02
FUEL.S	0.950	0.870	0.74	14.428a	3.345s	2.099	0.02
Total Tanks----->			1.49	14.428a	0.000	2.099	0.05
Total Weight----->			48.28	10.877a	0.094s	2.047	
		Displ(MT)-----	LCB-----	TCB-----	VCB-----		
HULL	1.000	48.28	10.879a	0.107s	0.464		

Righting Arms:

0.000 0.000s

Distances in METERS.-----Moments in m.-MT.

## TANK STATUS

Trim: Aft 0.09 deg., Heel: Stbd 0.49 deg.

Part-----	Load-----	SpGr-----	Weight(MT)-----	LCG-----	TCG-----	VCG-----	RefHt-----
FUEL.P	0.950	0.870	0.74	14.428a	3.345p	2.099	-2.573
FUEL.S	0.950	0.870	0.74	14.428a	3.345s	2.099	-2.516
Total Tanks----->			1.49	14.428a	0.000	2.099	

Distances in METERS.-----

## CRITICAL POINT STATUS

Baseline draft: 0.730 @ Origin

Trim: Aft 0.09 deg., Heel: Stbd 0.49 deg.

Critical Points-----	LCP-----	TCP-----	VCP-----	Height-----
(1) Engine Vent stern	FLOOD	20.100a	3.350s	2.138
(1) Engine Vent stern	FLOOD	20.100a	3.350p	2.138
(2) Engine Vent side	FLOOD	18.354a	3.660s	2.138
(2) Engine Vent side	FLOOD	18.354a	3.660p	2.138

Distances in METERS.-----

GHS 10.44J

TRAVERSE INTACT ANALYSIS

MAX LOAD WITH HIGH-LIFT HOOKED LOAD

## HYDROSTATIC PROPERTIES

Trim: Aft 0.09 deg., Heel: Stbd 0.49 deg., VCG = 2.047

LCF	Displacement	Buoyancy-Ctr.	Weight/	Moment/
Draft----	Weight(MT)----	LCB-----	VCB-----	cm-----
0.747	48.28	10.879a	0.464	0.89
				10.520a
				46.53
				55.22
				10.776

Distances in METERS.-----Specific Gravity = 1.000.-----Moment in m.-MT.  
 Draft is from Baseline. True Free Surface included.

## RIGHTING ARMS vs HEEL ANGLE

Fixed CG: LCG = 10.764a TCG = 0.097s VCG = 2.045

Origin	Degrees of	Displacement	Righting Arms	Flood Pt
Depth----	Trim----	Heel----	Weight(MT)----	in Trim--in Heel--> Area --Height
0.730	0.09a	0.49s	48.28	0.000 0.000 0.0000 1.346(1)
0.727	0.10a	2.49s	48.28	0.000 0.378 0.0066 1.217(2)
0.720	0.12a	4.49s	48.28	0.000 0.754 0.0264 1.085(2)
0.707	0.16a	6.49s	48.27	0.000 1.131 0.0593 0.950(2)
0.684	0.23a	8.49s	48.27	0.000 1.474 0.1048 0.817(2)
0.647	0.31a	10.49s	48.27	0.000 1.758 0.1612 0.691(2)
0.595	0.40a	12.49s	48.27	0.000 1.987 0.2266 0.573(2)
0.551	0.49a	13.61s	48.28	0.000 2.075 0.2660 Deck Imm.
0.500	0.60a	14.49s	48.28	0.000 2.101 0.2984 0.463(2)
0.396	0.66a	16.49s	48.28	0.000 2.065 0.3716 0.402(2)
0.297	0.69a	18.49s	48.28	0.000 2.010 0.4429 0.349(2)
0.197	0.72a	20.49s	48.28	0.000 1.952 0.5121 0.293(2)
0.097	0.76a	22.49s	48.28	0.000 1.890 0.5792 0.234(2)
-0.001	0.80a	24.49s	48.28	0.000 1.825 0.6440 0.173(2)
-0.097	0.84a	26.49s	48.28	0.000 1.756 0.7065 0.110(2)
-0.192	0.87a	28.49s	48.28	0.000 1.684 0.7665 0.046(2)
-0.258	0.90a	29.90s	48.28	0.000 1.633 0.8071 -0.000(2)

Distances in METERS.-----Specific Gravity = 1.000.-----Area in m.-Rad.

Note: The Center of Gravity shown above is for the Fixed Weight of 46.79 MT. As the tank load centers shift with heel and trim, the total Center of Gravity varies. The righting arms shown above include the effect of the C.G. variation.

Critical Points-----	LCP-----	TCP-----	VCP
(1) Engine Vent stern	FLOOD 20.100a	3.350	2.138
(2) Engine Vent side	FLOOD 18.354a	3.660	2.138

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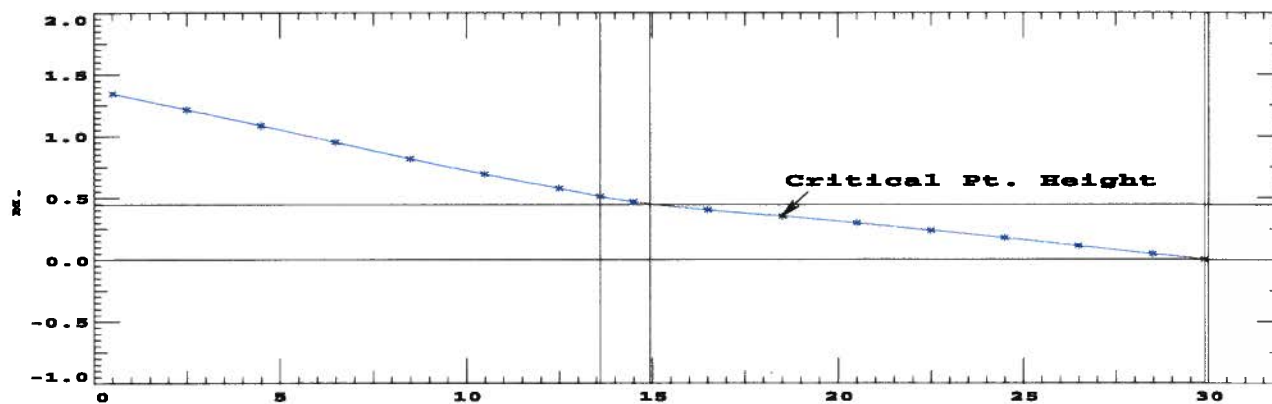
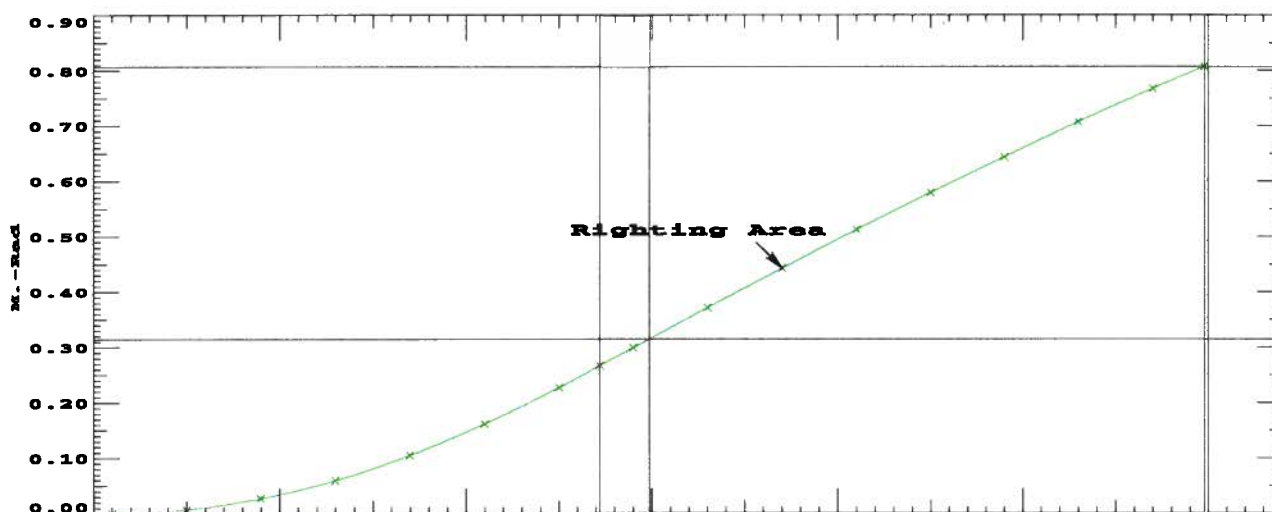
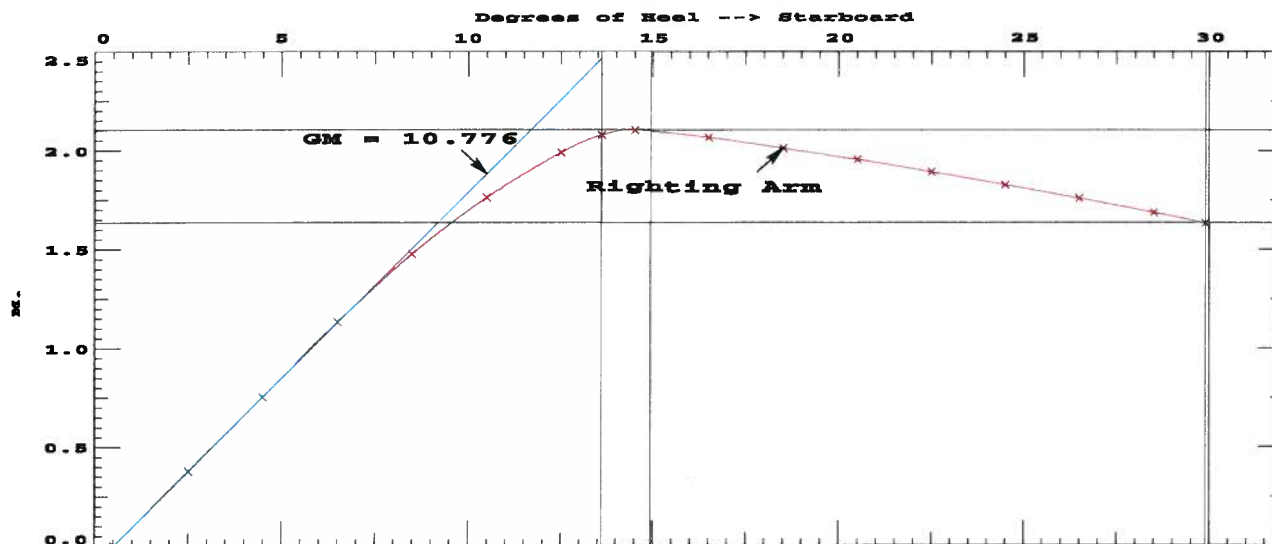
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TRAVERSE INTACT ANALYSIS

MAX LOAD WITH HIGH-LIFT HOOKED LOAD

LIM-----	STAB 6 CRITERION-----	Min/Max-----	Attained
(1)	Area from Equilibrium to abs 30 deg	> 0.0550 m.-Rad	UNDEF
(2)	Area from Equilibrium to abs 40 deg	> 0.0900 m.-Rad	UNDEF
(3)	Area from abs 30 deg to abs 40	> 0.0300 m.-Rad	UNDEF
(4)	Righting Arm at abs 30 deg	> 0.200 m.	UNDEF
(5)	Absolute Angle at MaxRA	> 25.00 deg	14.49 F
(6)	GM at Equilibrium	> 0.150 m.	10.776 P
(7)	Absolute Angle at Flood	> 0.00 deg	29.90 P
(8)	Absolute Angle at Deck Immersion	> 0.00 deg	13.61 P
(9)	Area from Equilibrium to Flood	> 0.0900 m.-Rad	0.8071 P



GHS 10.44J

## TRAVERSE INTACT ANALYSIS

MAX LOAD WITH OUT-LIFT HOOKED LOAD

## CONDITION NUMBER 5a

## MAX LOAD WITH OUT-LIFT HOOKED LOAD

## WEIGHT and DISPLACEMENT STATUS

Baseline draft: 0.730 @ Origin

Trim: Aft 0.09 deg., Heel: Stbd 1.28 deg.

Part-----	Weight(MT)-----	LCG-----	TCG-----	VCG-----			
LIGHT SHIP	34.68	12.107a	0.104s	1.865			
Crew (skipper)	0.10	12.670a	0.000	6.220			
Crane Operator	0.11	3.100a	1.060s	2.500			
Deck Crew (2)	0.23	6.450a	0.000	2.500			
Crew Effects (200lbs)	0.09	18.870a	0.000	2.800			
Stores (650lbs)	0.30	12.500a	1.400s	2.500			
Deck Cargo (17240lbs)	7.82	6.784a	0.000	1.900			
Out-Lift Load (2760lbs)	1.25	2.920a	6.190s	3.850			
Ballast P (Water Tank)	1.10	8.371a	1.464s	0.785			
Ballast S (Water Tank)	1.10	8.371a	1.464p	0.785			
Total Fixed----->	46.78	10.764a	0.254s	1.893			
Load-----	SpGr-----	Weight(MT)-----	LCG-----	TCG-----	VCG-----	FSM-----	
FUEL.P	0.950	0.870	0.74	14.428a	3.344p	2.099	0.02
FUEL.S	0.950	0.870	0.74	14.428a	3.346s	2.099	0.02
Total Tanks----->			1.49	14.428a	0.001	2.099	0.05
Total Weight----->			48.27	10.877a	0.246s	1.899	
		Displ(MT)-----	LCB-----	TCB-----	VCB-----		
HULL	1.000	48.27	10.879a	0.278s	0.466		

Righting Arms:

0.000 0.000s

Distances in METERS.-----Moments in m.-MT.

## TANK STATUS

Trim: Aft 0.09 deg., Heel: Stbd 1.28 deg.

Part-----	Load-----	SpGr-----	Weight(MT)-----	LCG-----	TCG-----	VCG-----	RefHt-----
FUEL.P	0.950	0.870	0.74	14.428a	3.344p	2.099	-2.618
FUEL.S	0.950	0.870	0.74	14.428a	3.346s	2.099	-2.468
Total Tanks----->			1.49	14.428a	0.001	2.099	

Distances in METERS.-----

## CRITICAL POINT STATUS

Baseline draft: 0.730 @ Origin

Trim: Aft 0.09 deg., Heel: Stbd 1.28 deg.

Critical Points-----	LCP-----	TCP-----	VCP-----	Height-----
(1) Engine Vent stern	FLOOD 20.100a	3.350s	2.138	1.300
(1) Engine Vent stern	FLOOD 20.100a	3.350p	2.138	1.450
(2) Engine Vent side	FLOOD 18.354a	3.660s	2.138	1.296
(2) Engine Vent side	FLOOD 18.354a	3.660p	2.138	1.460

Distances in METERS.-----

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## TRAVERSE INTACT ANALYSIS

MAX LOAD WITH OUT-LIFT HOOKED LOAD

## HYDROSTATIC PROPERTIES

Trim: Aft 0.09 deg., Heel: Stbd 1.28 deg., VCG = 1.899

LCF	Displacement	Buoyancy-Ctr.	Weight/	Moment/
Draft----	Weight(MT)----	LCB-----	VCB-----	cm-----
0.747	48.27	10.879a	0.466	0.89
				10.515a
				46.75
				55.49
				10.940

Distances in METERS.-----Specific Gravity = 1.000.-----Moment in m.-MT.  
 Draft is from Baseline. True Free Surface included.

## RIGHTING ARMS vs HEEL ANGLE

Fixed CG: LCG = 10.764a TCG = 0.254s VCG = 1.893

Origin	Degrees of	Displacement	Righting Arms	Flood Pt
Depth----	Trim----	Heel----	Weight(MT)----	in Trim--in Heel--> Area --Height
0.730	0.09a	1.28s	48.27	0.000 0.000 0.0000 1.296(2)
0.725	0.11a	3.28s	48.27	0.000 0.383 0.0067 1.165(2)
0.716	0.14a	5.28s	48.27	0.000 0.764 0.0267 1.032(2)
0.700	0.19a	7.28s	48.27	0.000 1.140 0.0600 0.897(2)
0.671	0.26a	9.28s	48.27	0.000 1.466 0.1055 0.767(2)
0.628	0.34a	11.28s	48.27	0.000 1.734 0.1614 0.644(2)
0.567	0.45a	13.28s	48.27	0.000 1.941 0.2255 0.528(2)
0.551	0.49a	13.61s	48.27	0.000 1.962 0.2368 Deck Imm.
0.482	0.62a	14.81s	48.27	0.000 1.993 0.2781 0.449(2)
0.457	0.65a	15.28s	48.27	0.000 1.988 0.2945 0.434(2)
0.358	0.67a	17.28s	48.27	0.000 1.942 0.3633 0.382(2)
0.258	0.70a	19.28s	48.27	0.000 1.892 0.4303 0.328(2)
0.158	0.73a	21.28s	48.27	0.000 1.839 0.4955 0.271(2)
0.059	0.77a	23.28s	48.27	0.000 1.783 0.5587 0.211(2)
-0.038	0.81a	25.28s	48.27	0.000 1.723 0.6199 0.150(2)
-0.134	0.84a	27.28s	48.27	0.000 1.660 0.6790 0.086(2)
-0.228	0.88a	29.28s	48.27	0.000 1.595 0.7358 0.021(2)
-0.258	0.89a	29.93s	48.27	0.000 1.573 0.7538 -0.000(2)

Distances in METERS.-----Specific Gravity = 1.000.-----Area in m.-Rad.

Note: The Center of Gravity shown above is for the Fixed Weight of 46.78 MT. As the tank load centers shift with heel and trim, the total Center of Gravity varies. The righting arms shown above include the effect of the C.G. variation.

Critical Point-----	LCP-----	TCP-----	VCP
(2) Engine Vent side	FLOOD 18.354a	3.660	2.138

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TRAVERSE INTACT ANALYSIS

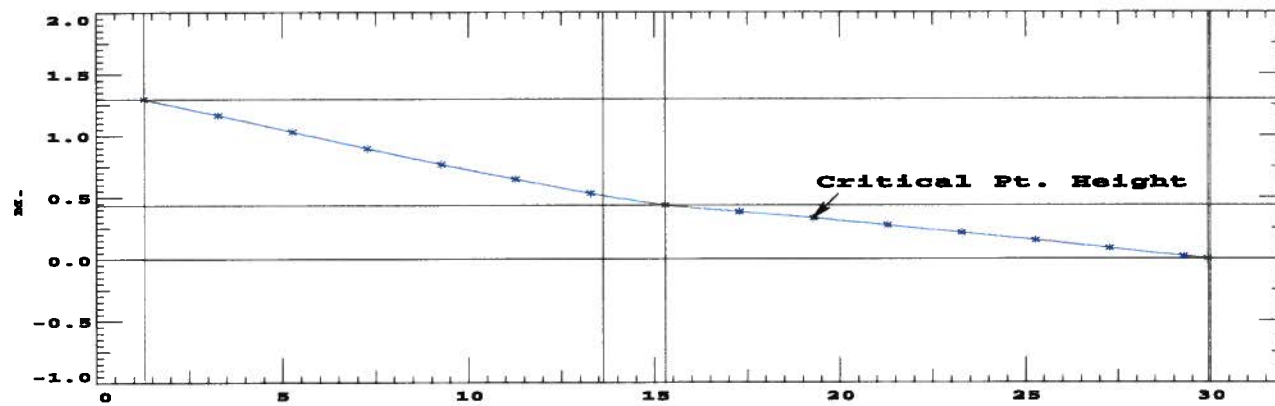
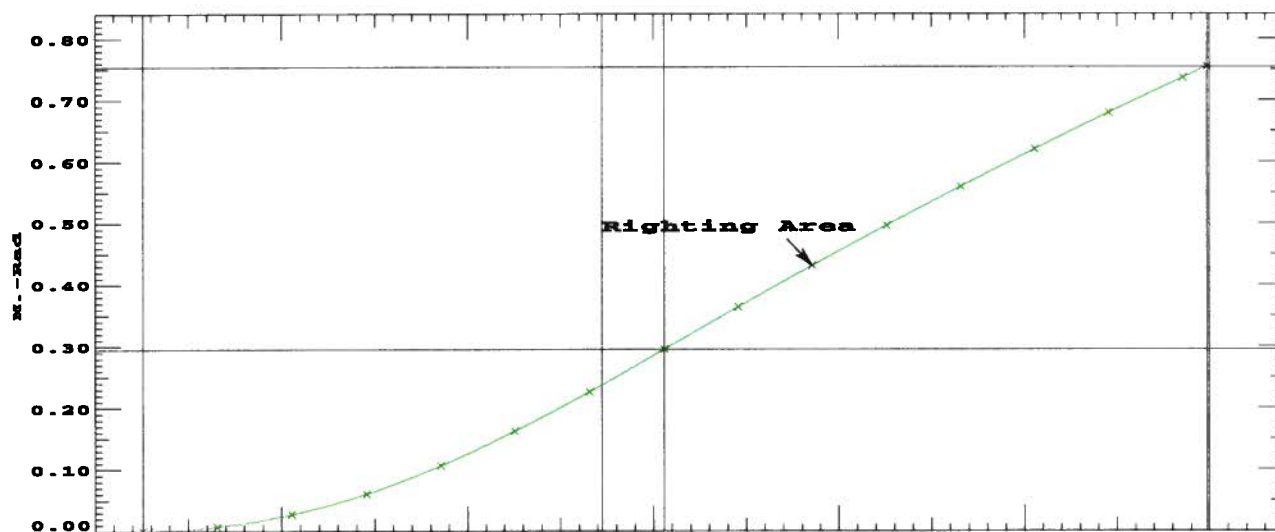
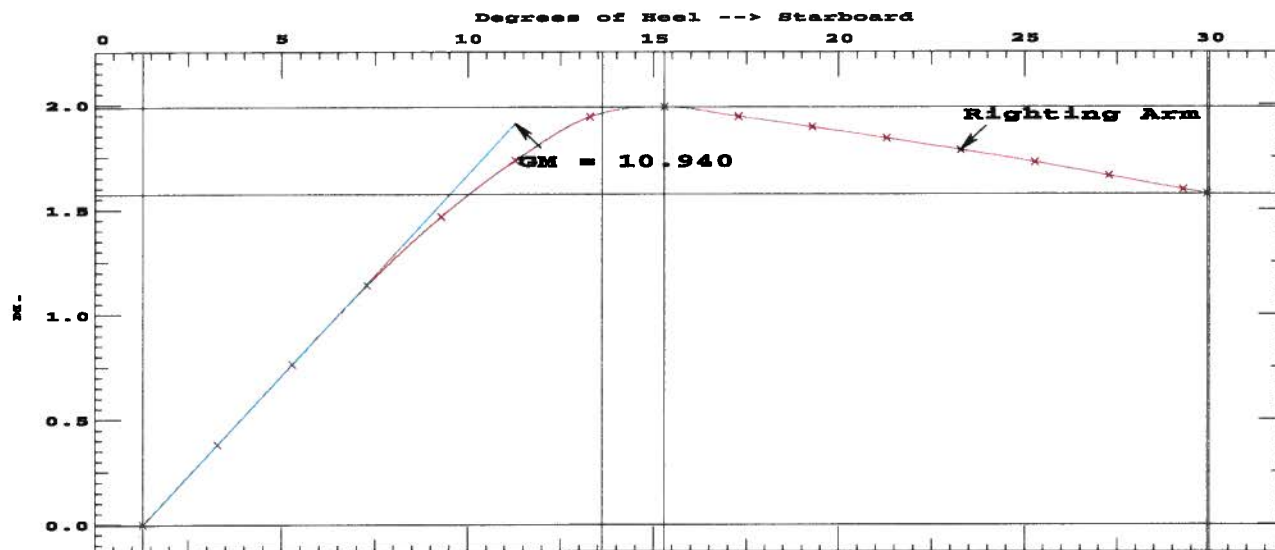
MAX LOAD WITH OUT-LIFT HOOKED LOAD

LIM-----	STAB 6 CRITERION-----	Min/Max-----	Attained
(1)	Area from Equilibrium to abs 30 deg	> 0.0550 m.-Rad	UNDEF
(2)	Area from Equilibrium to abs 40 deg	> 0.0900 m.-Rad	UNDEF
(3)	Area from abs 30 deg to abs 40	> 0.0300 m.-Rad	UNDEF
(4)	Righting Arm at abs 30 deg	> 0.200 m.	UNDEF
(5)	Absolute Angle at MaxRA	> 25.00 deg	14.81 F
(6)	GM at Equilibrium	> 0.150 m.	10.940 P
(7)	Absolute Angle at Flood	> 0.00 deg	29.93 P
(8)	Absolute Angle at Deck Immersion	> 0.00 deg	13.61 P
(9)	Area from Equilibrium to Flood	> 0.0900 m.-Rad	0.7538 P

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## TRAVERSE INTACT ANALYSIS

MAX LOAD WITH OUT-LIFT HOOKED LOAD





## **APPENDIX E**

### **GZ CALCULATION**

### EXAMPLE SHOWING USE OF CROSS CURVES (KN)

The approximate GZ curve for any intact loading condition can be obtained by reading the vessel's draft marks and using the hydrostatic curves contained in Appendix A and the cross-curves contained in Appendix B. The user will also need to determine the vessel's approximate vertical centre of gravity based on the Lightship and loading values provided in sub-section 7 of the manual.

#### Determining Vessel Displacement

Read the vessel draft marks both port and starboard and forward and aft and calculate the vessel's mean draft using the following formulas:

$$\text{draft\_fwd} = (\text{draft\_fwd\_port} + \text{draft\_fwd\_stbd}) / 2,$$

$$\text{draft\_aft} = (\text{draft\_aft\_port} + \text{draft\_aft\_stbd}) / 2,$$

$$\text{draft\_ms} = (\text{draft\_fwd} + \text{draft\_aft}) / 2.$$

That draft value (draft\_ms) from this calculation can then be used to obtain the vessel displacement from the Hydrostatic tables or curves provided in Appendix A.

#### Determining Vessel Vertical Centre of Gravity

The vertical centre of gravity can be determined by using condition tables similar to those presented in sub-section 7 of this manual and as reproduced in Table E1 below. Deadweight Items that are onboard the vessel should be itemized, their weight and location estimated, as example below, and should be added to the known lightship displacement of 34.68 tonnes. The resulting loaded displacement should be checked against the displacement obtained from the draft marks as a check against the accuracy of the estimate. The Vertical Centre of Gravity corresponding to this displacement is obtained by summing the Vertical Moments of the individual Lightship and Load Items and dividing this number by the Loaded Displacement of the vessel.

Table E.1: Calculation of Vertical Centre of Gravity

	WEIGHT [Tonnes]	VCG [m] Above Keel	Vertical Moment [Tonne.m]
LIGHTSHIP	34.68	1.865	64.67
Crew	0.4	3.5	1.4
Crew Effects	0.1	2.8	0.28
Ballast P (Water Tank)	1.10	0.785	0.86
Ballast S (Water Tank)	1.10	0.785	0.86
Fuel Tank Port – 10%	0.08	1.680	0.13
Fuel Tank Stbd – 10%	0.08	1.680	0.13
Cargo	6.46	4.5	29.1
Loaded Displacement	44.00	2.21	97.43

### Calculating Resulting GZ Curve

The displacement value obtained from the drafts, and validated above, should now be used in conjunction with the Cross Curve Graphs and Tables in Appendix B to obtain KN values for each angle of heel. These KN values from Appendix B should be filled in a table similar to that presented in E2 below.

Having obtained the KN values at each heel angle for the required displacement the GZ values can be obtained by subtracting from KN the value of  $KG \sin \Theta$ :

$$\text{Righting Lever GZ} = \text{KN} - \text{KG} \sin \Theta$$

where KN = Cross Curve ordinate

KG = Vertical Centre of Gravity above baseline

$\Theta$  = Angle of Inclination

For the Loaded Displacement and Centre of Gravity in Table E1 the Corresponding GZ values have been calculated in Table E2.

Displacement,  $\Delta$ : 44.00 Tonnes,

Vertical Centre of Gravity, KG: 2,21 metres

**Table E.2: Calculation of GZ**

KN	$\Theta^\circ$	$\sin \Theta$	$KG \sin \Theta$	$GZ = (KN - KG \sin \Theta)$
1.219	5	0.0872	0.193	1.026
2.275	10	0.1736	0.384	1.891
2.723	15	0.2588	0.572	2.151
2.759	20	0.3420	0.756	2.003
2.772	25	0.4226	0.934	1.838
2.757	30	0.5000	1.105	1.652
2.715	35	0.5736	1.268	1.447
2.648	40	0.6428	1.421	1.227
2.558	45	0.7071	1.563	0.995
2.443	50	0.7660	1.693	0.750
2.307	55	0.8192	1.810	0.497
2.151	60	0.8660	1.914	0.237

## **APPENDIX F**

### **GZ CALCULATION WORKSHEET**

**GZ CALCULATION WORKSHEET**

GZ values for any condition can be obtained by using draft reading, hydrostatic and cross-curves.

**STEP 1:**

Obtain reading from draft marks and calculate average for midship and centerline by following formulas:

$$\begin{aligned}\text{draft\_fwd} &= (\text{draft\_fwd\_port} + \text{draft\_fwd\_stbd}) / 2 \\ &= ( \quad + \quad ) / 2 \\ &= \quad \text{m}\end{aligned}$$

$$\begin{aligned}\text{draft\_aft} &= (\text{draft\_aft\_port} + \text{draft\_aft\_stbd}) / 2 \\ &= ( \quad + \quad ) / 2 \\ &= \quad \text{m}\end{aligned}$$

$$\begin{aligned}\text{draft\_ms} &= (\text{draft\_fwd} + \text{draft\_aft}) / 2 \\ &= ( \quad + \quad ) / 2 \\ &= \quad \text{m}\end{aligned}$$

**STEP 2:**

Use the above draft value (draft\_ms) to obtain displacement,  $\Delta$  from the hydrostatic curves.

$$\text{Displacement, } \Delta = \quad \text{mt}$$

**STEP 3:**

Determine the vertical centre of gravity by using condition tables in Table E1 below. Deadweight items that are onboard the vessel should be itemized, their weight and location estimated, and should be added to the known lightship displacement of 34.68 tonnes. The resulting loaded displacement should be checked against the displacement obtained from the draft marks as a check against the accuracy of the estimate. The Vertical Centre of Gravity corresponding to this displacement is obtained by summing the Vertical Moments of the individual Lightship and Load items and dividing this number by the Loaded Displacement of the vessel.

**Table F.1: Calculation of Vertical Centre of Gravity**

	WEIGHT [Tonnes]	VCG [m] Above Keel	Vertical Moment [Tonne.m]
LIGHTSHIP	34.68	1.865	64.67
Crew			
Crew Effects			
Ballast P (Water Tank)	1.10	0.785	0.86
Ballast S (Water Tank)	1.10	0.785	0.86
Fuel Tank Port			
Fuel Tank Stbd			
Cargo			
Loaded Displacement	$\Sigma =$		$\Sigma =$

$$\begin{aligned}\text{VCG (or KG)} &= \Sigma \text{ Vertical Moments} / \Sigma \text{ Weights} \\ &= \underline{\hspace{2cm}} / \underline{\hspace{2cm}} \\ &= \underline{\hspace{2cm}} \text{ m}\end{aligned}$$

**STEP 4:**

Use the displacement value from Step 2 in the Cross Curves in Appendix B to obtain the KN readings for each angle of heel from the graph. These readings shall be filled in the table below.

**STEP 5:**

Having obtained the KN values at each heel angle for the required displacement, the GZ values can be obtained by subtracting from KN the value of  $\text{KG Sin } \Theta$ .

$$\text{Righting Lever GZ} = \text{KN} - \text{KG Sin } \Theta$$

where KN = Cross Curve ordinate (m)

KG = Centre of Gravity above baseline (m)

$\Theta$  = Angle of Inclination (deg)

Condition:

Corresponding Displacement,  $\Delta$ :                  mt

Centre of Gravity, KG:                  m

**Table F.2: Calculation of GZ**

KN	$\Theta^\circ$	Sin $\Theta$	KG Sin $\Theta$	GZ = (KN - KG Sin $\Theta$ )
	5	0.0872		
	10	0.1736		
	15	0.2588		
	20	0.3420		
	25	0.4226		
	30	0.5000		
	35	0.5736		
	40	0.6428		
	45	0.7071		
	50	0.7660		
	55	0.8192		
	60	0.8660		