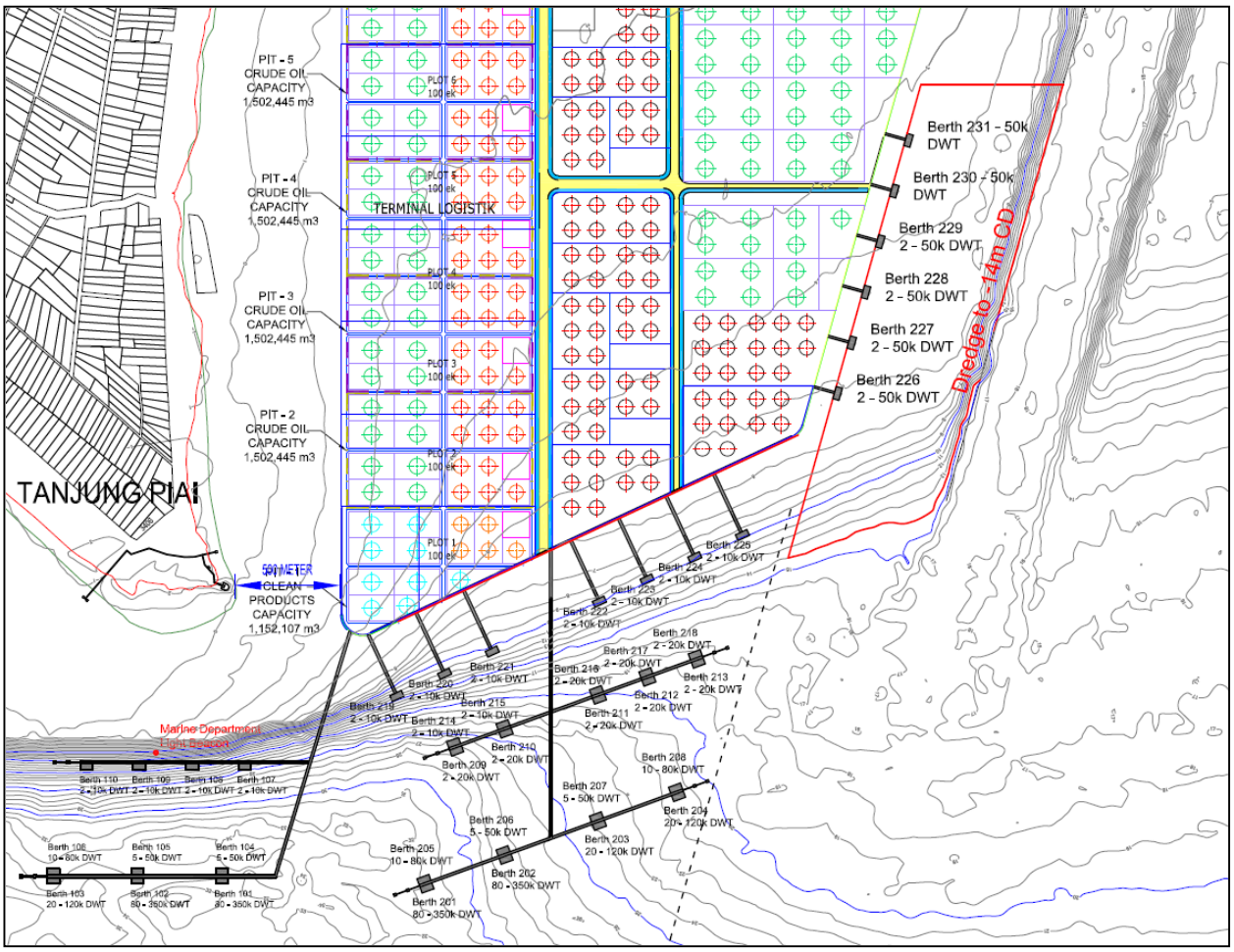
FTS

Proposed Development of an Integrated Petroleum Hub and Maritime Industrial Park including Reclamation at Tanjung Piai, Johor, Malaysia

Navigation Simulation Study

Date: September 2014



Report No. 1

Proposed Development of an Integrated Petroleum Hub and Maritime Industrial Park including Reclamation at Tanjung Piai, Johor, Malaysia

Navigation Simulation Study

Final Report

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1. Introduction

DHI Water and Environment (M) Sdn Bhd (DHI) engaged Force Technology Maritime Simulation Services Pte Ltd (FTS) to conduct ship manoeuvring simulation studies for the Proposed Development of an Integrated Petroleum Hub and Maritime Industrial Park including Reclamation (IPH & MIP) at Tanjung Piai, Johor, Malaysia. The focus of the study was to assess the safety of tankers arriving at and departing from the proposed terminal.

The study was carried out using FTS's Desktop Simulator based on the layout of the jetties, berths, current, wind and bathymetric data provided by DHI.

Figure 1 shows the general location of the Proposed IPH & MIP and study area.

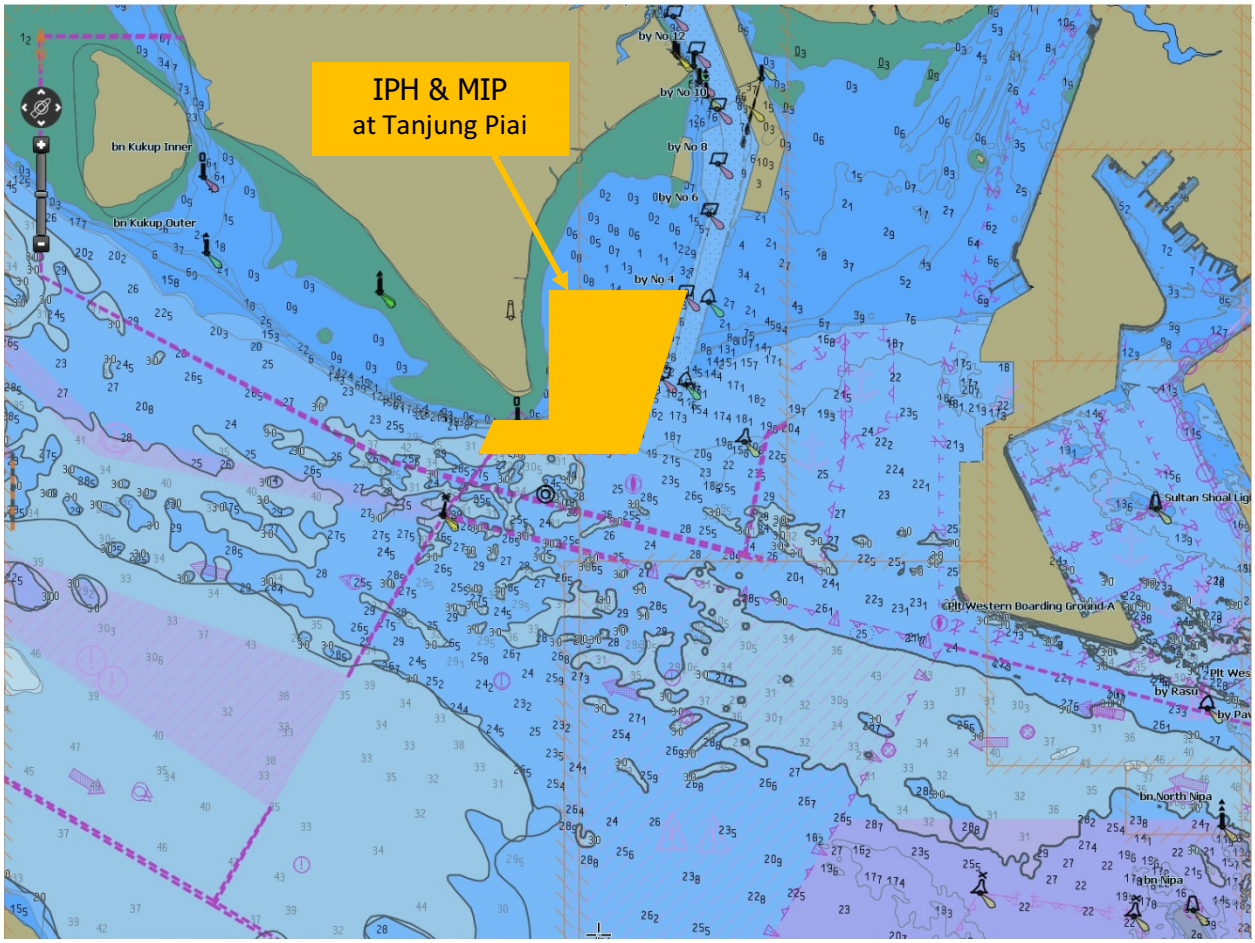


Figure 1: General location, IPH & MIP at Tanjung Piai Study Area

1.1 Scope of Work

The main focus for the ship manoeuvring simulation study was to determine:

- The safety of tankers berthing and unberthing at the proposed IPH & MIP at Tanjung Piai under various environmental conditions;
- The adequacy of the proposed dredged channel for laden tankers berthing at berths 226 to 231; and
- The tug requirements for vessels arriving at and departing from the proposed IPH & MIP at Tanjung Piai.

2 Area Description

The proposed IPH & MIP at Tanjung Piai is off South West Johor near to the Singapore Straits Traffic Separation Scheme (TSS).

Figure 2.1 shows the layout of the proposed IPH & MIP at Tanjung Piai

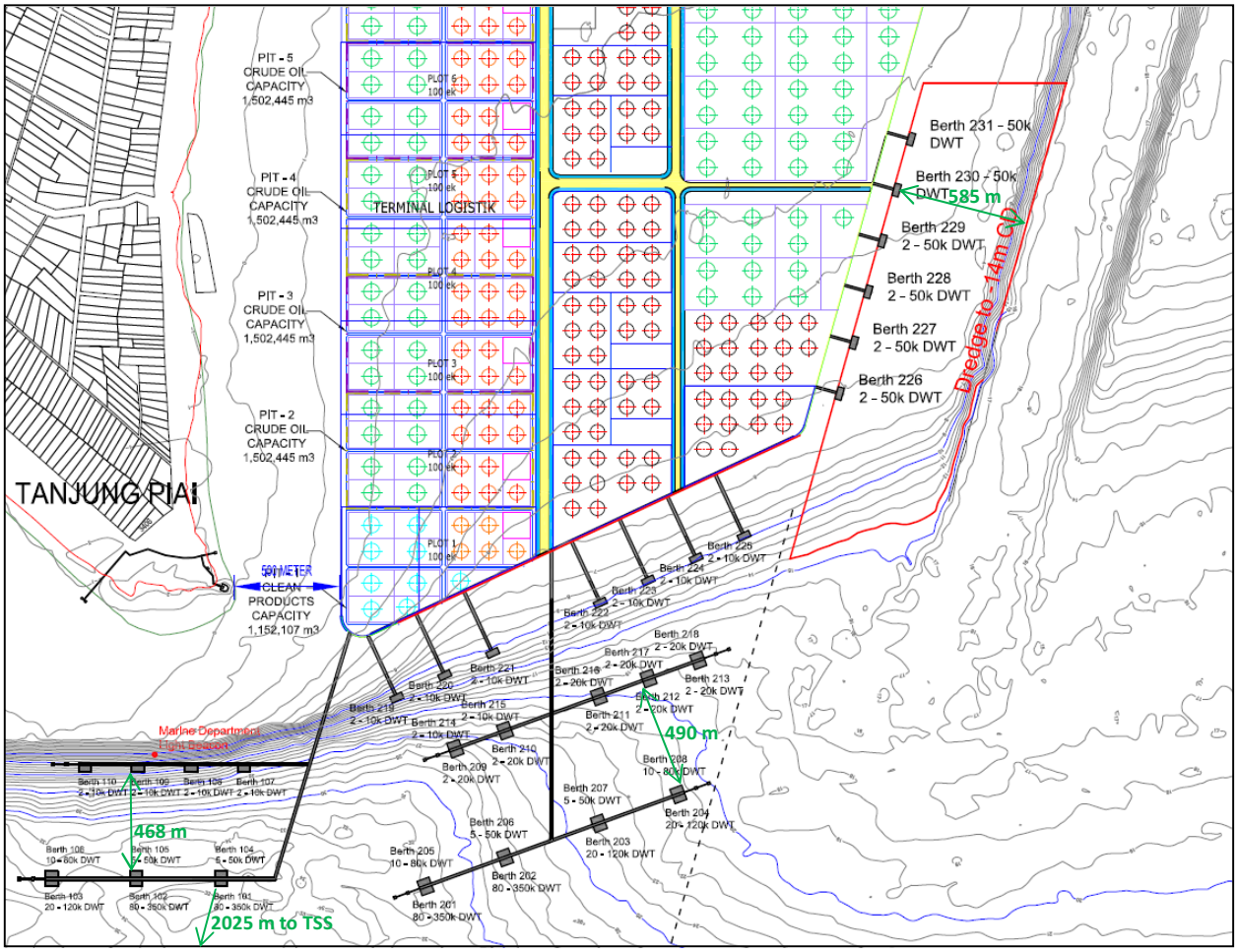


Figure 2.1: Layout & Proposed Dredge Area of IPH & MIP at Tanjung Piai

The measured distance:

- Between the berth line of 104/106 and 107/110 is about 468 metres;
- Between the berth line of 207/208 and 211/213 is about 490 metres;
- Between the dredged limit and berth line of 226 to 231 is about 585 metres;
- Between the Northern limit of the TSS and berth 101 is about 2025 metres.

2.1 Wind Characteristics

The prevailing winds used in the study are those encountered during the Northeast (NE) and Southwest (SW) Monsoons i.e. 340^0 x 15 knots and 160^0 x 15 knots respectively.

2.2 Tidal Current Characteristics

The tidal currents in the approaches and at the proposed IPH & MIP at Tanjung Piai are the West-going (Ebb) and East-going (Flood) during spring tides as modelled by DHI.

Figure 2.2 shows the West-going (Ebb) spring current

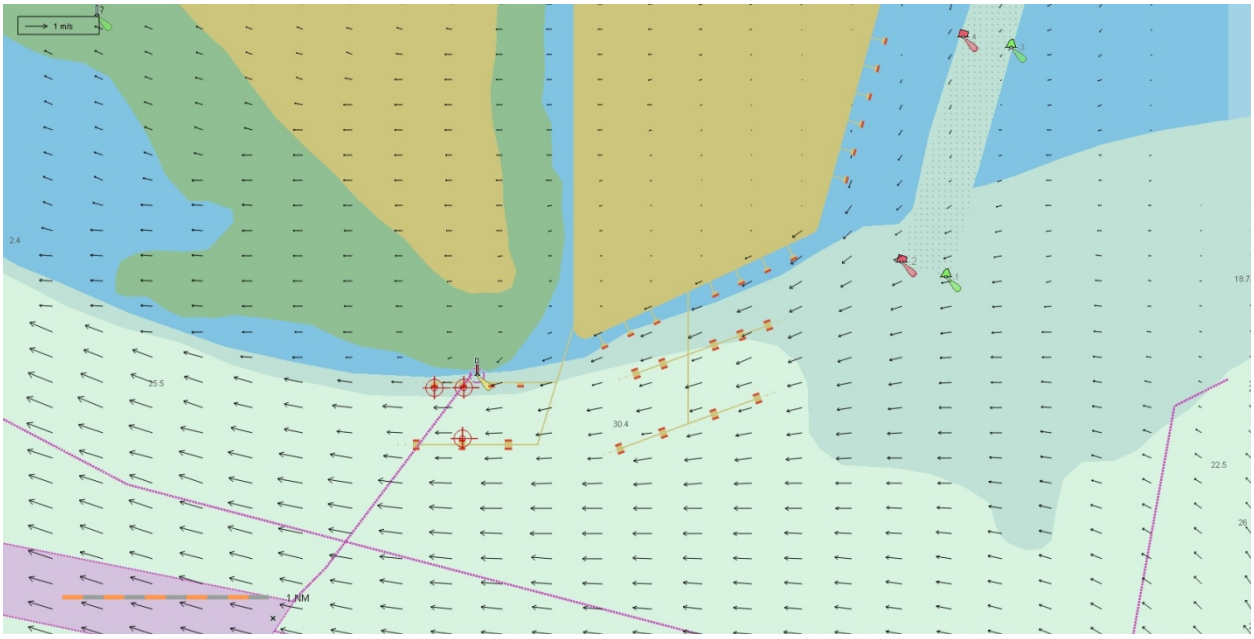


Figure 2.2: West-going (Ebb) spring current at IPH & MIP at Tanjung Piai

Figure 2.3 shows the East-going (Flood) spring current

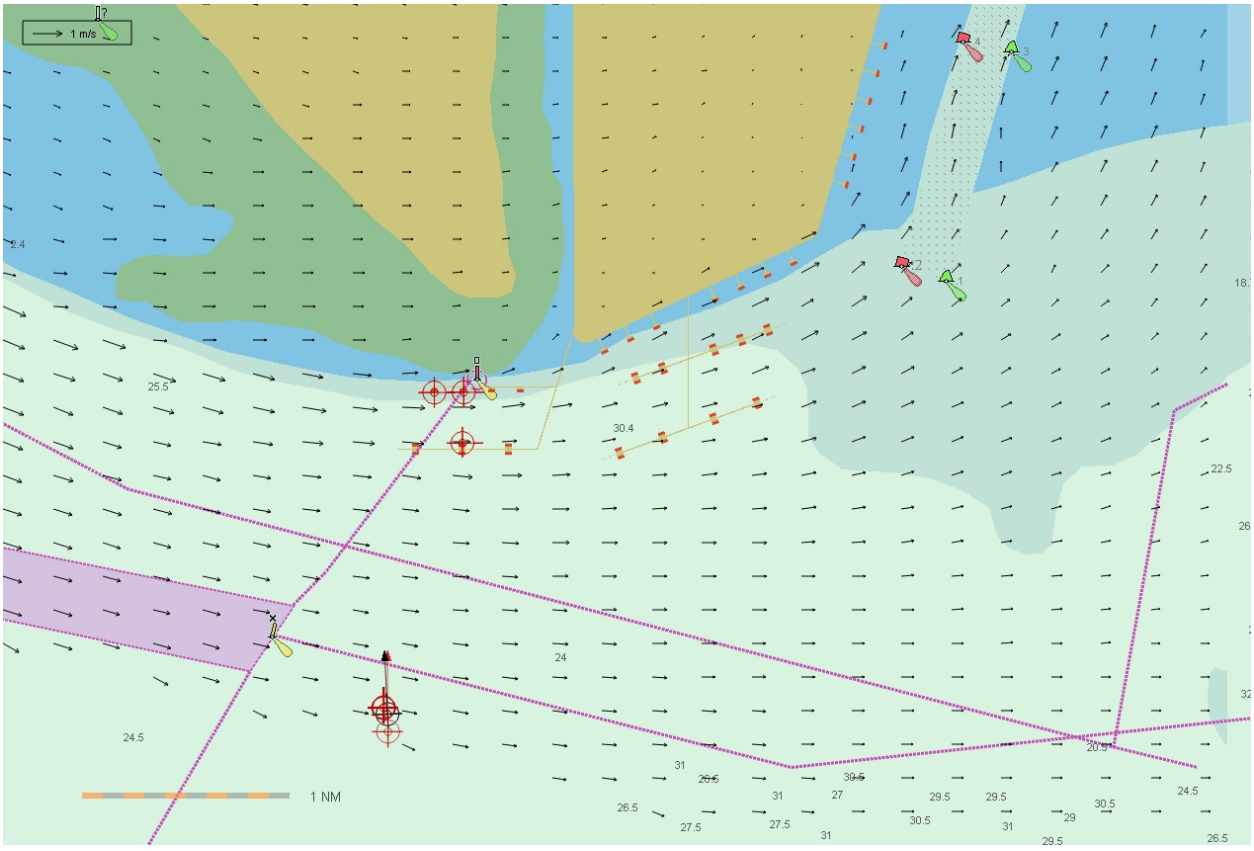


Figure 2.3: East-going (Flood) spring current at IPH & MIP at Tanjung Piai

3 Navigation Study

3.1 Simulator Procedure

The simulation runs were conducted in FTS Desktop Bridge in real time by a master mariner with pilotage experience. And they were analysed by a master mariner with more than 25 years of pilotage experience. He had also handled numerous port and marine consultancy projects in China, India, Indonesia and Singapore.

All simulation runs are logged electronically to enable replay of what happened during the runs. This includes time series of a large number of parameters, e.g. speed over ground and through the water, rudder angle, propeller revolutions, tug usage, etc. This allows for investigation of all runs in detail at a later stage.

3.2 Ship Models Used for the Simulation Runs

SIMFLEX Ship Model	Displacement *(m^3)*	LOA *(m)*	Draft *(m)*	Tugs *(No x Bollard Pull)*
3059 Laden VLCC	344,500	343.7	21.8	4 x 60 tonne
3170 Ballast VLCC	177,051	343.7	12.0	2 x 60 tonne
3195 Laden Tanker	96,000	228.6	15.0	2 x 60 tonne
3141 Ballast Tanker	33,429	228.6	7.0	2 x 60 tonne
3191 Laden Tanker	78,200	217	13.0	2 x 60 tonne
3192 Ballast Tanker	43,000	217	8.0	2 x 60 tonne

Table 3.1: Principal particulars of ship models used for the simulation runs

All the ship models used have one rudder and one right-hand fixed pitch propeller.

3.3 List of Simulation Runs

The simulation matrix takes into consideration all the likely scenarios and the ones chosen are those with the greatest challenges.

3.3.1 28 simulation runs were carried out with the following scenarios and designed vessels:

Run No	Berth	Arrive Depart	Ship (DWT)	A/S		Tide (Spring)		Wind	
				Port	*Stbd*	*West going*	*East going*	*160° 15 Knots*	*340° 15 Knots*
101	101	Arrive	300,000 Laden	√		√			√
102					√		√		√
103				√		√		√	
104					√		√	√	
105		Depart	300,000 Ballast		√	√			√
106				√			√		√
107					√	√		√	
108				√			√	√	
109	106	Arrive	80,000 Laden		√	√			√
110				√			√		√
111					√	√		√	
112				√			√	√	
113		Depart	80,000 Ballast		√	√			√
114					√		√		√
115					√	√		√	
116					√		√	√	
117	207	Arrive	60,000 Ballast		√	√		√	
118				√			√	√	
119		Depart	60,000 Laden	√		√		√	
120				√			√	√	
121	230	Arrive	60,000 Ballast	√		√			√
122					√		√		√
123				√		√		√	
124					√		√	√	
125		Depart	60,000 Laden	√		√			√
126				√			√		√
127				√		√		√	
128				√			√	√	

Table 3.2: Simulation Run List

3.3.2 The following additional runs were carried out to assess the adequacy of the approaches to the berths in case of Sumatras, machinery or tug failure.

Run No	Berth	Arrive Depart	Ship (DWT)	A/S		Tide (Spring)		Wind		Crisis
				Port	*Stbd*	*West going*	*East going*	*340° 15 Knots*	*160° 15 Knots*	
129	106	Depart	80,000 Ballast		√		√		√	with Sumatras
130	206	Arrive	60,000 Ballast		√	√			√	
131	230	Arrive	60,000 Ballast		√		√		√	with tug failure
132	230	Depart	60,000 Laden	√			√	√		with engine failure

Table 3.3: Simulation Additional Run List

4 Simulation Methodology

The real-time simulation runs were carried out in line with the good practices for the conduct of ship manoeuvring simulation studies. Strict criteria were used in the evaluation in order to provide a good indication of the potential difficulty and the resources needed to conduct the vessel safely. This is because no simulation can truly represent the actual conditions to be encountered on the ground.

The swept paths and related information from each simulation run are documented for easy reference in Appendix 2.

4.1 Arrivals

The starting position of the vessel chosen was to cater for vessels arriving from the west which is more challenging than those arriving from the east. This is because she has to cross the TSS (using the precautionary area) which exposes her to the full extent of the cross currents.

The simulation ends when the vessel is safely in position close to the berth with minimal resources required to maintain position.

4.2 Departures

The simulation starts with the vessel alongside her berth held by one line and one spring at each end. And it ends when the vessel is safely on her outbound course to join or cross the TSS.

5 Findings & Recommendation

The findings and recommendations are based on the results of the simulations conducted and apply only:

- To vessels with similar or close to similar conditions and handling characteristics as the vessels used e.g. vessel type, propulsion, principle dimensions, draft and displacement;
- To current flow patterns similar in direction and strength as those used in the area covered by the simulation study; and
- In wind conditions similar to those used in the simulation.

5.1 Findings

The following are a summary of the evaluation of simulation runs carried out:

5.1.1 Berths not in alignment with the spring currents:

Berth		West-going (Spring) Current		East-going (Spring) Current	
No.	*Alignment*	*Dir x Strength*	*Impact*	*Dir x Strength*	*Impact*
101	$270^0 - 090^0$	265^0 x 1.3	5^0 away	089^0 x 1.0	1^0 towards
106	$270^0 - 090^0$	274^0 x 1.3	4^0 away	094^0 x 1.4	4^0 towards
207	$250^0 - 070^0$	255^0 x 1.1	5^0 away	075^0 x 0.9	5^0 towards
230	$015.5^0 - 195.5^0$	207^0 x 0.1	Negligible	020^0 x 0.5	4.5^0 away

Table 5.1: Impact of Berth Not Aligned with Current

a) The impact of the west-going current sets the vessel away from berths 101, 106 and 207. What this means is that:

   i. For berthing at berth 101, vessels will have to berth at an angle of about 5 degrees towards the berth (bow pointing towards the berth/stern away from the berth), which makes it difficult to gently land the vessel parallel onto all fenders;
   ii. For unberthing, great care must be taken to gently ease the vessel away from the berth such that she remained more or less parallel to the berth until she is sufficiently clear to swing around or manoeuvred safely away; and
   iii. Whilst alongside, the west-going current will set the vessel away from the berth and she risked breaking away from her berth if the mooring lines are on self-tensioning winches (auto mode) or not attended to carefully.

b) The impact of the east-going current sets the vessel onto berths 101, 106 and 207. But it is manageable as the maximum strength is about 1 knot except for berth 106 where it is 1.4 knots.

   This means that she is totally dependent on the assisting tugs to hold her against the set onto the berth.

5.1.2 Unberthing a laden tanker with strong following currents (i.e. current coming from astern) setting towards the cross berth or jetty at end berths:

An end berth is one that is adjacent to a cross berth or jetty, usually at an angle of about 90 degrees to each other. E.g. berth 207

This manoeuvre presents great dangers as:

a) There is no room for errors, misjudgements or machinery failures. Any of this will set the vessel onto the cross berth or jetty;
b) The astern power of most ships is less than ahead power; and
c) The vessel is unable to control her heading when using astern propulsion. She is totalling dependent on the tugs for this.

Therefore it is recommended that such manoeuvres be undertaken in tidal strength of not more than 0.5 knots.

5.1.3 Crisis Scenarios

a) Sumatras striking in the midst of manoeuvres

The Sumatras were chosen to strike at the most vulnerable stage of the manoeuvre.

The degree of safety was adequate and there were sufficient reserve power resources to cope with the doubling of wind force and any misjudgements. However, it is recommended that Full Mission Shiphandling Simulation Studies and/or Training are carried out. This is because a 2D Study do not have the effects of rain and poor visibility and is dependent on instruments which are reliable and accurate. Onboard ships, some instruments may not be available or if available, may not be working, accurate or reliable.

b) Machinery/Tug Failures

In run 131, the ship's propulsion and rudder were used to abort the berthing manoeuvre when both tugs failed at the point when they were to assist in swinging the vessel around. The anchors were not required as the swinging room was adequate.

In run 132, the tugs were used to continue pulling the tanker away from the berth and swing her around to tow her out when her engines failed. The maximum power used by the tugs was 50%.

Although the crisis were handled successfully, we must bear in mind that there are occasions where aborting the manoeuvre may not be possible e.g. when tug/s failed at the point when the vessel is about 20 metres from the berth with fresh onshore winds. In such cases, effort must still be made to minimise damage.

5.2 Recommendations

5.2.1 Berths not in alignment with the spring currents:-

Berths should, as far as possible be in alignment with the actual direction of spring currents for safety reasons.

Mitigation measures for berths not in alignment would include:

a) Berthing and unberthing should be scheduled during periods where the tidal strength is not more than 1 knot.
b) Whilst alongside, tug or tugs assistance would be required during periods of strong west-going currents; and

c) Highlight the effects of the east and west-going currents and include this as an extra precaution required in the standard operating procedures for all vessels calling at the terminal.

5.2.2 Unberthing a laden tanker with strong following currents (i.e. current coming from astern) setting towards the cross berth or jetty at end berths:

This manoeuvre presents great dangers as there is no room for errors, misjudgements or machinery failures. Any of this will set the vessel onto the cross berth or jetty.

Therefore it is recommended that such manoeuvres be undertaken in tidal strength of not more than 0.5 knots.

5.2.3 Operations at a New Terminal:-

Starting up operations at a new terminal has its challenges and one of it is unfamiliarity with the environment conditions. Therefore the following is recommended:

a) Real time monitoring and data collection of tidal currents, winds and waves at the jetties;
b) Full Mission Shiphandling Training and Familiarisation Course for the pilots;
c) Ship manoeuvres during the start up phase be restricted to:
   i) Daylight hours;
   ii) Tidal current strength ≤ 1.0 knot;
   iii) Wind speed ≤ 15 knots;
d) Number of tugs and minimum bollard pull:
   i) Berthing laden VLCCs - 2 x 60 tonne + 2 x 45 tonne ASD tugs.
   ii) Unberthing VLCCs in ballast - 2 x 45 tonne ASD tugs.
   iii) Laden tankers with draft greater 10 metres- 2 x 45 tonne ASD tugs.
   iv) Others - 2 x 30 tonne ASD tugs.
   v) A third tug may be required in exceptional circumstances like strong on-berth winds for tankers in ballast.
e) Real time monitoring of lateral berthing speeds, especially for laden VLCCs and tankers close to the maximum designed displacement for the jetty.

The restrictions on ship manoeuvres may be gradually lifted after consultations with the pilots as they gain more experience. A Full Mission Shiphandling Simulation Studies with emergencies is therefore recommended to ensure best operational practices and adequate tug requirements.

5.2.4 Standard Operating Procedures (SOP):-

These safety guidelines should include, but not limited to, the:
a) Maximum length overall (LOA);
b) Maximum draft;
c) Maximum displacement;
d) Maximum tidal current strength;
e) Maximum wind speed;
f) Maximum Lateral berthing speed;
g) Maximum Angle of approach;
h) Day/night;
i) Minimum under keel clearance (UKC); and
j) Number of tugs and minimum bollard pull.

5.2.5 Crash Barriers

Crash barriers are recommended to protect the jetties with critical pipelines and cables (see figure 5.1).

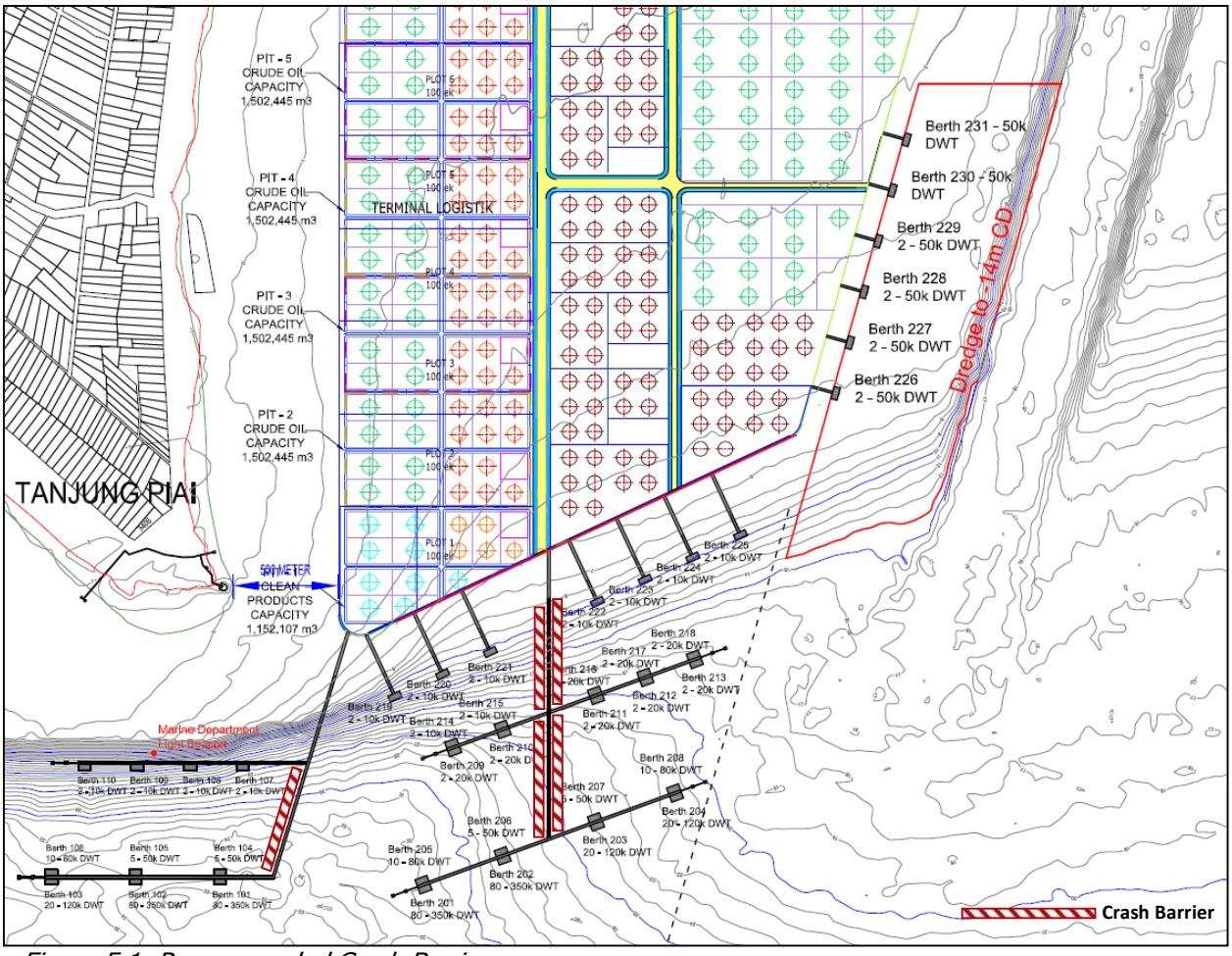


Figure 5.1: Recommended Crash Barriers

5.2.6 Crisis Management

Regular crisis management training is recommended for pilots to sharpen their skills and reduce reaction time. This is necessary as such crisis is few and far between. But when it happens, the pilot's skills and reaction time can mean a difference between success and disaster.

APPENDIX I

Details of Ship Models

VLCC (300,000 DWT - Fully Laden)

Type of ship Condition Ship No.		Tanker Loaded 3059
Length between Perpendiculars	m	327.0
Length overall	m	343.7
Breadth moulded	m	56.4
Depth moulded	m	30.4
Draught fore/aft	m	21.8/21.8
Displacement	m^3	344500
Wetted Surface	m^2	27429
Frontal wind Area	m^2	1060
Lateral wind Area	m^2	4034
Block Coefficient based on L_{pp}	-	0.857
Trim by the Stern	%	0.0
Metacentric Height	m	5.95
LCB, % of L_{pp} forw. of $L_{pp}/2$	%	3.15
Radius of Inertia, % of L_{pp}	%	25
Type of Engine		Diesel
Number of Propellers		1
Type of Propellers		FP
Direction of Rotation		Clockwise
Number of Blades		4
Propeller Diameter	m	9.17
Pitch Ratio at 0.7·R		0.625
Area Ratio		0.608
Shaft Power (ahead) total	kW	23550
Number of Rudders		1
Type of Rudders		Semi Spade
Position off CL	m	0
Area of Rudder (movable part)	m^2	135
Total rudder Area/(L_{pp} x T)	%	1.90
Turning Velocity of Rudder (two Pumps)	deg/s	4.60
Max. rudder Angle	deg	35
Anchor Weight	kg	2 x 26000
Chain Weight	kg/m	548
Number of bow Thrusters		0
Nominal bow thruster Power	kW	-
Number of stern Thrusters		0

TANKER (80,000 DWT - Ballast)

Type of ship Condition Ship No.		Tanker Ballast 3141
Length between Perpendiculars	m	218.70
Length overall	m	228.60
Breadth moulded	m	32.24
Depth moulded	m	21.60
Draught fore/aft	m	5.00/7.00
Displacement	m^3	33429
Wetted Surface	m^2	8011
Frontal wind Area	m^2	900
Lateral wind Area	m^2	3971
Block Coefficient based on Lpp	-	0.790
Trim by the Stern	%	0.914
Metacentric Height	m	-1.18
LCB, % of LPP forw. of LPP/2	%	2.53
Radius of Inertia, % of LPP	%	25.0
Type of Engine		Diesel
Number of Propellers		1
Type of Propellers		FP
Direction of Rotation		Right Hand
Number of Blades		4
Propeller Diameter	m	7.20
Pitch Ratio at 0.7R		0.80
Area Ratio		0.46
Shaft Power (ahead) total	kW	8.120
Number of Rudders		1
Type of Rudders		Spade
Position off CL	m	0
Area of Rudder	m^2	49.4
100 x total rudder Area/LBP x T		3.76
Turning Velocity of Rudder (two Pumps)	deg/s	2.3
Max. rudder Angle	deg	35
Anchor Weight	kg	8340
Chain Weight	kg/m	231.2
Number of bow Thrusters		1
Nominal bow thruster Power	kW	1500 ~ 20.4 t
Number of stern Thrusters		1
Nominal stern thruster Power	kW	1500 ~ 20.4 t

TANKER (60,000 DWT - Fully Laden)

Type of ship Condition Ship No.		Tanker Loaded 3191
Length between Perpendiculars	m	206.0
Length overall	m	217.0
Breadth moulded	m	36.0
Depth moulded to upper deck	m	21.0
Draught fore/aft	m	13.0 / 13.0
Displacement	m^3	78200
Wetted Surface	m^2	10832
Frontal wind Area	m^2	738
Lateral wind Area	m^2	2200
Block Coefficient based on L_{pp}	-	0.811
Trim by the Stern	%	0.0
Metacentric Height	m	3.98
LCB, % of L_{pp} forw. of $L_{pp}/2$	%	2.10
Radius of Inertia, % of L_{pp}	%	25
Type of Engine		Diesel
Number of Propellers		1
Type of Propellers		FP
Direction of Rotation		Clockwise
Number of Blades		4
Propeller Diameter	m	6.6
Pitch Ratio at 0.7·R max.		0.85
Area Ratio		0.50
Shaft Power (ahead) total	kW	9500
Number of Rudders		1
Type of Rudders		Semi-spade
Area of Rudder (movable part)	m^2	47.7
Total rudder Area/(L_{pp} x T)	%	1.78
Turning Velocity of Rudder (two Pumps)	deg/s	4.6
Max. rudder Angle	deg	35
Anchor Weight	kg	2 x 11730
Chain Weight	kg/m	167
Number of bow Thrusters		0
Nominal bow thruster Power	kW	-
Number of stern Thrusters		0

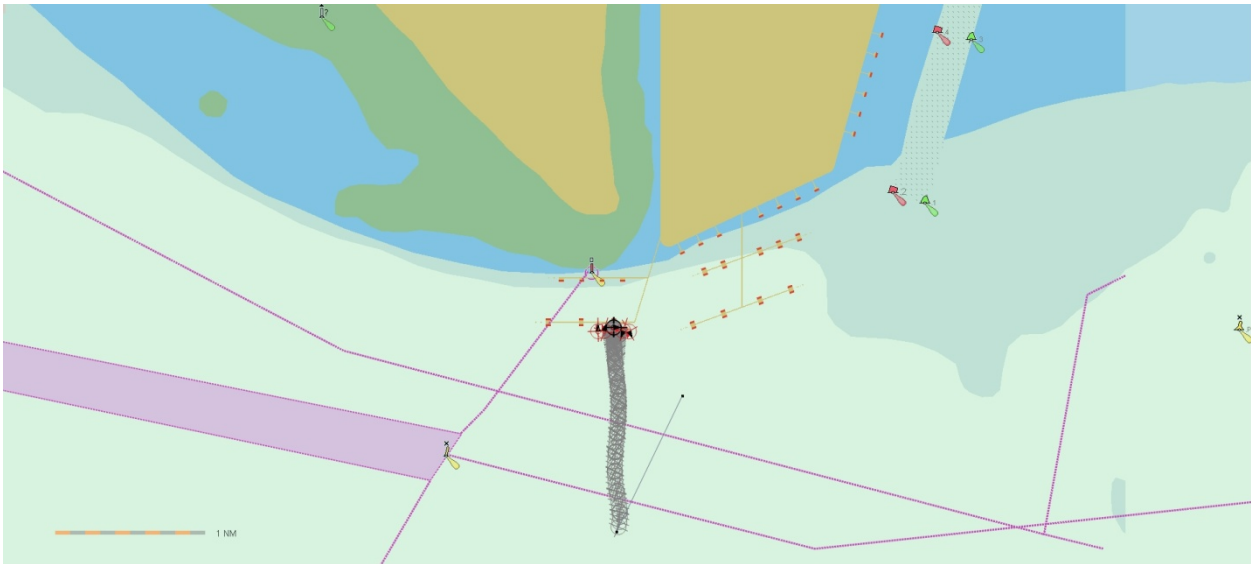
TANKER (60,000 DWT - Ballast)

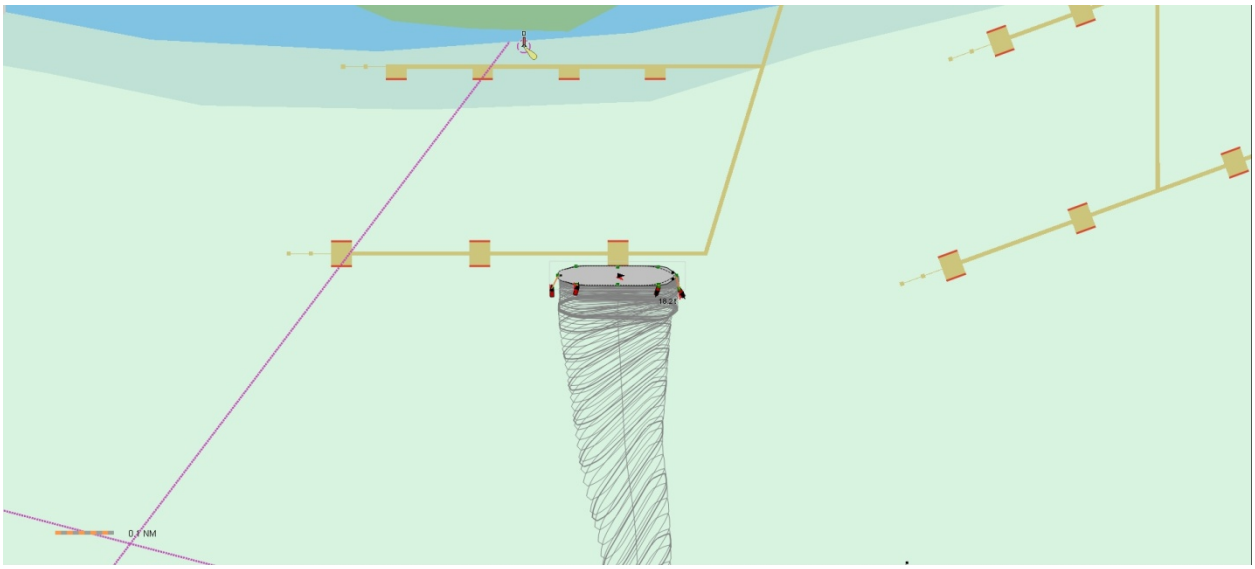
Type of ship Condition Ship No.		Tanker Ballast 3192
Length between Perpendiculars	m	206.0
Length overall	m	217.0
Breadth moulded	m	36.0
Depth moulded to upper deck	m	21.0
Draught fore/aft	m	6.5 / 8.0
Displacement	m^3	43000
Wetted Surface	m^2	8680
Frontal wind Area	m^2	900
Lateral wind Area	m^2	2858
Block Coefficient based on L_{pp}	-	0.800
Trim by the Stern	%	0.7
Metacentric Height	m	11.06
LCB, % of L_{pp} forw. of $L_{pp}/2$	%	0.0
Radius of Inertia, % of L_{pp}	%	25
Type of Engine		Diesel
Number of Propellers		1
Type of Propellers		FP
Direction of Rotation		Clockwise
Number of Blades		4
Propeller Diameter	m	6.6
Pitch Ratio at 0.7·R max.		0.85
Area Ratio		0.50
Shaft Power (ahead) total	kW	9500
Number of Rudders		1
Type of Rudders		Semi-spade
Area of Rudder (movable part)	m^2	47.7
Total rudder Area/(L_{pp} x T)	%	3.19
Turning Velocity of Rudder (two Pumps)	deg/s	4.6
Max. rudder Angle	deg	35
Anchor Weight	kg	2 x 11730
Chain Weight	kg/m	167
Number of bow Thrusters		0
Nominal bow thruster Power	kW	-
Number of stern Thrusters		0

APPENDIX II

Plots & Comments

Run 101 Laden VLCC Arrival Berth 101





Initial Heading	: 026^0	Current	: West-going - Spring
Initial Speed	: 4 knots	Wind	: 340^0 x 15 knots
Tugs	: 4 x 60 tonne bollard pull ASD		
Duration of Run	: 48 minutes		

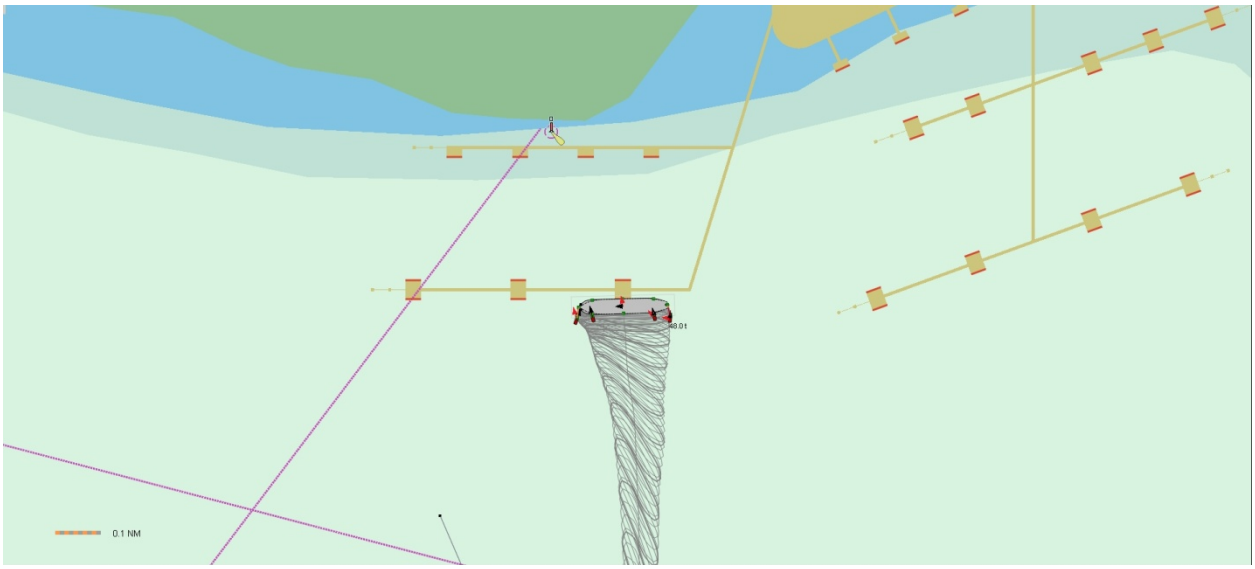
The starting position of the vessel chosen was directly south of the berth. This presented the most challenging situation as it exposes the VLCC to abeam current and she has to turn through 90 degrees in order to stem it.

Her speed was reduced after clearing the TSS and the vessel turned to stem the tide approximately 200 metres from the jetty before being pushed alongside.

Some degree of difficulties was encountered as the west-going current, about 5^0 from the line of berth sets the VLCC away from the berth.

The degree of safety was adequate and there were sufficient reserve power resources to cope with any misjudgements and equipment failures.

Run 102 Laden VLCC Arrival Berth 101



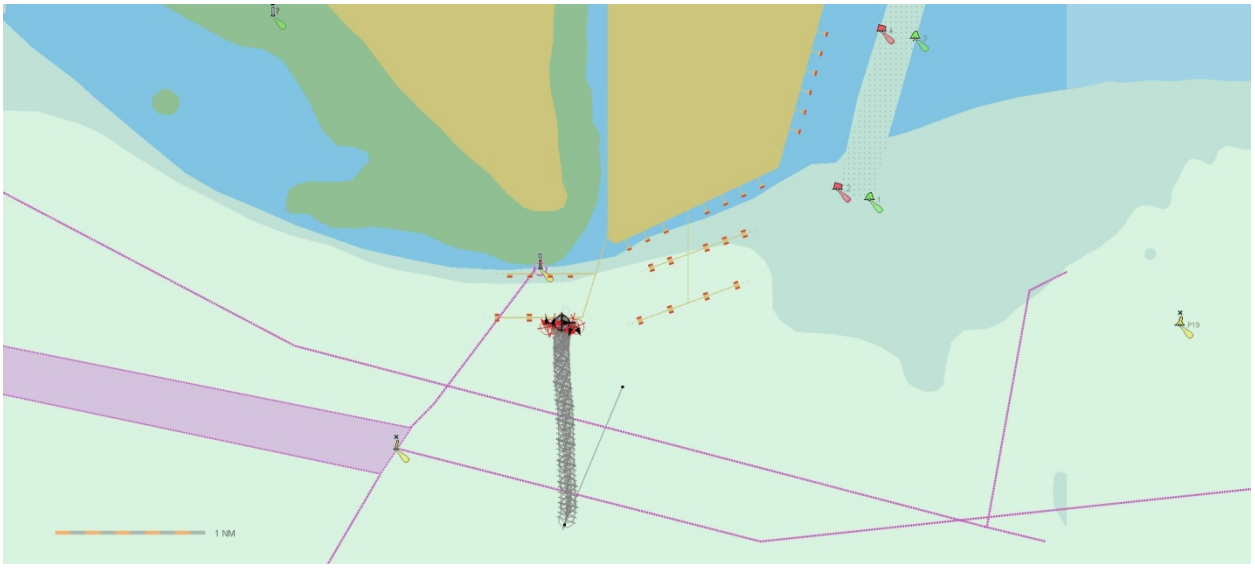
Initial Heading	: 337^0	Current	: East-going - Spring
Initial Speed	: 4 knots	Wind	: 340^0 x 15 knots
Tugs	: 4 x 60 tonne bollard pull ASD		
Duration of Run	: 37 minutes		

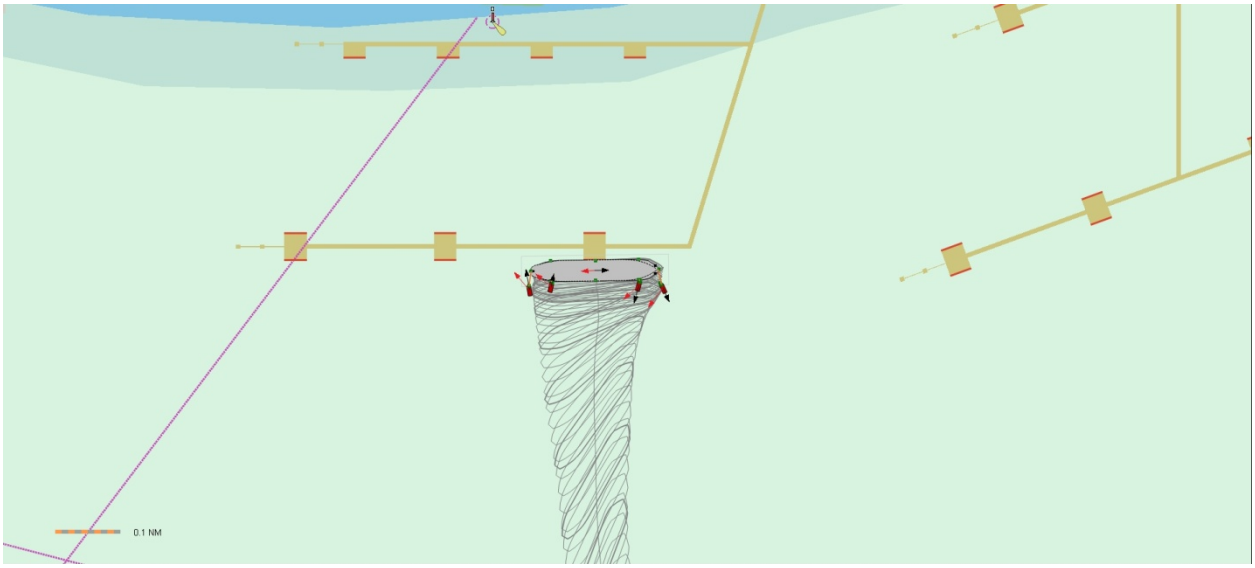
The starting position of the vessel chosen was directly south of the berth. This presented the most challenging situation as it exposes the VLCC to abeam current and she has to turn through 90 degrees in order to stem it.

Her speed was reduced after clearing the TSS and the vessel turned to stem the tide approximately 200 metres from the jetty before being pushed alongside.

The degree of safety was good and there were sufficient reserve power resources to cope with any misjudgements and equipment failures.

Run 103 Laden VLCC Arrival Berth 101

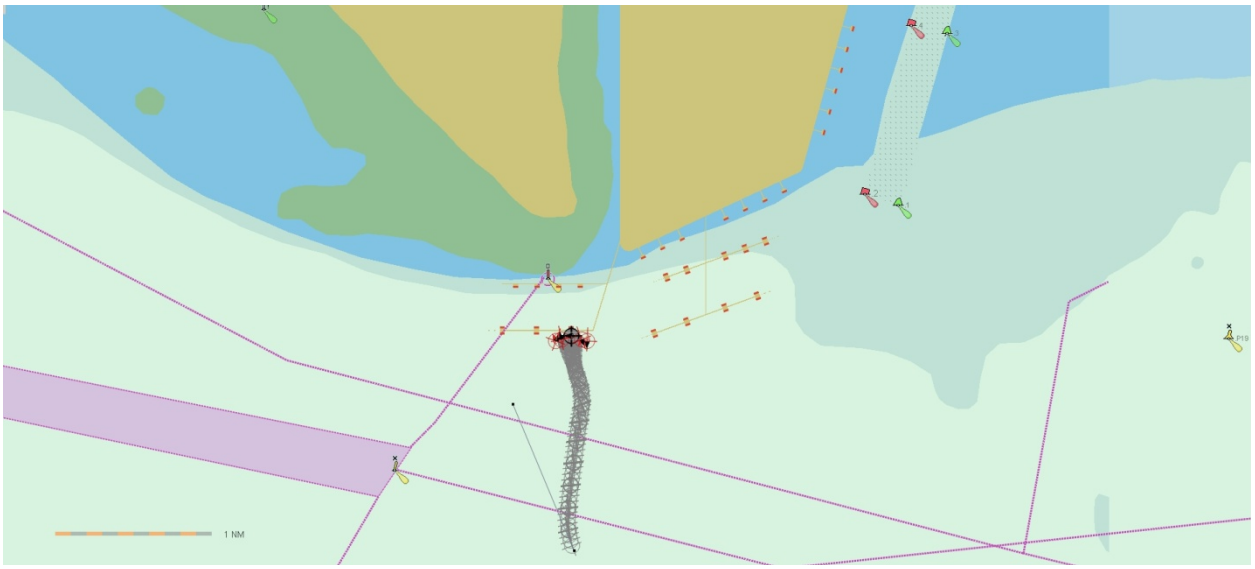


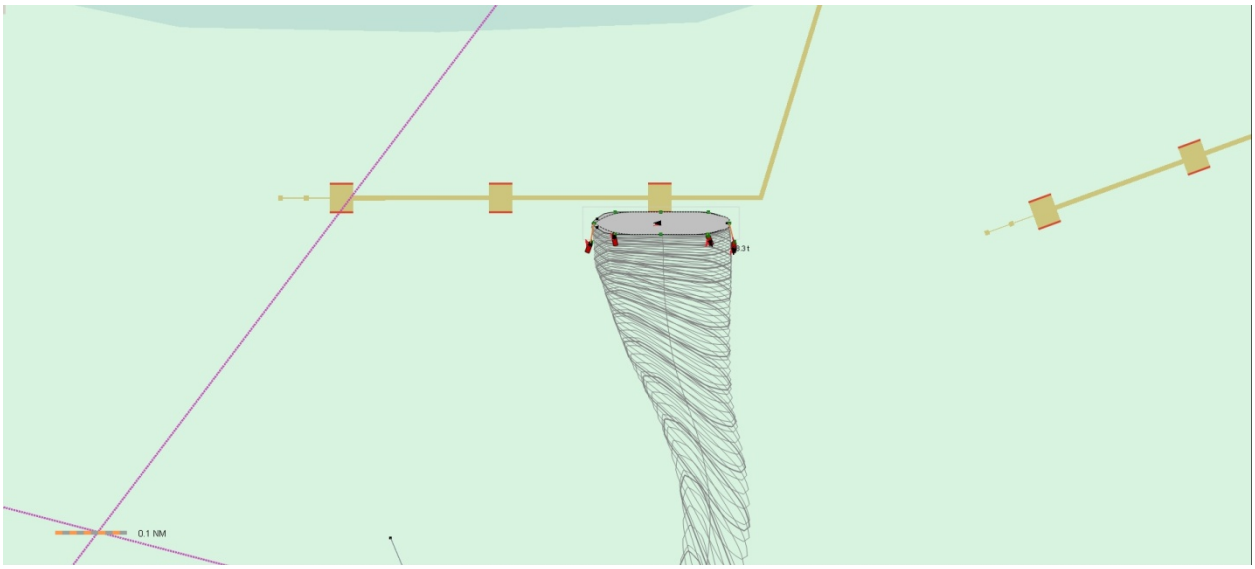


Initial Heading	: 022^0	Current	: West-going - Spring
Initial Speed	: 4 knots	Wind	: 160^0 x 15 knots
Tugs	: 4 x 60 tonne bollard pull ASD		
Duration of Run	: 32 minutes		

This run is similar to Run 101 except for the wind direction, the effect of which is manageable as the VLCC is fully loaded.

Run 104 Laden VLCC Arrival Berth 101

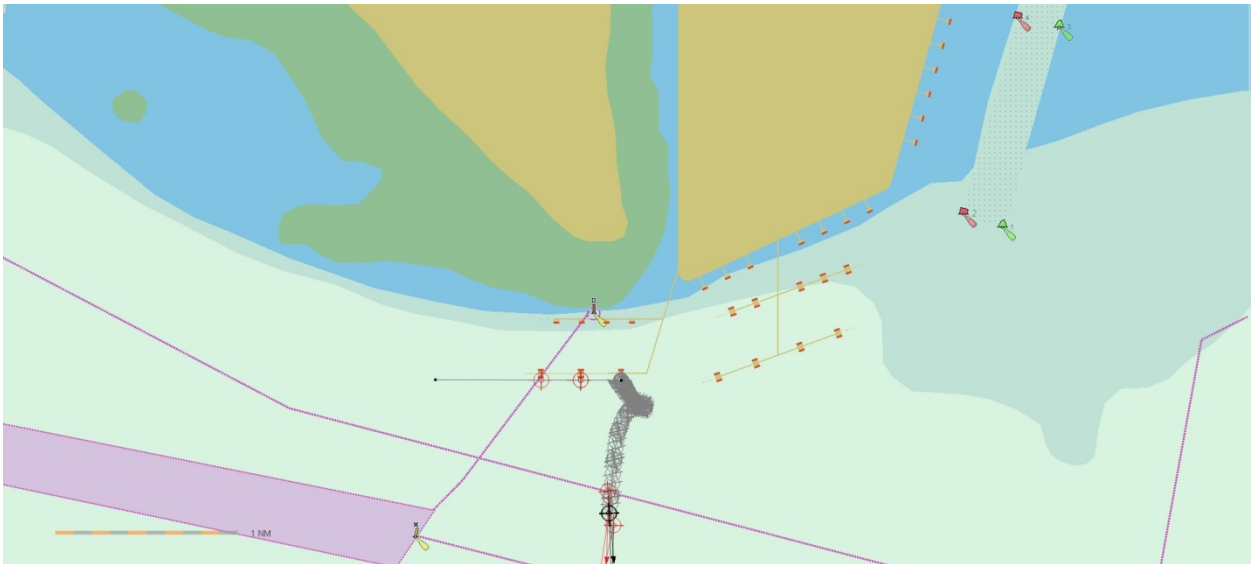


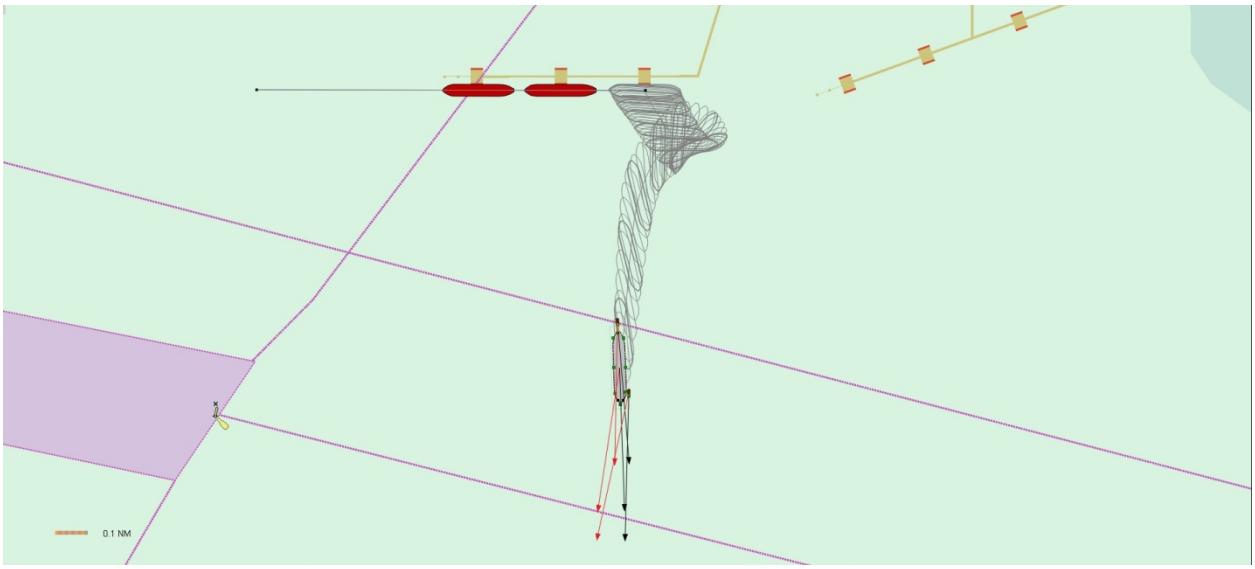


Initial Heading	: 338^0	Current	: East-going - Spring
Initial Speed	: 4 knots	Wind	: 160^0 x 15 knots
Tugs	: 4 x 60 tonne bollard pull ASD		
Duration of Run	: 40 minutes		

This run is similar to Run 102 except for the wind direction, the effect of which is manageable as the VLCC is fully loaded.

Run 105 Ballast VLCC Departure Berth 101



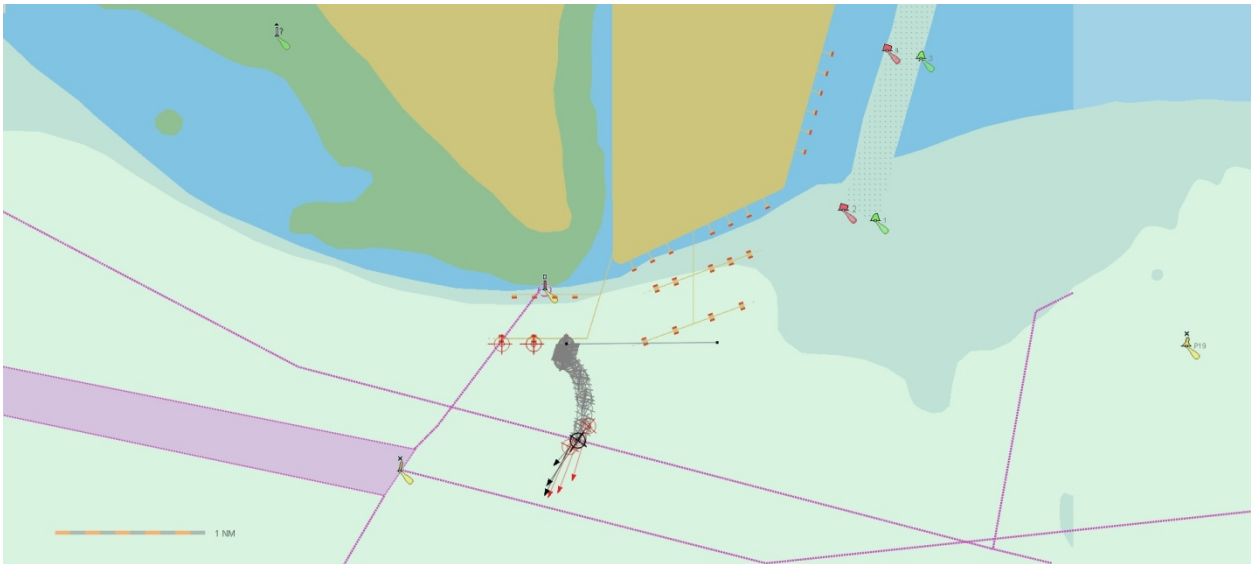


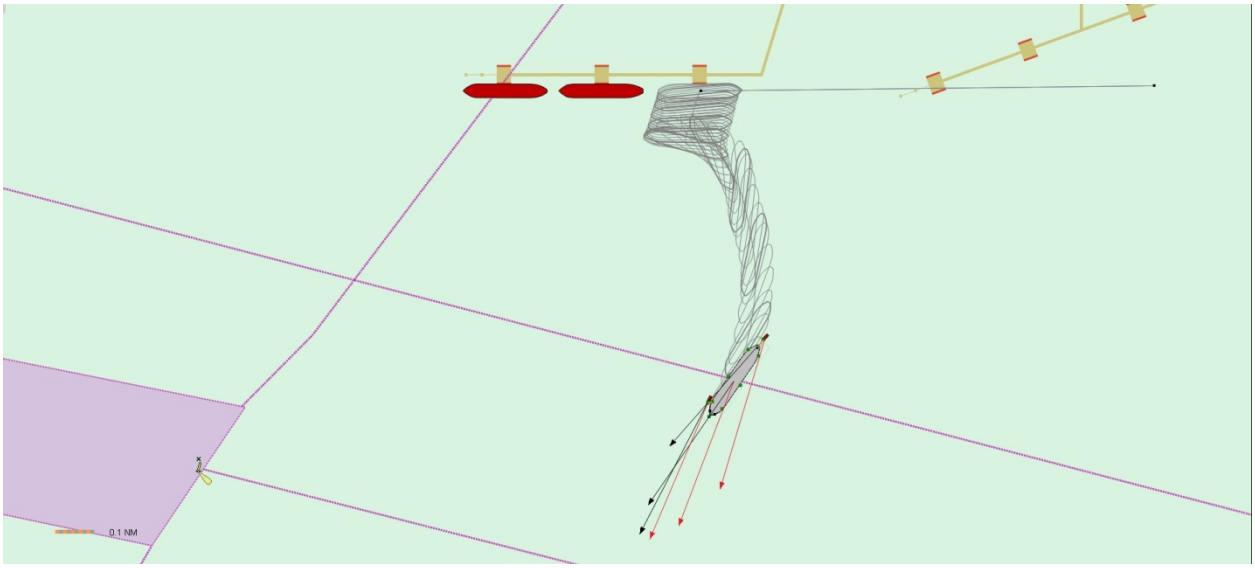
Initial Heading	: 270^0	Current	: West-going - Spring
Initial Speed	: 0 knot	Wind	: 340^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 27 minutes		

The west-going current sets the VLCC away from the berth, therefore the 2 tugs were used to ease her gently away from the berth. Then they pulled until the VLCC is about 200 metres away from the berth before she was swung around to head south for her next port.

The degree of safety was adequate and there were sufficient reserve power resources to cope with any misjudgements and equipment failures.

Run 106 Ballast VLCC Departure Berth 101



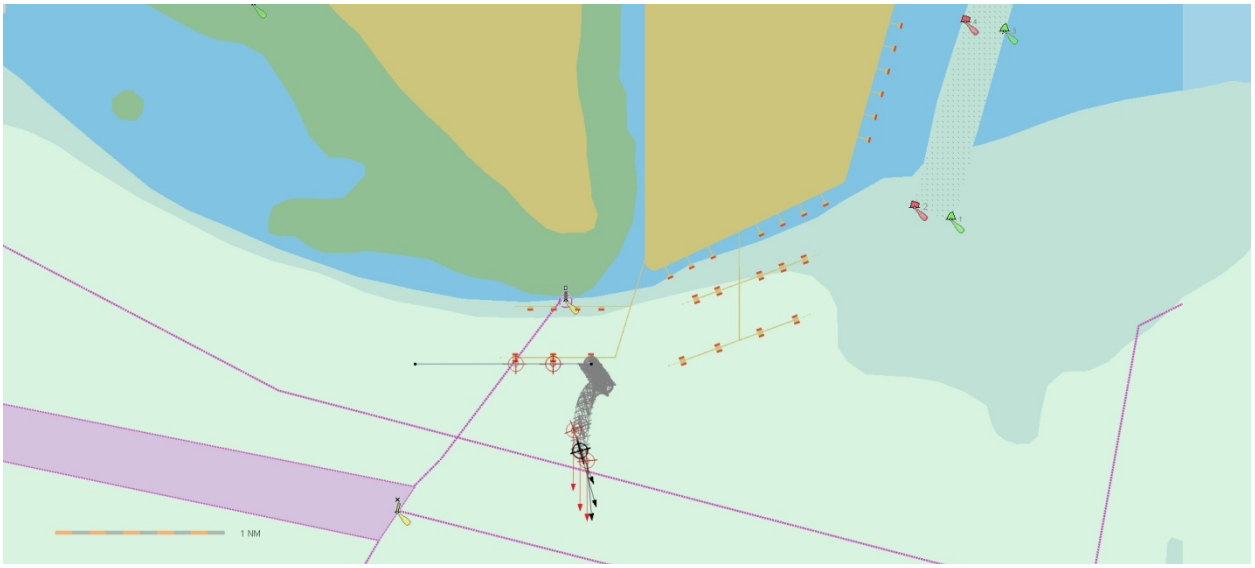


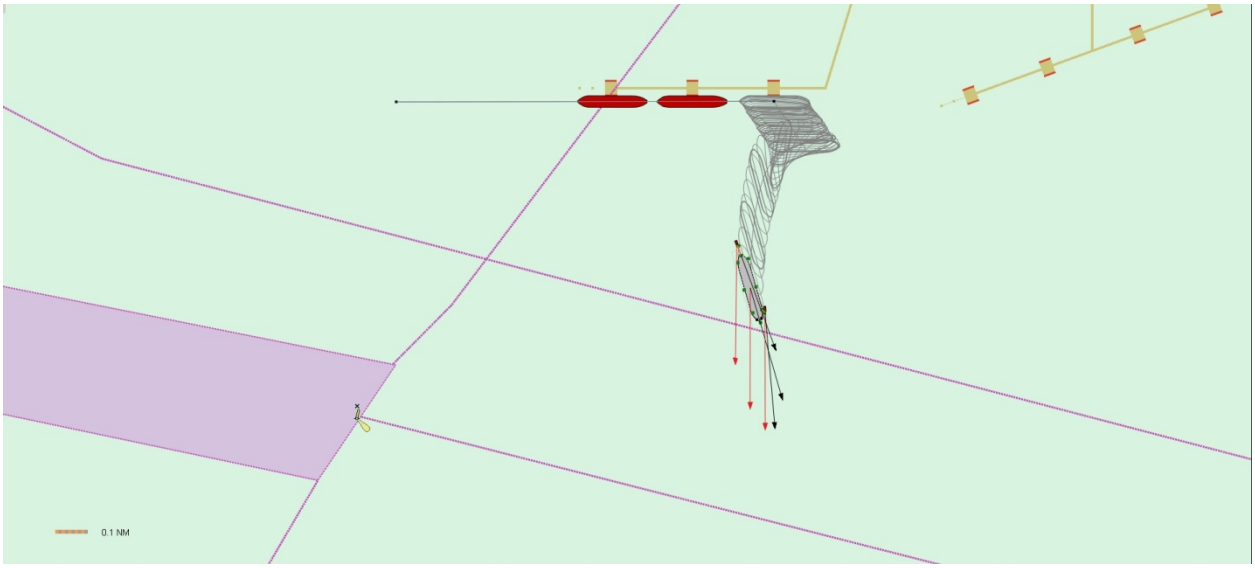
Initial Heading	: 090^0	Current	: East-going - Spring
Initial Speed	: 0 knot	Wind	: 340^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 22 minutes		

The 2 tugs were used to angle the VLCC such that the current set her away from the berth and then continued pulling until the VLCC is about 200 metres away from the berth. Then she was swung around to head south for her next port.

The degree of safety was good and there were sufficient reserve power resources to cope with any misjudgements and equipment failures.

Run 107 Ballast VLCC Departure Berth 101



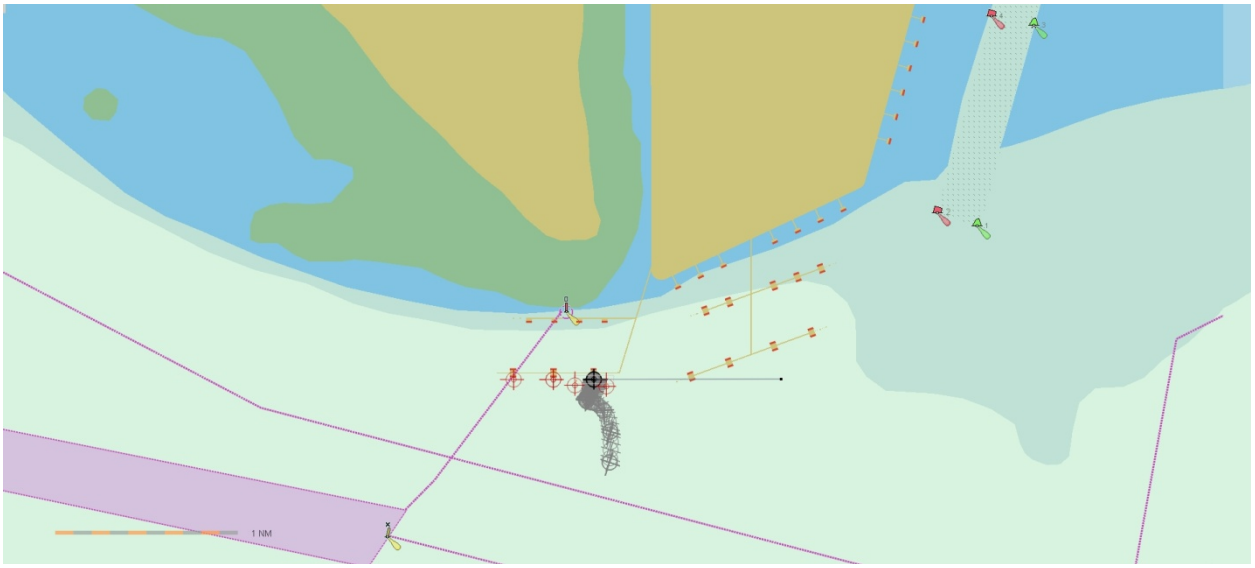


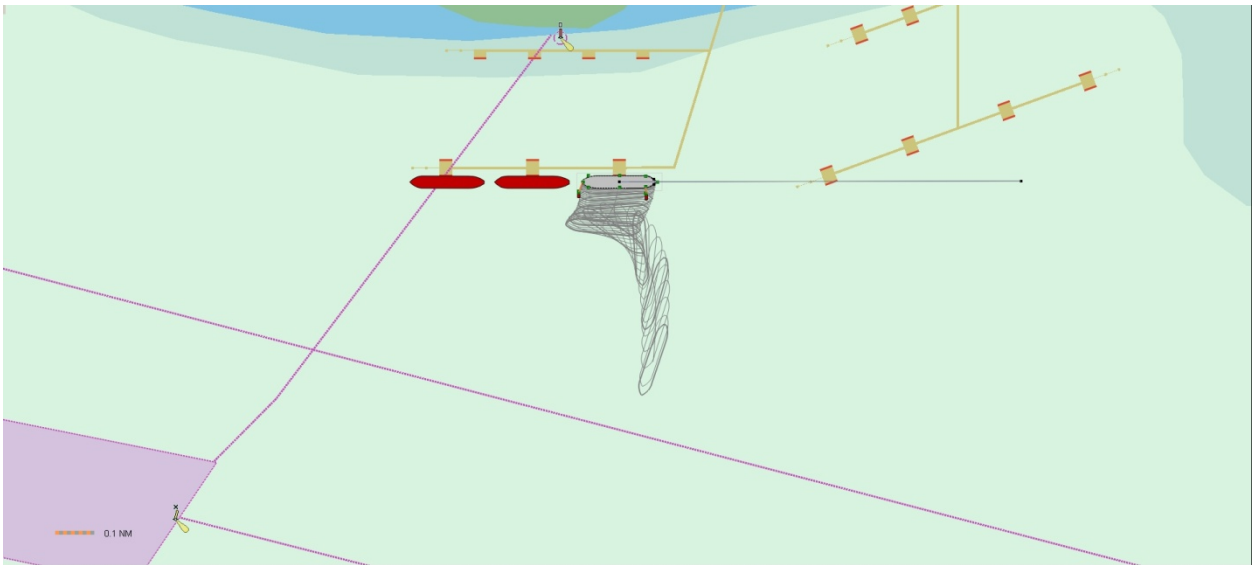
Initial Heading	: 270^0	Current	: West-going - Spring
Initial Speed	: 0 knot	Wind	: 160^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 24 minutes		

The west-going current sets the VLCC away from the berth, therefore the 2 tugs were used to ease her gently away from the berth. Then they pulled until the VLCC is about 200 metres away from the berth before she was swung around to head south for her next port.

The degree of safety was adequate but there were limited reserve power resources to cope with misjudgements and equipment failures, especially tug failures.

Run 108 **Ballast VLCC** **Departure Berth 101**



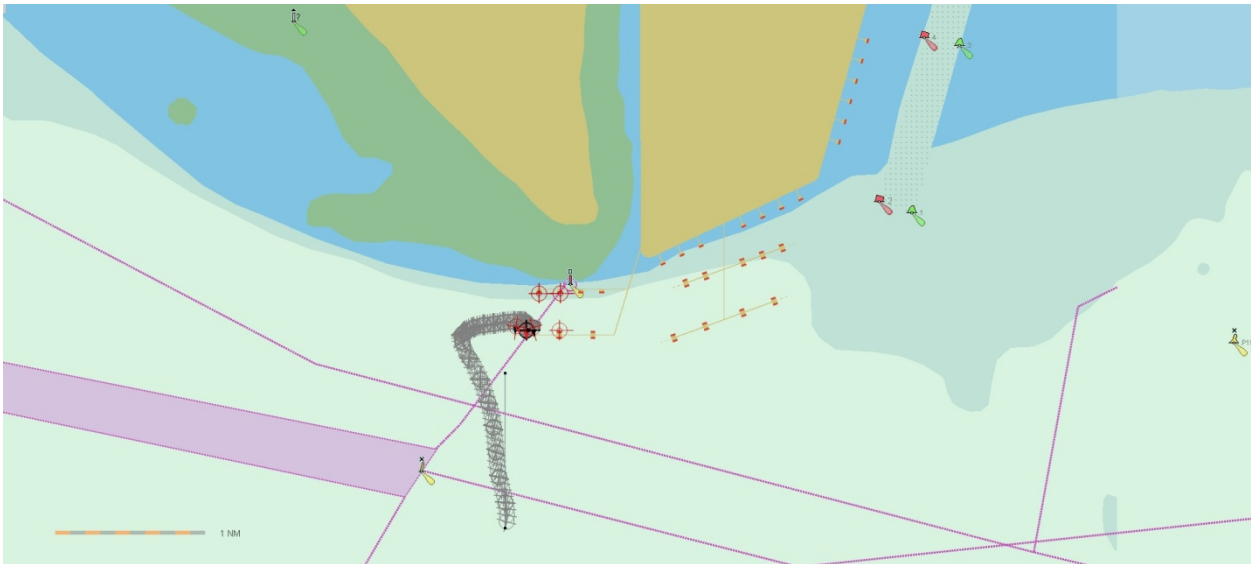


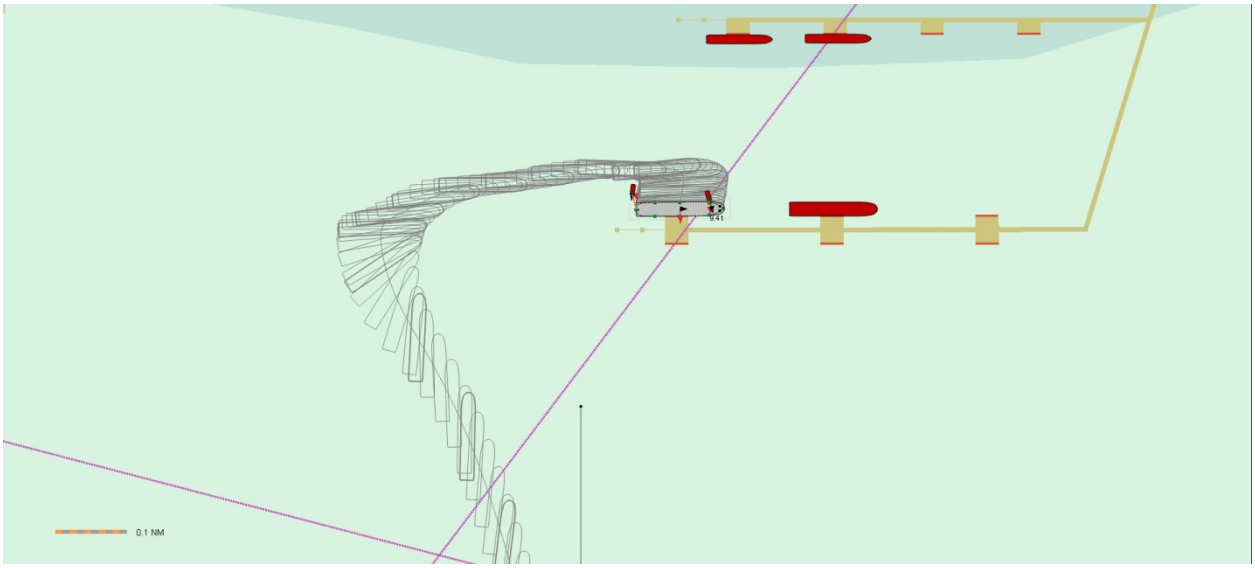
Initial Heading	: 090^0	Current	: East-going - Spring
Initial Speed	: 0 knot	Wind	: 160^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 23 minutes		

The 2 tugs were used to angle the VLCC such that the current set her away from the berth and then continued pulling until the VLCC is about 200 metres away from the berth. Then she was swung around to head south for her next port.

The degree of safety was adequate but there were limited reserve power resources to cope with misjudgements and equipment failures, especially tug failures.

Run 109 Laden Tanker (80,000 DWT) Arrival Berth 106





Initial Heading	: 360^0	Current	: West-going - Spring
Initial Speed	: 5 knots	Wind	: 340^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 44 minutes		

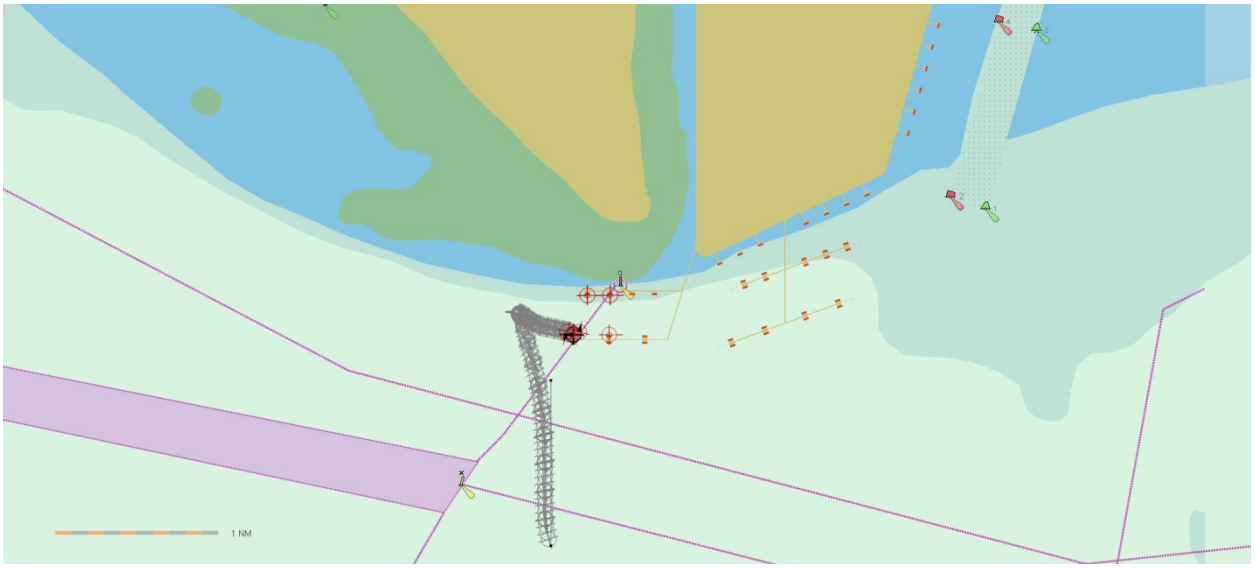
The starting position of the vessel chosen was directly south of the berth. This presented the most challenging situation as it exposes the laden tanker to abeam current.

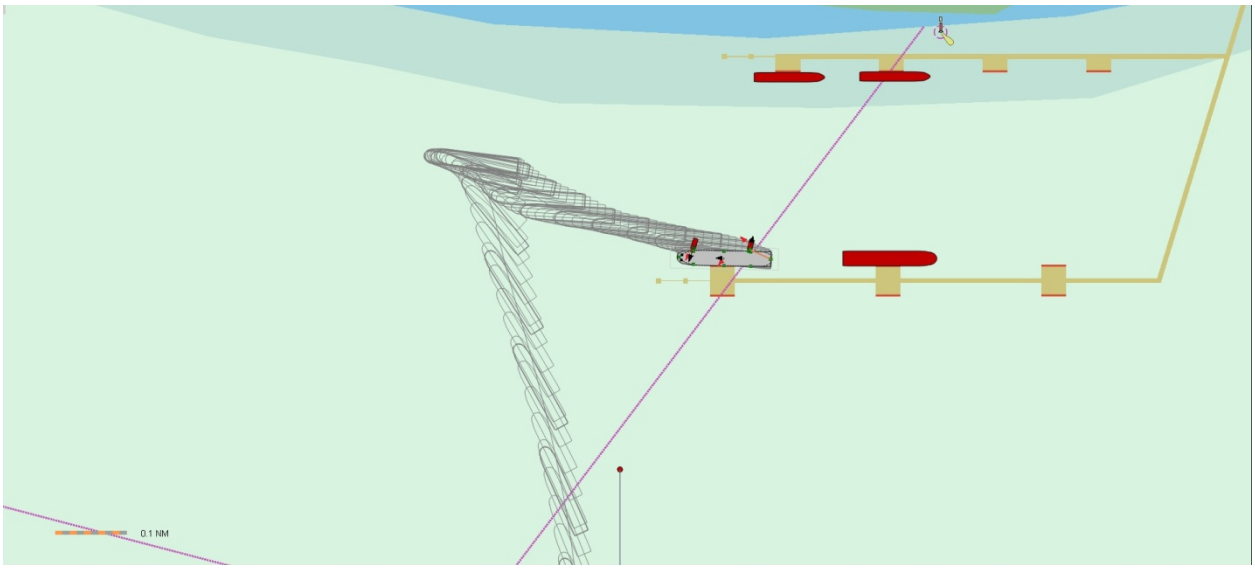
The vessel was allowed to continue more or less on her northerly heading as the current set her westward away from the berth and dolphin. Then she was swung to starboard to approach her berth.

The run against the current to her berth was straight forward and the tugs assisted in berthing her alongside.

The degree of safety was adequate and there were sufficient reserve power resources to cope with any misjudgements and equipment failures.

Run 110 Laden Tanker (80,000 DWT) Arrival Berth 106





Initial Heading	: 360^0	Current	: East-going - Spring
Initial Speed	: 5 knots	Wind	: 340^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 44 minutes		

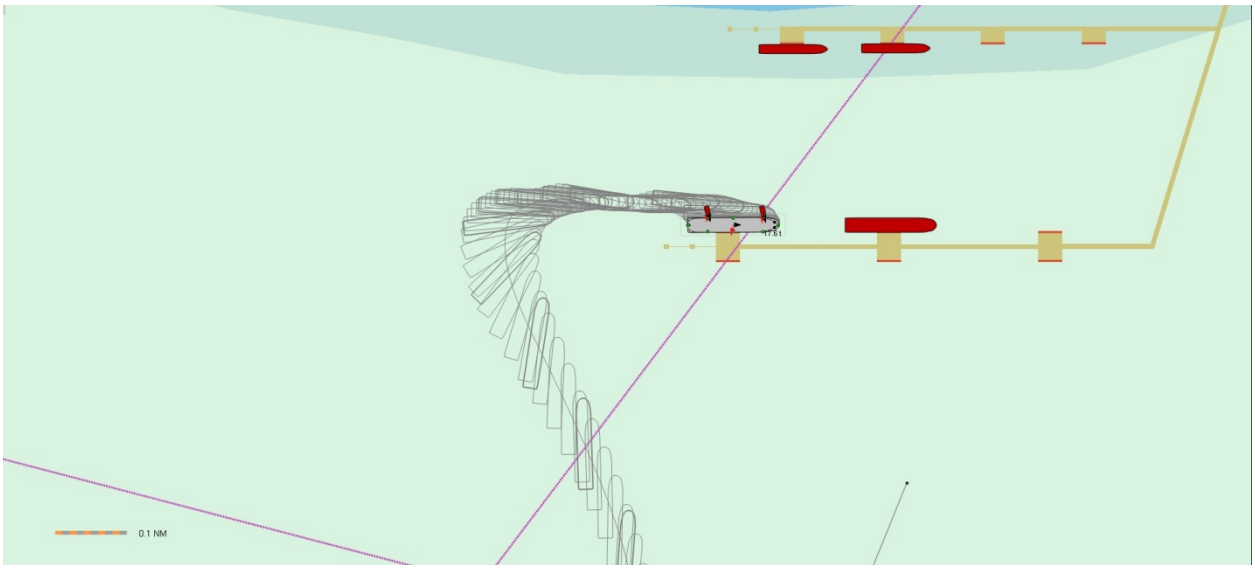
The starting position of the vessel chosen was directly south of the berth. This presented the most challenging situation as it exposes the laden tanker to abeam current.

The vessel heading was altered to port in order to track well clear of the dolphin as the current set her eastwards towards the dolphin. Once clear of the dolphin, she was swung to port to stem the current before backing to her berth.

Backing a vessel to her berth is more difficult as control of her heading is totally dependent on the assisting tugs. The current also sets the vessel onto the berth which aggravates the situation.

The degree of safety was adequate but there were limited reserve power resources to cope with misjudgements and equipment failures, especially tug failures.

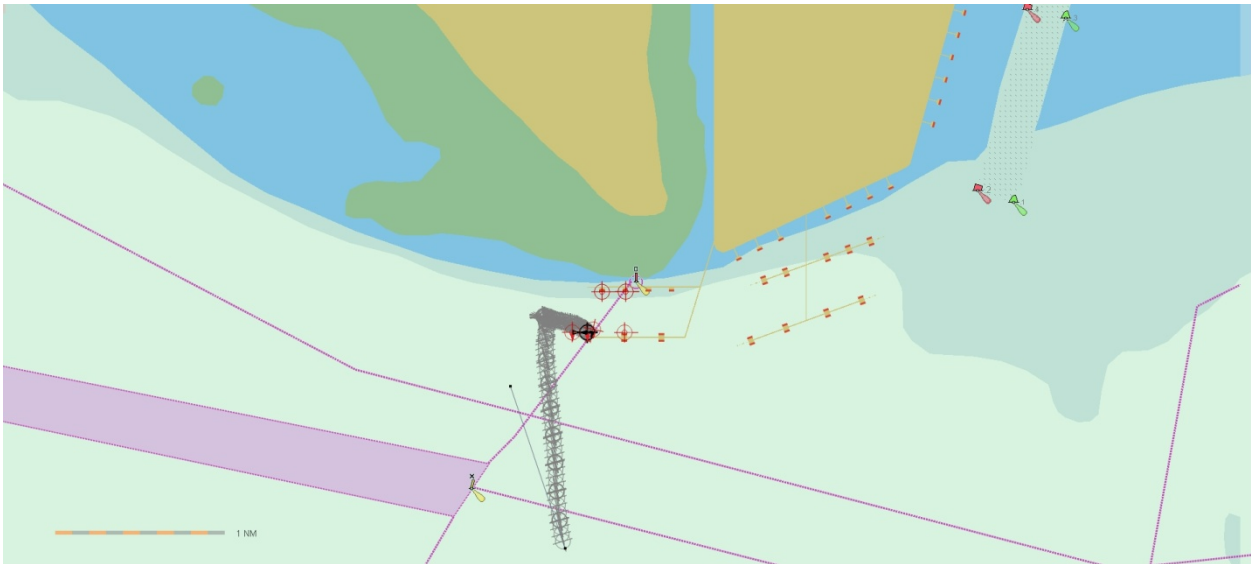
Run 111 Laden Tanker (80,000 DWT) Arrival Berth 106

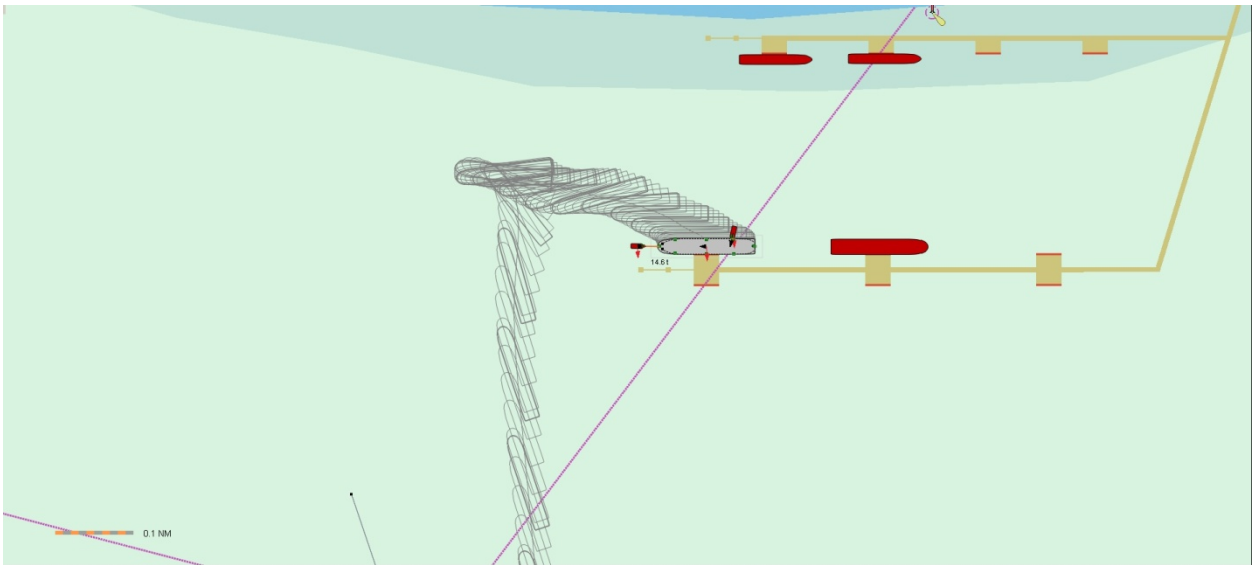


Initial Heading	: 022^0	Current	: West-going - Spring
Initial Speed	: 5 knots	Wind	: 160^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 43 minutes		

This run is similar to Run 109 except for the wind direction, the effect of which is negligible as the tanker is fully loaded.

Run 112 Laden Tanker (80,000 DWT) Arrival Berth 106

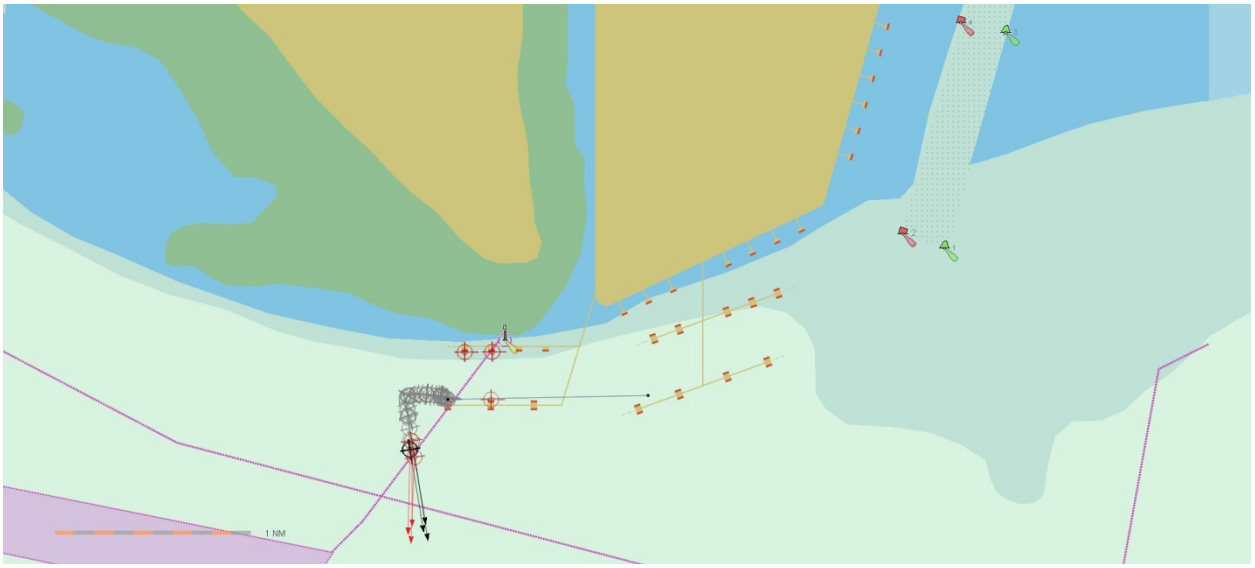


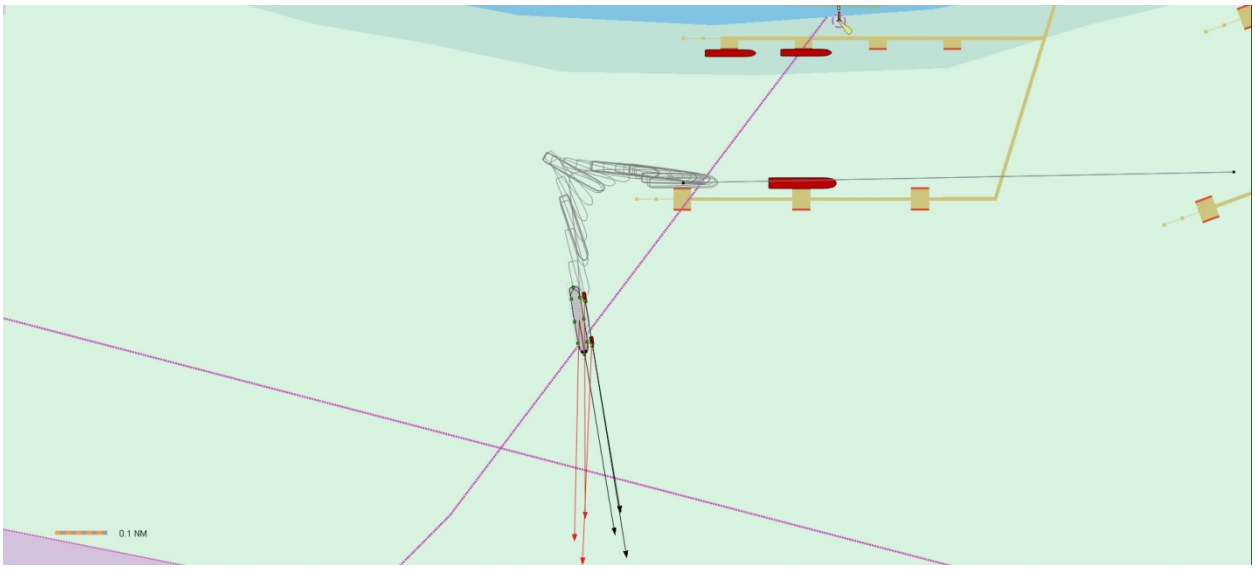


Initial Heading	: 342^0	Current	: East-going - Spring
Initial Speed	: 5 knots	Wind	: 160^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 43 minutes		

This run is similar to Run 110 except for the wind direction, whose effect is negligible as the tanker is fully loaded.

Run 113 Ballast Tanker (80,000 DWT) Departure Berth 106



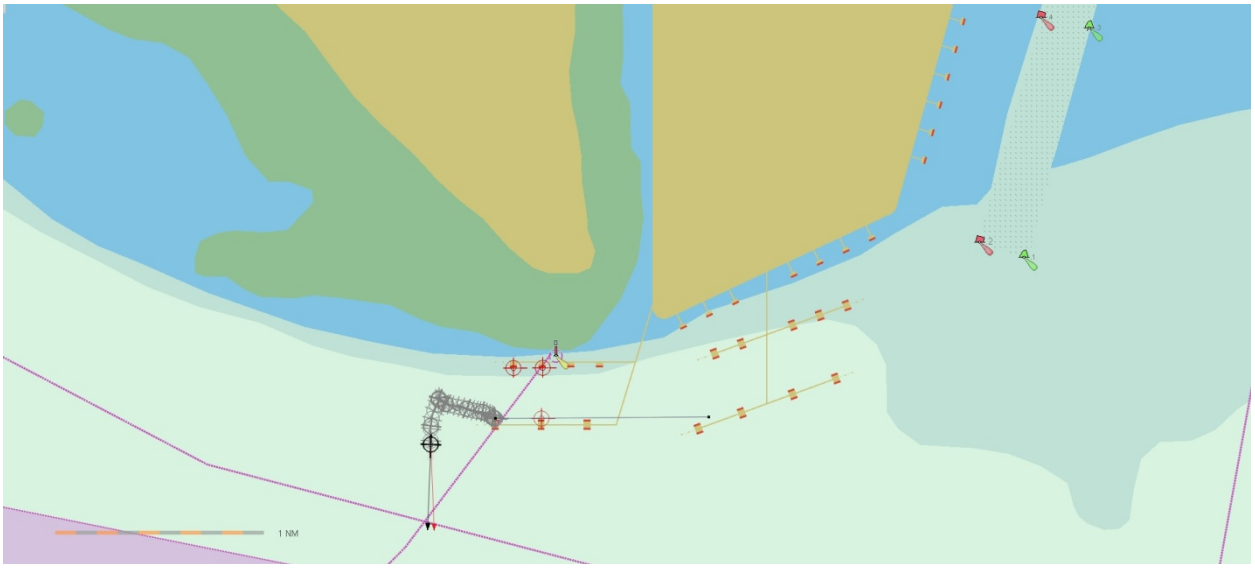


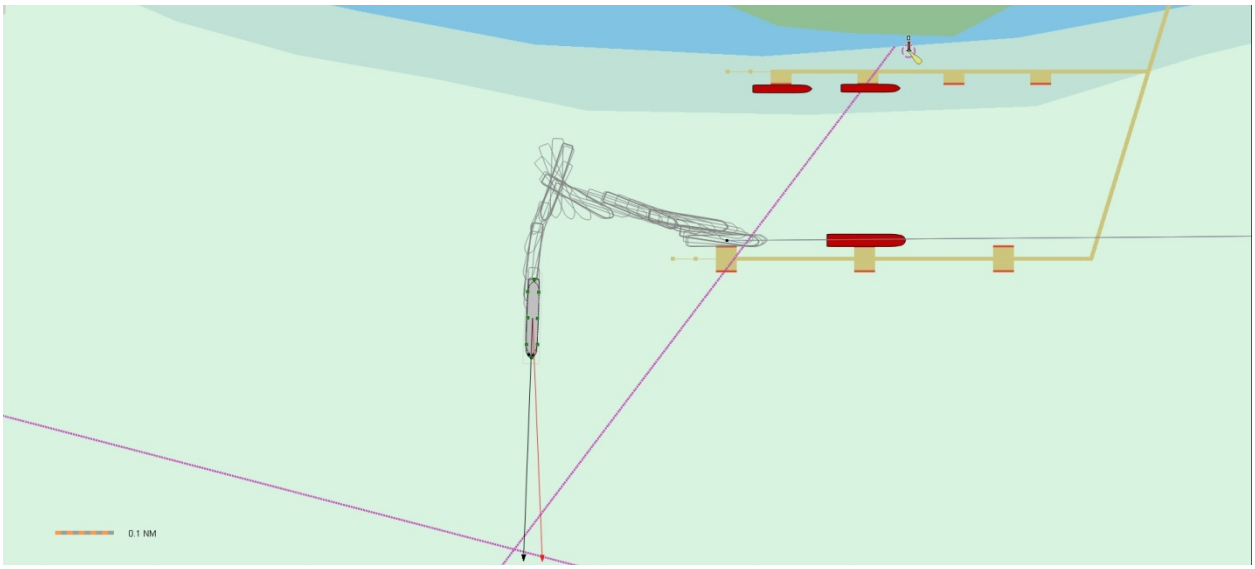
Initial Heading	: 090^0	Current	: West-going - Spring
Initial Speed	: 0 knot	Wind	: 340^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 12 minutes		

The assisting tugs pulled (with up to 50% power) the tanker away from the berth. When sufficiently clear from the berth, astern engines were used to back her clear of the dolphin. She was swung round to head out when her bow was well clear of the dolphin.

The degree of safety was adequate and there were sufficient reserve power resources to cope with any misjudgements and equipment failures.

Run 114 Ballast Tanker (80,000 DWT) Departure Berth 106



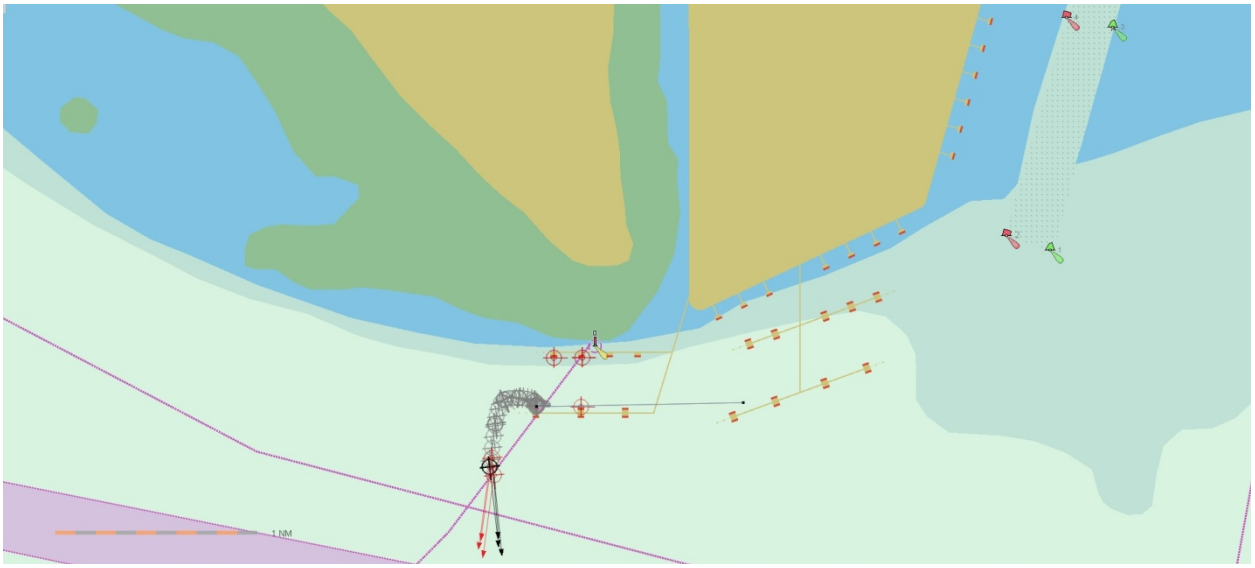


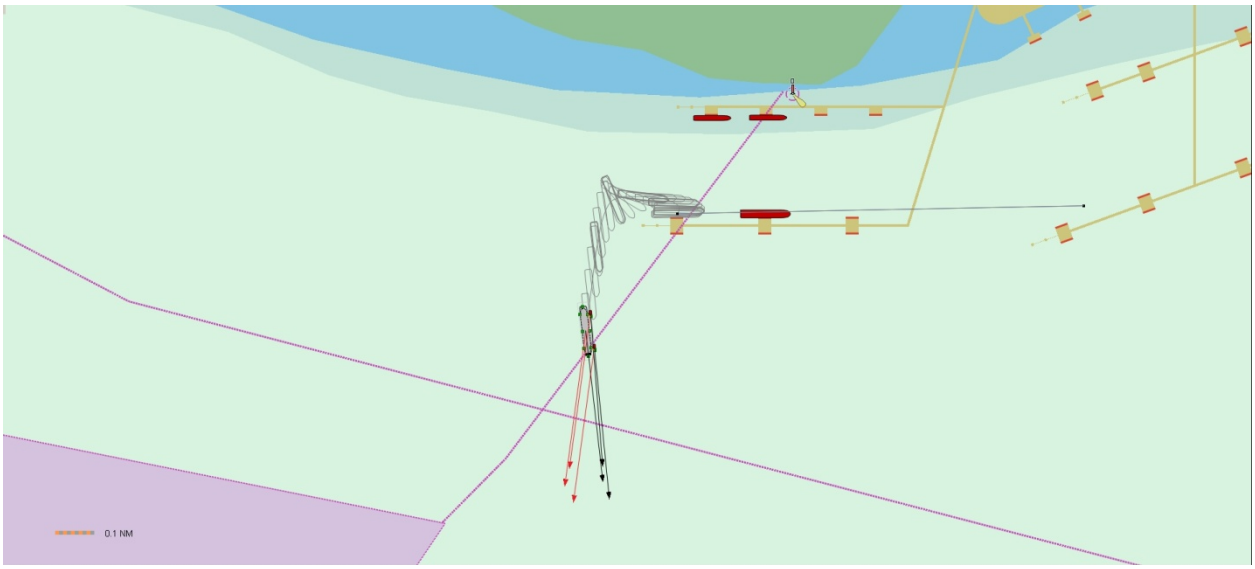
Initial Heading	: 090^0	Current	: East-going - Spring
Initial Speed	: 0 knot	Wind	: 340^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 13 minutes		

Astern engines were used to back the vessel away from the berth when she was pulled sufficiently away from berth. She was swung around to head out only after she was a good distance away from the dolphin (to allow for the easterly set towards it).

The degree of safety was adequate but there were limited reserve power resources to cope with misjudgements and equipment failures, especially tug failures.

Run 115 Ballast Tanker (80,000 DWT) Departure Berth 106

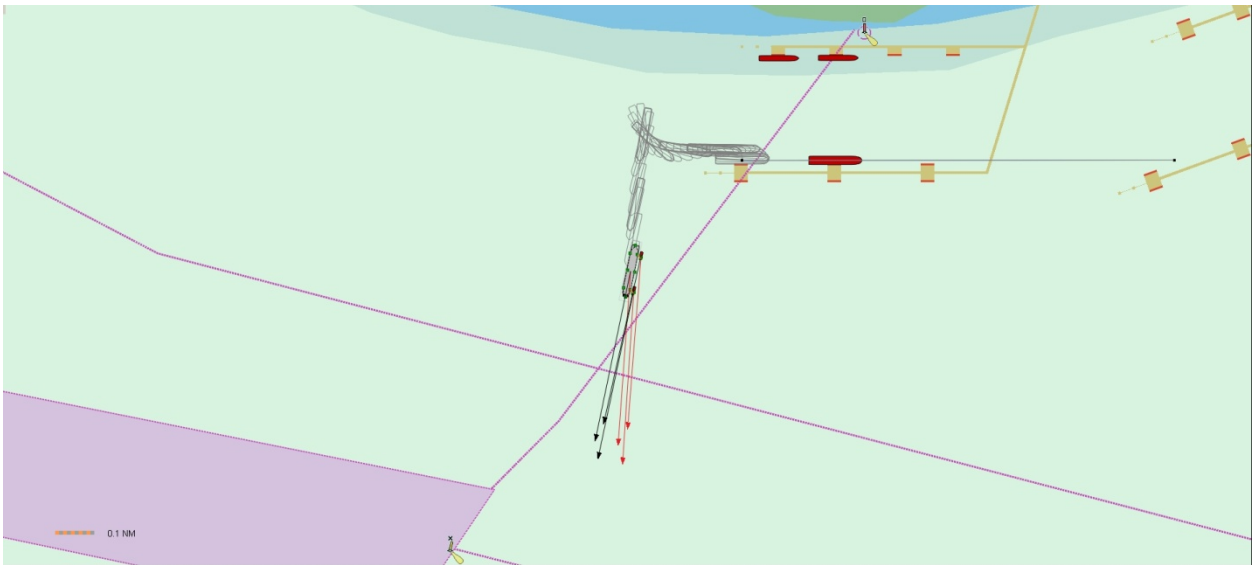




Initial Heading	: 090^0	Current	: West-going - Spring
Initial Speed	: 0 knot	Wind	: 160^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 12 minutes		

This run is similar to Run 113 except for the wind direction, the effect of which has to be managed carefully.

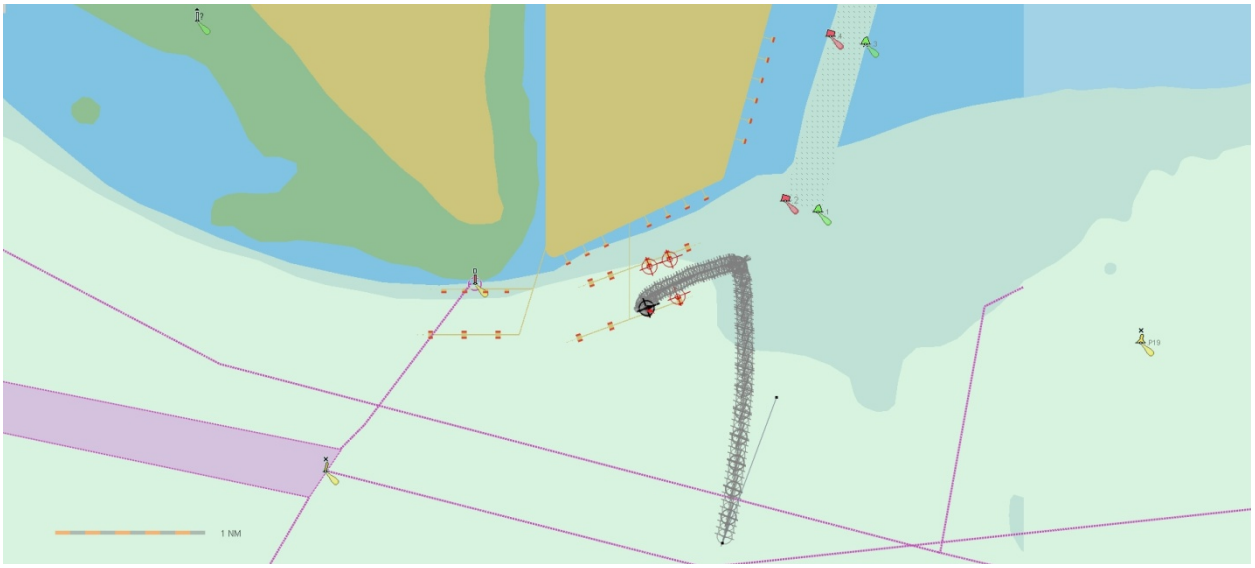
Run 116 Ballast Tanker (80,000 DWT) Departure Berth 106

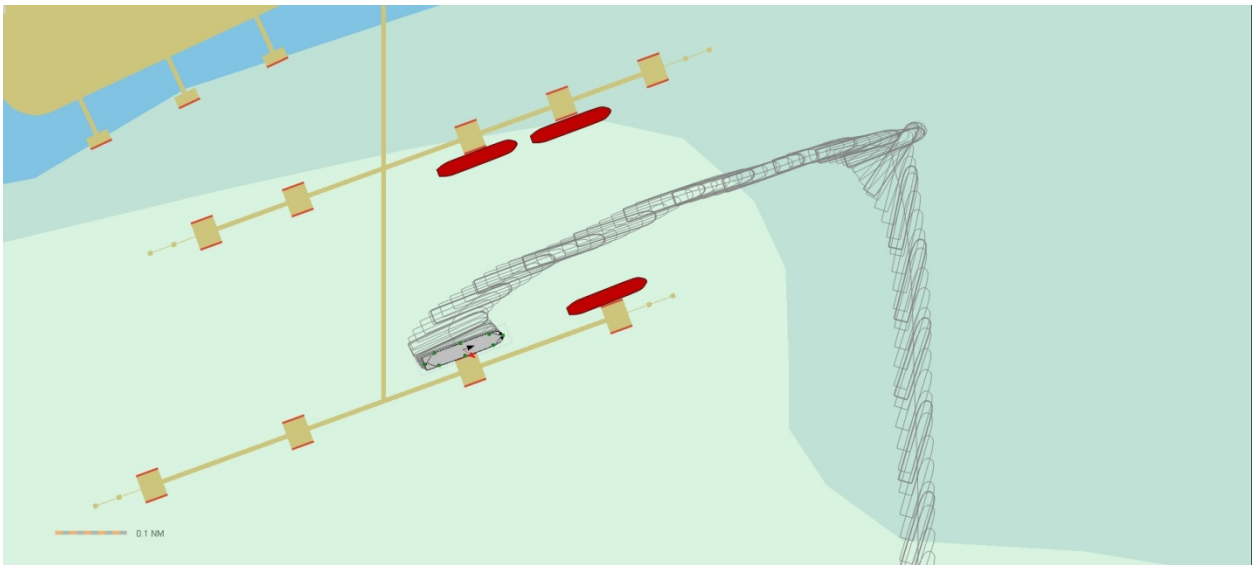


Initial Heading	: 090^0	Current	: East-going - Spring
Initial Speed	: 0 knot	Wind	: 160^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 16 minutes		

This run was similar to Run 114 except for the wind direction, the effect of which has to be managed carefully.

Run 117 Ballast Tanker (60,000 DWT) Arrival Berth 207





Initial Heading	: 020^0	Current	: West-going - Spring
Initial Speed	: 5 knots	Wind	: 160^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 53 minutes		

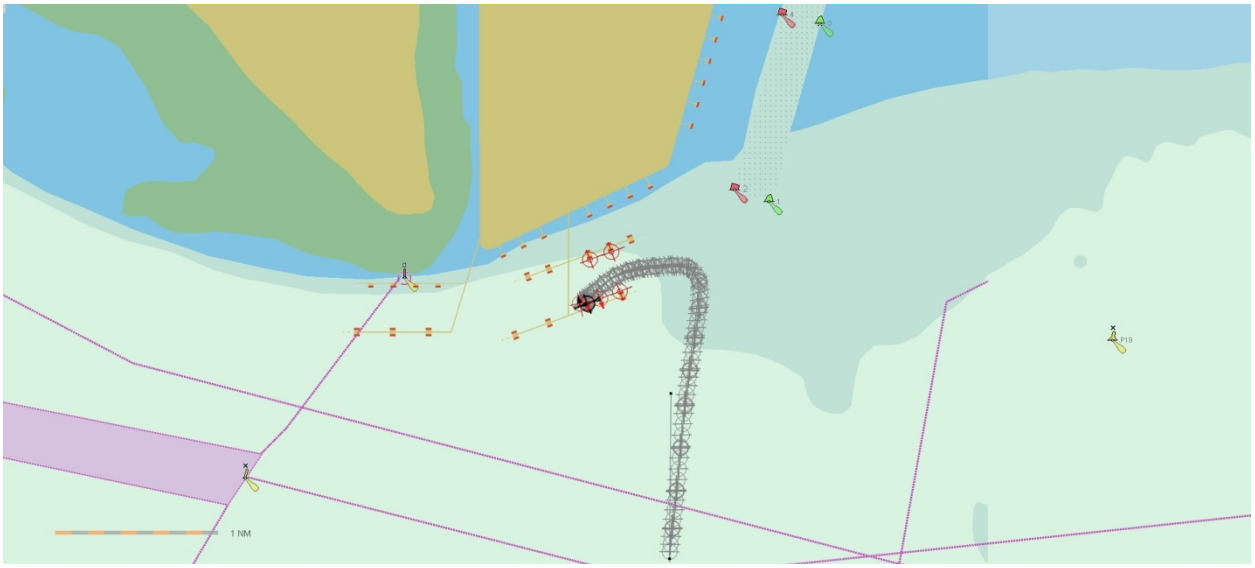
The vessel heading must be such as to track well clear of the dolphin as the current set her westwards towards it. Once clear of the dolphin, she was swung to starboard to stem the current before backing to her berth.

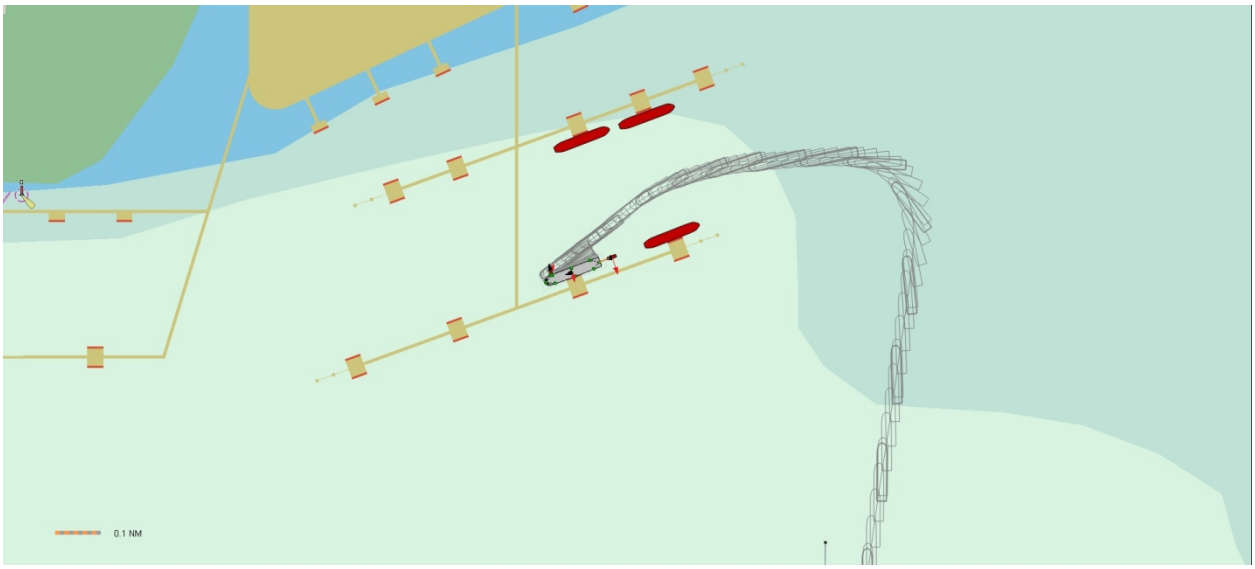
Backing a vessel to her berth is more difficult as control of her heading is totally dependent on the assisting tugs.

As this is an end berth, care must be taken to ensure that her backing speed is kept low.

The degree of safety was adequate but there were limited reserve power resources to cope with misjudgements and equipment failures, especially engines and tug failures.

Run 118 Ballast Tanker (60,000 DWT) Arrival Berth 207





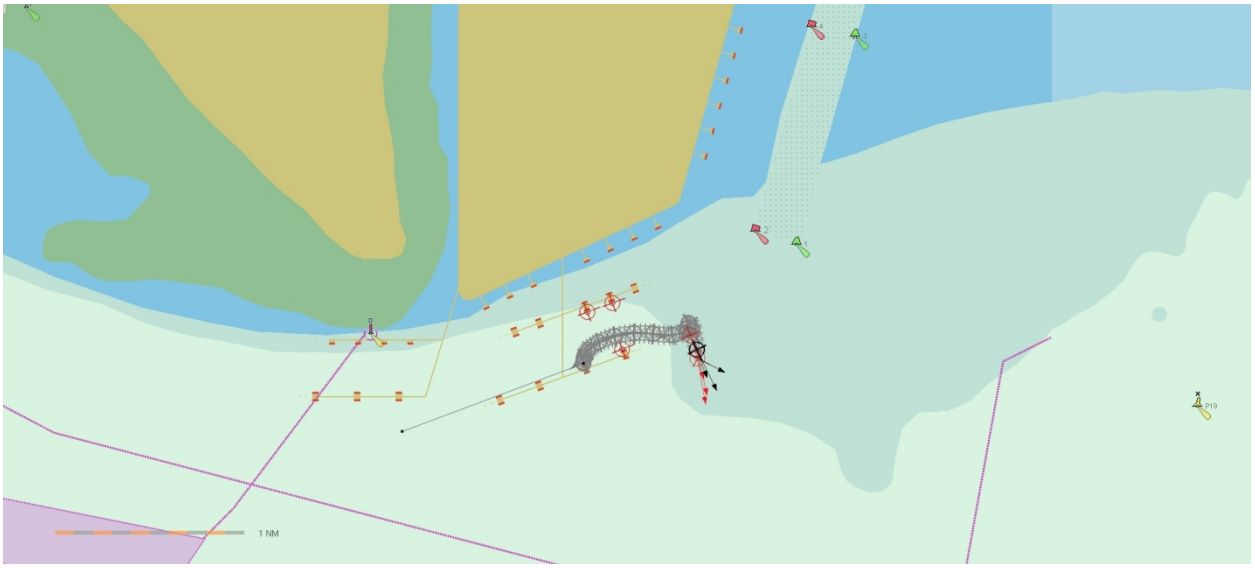
Initial Heading	: 360^0	Current	: East-going - Spring
Initial Speed	: 5 knots	Wind	: 160^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 42 minutes		

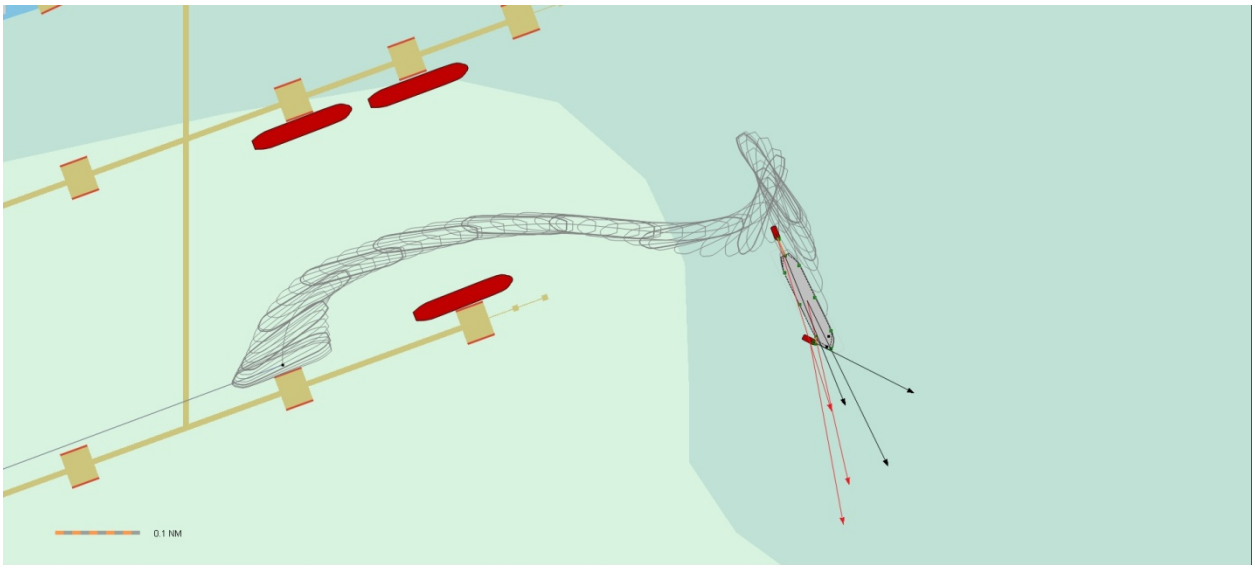
The vessel was allowed to continue more or less on her northerly heading as the current set her eastwards away from the berth and dolphin. Then she was swung to port to approach her berth.

The run against the current to her berth was straight forward and the tugs assisted in berthing her alongside. Care must be taken to keep her speed low as this is an end berth.

The degree of safety was adequate and there were sufficient reserve power resources to cope with any misjudgements and equipment failures.

Run 119 Laden Tanker (60,000 DWT) Departure Berth 207



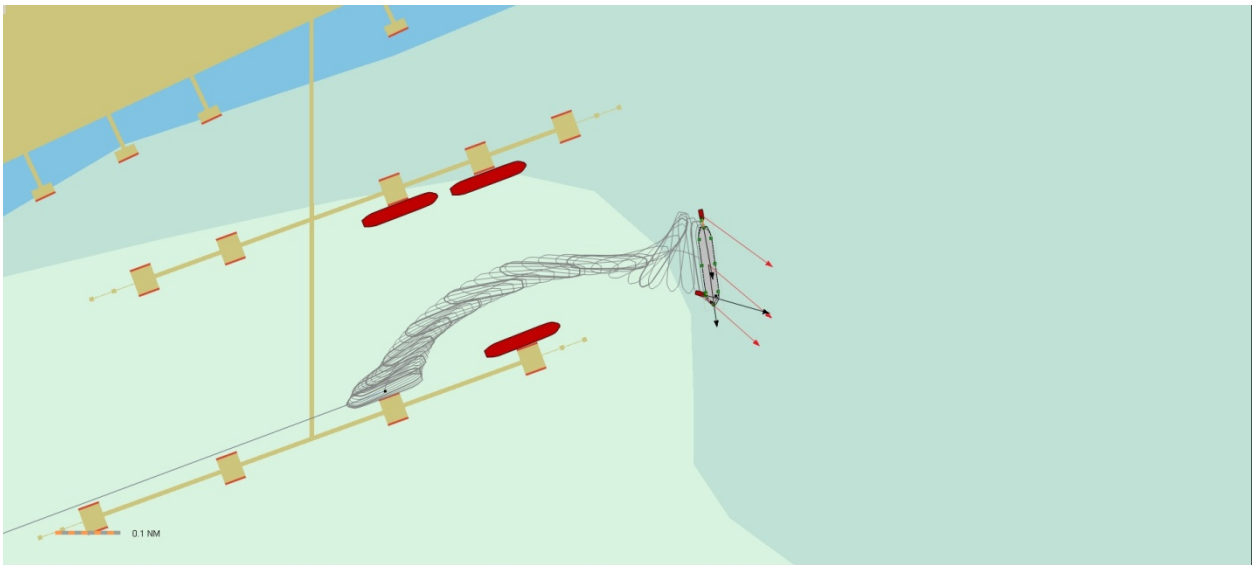


Initial Heading	: 250^0	Current	: West-going - Spring
Initial Speed	: 0 knot	Wind	: 160^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 24 minutes		

The vessel was unberthed using the 2 tugs to pull her off the berth, with the stern coming out slightly faster than the bow. She was towed out by the aft tug with the bow tug assisting to adjust her heading. Then she was swung to port when she was well clear of the dolphin with sufficient room to allow for the westerly set.

Unberthing a laden tanker with moderate current from the stern at an inner end berth should be done with caution. The vessel will drift towards the jetty should there be any slow reaction or equipment failure, especially tug failure. Therefore it is recommended that such manoeuvres be undertaken in tidal strength of not more than 0.5 knots.

Run 120 Laden Tanker (60,000 DWT) Departure Berth 207

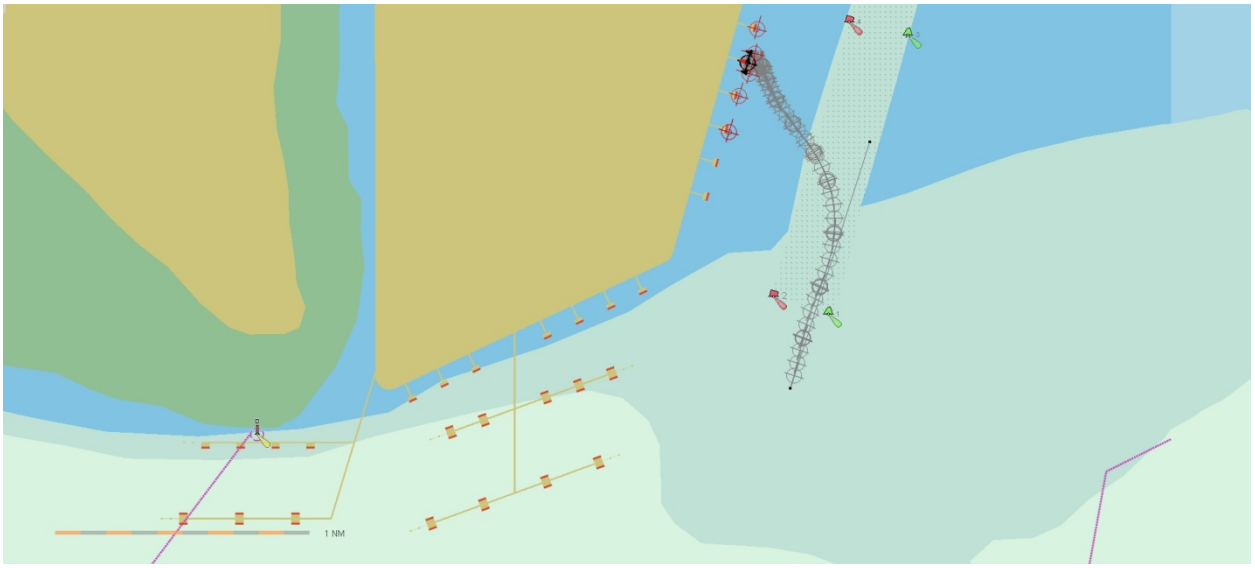


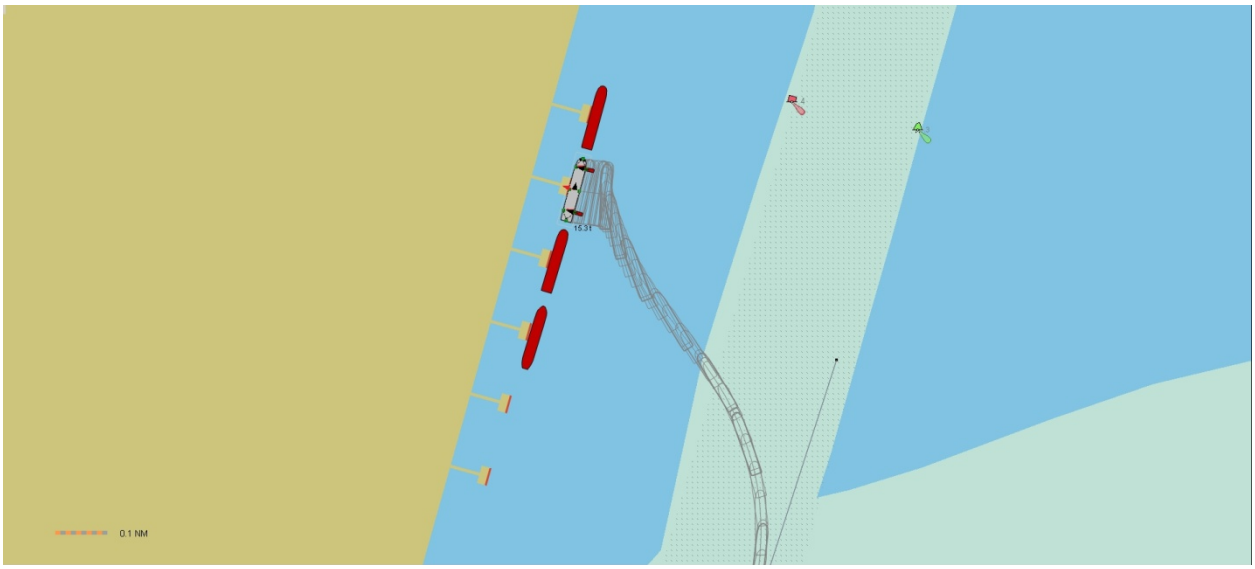
Initial Heading	: 250^0	Current	: East-going - Spring
Initial Speed	: 0 knot	Wind	: 160^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 21 minutes		

The vessel was unberthed using the 2 tugs to pull her off the berth, with the bow coming out slightly faster than the stern. This was to allow the current to set her to starboard. She was towed out by the aft tug with the bow tug assisting to adjust her heading after she was sufficiently clear of the vessel at berth 208. Then she was swung to port when she was clear of the dolphin.

The degree of safety was adequate and there were sufficient reserve power resources to cope with any misjudgements and equipment failures.

Run 121 Ballast Tanker (60,000 DWT) Arrival Berth 230





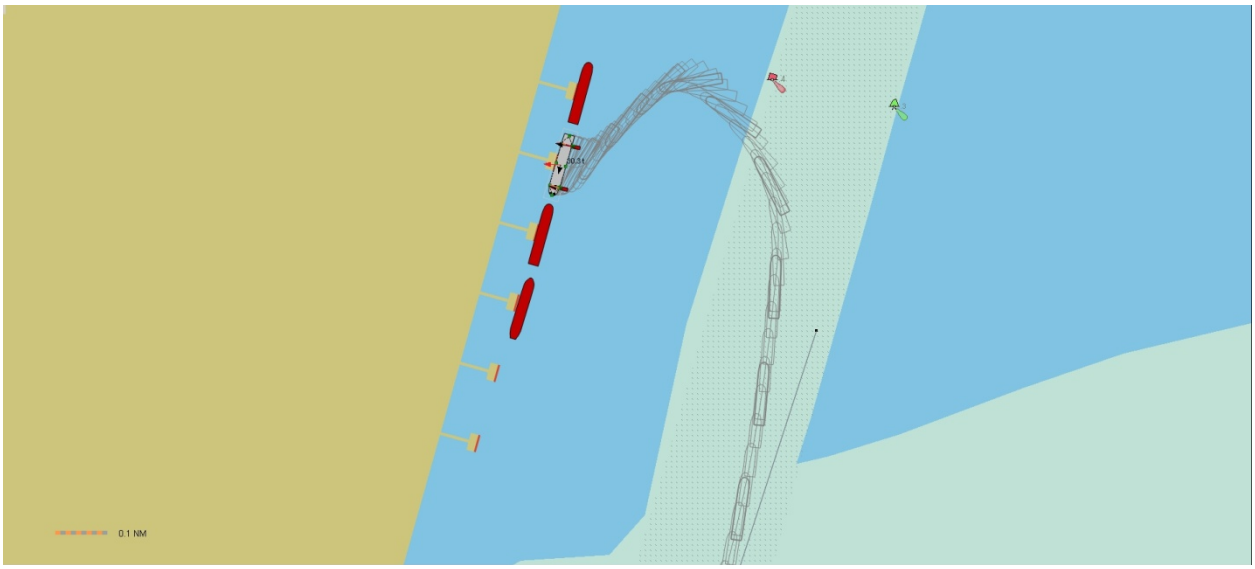
Initial Heading	: 018^0	Current	: West-going - Spring (207^0 x 0.1 knot)
Initial Speed	: 6 knots	Wind	: 340^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 25 minutes		

The current in the Tanjung Pelepas Approach Channel is stronger than in the channel fronting berths 226 to 231. Therefore using the Tanjung Pelepas Approach Channel is more difficult as one has to cope with traffic moving in and out of the Port of Tanjung Pelepas as well.

The run against the current to her berth was straight forward and the tugs assisted in berthing her alongside.

The degree of safety was good and there were sufficient reserve power resources to cope with any misjudgements and equipment failures.

Run 122 Ballast Tanker (60,000 DWT) Arrival Berth 230



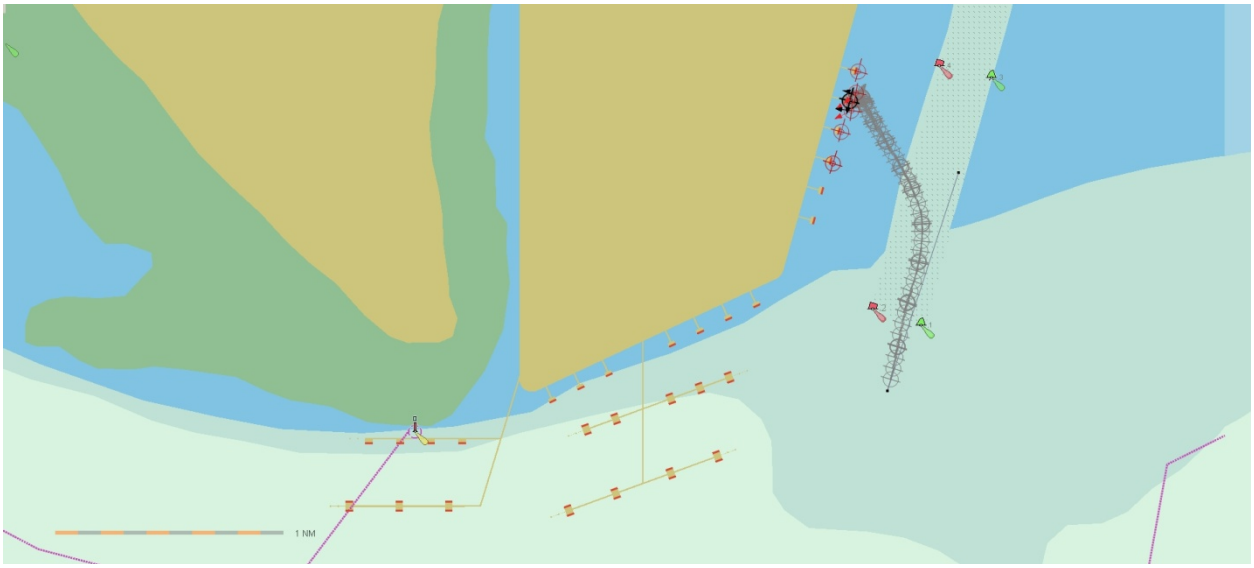
Initial Heading	: 018^0	Current	: East-going - Spring (020^0 x 0.5 knots)
Initial Speed	: 6 knots	Wind	: 340^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 28 minutes		

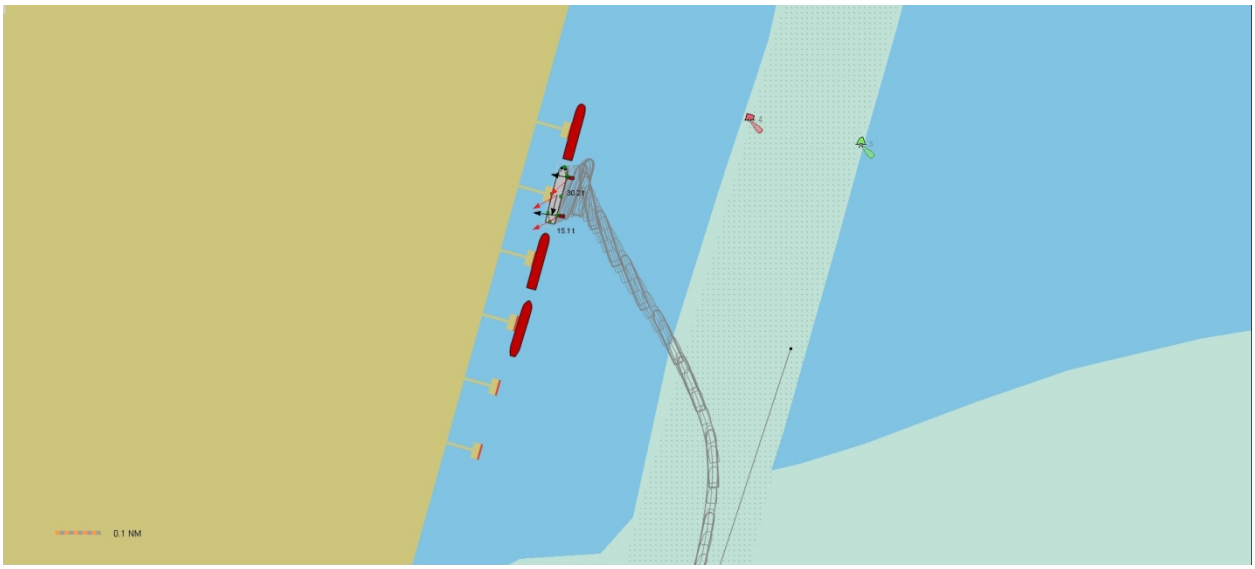
The current in the Tanjung Pelepas Approach Channel is stronger than in the channel fronting berths 226 to 231. Therefore using the Tanjung Pelepas Approach Channel is more difficult as one has to cope with traffic moving in and out of the Port of Tanjung Pelepas as well.

The run with the current and turning her around before berthing posed some challenges but was manageable.

The degree of safety was adequate but there were limited reserve power resources to cope with misjudgements and equipment failures, especially tug failures.

Run 123 Ballast Tanker (60,000 DWT) Arrival Berth 230

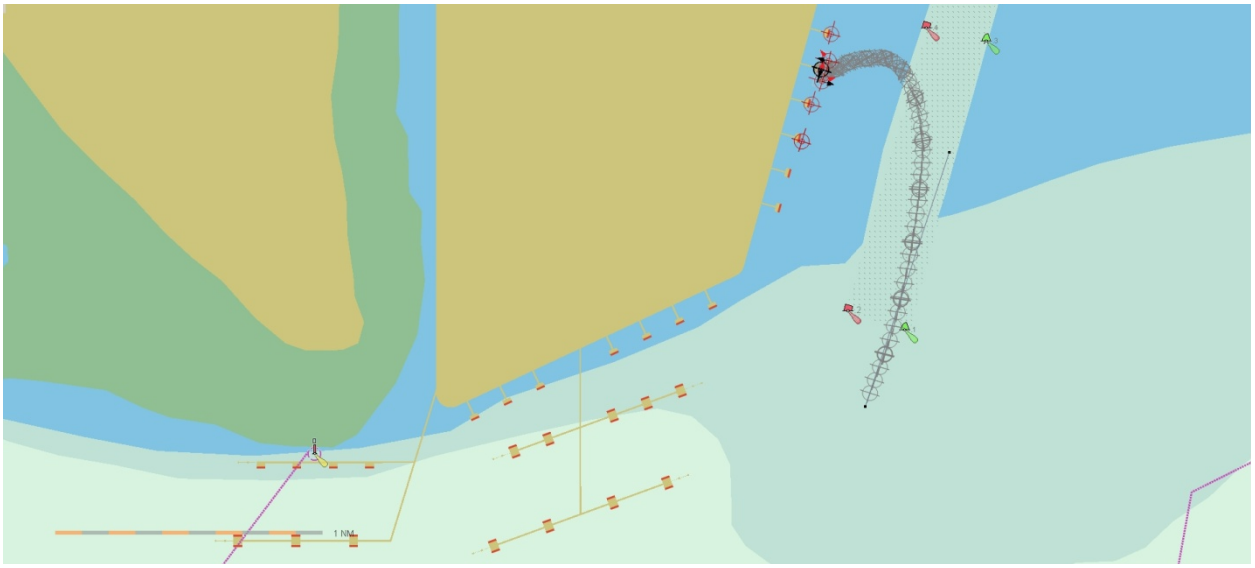


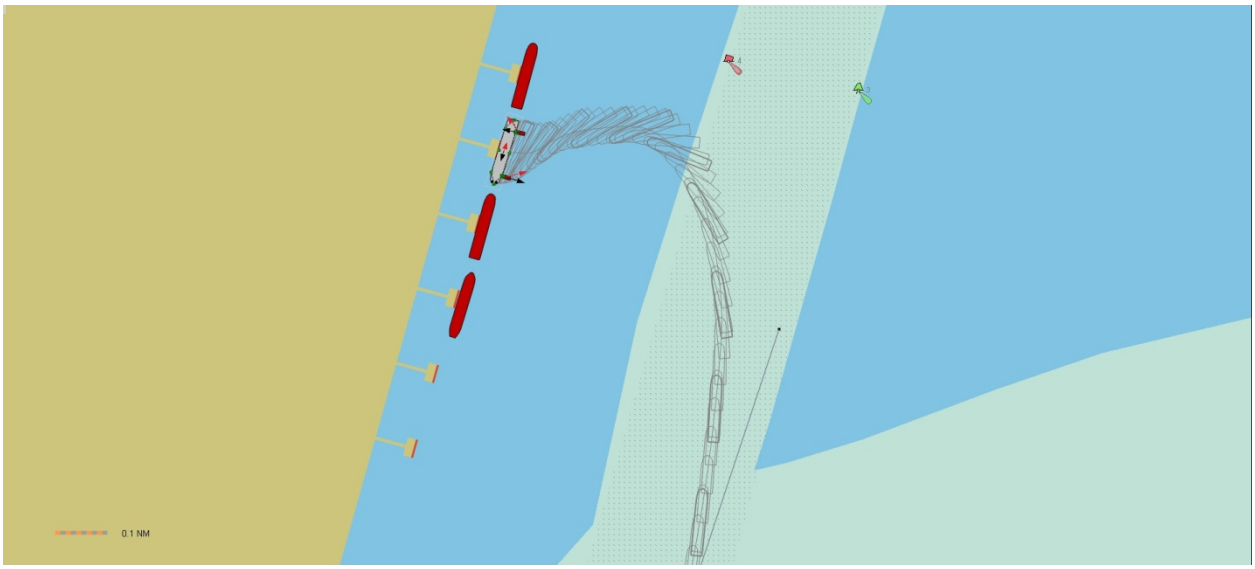


Initial Heading	: 018^0	Current	: West-going - Spring (207^0 x 0.1 knot)
Initial Speed	: 6 knot	Wind	: 160^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 25 minutes		

This run was similar to Run 121 except for the wind direction, the effect of which has to be managed carefully.

Run 124 Ballast Tanker (60,000 DWT) Arrival Berth 230

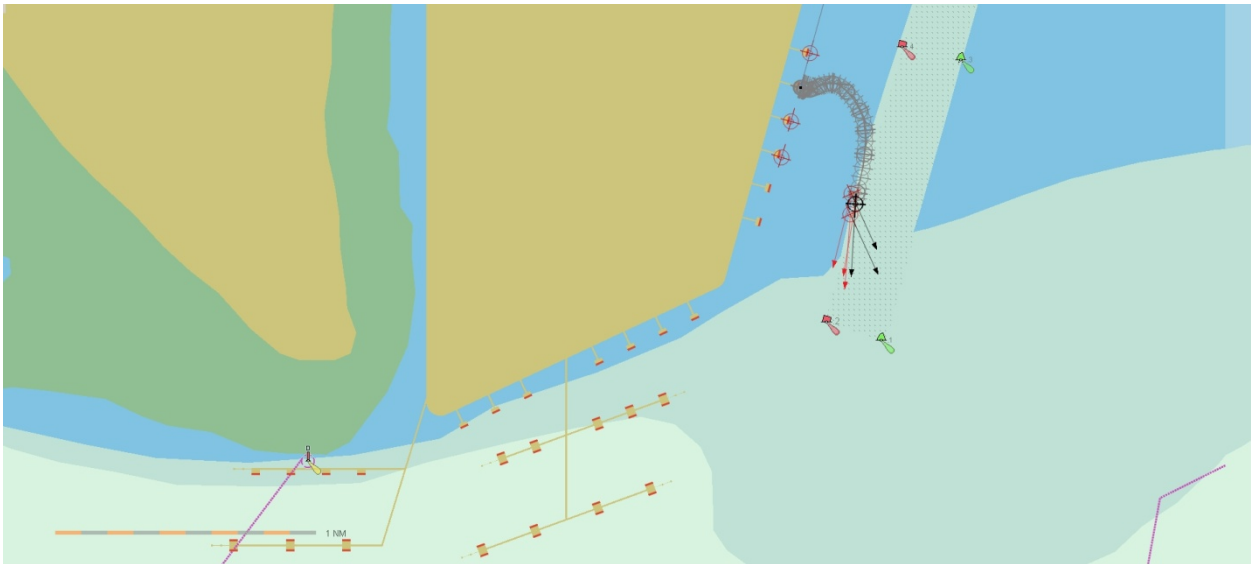


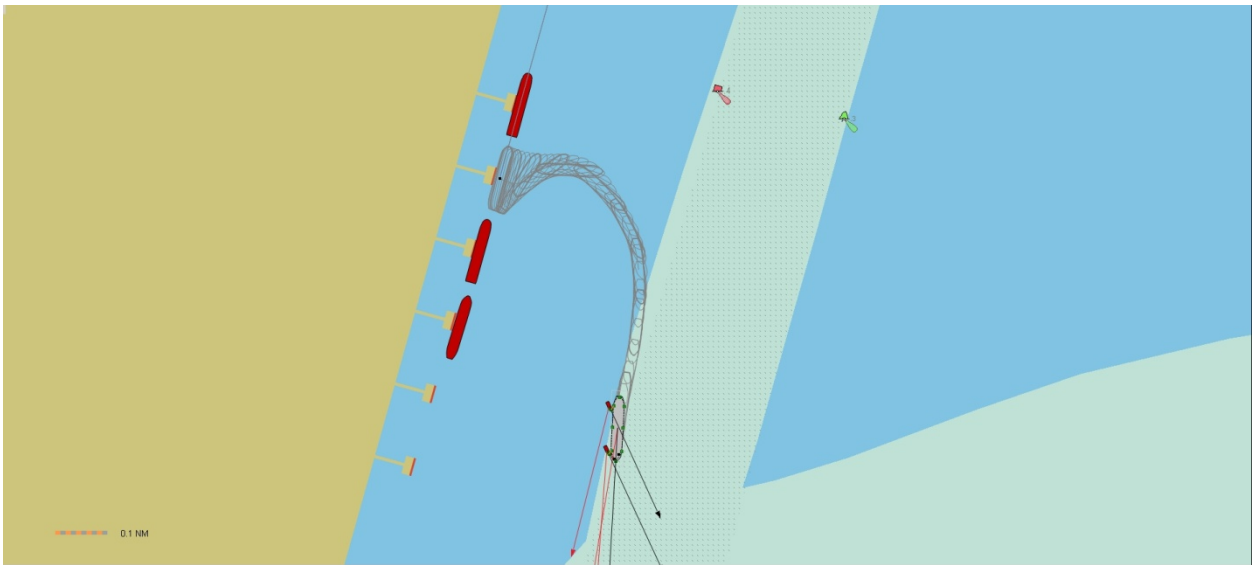


Initial Heading	: 018^0	Current	: East-going - Spring (020^0 x 0.5 knots)
Initial Speed	: 6 knot	Wind	: 160^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 26 minutes		

This run is similar to Run 122 except for the wind direction, the effect of which was challenging while making the U-turn but was manageable.

Run 125 Laden Tanker (60,000 DWT) Departure Berth 230



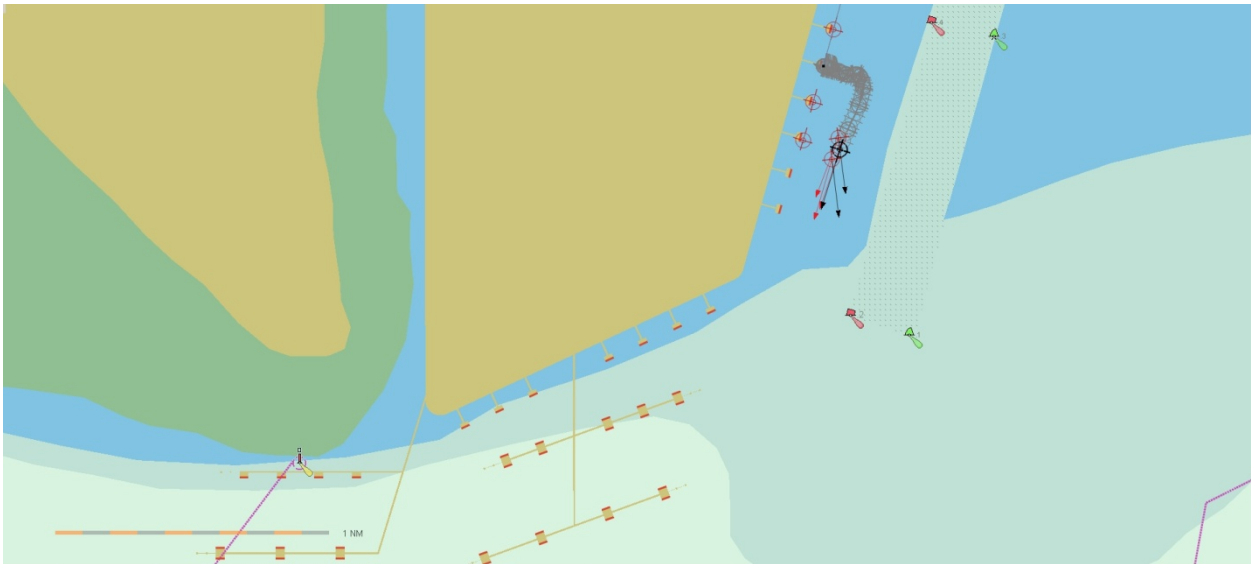


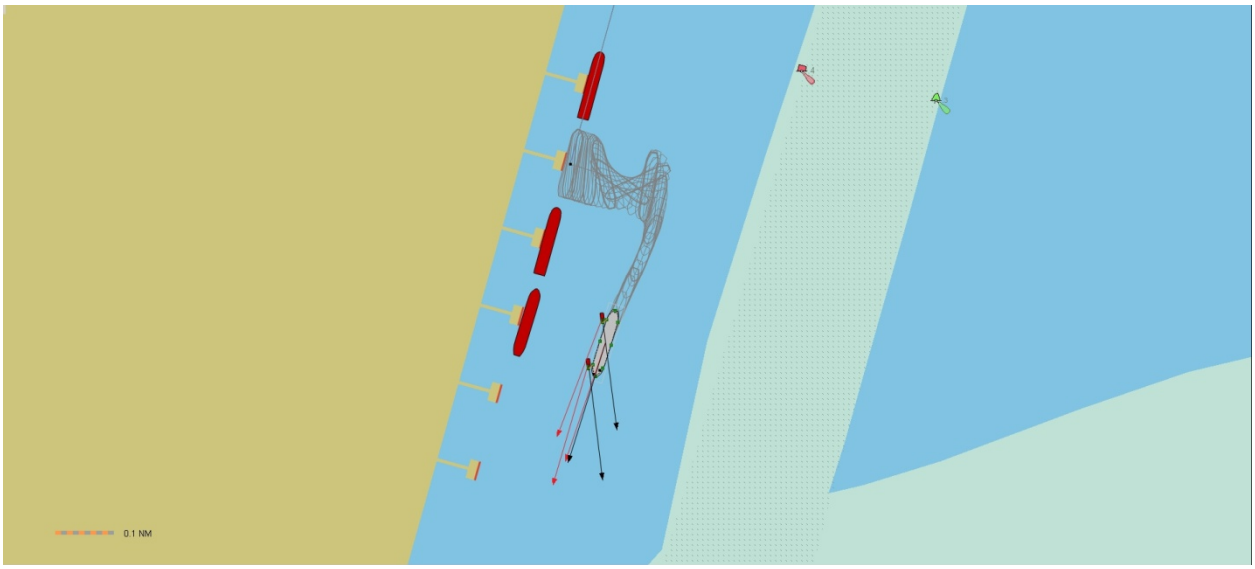
Initial Heading	: 015.5^0	Current	: West-going - Spring (207^0 x 0.1 knot)
Initial Speed	: 0 knot	Wind	: 340^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 21 minutes		

The vessel was unberthed using the 2 tugs to pull her off the berth, with the bow coming out slightly faster than the stern. This was to allow the current to set her to starboard. Then she was swung to starboard when she was clear of the berth.

The degree of safety was good and there were sufficient reserve power resources to cope with any misjudgements and equipment failures.

Run 126 Laden Tanker (60,000 DWT) Departure Berth 230



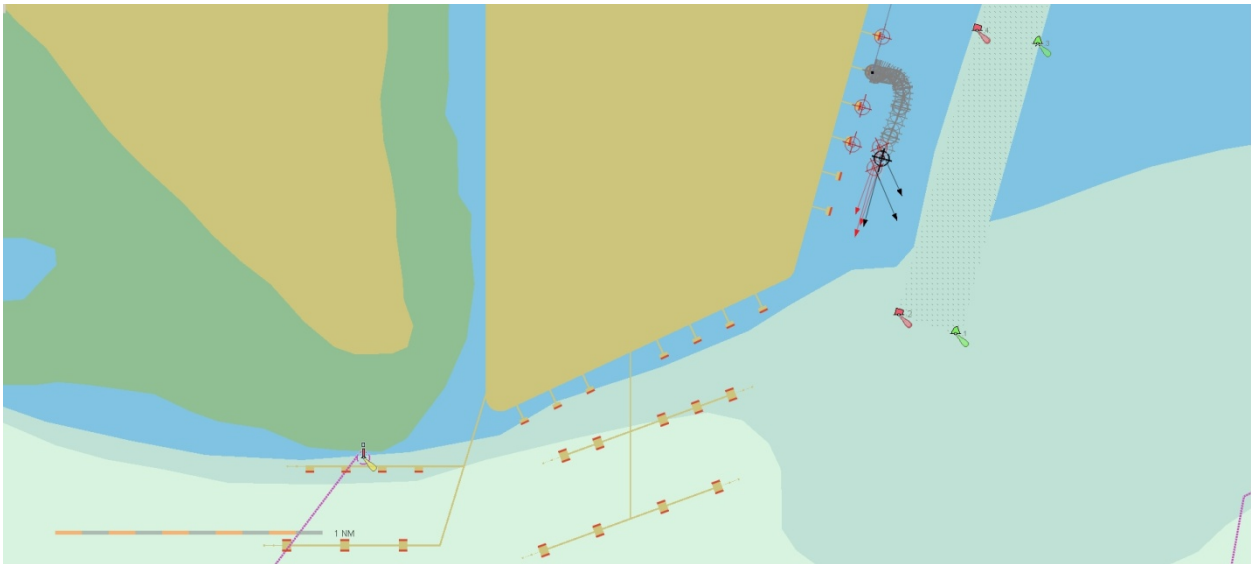


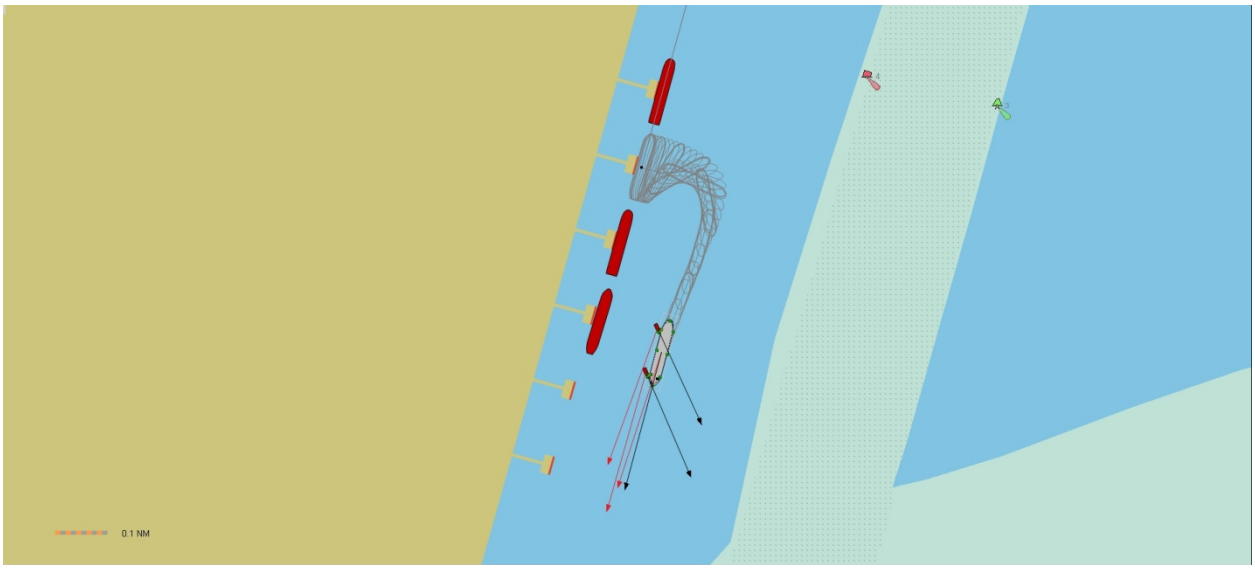
Initial Heading	: 015.5^0	Current	: East-going - Spring (020^0 x 0.5 knots)
Initial Speed	: 0 knot	Wind	: 340^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 22 minutes		

The vessel was unberthed using the 2 tugs to pull her off the berth, with the stern coming out slightly faster than the bow. This was to allow the current to set her to starboard. Then she was swung to port when she was well clear of the berth.

The degree of safety was good and there were sufficient reserve power resources to cope with any misjudgements and equipment failures.

Run 127 Laden Tanker (60,000 DWT) Departure Berth 230

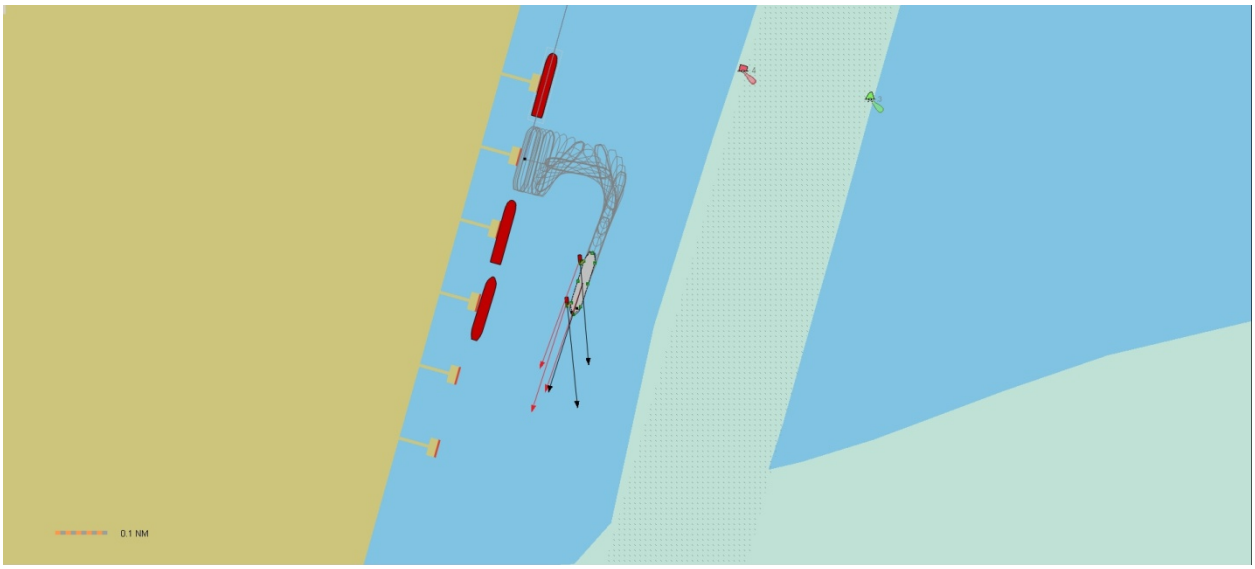




Initial Heading	: 015.5^0	Current	: West-going - Spring (207^0 x 0.1 knot)
Initial Speed	: 0 knot	Wind	: 160^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 18 minutes		

This run is similar to Run 125 except for the wind direction, the effect of which is negligible as the tanker is fully loaded.

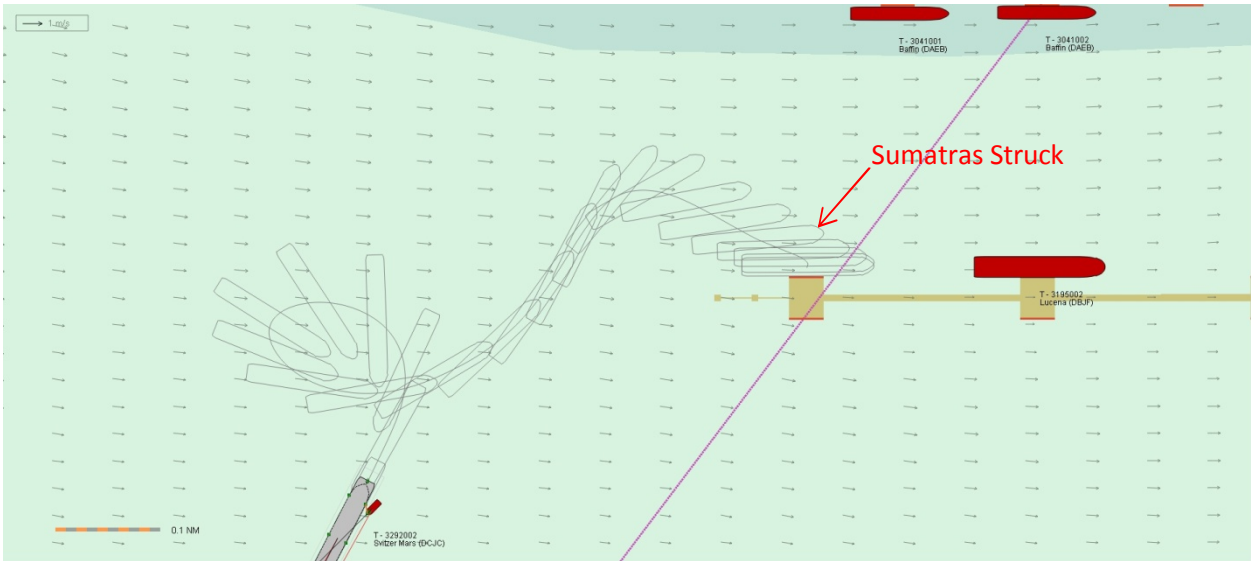
Run 128 Laden Tanker (60,000 DWT) Departure Berth 230



Initial Heading	: 015.5^0	Current	: East-going – Spring (020^0 x 0.5 knots)
Initial Speed	: 0 knot	Wind	: 160^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Duration of Run	: 16 minutes		

This run is similar to Run 1126 except for the wind direction, the effect of which is negligible as the tanker is fully loaded.

Run 129 Ballast Tanker (80,000 DWT) Departure Berth 106

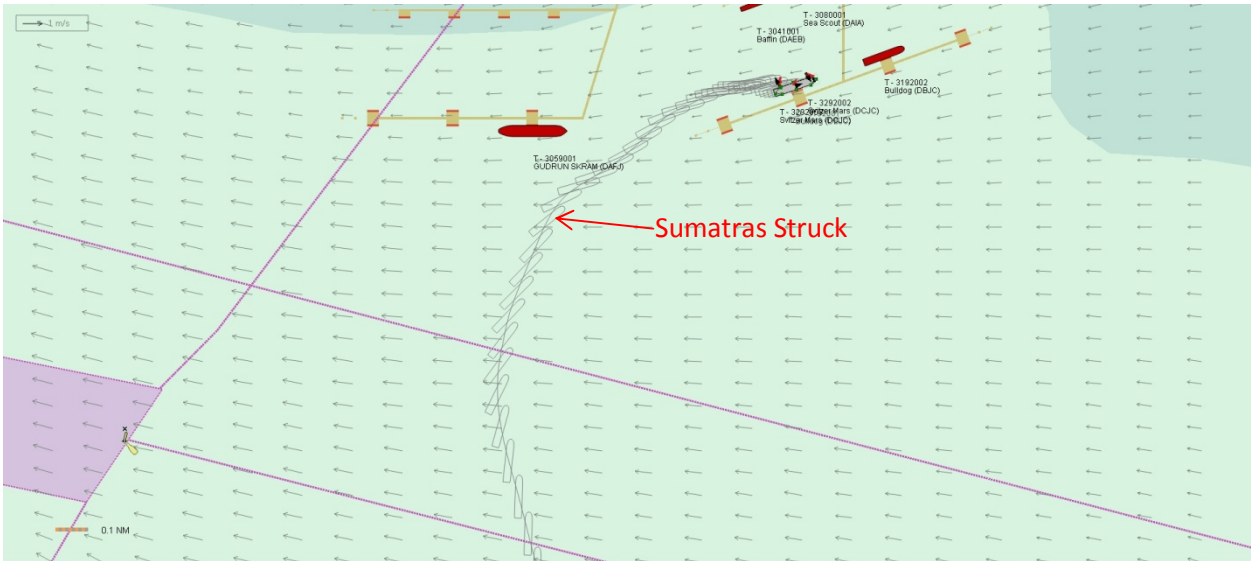


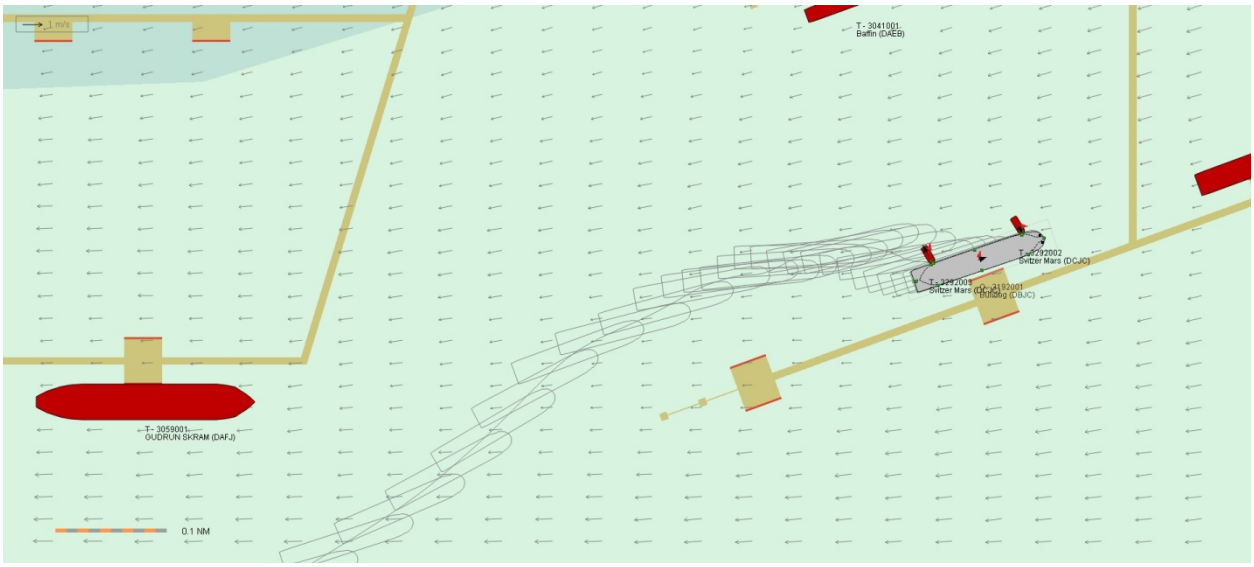
Initial Heading	: 090^0	Current	: East-going - Spring (094^0 x 1.4 knots)
Initial Speed	: 0 knot	Wind	: 160^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Crisis	: Sumatras (180^0 x 30 knots)		
Duration of Run	: 24 minutes		

The Sumatras struck when the vessel was about 50 metres away from the berth. To mitigate the effect of the strong winds, the aft tug was used to push the stern of the vessel while continuing to back the vessel westwards. As the tug could control the vessel with 25% power, it was decided to increase the wind speed to 50 knots to test the limits. The maximum power used was 75% to back the vessel out sufficiently before swinging her around to head into the wind.

For up to 30 knots wind, the degree of safety was adequate and there were sufficient reserve power resources to cope with the doubling of the wind force and any misjudgements. However, it is recommended that Full Mission Shiphandling Simulation Studies and/or Training are carried out. This is because a 2D Study do not have the effects of rain and poor visibility and is dependent on instruments which are reliable and accurate. Onboard ships, some instruments may not be available or if available, may not be working, accurate or reliable.

Run 130 Ballast Tanker (60,000 DWT) Arrival Berth 206



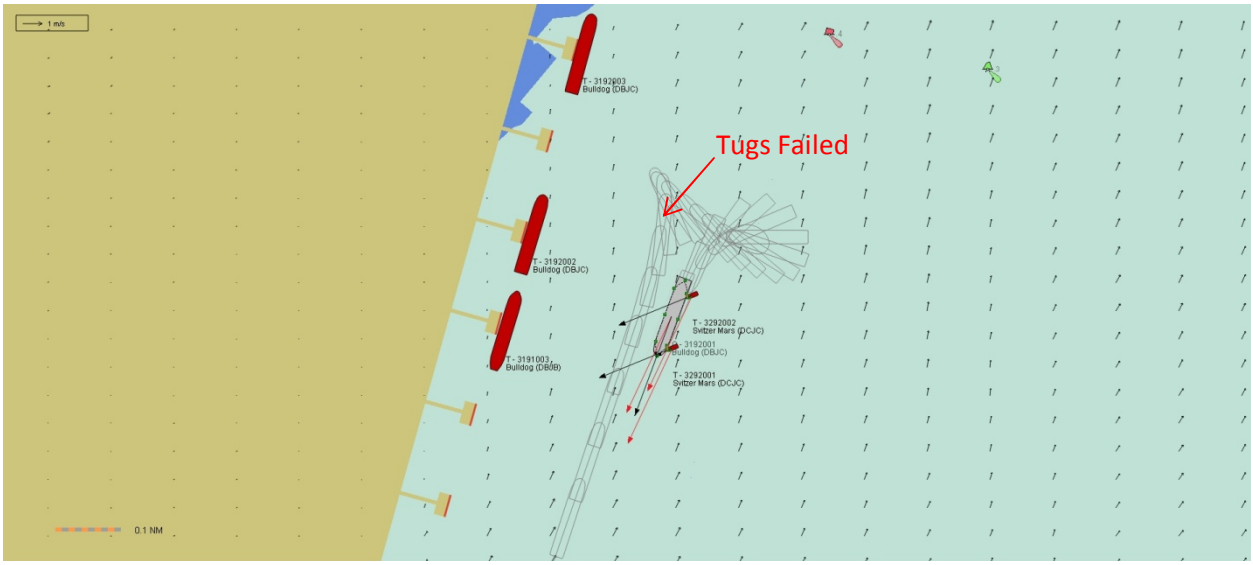


Initial Heading	: 360^0	Current	: West-going - Spring (261^0 x 1.1 knots)
Initial Speed	: 5 knot	Wind	: 160^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Crisis	: Sumatras (180^0 x 30 knots)		
Duration of Run	: 43 minutes		

The Sumatras struck when the vessel was about 500 metres away from the VLCC at berth 101. The vessel was turned to starboard using helm and engines. Then the vessel was manoeuvred to her berth. The tugs were able to control the vessel with up to 25% power, from the onset of the Sumatras until she is off the berth to run mooring lines.

The degree of safety was adequate and there were sufficient reserve power resources to cope with the doubling of the wind force and any misjudgements. However, it is recommended that Full Mission Shiphandling Simulation Studies and/or Training are carried out. This is because a 2D Study do not have the effects of rain and poor visibility and is dependent on instruments which are reliable and accurate. Onboard ships, some instruments may not be available or if available, may not be working, accurate or reliable.

Run 131 Ballast Tanker (60,000 DWT) Arrival Berth 230

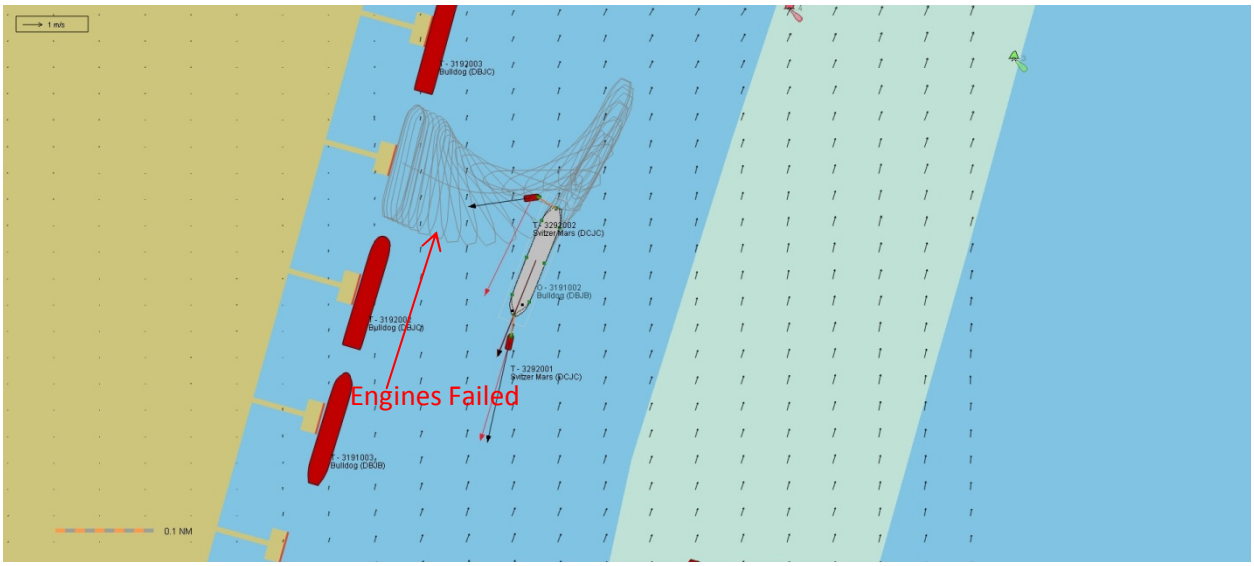


Initial Heading	: 018^0	Current	: East-going - Spring (016^0 x 0.8 knots)
Initial Speed	: 5 knot	Wind	: 160^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Crisis	: Tugs Failure; Forward one followed soon after by the aft tug.		
Duration of Run	: 25 minutes		

The forward tug suffered a blackout about 2 minutes after she started pulling the vessel's bow to port. About a minute later, the aft tug also suffered a blackout. The abort manoeuvre was carried out using only the vessel's helm and engines. The anchor was not required as there were sufficient room for her to swing around to head out.

Although the crisis was handled successfully, we must bear in mind that there are occasions where aborting the manoeuvre may not be possible e.g. when tug/s failed at the point when the vessel is about 20 metres from the berth with fresh onshore winds. In such cases, effort must still be made to minimise damage.

Run 132 Laden Tanker (60,000 DWT) Departure Berth 230



Initial Heading	: 015.5^0	Current	: East-going - Spring (016^0 x 0.8 knots)
Initial Speed	: 0 knot	Wind	: 340^0 x 15 knots
Tugs	: 2 x 60 tonne bollard pull ASD		
Crisis	: Engines Failure		
Duration of Run	: 32 minutes		

The vessel's engines could not start when it was required. It happened when the vessel was about 50 metres away from the berth, so the unberthing manoeuvre had to be continued with only the two tugs. The manoeuvre could be carried out safely with the tugs using a maximum of 50% power.

APPENDIX III

Definitions

Definitions

1 Wind in the Simulator

In the simulator, the wind speed is given in "meteorological wind speed" which corresponds to a 10 minutes mean wind at 10 metre height.

2 End Berths

An end berth is one that is adjacent to a cross berth or jetty, usually at an angle of about 90 degrees to each other. E.g. berth 104, 106, 108, 204, 207 and 210.

Berth 201 would be considered a restricted berth for vessels with draft >17 metres.

3 Sumatras

Sumatras are lines of thunderstorms which usually occur between March and November each year. These squalls (lines of thunderstorms) develop at night over Sumatra or the Malacca Straits and move east towards Singapore and Peninsular Malaysia usually during the pre-dawn and early morning. They are often characterised by sudden onset of strong gusty surface winds and heavy rain lasting from 1 to 2 hours as they move across the island. Maximum gusts of up to 26 metres per second (93 km/h) have been recorded during the passage of a Sumatra squall (Gusts are temporary increase in wind speed).
(*Source: http://app2.nea.gov.sg/training-knowledge-hub/weather-climate/sumatras*)

4 Duration of Run

The duration of run is the actual time taken from the start of the simulation to the time it was terminated when the vessel is in a safe position for sending mooring lines (for berthing scenario) or when she is in a safe position for her outbound passage. It does not take into account the time taken for:

a) Setting up of the scenario;
b) Briefing and/or passage planning (of the manoeuvre); and
c) Debriefing, comments and evaluation of the completed manoeuvre.