Annex 14.3

Simulation Study at South Tyneside College on the Proposed Multi User Terminal on the River Humber

(BMT Isis)

BMT ARGOSS

Simulation Study at South Tyneside College on the Proposed Multi User Terminal on the River Humber
for
ABLE UK

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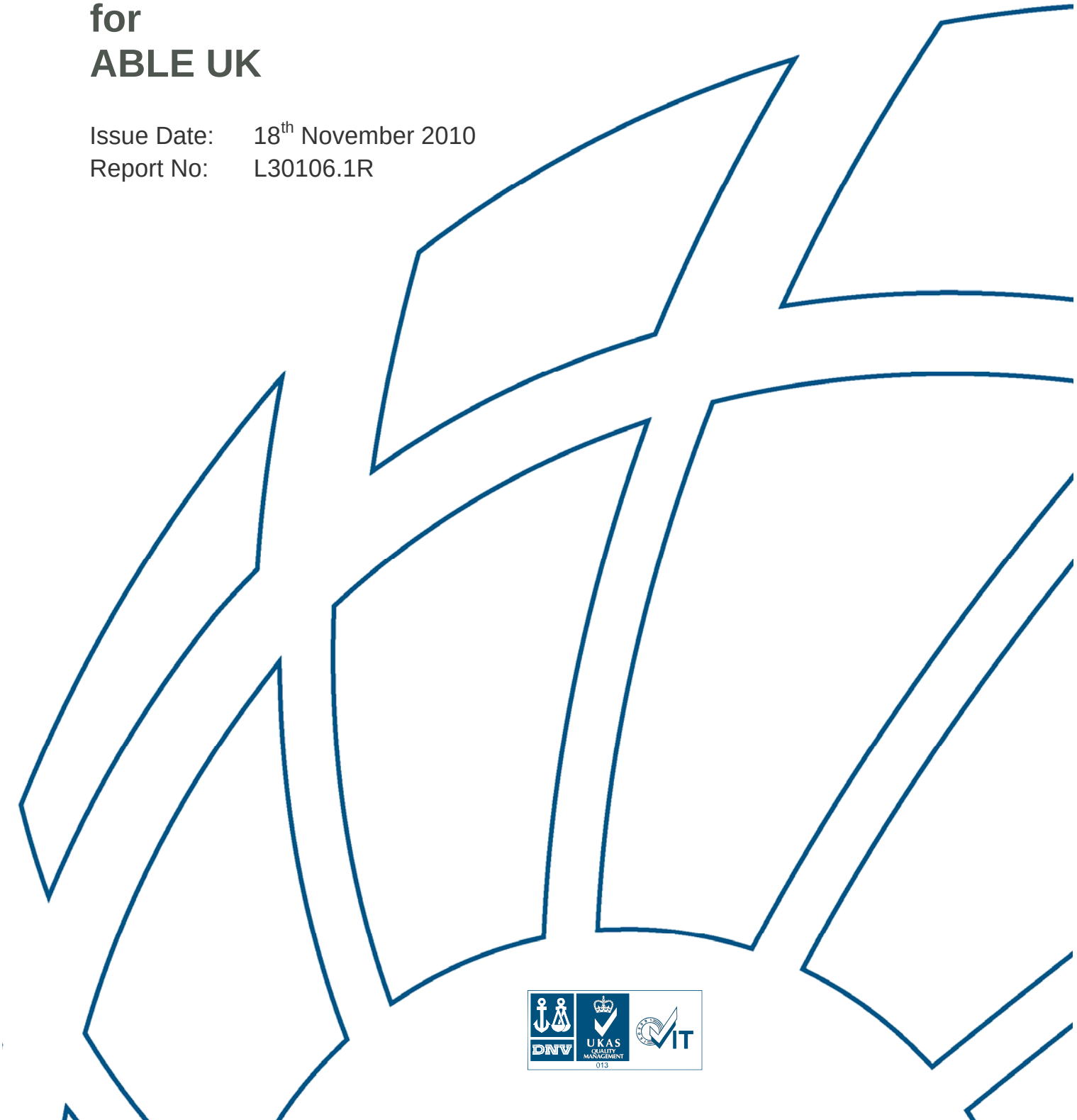

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1 TERMS OF REFERENCE

BMT ARGOSS Ltd (BMT) was instructed by ABLE UK (ABLE) to attend a two day simulation workshop at South Tyneside College (STC) in order to assess the feasibility of berthing and un-berthing at a proposed multi user terminal on the River Humber.

The workshop was attended by an experienced member of BMT staff with the simulations being conducted using STC's Kongsberg Full Mission Bridge simulator. This report describes the methodology adopted for this project and includes a DVD of the simulation results and appropriate recommendations for this project.

2 OBJECTIVES OF THE STUDY

The aim of the study was to test the feasibility of the proposed multi user terminal and to assess the entry and departure of various vessels at the adjacent berths. The objectives as indicated by Capt Colin Harrison (ABLE UK) are shown below:

- Objective 1 – To assess the berthing/un-berthing of ferries and larger vessels at HST, at the North end of the proposed new quay.
- Objective 2 – Assess the berthing/un-berthing at ABLE UK's Northern Berth.
- Objective 3 – Assess the berthing/un-berthing at ABLE UK's Southern Berth with a vessel occupying Killingholme Oil Jetty.
- Objective 4 – Assess the Berthing/un-berthing of wind off shore vessels.
- Objective 5 – Determine the turning circle area

3 METHODOLOGY

The study was completed using STC's Kongsberg simulator with members of ABP Humber Pilots running the simulations. The Kongsberg simulator is a preferred method of training by ABP Humber Pilots who have adapted the Humber database of the years to include accurate current modelling. The simulator operates in real time using 'hands-on' control (man-in-the-loop).

The Kongsberg database was built using engineering drawings provided to STC and the simulator provided an interactive back-drop to the simulations. It combined a high-fidelity mathematical ship model with 3-D 'out of the window' visuals and detailed environmental data to provide accurate, dynamic simulation of marine operations. A narrative and DVD of each simulation is provided for presentation to interested parties.

The following sections describe the work undertaken in more detail.

3.1 The Electronic Chart

The database was created by STC with the sites bathymetry, approach channel turning circles, berths and berthing pockets (as proposed) were defined by the engineering drawings provided by ABLE UK.

Plan views of the Kongsberg database can be obtained by Mr Chris Thompson (STC)

3.2 Current Modelling

In order to produce an accurate set of simulations based on the proposed terminal's capabilities, STC used very detailed hydrodynamic modelling current information provided by ABP Humber Pilots and ABLE UK. It was however evident that the latest bathymetry based on the new terminal from JBA consultants was not provided to STC for these simulations.

The height of tide and current information can be seen in the simulation matrix provided in Section 3.3.

3.3 Vessel Mathematical Models

STC provides mathematical modelling of ships and other floating craft in 6 Degrees of Freedom (DoF), namely surge, sway, yaw, heave, pitch and roll.

ABP Humber Pilots in consultation with ABLE UK, selected suitable vessels from the available STC library vessel list for the simulations. These vessels are assumed to be fully validated and a list of the ship models, with their principal particulars, is provided in Table 3.1 below.

Ship Name	*Ship Type*	*Length Overall (m)*	*Breadth (m)*	*(DWT)*
Mazarine	RoRo	195m	26.2m	14,552
Clementine	RoRo	162.49m	25.64m	9,655
Alpha Italia	Tanker	247m	43m	80,124
POS Dignity	Bulk Carrier	225m	32m	45,420

Table 3.1: Vessel Model Principal Particulars

3.4 Use of Tugs

STC's Kongsberg system allows for fully validated tugs to be included within the simulations. The tugs were controlled by Mr Chris Thompson through a VHF connection with the Pilot and were manoeuvred according to standard ABP Humber tug operating procedures.

A list of the tugs used can be seen below in Table 3.2.

Tug	Operator	Bollard Pull (Tonnes)	Propulsion
Svitzer Laura	Svitzer	75	ASD
Svitzer Debbie	Svitzer	50	ASD
No 4	Svitzer	70	ASD
Svitzer Josephine	Svitzer	50	ASD

Table 3.2: Tug suite capability used during the River Humber simulations

3.3 The Simulation Matrix

The simulation matrix was made up of 11 scenarios using the most extreme weather and current conditions. The simulations incorporated a number of different manoeuvres in order to quickly ascertain operational limits. The table below shows the simulation matrix for the vessels used.

Run	Operation	Ship	Wind		Current
			Dir	Spd	
1	Departure (HST No 5 Berth)	Mazarine	SW	15kts	HW + 4hrs
2	Departure (HST No 5 Berth)	Mazarine	SW	15kts	HW + 4hrs
3	Arrival (HST No 5 Berth)	Mazarine	SW	15kts	HW – 5hrs
4	Arrival (HST No 6 Berth)	Clementine	SW	15kts	HW + 2hrs
5	Departure (HST No 6 Berth)	Clementine	NE	20kts	HW + 2hrs 42mins
6	Arrival (S.Killingholme Port side)	Alpha Italia	SW	5 to 10kts	HW – 30mins
7	Departure (S.Killingholme Port Side)	Alpha Italia	SW	5 to 10kts	HW – 30mins
8	Departure (S.Killingholme Port Side)	Alpha Italia	SW	10kts	HW – 1hr
9	Departure (ABLE South)	Alpha Italia	SW	20kts	HW – 90mins
10	Departure (ABLE South)	Alpha Italia	SW	20kts	HW – 90mins
11	Departure (ABLE North)	POS Dignity	SE	25kts	HW – 2hrs

Table 3.3: Simulation run matrix

3.4 Simulation Methodology

The two day workshop commenced with a review of the objectives. Present at the meeting were; James Norwood (BMT), Capt Philip Pannett (ABP), Capt David Hunter (ABP), Capt Colin Harrison (ABLE UK), Capt Philip Cowling (ABP) and Capt Chris Thompson (STC).

Capt Philip Pannett and Capt David Hunter ran the simulations from the main bridge simulator with Capt Chris Thompson and James Norwood observing from the instructor station. The tugs were controlled by Capt Chris Thompson through VHF communications with directions given by the two pilots.

Each run was set up with the met-ocean conditions and the ship's initial position, speed and course. The vessels initial speed, for the arrival, was set at around 3 - 4ts inside the dredged area. For departure manoeuvres, the simulations started with the vessel alongside the berth (stopped) and the speed was gradually increased as appropriate to the conditions.

At the end of each run, a run report form was completed. The run report forms are included in Appendices A. They present the difficulty of performing each manoeuvre as a means of comparison for the study. The contents of the report forms and the grading were completed upon the conclusion of each manoeuvre.

4 SIMULATION RESULTS

The run report forms for each run are presented in Appendices A. The simulation DVD has been provided to ABLE UK by STC.

5 KEY CONCLUSIONS & RECOMMENDATIONS

- It was evident that STC had not been provided with the latest current information from JBA Consultants and hence all the simulations were conducted on existing current conditions. It is imperative that up to date environmental conditions are used in the simulations in order to maintain a high validity of the results.

- From the initial simulations conducted on the HST Berth it was clear that in an ebb current the Pilot struggled to manoeuvre the vessel off the berth and stop it so as to then crab the vessel across the channel before proceeding ahead and passing the ABLE North berth at a safe distance. In the simulations the Pilot can be seen to manoeuvre clear of the berthed vessel on ABLE North but it should be made clear that the Pilot conducting the simulation was very experienced and he was unable to stop the vessel dead in the water after letting go his lines. From the bridge of the vessel, whilst alongside, the berthed Panamax vessel on ABLE North (between NP and PG buoy) is directly in his field of vision. By removing the extended North pier the Pilot would have a better field of vision to the River.

- Within the ABP Humber Pilotage Manual there is an exclusion of 400m around the HST berth. In discussion with Captain Phil Pannett, it was found that this was a self imposed exclusion zone made by HST owners to protect their berth and operations.

- It was evident that the angle of the berth had changed somewhat from previous drawings supplied to BMT and ABP Humber. In discussion with Captain Phil Cowling and Captain Phil Pannett, it was found that this new angle provided a much better line of approach to the HST berth and prevented a Panamax bulk carrier, berthed on the Northern limit of the ABLE berth (not between PG and NP buoy) from impeding the HST dredged approach channel. BMT would recommend to ABLE that this line of berth be passed to JBA Consultants as it could affect the current modelling within that area.

- It has been discussed within ABLE that a dredged depth of 11m be made to the approach channel of the proposed berth. In discussion with Captain Phil Pannett, Captain Colin Harrison and Captain Chris Thompson it was found that the proposed depth was not required due to draught and tidal constraints further down River of around 8.5m CD (Chart Datum). This 8.5m (CD) means that with a 5.8m MHWN (Mean High Water Neap) tide there will only be 14.3m of water and with a 1.5m - 2m UKC (Under Keel Clearance) ABP Humber pilots could only be expected to receive vessels of around 12.3 – 12.5m draught. So in order to reduce unnecessary dredging costs, BMT recommends that ABLE re-consider the dredged effort at their approach channel.

- Run 11 is a crucial simulation in that a panamax bulk carrier departed ABLE North at HW – 2hrs. This would be a regular movement for vessels of this size. As soon as the vessel swung to port she was set to the North and her total footprint from alongside to finally swung and coming ahead on a heading of 135 was around 450m. This manoeuvre was quite safe and the vessel gave the HST berth a wide berth. However, when BMT's James Norwood suggested super imposing this vessels track to the North where a Bulk Carrier had just left the ABLE berth between PG and NP buoy, the vessel was less than a 150m off the HST Berth and well within the enforced 400m exclusion zone.

- During discussions with Richard Cram (ABLE UK) it was understood that the new terminal should include 6 berths of 200m each. With the suggested removal of the terminal between NP and PG buoy, due to its close proximity to the HST Berth, this would reduce the berth frontage by around 150 – 200m. In response to this it was suggested by Captain Phil Pannett that two berths be indented into the current design at the Northern end and Southern end of the ABLE terminal. This would maintain the 6 berth requirement and increase terminal frontage by a further 150m to 200m on the proposed 1200m requirement without affecting adjacent terminal users. BMT would recommend that vessels using these two berths be highly manoeuvrable RoRo vessels or DP ships.

- BMT would recommend that a further set of runs be conducted on the new terminal with the indented roRo berths to ascertain the operational limits and capabilities of the two new berths. If this design is found to be a possible alternative, current modelling and sedimentation modelling should be undertaken. BMT would also recommend that further simulation testing be carried out on the turning circle so as to determine an optimal design.

Appendix A

Simulation Run Reports

Project:	Humber Marine Studies	**Job No.:**	L30106	**Captain/Pilot:**	Capt Phil Pannett
Subject:	PC Rembrandt Simulation Study for ABLE UK				
Date:	19/10/2010	**Time:**	**1000**	**Site:**	South Tyneside College, South Shields
Run No. 1					
	The Pilot manoeuvred the vessel off the berth using the bow thrust and assistance from the South Westerly wind. The stern required stbd wheel and a kick of the engine to assist it off the berth. The vessel manoeuvred off the berth with ease and there was a safe distance left between us and the vessel on berth 2. It was important that the Pilot did not gather to much headway as he wanted to crab into the channel once the stern was safely clear of the bow of the vessel on Berth No2. With a following current the Pilot struggled to slow the vessel down once clear and she crabbed very slowly to port with a headway of 2kts ahead. This headway also restricted the effectiveness of the bow thrust. The vessel past the berthed vessel at a safe distance but on completion of the run the Pilot mentioned that the limitations of the vessel used was too restrictive and that the vessel in real life would have more stern power allowing him to stop the vessel more quickly in a following current of 4kts and hence give him more manoeuvrability and control in this manoeuvre.				

Project:	Humber Marine Studies	**Job No.:**	L30106	**Captain/Pilot:**	Capt Phil Pannett
Subject:	PC Rembrandt Simulation Study for ABLE UK				
Date:	19/10/2010	**Time:**	**1030**	**Site:**	South Tyneside College, South Shields
Run No. 2					
	Same scenario as above with an amended ship model that has the same power ahead as astern. As soon as the vessel lets go her lines she gathers momentum very quickly. It is important that the Pilot manoeuvres the vessel off the berth to stop her being dragged down the berth. As with the above scenario, the stbd qtr closed on the berth and had to be assisted off the berth with a combination of stbd rudder, bow thruster, stern thrust and engine. The Pilot needs to be careful that he does not get the current on the port qtr as this would result in it swinging into the berth. With the stern clear of the vessel on Berth No2 the Pilot was able to stop the vessel in the following current, position the current on the stbd qtr and assist him in crabbing the vessel out to port. This manoeuvre allowed the Pilto to keep the vessel 200m off the berthed Panamax Bulker on the Northern edge of the ABLE berth.				

Project:	Humber Marine Studies	**Job No.:**	L30106	**Captain/Pilot:**	Capt Phil Pannett
Subject:	PC Rembrandt Simulation Study for ABLE UK				
Date:	19/10/2010	**Time:**	**1115**	**Site:**	South Tyneside College, South Shields
Run No. 3					
	Transit past the ABLE berth was conducted at a safe distance and at ease with a 50T BP tug in attendance. As the vessel approached the swing the Pilot positioned the tug on the port side to assist him if required in the turn. With a following current the vessel was slowed early on and then swung when adjacent to the second vessel berthed from the North edge of the berth. The vessel was swung comfortably within the confines of the dredged channel with the tug remaining on the port bow. With a flood current the vessel was set to the North West and was swung surprisingly quickly having completed an 180 deg turn before reaching the edge of the North tip of the ABLE jetty. With the vessel into current she was manoeuvred comfortably astern towards the berth but care needs to be taken by the Pilot that he manoeuvres the current around the Berth to assist him in crabbing the vessel towards the Berth. The tug was positioned on the port bow to assist the vessel alongside when in the berth pocket and prevent the vessel being set on to the berthed vessel on No5 Berth when the vessels speed reduced and the South Westerly would take more effect. As the vessel approached the current on the bow affected the approach and the Pilot manoeuvred the vessel to the South East to align the vessel for a second approach. To achieve this he crabbed the vessel across the entrance to Berth No 1 and 2 by using the current on the port bow and ferry gliding with the engine and rudder to the South West. Once the stern was aligned with the berth of No5 the Pilot manoeuvred the vessel astern with ease with the tug positioned on the port side to assist if required. This scenario proved that if the approach to the berth went wrong for any reason, the Pilot was able to take control, recover the situation and make a second approach without the vessel getting into danger.				

Project:	Humber Marine Studies	**Job No.:**	L30106	**Captain/Pilot:**	Capt Phil Pannett
Subject:	PC Rembrandt Simulation Study for ABLE UK				
Date:	19/10/2010	**Time:**	**1315**	**Site:**	South Tyneside College, South Shields
Run No. 4					
	Transit towards the berth was conducted with ease with the vessel passing the berthed vessels at a safe distance. The vessel on the Northern Berth of the ABLE jetty was setup with two tugs alongside with a 30m LOA. This meant the Pilot had to reduce speed and also give this vessel a wider berth than normal due to tug operations. The Pilot was able to manoeuvre to the East edge of the dredged channel without incident and reduce speed to around 2kts under control before swinging the vessel to stbd 335m North East of the ABLE berth. The swing to stbd was conducted with ease with minimal set to the South East and the Pilot manoeuvred the vessel aft with ease using the current on the port qtr to assist the Pilot in crabbing the vessel towards No6 Berth. The Pilot needs to carefully monitor this crabbing to stbd to make sure that he can check it once aligned with the berth as the vessel could gather momentum and run aground to the South West. With the current directly on the stern the Pilot was able to manoeuvre the vessel into No 6 Berth pocket but as the vessel was 30m off the berth the current managed to take affect on the stbd qtr and the stern was soon set towards the jetty. The Pilot was able to manoeuvre back off the berth, recover the situation and make a second approach. It proved difficult on the second approach to align the stern due to the South Westerly wind and the current on the port qtr but by mix matching engines the Pilot was able to berth the vessel.				

Project:	Humber Marine Studies	**Job No.:**	L30106	**Captain/Pilot:**	Capt Phil Cowling
Subject:	PC Rembrandt Simulation Study for ABLE UK				
Date:	19/10/2010	**Time:**	**1440**	**Site:**	South Tyneside College, South Shields
Run No. 5					
	With a 50T BP tug on the stbd side (standby) the vessel was set quickly off the berth when the vessel let go her lines. The stern moved off the berth quicker than the bow and as the vessel came ahead, the Pilot used stbd helm to prevent the vessel from veering to port and seeking the wind. The Pilot then used stbd helm to stop the stern being set onto the drying height by the current acting on the port qtr, the Pilot could not turn to port and drive the vessel out due to the high probability of the vessel being set onto the ABLE jetty and the stern hitting the drying height. The Pilot therefore used the tug on the stbd bow to hold the vessel and once clear aft of the jetty, the Pilot configured his engines and propellers to crab the vessel across the current and into the dredged channel. Once the current was on the stbd qtr the vessel crabbed easily to port with the assistance of the tug on the stbd bow. However, the current on one occasion did manage to affect the port qtr again and this slowed the crab to port considerably until it was rectified. With the tug midships at this point the vessel was manoeuvred to the East of the dredged channel before the Pilot came ahead and realised the tug. It was evident that once clear of the berth it is tempting to make a dash for the dredged channel but this is the worst action to take as you will be set down on the ABLE berth.				

Project:	Humber Marine Studies	**Job No.:**	L30106	**Captain/Pilot:**	Capt David Hunter
Subject:	PC Rembrandt Simulation Study for ABLE UK				
Date:	19/10/2010	**Time:**	**1500**	**Site:**	South Tyneside College, South Shields
Run No. 6					
	With four tugs attached (one centre lead fwd, one centre lead aft and two on the stbd side) the vessel was manoeuvred up the channel with the aft tug at 50% power to assist manoeuvring and reduce the vessels headway due to the following current. With the deeper draught the vessel was affected more by the current rather than the wind. The Pilot manoeuvred the vessel safely towards the South Killingholme jetty keeping the vessel 150m off the Immingham Gas Terminal. Due to the slow response of the engines and rudder at this speed the Pilot used the tugs to reduce speed and the fwd tug to direct the bow. It was evident from the close proximity of the ABLE jetty that the largest tug be situated aft on the tanker to exert more force in stopping the vessel if she comes in to quick or if the current sets her to the North East. Once 14m off the berth the heaving lines were thrown and the vessel positioned using the tugs before being pushed towards the jetty. From this simulation it was clear that the Pilot did not deviate from his standard approach due to the development.				

Project:	Humber Marine Studies	**Job No.:**	L30106	**Captain/Pilot:**	Capt Dave Hunter
Subject:	PC Rembrandt Simulation Study for ABLE UK				
Date:	19/10/2010	**Time:**	**1620**	**Site:**	South Tyneside College, South Shields
Run No. 7					
	With the tugs positioned as the above scenario the vessel let go all her lines and the Pilot used both fwd and aft tugs to pull the vessel off the berth with ease. The vessel was brought slowly off the berth and one of the fwd tugs was detached and manoeuvred onto the port bow ready for the swing to stbd. The pilot needed to be aware of the vessels bow on the ABLE jetty and this became even more apparent if he decided to swing early resulting in the stern hitting the berth. In this manoeuvre the pilot did close the stern of the vessel against the jetty to within 20m before checking this with both pilots, engine and stbd rudder. The Pilot manoeuvred into the channel to a point where the vessel port qtr was 80m on the berthed vessel before swinging to stbd. At this point the Pilot applied astern power to reduce headway in the turn and it was at this point that the aft tug was detached but remained in attendance. The swing was conducted with ease using two tugs fwd and one aft. Once swung all three remaining tugs were detached and the vessel came ahead into current				

Project:	Humber Marine Studies	**Job No.:**	L30106	**Captain/Pilot:**	Capt Dave Hunter
Subject:	PC Rembrandt Simulation Study for ABLE UK				
Date:	20/10/2010	**Time:**	**0930**	**Site:**	South Tyneside College, South Shields
Run No. 8					
	With four tugs positioned as above the Pilot let go all lines and then used the fwd and aft tug to pull the vessel off the berth. With 20% on both tugs the vessel pulled off the jetty parallel to the berth, The Pilot used the vessels engine at 'slow astern' to keep the vessel into current and prevent her being set to the North West. The Pilot needs to monitor the stern as the current acting on the port/stbd qtrs could result in the vessel sheering. Once safely off the berth the Pilot reconfigured his tugs so that the vessel would swing to port. Using port rudder and dead slow ahead the Pilot used the vessel to assist the tugs in the swing. Once perpendicular to the berth the Pilot ran on for 'half ahead' to get the vessels speed up into current. It was at this point that the aft tug was detached. Once swung the second aft tug was detached followed by the two fwd tugs. Manoeuvre was conducted safely.				

Project:	Humber Marine Studies	**Job No.:**	L30106	**Captain/Pilot:**	Capt Dave Hunter
Subject:	PC Rembrandt Simulation Study for ABLE UK				
Date:	20/10/2010	**Time:**	**1000**	**Site:**	South Tyneside College, South Shields
Run No. 9					
	With tugs positioned as before the Pilot used the fwd tugs to swing the bow off quicker than the stern. The Pilots intention was to swing stbd, a manoeuvre that requires careful monitoring of the port qtr to prevent it from hitting the berth. The Pilot manoeuvred the vessel safely off the berth with adequate distances between the vessel in front and the stern. The Pilot used the vessels engine to maintain station within the channel whilst the tugs swung the vessel safely to stbd. Once safely swung and the vessel had gathered enough headway, the Pilot started detaching the tugs except the aft tug which remained in escort mode for the passage to the Sea. The manoeuvre was conducted very tight towards the berth whilst at the same time remaining safe.				

Project:	Humber Marine Studies	**Job No.:**	L30106	**Captain/Pilot:**	Capt Dave Hunter
Subject:	PC Rembrandt Simulation Study for ABLE UK				
Date:	19/10/2010	**Time:**	**1130**	**Site:**	South Tyneside College, South Shields
Run No. 10					
	Same run as before but this time the Pilot swung the vessel to port. The vessel was brought off the berth with ease using minimal – medium (50% used) tug power. The aft tug was used to stem the vessel against the current and prevent the vessel being set to the North West. Increasing the power of the aft tugs the stern swung quicker off the berth until the current acting on the port qtr assisted the Pilot in swinging the vessel to port. The Pilot reconfigured his tugs during the swing and used the vessel engines and rudder (port 35) to assist the tugs. Once perpendicular to the berth the Pilot reduced power on the aft tugs, as the current was assisting him in turning the stern whilst the bow was pushed up into the current. It was at this point that the Pilot ran on for 'half ahead'. With the vessel on a Southerly heading to the aft tug was detached followed by the tug on the stbd shoulder. To assist in reducing the swing the fwd tug was positioned on the stbd bow whilst stbd helm was applied. Once steady all three tugs were detached and the vessel navigated down the channel with ease.				

Project:	Humber Marine Studies	**Job No.:**	L30106	**Captain/Pilot:**	Capt Dave Hunter
Subject:	PC Rembrandt Simulation Study for ABLE UK				
Date:	19/10/2010	**Time:**	**1315**	**Site:**	South Tyneside College, South Shields
Run No. 11					
	With 3 tugs attached stbd side the Pilot let go all lines. With a strong South Easterly wind and the flood current, the Pilot had to make sure that the vessel was not set to the North West and so when the fwd and aft tugs were used to pull the vessel off the berth, the aft tug was positioned towards the East. During the manoeuvre off the berth the Pilot repositioned the tug situated amidships ready for the swing. He manoeuvred the tug fwd in push mode ready for a port swing. It was clear once off the jetty that the environmentals had little effect on the ship and hence some sternway had gathered. The pilot repositioned the aft tug so that it was 90deg on the stbd qtr and came ahead 'Dead Slow Ahead' to reduce speed astern. Once the vessel had swung sufficiently for the current and wind to be on the port qtr the vessel swing to port increased rapidly and so the Pilot came astern to stop the vessel from driving into the berth. It was surprising, once on a heading of 283, the drift of the vessel caused by the environmentals. To minimise this it would be recommended that an extra tug be attached for the swing. Once perpendicular to the berth the Pilot used port wheel and 'Slow Ahead' to assist the tugs in swinging the vessel. Once swung, the fwd and aft tugs were detached with the tug on the stbd bow assisting the Pilot in stopping the swing so that the vessel could align itself with the channel.				