



## Using PIANC guidelines to develop an operating tool for planning ship manoeuvres

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### Overview

- Motivation
- Introduction
- Desk based reviews of:
  - Site characteristics
  - Existing operating parameters
  - Ships that operate at the terminal
- Assessment of tug requirements
- Navigation simulation study
- Determining operating limits
- Developing the operating tool



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## Motivation

- Ensure operability
- Reduce unnecessary shipping delays
- Maintain safe operations

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## Introduction

LNG terminal operator identified the need to modify operating parameters for ship manoeuvres.

The operator commissioned HR Wallingford to develop a new operating tool to aid decision making for ship manoeuvres.

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## Introduction

Previously, a basic table to identify operating parameters was used.


Parameters were determined in terms of wind speed and tug allocation.

Tug provision	Windage <9000m <sup>2</sup>	Windage >9000m <sup>2</sup>
3 tugs	20 knots	15 knots
4 tugs	25 knots	20 knots

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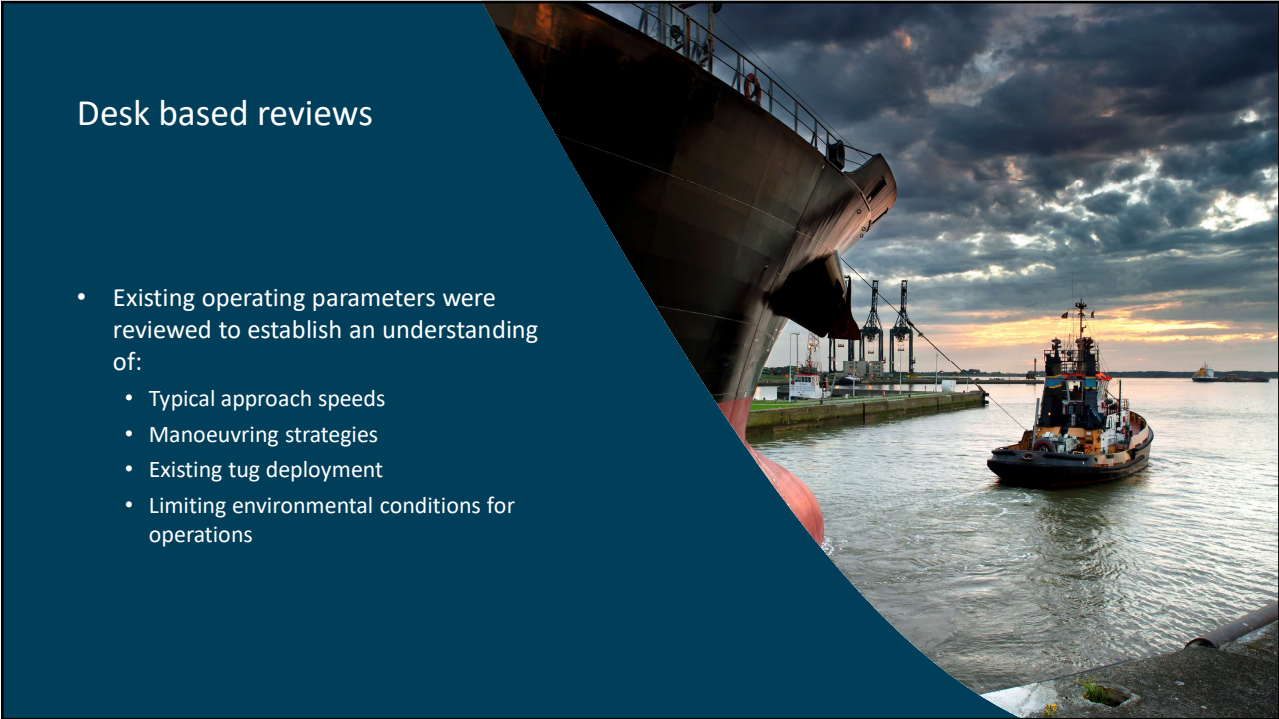
## Desk based reviews

- The site characteristics were reviewed to provide an understanding of:
  - Terminal parameters
  - Channel dimensions
  - Manoeuvring area dimensions
  - Berth location and parameters
  - Environmental conditions
  - Available tug fleet



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## Desk based reviews


- Existing operating parameters were reviewed to establish an understanding of:
  - Typical approach speeds
  - Manoeuvring strategies
  - Existing tug deployment
  - Limiting environmental conditions for operations


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### Desk based reviews

- Two ship groups used for operating parameters previously, based on lateral windage area
- Study identified parameters could be specific to ship type
- Review of design ships that operate at the terminal
  - Fleet assessment based on terminal ship call data
  - Determined ship types based on cargo containment type and capacity
  - Ship groups represented a range of ship size and windage areas


  
 4 x Spherical LNGCs

  
 3 x Membrane LNGCs

  
 2 x Sayaendo LNGCs

  
 1 x Condensate tanker

Membrane LNGCs 157,000m <sup>3</sup> to 170,000m <sup>3</sup> capacity		
Lateral windage (ballast) from:	6,900 m <sup>2</sup>	to 7,700 m <sup>2</sup>
Draught (laden) up to:	11.5 m	
Overall length up to:	300 m	



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## Assessment of tug requirements

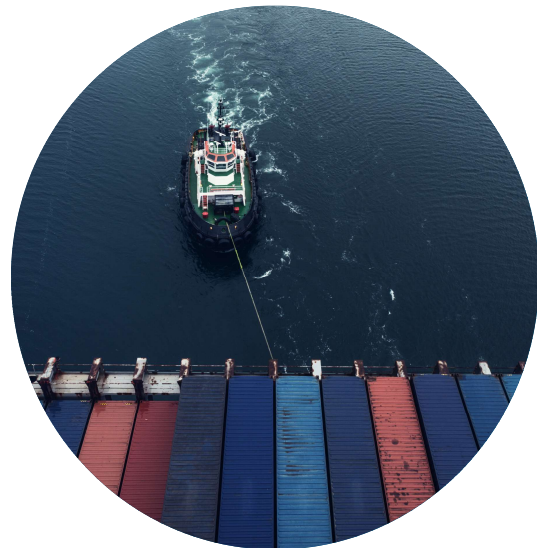
- Static calculation for each ship type
- Wind and current forces calculated using coefficients provided by OCIMF MEG4
- Wave forces also considered
- Total of calculated forces translated to required tug bollard pull for given wind and current speeds
- Required aggregate bollard pull calculated with the method detailed in PIANC guidelines report WG116 "Safety aspects affecting the berthing operations of tankers to oil and gas terminals"




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## Required bollard pull considerations

- Tug efficiency losses due to:
  - Operating in waves
  - Relative tow line angles
- Safety operation factor applied
  - Redundancy equal to the bollard pull of one tug




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## Outcome of tug requirements assessment

- Number of tugs required to hold ships against environment determined
- Maximum wind speed for manoeuvres with available tugs identified



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## Navigation simulation study

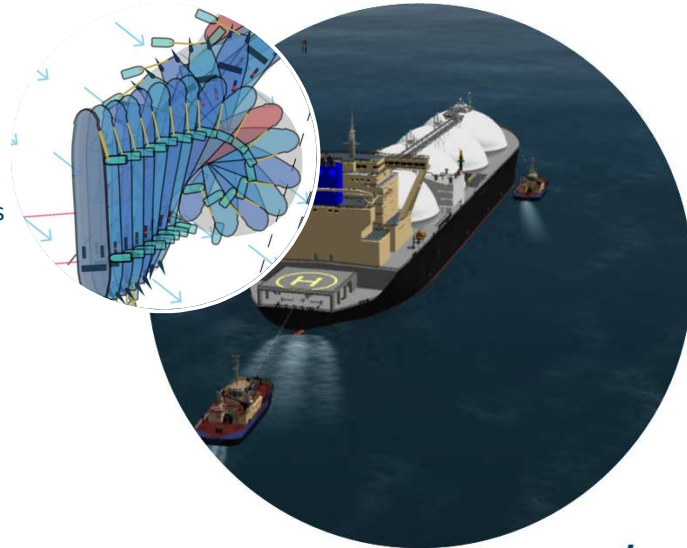


- Real time, full mission bridge simulators used
- Manoeuvres by pilots and tug masters from the terminal
- Simulations conducted to:
  - Verify assessment of tug requirements with dynamic manoeuvres
  - Identify manoeuvring strategies with available tugs
  - Determine operating limits

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## Standard arrival and departure manoeuvres

- Verified tug bollard pull requirements
- Assessed if any additional tug power was required during dynamic manoeuvres including:
  - Channel transits
  - Slowing the ship on arrival
  - Turning the ship
  - Berthing/unberthing

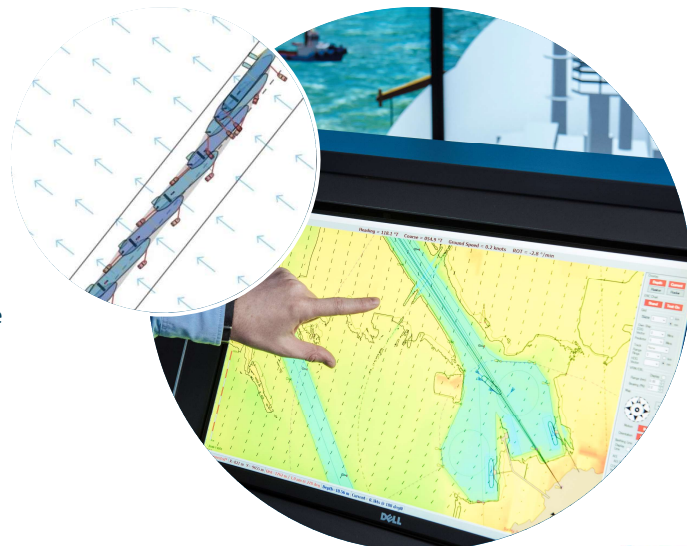


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## Failure scenarios

- Review of risk associated with manoeuvres at suggested limiting conditions
  - Risk to the berth structure: tug failure during berthing/unberthing
  - Risk of a ship grounding: steering failure in the channel



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## Navigation simulation outcomes

- Identified which manoeuvring and tug operating procedures could continue, such as tug positioning.
- Identified modifications to procedures, such as reduction of channel transit speed from 8 to 7 knots.
- All ship manoeuvres feasible in wind speeds of 20 knots.
- Tug requirements calculations were verified.
- Operating limits could be calculated as a result of the verifications undertaken.
- Simulations undertaken in the most onerous conditions, however operating tool should consider all realistic conditions.



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## Determining operating limits

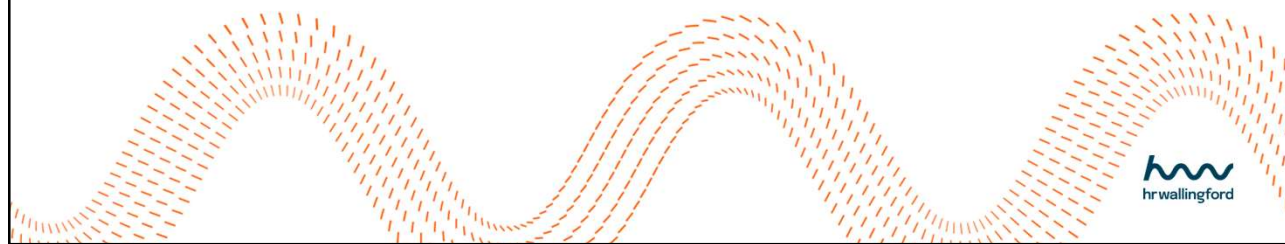
- Tug requirements were previously calculated for the most onerous wind, current, wave directions.
- Operating tool designed to calculate limits with all realistic wind, current, wave directions.
- Available tug fleet and ship manoeuvring assets included in calculations.



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## Determining operating limits

- Critical ship headings identified
  - Berthing/unberthing
  - Channel transit
- Environmental forces and moments calculated
  - Wind from all relative directions at 10°
  - Wave directions associated with wind
  - Peak flood and peak ebb currents
  - Current speeds and directions determined from flow model
  - Wind and current coefficients for different ship types
- Required aggregate bollard pull calculated
- Tug availability compared to required bollard pull



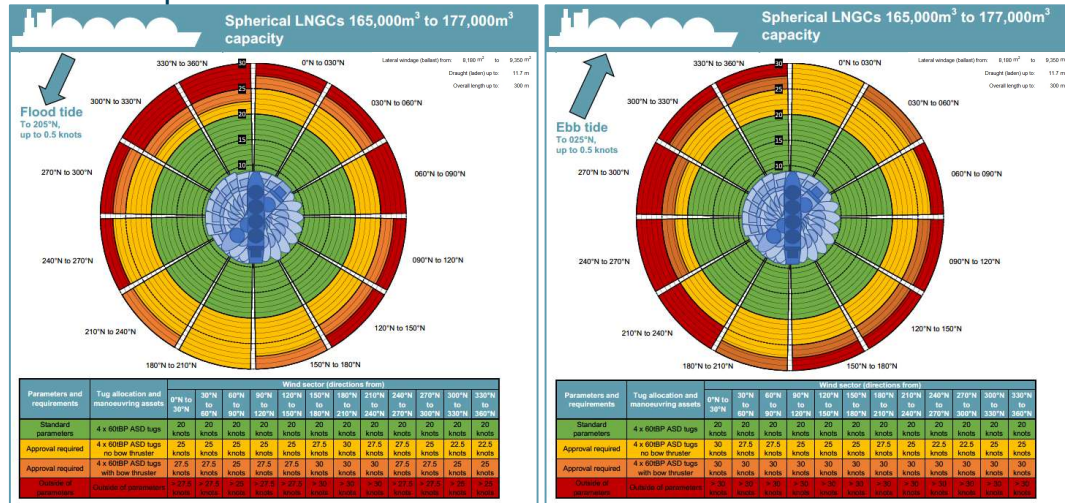
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## Developing the operating tool

- Operating tool for showing operating limit for given wind, wave, current directions, for given:
  - Tug provision
  - Ship manoeuvring assets
- Usability requirements:
  - Simple to use without high levels of IT skills
  - Easy to interpret for marine personnel
- Static tool chosen to fulfil usability requirements

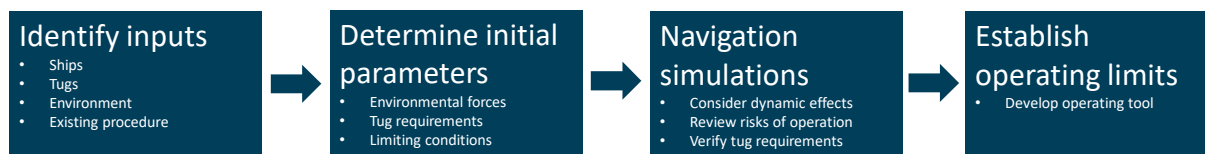
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### Tool examples



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### Methodology overview



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## Conclusive remarks

- Operating tool under trial
- Positive feedback
- Used PIANC WG116
- Similar tools for other terminals
- Comprehensive operating criteria study suitable

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