ONLINE MARINE ENGINEERING

Transport Analysis Report

Tow Speed and Bollard Pull Analysis

Project

EXAMPLE PROJECT

DEMO RUN FOR REVIEW

Client

ORCA OFFSHORE

Issue Date

18/11/2010

Report reference number: Herm-18-Nov-10-38284

Report Prepared by: Online Marine Engineering

www.transportanalysis.com

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References

1. “General Guidelines for Marine Transportation”. Noble Denton International Limited, Rep No. 0030/NDI/JR Rev. 4, March 2010.
2. "Rules for planning and executing marine operations", DNV, 1999, incl. ADDENDUM 2000
3. “Online Moses Reference Manual”, UltraMarine

1.0 GENERAL

1.1 Introduction

This report presents a bollard pull and a tow speed analysis on request of SPT Offshore b.v. for the EXAMPLE PROJECT Project.
The report presents the used input data and a full report of the analysis.

This report has been created online without any human interference. The client should carefully check the input and output before the results can be used. It is the sole responsibility of the client to assure that the results are correct.

1.2 Scope

The scope of this report is to present the bollard pull requirements and speed estimate of this transport.
The analysis includes:

- Floatation analysis
- 3-D Diffraction analysis
- Bollard-pull calculation
- Tow speed Estimate

1.3 Bollard pull requirement

The NDI guidelines requires that the tow should be able to maintain position for zero forward speed against the following conditions acting simultaneously:

- 40 knots wind
- Hs = 5.0 m seastate
- 0.5 m/s current

The above requirements can be found in reference 1 or 2. depending on the selected guideline for this analysis.

Minimum towline pull required (TPR) will be computed based on the above conditions.
The following loads will be calculated:

- Wind loads — Using Morrison Equation with default CD
- Wave Drift forces — Using 3-D Diffraction
- Current Loads — Using Morrison Equation with default CD

Minimum required static bollard pull of the tug(s) will be calculated as follows:

BP = TPR / Te

where Te = the tug efficiency factor.
For this analysis a Te of 0.75 is used.

1.4 Tow speed estimate

The target transport velocity will be 7 kn.
The tow speed for different power settings of the tugs will be calculated for Stillwater conditions and for the following environment:

Seastate Hs = 2.0 m, Significant wave height
Tp = 6.5 sec (Seastate Peak Period)
Wind Vw =20.0 Knots Mean wind velocity at 10 m

To represent the seastate a Jonswap spectrum with a peak shape factor of 3.3 will be used without spreading.

1.5 Cargo characteristics

The following table presents the characteristics of the cargo that has been used for this analysis.

No	Name	Weight	LCG	TCG	VCG	Roll Radius	Pitch Radius	Length	Width	Height
-		Ton	m	m	m	m	m	m	m	m
1	Accom	500.0	145.00	0.00	11.00	10.00	10.00	35.00	55.00	22.00
2	S1-S8	30000.0	-7.50	0.00	12.50	10.00	25.00	225.00	50.00	25.00
3	Flare	250.0	-145.00	0.00	67.50	60.00	60.00	2.00	2.00	135.00
	Total	30750.0	-6.14	0.00	12.92					

Table 1.2 Cargo characteristics

Legend:

LCG = Longitudinal Centre of Gravity (From Midship to aft)
TCG = Transverse Centre of Gravity (From Barge centreline to Starboard)
VCG = Vertical Centre of Gravity (z) (From Barge deck upwards)
Roll Radius = Roll Radius of Inertia
Pitch Radius = Pitch Radius of Inertia
Length = Length of Cargo
Width = Width of cargo

1.6 Barge Characteristic

The following cargo barge have been used:

Name	=	FPSO
Model name	=	Barge
Length	=	330 m
Width	=	61 m
Depth	=	34 m
Lightship	=	88974.59 Ton with VCG at 17.00 m above keel

1.7 Tug Characteristic

The following tugs have been used:

No	Name	Bollard Pull	Maximum Speed	Length pp
-		Ton	kts	m
1	Tug1	285.0	18.00	67.00
2	Tug2	285.0	18.00	67.00
	Total	570.0		

Table 1.3 Tug characteristics

2.0 SUMMARY OF RESULTS AND CONCLUSIONS

2.1 Summary of Results

The transport with the barge FPSO for project EXAMPLE PROJECT has been analysed with regard to bollard pull criteria and tow speed.

2.2 Conclusions

The proposed tug arrangement does have sufficient capacity to meet the bollard pull requirement as set by NDI.

The proposed tug arrangement does NOT have sufficient capacity to maintain the design speed at calm conditions at 85% MCR power setting.

The proposed tug arrangement does NOT have sufficient capacity to maintain the design speed at the defined environmental conditions at 85% MCR power setting.

3.0 COMPUTER MODEL

3.1 General

This chapter presents the description of the model that has been used for the hydrostatic analysis of the transport.

For the marine analysis, MOSES from Ultramarine, has been used. MOSES is a multipurpose marine and structural simulation computer program widely used for transport and installation design of offshore structures. See the ultramarine internet website for more information on MOSES, address is: http://www.ultramarine.com/, see reference 3.

The computer model used for this run has been developed by Online Marine Engineering and bears revision code M.1.5.A.1.14..

The definition of the co-ordinate system for the marine analysis is as follows:
Origin at barge centre, keel level and centre line.

X-axis : Positive from barge bow towards stern
Y-axis : Positive towards Starboard side
Z-axis : Positive is upwards

See figure 3.1.

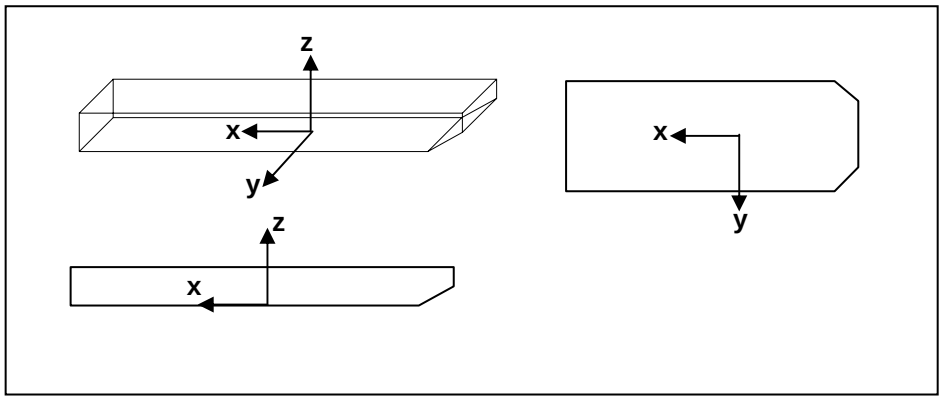


Figure 3.1 Definition of marine co-ordinate system

3.2 Description of the barge model

To calculate stability a single body model is used.

This model consists of one rigid body composed of several compartments with the following properties:

Compartment	Type	Remark
Barge	Standard	Strip theory model
Barge Ballast Tanks	Standard	All tanks have been modelled

Table 3.1 Compartment properties

The weights of all items have been modelled as point loads with correct inertia properties.

4.0 ANALYSIS RESULTS

4.1 General

The scope of the hydrostatic analysis is to analyse the floating condition including intact and damaged stability of the transport.

4.2 Hydrostatic Results

The following table presents the results of the hydrostatic analysis.

		Units	Remarks
Tow condition Intact			
Mean Draft	10.00	m	
Heel	0.00	Degree	
Trim	0.20	Degree	Positive is Aft down
Displacement	187826.30	Ton	Barge Displacement

Table 4.1 Tow condition Intact results

Attachment 1 presents the detailed output of the MOSES hydrostatic analysis.

4.3 Bollard Pull analysis

Minimum towline pull required (TPR) has been computed for zero forward speed against the following conditions acting simultaneously:

- 40 knots wind
- Hs = 5.0 m seastate
- 0.5 m/s current

The following loads have been calculated:

Wind Drag	209.8	Ton
Wave drift loads	109.8	Ton
Current Drag	8.3	Ton
Total TPR	327.9	Ton

Minimum required static bollard pull of the tug(s) will be calculated as follows:

BP = TPR / Te

where Te = the tug efficiency factor.
For this analysis a Te of 0.75 is used.

BP = 327.9/ 0.75 = 437.2 Ton Minimum required Bollard pull

The proposed tug arrangement does have sufficient capacity to meet the bollard pull requirement.

4.4 Tow speed estimate

For the design speed of 7.0 kn, the total drag at transport draft is: 413.7 Ton.

Figure 6 in attachment 1 presents the towline pull against speed curve for the tow. On this graph the expected tow speed has been presented for different tug power settings. The following tables presents the results:

Power Setting	100%	85%	70%	
Speed	6.6	6.1	5.7	**Knots**
Towline Pull	362.5	317.2	270.1	**Ton**

Table 4.2 Tow speed Stillwater conditions

The proposed tug arrangement does NOT have sufficient capacity to maintain the design speed at calm conditions at 85% MCR power setting.

Power Setting	100%	85%	70%	
Speed	6.1	5.6	5.1	**Knots**
Towline Pull	378.3	334.0	287.9	**Ton**

Table 4.3 Tow speed with environmental conditions

The proposed tug arrangement does NOT have sufficient capacity to maintain the design speed at the defined environmental conditions at 85% MCR power setting.

The Froude number for the barge at this speed is FR = v/(g.L)^0.5 = 0.06 . For Froude numbers large than 0.11 wave resistance will start to dominate and should be added to the above reported drag resistance to find the total resistance during tow at the design speed.

ATTACHMENT 1: COMPUTER OUTPUT

```
*****************************************************************************************************
*                                          *** MOSES   ***                                          *
*                                          ----------------                  18 November, 2010      *
*          User: SPT Offshore b.v.  NO.: 2 - EXAMPLE PROJECT                                        *
*          Barge Hydrostatic Model check                                                            *
*                                                                                                   *
*****************************************************************************************************
```

+++ H Y D R O S T A T I C P R O P E R T I E S +++

For Body MODEL

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

Condition			Displac-	Center Of Buoyancy			W.P.	C. Flotation		Metacentric Heights			
Draft	Trim	Roll	M-Tons	X	Y	Z	Area	X	Y	KMT	KML	BMT	BML
0.00	0.00	0.00	2.23	-8.25	0.00	0.00	17111	-8.25	0.00	99999.99	99999.99	99999.99	99999.99
0.20	0.00	0.00	3513.82	-8.12	0.00	0.10	17158	-7.99	0.00	1551.67	99999.99	1551.57	99999.99
0.40	0.00	0.00	7035.12	-7.99	0.00	0.20	17205	-7.73	0.00	777.30	99999.99	777.10	99999.99
0.60	0.00	0.00	10566.12	-7.86	0.00	0.30	17253	-7.47	0.00	519.13	99999.99	518.83	99999.99
0.80	0.00	0.00	14106.83	-7.73	0.00	0.40	17300	-7.21	0.00	390.08	8423.60	389.68	8423.20
1.00	0.00	0.00	17657.26	-7.60	0.00	0.50	17347	-6.96	0.00	312.68	6785.43	312.17	6784.93
1.20	0.00	0.00	21217.38	-7.47	0.00	0.60	17395	-6.70	0.00	261.10	5693.44	260.50	5692.84
1.40	0.00	0.00	24787.21	-7.34	0.00	0.70	17442	-6.44	0.00	224.30	4913.58	223.59	4912.88
1.60	0.00	0.00	28366.76	-7.21	0.00	0.80	17489	-6.18	0.00	196.71	4328.80	195.91	4328.00
1.80	0.00	0.00	31956.01	-7.08	0.00	0.90	17537	-5.92	0.00	175.28	3874.09	174.38	3873.19
2.00	0.00	0.00	35554.97	-6.95	0.00	1.00	17584	-5.66	0.00	158.15	3510.42	157.15	3509.42
2.20	0.00	0.00	39163.64	-6.82	0.00	1.11	17632	-5.40	0.00	144.16	3212.97	143.05	3211.86
2.40	0.00	0.00	42782.00	-6.69	0.00	1.21	17679	-5.14	0.00	132.51	2965.18	131.31	2963.97
2.60	0.00	0.00	46410.09	-6.56	0.00	1.31	17726	-4.89	0.00	122.67	2755.59	121.36	2754.28
2.80	0.00	0.00	50047.88	-6.43	0.00	1.41	17774	-4.63	0.00	114.25	2576.02	112.84	2574.61
3.00	0.00	0.00	53695.37	-6.30	0.00	1.51	17821	-4.37	0.00	106.97	2420.47	105.46	2418.96
3.20	0.00	0.00	57352.57	-6.16	0.00	1.61	17868	-4.11	0.00	100.61	2284.43	99.00	2282.81
3.40	0.00	0.00	61019.47	-6.03	0.00	1.71	17916	-3.85	0.00	95.01	2164.45	93.29	2162.74
3.60	0.00	0.00	64696.09	-5.90	0.00	1.81	17963	-3.59	0.00	90.04	2057.87	88.22	2056.05
3.80	0.00	0.00	68382.41	-5.77	0.00	1.92	18010	-3.33	0.00	85.61	1962.56	83.69	1960.64
4.00	0.00	0.00	72078.45	-5.64	0.00	2.02	18058	-3.07	0.00	81.62	1876.84	79.61	1874.82
4.20	0.00	0.00	75784.18	-5.51	0.00	2.12	18105	-2.81	0.00	78.03	1799.33	75.91	1797.21
4.40	0.00	0.00	79499.65	-5.37	0.00	2.22	18153	-2.56	0.00	74.78	1728.92	72.55	1726.70
4.60	0.00	0.00	83224.77	-5.24	0.00	2.32	18200	-2.30	0.00	71.81	1664.68	69.49	1662.36
4.80	0.00	0.00	86959.64	-5.11	0.00	2.43	18247	-2.04	0.00	69.10	1605.84	66.68	1603.41
5.00	0.00	0.00	90704.22	-4.98	0.00	2.53	18295	-1.78	0.00	66.62	1551.75	64.09	1549.22
5.20	0.00	0.00	94458.48	-4.85	0.00	2.63	18342	-1.52	0.00	64.33	1501.86	61.70	1499.23
5.40	0.00	0.00	98222.44	-4.71	0.00	2.73	18389	-1.26	0.00	62.22	1455.71	59.49	1452.98
5.60	0.00	0.00	101996.13	-4.58	0.00	2.83	18437	-1.00	0.00	60.27	1412.90	57.44	1410.06
5.80	0.00	0.00	105779.54	-4.45	0.00	2.94	18484	-0.74	0.00	58.46	1373.07	55.52	1370.13
6.00	0.00	0.00	109572.66	-4.32	0.00	3.04	18531	-0.49	0.00	56.78	1335.94	53.74	1332.90
6.20	0.00	0.00	113375.46	-4.18	0.00	3.14	18579	-0.23	0.00	55.21	1301.23	52.07	1298.09
6.40	0.00	0.00	117187.97	-4.05	0.00	3.25	18626	0.03	0.00	53.75	1268.74	50.50	1265.49
6.60	0.00	0.00	121010.20	-3.92	0.00	3.35	18674	0.29	0.00	52.38	1238.24	49.03	1234.89
6.80	0.00	0.00	124842.13	-3.78	0.00	3.45	18721	0.55	0.00	51.10	1209.57	47.65	1206.12
7.00	0.00	0.00	128683.77	-3.65	0.00	3.55	18768	0.81	0.00	49.90	1182.57	46.34	1179.02
7.20	0.00	0.00	132535.14	-3.52	0.00	3.66	18816	1.07	0.00	48.77	1157.10	45.11	1153.44
7.40	0.00	0.00	136396.17	-3.38	0.00	3.76	18863	1.33	0.00	47.70	1133.04	43.94	1129.28
7.60	0.00	0.00	140266.92	-3.25	0.00	3.86	18910	1.59	0.00	46.70	1110.27	42.84	1106.41
7.80	0.00	0.00	144147.41	-3.12	0.00	3.97	18958	1.84	0.00	45.76	1088.70	41.79	1084.73

```
*****************************************************************************************************
*                                          *** MOSES   ***                                          *
*                                          ----------------                  18 November, 2010      *
*          User: SPT Offshore b.v.  NO.: 2 - EXAMPLE PROJECT                                        *
*          Barge Hydrostatic Model check                                                            *
*                                                                                                   *
*****************************************************************************************************
```

+++ H Y D R O S T A T I C C O E F F I C I E N T S +++

For Body MODEL

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

/--- Condition ---/			Displacement	Wetted Surface	Load To Change Draft 1 MM	/----- For 0 KG -----/ Moment To Change .01 Deg	
Draft	Trim	Roll				--- Heel ---	--- Trim ---
0.00	0.00	0.00	2.23	17110.5	17.53	948.92	20064.88
0.20	0.00	0.00	3513.82	17278.7	17.58	951.55	20231.98
0.40	0.00	0.00	7035.12	17447.2	17.63	954.17	20400.00
0.60	0.00	0.00	10566.12	17616.1	17.68	956.80	20568.94
0.80	0.00	0.00	14106.83	17785.2	17.73	959.43	20738.82
1.00	0.00	0.00	17657.26	17954.6	17.78	962.05	20909.62
1.20	0.00	0.00	21217.38	18124.4	17.82	964.68	21081.36
1.40	0.00	0.00	24787.21	18294.5	17.87	967.31	21254.04
1.60	0.00	0.00	28366.76	18464.8	17.92	969.93	21427.66
1.80	0.00	0.00	31956.01	18635.5	17.97	972.56	21602.22
2.00	0.00	0.00	35554.97	18806.5	18.02	975.19	21777.73
2.20	0.00	0.00	39163.64	18977.8	18.07	977.81	21954.19
2.40	0.00	0.00	42782.00	19149.4	18.12	980.44	22131.59
2.60	0.00	0.00	46410.09	19321.3	18.16	983.07	22309.95
2.80	0.00	0.00	50047.88	19493.6	18.21	985.69	22489.27
3.00	0.00	0.00	53695.37	19666.1	18.26	988.32	22669.54
3.20	0.00	0.00	57352.57	19839.0	18.31	990.95	22850.78
3.40	0.00	0.00	61019.47	20012.2	18.36	993.57	23032.98
3.60	0.00	0.00	64696.09	20185.6	18.41	996.20	23216.14
3.80	0.00	0.00	68382.41	20359.4	18.46	998.83	23400.27
4.00	0.00	0.00	72078.45	20533.5	18.50	1001.45	23585.38
4.20	0.00	0.00	75784.18	20707.9	18.55	1004.08	23771.45
4.40	0.00	0.00	79499.65	20882.7	18.60	1006.71	23958.50
4.60	0.00	0.00	83224.77	21057.7	18.65	1009.33	24146.54
4.80	0.00	0.00	86959.64	21233.0	18.70	1011.96	24335.54
5.00	0.00	0.00	90704.22	21408.7	18.75	1014.59	24525.54
5.20	0.00	0.00	94458.48	21584.7	18.80	1017.21	24716.53
5.40	0.00	0.00	98222.44	21760.9	18.84	1019.84	24908.50
5.60	0.00	0.00	101996.13	21937.5	18.89	1022.47	25101.46
5.80	0.00	0.00	105779.54	22114.4	18.94	1025.09	25295.42
6.00	0.00	0.00	109572.66	22291.6	18.99	1027.72	25490.37
6.20	0.00	0.00	113375.46	22469.1	19.04	1030.35	25686.33
6.40	0.00	0.00	117187.97	22647.0	19.09	1032.97	25883.28
6.60	0.00	0.00	121010.20	22825.1	19.14	1035.60	26081.24
6.80	0.00	0.00	124842.13	23003.6	19.18	1038.23	26280.20
7.00	0.00	0.00	128683.77	23182.3	19.23	1040.86	26480.18
7.20	0.00	0.00	132535.14	23361.4	19.28	1043.48	26681.17
7.40	0.00	0.00	136396.17	23540.8	19.33	1046.11	26883.17
7.60	0.00	0.00	140266.92	23720.5	19.38	1048.74	27086.19
7.80	0.00	0.00	144147.41	23900.5	19.43	1051.36	27290.22

```
*****************************************************************************************************
*                                        ***  MOSES   ***                                           *
*                                        ----------------                  18 November, 2010      *
*          User: SPT Offshore b.v.  NO.: 2 - EXAMPLE PROJECT                                        *
*          Bollard Pull check with Vessel Barge L=    330m B=    61m D=    34m                      *
*                                                                                                   *
*****************************************************************************************************
```

+++ B U O Y A N C Y A N D W E I G H T F O R M O D E L +++

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

Results Are Reported In Body System

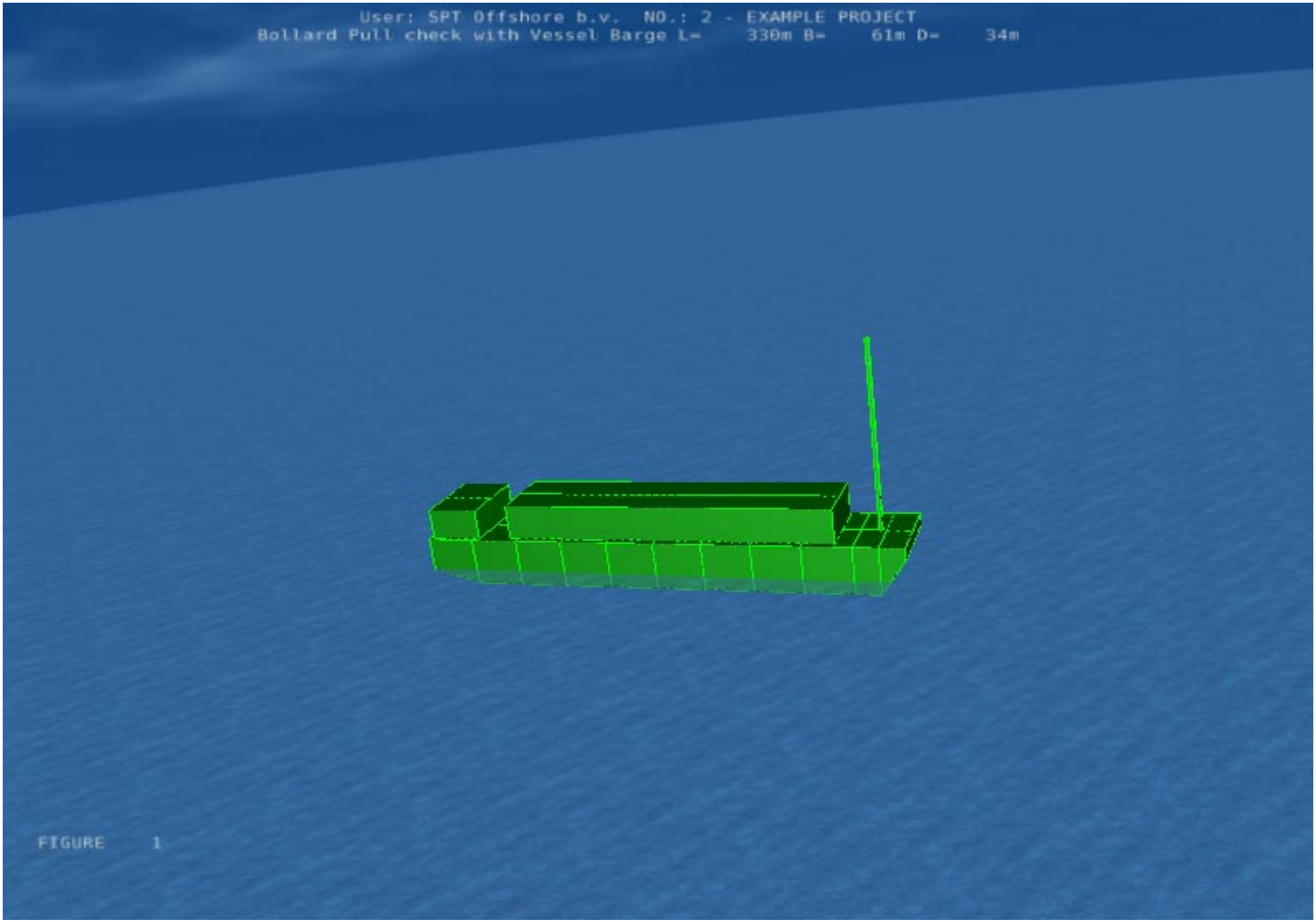
Draft = 10.00 Roll Angle = 0.00 Pitch Angle = 0.20

Wet Radii Of Gyration About CG

K-X = 24.08 K-Y = 93.89 K-Z = 90.06

GMT = 18.44 GML = 854.62

Name	Weight	/-- Center of Gravity ---/ ---X---	---Y---	---Z---	Sounding --------	% Full --------
---------- Part BARGE ----------						
--- Contents ---						
CP2	3142.08	-98.51	-9.15	1.30	2.59	7.62
CP3	3317.14	-32.53	-9.15	1.37	2.73	8.04
CP4	3492.20	33.44	-9.15	1.44	2.88	8.47
CP5	3667.25	99.42	-9.15	1.51	3.02	8.89
CS2	3142.08	-98.51	9.15	1.30	2.59	7.62
CS3	3317.14	-32.53	9.15	1.37	2.73	8.04
CS4	3492.20	33.44	9.15	1.44	2.88	8.47
CS5	3667.25	99.42	9.15	1.51	3.02	8.89
WP1	3017.52	-141.13	-15.25	2.79	5.38	10.81
WP2	3142.08	-98.67	-24.40	1.94	3.89	11.43
WP3	3317.14	-32.69	-24.40	2.05	4.10	12.07
WP4	3492.20	33.30	-24.40	2.16	4.32	12.70
WP5	3667.25	99.28	-24.40	2.27	4.54	13.34
WP6	3795.97	141.49	-15.25	5.84	8.76	12.99
WS1	3017.52	-141.13	15.25	2.79	5.38	10.81
WS2	3142.08	-98.67	24.40	1.94	3.89	11.43
WS3	3317.14	-32.69	24.40	2.05	4.10	12.07
WS4	3492.20	33.30	24.40	2.16	4.32	12.70
WS5	3667.25	99.28	24.40	2.27	4.54	13.34
WS6	3795.97	141.49	15.25	5.84	8.76	12.99
---------- Part CARGO1 ----------						
LOAD_GRO	500.00	145.00	0.00	45.00		
---------- Part CARGO2 ----------						
LOAD_GRO	30000.00	-7.50	0.00	46.50		
---------- Part CARGO3 ----------						
LOAD_GRO	250.00	-145.00	0.00	101.50		
---------- Part LIGHTSHI ----------						
LOAD_GRO	88974.59	0.00	0.00	17.00		
---------- Part MODEL ----------						
Total	187826.30	1.52	0.00	16.57		
Buoyancy	187826.34	1.56	0.00	5.12		


User: SPT Offshore b.v. NO.: 2 - EXAMPLE PROJECT
Bollard Pull check with Vessel Barge L= 330m B= 61m D= 34m
FIGURE 1

User: SPT Offshore b.v. NO.: 2 - EXAMPLE PROJECT
Bollard Pull check with Vessel Barge L= 330m B= 61m D= 34m

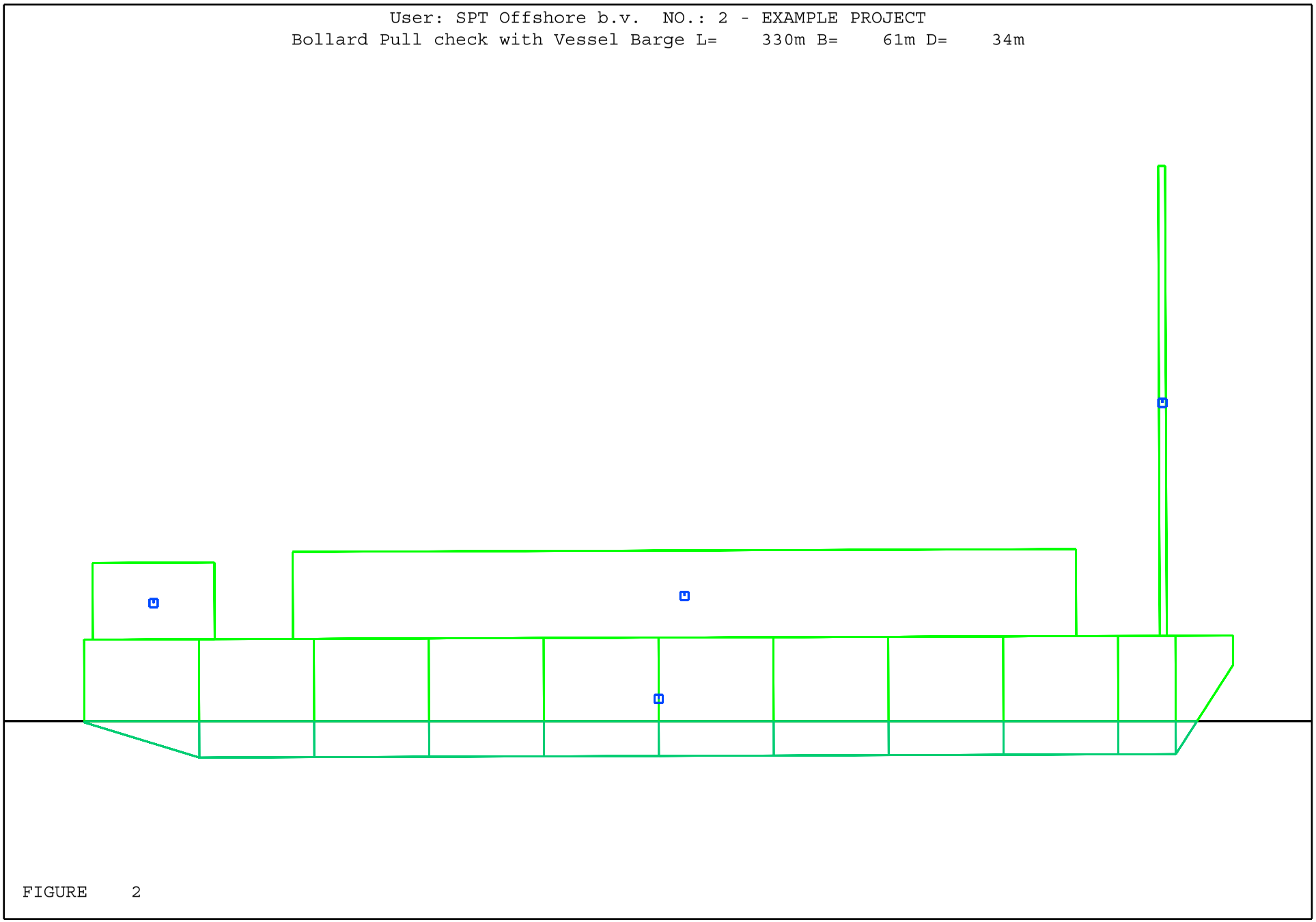


FIGURE 2

User: SPT Offshore b.v. NO.: 2 - EXAMPLE PROJECT
Bollard Pull check with Vessel Barge L= 330m B= 61m D= 34m

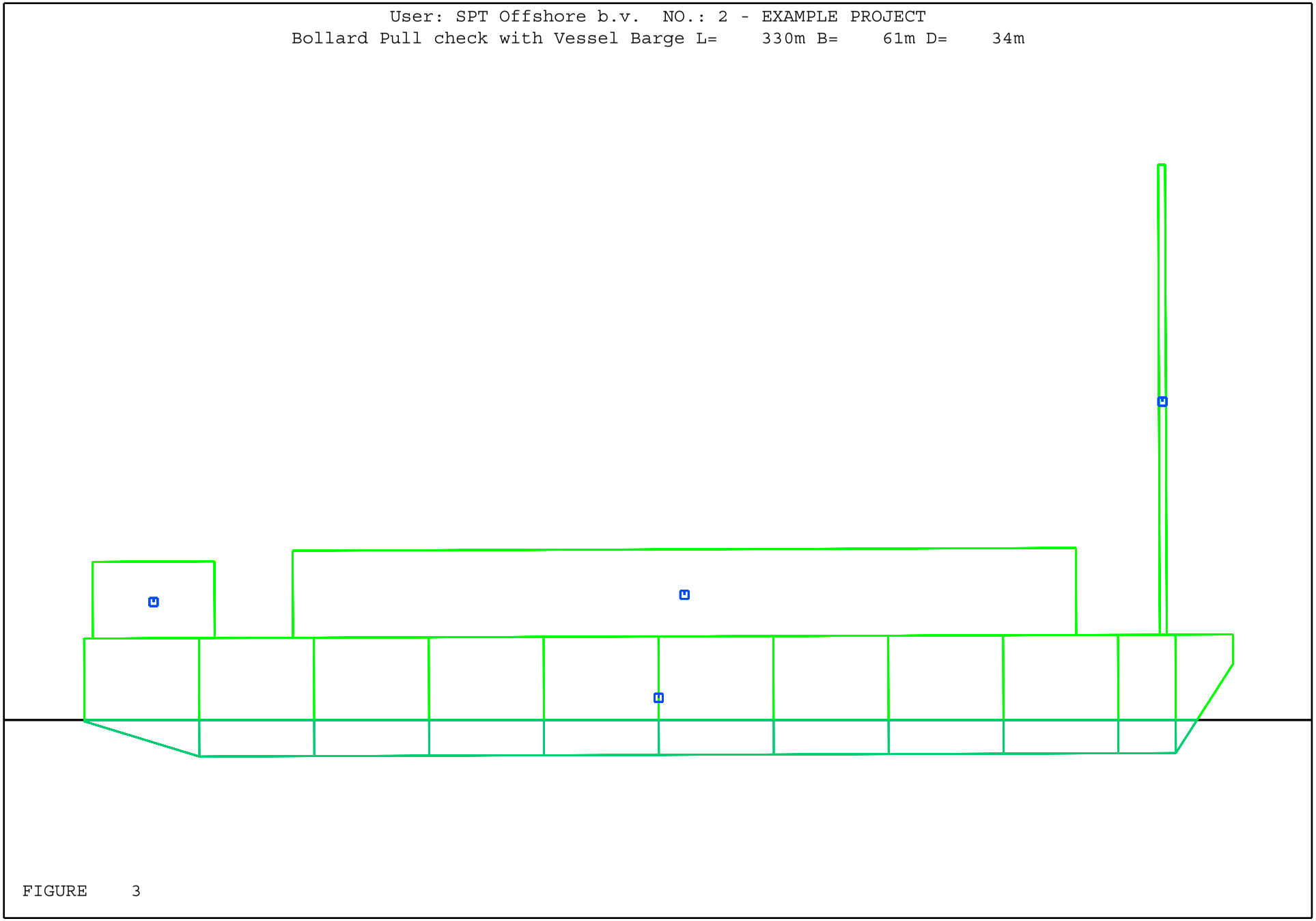


FIGURE 3

User: SPT Offshore b.v. NO.: 2 - EXAMPLE PROJECT
Bollard Pull check with Vessel Barge L= 330m B= 61m D= 34m

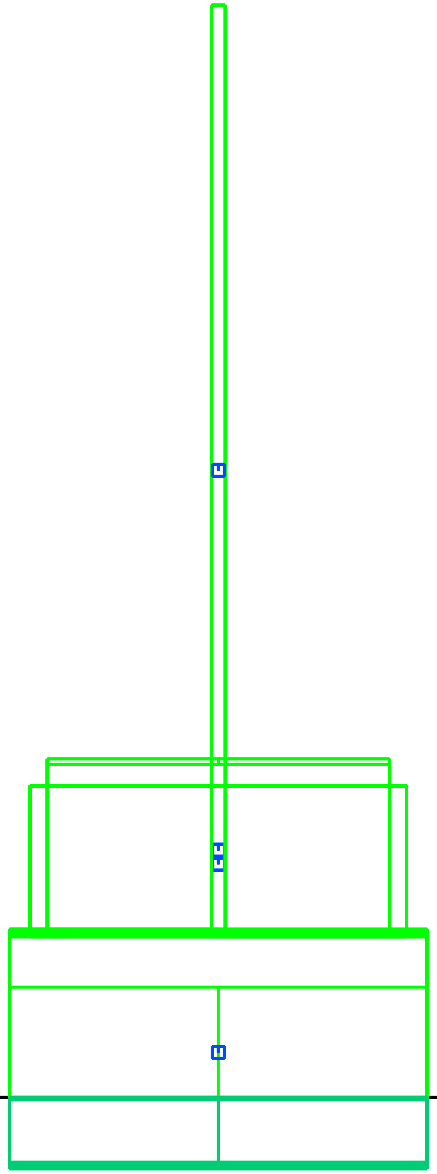


FIGURE 4

User: SPT Offshore b.v. NO.: 2 - EXAMPLE PROJECT
Bollard Pull check with Vessel Barge L= 330m B= 61m D= 34m

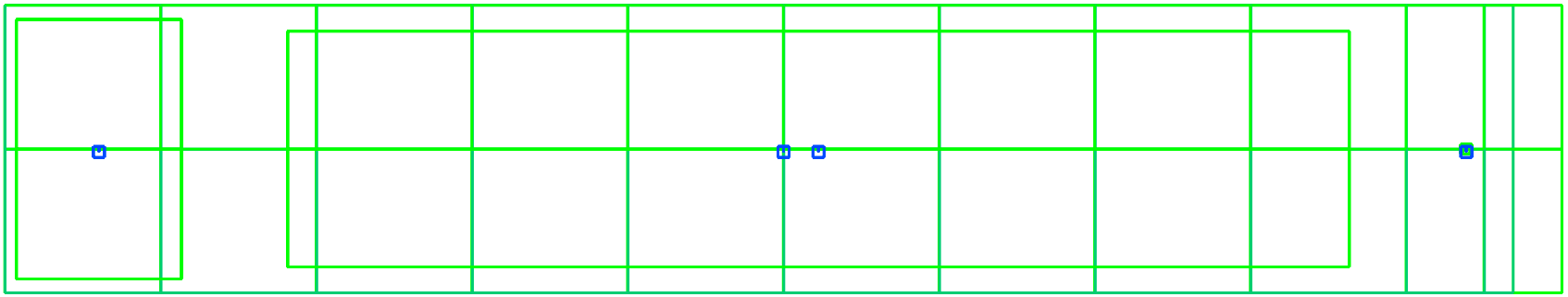


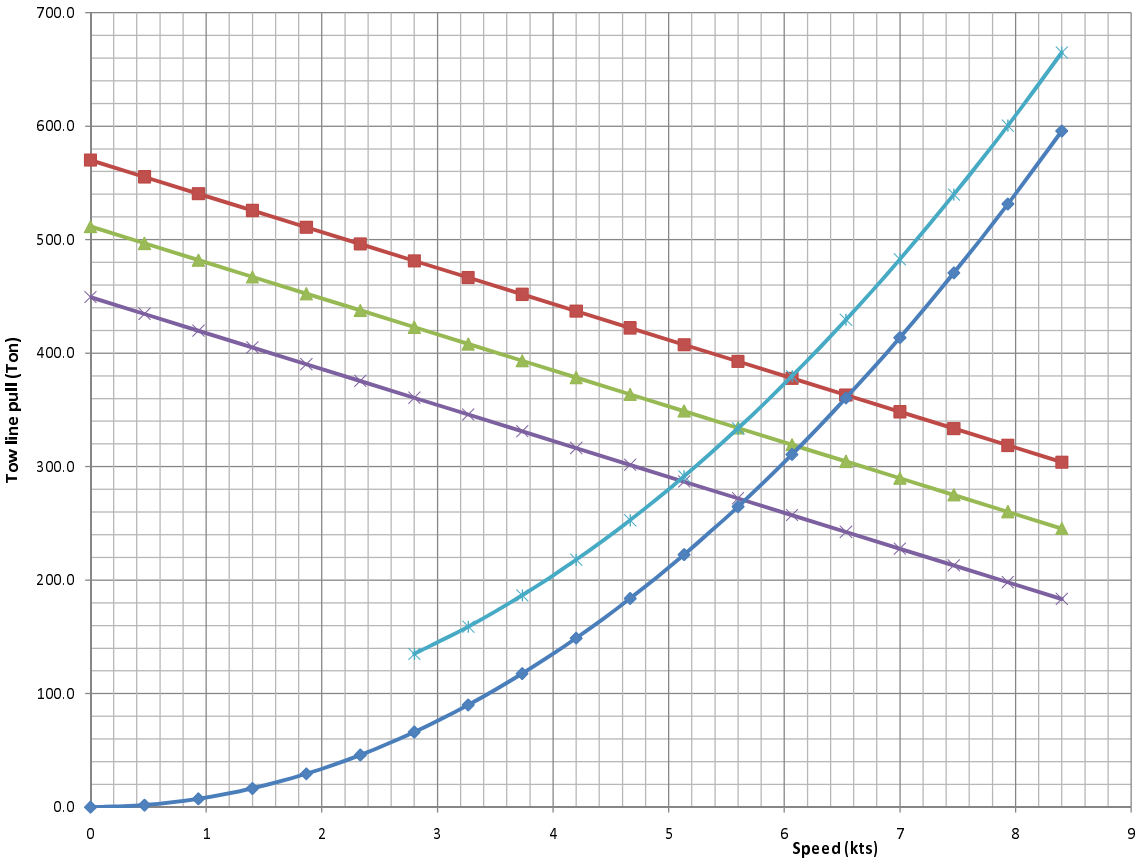
FIGURE 5

ONLINE MARINE ENGINEERING

EXAMPLE PROJECT

Resistance - Speed diagram

FPSO



Tug Data						Units
Name	Tug1	Tug2				
BP	285	285	0	0	0	Ton
Vmax	18	18	0	0	0	knots
Length	67	67	0	0	0	m
Tow speed estimate Stillwater						
MCR	100%	85%	70%	Power setting		%
Speed	6.6	6.1	5.7	Tow speed Stillwater		knots
Load	362.5	317.2	270.1	Tow Force Stillwater		Ton
Tow speed estimate with Environment						
MCR	100%	85%	70%	Power setting		%
Speed	6.1	5.6	5.1	Tow speed Head wind		knots
Load	378.3	334.0	287.9	Tow Force Head Wind		Ton
Hs	2.0	2.0	2.0	Significant wave		m
Vw	20.0	20.0	20.0	Mean Wind speed		Knots

	TOW PULL LINE - SPEED DIAGRAM	REV 0

FIGURE 6

```
*****************************************************************************************************
*                                          ***  MOSES   ***                                         *
*                                          ----------------                  18 November, 2010    *
*          User: SPT Offshore b.v.  NO.: 2 - EXAMPLE PROJECT                                        *
*          BOLLARD PULL ANALYSIS - Wind 40 knots, Current 0.5 m/s and Hs = 5.0 m                    *
*                                                                                                   *
*****************************************************************************************************
```

+++ C U R R E N T E N V I R O N M E N T +++

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

Environment Name BOLLARD

Observation Time = 500.0 Time Increment = 0.500
Time Offset = 0.0 Time Reinforce = 12000.0

S E A C O N D I T I O N

Type = JONSWAP Hs = 5.00 Mean Period = 8.67 Gamma = 3.3 Dir = 0.0
S.Coe = 200

W I N D D A T A

1 Hr. Wind Speed = 40.0 Knots, Direction = 0.0
Design Wind Based On ABS Rules
Wind Height Variation Based on ABS Rules
Wind is Static

C U R R E N T D A T A

DEPTH	SPEED	DIRECTION
0.0	0.50	0.0

```
*****************************************************************************************************
*                                          ***  MOSES   ***                                         *
*                                          ----------------                  18 November, 2010    *
*          User: SPT Offshore b.v.  NO.: 2 - EXAMPLE PROJECT                                        *
*          BOLLARD PULL ANALYSIS - Wind 40 knots, Current 0.5 m/s and Hs = 5.0 m                    *
*                                                                                                   *
*****************************************************************************************************
```

+++ F O R C E S A C T I N G O N M O D E L +++

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

Results Are Reported In Body System

Type of Force	X	Y	Z	MX	MY	MZ
Weight	421.2	0.0	-119723.9	0	-178351	0
Contents	239.6	0.0	-68101.1	0	474765	0
Buoyancy	-660.8	0.0	187825.2	0	-296460	0
Wind	-209.8	0.0	-0.7	0	-8318	0
Drag	-8.3	0.0	0.0	0	-39	0
Wave	-109.8	0.0	-128.4	0	3977	0
Total	-327.9	0.0	-128.9	0	-4429	0

```
*****************************************************************************************************
*                                          ***  MOSES   ***                                         *
*                                          ----------------                  18 November, 2010    *
*          User: SPT Offshore b.v.  NO.: 2 - EXAMPLE PROJECT                                        *
*          CALM WATER DRAG ANALYSIS - Speed 7 kn                                                    *
*                                                                                                   *
*****************************************************************************************************
```

+++ F O R C E S A C T I N G O N M O D E L +++

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

Results Are Reported In Body System

Type of Force	X	Y	Z	MX	MY	MZ
Weight	421.2	0.0	-119723.9	0	-178351	0
Contents	239.6	0.0	-68101.1	0	474765	0
Buoyancy	-660.8	0.0	187825.2	0	-296460	0
Drag	-413.7	0.0	0.0	0	-2078	0
Total	-413.7	0.0	0.2	0	-2126	0

```
*****************************************************************************************************
*                                          ***  MOSES   ***                                         *
*                                          ----------------                    18 November, 2010   *
*          User: SPT Offshore b.v.  NO.: 2 - EXAMPLE PROJECT                                        *
*          DRAG ANALYSIS with head sea - Wind 20 knots and Hs = 2 m                                 *
*                                                                                                   *
*****************************************************************************************************
```

+++ C U R R E N T S Y S T E M C O N F I G U R A T I O N +++

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

Location and Net Force at Body Origin

Body		X	Y	Z	RX	RY	RZ
MODEL	Location	0.00	0.00	-10.00	0.00	0.20	0.00
	N Force	-482.66	0.00	-6.00	0	-4294	0

```
*****************************************************************************************************
*                                          ***  MOSES   ***                                         *
*                                          ----------------                    18 November, 2010   *
*          User: SPT Offshore b.v.  NO.: 2 - EXAMPLE PROJECT                                        *
*          DRAG ANALYSIS with head sea - Wind 20 knots and Hs = 2 m                                 *
*                                                                                                   *
*****************************************************************************************************
```

+++ F O R C E S A C T I N G O N M O D E L +++

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

Results Are Reported In Body System

Type of Force	X	Y	Z	MX	MY	MZ
Weight	421.2	0.0	-119723.9	0	-178351	0
Contents	239.6	0.0	-68101.1	0	474765	0
Buoyancy	-660.8	0.0	187825.2	0	-296460	0
Wind	-52.4	0.0	-0.2	0	-2079	0
Drag	-413.7	0.0	0.0	0	-2078	0
Wave	-16.5	0.0	-6.0	0	-87	0
Total	-482.7	0.0	-6.0	0	-4294	0