Appendices

APPENDIX - I (Glossary)

Abeam  direction at right angles to the fore and aft line of a vessel
Aft    rear of the vessel
Athwartships  transversely across a vessel
Beam   width of a vessel
Beaufort scale  system of estimating wind speed
Bollard firmly secured post of circular section used to secure ropes
Bollard pull  measure of the static pull a vessel can exert
Bowse  to exert a downward pull on a rope
Bulkhead  nautical term for wall
By the head said of a ship when its draught forward is greater than its draught aft
Chart datum  zero height referred to on a marine chart
Case Study Individual maritime safety agency accident report, analyzed to extract harbor towage operations risk and safety data.
Dolphin structure used for mooring ships
Draught depth in water at which a vessel floats
Expert Interview  Qualitative interview (supported by written submission and observational analysis) of expert witness experience of harbour towage operations safety.

Routine Ship Towage/ Harbor Towage Operation

Movement, berthing or unberthing of a vessel with the assistance of a tug(s) within a harbour, port or equivalent area.

Girt ing  (Also similar: Girding and Tripping). Where a vessel is caused to potentially capsize, most commonly as a result of external towline and interaction forces. Condition of a tug when it is heeled by the direction of pull on a towline and is in danger of capsizing

Gob line  a line used to bowse a towline to move the towing point aft

Gross tonnage  a measure of the internal capacity of a ship; enclosed spaces are measured in cubic metres and the tonnage derived by formula

H frame  post on a tug for securing the towline

Heel  angle of tilt caused by external forces
<table>
<thead>
<tr>
<th>Interaction</th>
<th>Hydrodynamic forces commonly found immediately adjacent to a vessel moving through the water.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knot</td>
<td>one nautical mile per hour</td>
</tr>
<tr>
<td>Kort nozzle</td>
<td>solid shroud around the propeller of a vessel</td>
</tr>
<tr>
<td><strong>Non-Routine Ship Towage/Non-Harbor Towage Operation</strong></td>
<td>Any operation or activity other than harbour towage, involving a tug(s) carried out in any sea area.</td>
</tr>
<tr>
<td>Port</td>
<td>left-hand side when facing forward</td>
</tr>
<tr>
<td>Questionnaire</td>
<td>Survey of current practitioners experience of harbour towage operations safety, using a Likert style questionnaire <em>(See Appendix A).</em></td>
</tr>
<tr>
<td>Risk Factor</td>
<td>An element whose presence or absence has potential to lead to an unsafe event.</td>
</tr>
<tr>
<td>Spring tide</td>
<td>period of highest and lowest tides in a lunar cycle</td>
</tr>
<tr>
<td>Stability</td>
<td>property of a ship by which it maintains a position of equilibrium, or returns to that position when a force that has displaced it ceases to act</td>
</tr>
<tr>
<td>Starboard</td>
<td>right-hand side when facing forward</td>
</tr>
<tr>
<td>Trim</td>
<td>difference between the forward and aft draughts of a floating vessel</td>
</tr>
<tr>
<td>Tow Planning</td>
<td>Planning and management of a harbour towage operation, commonly undertaken by a licensed pilot.</td>
</tr>
<tr>
<td>Yaw</td>
<td>to swing to either side of an intended course</td>
</tr>
</tbody>
</table>
APPENDIX – II (Questionnaire Form)

PhD Research - Towage Safety Questionnaire

This questionnaire has been produced by Abhijit Singh, as part of a PhD research into Tug Safety, with University of Petroleum and Energy Studies, Dehradun. The purpose of this questionnaire is to identify the specific risks involved in Tugboat towage operations. It is addressed to all Harbour Masters, Port Authorities and Master Mariner & asks them to describe one berthing or unberthing operation which raised an issue of tug and vessel safety. This might have been a near miss or an incident, but it includes challenging jobs; for example where different choices were made on subsequent occasions.

All information provided will remain strictly confidential to myself, the researcher. Anything that attributes information to a particular person, vessel or company will be removed; any information provided is purely for statistical analysis. All responses will be destroyed upon completion of the research project in December 2015.

To fill in the form, respondents are asked to put a cross (X) in the most applicable box. If a question is not applicable, you are unsure about the answer, or you do not wish to answer a question, please leave it blank.

Please email your completed questionnaire to:
apshree4@gmail.com

Alternatively, this can be hand it over to the personal in recipient present.
I can be contacted at the above email address.
Thank you for your help with this research.


APPENDIX – II (Questionnaire Form)

1. Vessel type (Tanker, Bulk, Container, barge, etc.)
   - Bulk

2. Approximate size (dwt, tonnes etc)
   - Coastal/Barge (<10,000mt)
   - Handy (10,000-30,000mt)
   - Large (31,000-160,000)
   - Very Large (>160,000)
   - Not known / other

3. Bow form
   - Fine
   - Moderate
   - Broad
   - Unsure / other (Please state.............)

4. Type of tug
   - Conventional (propeller/rudder)
   - ASL
   - tractor
   - Not known / other

5. Tug Bollard Pull (Approx)
   - Moderate <30t
   - Medium 31t - 65t
   - High > 65t
   - Not known / other

6. Tug Help
   - Push &/or pull
   - Tow on a line
   - Not known / other (Please state.............)

7. Tug Position
   - Tug Forward
   - Amidships
   - Tug Ast
   - Not known / other (Please state.............)

8. Whose line
   - Tug’s
   - Ship’s
   - Unsure / Not Appropriate

9. Wind (Beaufort Scale)
   - Low (<F3)
   - Moderate (F4-F6)
   - Gale (F7-F8)
   - Storm (>F9)
   - Unsure

10. Swell height (m)
    - Calm (<0.2)
    - Moderate (0.3 - 0.9)
    - Rough (1.0-1.5)
    - Storm (>1.5)
    - Unsure

11. Current (knots)
    - Low (<1)
    - Moderate (2-3)
    - Strong (>3)
    - Unsure

12. Other external condition (please state)
14. Indicate the extent to which the following factors influenced the safety issue.

<table>
<thead>
<tr>
<th>Factor</th>
<th>No effect</th>
<th>Some effect</th>
<th>Important effect</th>
<th>Fundamental effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training insufficient (e.g. more training in working with tugs would be beneficial)</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Human factors (e.g. tug or ship's crew poor concentration, fatigue, etc.)</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Language difficulties (e.g. lack of spoken English)</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Inadequate tugs communication equipment (e.g. poor VHF)</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Tug equipment inadequate (e.g. failure of emergency quick release)</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Ship securing arrangements (e.g. suitable fairleads in wrong position)</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Practical difficulties (e.g. tug needs to remain in “critical area” to pass tow line)</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Excessive wind strength (e.g. too great for tug power)</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Excessive current (e.g. tug finds it difficult to control vessel)</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Excessive swell (i.e. snatching or parting tow line)</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Interaction between vessel &amp; tug (e.g. tug enters ship’s bow pressure wave)</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Girding, Girdling or Tripping (i.e. potential for or actually observed)</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Insufficient detailed planning of tow (e.g. pilot orders insufficient tug bollard pull)</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Speed through water too fast (e.g. tug unable to maintain required position)</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Ship size too large for tug(s) (e.g. wind too great for tug bollard pull)</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Ship too powerful for tug(s) (e.g. main engines overpowering tug pull)</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Wrong tug type used for job (e.g. conventional tug used in vulnerable position)</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Lack of manoeuvring space (e.g. restrictions of shallow water, buoys or piers)</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Other (please state and continue in “Brief Description” above)</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>
15. How likely were the following outcomes in this case [The risk to vessel or tug]

<table>
<thead>
<tr>
<th></th>
<th>Not likely / Not applicable</th>
<th>Possible</th>
<th>Likely</th>
<th>Highly likely</th>
<th>Inevitable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collision</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grounding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foundering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major damage</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Minor damage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of life</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major injury</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Minor injury</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Pollution</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

16. Please use this space to briefly describe any other factors not already covered elsewhere.

........................................
APPENDIX – III (RISK ASSESSMENT GUIDANCE)

Risk Assessment Guidance

The assessor can assign values for the hazard severity (a) and likelihood of occurrence (b) (taking into account the frequency and duration of exposure) on a scale of 1 to 5, then multiply them together to give the rating band:

<table>
<thead>
<tr>
<th>Hazard Severity (a)</th>
<th>Likelihood of Occurrence (b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – Trivial (eg discomfort, slight bruising, self-help recovery)</td>
<td>1 – Remote (almost never)</td>
</tr>
<tr>
<td>2 – Minor (eg small cut, abrasion, basic first aid need)</td>
<td>2 – Unlikely (occurs rarely)</td>
</tr>
<tr>
<td>3 – Moderate (eg strain, sprain, incapacitation &gt; 3 days)</td>
<td>3 – Possible (could occur, but uncommon)</td>
</tr>
<tr>
<td>4 – Serious (eg fracture, hospitalisation &gt;24 hrs, incapacitation &gt; 4 weeks)</td>
<td>4 – Likely (recurrent but not frequent)</td>
</tr>
<tr>
<td>5 – Fatal (single or multiple)</td>
<td>5 – Very likely (occurs frequently)</td>
</tr>
</tbody>
</table>

The risk rating (high, medium or low) indicates the level of response required to be taken when designing the action plan.

Rating Bands (a x b)

<table>
<thead>
<tr>
<th></th>
<th>LOW RISK (1 - 6)</th>
<th>MEDIUM RISK (9 - 12)</th>
<th>HIGH RISK (15 - 25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unlikely</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Possible</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likely</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very likely</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Risk Assessments

There are a number of explanations needed in order to understand the process and the form used in this example:

HAZARD: Anything that has the potential to cause harm. (Lifting/moving heavy items, vehicles, fire etc)

For example
- Physical causes (falling, injury from equipment)
- Environmental (water, rivers, hillsides etc)
- People (launch drivers, players, coaches)

PERSONS WHO MIGHT BE HARMED: e.g. the general public, employees, spectators etc

RISK: expresses the likelihood that harm from a potential hazard will be realised and taking into account the likely severity of harm.

The questions that need to be asked are:

How frequently does this sort of hazard occur in the activity taking place? (i.e. seldom, sometimes to often)
How severe are the consequences of an accident occurring from that hazard? (i.e. bruised arm or death – or something in between)
How many people are likely to be exposed to the hazard? (i.e. one, a small group or many)
Are specific groups more vulnerable than others? (i.e. inexperienced, children, people with disabilities, pregnant women)

RISK CONTROLS IN PLACE: What is already in place that has reduced the chance of somebody being harmed by the hazard?

Severity (of hazard) x Likelihood (of occurrence) = Overall risk

So, the severity of a plane accident could be high (death), the likelihood of a plane accident (given a company of international repute) is low (because of the huge amount of money and effort that goes into reducing likelihood) so the overall risk is low.

Severity (of the hazard) could be measured on a 4-point scale:
1 = No injury
2 = Minor injury – may need some first aid assistance, not life threatening
3 = Major injury – admission to hospital etc (not visit to A & E)
4 = Fatal

Likelihood (of occurrence) could be measured on a 5-point scale:
Improbable – so unlikely that probability is close to zero
1 = Remote – unlikely, although conceivable
2 = Possible – could occur sometime
3 = Probable – not surprised, will occur several times
4 = Likely – occur repeatedly/event only to be expected

Multiplying the Severity x Likelihood gives a number between 1 and 25. The person completing the Risk Assessment then has a relative scale of the overall risk on which to manage the problem and introduce any preventative or protective measures.

1 to 8 could be classed as a LOW risk
9 to 15 could be classed as a MEDIUM risk
15 + could be classed as a HIGH risk

The overall aim is to reduce or remove the risk to an acceptable (as close to 1 as possible) level!
### APPENDIX – IV (Sample VOYAGE PLAN)

<table>
<thead>
<tr>
<th>Transit under 4 hours</th>
<th>Transit over 4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tug: Shenandoah</td>
<td>Date: ________________</td>
</tr>
<tr>
<td>Barge: _______________</td>
<td>Cargo: ______________</td>
</tr>
<tr>
<td></td>
<td>Amount: ______________</td>
</tr>
<tr>
<td>Length/Width/Capacity</td>
<td>Drafts: ______________</td>
</tr>
<tr>
<td>Voyage Description:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>LNM Updates (if applicable):</td>
<td>______________________</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Weather Forecast:</td>
<td></td>
</tr>
<tr>
<td>Anticipated Tide and Current:</td>
<td>______________________</td>
</tr>
<tr>
<td>Fore and Aft Drafts &amp; Minimum Clearances:</td>
<td>______________________</td>
</tr>
<tr>
<td>Anticipated Speed and ETA:</td>
<td>______________________</td>
</tr>
<tr>
<td>VTS, Bridges, Enhanced Security Calls and Destination:</td>
<td>______________________</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Key Safety Factors:</td>
<td>______________________</td>
</tr>
<tr>
<td>Master: _______________</td>
<td>Mate: ________________</td>
</tr>
<tr>
<td>Deckhand: ______________</td>
<td>Deckhand: ______________</td>
</tr>
<tr>
<td>Engineer: ______________</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX – V (Best Practice: Pre-Towing CHECKLISTS)

1) Safe Towage Operations Checklist

<table>
<thead>
<tr>
<th>Task / Duty</th>
<th>Officer’s Initials</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>When preparing to undertake a towage operation:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Identify the principle risks and method of assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Identify and understand the reasons for the towage method to be used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Visual inspection of the towing wire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Identify suitable towage points and the chafing areas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Identify the characteristics of the tow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Ensure rigging and correct deployment of the towing gear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Knowledge of safe handling of the towing gear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Identify safe areas on deck</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Ensure adequate lighting of working areas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Identify the stability of the tug and tow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Prepare a passage plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Identify local byelaws that may affect the operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Identify where different phases of the tow may require</td>
<td></td>
<td></td>
</tr>
<tr>
<td>different towing requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Identify berthing arrangements on arrival</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

On Passage

<table>
<thead>
<tr>
<th>Task / Duty</th>
<th>Officer’s Initials</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>15. Follow correct procedures to connect, let go and change of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the towing gear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Monitor the tow to take timely and effective corrective action when</td>
<td></td>
<td></td>
</tr>
<tr>
<td>required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Aware of the importance of avoiding large dynamic forces on the tow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>line</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2) Fitness for Purpose Checklist

<table>
<thead>
<tr>
<th>Task / Duty</th>
<th>Master’s Initials</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For an intended passage:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Check correct documentation for the tug</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Check correct documentation required for the tow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Verify tug requirements for the tow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Assess fitness and suitability of navigation equipment for proposed passage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Assess number, experience and qualifications of crew</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Assess the suitability of the towing equipment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3) Internal & External Communications Checklist

<table>
<thead>
<tr>
<th>Task / Duty</th>
<th>Master’s Initials</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Verify Internal Communications</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 A pre-tow briefing with crew</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 The use of hand signals and state the importance of non-verbal signals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 The use of hand held radios and state the importance of correct radio procedures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 The use of on-board CCTV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 The use of on board alarms, signage and announcements</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Verify External Communications</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ensure:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Tow set up briefing with external stakeholders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Agreement of terminology with pilot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Check communications with other tugs and vessels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Check traffic reports and communication with VTS / Port Control/vessel</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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4) Emergency Procedure Checklist

<table>
<thead>
<tr>
<th>Task / Duty</th>
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<tr>
<td>Verify Actions to be taken in the event of:</td>
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<tr>
<td>1 Failure of towing lines and equipment</td>
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<td>2 Failure of gog arrangements</td>
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<td>3 Failure of engines, steering, electrical systems</td>
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<td>4 Failure of steering gear</td>
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<td>5 Failure of electrical systems</td>
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<td>6 Loss of external communication to pilot /port control etc</td>
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<tr>
<td>7 Mechanical problem on the towed vessel</td>
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<td>8 Rope in propulsion system</td>
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<tr>
<td>9 Compromise of watertight integrity of tug when towing</td>
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<td>10 Collision</td>
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<td>11 Grounding of tug and/or tow</td>
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<td>12 Man overboard</td>
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<tr>
<td>13 Fire</td>
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<td>14 Pollution</td>
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<td>Verify:</td>
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<tr>
<td>15 Use of the emergency controls</td>
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<tr>
<td>16 Deployment of the emergency tow line</td>
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<td>17 Emergency release of the tow procedure</td>
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<td>18 Crew preparedness at emergency stations</td>
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<tr>
<td>Awareness of:</td>
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<tr>
<td>19 The statutory requirement to render assistance</td>
<td></td>
<td></td>
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<tr>
<td>20 The difference between responding to a Mayday and rendering salvage assistance</td>
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</table>
Choosing my research methodology was perhaps the most difficult part of my research and caused me the most concern. Not because I could not decide how to conduct my research but more to find a category that my, what initially appeared to be unique approach, would fit in.

I wanted the research methodology to develop as the research progressed and that the data I would collect would be not only in the form of words but also to be in numbers, that, according to Fox et al (2007 pp.116), indicated a flexible design rather than fixed. 'Quantitative researchers collect facts and study the relationship of one set of facts to another.... Researchers adopting a qualitative perspective are more concerned to understand individuals' perceptions of the world.' Bell J. (2005 pp.7).

I have opted for a qualitative perspective as described by Bell and, in my research I will primarily use qualitative data, however I will use quantitative data to support and add impact to my findings. Rational for this comes in part from Fox et al who state, "The key goal is to use the strength of one method to enhance the impact of the other. So information gained from one part of the study (either quantitative or qualitative) is used to strengthen the other aspects of the research. This is important to practitioner researchers who are often working on complex, multifaceted issues." Bell J. (2005 pp.7).

Having determined that I required a flexible design collecting qualitative data I considered the methods I would use to collect my data.
These included:
• Questionnaires
• Selective case study of accidents and incident reports
• Participant Observation
• Non-structured interview, and
• Literature review.

To encompass all the above research methods I would need a 'multi method' Robson (2002 pp.92) strategy. My research does not lend itself easily to action research, as I do not see any change being implemented by enforcement such as by legislation. Change will come from identifying the problem and providing a cost effective and ethical approach to its solution. This is one of my reasons for partnering with the Admiralty Group as they are in a global position to highlight the problem without political or commercial interference.

Reflecting on the problem I am addressing and the solution I have proposed I believe that a 'soft' approach is far more likely to produce the required results than a 'hard' approach such as with Action Research; I want people to engage with my research and to enter into the conversation. With this in mind I looked closely at Soft Systems Methodology which as Denscombe describes 'The basic shape of the approach is to formulate some models which it is hoped will be relevant to the real-world situation, and use them by setting them against perceptions of the real world in a process of comparison. That comparison could then initiate debate leading to a decision to take purposeful action to improve the part of real life, which is under scrutiny.' (Denscombe, 2003).

On reflection, this approach is too complex for what I am trying to achieve by producing just one model, but the basic principle is correct.
Use of a questionnaire as my primary research tool naturally led me to consider survey as a research approach however Judith Bell (2005 pp. 13-14) reminds us *inter alia* that:

‘Great care has to be taken to ensure that the sample population is truly representative, All respondents will be asked the same questions in, as far as possible, the same circumstances, and Surveys can provide answers to the questions What? Where? When? and How?, but it is not so easy to find out Why?’

It is my aim to conduct much of my research through the Admiralty Group.

I do intend to ask the same questions of my respondents however in a widely differing circumstances as possible as I wish to gain a ‘snap shot’ evaluation of the perceived global problem. This research would, in my opinion, be useless if I did not provide practical and ethical solutions to the problem I am researching. Therefore the ‘How?’ question will be extremely important in my research. In rejecting survey as a research approach I note that Robson (2002 pp.87-89) does not list it as one of three approaches particularly relevant to real world solutions, instead listing ‘case studies, ethnographic studies and grounded theory studies.’

In real world research such as this, and with the facilities available to me for research, it seems very appropriate to combine approaches, thus providing a more holistic approach to the problem. With the above in mind I have concluded that a Case Study, Questionnaire & Interview with triangulation approach would be the most appropriate to my research project. As Bell describes it “*All organizations and individuals have their common and unique features. Case study researchers aim to identify such features, to identify or attempt to identify the various interactive processes at work, to show how they affect the implementation of systems and influence the way an organization functions*.” (Bell J. 2005 pp.10). In the context of my research we know that the incidence of marine accidents and incidents is increasing.
APPENDIX - VII (Interview Transcripts)

Participants interviewed by the researcher were asked two questions:

(Question 1) “In broad category, we have identified seven risk factors relevant to Indian towage industry; such as poor maintenance/substandard condition of equipment’s, poor work process, Incompetency, rough weather, poor safety engagement and unsuitability of tug. What’s your say on these identified risk factors?

(Question 2) “Please describe various safety issues in towage operation and your recommendation to deal with those”

Probing questions were also used to guide the interview when needed.

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<th>PARTICIPANTS</th>
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<th>WORK PROFILE/EXPERTISE</th>
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<th>WORK EXP (years)</th>
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</table>
REPLY TO QUESTION 1

The towing industry is still a dangerous business.... People get hurt real easily... We try to manage the risks and the dangers....

New vessel safety management system (VSMS) helps us to manage those risks by identifying any potential problems on our boats and by helping crew gain a heightened sense of how to operate safely...

We're always trying to go for zero incidents... I think it's helped us to achieve that, the company's new management safety system....

... We move barges around the port primarily serving a power plant by delivering coal for fuel and limestone for the scrubbers that remove pollutants from its stacks. Typically it is paired with a 360-foot barge that can carry 8,000 tons of coal... Occasionally the tug makes the 300-mile round trip and back... of late vessel safety management systems have taken center stage in the towing industry because of the U.S. Coast Guard's proposed Subchapter M requirements.........

Under the new rules, most towing vessels would have to meet mandatory inspection requirements.... Towing companies would have to pass an annual inspection by the Coast Guard. Alternatively, an operator could create a towing safety management system, have it audited by an outside third party such as a classification society and then submit it to the Coast Guard for acceptance....

This the biggest change the industry has ever seen. If that doesn't shake them to the core, nothing will...

Despite the uncertainty about when the new regulations will take effect, our management decided it wanted to be ahead of the game by developing a VSMS that would be in place when the new rules are adopted.... Aside from regulatory compliance, the company sees the safety management program as valuable in and of itself. First, it reinforces the company's longstanding commitment to safety.... and being able to demonstrate that commitment may give company a competitive advantage when approaching customers concerned about the safe movement of their cargo...

We have long been a participant in the American Waterways Operators' (AWO) Responsible Carrier Program (RCP). Using the RCP as a starting point, We decided to develop a safety system that

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would meet the standards of the International Safety Management (ISM) Code, which the Coast Guard proposes to accept as equivalent to the TSMS requirements.

Please elaborate TSMS?

A TSMS is a Towing Safety Management System.... The TSMS is a document that is customized to your company and details the safe and correct way to perform the duties both on the vessel and ashore.....

The goal is safety and environmental protection.... Keep the crew safe, the equipment safe and functioning as designed and protect the waterways, land and air around the vessel.

It boils down to risk assessment – something that each of us do daily and something that our mariner's do as such a regular part of their jobs that it is second nature. ... Risk assessments are conducted to estimate how much damage or injury can be expected from exposures to a given risk agent and to assist in judging whether these consequences are great enough to require increased management and/or regulation....

So the TSMS starts out as a compilation of the assessed risks and how we deal with them.... It encompasses the what-if's – what if we went aground, what would we do to minimize injury or death, damage to the equipment and damage to the environment. ... It covers the procedures for safe use of equipment – deck machinery, tools, ladders, etc. ... and it is built on a foundation of commitment. The company commits to operating in a safe and environmentally aware way. Roles and responsibilities are defined.... Authority of the Master is acknowledged. A maintenance program is committed to so that equipment is not just run to failure, but rather maintained in a responsible, safe manner....and then, the whole system is checked both internally and externally and the results of the audits are used to improve the company.

I show you the document....Here's part of what Sub M says a TSMS is:

Safety Management

All towing vessels must be operated in compliance with an Owner/Managing Operator (O/MO) implemented TSMS or be subject to an annual USCG inspection regime.

**Purpose of TSMS**

(c) TSMS establishes policies and procedures and require documentation to ensure the O/MO meets its established goals while ensuring continuous compliance with all regulatory requirements. The TSMS must contain a method to ensure all levels of the organization are working within the framework.

(d) A TSMS establishes and maintains:
(1) Management policies and procedures that serve as an operational protocol for all levels within management
(2) Procedures to produce objective evidence that demonstrates compliance with the requirements of this subchapter
(3) Procedures for an O/NO to self-evaluate that ensure it following its own policies and procedures and complies with the requirements of this subchapter
(4) Arrangements for a periodic evaluation by an independent third party to determine how well an O/NO and their towing vessels are complying with their stated policies and procedures and to verify that those policies and procedures comply with the requirements of this subchapter; AND
(5) Procedures for correcting problems identified by management personnel and third parties and facilitating continuous improvement

Objectives of TSMS
The TSMS through policies, procedures and documentation MUST:
(a) Demonstrate Management Responsibility. The management must demonstrate that they implemented the policies and procedures as contained in the TSMS and the entire organization is adhering to their safety management program.
(b) Document Management Procedures. A TSMS must describe and document the O/NO's:
   - organizational structure
   - responsibilities
   - procedures
   - resources which ensure quality monitoring
(c) Ensure Document & Data Control. There must be a clear identification of what types of documents and data are to be controlled, and who is responsible for controlling activities, including:
   - Approval
   - Issue
   - Distribution
   - Modification
   - Removal of obsolete materials
   - Other related administrative functions
(d) Provide a process and criteria for the selection of third parties. Procedures for the selection of third parties must exist that include:
   - How third parties are evaluated

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• Selection criteria

e) Establish a System of Record-keeping. Records must be maintained to demonstrate effective operation of the TSMS. This should include:

• Audit records
• Non-conformity reports
• Corrective Actions
• Auditor qualifications
• Auditor training
• Other records as considered necessary

(f) Identify and Meet Training Needs. Documentation procedures for identifying training needs and providing training must be established and maintained.

(g) Ensure Adequate Resources. Identify adequate resources and procedures necessary to comply with the TSMS

Functional Requirements of TSMS

The functional requirements of a TSMS include:

(a) Policies and procedures to provide direction for the safe operation of the towing vessels and protection of the environment in compliance with applicable US law, including the CFR’s, and international laws where applicable,
(b) Defined levels of authority and lines of communication between shore side and vessel personnel.

(c) Procedures for reporting accidents and non-conformities

(d) Procedures to prepare for and respond to emergency situations by shoreside and vessel personnel

(e) Procedures for verification of vessel compliance with this subchapter

(f) Procedures to manage contracted (vendor) safety services

(g) Procedures for internal auditing of the TSMS, including shoreside and vessel

(h) Procedures for external audits

(i) Procedures for management review

(j) Process to evaluate recommendations made by management personnel

TSMS Elements

The TSMS must include the following (non-applicable elements must be accompanied by documented justification that is subject to acceptance by the third party):

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(a) Safety Management System Administration and Management Organization. A policy must be in place that outlines the TSMS culture and how management intends to ensure compliance with this subpart.

(b) Personnel. Policies must be in place that cover the O/MO’s approach to managing its personnel, including, but not limited to:

- Employment
- Training
- Health
- Safety

Supporting these policies, the following procedures and documentation must be included:

1. Employment Procedures.
2. Training of Personnel. The TSMS must contain a policy related to the training of personnel, including:
   (i) New Hire Orientation
   (ii) Duties associated with the execution of the TSMS
   (iii) Execution of operational duties
   (iv) Execution of emergency procedures
   (v) Occupational health
   (vi) Crew Safety AND
   (vii) Training required by this subchapter

(c) Verification of Vessel Compliance. Policies must be in place that cover the O/MO’s approach for ensuring vessel compliance, including but not limited to:

- Maintenance and Survey
- Safety
- The environment
- Security
- Emergency preparedness

Supporting these policies, the following procedures and documentation must be included:

1. Maintenance and Survey. Procedures outlining the O/MO’s survey regime must specify all maintenance, examination and survey requirements.
2. Safety, Environment and Security. Procedures must be in place to ensure the safety of property, the environment and personnel. This must include procedures to ensure
   - the selection of the appropriate vessel,
   - including adequate maneuverability and horsepower,
appropriate rigging and towing gear,
proper management of the navigational watch,
compliance with applicable security measures

(3) All procedures required by this subchapter must be contained in the TSMS

(d) Compliance with Subchapter M. Procedures and documentation must be in place to ensure that each towing vessel complies with the operational, equipment and personnel requirements of this subchapter

(e) Contracted (Vendor safety) Services. Procedures must be in place to ensure the safety, effective management and compliance with applicable regulations for contracted vessel towing services, including:

(1) Procedures to evaluate personnel qualifications
(2) Procedures to evaluate adequacy of vessel capability, condition and compliance with applicable regulations
(3) Compatibility of Safety Management Systems, AND
(4) Procedures to maintain objective evidence as required by both organization’s SMS’s.

However, we have observed few mistakes common to all quality systems

Inadequate Management Support
Inappropriate Scope
Inadequate Resources
Giving Up Early On

REPLY TO QUESTION 2

First and foremost area I believe is to define responsibilities and accountability

Organisational command lines should be established and responsibilities and duties clearly defined before a new towage commences....

The tug master is at all times responsible for the vessel and crew and if acting as towing master also responsible for the towed unit. The tug master should always be satisfied before departing that his vessel is:

Compliant with appropriate regulations and all machinery and equipment is in good order and fit for the intended tow.

In addition:

- Crew are correctly certified, trained and using correct and appropriate personal protection equipment (PPE).
- Communications are established with the tow and tow master.

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- Towing gear is in good condition and prepared.
- Watertight doors, hatches and ports are closed prior to the tow commencing.
- The barge certification is in order and the stability of the barge has been verified where applicable.
- It must be clear between the parties (other tugs etc.) who the towing master is and his responsibilities. Investigators often cite the failure of not having someone in overall control of the towing operation as a factor in incidents. All personnel should be aware of their own responsibilities and tasks.

The whole report boils down to a few crucial indispensables:

- TRAINING
- EXPERIENCE
- COMMUNICATIONS
- SAFE PROCEDURES

Most essential:

KNOW YOUR TUG. KNOW THE CAPABILITIES AND LIMITATIONS. KNOW THE CIRCUMSTANCES

It is strongly recommended that all parties involved in harbour towage operations pay the greatest attention to these essential aspects for safe towage operations.

In more detail...

Safe speeds

- Recommended safe speeds are Maximum 6 knots for securing at the bow, and maximum 6-8 knots for securing alongside and at the stern....
- The capabilities and limitations of the tugs should be known and taken into account, as well as weather conditions and tug master experience.
- Speed regulations are a very important aspect of tug safety... It is strongly recommended that ports, towing companies and pilot organisations create standards for safe speeds for tugs making fast to a ship having headway and when fastened.
- When speed regulations and/or guidelines are in effect in a port, it is vital to confirm regularly that they are complied with...
- It is strongly recommended to verify if the following method can be used to determine the safe connection speed for a specific tug that has to secure at the bow of a ship - Safe speed to be based on what speed a tug master can drive his/her tug in a controlled manner (particularly going astern for bow-to-bow operations) on one engine. Once this speed is established for the specific tug, prevailing conditions and competency of the tug master, it is
recommended to take one knot off the figure and that should be close to the safe connection speed.....

Company should have their Towing Standard Operating Procedures (SOPs) for critical operations, like

ALONGSIDE

- Before making up to the barge, find out where it will end up. This will help determine which side you should make up to for a more controlled landing at your destination.

- Check the weather. If you have a short run and need to be alongside, determine which side will be the lee side. It will be more comfortable for the crew and will lessen surging between tug and barge on the lee side.

- The tug secures to one side of the tow with her own stern abaft of the stem of the tow. This will increase the effect of the tug's screw and rudder. The side chosen depends on how much the tug must maneuver with the tow.

- If all turns are to be made with the tug's screw going ahead, she will be more favorably placed on the outboard side of the tow -- the side away from the direction toward which the most turns are to be made.

- If a sharp and difficult turn is to be made under headway, the tug should be on the side toward which the turn is to be made. Here she is properly placed for backing to assist the turn, because as she slows, the tow's bow will turn toward the side the tug is on.

- If a turn is to be made under no headway, the tug is more efficient on the starboard side of the tow. When the tug backs to turn, the port send (side force) of her screw will combine with the drag of the tow to produce a turning effect greater than that which could be obtained with the tug on the port side.

- The best position for a long back in a straight line is to have the tug on the port side. Then the drag of the tow tends to offset the port send of the backing screw.

- As you come alongside, the deckhand should be preparing to put out a spring line.

- Once the spring line is secured, angle the bow in and make up the head (bow) line. The bowline or backing line is paid out over the outboard side of the bow stem or king post and lead to a bitt on the forward end of the tow. Once the bowline is secured on the tow, all the slack is taken in and the bowline secured. This will bring the tug into proper position, slightly bow-in to the tow. When backing down, the bowline becomes the towline.
• Once the bow line is secured bring the stern in and make up the stern line. The stern line or turning line is lead from the tug’s stern to the outboard side of the tow’s stern. The purpose of this line is to keep the tug’s stern from drifting out. The three lines, when properly secured and made taut, will make the tug and tow work as one unit.

• It will be necessary to work up as hard as practical (up to 1450 rpm’s) to get the stern line tight. Make sure that you are against a pier that can handle the tug working up hard on the barge. Also, watch your wheel wash. If the lines are great between the barge and pier, or if other factors won’t allow you to work up hard then make it up as tight as you can then once out in open water off the pier, work her hard over (stern to barge) and tighten the line.

• If taking the barge alongside in open water (not against a wall or pier) make sure that you have sufficient room to turn a full circle as you put out and tighten lines. This includes room around all piers, docks, marinas, shorelines, etc and other vessels.

• It is usually a good practice to double up on your spring line and bow line. You can also double up the stern line. It will provide a better ride and peace of mind.

• You may find yourself with two barges. If you have to pick them up at a pier and they are side by side, nose between them after you have taken off the stern line (line at your bow) between the barges. Leave the bows tied together. Make up as you would with a single barge. Get all lines between the tug and barges as tight as possible. Double up the line between the barges’ bows.

• Use chafing gear. If any of the lines lead over rough or sharp edges, put out chafing gear. This could be fire hose or rug wrapped around the line or wood placed under the lines at the wear points.

• Don’t forget the barge lights both putting them out and taking them in.

• Occasionally, it will be necessary to shift from one side of the tow to the other. You can let the barge go completely if you have enough sea room, or you can keep lines out.

**Warning**

3. When securing these tow lines, remember; NEVER secure the line so that it cannot be thrown off quickly and easily.

4. Areas of the harbor subject to wave action should be avoided whenever possible. The tug and tow seldom pitch in the same tempo. When both start pitching out of harmony, the lines take a heavy strain and may part. When equipped with a rudder the tow assists in steering. Size and loading of the tow
may obstruct the view of the tug’s conning officer. In that case, a lookout is stationed aboard the top who keeps the conning officer fully informed of activity and hazards in

PUSHING

- Before making up to the barge, find out where it will end up. This will help in determining which end to push from. The contractor may want the crane end forward and the crane may be on the stern of the barge. If your destination is a narrow space, you may not have room to spin the barge and put the crane end where they want it. Ask first!
- Check the weather. Do not push in seas over 2 feet.
- As you come up to the barge, the deckhand must get your head line(s) out first.
- On barges without a center bitt/client, run a line to each side from the tug’s stern.
- Put out the safety lines next from the tug’s forward quarter bitts to the barge’s corners.
- Put out the push wires last. Make sure the tug is centered and straight for maximum steering.
- If you know that you are going to handle the same barge later, when breaking down, slack one wire and then when you make up again, put that wire out first (after the head and safety lines).
- Don’t forget the barge lights both putting them out and taking them in.

ASTERN

- You will generally tow astern because the weather will not permit you to tow alongside or push.
- Check the weather! The forecast will help you determine how much hawser to put out.
- Unless towing on gate lines, you want the barge away from the tug’s stern. The tug’s wheel wash will have an effect on the tow. It will try to push the barge backwards. Get the tow out of your wheel wash.
- Gate lines are for towing short with the maximum steerage. You will take two lines and run them out to the barge. One on each corner and then bring them back to the tug’s stern quarter bitts. You can lead them around the bitts and make up on the H-Bitt if it is easier for you. The lines must be of equal length when made up. Ideally, you will almost be able to step off of the tug’s stern onto the barge when made up.
- Use chafing gear. The Shenandoah has a hawser board to minimize chafing of the hawser on the tug’s stern. Also, if the barge has sharp edges, use chafing gear on the bridles or shackle the bridles into chain or cable donuts that are looped over the bitts and lead over the sharp/rough edge.
- Old fire hose cut into 4- to 6-foot lengths and then split lengthwise makes excellent chafing gear. It is wrapped around the hawser or towing cable to protect it from wear due to constant rubbing.

- Hawser length will be determined by the sea! Barge and tug must be in step. Too much line out could cause the towline to foul on the bottom. Too little line out will cause the line to jump out of the water. This puts too much strain on the line.

- The scope of a hawser should be long enough to provide a good catenary, but not to the extent of having the towline drag on the bottom if in shallow water. A catenary absorbs shocks. You should not put stress on a towline to the extent of lifting it out of the water, but you can increase the catenary by reducing the tug’s speed.

- Towlines should never be made fast on the capstan.

- To rig a stern towline, the towing hawser should be hanked out in the fantail of the tug. This will ensure that the hawser will pay out without becoming fouled.

- The eye of the hawser is led back over the top of the "H" bitt, over the shoulder of the horn, and back through the legs of the bitt. Then the hawser is payed out. When you get close to the point where you are going to secure the tow, take a full round turn and cross the line back onto itself. Then take two or three additional round turns before you figure eight the line on the bitts, and finish it off with two or three turns on the arm of the bitt.

Notes: A hawser watch must be posted on the after deck to keep tow and gear under constant observation. Instruct the crew member, on watch, to immediately report the following:
  - Too much tension is on the towline.
  - The tow is not weathering properly.
  - The briddles or other gear fail.

- In addition to chafing gear, continued monitoring of the towline’s condition is necessary and important. Stern rollers and other fairleads must be properly lubricated and all possible points of line wear offered a fairlead. Canvas, hose, line, wood, or other materials should be used for chafing gear as required. Chafe must be eliminated or reduced on board the tow and the tug as much as possible. Continued paying out and retrieving of the towline can cause excessive chafing. Freshening the nip and lengthening or shortening the tow wire should be done every few hours in moderate weather and more often during heavy seas.

- The towline must be checked periodically for a fairlead and chafing. Points of chafe must be protected. Appropriate lubrication and wearing surfaces should be placed so as to eliminate towline-to-hull contact.

**Tandem Tow Make-up**

- When towing more than one barge astern, it is referred to as tandem towing. In a pure sense, tandem means one behind the other.

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• In this method, the tug is connected to the first tow. The first tow connects to the second, and so on if additional units are towed. The intermediate hawser, connecting the first tow to the second, must be streamed and allowed a proper catenary depth. The surging action must be eliminated between tug and first tow and between first tow and second tow.

Honolulu Tow Make-up

• In this method, the first tow is connected to the main tow wire. The second tow is connected, with an auxiliary tow wire, to the bitts on deck. The Honolulu rig allows independent connection of the two tows. Disconnecting and control are readily workable.

WARNINGS:

5. Always face your work.
6. Never step over a line that is laying on the deck. Either lift it up and walk under it, or step on top of it and cross over. Never straddle or step in the bight of a line.
7. When towlines are coming under or are under a strain, work fast. Get the turns or figure eights on a quickly as possible. When surging or slackin off on a line that is under strain, keep your hands clear of the bitts.
8. The greatest danger in using towlines is that if the line should part when under strain, it will snap back its full length like a bull whip. The force of the snapback is tremendous depending on the strain that the line was under at the time it parted. There is no set pattern on how the line will whip back. It may snap back immediately on itself or it may whip from side to side. There is no way to tell what it will do. If you see a synthetic fiber line under strain parting or beginning to part—DO NOT RUN—just fall flat down on the deck.

Safe tug communications

• Towing companies and tug masters, if possible together with pilots, should develop safe procedures for how to approach a ship for picking up a heaving line and for passing a tow line. It is recommended that these procedures include an instruction that tugs only approach the bow when the crew is ready.
• In case of a too high ship speed it is recommended to secure the stern tug first, in case a stern tug would be used, and when ship speed has dropped to an acceptable level the forward tug(s) can be secured.
• There must be safe and effective communication procedures between pilots and tug masters. Communication should include issues such as safe speeds, when and where to make fast to the ship, SWL of bollards and fairleads, intended manoeuvres, mooring details and all other relevant information.
• It should be made standard that a pilot translates communications with the tugs into English, unless the ship captain speaks the same language as the pilot.
Training of tug masters

- Training of all tug masters is vital and should include refresher courses. Training should include the capabilities and limitations of tug types in use, safe procedures, safe speeds, knowledge about interaction effects and their effect on tugs, teaching the right attitude (particularly for young tug masters), and all other important aspects of safe towing.
- Training, regular refresher courses and competency checks should be carried out by certified institutes and trainers.
- Interaction effects between tug and ship, including pressure waves (see bow wave figure 3 Appendix), should be replicated in a realistic way in simulators used for training. Simulated interaction effects should be accurate for various hull forms, speeds, draughts, under keel clearances, tug locations with respect to the attended ship and distances between tug and ship.
- Pilots should always alert tug masters to problems e.g. regarding ships with high Dead Slow speeds, deep draft vessels, SWL of bollards, poor seamanship on board ships handled, and any other relevant information.

Training of pilots

- It is recommended that pilots (including PEC -Pilot Exemption Certificate- holders are trained on the same subjects as mentioned above, such as with regards to the capabilities and limitations of tug types in use, safe tug and communication procedures, safe speeds, knowledge about interaction effects and their effect on tugs, and all other important aspects of safe towing.

Safe procedures shipping companies and ship captains

- Shipping companies and ship captains should implement rules for safe procedures regarding the securing and releasing of tugs, including safe speeds, use of suitable heaving lines and proper handling of heaving lines and tow lines in a safe and efficient way, SWL of bollards and fairleads, proper bollard use with respect to towlines, and keeping an eye on the tugs when fastening and releasing. Ship's crew should be trained in all these issues.

Line throwing systems

- It should be investigated whether line throwing systems can safely and effectively be used for passing a heaving line to a tug.

Bow camera

- It is recommended to investigate whether a camera on the ship's bow can help in monitoring the tugs.
PARTICIPANT 2

<table>
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<tr>
<th>BUSINESS OF ORGANISATION</th>
<th>TOWAGE SERVICE PROVIDER</th>
<th>POSITION</th>
<th>SR SAFETY OFFICER</th>
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<td>WORK EXP</td>
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<td>LOCATION</td>
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<td>DURATION OF INTERVIEW</td>
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REPLY TO QUESTION 1

We have system & procedures for inspecting our vessels, a much more rigorous system for documenting everything that is done... In the past some things would just be taken care of informally, perhaps with just a phone call. Now there is a paper trail for all the issues identified and the work done to resolve them....

In one sense, not much has changed as a result of the creation of the VSMS and the manual that defines it. The company’s inspections of its vessels are not more frequent or rigorous and the operation procedures are much as they were....

In another sense, the changes are profound. From a regulatory perspective, we can now prove to outside parties the rigor of its maintenance and repair programs, and its operating procedures... and internally it has a document that it can use as a teaching tool to drive home to its crews the central importance of safe operations...

The ultimate goal is to get (the crew) to read this manual, to make it a part of their lives.

Essentially, the VSMS manual has become the textbook for each employee’s continuing safety training.

There are at least four safety drills per month. An additional safety drill or safety meeting on a topic selected by the head office is performed weekly. The captain leads the onboard safety meetings, often in the mess area during lunch. The captain has wide discretion on how to conduct the meetings. In each case — whether drill or safety meeting — the topic corresponds to a section of the VSMS manual.

For example, in April the first safety meeting was to cover Vessel Safety Orientation. Chapter 5 of the manual has a section that discusses that topic. One drill for the month was Man Overboard. Those procedures are described in Chapter 6. With each drill and safety meeting, the crews are reminded of what the manual has to say on the subject.

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New VSMS reinforces the company’s longstanding commitment to operating safely, while demonstrating to customers that the company’s vessels meet stringent safety operating standards. Each week, the captain has an explicit duty to remind his crew of its contents. They are forced to open the book and involve the crew.

Each vessel gets an inspection visit from either Safety Officers once every three months. We expect this book to be dirty when we get aboard. They should have fingerprints on them. If they don’t, That’s an alarm.

While the company expects crews to abide by the manual, it also wants them to understand that this is a living document that will be constantly revised to reflect new information.

If an item is brought up by a customer, we change it, not just on that one (vessel); we change it companywide.

Information from inside the company can lead to changes as well. Suggestions from crews, lessons learned from an injury or near collision — any and all sources are considered. This isn’t a set-in-stone book.

REPLY TO QUESTION 2

High Bollard Pull of tugboats vs. strengths of ships’ Bollards and Fairleads

The Problem: With the enormous growth of ships’ sizes over the last years, the towage industry was forced to deploy different tugboats with strongly increased bollard pulls. Industry practitioners has experienced that often designs of bollards and fairleads on all kinds of vessels are not in step with safety requirements. There have been cases were bollards and fairleads have been torn away, especially when tugboats have to work in the ‘indirect towing mode’. There are wind forces and currents as well as on drag forces. If bollards, fairleads and winches of ships can withstand these calculated forces then these are considered suitable for ‘normal’ towing, i.e. harbour towage. The rules differentiate though between “normal towing” and “escort towing”. The difference between these two “towing modes” is enormous. When a tug operates at the stern of a ship in ‘indirect mode’, towing forces can be up to 5 times higher than the static bollard pull of the tug. This has to be taken into account when designing ships’ equipment.

Suggestions:

- ships’ crews, pilots and tug-masters must repeatedly be made aware of such possible forces and the inherent dangers.
- ships' operators, naval architects, shipyards, classification societies, marine surveyors as well as equipment providers must be made aware of these forces and include these considerations in their planning
- we need to be more specific on such towing aspects and here in particular in respect to container ships
- Ships' crews and pilots should be facilitated to have the "Towing and Mooring Arrangement Plan" at hand, summarizing on-board equipment and SWL's also for daily harbour towage operations

**Position of ships' bollards, fairleads and winches**

The Problem: Bollards, fairleads and winches on board vessels are often not optimally placed for connecting tugboats and for different tugboat manoeuvres. The positions of winches sometimes make it difficult for the ships' crews to safely handle heavy towing gear. Bollards and fairleads are often too far apart with the consequence that the towing gear might be damaged.

Towing and Mooring Arrangement Plans are issued by Classification Societies helping Masters and Pilots to be aware of the acceptable loads of these relevant parts for towing and mooring on board the ship. Since about 10 years the rules require marking of bollards, fairleads and winches with the SWL (Safe Working Load) limits. Amongst IACS members different opinions prevail whether the safety margins should be 1.25 or 1.5 times the actual towing forces. A very practical problem is that SWL's mentioned in ships' plans are expressed technically correct in Kilo Newton (kN) whereas ships' equipment is commonly marked in Metric Tons (MT), which, however, is only 10% of the kN figure (e.g. 230 kN = 23 mt). These differences can easily lead to serious misunderstandings as to equipments' capacity.

As far as we understood, classification societies do not check the "Towing and Mooring Arrangement Plans" upon practicability, for example whether ships have Centreline Fairleads, distances between fairleads and bollards, whether sufficient winch capacity is available to heave up the heaving towing gear etc.

Suggestions:
- "Towing and Mooring Arrangement Plans" are to be designed for good and safe seamanship
- Ships' crews and pilots should be facilitated to have the "Towing and Mooring Arrangement Plans" at hand, summarizing on-board equipment and SWL's also for daily harbour towage operations. Limitations need to be communicated to the tug-masters.

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- Specific needs for harbour-towage (not only emergency-towing) to be recognized and considered for ships' designs

_Push Points_

The Problem: Push points on ships' hulls are located on transverse bulkheads or web frames to avoid damages to the shell plating. None of these Push Points is marked with any max SWLs. Are the acceptable pressures of these Push Points known? Will they stand the force of a 70 TBP tug pushing with full power on less than 1 m² plate/hull area? As far as we understood, such calculations are only available for the impact on shore fenders. Often no information is available whether it is acceptable to let tugs push on the transom stern of the ship.

Suggestions:
- Push Points to be clearly marked with SWL’s
- On-board information to be readily available whether tugs pushing at the transom stern is acceptable
- Already in the design phase, these criteria should be considered

_High minimum speeds_

The Problem: The latest generation of large container vessels have an enormous main engine output. Engine manufacturers and ship operators as well as many other actors in the maritime chain have focussed on economic fuel consumption, taking advantage of the ever increasing economies of scale and on the ever increasing sizes of ships. However, the downside is that 'Dead Slow' of these large vessels is usually in excess of 6-11 knots through the water.

Making fast a tug for a harbour towage at this speed - especially on the ship's bow - is simply dangerous. The maximum speed of a tug is approximately 11 to 12 knots. Once safely connected, high passage speeds are reducing tugs' abilities. Beyond 8 kn, tug’s capabilities are very limited and on top it is getting very dangerous for tug and crew.

Our suggestion:
- Engines to be designed for 3-6 knots at 'Dead Slow' for safe harbour work of tugs and tugs' crews.

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PARTICIPANT 3

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<th>POSITION</th>
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<td>TRAINING – SIMULATOR</td>
<td>WORK EXP</td>
<td>21 YEARS</td>
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<td>LOCATION</td>
<td>SINGAPORE/PARADIP</td>
<td>DURATION OF INTERVIEW</td>
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REPLY TO QUESTION 1

We meet the standards of the AWO’s Responsible Carrier Program. The AWO is working with the Coast Guard so that its program will become a Coast Guard-accepted towing safety management system by the time the Subchapter M requirements take effect. That would give the AWO program the same status as an ISM system.

The foundation of our safety management system continues to be RCP. The leadership of the company is thinking not just in terms of meeting the minimum regulatory requirements, but in achieving the highest safety operating standards possible... We operate a fleet of 35 towboats and more than 800 barges. Much of its business involves the transport of petroleum products. Its approach to safety management has been greatly influenced by practices developed in the petroleum industry. Notable among them is a program called Tanker Management Self-Assessment (TMSA)... The oil industry devised the system to help vessel operators transporting their products meet higher safety standards. TMSA employs a process of continual improvement to prevent injury to people (both employees and the public), the environment and equipment. We are using TMSA since 2008 as a way to improve its management system effectiveness and operations.

Under TMSA, we assess specific aspects of its operations, including safety of mariners, navigation safety, environmental stewardship, preventive maintenance and risk assessment... The idea is to keep getting better rather than simply meet a set of standards or regulations. In the course of this effort, the company is constantly reshaping existing procedures and creating new ones to manage and reduce risk. This will help us go way beyond compliance... The involvement of the crews has been a key element in the success of this approach. This engagement is very crucial to the success of any safety management system. We do have good support from our mariners. Refining and

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improving procedures and then implementing them with the assistance of employees aboard vessels and ashore is not easy. Without a doubt, this has been hard work, over time it is very rewarding.
We are making significant progress, with the environment, with people and with the equipment.
Over the last eight years equipment has become more reliable and the number of spills has been reduced. Vessel crews have been involved in fewer collisions and groundings... and the severity of those incidents has also declined.
Continuous improvement is the mission............
The tugboat industry has come a long way - we have built the super tugs, we have installed the render recover winches, we’ve added all the computer navigation systems available - but we still haven’t implemented a training system that brings all of these elements together for successful tugboat operations............. These new tugs are the most powerful and dynamic tugs that have ever been built, and we have no standards for training to match the sophistication of these vessels..... What we need is a comprehensive training regime that would encompass every aspect of training to enable new captains and crew of these powerful vessels to utilise them to their fullest extent... In recent surveys of operational vessels, it appears that the tugs we have now are being utilised less than 80 per cent of their potential; the customer is expecting 100 per cent. There is a desperate need for new training methods.....
Quarter-scale tugboats, approximately 7.9m long (26ft), would make a superb choice for the training of new tug skippers.... These scale tugs would be fully equipped with all the same equipment as real tugs, including realistic scale thrust and dynamics, providing a base for skippers to build their skills while generating cost recovery.

REPLY TO QUESTION 2

Operational training

Today’s tugs are becoming increasingly powerful and sophisticated but, above all, extremely manoeuvrable.

The agility of the modern ship handling tug is such that it has the ability to ensure that the vessel’s BP can be applied precisely, where and when it is required... In this way ship handling becomes quicker, safer and more efficient. This ability is, however, coupled to a real need for understanding by the tug master of exactly how a tug will react... With the agility and power available, mistakes can occur rapidly in the hands of the unwary. In order to benefit fully from the advantages offered by modern ship handling tugs, a new standard of crew training is essential....
Operational requirements during escort and docking operations will also see a new set of commands between pilots and tugs to utilise the full potential of the new technology. Considerable simulator training already takes place for both pilots and tug crews, particularly where the handling of large tankers and LNG shipping is involved, but training new tug masters does require a more hands-on approach. Traditionally new tug masters have come up through the ranks, starting as deckhands, progressing to mate and then captain. On modern high-tech tugs, designed for use with very small crews, many of those training opportunities have been lost. Equally, putting a partially-trained novice into the driving seat of the company's latest new US$10m addition to the fleet is also fraught with problems. An opportunity to take the latest pieces of equipment away into a secluded corner to 'play and learn' for a few hours, which is possible in many other industries, rarely occurs in the towing business.

A possible alternative could be a quarter-scale training tug, just 7.3m (26ft) long with all the dynamics of the full-size tug. Any such vessel would, of course, have to earn its keep and could be equipped to carry out other duties that require a small, agile, vessel with adequate (scale) power. Line handling and small ship assist duties might well contribute to a cost-effective training facility.

Scale model testing, employing smaller models, is being used very effectively for special tug master and pilot training, and works very well. Models are also used almost routinely to develop new techniques and hull designs. In the early days of model testing, the use of powered models was shunned because suitable propulsion and control systems that could produce a scale performance were not available. That is no longer the case. Realistic, radio-controlled, scale models are now providing valuable data in the hands of design teams.

Recruit, train and retain

In the next 10 years, the industry will lose the largest number of senior staff in its history and will need to train a large number of tug masters to a new level of competency. This will require an investment in time and a carefully configured company training programme. This will be more difficult than ever before because, as previously mentioned, there is less scope in a very small crew to undertake 'on the job' training. A world shortage of marine manpower has shown that an accelerated rate of intake and training is required. In this world downturn this must be done efficiently.

Introduction to new technology

Unprecedented development and the introduction of modern technology have resulted in the introduction of a wide variety of new vessels. These range from small 'compact' ship handling tugs
of only 22-24m in length with BPs of up to 70 tonnes, to 36m terminal tugs… The latter continue to develop and BP figures of 90-110 tonnes are not uncommon. Inherent in the modern terminal tug are a very real escort capability and the ability to produce dynamic forces in the towline exceeding 150 tonnes at a speed of 10 knots in the tethered escort mode…

The foregoing new vessels require new and greater skills to deliver safe operation – the dynamic performance of escort tugs alone demands real understanding to achieve the best and safest results. The next generation of crews will have new skills in order to utilise these technologies in the best possible manner… Winch development in the last five years has advanced to match the new tug performance, enabling and requiring the tug master to manage line tension in an entirely different way. History has shown that hands on the controls and time on the job will build confidence; modern training tugs and methods, with support from seasoned tug masters, will give us a new generation of tug captains for the future.

Tools for success
To be successful, a candidate must be pre-screened and become familiar with the type of tug and its design dynamics. Docking procedures and techniques must be fully explained and understood, in theory and practice…
Candidates must train on the new types of winch currently in use and be capable of working with pilots on voyage planning and communications. The safety requirements for LNG and crude shipments leave no room for mistakes.

Training
- Pilots and Skippers train together
- Pilots Tripping on Tugs
- Skippers tripping with Pilots
- Pilot familiarity with new plant
- Simulator training for new techniques
- Cross pollination of training
- Regular pilot / tug crew meetings
- At job end, if possible - debrief
- Tug companies to exchange ideas.

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<td>WORK PROFILE/EXPERTISE</td>
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<td>LOCATION</td>
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REPLY TO QUESTION 1

I believe in writing down the best procedure for a particular operation in a safety management system (SMS) helps standardize operations and minimize human error.

The content of each SMS will vary greatly, even within the same industry. That’s because it’s up to the company using or developing it to determine which operations should be included. Some regulatory requirements or industry programs dictate what topics require policies and procedures, but most provide general headings. For example, the International Safety Management (ISM) Code provides a general outline, such as Section 7 – Shipboard Operations. The company is expected to fill in the blanks...

Subchapter M is no different. The proposed requirements for the Towing Safety Management System (TSMS) states: “Procedures must be in place to ensure safety of property, the environment and personnel.” But what procedures must be in place? This is where risk assessment comes into play....

What are the most dangerous evolutions that occur? How have people been hurt in the past? What caused a spill?

If a tugboat company handles lines all day every day, and parting lines pose a real and significant danger to crews, the company’s SMS should contain procedures based upon the line manufacturers’ specifications, inspect the lines regularly and know when they have become unserviceable....

Even if an auditor or government inspector doesn’t catch these omissions, the courts may. In a recent court decision involving a deckhand that was crushed to death in a capstan during a swing manoeuvre, the vessel was found to be “unseaworthy.” This ruling made the tug owner strictly liable under general maritime law. It was determined that the owner failed to adequately implement procedures and guidelines that would have provided the crew with the training, skill and knowledge to perform the maneuver safely.

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Hence, my suggestion is to don't buy a TSMS off the shelf. Get someone to facilitate the development of one specific for your company and make sure your best captains are involved in it.

One problem is complacency; old skippers saying, I've always done it this way...there is no reason for this to occur other than negligence

**REPLY TO QUESTION 2**

**Personnel Injury Risk**

Risk of personal injury is high. Recent studies indicate that the one of the largest risks to personnel is falling over the side into the water.

Owners and tug masters should have a Clear Deck policy that does not allow personnel onto the towing area when the unit is being towed.

Personnel working on tugs have a responsibility for their own and their colleagues' safety. They should:

- Wear approved personal protective equipment (PPE) (hard hat, safety footwear, high visibility clothing etc). Personnel not wearing the correct PPE are exposed to increased risk. Tug masters should demand that their crews wear the appropriate PPE.

- Wear approved and appropriate in-date self-inflating lifejackets whenever on deck. Not using a lifejacket when working on deck, boarding, tying up or connecting up a barge can be hazardous.

- Ensure that working areas are safe and free from trip or slip hazards, particularly around bollards.

- Remain alert to the ongoing operations.

- Listen to orders from the tug master.

- Hold a line by the side of the eye or the standing part.

- Be aware of lines (towing or mooring) suddenly coming under tension.

- Stay clear of snap back zones.

Other factors that can impact on the safety of crew during a towing operation include:

- Fatigue should not be underestimated and it is now acknowledged that many incidents occur where fatigue is a factor. Local and international regulations may apply to the working hours of the crew. The international rules for working hours are regulated by the IMO Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), amended in 2012. These require a minimum of ten hours of rest in any 24 hour period; hours of rest may be divided into no more than two periods, one of which shall be at least six hours in
length. These regulations may not apply to non-international trading tugs, but in the absence of other guidelines could be used.

- Poor weather increases the risk to a towing operation and has to be properly assessed by the tug master. It is better to abort an operation than risk life.
- Night working requires additional vigilance and good lighting.
- Danger from damaged tow lines or equipment.
- Working in rivers or tidal areas is particularly hazardous due to strong currents and unexpected change of current direction.
- Working alone.
- Failures to communicate effectively.
- Tug working decks should be non-slip in the working areas, well lit with obstructions, trip hazards and snap back zones highlighted. Steps and ladders should be in a good condition with non-slip steps painted in a light colour to be easily visible at night.
- The tug shall have means of recovering a man overboard (MOB) either by a rescue boat or a MOB device such as a Jason’s Cradle when the tug can actually pick up the casualty alongside.

Communication

Communication equipment on board both the tug and the towed unit must comply with the requirements of the administration.

Attention should be given to the communication equipment on board a manned towed unit. This should include at least two portable VHF radio telephones and a daylight signalling lamp. If the towed unit is boarded at least two VHF radios should be available.

Lack of effective communication is often a factor in the cause of accidents. Effective communication must include:

Good communication between the wheelhouse, working deck and engine room. The use of pre-towing briefings (tool box talks) is essential.

Good communication from the tug to the port/river authorities to keep the tug updated on hazards and traffic movements.

Good communication with the tow master and the towed unit.

All personnel must understand any agreed hand signals.

Equipment Maintenance

Mooring winches, capstans, windlasses, mooring lines and mooring fixtures and fittings must be properly maintained and periodic maintenance undertaken as prescribed in the planned maintenance system.
Routine maintenance should include regular visual inspections of all equipment, greasing of grease nipples on moving machinery and of rollers on fairleads and pedestal fairleads. Open gearing and clutches should also be suitably greased with an appropriate dressing. Brakes should be closely examined to ensure all linkages are working correctly, brake band material thickness is adequate and the condition of the brake lining is satisfactory.

Clutches should operate smoothly and pins for securing the clutches should be attached to the clutch control levers ready for use. Winch control levers must be marked with the direction of operation for both paying out and heaving in. Drum ends should be kept free from damage, rust and paint, and machinery bed plates should be periodically inspected for deterioration or damage.

It must be ensured that mooring fairleads are all turning freely and that their surfaces are free of rust or damage that could abrade the mooring lines. The integrity of all mooring equipment such as bits, pad eyes and leads should be closely examined.

Information on mooring line care and maintenance can be found in Risk Alert 07.

Prior to mooring operations commencing, all equipment should be visually examined for any visible defects and machinery tested. Any defective equipment must be taken out of service.

**Personal Protective Equipment**

All personnel engaged in mooring and towing operations should wear the correct personal protective equipment. This should be detailed in the vessel’s Safety Management System and will include high visibility coveralls, a hardhat with chin strap, safety shoes or safety boots, gloves and in colder weather suitable high visibility warm clothing. Personnel on the forecastle should have safety goggles to hand in case the anchor has to be let go in an emergency. The use of gloves for mooring operations is an often debated topic, the best advice being that gloves should ideally not be too loose fitting so that they do not get trapped within ropes on drum ends. Gloves should always be used when handling wire ropes due to the possibility of hand injury arising from broken wires.

**Tug Operations**

Personnel standing by forward and aft will be advised by the bridge when tugs are to be utilised, they will be informed when and where tugs are to be made fast and whether a tug’s line or ship’s line is to be used. In most instances a tug’s line will be used, but if a vessel’s mooring line is to be utilised it has to be confirmed that this has a minimum breaking load (MBL) that is at least twice the bollard pull of the tug, to allow for any possible dynamic snatch loadings that may be imparted during the towage operation. Vessels’ lines used for towage must be in good condition with sound splices and without short splices within their length.

When heaving lines are used to pick up the tug’s messenger line or to run lines to the berth these should be made up with a Monkey’s Fist that does not contain any additional material or weight.

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This is to reduce the risk of injury in the event of it striking personnel on the tug or ashore. Personnel on the tug must be directed to stand clear whilst the heaving line is being thrown to the tug’s deck.

Once the towing line is made fast the tug must be informed that the line is fast and that weight can be applied. All crew must be standing clear in a position of safety as tension may come on the towing line suddenly with little warning.

Tugs’ lines used for towing the vessel must be placed with the eye over the post of a mooring bitt, and vessels’ lines used for towing should be laid up on bitts. The bitts used must have a safe working load in excess of the expected dynamic loads in the towline. The safe working load of the bitts should be prominently marked.

Whilst engaged in towing operations, crew should keep well clear of the tow line as it may come under tension suddenly and crewmembers must ensure they remain in a position of safety clear of the area where the line would snap back in the event of it parting whilst under tension. Lines will generally snap back in an area based along the line in which it was leading. If led around a bollard or pedestal the line may snap back and whip around the bollard or fairlead in a much wider arc.

Tugs’ lines should only be let go when the order to do so is received from the bridge. Once the tow line eye has been removed from the bitts the tug should be signalled that recovery of the line can commence. The tug’s line should be lowered under control with the messenger tended carefully whilst the tug heaves in his line.

The person tending the messenger must ensure they are standing clear of the loose messenger line flaked on the deck. Once the tug has recovered his towing line on deck, the messenger should be tended so far as possible whilst the tug crew are recovering it on deck.

Towing lines and messengers should not be let go and dropped into the water as this can lead to problems as one of the following case histories shows.

Case History

A crew member standing by aft on a bulkcarrier had his foot severed by the 20mm messenger line attached to the tug line whilst releasing the tow. The tug had been instructed by the pilot that the line had been released and then heaved in the towline, a crewman on the tug then went to pull the messenger line in manually but it became tight. The injured crewman on the bulk carrier had been slacking the messenger line that was turned around a mooring bitt post on deck. It would appear that he was standing in the bight of the messenger line. As the towline and messenger line were being recovered on the tug her engines were idling, however the bulk carrier went from slow to half ahead placing strain on the messenger line which trapped and severed the crew member’s foot. In addition no hand signals were received by the tug from the vessel’s poop deck when recovering the towline.

The only instruction that the towline could be recovered came from the pilot.

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Case History
A tug was involved in unmooring a vessel and was made fast to her starboard bow using a line from the tug’s stern. After pulling the vessel clear of the berth and then astern into the river and turning her, the tug’s line was let go. The ship’s crew were supposed to lower the tug’s line under control, but this was not done and the line was released while the three crew on the tug’s after deck were retrieving the line by hand. As the ship went ahead the Master on the tug’s bridge went astern to keep up with the ship, thinking the line was still being lowered and unaware the line was actually all in the water. With about 5 metres of the towline, along with a messenger and heaving line still outboard and in the water, the towline became caught in the tug’s starboard propeller. As this happened, one of the deckhands laid up the towline on a cleat on deck to stop it all being taken around the propeller. The line subsequently went tight and struck one of the crew, it briefly went slack and then tight again and struck the same crewman once more. He sustained serious knee and chest injuries.

Mooring
The bridge will advise which side the vessel is to berth alongside, the number of headlines/stem lines, breast lines and springs that are to be deployed, and which line will be the first line to be sent ashore, both forward and aft, and how this is to be sent ashore, be it by line boat or heaving line. Anchor lashings need to be cleared away along with hawse and spurring pipe covers, and the anchors made ready for letting go. When it is not possible to let go the anchor ‘from the pipe’ the anchor must be walked back clear of the hawse pipe and put on the brake and the windlass taken out of gear so that is ready for use in an emergency.
Sufficient lengths of mooring line for the intended operation should be taken from the winch drums or loose coiled ropes and be flaked on deck prior to arrival ready for running to the berth. When running lines it is bad practice to attempt to stand on a line to stop it running away.
When heaving lines are to be thrown to the berth the linesman ashore should be alerted to the fact. When heaving lines are being returned those on the deck must be alerted that a heaving line is being thrown back to the deck.

When line boats are used to run lines, care must be taken when lowering ropes that these are lowered under control at all times and are not let go to fall uncontrollably into the line boat.
When drum ends are used to tension lines, two personnel should be engaged in the operation, one tending the line on the drum end and one coiling the rope on deck as it is heaved in.
Three turns around the drum end should suffice for heaving; however, on whelped drums more turns may be necessary. The rope should not be surged on the drum end to prevent the rope melting and

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fusing on the drum end. Once adequate tension has been achieved, the rope should be stoppered and laid up on the mooring bitts.

With fibre ropes the stopper used should ideally be of the same material as the rope being stoppered, with synthetic stoppers for synthetic lines and natural fibre stoppers for natural fibre lines. The MBL of the stopper should be around 50% of the MBL of the line being stoppered.

Polyamide (nylon) stoppers should not however be used on polyamide lines due to the low coefficient of friction of the material. Wire ropes should be stoppered with a chain stopper with a widely spaced cow hitch being used and the tail of the chain wrapped around the wire against the lay. A clove hitch must not be used as this may damage the wire. When laying up the line onto the mooring bitts, the first one or two turns should be taken directly around the first post of the bitts or around the outside of both posts before the rope is laid up in figures of eight around the bitts. Once a rope is laid up on the bitts, the stopper should be released from the rope. Ropes should never be left on drum ends when not being tensioned; they must always be laid up on the bitts.

Split drum winches are designed so that the line under tension is on the first wrap on the drum providing maximum holding power. When transferring the mooring line from the storage side of the drum to the tensioning side, care has to be taken when manoeuvring the line through the gap in the drum divider. Personnel should stand so that they are pulling the line from the storage side towards the tension side rather than pushing, which has the risk of the line springing back towards the crewmember pushing it and possibly causing injury.

Once the vessel is at fast alongside, the anchors need to be secured by placing the guillotine bars in place across the anchor cables.

Some vessels are fitted with winches that have a self tensioning or automatic mode. It is recommended that these are not used in the self tensioning mode when connected to a shore manifold or when space ahead and astern is limited, as there have been instances of vessels creeping along berths due to the prevailing environmental conditions.

As can be seen in the following case studies, the poor condition of mooring ropes coupled with personnel standing in snap back zones can sometimes prove fatal when ropes part.

Case History

While a 15,000 GT container vessel was engaged in mooring activities one of her mooring lines parted and the snap back of the line was so powerful that it struck two shore linesmen, one of whom was killed and the other seriously injured.
Case History
During unmooring operations on a 6,000 GT inter island RORO ferry a member of the ship's crew was seriously injured when a mooring line parted and the snap of the line struck him so as to cause serious head, arm and leg injuries.

Unmooring
When letting go, lines should be released and heaved onboard in accordance with instructions received from the bridge.
Once the order is given to let go the remaining lines these should be promptly slacked and then heaved in once let go by the linesmen. Once they have been let go from the shore bollards the bridge should be advised of the fact. The bridge must also be advised once the lines are clear of the water and it is safe to use the propelling machinery and thrusters.

Anchors are to be secured once the order to do so is given by the bridge, and the bridge informed once the anchors have been made fast with all lashings for the sea passage applied and hawse and spurling pipes covered.

Record Keeping
As a minimum the tug should keep a towing log as well as other logs and records required by the flag state. It is important that good records are maintained. In the event of an incident these are referred to in detail and are important in supporting the tug master's description of events and defending a Member's position in the event of a related claim.
PARTICIPANT 5

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REPLY TO QUESTION 1

Effective OHS&E requires building an environment where people are highly motivated because it is dependent on community interest to achieve the promise of the theory...

The elements of a successful safety program extend beyond the systems, policies and procedures to include the perceptions, values and actions of its participants...

The promise of a systematic safety program is to achieve the wellbeing and safety of all employees; however the promise will not be achieved without a commonly held goal and without motivated and diligent application....

Why a Safety Culture? ... the most sophisticated safety system is useless without a supportive culture...

Today, most organisations will have a safety infrastructure comprising policy, procedure and safety hardware. All this is designed to protect employees and third parties from harm. Safety Management Systems are carefully drawn up and regularly reviewed to ensure that they are effective and that they comply with legislative requirements. Often these systems are elegantly presented and may even be accessible through intranet technology. The fact is they are useless in achieving 'the promise of the theory' if left on the bookshelf or in the computer files.

So, if the safety system is the machine or tool, the safety culture may be described as being what energizes the machine or, what makes it do the job for which it was designed.

For a set of values to become a culture they must be held by more than the individual, indeed, for a culture to exist it takes a common commitment by the overwhelming majority of the members of the organisation. So we can say that for a safety culture to exist in any Company there must be, across all levels, the same perceptions, values, goals and commitments, as well as practices, to ensure that the safety system achieves its potential.

.........What defines a Safety Culture?

The overriding feature of a successful culture is that people believe in it. There must be a commonly held belief that it is a worthy culture, i.e. it has value, and that it is an effective culture, i.e. it works.

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People have to think and act the OHS policy, not merely comply with it........
Rather than mere compliance out of duty or fear, a vibrant safety culture will consist of informed participants. ....There are four main features of an informed and participative culture of safety. Those features are; a reporting culture, a just culture, a learning culture and a flexible culture.
The crucial feature of an informed culture is that it is a reporting culture, one in which people are prepared to report their errors and near misses. The issue is not whether the organisation has a reporting system, it is whether, as a matter of practice, errors and near misses are reported......
The success of a reporting system will depend on whether the culture is deemed to be just. A just culture is one where punitive measures are reserved for proven instances of purposeful malpractice or neglect. A learning culture seeks to take the details of a report as instructive, using the lessons presented to improve procedures and practice. Finally, a flexible culture is one that can readily adapt to changing circumstances and needs.
.........Looking beyond the workplace.
Everyday work practice is also affected by influences from outside the workplace. The way we behave away from work is likely to sway the way we behave at work. We come to work as whole people carrying all our baggage. In order to be consistent, we need to assess our attitudes to the importance of safety in our private lives. This will mean looking at our homes, our road use and our recreation.
.........Introducing a focus on non-work related factors builds the health and safety culture by emphasising the importance of human wellbeing not just worker wellbeing........
.....What we need to ask.
Is my safety, and that of those around me, important 24 hours a day?
Am I an informed participant or do I merely cover my a$$?e?
Does the OHS Policy of my Company state values, goals and commitments that are worthy?
Do the actions of my Company, at all levels, demonstrate commitment to worthy goals and values?
The answers to these questions will help to reveal whether we have a culture of safety or just a safety system.

Safety Management
Although many towing companies are not required to comply with the ISM code, it is however recognised that implementing an SMS is consistent with good practice. A structured and recorded system of an appropriate size to the operation not only improves safety, and protects the employees but also protects the owner/operator. It is difficult to comply with accepted good practice if no SMS system is in place.
Experience shows that accidents often occur during routine operations and an SMS assists to identify the risks, allowing important lessons to be learnt so they will not be repeated.

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REPLY TO QUESTION 2

Risks are increased with:

- Poor planning.
- Poor communication.
- Poor supervision.
- Failure to appreciate the dangers of a task or operation.
- Lack of experience or knowledge.
- Misuse of equipment.
- Taking of short cuts, possibly due to commercial pressure.
- Unpredictable environmental factors such as weather, tide or current.
- Changes or unappreciated factors of the tow, such as cargo shift.
- Unexpected events, such as equipment failure or unusual traffic movements.

Effectively managing the human factor can lessen the exposure to accidents. A safety management system allows a company to put into place the building blocks for reducing incidents of human error...others are..

Girling, girthing or tripping (GGT)

The terms mean the same thing and refer to the situation when a vessel, usually a tug, is towed broadside by a towline and is unable to manoeuvre out of this position.

This phenomenon is known to all tug masters. It is the most prevalent reason for tugs to capsize and can cause fatalities. This occurs at either end of the tow and can happen very quickly. Rarely does it happen slowly enough to allow all of the crew to leave the tug before it capsizes. Tug masters must be aware of the phenomenon and understanding the quick release to the tow wire is essential if disaster is to be averted....

GGT is particularly relevant to conventional single screw tugs. Tractor and ASD (Azimuthing stern drive) tugs are less likely to girth because their tow is self-aligning and the tug master is able to produce significant thrust in all directions. It is clearly understood that towing from a point near amidships on a conventional tug is inherently unstable and can result in situations where the load on the tow rope can heel the tug over to a large and dangerous angle.

Various organisations have issued advice, recommendations and investigation reports into girthing incidents.
A recurring feature of these accidents has been that, once girded, the towboat capsized so rapidly that crew members were unable to operate the tow, abort control or make use of lifesaving equipment.

The use of well-established towing arrangements to prevent girding may not always be effective in certain confined areas involving smaller towboats. In such cases potential dangers can best be avoided through careful planning and by each crew member being vigilant. A back-up strategy should always be considered in advance if, because of unusual or unforeseen conditions, a particular manoeuvre or action is not having the desired effect.

A review of girding incidents has shown that a towboat carrying out routine tasks in close proximity to the forward end of a barge under way is particularly at risk. At such times it is essential to ensure that the manoeuvrability of the towboat is not compromised by the weight and motion of the tow.

Tug masters should consider practical measures which might be adopted to avoid being placed in a girding situation.

Girding can occur for a number of reasons including:

The ship or barge being assisted turns or shears abruptly away from the tug.

The speed of the vessel or barge being towed is too high, either intentionally or due to external forces such as increased currents or windage on a towed unit.

The tug is too far astern of its intended position compared to the speed of the vessel if the tow is moving ahead, or too far astern if the tow is moving astern.

The design of the tug, hull form and propulsion arrangements can affect performance in a girding situation. It should be noted that in some ports the ship’s speed is restricted to as low as 5 knots whilst making the tow connection.

If an approach is made to a fast moving unit there is the danger from the hull interaction which can cause the tug to be sucked to the towed hull. As a rule the interaction force increases by the square root of the towed unit’s speed.

The conventional tug is particularly vulnerable to girding when acting as the stern tug or as a brake at speeds above approximately 3 knots in a towed situation. To minimise the risk of girding a gob wire or similar arrangement can be used. When the tug is fast ast and used as a brake the tug master should concentrate on the following:

Risk of girding increased due to changes in the speed and/or course of the towed unit.

The tug is often out of sight of the lead tug or bridge of the assisted vessel and therefore good communication is essential. On a conventional tug a gob wire is recommended, pulled down as far aft as possible.
Gob/Gog wire or rope

By shifting the tow point aft or by using a gob rope or wire tow stability can be improved on conventional tugs. A gob wire or rope, sometimes referred to as a gage rope or bridle is a short wire or rope made fast to the towline at the after end of a tug. In this way the use of the gob wire effectively moves the towing point aft, closer to the tug’s stern. This gives the tug master greater control and allows more maneuverability to prevent getting when the tug is acting as a stern tug. Some port authorities make it a requirement that a gob rope is used by all conventional stern-drive tugs.

A gob wire can be rigged in a number of ways including the two ways which use a length of wire secured to the tug that passes through a fairlead or appropriate bollard on the centre line of the work deck. The end of the wire holds a large shackle which is attached around the towline. The large shackle is free to slide along the towline. When the towline moves towards the tug’s beam, the bridle wire comes tight and keeps the towing point aft and close to amidships. Another method of rigging a gob wire is to have a separate gob wire winch with the gob wire leading through a swivel positioned at the centreline at the aft end of the tug. A shackle is used to slide along the towline and the winch is used to vary the length of the gob wire. Obviously this cannot be varied when the gob rope is under tension.

If a single wire or chain gob wire system is used the connection point should be on the centreline of the tug and the length of the gob wire should not exceed half the distance to the protection rails or side bulwark.

If a fixed towing pod is used it should also be on the centreline, in line with the towing winch drum and have a bend radius at least ten times the diameter of the tow wire.

It is important that the shackles and wires used are appropriate for the operator, certified and in good condition. Some small tugs or work boats may be fitted with centreline rings fitted into the aft part of the main deck from which the gob wire can be attached. These should be certified for use to take the weights applied and regularly checked to be in a good condition.

Other methods can be used to prevent a towing wire moving onto the tug’s beam. For example, the fitting of stop or tow pins positioned on each quarter.

The use of the gob wire still requires the emergency quick release system to work correctly. The method of quick release must be known to those who are likely to be on the bridge. Small work boats towing without the facility of a quick release system should always have a cutting axe nearby should the tow line need to be parted quickly.

Bridles or gobs should only be adjusted or released under the direction of the tug master during towing operations.
Emergency quick release systems for towline

Most tugs are designed with emergency quick release systems which either trip the hook or release the brake on the towing winches so as to take the load off the towline and allow the tug some more time to regain control from a potential gittering situation. These release systems are usually capable of being remotely activated from the bridge. There are also manual override arrangements available at the winch/hook in case of failure of the remote control. Crew members should familiarise themselves with these ship-specific arrangements, including limitations if any, as soon as they join the vessel. It must be borne in mind that these emergency quick release arrangements may not always release instantaneously due to various contributing factors such as the direction of pull, the heeling angle etc. and hence allowance must be made when contemplating its activation.

The effect of wind

Not appreciating the effects of the wind when towing can result in collisions, groundings, towlines parting, injury and gittering. The wind causes headings to change, speeds to increase and a towed craft to drift.

Manoeuvring can become difficult if the wind increases or changes direction suddenly. Tug masters should always be aware of the potential effects of the wind before a tow commences or before commencing the next part of a towing operation. Knowing the forecast or local weather conditions is essential.

The effect of current

Mariners will be aware of the effects that currents have on a craft being manoeuvred in water. The effects of current in open waters are less important than the effects in confined waters which can be significant particularly when manoeuvring in busy waters or rivers. The speed and direction of currents are also unpredictable, reasons include; changes in tidal direction, sudden water flows at river mouths due to rains or ice melt, constraints such as narrows, reefs, breakwaters and harbour walls. The effect of squat in shallow water can be considerable, particularly for large barges with a flat hull form.

Current direction can be influenced by:

- Bends in rivers or configuration of channel or river entrances.
- Shallow water.
- Man-made constructions; piers, berths, breakwaters.
- Bridges with pillars.
- Industrial cooling water outlets.
- Geographical obstructions such as islands.

Currents can also help manoeuvring, for example:

- To control speed when approaching a berth.
- To assist a tug and tow to move sideways.
- To assist in a turn.

River tugs work where currents can be strong and changeable over short distances. Over the width of a river the current strength may vary. The outer parts of the river may be faster flowing than in the centre. The more forceful current at the starboard bank impacts on the port quarter and as the vessel turns the bow is in a less strong current and so there is a turning moment to port. This effect can be sudden and the effect should not be underestimated. The Club has unfortunately suffered many incidents where this has been the case and contact has been made with installations on the river bank. Navigating in water where there is a constant current could be safer.

The act of assisting a tow to berth or un-berth needs to take account of the current. It is usual for a river berth to lie in the same direction as the prevailing current so that the current can be used to assist with berthing.

A berth can be approached bow into the current to give a relatively high speed through the water with a reduced speed over the ground which will provide good steering because of the good water flow over the rudders. The towed unit is also easier to stop and the current can be used to assist the tow alongside the berth. Currents in some locations can be complex and changeable so again local knowledge is essential.

Berthing in a following current is difficult and potentially dangerous since the tug and tow must develop sternway through the water in order to be stopped over the ground. In these circumstances, control of a conventional tug will not be easy and an approach into the current is possibly the best method of nearing the berth.

**Other concerns affecting manoeuvrability**

**Wash effect:** this is when the wash’s contact with the towed object/berge reduces the pulling effectiveness of the unit. Factors that can contribute to this are:

- Small under keel clearance of the assisted unit.
- Hull form of the assisted unit.
- Length of tow line.
• Area of operation – confined areas will increase the wash effect.

Under keel clearance: If the under keel clearance is small the propeller wash effect is increased reducing the tug’s pulling effectiveness. Obviously pulling a barge or a vessel that is effectively aground or stuck in mud will increase the tension in the tow line. The suction effect can cause unexpected dangers as the barge can come clear of the suction effect of the mud and become free suddenly. Tugs’ crews should be aware of this possibility and stand in a place of safety.

Squat effect: is often applied to ships, but any moving craft through the water can be affected by squat. The effects of squat are greatly increased by speed and if operating in waters of a confined width and may result in the change to the vessel’s headings and the possibility of the towline shearing.

Length of towing line

The less water under the keel the more power the tug will need to apply. This will increase the wash effect and a longer towline can reduce or avoid the wash effect.

A short tow line in a confined area can produce a significant wash effect. Tractor tugs pulling over the stern and ASD tugs pulling over the bow can reduce the wash effect since the propellers are further away from the towed unit’s hull.

Shortening the length of the tow

Very often, the tug and barge transit through waters where the sea room is restricted. The master then must consider shortening the tow wire to ensure better control of the barge. The length of the tow wire is at the master’s discretion depending on the prevalent situation. The shortening of the tow should be carried out preferably in deep water, weather permitting, and most certainly before entering congested waters. The shortening in deep water reduces a lot of wear and tear in the wire which it would have endured with dragging on the seabed. However, if the weather is severe, then there will be no choice but to defer it to as late as possible.

It is recommended that the length of the tow should not be too short as if anything were to go wrong, the tug will not be able to manoeuvre out of the barge’s path and can result in her coming into contact with by her own tow. If the tug has a wild tow on a short wire, the master should call for assistance without further delay to bring the barge under control. When on a short wire, utmost caution must be taken to avoid sharp alterations or else the chances are that the barge may violently swing out of control. If this happens then the master should immediately consider paying out some length of tow wire to dampen the violent movement.

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Establishing the tow connection

There are no strict rules to making fast the tow. Each tow will be different; the barge size, shape, draught, weather, current strength, light or location will vary. Prior planning will make the operation safer. A briefing between the tug master and his crew on how the job is to be approached is vital. Before arrival at the connecting location effective communications should be established between the tug and towed unit if manned. Ideally, a risk assessment would be in place. Tug speed should be adjusted for a safe rendezvous and connection.

If the tugs crew are required to access the towed unit plans must be made so that it can be carried out safely in the prevailing circumstances.

Position of barges

If the tow consists of a number of barges with different loads, sizes and shapes, the barges should preferably be arranged by similar size and design, with similar sized barges as the lead. If possible, loaded barges should be placed first with empty barges astern.

Tow ropes should be similar sized and of the same material, secured to the barges in equal lengths, with the same number of turns so that the tow ropes can be equally rendered if necessary and the stretch is similar. Where more than one barge is towed the remaining barges can be bundled into ranks using rope breast or stern lines.

Towing alongside

When a barge is to be towed alongside the tug, the connection should be made with a suitable heavy spring and a stern rope. The tug should be positioned close to the stern of the barge so that the tug’s stern overhangs the stern of the barge. The further forward the tug is positioned the more difficult it is for the tug to steer the combined unit. Barges should be made fast to each other with the use of non-jamming turns so that they can be released if necessary. Picking the best leads is also important, particularly when the barges are of a different size or height.

Pushing ahead

Tugs will regularly have to push barges ahead even though they may not be specifically designed to do so. It is recommended that the barge is secured to the tug using winch wires attached to corner bollards of the barge/s so that the whole unit can be operated as a single unit. There should also be
two substantial ropes made fast to the tug's centre bollard and the barge's port and starboard quarter bollards.

**Double taws and tandem taws**

In this booklet a double tow refers to the an operation that is undertaken with two wires from two towing drums, or in the case of a tug with a single drum winch using a Canadian link and an under rider to the rear barge. The term tandem tow is often taken to be referring to in-line or series tows where the rear barge is connected to a bridle on the aft end of the forward barge. This set-up is not suitable for ocean tows. The control of the barge's relative motions can be lost in a seaway and snatch loads can part tow wires, not to mention other problems with the tracking or over-running of the barges. This method of towing is regarded as suitable only for rivers and sheltered inland waterways. The term tandem towing has also been used for tows with two or more tugs attached to a single towed object. This terminology is commonly encountered when multiple tows are proposed.

Having established a set of criteria for setting up double tows, i.e. either two wire set ups or under riders, the methodology of the tow becomes somewhat clearer. Obviously the making up and breaking up the tow at each end of the voyage is more complex than single tows. It involves factoring in the planning of the roles of the assist tugs, weather and sea conditions, setting up the gob arrangement, water depths and crew skills as well as equipment selection for the tug and the barges including the barge's main and emergency gear. Procedures during the passage such as catenary management, freshening the nip, control of the gob arrangement and tracking of the barges are all skills which require experience and intuition rather than ones that can be set out in formal text.

**Single wire under rider taws**

The single wire/under rider taws (often referred to as Honolulu or Christmas tree rigs in some areas) have several benefits when compared with tows from two separate towing drums. The make up and break up of single wire tows can often be less complicated than a two wire tow. The gob arrangements, chafe protection and freshening of the nip are simplified and some masters maintain barges track better with an under rider to the second barge compared to a two wire tow.

This type of tow does require some specific features on the tug, being the Canadian Link permanently fitted in the tow wire and the winch spooling gear designed to allow the link to pass through the rollers and wind onto the winch drum. The main drawback to this system lies in the vulnerability of the tow if the tow wire parts, leaving two barges adrift and still connected to each other.

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Two wire tows

With a two wire tow the exposure from a wire parting is reduced to one barge adrift while the second barge remains under tow. However, the makeup and discharge of the tow can be more complex and wire management on deck requires more planning with two gobs, two chafing sleeves and routine freshening of the nip. The daily work load on deck increases with the efficient monitoring and managing of the tracking of the tows and the position of the wires. This requires skill and experience from the tug master, crew and officers.

During the tow

In addition to the normal navigational and collision avoidance duties, the watch keeper has to ensure that the tow wire and tow are positioned correctly. The tug master should ensure that those carrying out wheelhouse duties are aware of the requirements of the towing operation. This should be written down in the tug master’s order book or as part of the standing orders. The tug master should always be satisfied that his watch keepers are aware of how to use the towing winch and its quick release system correctly.

These instructions may also include:
- In what circumstances the tug master wants to be alerted.
- In what circumstances the watch keeper should shorten or lengthen the tow line.
- Appropriate engine revolutions.
- In what circumstances and how often the watch keeper should freshen the tow line particularly in heavy weather.
- What length of tow wire and catenary should be maintained.
- Precautions to take in different water depth and weather conditions.
- Attention paid to chafing or friction in the towline; position of protectors or regularly adjustment tow wire length.
- Towing speed and headings to be maintained.
- Vessel Traffic Service and security communication if appropriate.

During the voyage the duty officer on the tug must also keep watch on the barge. One easy way to determine that the barge integrity has not been compromised and is not taking in water would be to paint the barge with a strip of high visibility paint at the waterline on the bow before commencement of the voyage. This would be a good benchmark for the duty officer to observe during the sea passage and so long as he can observe this line above the water, it can be safely concluded that the barge’s draughts have remained the same.

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### PARTICIPANT 6

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### REPLY TO QUESTION 1

Tugmasters...bear a responsibility for the safety of vessel and crew. This responsibility extends to those around them, the ships and crews, and to other users of the waterways on which they operate. A successful outworking of this responsibility means they all get to go ashore both fit and well.

Safety is a very broad subject on board a vessel and extends from the most mundane routines of ship’s husbandry to the most complicated aspects of vessel operations. In its most basic and immediate sense it is as simple as think before you act. In the broader context it means managing the things we can control and planning for the things we can’t.

There are many factors which have an influence over the way in which we ‘do’ safety. Not the least of these is culture and values. We have experts from many different backgrounds. This means that the concept of what is acceptable risk vary.

Organizations such as the International Labour Organization (ILO) through its ‘Safework’ program, The International Maritime Organization (IMO) and the International Transport Workers’ Federation (ITF), are seeking to bring about a global perspective on safety at work. Culture and values will certainly influence our attitude toward safety. Attitudes are a primary factor in the success or failure of safety programs. Attitudes that say ‘we’ve always done it that way,’ ‘it costs too much,’ or ‘it’s too slow’ predicate failure. ...Whereas attitudes that adapt to change and learn from experience are necessary for success.

### REPLY TO QUESTION 2

Training for safety.

One of the cornerstones of a successful safety program is that all participants are well trained. It cannot be expected that the uninstructed person will have an understanding of the hazards and risks involved in an occupation. Without that understanding mistakes are inevitable. Therefore it is important that training programs are implemented at all levels and disciplines. It is important to...
ensure that in the hurly burly of high pressure operations, as well as in the doldrum of routine; when we are too stressed or tired to think on our feet, that the safe option becomes the default.

I well recall taking command of my first tugboat, a small single screw wooden vessel engaged in port services. The attitude of management then was, ‘you’ve got the ticket, do the job’. So, left to my own devices, I learned more from the kindly old deckhand than from any of my peers. Thankfully attitudes have changed, but not everywhere. Any Master taking command of a tug should not be expected to do so without first being trained to operate the vessel safely.

Communicate.

Another cornerstone of safety is effective communication. Safety has no secrets. The old attitude of knowledge is power sought to contain knowledge. A better attitude is knowledge empowers, where the sharing of knowledge gives us all a better understanding of what is going on and what is required to work safely and efficiently. In an occupational health and safety aspect we need to ensure that the deckhand is aware of the right way to carry out a task. In an operational safety aspect it is important to communicate with crew, pilots, authorities and other vessels to ensure that the full picture is apparent to all.

Managing safety.

The fundamental elements of safety management are hazard identification and risk management. Hazard identification involves examination of a task in its elements to assess where it could go wrong. Effective hazard identification involves training, experience and communication. Safety Management Systems use tools such as Job Safety Analyses (JSA) and checklists to aid in hazard identification. Risk management involves assessment of the severity of the risk and implementation of risk control measures. The severity of risk is most often determined by evaluating the likelihood of a situation occurring and the expected outcome of such an event. A risk assessment matrix is a common tool used. Risk control means developing and implementing ways to ensure the hazard is not allowed to become an event. This is done by adopting the highest level controls from a hierarchy of control measures that range from elimination of the hazard by doing the task differently (or not at all), down to the use of personal protective equipment. Most often effective control will involve a selection of measures from various levels.

The application of managing what we can control and planning for what we can’t is usually achieved through the use of the safety management system, i.e. standard and emergency procedures. Masters and crew alike should be well versed in these procedures which have been developed to facilitate.
safe operations and work practices. The safety management system should include a process to be adopted for use when the unusual task presents, i.e. the JSA.

Leadership

Tugmasters need to show leadership in all areas of operation, it is fundamental to their position and role. The key to developing a successful culture of safety onboard is leadership. Leadership must be displayed by Masters and supported by shore management. Before leadership can be displayed it is necessary for the leader to believe in, and be committed to, safe work practices and operations. This means that ‘cowboys’ need not apply! There is an old attitude which says that a concern for safety is less than manly and that real men just get on with the job. Among today’s tough tugboatmen such attitudes can still be found. It is my belief that toughness should be tempered with humanity and a concern for those we work with.

Safety makes sense (and cents)

A good safety record is now regarded as a commercial asset. It can help to win tenders and maintain contracts. Getting the job done safely means a gain for efficiency. Accidents have a commercial cost; but more than that, accidents disrupt, and sometimes steal, the lives of fellow mariners. They also have ongoing ramifications that will affect the lives of managers and supervisors, workmates, and family members. The sensible approach is to take action to avoid accidents at the outset.

PREPARING FOR TOWAGE OPERATIONS

a) Planning and Coordination

Before beginning towing operations, a comprehensive plan, as part of the ship’s port passage plan and the Pilot’s own plan, should be agreed by the Master and Pilot, where a Pilot is embarked. This should take account of all relevant factors, including tide, wind, visibility, ship size, type and characteristics, and specific berth requirements. A good knowledge of the type and capabilities of the tugs allocated to the job is important, in order that the Master / Pilot can ensure tugs are both suitable for the task ahead and positioned on the vessel so as to be most effective to facilitate a safe operation.

Any conflict or mismatch between the required manoeuvre and the tugs allocated must be resolved before the towage operation begins. Responsibility for co-ordinating a towage operation lies with whoever has the conduct of the vessel being towed, be that the Master or the Pilot. Communication

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with the tugs will be through the pilot. When berthing and unberthing, it is the duty of the Master / Pilot to ensure that the vessel is handled in a safe and controlled manner, having due regard to the safety of all those involved, including the assisting tugs, line-handlers or mooring gangs and other port users as appropriate.

The number of personnel employed in any towage operation should be determined having due regard for the size of the vessel and the prevailing operational and environmental circumstances. In all cases, sufficient manpower should be provided to ensure that individuals are not exposed to undue risk, and that the operation can be conducted safely and efficiently. Due regard should also be given to the size, weight and scope of the towing gear and lines to be handled.

All those with a responsibility for personnel or equipment involved in assisting the towage / mooring of vessels have a duty to ensure that safe working practices are followed, and that associated equipment is fit for purpose. They should also ensure that those involved are properly trained, adequately briefed in their duties and issued with, and use, suitable and effective personal protective equipment (PPE).

b) Pilot/Vessel Master Exchange

In addition to the standard information passed to the Pilot, it is recommended that the Master provides the Pilot with a plan showing the layout and safe working load (SWL) of the mooring fittings and inform him:

- which fairleads, chocks, bollards and strong points can be used for towing;
- the SWL of this equipment;
- areas of hull strengthened or suitable for pushing by tugs and relevant identification marks employed;
- any special features (e.g. controllable pitch propellers, thrusters etc.);
- power available at fairleads

The Pilot should advise the Master of the following:

- the tug rendezvous time and position;
- the number of tugs and the mode of towage;
- the planned (optimum) ship speed when connecting the tugs’ lines;
- whether the ship’s or the tug’s lines are recommended for use;
- the type of tugs to be used and their bollard pull;
- if escorting, the maximum towline force that the tug may generate at escort speeds;
- maximum planned speed for the passage;

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• the method by which the ship’s crew should heave and release the tug’s towline;
• a dedicated crew member to monitor tug and tug’s line during heave and release;
• the prohibition on the use of weighted heaving lines;
• that on release, the tug’s gear should be lowered back under control;
• areas of the transit posing particular risks with respect to the possible use of the tug;
• intentions with regard to use and positioning of each tug for berthing manoeuvres;
• intentions with regard to use of tugs in an emergency (escort operations); and
• primary and secondary VHF channels for use in the operation.

c) Pilot/ Master/Tugmaster Exchange

The Pilot / Master and Tugmaster should, as a minimum, discuss the following issues:
• the SWL of the vessel’s chocks, bollards and strong points to be used for towing;
• the tug hook up point, taking into account the prevailing weather and sea conditions,
  for escorting operation (if appropriate) and berthing;
• the planned (optimum) ship speed when connecting to the tug’s lines;
• if active escorting, the start point of the escorted passage;
• the maximum speed of the tug;
• passage details in their entirety while accompanied by the tugs, particularly details of
  any swing, manoeuvre, release position and sequence of release;
• berthing details in their entirety, including tug positioning around the vessel’s hull and
  the vessel’s required position on the berth;
• intended and emergency use of ship’s anchors;
• any unusual items regarding the particular vessel as gleaned from the Master / Pilot
  exchange;
• if appropriate, any shallow water or bank effect areas where significant surges may
  be experienced that might add to the tug loads;
• the Tugmaster should advise the Pilot / Master (as far in advance as possible of the
  scheduled manoeuvre) if the tug is experiencing a failure or reduction in its ability to
  manoeuvre or deliver full bollard pull;
• when confirming that the tug is fast and ready to assist, the Tugmaster should also
  confirm both the tug’s name and her position on the vessel.

d) Preparations on-board the tug

Operations such as mooring and towing impose very great loads upon ropes or wires, gear and
equipment. As a result of the imposed loads, sudden failure in any part of the system may cause
death or serious injury to personnel. Tugmasters should avoid men being stationed at or
unnecessarily near towing gear.

Working in the bight of a wire or rope formed by the lead from the winch or windlass round and
through the fairleads and over-side should be avoided. In any case, the consequences of failure in
any part of the system must be carefully considered and effective precautions taken.
All fixed and running gear including ropes shall be carefully maintained, tested, certified and
regularly inspected against wear, damage and corrosion. Particular attention is drawn to the need to
ensure that fairleads, lead bollards, mooring bitts etc. are used appropriately and within their design
capabilities and effectively secured to a part of the ship's structure which is suitably strengthened.
The emergency release mechanisms on towing hooks and winches must be tested, both locally and,
where fitted, remotely, at frequent intervals to ensure correct operation. All towing equipment in use
should be inspected for damage before undertaking and after completing a towage operation. The
release mechanism should be capable of being released on the bridge, locally and in a blackout.
Tug crews involved in towage operations on deck will always wear approved and in-date self
inflating lifejackets and other appropriate PPE throughout the operation. They should ensure that the
working area is safe and free from trip or slip hazards and remain alert to what the vessel crew is
doing.

Mooring winches and other equipment shall be maintained to the manufacturers' specifications and
be properly serviced. Equipment such as heaving lines and messengers should be of appropriate
length and strength. All equipment shall be checked before the start of each operation. Life saving
equipment shall be available for immediate use.

When a tug is engaged on any towage operation all watertight openings must be securely fastened.
All watertight openings shall be marked with a sign stating that they are to remain closed during
towage operations. Any such openings used whilst moving about the tug during a towage operation
are to be re-secured immediately after use.

e) Communications

VHF Working Channels
VHF Channels signals, 8, 10, 9, 12, 15

Whistle Signals

Whistle signals to be used between tug and tow
A power driven vessel and any vessel being towed by it when signalling to each other by means of a whistle shall use the following signals and no others:

a) Signals to or from a towing vessel ahead:
   - Tow ahead – one prolonged blast followed by three short blasts.
   - Tow to port bow – one prolonged blast followed by two short blasts.
   - Tow to starboard bow – one prolonged blast followed by one short blast.
   - Cease tow – one prolonged blast followed by six short blasts in succession.

b) Signals to or from towing vessel astern:
   - Tow astern – three short blasts.
   - Tow to port quarter – two short blasts.
   - Tow to starboard quarter – one short blast.
   - Cease tow – six short blasts in succession.

c) Signals to all towing vessels:

   - Hold in position – one prolonged blast followed by one short blast followed by one prolonged blast followed by one short blast.
   - Let go – one prolonged blast followed by two short blasts followed by one prolonged blast.

f) Tow Master Requirements on Dumb Tows Routine and non piloted

A Towmaster should be nominated for each tow. The Towmaster will present a tow plan to the Harbourmaster in good time for a review and for permission to be given or other requirements to be accommodated.

The tow plan should include taking all the action a prudent Master or Pilot would in having conduct of the operation. This tow plan should include but not be limited to:

Risk Assessment

   - Method Statement
   - Number and position of tugs
   - Type of tug (e.g. push/pull, on hip etc.)
   - Use of particular tugs
   - Position of tugs
   - Use of release mechanism
   - Manning
   - Passage plan berth to berth
o Regular dumb tow operations e.g. barges, pontoons and leisure operations may be covered with a generic tow plan and details of Skipper/Master/Coxswain qualifications e.g. STCW, Voluntary Endorsement Scheme (MGN 486(M)) or other.

Non Routine Dead Tows

The same principle applies to dead tows involving piloted or non piloted craft, e.g. large barges to Gelliswick Bay beach and large, disabled commercial vessels entering or departing Milford Haven.

The nominated Townmaster should present the tow plan as before to the Harbourmaster for approval. This will not unreasonably be withheld but will involve marine staff from MHPA in the decision. To that end, sufficient time must be given for the tow plan to be reviewed.

In the case of complex dumb tows, a Harbormasters Working Group may be convened consisting of appropriately skilled personnel to ensure that all risks have been considered.

TOWAGE OPERATIONS

a) Connecting and disconnecting towing gear

Before arrival at the tug connecting position, the Pilot / Master shall establish effective communications with each tug and agree working channels. Likewise, effective communications must be established between the bridge and the vessel’s crew at ‘stations’ and they should confirm that they are ready to receive the tug. The vessel’s speed must be reduced to that which allows a safe rendezvous and connection with the tug. The required speed should be agreed in advance between the Master / Pilot and with all Tugmasters involved. At all times during the connecting process, the Pilot / Master should be aware of the position and intention of all relevant shipping movements in the area.

The Pilot / Master should ensure that his planning takes full account of the time taken to connect each tow, especially if adverse conditions are likely to extend this process. Account should also be taken of potential language difficulties, which may lead to confusion. Vessel mooring parties should be fully briefed and the Pilot / Master should check when in doubt and be confident that his instructions are being followed.

Ships heaving lines should be readily available and of a suitable make up. **Extra weights must NEVER be inserted in the ‘Monkey’s Fist’ or attached to the heaving line.**

A small canvas sandbag is the towage industry’s preferred option. Ship’s personnel should wherever possible, agree with the tug crew the area where the heaving line is to be thrown, to allow the recipients to move clear. When connecting to the vessel, the tug crew should ensure that the towing...
gear is clear of any obstructions, able to run freely and is released from the tug in a controlled manner. The ship shall not test the bow or stern thrust controls prior to berthing at the time when the tug is under the bow or stern passing a line.

Changes in speed and or course should also be avoided while the towing gear is being connected as it may not be possible for tugs to react sufficiently quickly to sudden increase or decrease in a ship’s speed/direction. Where a change in speed/course is necessary, the Pilot / Master should ensure that all tugs involved in the operation are advised in good time.

Svitzer Marine Ltd. tugs may use a compressed air line throwing apparatus to efficiently send a line from the tug to the ship’s crew. Before any such exercise is undertaken, the Tugmaster will advise the Ship’s Master and Pilot so that appropriate instruction can be passed to crew at stations.

The Pilot / Master shall maintain contact with the Tugmaster / vessel crew throughout the process. He should be ready to revise the intended tug position if the Tugmaster reports any restrictions at the chosen position, e.g. large flare, overhanging anchor or unsuitable push up point. The Pilot / Master must keep all those involved up to date on the plan and apprised of any changes to the agreed plan.

During disconnection, both the vessel’s and tug’s crew on deck should be aware of the risk of injury if the towing gear is released from the tow in an uncontrolled manner and avoid standing directly below. They should also be aware that any towing gear which has been released and is still outboard may ‘foul’ on the tug’s propeller(s), steelworks or fendering, causing it to come tight unexpectedly. The towline should always be lowered onto the tug deck, never just ‘cast off’ and left to run, unless specifically directed by the Tugmaster.

The positioning of tugs on a vessel is a matter for discussion between the Pilot / Master and the Tugmaster, having full regard for the areas of the hull which should be avoided, e.g. watertight doors, between frames etc. The forward tug is especially vulnerable when passing up the tow line. This tug has to position itself very close under the bow, sometimes under 1 metre from the ship’s water plane. The Tugmaster will be concerned about any bulbous bow or other underwater protrusion, the proximity of the flare of the bow etc. At the same time the Tugmaster is countering the hydraulic pressure wave that exists around the bow to avoid severe interaction.

Flares or cut-aways at the bow or stern are of particular concern and can increase the dangers of interaction. Extra caution should be taken by Pilots / Masters when the tug is making fast under a flare / cutaway, especially when the vessel is moving / swinging towards the tug. The danger is compounded at night with the risk of shadows from deck lighting.
b) Safe speed

Speed is a critical factor for the tug when making fast and letting go. When considering speed it is the speed through the water that is of concern. It is generally accepted that 5 to 8 knots is appropriate when making fast and letting go Svitzer tugs in the Haven; however, due consideration should be given to tugs manoeuvring astern.

For other, possibly smaller, tugs a safe speed may be lower and this should be discussed between the Master, Ship Master and Pilot. For Escort duties entering the West Channel, the optimum speed for the tug to be effective is 8 knots.

Caution must be exercised when using the engines whilst the tugs are working. The stem tug will be affected by the wash and every tug will be affected by the change of speed either up or down, and a rapid change in speed is all the worse. If the situation dictates the use of the engines, the minimum that the situation allows should be used and the tugs should be informed of what the ship is about to do as it will affect their own actions. In strong tidal conditions a high percentage of the tug’s power may be utilised in maintaining position on the vessel before applying thrust to the vessel. If the tugs are made fast alongside they are at their most effective with a minimal ship speed through the water.

c) Interaction

Interaction and its effects on the tug and its handling are well known, and appreciated in port/harbour towage. Pilots, Masters and Tugmasters are reminded that these effects are multiplied as the vessel’s speed increases. Areas of high and low pressure exist in and around the ship’s hull and these areas can cause adverse movements of smaller vessels in close proximity. The speed of water flowing between the tug and the vessel increases at the last moment as the tug comes alongside. As this happens the tug therefore has to increase speed to maintain the same speed as the vessel. The Tugmaster has to compensate for the tug either being drawn in or pushed off the vessel.

In areas where interaction exists, and when manoeuvring alongside a vessel, the Tugmaster should be aware of the possibility of underwater obstructions such as bulbous bows, stabiliser fins etc.; and areas of the ship’s side, such as pilot doors, which are to be avoided.

The Pilot/Master and the crew should be aware of interaction and the effect it may have on the tug. Marine Guidance Notice 199(M) – Dangers of Interaction – provides further guidance and information on the effects of interaction, including when manoeuvring at close quarters.
RUNNING AGAINST THE TIDE

Masters and Pilots should be aware that it is sometimes difficult to manoeuvre a tug into position against the tide without putting any weight on the towline. Sometimes it may be appropriate for a tug to run with the vessel stern first to make fast and thus be ready to tow in the same direction.

PRECAUTIONS DURING TOWAGE OPERATIONS

Once the towing gear is connected, the crew should indicate this to the Tugmaster and then clear the area. Any crew that are required to remain on deck should stand away from the towing gear in a safe position. If the crew are required to attend the towing gear during a towing operation, the length of time exposed should be kept to a minimum.

During towage operations the towing gear equipment and personnel should be continuously monitored and any change in circumstances immediately relayed to the Tugmaster. This is particularly important on tugs where the Tugmaster has a restricted view of the towing area/personnel. Tug and vessel crews should be aware that the towline may have to be release in an emergency situation, and that this may occur without warning.

Ships crew confirm with tug crew that tow is secure. The Tug master, having verified with the tug and vessel crews that the towline is fast to the vessel, must confirm this with the vessel’s bridge. The Pilot / Master should then re-confirm this to the Tug master, thus completing the communication loop. Sometimes it is not possible for the Tug master to see the crew on deck due to structural design or at night when they may be obscured by deck lighting on the ship.

Tug masters, Pilots and Masters should be aware, at all times, of the position and intentions of mooring boats, especially in strong tidal conditions, at night or during restricted visibility or adverse weather conditions. This is particularly important in circumstances where visibility is limited from the tug’s wheelhouse and ship’s bridge. Remember that bow and stern thrusters, and the wash from tugs and the vessel being assisted, can all cause significant problems for mooring boats, especially when they are in close to the vessel and/or tug(s), picking up and running with lines. Controllable pitch propellers are a separate but equally dangerous hazard.

The Pilot or Master should never use the vessel’s engines without confirming with the Boatmen and / or Line handlers as to the position of the mooring boats. Sound signals can be used as a warning on occasions when vessel noise compromises VHF monitoring.
Towage in Restricted Visibility

Should visibility become restricted during a towage operation, the Pilot / Master and the Tug master will discuss the situation immediately and agree upon a course of action to ensure the safety of all persons and vessels involved given the location, environmental and vessel traffic conditions, seeking the advice of Port Control as appropriate.

The Pilot or Master will advise Port Control of the circumstances and any decisions made immediately, keeping Port Control informed of any operational developments, or any improvement or deterioration of the visibility.

The Tug master should immediately inform the Pilot / Master and Port Control of any concerns that he may have as to the safety of his tug and crew. The Pilot / Master and Tug master should take immediate action to ensure the safety of both the tug and the assisted vessel. If necessary the operation should be aborted as soon as it is safe to do so.

PROCEDURES WHEN RESTRICTED VISIBILITY EXISTS OR IS EXPECTED

- Towage operations should not normally take place in visibility of less than those described in Port Guidelines for visibility;
- The pick up speed in reduced visibility to be a maximum of 3-5 knots through the water;
- Tug masters may request the Pilot / Master to take all way off the vessel and the tugs maneuver the vessel;
- Tugmaster to confirm watertight integrity of tug. Pilot / Master to inform tug if they observe any exterior openings on the tug that are not closed, and which affect tugs’ watertight integrity;
- Pilot / Master and Tugmaster to agree the plan, which should be recorded;
- During operations in restricted visibility the Pilot / Master of the assisted vessel shall provide well in advance all engine movements, thrusters movements and alterations of course;
- Both Pilot / Master and Tugmaster shall inform the other of any changes in their circumstances that will impact on the agreed plan.
PARTICIPANT 7

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</table>

REPLY TO QUESTION 1

There are different factors leading to safe tug use, and if one of these factors does not get proper attention or has not been handled carefully, operational risks increase and accidents will happen. The different factors are:

- Safe tug operators (towing companies).
- Safe tug and safe tug equipment.
- Safe tug operations.
- Safe working practices of pilots.

The four factors will be highlighted below.

Safe tug operators

Safe tug operators will take care of the following major aspects:

- Safe tugs.
- Well trained and experienced tug crews.
- Safe working schedules.
- Safe tug and safe tug equipment

It is the towing company’s responsibility that their tugs are safe working tugs in the conditions and circumstances that can be expected in the relevant operating areas.

The tugs should comply with all relevant safety regulations.

The tugs should in all aspects be safe tugs. This applies to:

- Operational reliability of engines, propellers/thrusters, steering equipment, deck equipment, etc.
- Seaworthiness (if applicable).

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when rendering assistance;
- in case of engine/steering failures;

Other important aspects requiring serious attention are:
- stability and freeboard;
- tug performance;
- fendering;
- deck equipment;

Wheelhouse: ergonomics, radar, communication systems, engine and/or rudder controls, winch control, quick release system, switching between manoeuvring panels, optimal visibility from the wheelhouse, clear windows, lighting, back-up systems, etc. The wheelhouse should be properly designed to minimize incidents with respect to human factor.

More items can be added, of which several may depend on the work to be done by the tug.

The tug should furthermore be suitable for the tasks to be carried out. Winch, fairlead and towing hook constructions and foundations should be strong enough for the forces that can be expected. The same applies to tow lines. Appropriate safety factors should be taken into account.

If one of the aspects mentioned is not treated carefully, not in a safe and reliable condition and/or not maintained properly, problems and accidents can be expected.

**REPLY TO QUESTION 2**

Safe tug operations

A safe tug and safe tug equipment alone is not sufficient. Tug operations can only be carried out safely if the tug’s captain and crew have the right attitude, are well trained and have the right experience.

Towing companies therefore have the responsibility for suitable training programs and appropriate promotion systems. This is crucial for the safety of tug crews, the safety of the tug, as well as for the safety of the ships to be assisted, the environment and the port’s infrastructure.

The training should not just be general training, but also focussing on the specific tug - with its capabilities and limitations - the captain, mate and engineer are sailing on, and on the specific manoeuvres to be carried out, for instance escort manoeuvres. Proper tow line use as well as the use of the most suitable tow line lengths should be part of the training. Training in emergency procedures is another important item, e.g. in case of a failure of one of the thrusters, and in the use
of back-up systems; furthermore in WiFi (if applicable), radar use, optimal communicating, first aid, etc.

_Suction forces and turning moments working on a tug_ when operating in close vicinity to a vessel, often a cause for accidents, should be addressed during training, as should another important aspect, _viz._ _safe speeds_. These factors are of specific importance when passing or retrieving a tow line, when coming alongside a vessel at speed and when rendering assistance.

Much can be _learned from accidents_ that have happened, even from accidents that happened in other ports around the world. If relevant, such studies should be included in the training. Below are references to where information can be obtained about tug accidents.

It should also be clearly understood that training is only as good as the instructor. The instructor should not only have the capability to train other people but should also have the right experience regarding the aspects he is training.

The towing company should have a _safety manual_. Tug captains and crews should know the contents of it and should operate accordingly. For instance, doors and all openings on the weather deck should be closed during operations.

_Tug maintenance_ is also an important factor to pay attention to.

_Safe working schedules_ are a responsibility of the tug company as well. Tug crews should have sufficient rest in order to avoid accidents due to fatigue.

If a crew is well trained and has sufficient experience on a certain tug type, and fatigue does not play a role, towing operations can be carried out safely.

**Safe working practices of pilots**

Three factors have been addressed. The last factor, safe working practices of pilots, is also important. Because pilots and tug masters work as a team, _optimal communication between pilots and tug captains_ is needed. The manoeuvres a pilot is intending to carry out will affect the assisting tugs. This can be a positive or a negative effect.

A negative effect may include risks for the tugs. To have the tugs performing to their best capabilities it is necessary for a pilot to have knowledge of the _capabilities and limitations of the_
tugs. This applies in the first place to the ship’s speed while tugs are making fast, when rendering assistance and in foggy conditions. A pilot should know what safe ship speeds are for the attending tugs. Otherwise, the tug captains must tell him.

Safe speeds are also of importance to reduce the interaction effects between ship and tug. The lower the ship’s speed the smaller the forces and turning moments working on the tug due to the fact that the tug is operating in close vicinity to the ship. Interaction forces increase with the square of ship’s speed. This means that interaction forces at 6 knots are more than two times as high as with a speed of 4 knots.

It is also important to keep the tug captains informed about ship’s propeller and rudder use. To be aware of propeller use is especially important for the stern tugs.

If the pilot has sufficient knowledge of the capabilities and limitations of the tugs, he is also able to place the tugs where they are most effective. Correct tug placement is an important issue in handling a ship effectively.

Finally, a pilot should have knowledge of how much tug bollard pull is needed. This is not always easy, particularly with high sided vessels in windy conditions.

With increasing tug power it becomes more and more important that a pilot has knowledge of the strength of the ship bollards and fairleads.

From the foregoing it can be seen that a pilot plays an important role with respect to safe tug use and operational safety.

In the first place, the right attitude is needed to achieve operational safety with respect to tug use. This applies to towing companies, tug captains, tug crews and pilots. One person or one party alone cannot achieve a high level of safety. It requires a combined effort of the parties involved, all with their own responsibilities, but with the same goal: Safety of Operations.

Safety of operations can only be achieved by building safe tugs, by training and experience, and by teamwork.

Planning

Incidents may occur because no pre-planning was carried out. Incidents can occur if the operations are not thought through prior to commencing the towage operations. In some cases the local port authority was not informed of the proposed towage operation and therefore important impending traffic information was not received by the parties concerned.

In all incidents pre-planning may not have been carried out for a variety of reasons; sometimes it is because the task is considered routine or there is no time available. Often, the argument is made that
hands-on operational type work cannot be planned. However, in the form of a risk assessment it may effectively reduce the risk to personnel, damage to the environment and property.

Tow plan
Planning and preparation before a tow commences might include:
Assessing the size and type of vessels or barges to be towed and any limitations of the tow. Confirmation that the tug is of suitable; size, manning, sea-keeping, horse power (HP) and bollard pull (BP). Tow wire and towing equipment is suitable for the planned tow.
Route to be taken and passage planned, including safe transit times (day/night transits), times when passing through narrows, under bridges or areas of high traffic density, tight bends in rivers and adjacent river berths.
Noting any areas of reduced depth, tidal limitations and currents expected during the voyage. A list of bridges with maximum and minimum height; tide height for each arch to be passed under showing the bridge’s maximum air-drafts.
Weather forecasts to include outlook for at least 48 hours. Confirmation of sufficient fuel, water, spares on board.

Preparations on board the tug
It is essential that checks should be completed on board the tug and vessel or barge to be towed, which should include:
All water/weather tight openings are securely closed with signs indicating that they should remain closed for the duration of the voyage. It is a reality that tugs have capsized as a result of doors and ports being left open when in difficulty, e.g. goring. Down flooding is a real danger to small tugs.
Life-saving and fire-fighting appliances must always be operational.
Navigational equipment, wheelhouse whistles, horns, shapes for day signals and communication gear are fully operational.
All critical machinery prior to commencing a towing operation should be confirmed as operational — this would include; main engine, steering gear and towing equipment (winches, wires) etc.
All personnel are fully familiar with the intended towage plan and their responsibilities.
Any change of fuel and ballast to the tug and/or tow have been fully calculated and the crew are aware of any factors of concern.

Checks on board the towed vessel or barge

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The tow should not proceed until a satisfactory inspection of the tow has been carried out by a competent party.

Checks should include:

- Condition of the towing arrangements.
- Condition of the anchoring equipment if fitted. If not fitted some authorities require a temporary anchor to be supplied of an adequate weight.
- Condition of tow including an inspection of the peaks and buoyancy spaces to check for water ingress.
- Watertight integrity of the unit to be towed; obvious signs of damage, especially in the hull and deck plating. Hatchways, ventilators, doors, scuttles, manholes and other openings are closed and sea valves shut.
- Fore and aft drafts, appropriate freeboard for the voyage and no evidence of a list. Generally a slight trim by the stern ensures that the tow is laterally stable when towed.
- Air draft of the tow, appropriate for the voyage and bridge transits.
- Power is available for navigation lights.
- Safe method of boarding available (portable or fixed rungs).
- Emergency towline rigged.
- Life-saving and fire-fighting appliances are in good condition and in the regulatory number required.

Some bulk cargoes pose a serious hazard, including spoil and certain ore cargoes which are liable to liquefaction e.g. spoil cargoes can contain a high amount of moisture which can assume a liquid state in a seaway and can cause the barge to lose stability, list and even capsize. Reference should be made to the IMO International Maritime Solid Bulk Cargoes (IMSBC Code). When it is suspected that cargoes with high moisture content have been loaded onto a barge advice should be sought. If cargo is liable to move e.g. vehicles and timber, the lashing arrangements and sea fastenings should be inspected.

**Planning for rough water**

Rough water in the context of a small tug or workboat is not restricted to being caused by strong winds. The Club has suffered many claims where the tug and tow unit have contacted a third party vessel, berth or other fixed floating object due to misjudging the prevailing weather conditions when manoeuvring. Adverse weather conditions can be caused by any of the following:

- The action of wind against tide.
- Tidal bores, rip tides or strong currents.
Interaction of strong river currents and prevailing currents/winds e.g. at mouths of large rivers.

- Sudden changes in the current due to increased rains.
- Turbulence, undertows and/or wash reflected off river or channel banks.
- Wash from passing craft.
- Geographical/seasonal issues such as the freshet where operations on the Fraser River are affected by the seasonal ice flows.

The effects of rough water on a tug and tow can be appreciable and in extreme cases water over the bow of the tow can impact on barge stability. Extra strain on towing and mooring lines and potential damage to barges being towed alongside or in tandem can occur.

In order to reduce the potential of an incident due to rough weather the following should be considered:

- Delay departure and wait for an improvement in weather or tide.
- Anchor or tie up and wait for an improvement in weather or tide.
- Reduce speed of tow.
- Increase the length of the tow to compensate for power surge and wire tension due to tow movement in the seaway/swell.
- Consider towing astern if tow is arranged for towing alongside.
- Alter course.

**Passage planning and bridge equipment**

Reference material is available on passage planning, including IMO Res.893 - Guidelines for Voyage Planning, which states that the need for voyage and passage planning applies to all vessels. A large part of a towage risk assessment can be included in the appropriate passage plan. Even for experienced tug masters, plying familiar waters, the formal process of planning the voyage, however short, is a useful one.

A passage plan as a minimum should include and consider, but not necessarily be limited to the following:

- Plotting the intended route on appropriate, large scale and up to date chart.
- Reference to appropriate routing and passage information, publications, sailing directions and local information published by competent authorities.
- Towing draughts in relation to water depths and under keel clearances.
- Proximity of other shipping traffic and anticipated high traffic density areas.
- Maneuverability of tow in relation to the navigational channel constraints, including river and river bank operations e.g. construction or diving.
- Current and tidal information.
- Weather information and forecasts, in particular forecasted restricted visibility.

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- Reporting positions and vessel traffic services information.
- Safe anchorages/places of shelter.
- Tow speed and adjustments to pass danger points.
- Consideration whether night-time transits should be restricted.
- Air-draft restrictions for passing under bridges.
- Navigational warnings, changes to navigational marks or lights.
- Available wheelhouse personnel, potential working hours and fatigue during the passage.

Current and tidal information may not be accurate even in well charted areas and therefore local knowledge may have to be relied on. Tugs work in all waters and at times extraordinary currents are a problem. In some rivers and inland waters where very high tides, heavy rains, or heavy ice melt has occurred, currents of 16 knots are not unusual (navigating through these areas, in and around slack water, is preferable if that option is available).

In addition it should be ensured that all critical bridge equipment must be in good working order prior to commencing any operation.

**Emergency planning**

A prudent towing plan includes 'what if' situations, unexpected events that could happen during the tow. This preparation could be a formal plan for specific contingencies and/or training.

Consideration should always be given on how to transfer personnel and equipment to the towed vessel or unit during an emergency. Personnel should always wear life-jackets and utilise communication equipment and portable lights during darkness. The safety of personnel is paramount and a transfer should not go ahead if considered too dangerous.

Contingency plans could include the following:

- Girting or girding situation.
- Failure or parting of the tow wire.
- Failure of gow wire arrangements.
- Grounding of the tug or tow.
- Loss of hull integrity in either tug or towed vessel.
- Collision or contact with a fixed object or installation.
- Loss of main propulsion power or electrical power.
- Failure of steering and/or other critical control systems.
- Man overboard.
- Bridge, accommodation or engine room fire.
- Actions to take in the event of unexpected poor weather.
<table>
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<th>POSITION</th>
<th>SR SURVEYOR</th>
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</table>

**REPLY TO QUESTION 1**

We have procedures in place to assist the tug master in case of a serious accident, collision or oil spill. Seafarer has the right to expect from the authorities following a serious accident or incident, and some general advice for managers and mariners who may be faced with a criminal prosecution in a jurisdiction with which they are not familiar.

Harbour towage companies which work in a specific area for an extended period of time will be familiar with local procedures and will have a good idea what to expect if there is a serious accident, so this advice may be more useful for seagoing members and their managers, who could find themselves dealing with the authorities in a place where they do not have detailed local knowledge.

**GENERAL GUIDANCE**

Good record keeping is essential. It is much easier to prove what happened if logbooks are well kept and up-to-date, positions are regularly plotted and relevant publications are in use. IMO and most flag states have standard accident report forms or frameworks, and these will offer valuable reminders of the information to be recorded after a serious accident. A camera can be an excellent tool if there is an accident. Contemporaneous photographs are extremely useful, so try to record as much as possible as soon as possible. Even a photograph of a GPS screen showing time and position in the immediate aftermath of a serious incident may be valuable if there is a dispute about the facts of a case. Photographs, videos, sketches and drawings can all be very useful evidence.

Similarly, a capture of AIS and radar information might prove to be invaluable later on. Radar data can sometimes be obtained from the local VTS or port control, and tugs which are fitted with a Voyage Data Recorder should ensure the data is saved if there is an accident.

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Key personnel are likely to be extremely busy, and there will be a lot happening after a serious incident. One person in the wheelhouse should be tasked with keeping accurate records and, if possible, should not be given any other duties. All key personnel should also keep individual records if possible.

Entries in the log book should always be written clearly and neatly in ink. If a mistake is made, cross it out with a single line through the relevant passage, and initial the crossing out.

Contemporaneous notes made by individuals may be very useful in helping the company to build up a complete picture of what happened. They can also be very useful in a subsequent court case, because witnesses are normally permitted to read their notes when giving evidence. However, these notes should always be factual and objective, because all parties to a case may be permitted to see them.

It may be necessary for crew members to give statements or written accounts after a serious incident. These should always be factual e.g. where they were, what they saw and at what time they saw it. Subjective opinions should be avoided wherever possible.

It is important to note the details of other vessels in the vicinity or other people who may have witnessed a serious accident.

People who respond well in emergency situations are almost always the ones who have prepared for them. Emergency drills should be realistic and should cover all imaginable scenarios.

FAIR TREATMENT FOLLOWING AN ACCIDENT

In 2006, the International Maritime Organisation (IMO) adopted Guidelines on the Fair Treatment of Seafarers in the Event of a Marine Accident. Members should be aware of the Guidelines, the major points of which are outlined below. Members are cautioned that this is a summary only, and should not be relied upon in the event of an accident.

REPLY TO QUESTION 2

PORTS OR COASTAL STATES SHOULD:

1. Conduct investigations in a fair and expeditious manner.
2. Co-operate with other interested States, shipowners and seafarers, and grant seafarers' organisations access to the seafarers.
4. Treat seafarers in a manner which preserves their basic human dignity.
5. Ensure or verify that detained seafarers are provided with adequate subsistence, including accommodation, food and medical care.
6. Give all seafarers the protection of due process without discrimination.

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7. Provide interpreters where necessary, ensure seafarers are advised of their rights, and provide access to independent legal advice.

8. Ensure seafarers are informed of the basis on which the investigation is being conducted (i.e. IMO or national legal procedures).

9. Ensure the States of the nationality of all seafarers concerned are notified, and that consular access is granted.

10. Ensure that detained seafarers are provided with the means to communicate privately with family members, welfare organisations, the shipowner, unions, national representatives and legal representatives.

11. Promptly conduct interviews for the coastal State investigation, taking into account the physical and mental condition resulting from the accident.

12. Take steps to ensure the seafarers, once interviewed or otherwise not required for the coastal State investigation, are re-embarked or repatriated without undue delay.

13. Consider non-custodial alternatives to pre-trial detention.

14. Promptly conclude the investigation and, if necessary, charge seafarers suspected of criminal actions. Ensure due process protections are provided to all seafarers charged.

15. If national laws allow, ensure there is a process for posting a reasonable bond or other financial security to permit the release and repatriation of detained seafarers pending any investigatory or judicial proceedings.

16. Ensure any court hearing, when seafarers are detained, takes place as quickly as possible.

THE FLAG STATE SHOULD:

i. Ensure that any investigation to determine the cause of a marine accident is conducted in a fair and expeditious manner.

ii. Co-operate and communicate with other interested States, shipowners and seafarers, and give seafarers’ representative organisations access to seafarers involved.

iii. Participate directly in any casualty investigation.

iv. Ensure shipowners honour their obligations to seafarers involved in a marine accident or investigation.

v. Verify that adequate provisions are in place to provide each detained seafarer with wages, food, accommodation and medical care as appropriate.

vi. Assist seafarers to secure fair treatment.

vii. Fund the repatriation of seafarers where shipowners fail to fulfil their responsibility.

viii. Ensure consular officers are permitted access to the involved seafarers, regardless of their nationality.

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ix. Ensure the fair treatment of seafarers employed on a vessel flying its flag.

x. Ensure no discriminatory or retaliatory measures are taken against seafarers because of their participation during investigations.

THE SEAFARER STATE SHOULD:

1. Co-operate and communicate with all interested States.
2. Monitor the physical and mental well-being and treatment of seafarers.
3. Fund the repatriation of their seafarers where shipowners and the flag State fail to fulfil their responsibility to repatriate.
4. Assist in the service of legal documents and the return to the port of seafarers needed as witnesses in any proceeding following a marine accident.
5. Ensure its consular officers are permitted access to the involved seafarers.
6. Ensure no discriminatory or retaliatory measures are taken against seafarers because of their participation during investigations.

With regard to investigations, shipowners have an overriding duty to protect the rights of the seafarers they employ, including the right to fair treatment and to avoid self-incrimination.

SHIPOWNERS SHOULD:

1. Ensure that no discriminatory or retaliatory measures are taken against seafarers because of their participation during investigations, and ensure that such conduct by others is not tolerated.
2. Take steps to expedite the efforts of any investigation.
3. Encourage their employees to co-operate with an investigation, with due regard to any applicable rights.
4. Use all reasonable means to preserve evidence and minimise the need for the continuing physical presence of any seafarer.
5. Fulfil their obligation to repatriate or re-embark their seafarers.
6. Ensure provisions are in place for the subsistence of each seafarer, including wages, suitable accommodation, food and medical care as appropriate.

GUIDELINES FOR SEAFARERS

SEAFARERS SHOULD:

1. Ensure they have appropriate translation services.
2. Ensure they understand their right not to incriminate themselves, and they understand that when statements are made to investigators these may potentially be used in future criminal prosecution.
3. If necessary, ensure they have access to legal advice prior to deciding whether to give statements.
4. Participate to the extent possible by providing truthful information to the best of their knowledge and belief.

CRIMINALISATION OF SEAFARERS FOLLOWING A SERIOUS ACCIDENT - ADVICE FOR MANAGERS AND MASTERS

Casualties which involve pollution and/or serious injury normally result in investigations by the local maritime authorities AND the police. These investigations may run in parallel, so it is important for seafarers to know which interview is taking place, and the purpose and possible consequences of giving the interview.

IN MOST COUNTRIES IT IS AN OFFENCE TO:

- breach COLREGS
- cause death or injury
- cause pollution
- cause damage to property.

Invariably, an offence has been committed during a serious accident and the local police may have wide powers to interview crew members, seize documents and inspect a vessel. Do not expect fair treatment or the application of natural justice - these are relative terms and may vary from place to place.

There are normally two types of interview which will be conducted. Witness statements are normally taken to establish the facts, and there is no guarantee of legal representation. Then there may be suspect interviews, at which legal representation is normally guaranteed and the interviews are conducted under caution. In some jurisdictions, a refusal to cooperate in a witness statement or a request for legal representation during a witness statement may be considered to be an admission of guilt.

In all such cases, specialist local legal advice should be obtained. The best local lawyers should be engaged, and it is worth remembering that the best for a particular case may be criminal lawyers rather than maritime lawyers.
Police forces may have little or no concern for the ship’s operational requirements or repair schedule. There may be long delays, and key witnesses may be removed from the vessel for extended periods. It is essential that owners send additional senior officers and superintendents, so that the ship can still be run in a safe and efficient manner, even if key people are taken ashore for questioning or become exhausted following their ordeal.

The crew should be given legal support, and their morale should be maintained. Their families should be kept informed, and suitable financial measures implemented to safeguard crew members and their families.

Complex cases, particularly those involving deaths or serious pollution, are the most difficult to deal with. There will often be a perception among the general public that ‘somebody must be to blame’ and it is easier to find a scapegoat when a foreign vessel with foreign crew is involved.

One way to sway public opinion is to quickly set up a claims procedure, so local people who have been affected by the accident have a way of gaining compensation without undue delay. The support of the vessel’s insurers is vital if this is to be done effectively.

Finally, some thought must be given to who will pay the costs of the case. P&I Club cover does not include the costs of defending criminal acts by seafarers, although the Clubs may offer support on a case by case basis. Owners should discuss this aspect with their insurers at an early date.
REPLY TO QUESTION 1

The cause of an accident is seldom just bad luck. In general, an accident is the total sum of a series of events which finally leads to an unfortunate outcome. Therefore, it is important to investigate the reasons behind an accident, the so-called root causes, in order to be able to prevent such accidents happening again.

The assisting ships and floating objects with tugs requires specific knowledge and competence, and that agreement about safe speeds and proper communications between parties are extremely important.

A nautical accident which involves loss of life is the worst nightmare for every harbour master, since he or she is responsible for nautical safety in their port. There is little comfort in knowing that risks can never be completely eliminated and must be considered in terms of making them ‘as low as reasonably possible’. This means that accidents, and the eventual dramatic aftermath, may still happen no matter how hard we try to eliminate them. Shipping without risk does not exist, but we still have an obligation to continuously strive for safety improvement and risk reduction. It is an essential element in the role of a harbour master.

On the other hand, severe accidents may also be seen as wake up calls. The harbour master is frequently challenged by politicians, the public and commercial parties to prove the necessity for investment in risk control options and measures or regulations which may cost money or limit entrepreneurial short-term goals. Of itself, there is nothing wrong with that, but a severe accident immediately makes every stakeholder aware of the necessity for constant improvement. Statistics and research are important, but do not have the same emotional effect as actual pain and damage. Beyond that, accidents often lead to new insights, lessons learned or comprehensive new research.

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The port industry and the nautical service providers have the professionalism and responsibility to learn from accidents in order to improve safety.

Quality in the safety context is about being able to reflect on your own operations and procedures, and being open to assessment by others. Nautical safety is not a project with an ending, it is a continuous process which involves many human factors. Learning and being aware are key elements in reducing risk.

REPLY TO QUESTION 2

Manning and Training

The International Convention on Standards of Training, Certification and Watch keeping for Seafarers (STCW Code) is often not applicable to towage operations carried out in some jurisdictions, particularly for non-international voyages, such as river passages. The manning of the towing vessel may be determined by an appropriate regulatory authority; however it is the responsibility of the owner/operator to ensure that the tug is manned with adequately certified and experienced personnel for the voyage. Following an accident it has sometimes been found that the cause was due to unqualified personnel, in which case P&I insurance cover could be compromised.

The towing master should be aware that inexperienced personnel must not be exposed without training and supervision to carry out high risk tasks, such as hooking up or releasing the tow. It is also the custom and practice in many areas that personnel supplied by barge operators are often part-time, contracted in and therefore possibly inexperienced and poorly trained. Their actions can therefore impact on the safety of a towing operation.

Training should be frequent and recorded in ship's log books. This should cover safety aspects such as lifesaving and fire-fighting, and:

- Dangers of and the safe practices for hooking up and releasing a tow.
- Capabilities and limitations of the towing equipment.
- Controls of the winches and use of the emergency quick release mechanism.
- Emergency contingency plans for if the wire/rope parts during a tow. Dangers associated with reconnecting the tow.
- Dangers associated with girting (girding) situations.
- Dangers associated with main engine or electrical failures.
- Risks associated with working in heavy weather and strong currents.
- Shortening the tow line.

An effective safety management system (SMS) allows these training requirements to be formalised and become second nature.
Planning for an emergency should include:

- Actions in bad weather
- Have to arrangements
- Available anchorages and safe ports for shelter
- Emergency towline rigging or bridle recovery.

In order to allow an effective and safe recovery, a bridle recovery system should be rigged. The most effective method is using a winch and recovery line as above. The winch should be able to lift 100% of the weight of the bridle, wire and attachments. For large barges the power for the winch should be available on the barge. For smaller barges alternative arrangements will have to be made, including manually operated recovery systems. It is recommended that the breaking load of the recovery wire be at least six times the weight of the recovery gear.

Emergency towline rigging

In the event of a towline or bridle failure, or the inability to recover a bridle, an emergency tow wire should be rigged. This is usually fitted to the bow and a suggested arrangement is as in the Figure 19.

Prior to departing on a voyage the emergency arrangement may include:

- Towing connection through a centre closed fairlead
- Length of wire, with similar breaking strength as main tow wire, at least the length of the barge, plus an extension wire long enough to allow the float line to extend over 75 metres astern of the barge
- A high visibility pick-up buoy, with reflective tape attached with a self-activating light to the end of the float line
- The emergency towline should be led over the main tow bridle and secured to the barge side with soft lashings
- Precautions taken to prevent chafe of the wire ropes
- Spare re-connection gear should be available on the barge.

In the event of any failure of the main towing arrangement, the tug must first retrieve the balance of the broken towing wire on board so that it does not foul the tug’s propulsion systems. If it is possible for the tug’s crew to board the barge, then they must attempt to retrieve the towing bridle on board. However, if this is not possible, then they must consider disconnecting it and slipping it to the seabed. Having the main bridle trailing over the side can cause it to foul with underwater obstructions or simply dredge the seabed and act as an anchor thereby making emergency towing
difficult. The tug must then approach the stern of the barge at a safe distance and retrieve the float line. The use of a boat hook can also be made to assist in the retrieval of the float line. Once the float line has made its way on board, it can be further hauled in with the use of the winch. This will help it break the soft clips which secure the towing pennant (spare towing wire) on the barge’s deck. Once the eye of the pennant comes on board the tug, it must be made fast to the towing hook. The tug must then gradually take weight on the towing pennant and commence towing the barge with her emergency towing system.

It must be borne in mind that the emergency towing systems are not designed to continue towing the barge on her ocean passage but only to tow the barge to nearby safety such as a holding area or a port of refuge.

Speed estimates

Regarding speed estimates following remark has been made by a tug master “With matching ship’s speed, it is clear what safety margin you have with respect to tug power”

The approach when making fast to the bow of a containership -Keeping pace with the ship allows you to feel the pressure wave. The pressure wave (in front of the bow) gives the tug additional speed. Be aware.

The approach when making fast to the bow of a bulk carrier or tanker -Overtaking the ship and then manoeuvring carefully towards the bow is acceptable, but keep clear of the pressure wave near the shoulder.

Voith-Schneider tugs

- Safe ship’s speed, skilled captain and proper communications are crucial factors.
- Good training is essential.
- Ship crew should be ready with heaving line.
- When connected ship’s speed will increase, carefully monitor changes to ship’s speed.
- Tug-ship contact near shoulder is ok, but tug-ship contact further forward is dangerous.

ASD-tugs operating over the bow

With respect to training and tug knowledge:

- Compulsory simulator training for all tug masters is a must, as well as certification of tug masters; it will make tug operations safer.
• Know your tug, the capabilities and limitations, the local conditions and the interaction effects. Tug master skill and ship's speed are key elements.
• Training on interaction is a must.
• With respect to speed:
  • Know the speed, ask the pilot/ship's captain to slow down if speed is considered too high.
  • Always keep enough reserve power in order to be able to drive out of danger.
  • Towing companies and harbour authorities should set maximum speed for bow-to-bow operations.
  • Pilot organisations, port authorities and towing companies should set a maximum speed.
  • Maximum 6 knots is safe.
  • Do not be afraid to ask pilot to slow down if speed is considered too high.
  • The slower the safer. Patience is a virtue.

With respect to safe tug operations:
• Why bow-to-bow? Use only tractor tugs.
• Why on the bow and not push-pull, which is much safer?
• Read Henk Hensen's 'Bow tug operations by Azimuth Stern Drive tugs'.
• Keep distance and use line thrower.
• Safe speed to be based on what speed a tug master can drive his/her tug in a controlled manner (particularly going astern for bow-to-bow) on one engine. Once this speed is established for the specific tug, prevailing conditions and competency of the tug master, I recommend taking one knot off the figure and we are getting close to determining the safe connection speed.

With respect to communications:
• Communicate with pilot.

Various:
• Do not oversteer when waiting in front of the ship.
• When vessel swings, first push her round before connecting.
• Never connect side tugs before front tug is connected so it can run along the side in case of engine failure.
• We have problems with vessel crews not using heaving lines, so we need to wait in a critical position before an appropriate line is presented. Safe use of tugs and how to (dis-)connect properly should be part of the SMS

Finally:

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• Speak up if you dislike a job, situation or pilot.

**ASD-tugs operating over the stern**

- Proper simulator training and refresher courses are absolutely vital.
- Some ASD-tugs are not suitable for operating bow-to-bow.
- Knowledge of towing in the conventional way is being lost and this can be dangerous.
- Planners must know tug's limitations.
- Designate a maximum speed, and send tug masters for training.

**ATD**

- Training is needed, including knowledge of interaction effects.
- Push-pull is safer.
- Always be aware that pilots are not familiar with tug types, and you are in command of the tug, not the pilot.
- Vessel crew has most difficulty in getting the heaving line on the tug, due to lack of seamanship of crew and improper heaving lines.

**ROTOR tugs**

- Approach from side to estimate ship speed and have spare power available.

**Interaction effects**

- All ship captains, tug masters and pilots know about interaction effects and the risks for tugs when operating in close vicinity to a ship.
- Several ship captains experienced interaction effects and a large percentage of pilots and tug masters had critical experiences with these effects.
- For ship captains and pilots, interaction effects were covered during their studies. However, some of the tug masters had not been trained or instructed about interaction effects. A large proportion of these are tug masters on ASD-tugs that operate as a conventional tug.
- The majority of pilots, tug masters and ship captains say that interaction effects are not represented in a simulator in a realistic way.

**Communication**

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• All pilots and most of the tug masters prefer to communicate in the local language. Possible mistakes and errors are mentioned by the pilots as reasons.

• On the other hand, all captains say that communication with the tugs should be done in English.

• Information communicated to tug masters includes SWL of bollards, where to secure tugs, mooring plan, etc.

• A majority of the pilots/ship captains discuss safe ship speeds with tug masters. It must also be noted that several ports already have rules regarding safe speeds. Please, see below.

Speed regulations in ports

• Half of the tug masters say there are speed limits in their ports, either through regulation, by guidelines, or established practice.

• A maximum speed of 6 knots is most common, with 7 or 8 knots in a very few ports.

• Pilots report that some ports have a pre-agreed speed of 6 knots through the water, or 5 knots for bow-to-bow operations. Some pilots say that they usually reduce speed to 6 knots, while others trust the tug masters' insight.

• Some tug masters reported that their towing companies have maximum speed restrictions or guidelines. A maximum speed of 6 knots is mentioned most often, and 11 knots for escorting.

Safe procedures for securing tugs

• About most of the pilots and all ship captains say they have safe procedures for securing tugs.

• It should be noted that several pilots complain about lack of good experienced crew members on board ships today.

• All ship captains say they have instructed their officers to keep an eye on the tugs in general and when they are not visible from the bridge.

• Most pilots do not ask the captain to keep an eye on the tugs when securing even if they might not be visible from the bridge. They expect the ship's crew to do so since it should be standard procedure. Some pilots find it a good idea and will do so in future.

• Almost all captains and pilots state that when tugs are making fast the ship should be on a steady course and the tugs should be warned about engine manoeuvres.

Tug approach manoeuvres

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- Most captains say that tugs should only approach the ship for securing when the crew is ready. More than half of the pilots prefer to instruct the attending bow tugs to approach the bow only when the ship's crew is ready to send a heaving line. Some rely on tug masters' experience.
- In general most tug masters keep pace with the ship; some will approach the securing position at the ship from behind.
- If securing at the bow of a container ship, almost half the tug masters will keep pace with the ship and will steer slowly towards the bow, regardless of tug type.
- Tug masters may wait right in front of the ship till it comes closer, while some will wait in front of the bow and somewhat to port or starboard, which is much safer in case the tug suffers engine failure.
- ASD-tugs that operate in the conventional mode will overtake the ship and will then carefully manoeuvre towards the bow.
- If securing at the bow of a loaded bulk carrier or tanker, the same approach manoeuvres as with container ships are used by approximately the same percentage of tug masters.
- There are a large variety of answers regarding the preferred location to pick up the heaving line, due to the different tug types and operating modes.

In case of securing at the bow of a container ship, the position straight in front of the bow is often preferred, but the position near the forward shoulder is also popular, particularly for ASD-tugs operating in the conventional way. For bulk carriers and tankers there is more preference for the forward shoulder. Most prefer to pick up the heaving line at the most forward position. The lee side is often mentioned as the preferred location, which is understandable.

Safe connecting procedures

- Regular meetings between port authority, pilots and tug masters about proper procedures.
- Day-to-day communication between pilots and tug masters to alert tug masters to problems e.g. high Dead Slow speeds, deep draft vessels, SWL of bollards, poor seamanship on board ships, etc.
- Optimum communication needed between ship's crew and tug.
- Training should include safe procedures.
- Ship should have safe procedures and implement them.

Complaints:

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- Improper heaving lines used.
- Ship's crew often creates unsafe situations.
- Towline eye is not positioned on the lowest part of bollard.
- Knowledge of towing in the conventional way is being lost.

Safe speeds
- Safe speeds depend on tug type. For instance, safe speeds for tractor tugs can be higher than for conventional tugs. Weather conditions and tug master experience play a role as well.
- Discussion between pilots and tug masters is very useful.
- Not all ports operate with bow tugs towing on a line.
- Safe speed to be based on what speed a tug master can drive his/her tug in a controlled manner (particularly going astern for bow-to-bow) on one engine. Once this speed is established for the specific tug, prevailing conditions and competency of the tug master, it is recommended to take one knot off the figure and that will be close to the safe connection speed.

How to reduce speed
The following manoeuvres are mentioned to reduce speed if it is too high:
- Stop engine frequently for as long as safety permits. If there is sufficient room, use fish-tailing with rudder. Abort approach and prepare anchors if necessary.
- Apart from the above suggestions a very good solution is to make a stern tug fast to assist in reducing speed.

Complaints:
- Many container ships have a Dead Slow Ahead speed of 10 knots or more.

Final remarks
- Proper communication and information exchange needed (and emergency communication sets).
- Proper heaving lines should be used.
- Training is a must for everyone involved. Refresher courses. Experience.
- Know your tug capabilities and limitations (this applies to planners as well), local conditions and interaction effects.
- Tugs should be on time and ship's crew ready.
- Know the speed and ask to slow down if speed is too high.

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- Sometimes tug masters make fast if speed is too high, even if they are told by the pilot not to do so.
- Young tug masters are sometimes too shy to ask the pilot to slow down.
- Keep sufficient reserve power.
- Towage companies, port authorities and pilot organisations to set maximum ship speeds for tug operations in general and for bow-to-bow operations in particular.
- Line throwing systems needed.
- Released towlines to be lowered carefully and slowly to the tugs.
- Lighter towlines with higher SWL needed.
- Set up an International Incident/Accident database. Set up a means of Formal Safety Assessment. Instigate Failure Mode & Effect Analyses for tugs to avoid single point failures, especially at the design stage. All these will help to avoid possible catastrophic failures for the forward tug.
- Why bow-to-bow? Use tractor tugs, or push pull method.
- Never connect a side tug before front tug is connected.
- Knowledge of towing in the conventional way is disappearing, and the knowledge is not being passed on, which can be dangerous.
PARTICIPANT 10

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REPLY TO QUESTION 1

The worst case scenario is of course a crew member getting injured.... Accidents always happen while you are unprepared, believing the operation to be going smoothly and efficiently.

You think you are in control doing what you always do while mooring and suddenly you are in the middle of a situation you never thought as possible with a major crisis to be managed – immediately and afterwards....

Ship handling towage from conventional single-screw tugs is giving way to increasing choices of technologies matching tug types to individual port profiles.... ASD drive, tractors, reverse tractors and Rotor Tugs are modern examples but it is important that ship’s crews understand their different operating modes, the guidelines explaining not only what you see but what is below the waterline.

Making the towing connection is critical considering the close vessel proximities and human physical involvement with best practice being explained including an alarming picture of items of heavy marine hardware used as heaving line weights.

Ensuring a safe conclusion to what in many ports is an evolution occurring many times daily depends however not only on the vigilance of the ship’s deck crew; decisions taken in the isolation of the wheelhouse (from where the tugs are often not visible) can have serious outcomes if not communicated adequately and the consequences of certain manoeuvres understood.

Pilots will be familiar with ship-assist operations, often accompanying tugs as part of their training but a detail as simple as referring to the tug’s name rather than its skipper’s name when conveying instructions is highlighted in assisting the vessel’s bridge team understand what is happening.

Situations including reduced visibility and foul weather are explored along with the merits of towing winches versus towing hooks. The “do” and “do not” section provides a virtual checklist, items

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intentionally repeated in both sections (in opposite ways) to increase the chances they will be noted and remembered.

Mooring is the operation performed first and foremost by the deck crew as the ship reaches the port — but it is also one of the most difficult, complex and dangerous jobs on board. Mostly things turn out safely. But sometimes an accident occurs and this usually has severe consequences.

Several cases have been reported in the past about accidents during mooring operations and many of them have led to severe injury or death of seamen.

Mooring, towing and hauling impose enormous strains on lines, warps, gear and equipment and major forces are involved. Therefore — take care and think carefully when mooring — especially ships with structures that make it hard to oversee what is happening. Also on ships calling at different ports the specific mooring arrangements may differ considerably.

As humans we tend to believe that things are safe if nothing happens. You might say that the norm for what we believe is dangerous decreases over time. Normally mooring goes well, but as time goes by, the level of safety slowly declines. Maybe you lose concentration, maybe you slacken your procedures just a little bit, maybe you get a little complacent. And then it suddenly happens — not because of one fact to Factors can be found in

- Equipment
- Work processes
- Crew qualifications
- Crew concentration
- Ship’s safety culture
- Weather

Preventing accidents is about reducing the risks of those factors. The only parameter that is hard to overcome in this respect is the weather.

Please describe various safety issues in towing operation and your recommendations to deal with those?

THREE COMMON REASONS FOR ACCIDENTS

- Seamen standing in bights or snap back zones and when lines part, those involved are often injured.
- Insufficiently trained crew are used during mooring operations and they are often seriously injured if something goes wrong.

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• The person supervising the mooring is also involved in the operation and is unable to carry out his role effectively.

Although a routine job, mooring often involves huge stress for the teams. There is often little time to prepare, so it is important that all are involved and fully aware of the limitations of the mooring process and that all use their best efforts so that the crew involved in mooring can act as a team.

There are very few rules that apply to all mooring operations, but the following dangers should be absolutely avoided in any situation.

It is also important to remember basic seamanship. Take the time to consider your own and your shipmates’ work and the work of those who are new or unfamiliar with the ship.

Overall, the mooring operation should have a fixed rhythm and coordination, with crew both fore and aft depending on each other. Timing is often a vital factor when making fast the various lines and if it is not done right the first time, it can put safety at risk.

The owner and/or master must develop a procedure to ensure that the vessel can be moored safely. The master is responsible for mooring the ship and to ensure that suitable mooring equipment is provided and properly stored. Before leaving the ship the master must ensure:

• allowance is made for tide conditions and weather
• unauthorised entry is restricted
• legitimate access of other vessels to facilities and navigation channels is not restricted
• the ship is secured to prevent any movement which could cause damage to the ship, its berth, any other ship, or property
• the ship is moored in the traditions of good seamanship
• all machinery and associated systems, including LP gas installations are isolated and/or secured to prevent accidents or pollution.

**Towing**

The master must have procedures in place and must consider the following before towing another ship:

• ships at sea are only obligated to attempt to save life. Property rescue should only be considered when, in the master’s opinion, there is no perceived risk to the crew and ship
• the vessel should be capable of towing or being towed by a vessel of similar size
• the tow should be made fast to the towing ship forward of the rudders and propellers so the ship will retain steerage. If this is not practical, a bridle using a running block can be arranged to move the effective towing point forward and retain steerage, even though the tow is attached to the stern of the ship.
the towing load should be distributed evenly across cleats and bollards, or if a strong point is provided for that purpose the tow should be attached to it
messenger lines or a dinghy can be used to carry the towline to the tow if it is difficult or dangerous to come in close to the tow
a means of communicating between the two ships must be established (radio, voice, flags, hand signals)
the master will make provision for the rapid slipping or cutting of the tow in an emergency situation
ensure the appropriate day shapes and lights are displayed
consider contacting insurance companies/owners.

Reducing speed

Regarding reducing speed pilots made following remarks:
• If speed is too high I refuse to let tugs make fast.
• I try to slow down by stopping engine frequently.
• Stop engine for as long as possible and, if there is sufficient (sea) room, use fishtailing with rudder.
• Slow down or abort approach.
• Immediately make a dramatic change in ship's engine settings or stop.
• Maybe there is a possibility to connect stern tug to reduce speed.
• Put wheel hard over several times and stop engine (kick ahead if necessary to maintain required heading).
• Slow down the ship. If necessary, stop engines and/or prepare anchors for letting go.
• Many container vessels have a Dead Slow speed of 10 knots or more. Very dangerous!!

Safe speeds

Pilots made following important remarks regarding safe speeds:

○ Speed to be 6 kn.
○ Some ports have a pre-agreed maximum speed of 6 knots, or 5 knots for bow-to-bow connection.
○ Some pilots say that they usually reduce speed to 6 knots, while others trust the tug masters' insight.
One pilot has the opinion that tugs should always approach from the side so they can judge the ship's speed more accurately, much better than when approaching from ahead.

Too high ship's speed

- Even if I tell the tug masters about speed and when to make fast, they make fast when they like, even when ship's speed is too high.
- I don't expect any tug master to make fast at speeds he considers unsafe.
- Some (young) tug masters are too shy to say: SLOW DOWN. I WILL NOT CONNECT. Everything is on tape and after an accident the tug master can explain.
- No need to approach ships doing a high speed: they can be controlled easily and don't need the assistance of tugs; tugs cannot assist at high speed.
- Communications and information exchange
- Better communication between pilot and tug. If I sometimes want to delay the securing of the tugs, the tug master is already making fast. I don't need them at 9 km speed.
- Don't know if towing companies have guidelines for maximum speed to approach a vessel, depending on tug type, etc. Better communication needed between tug master and pilot about safe speed.
- Always discuss any manoeuvre with the tug skipper before starting. Have regular pilot/crew seminars.
- Tugs should never approach a ship before being in VHF contact with master or pilot.
- Good communication is very important. Tug master should inform pilot if he thinks speed is too high. Pilots should inform crew to use good heaving lines, to follow instructions from tug master, tell tug crew when the line is on the bollard and keep the pilot informed.
- More and better communication and never assume!!!
- Clear and proper communication! Use line throwing guns on (bow) tugs. Use standard communication phrases for tugs and pilots. Have proper emergency communication procedures in case of communication breakdown (e.g. VHF failure) like in Rotterdam.
- Tug master should keep the pilot informed about what is going on. A camera at the bow is another possibility.
- Tugs should be on time. If not, inform pilot so he can slow down.
Safe procedures for connecting and releasing

- Use line throwing guns, so tug can stay out of danger zone while connecting.
- Too often tow lines are caught in tug propellers when tugs are released on ships making way. With respect to this one pilot gives several recommendations.
- When letting go the towline of a stern tractor tug, instruct crew to lower towline and messenger slowly on the tug, to keep it out of the thrusters.
- In the future I will have a final check whether the crew is ready before the tug is approaching.
- Tug should always have enough reserve power to escape. The use of proper heaving lines prevents the tug approaching too close to the bow. Make ship captains aware of the danger for tugs when making fast.
- Tugs should never secure when sailing astern, as with the ASD-tug 'Fairplay 22', if the tug is not able to stay safely in that position.
- In case wave height has a large influence on tug manoeuvring when approaching the bow, make it possible to pass towlines inside the port area; pass heaving line from the forward panama fairlead to the tug when sea conditions improve and allow.
- Don't approach bow to bow, but from the side, and get the ship's crew to run the heaving line from the shoulder to the centre lead.

Training
Better training of tug masters, with focus on PEC holders with limited training and less experience in tug use. More training for deck crew on this specific issue.

Finally

Set up an international incident/accident database. Set up Formal Safety Assessments. Use Failure Mode & Effect Analysis for tugs to avoid single point failures, especially at the design stage. All to avoid possible catastrophic failures for the forward tug.

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PARTICIPANT 11

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REPLY TO QUESTION 1

Being a good employer we live up to our responsibility and commitment to ascertain healthy and safe working conditions for all personnel engaged in our operations.

We always try to limit their impact on the environment and committed to deliver quality always on time. It is the company’s goal to ensure safety in ships operations, to ensure the safety of the crew and to avoid damage to property and the environment.

All owned and managed vessels are operated in such a way as to minimize Health and Safety risks of the crew and to protect the environment in accordance with international conventions and with national and flag state regulations.

To achieve these goals a safety management system has been implemented. Applicable codes, guidelines and standards as recommended by administrations, classification societies and organizations within the maritime industry, will continuously be taken into account.

Training, equipment and procedures are provided to minimize the impact to the environment during all operations, whether it be towage, offshore support, salvage or other operations.

Every employee ashore and onboard our vessels has to contribute to our goals as it is a team effort.

Recent accident investigation reports suggest that merchant seamen continue to be injured during mooring and towing operations. A clear plan of operation and good communications between the tug and tow, prior to operations commencing, will reduce much of the risk. Ship managers need to ensure their crews are fully briefed to ensure the successful performance of the operation and that all safety issues have been highlighted.

Although all ships are different to some degree, with varying equipment for mooring and towage, there are some basic principles which are common to all and which allow the towing or mooring operation to be done in a safe and efficient way.

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It is easy to become complacent, when the towing or mooring operation is a frequent event and, because, of this, there is a constant need to be reminded of safe practice. When towing and mooring operations are less frequent, crew have an equal need to be reminded about associated hazards and safe practice prior to the operation.

**Stability**

Conventional tugs in particular can experience very large tow line forces, sometimes in excess of the bollard pull. Good static and dynamic stability is required to accommodate the high forces likely to be experienced.

The IMO has established criteria, including statical stability curve requirements applicable to vessels over 24 metres in length on international trades. Other administrations and classification societies have set their own standards for small tugs and workboats. The International Association of Classification Societies (IACS) in 1998 recommended additional stability criteria, but these are not mandatory. The stability requirements, especially for smaller tugs and work boats, are not internationally harmonised and do not always take account of high towline forces. Even though the amount of stability data available may be regulated by the flag state or classification society, it is possible that no specific data is available on board accounting for the high towline forces. The tug master should be aware of the safe stability requirements for his vessel.

The stability of a tug is determined by the heeling moment occurring during towing and what safety margin is applied. Authorities can judge safety margins differently.

The heeling moment is caused by:

- The tow, when the tug is dragged by the tow line.
- The tug, when the heeling moment is caused by the combined action of its rudders, propellers, towline or hydrodynamic lateral force on the hull.
- A combination of the above.
- Water ingress.

Tug masters must be alert to the danger of capsizing which can occur when the tow wire/rope reaches a large angle to the centre line of the tug and the quick release cannot be activated and girting occurs. If girting is experienced tugs with towing hooks forward of the propeller system can find it difficult to recover. Contributory causes allowing a tug to capsize in a girting situation include:

- Small freeboard.
- Poor stability curve of righting levers.
- Watertight and watertight openings not secured correctly.
To reduce the dangers associated with girting, particularly with small tugs, the following is recommended:

- The towing gear should minimise the overturning moment due to the load of the towline, including the position of the tow hook and winch.
- The towing hook should have a positive, reliable means of quick release able to operate in all conditions.
- The release mechanism should be designed to be activated locally and from the wheelhouse. All crew members must be familiar with the characteristics of the system and it must be tested frequently.
- Maintenance of the towing gear must be carried out by competent persons.
- Openings such as watertight doors and ports must be kept closed during towing operations.
- Engine rooms should be fitted with high cowling ventilators; air pipes should be fitted with automatic means of closure.
- Utilisation of a gog/gob wire.

**REPLY TO QUESTION 2**

**Stability of towed unit**

We have experienced numerous claims that have arisen from inadequate stability of the barge, in particular those used in the carriage of containers. How to calculate the stability of a barge with cargo stowed on deck is important. The stability of the barge or towed unit should be assessed by the tug master or recognised organisation. This would include checking if tanks are empty or full to reduce free surface effects (FSE), all openings are closed and appropriate freeing ports operational. Effects of any ballasting needed during the voyage should be taken into account.

Some organisations have produced guidelines on the intact stability of the towed object and Members should check and verify this with their overseeing authority.

Other considerations should include:

- The Metacentric height (GM) should be positive throughout the intact range. The GM should include a margin for calculation error. GM should never be less than 0.15 metres.
- FSE should be considered, including cargo and ballast free surface.
- Effects of potential icing evaluated.
- Dynamic stability requirements for the barge/barges are met.
Maritime New Zealand 'Barge Stability Guidelines' provides information on the subject of pontoon barge stability. In respect to barge stability the following information should be ascertained before towage commences:

- Know the lightship displacement of the barge before loading.
- Know the lightship centre of gravity (KG) for the barge.
- Know the weight and centre of gravity of the cargo.
- Be aware of the block co-efficient of the barge.
- Be aware of initial metacentric height (GM) and know how to calculate it for the loaded barge using the rectangular block formula.
- Know how to calculate the combined KG for the barge loaded with its cargo.
- Be aware of the limiting KG curve and have one available for guidance in loading your barge.

It is important to ascertain that the stability information set down for the vessel being towed is current.

Bollard pull (BP)

When a tug is hired the chartering party requires knowledge of the BP of the tug i.e. the pulling capability of the tug. The charterer will know what the required BP is for the contract, either through experience or it will have been calculated. When newly built the pulling capability of the tug is measured using a load cell under certain conditions, including the main engines being at the manufacturers maximum recommended torque for a continuous period of 30 minutes. The classification societies have their guidelines on how the BP should be measured.

Problems can arise where the tug is chartered to carry out a task that requires a certain BP rating. The specification given to the charterer will usually be as per the BP certificate. The tug will have on board documentation, including a certificate issued by a competent authority proving the BP. It is not unexpected that as the tug gets older, the efficiency of the main engines and equipment will decrease the BP. It is generally accepted that if the BP certificate is less than 10 years old the BP rating is as stated on the certificate. Surprisingly some older tugs have actually produced a higher bollard pull than that recorded when the tug was built and this is often thought to be due to unsuitable conditions at the testing site which may have included one or more of the following conditions: insufficient depth of water, insufficient length of towing gear, high wind speeds, poor tidal conditions or a damaged load cell.

Other factors may also affect the tugs efficiency, e.g. age, appreciable hull growth, propeller condition and high sea water temperatures. Another factor identified in fatal accidents is when a tug

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is using a shaft alternator during a tow. Therefore the main engine output will be reduced and consequently the BP is reduced. This fact should always be taken into consideration when in an operational mode.

For tugs less than 10 years old with no valid BP certificate the BP can be estimated as (1 tonne/100) x Brake Horse Power (BHP) of the main engines. For tugs over 10 years old without a valid BP certificate the BP value can be estimated as 1 tonne/100 x BHP reduced by 1% per year of age greater than 10 years.4

A tug master should always be aware of the commercial demands made of his tug and that the tug is able to comply with those demands.

Pivot point

It is important to understand the effect of the pivot point on any vessel but particularly with tugs when towing. Knowledge of the pivot point assists the tug master to understand how the unit being towed will steer in different situations. A floating unit rotates about a point situated along its length called the pivot point and when a force is applied, it will turn about this point. These forces could be rudder movements, the tug pulling in one direction, wind or current. The position of the pivot point will change due to speed, draught, under keel clearance, rudder size/type, tug construction and hull form.

It is also important to understand how the pivot point of the towed unit changes. A ship or barge stopped in the water, with no external forces applied, will have a pivot point coinciding with the centre of flotation which is approximately amidships. When a vessel is making headway the pivot point will move forward. Generally it will move about 25% of the towed unit’s length towards the bow when moving ahead and vice versa if moving astern.

For example if a barge is moving forward towards a berth being assisted by a tug ‘breasting’ the barge alongside and the tug is positioned at the barge’s pivot point there will be no turning of the barge. If the tug is positioned away from the pivot point there would be a turning motion on the barge; the further away from the pivot point the greater the turning momentum.

A moving barge or ship will travel laterally or drift across the water when turning because the pivot point is not located at the craft’s centre when moving forward. It is useful to be aware where the pivot point lies on the assisted vessel and how lateral movement can cause sideways drift. This awareness is crucial when manoeuvring close to hazards.
Position of tug and interaction

The position of the tug is always important especially when assisting a barge or vessel. The safe position of the tug relative to the assisted unit depends on many factors which include the size and pivot point of the unit, the number of tugs assisting, the speed of the unit being assisted, the depth of water, and amount of manoeuvrable room, currents and winds. Often when assisting a barge or vessel the tug will have to make fast with a towline. If the tug is to make fast to the barge with its own crew the risks are obviously increased, more so in poor weather.

The phenomenon of interaction is well known to mariners and it is particularly dangerous in situations where there is a larger vessel or barge moving at speed in close proximity to another smaller vessel, such as a tug. The effect is increased further in confined and shallow waters. Tugs and smaller vessels have capsized as a result of this, particularly when being overtaken by a larger, faster vessel in a confined waterway, such as a river or channel.

When a tug approaches a vessel or barge that is going at a moderately fast speed through the water there are various suction and pressure forces around the vessels hull – the greater the speed, the greater the effect.

**Approaching the forward end of a ship or barge**

If a tug approaches a vessel going ahead at speed forward of the pivot point it will be pushed away and if approaching from aft of the pivot point there will be little or no suction effect. This suction effect will increase as the tug approaches the vessel's stem or quarters, as the water flow increases due to the hull shape or increased water flow from the ship's propellers. The amount of force felt is related to the distance from the hull of the vessel. The force can also be increased by reduced water depths or confined water areas such as narrow channels.

**Approaching the aft end of a ship or barge**

When a tug approaches the aft end of a ship or barge there is considerable suction effect. This effect is dependent on how close the tug is to the barge or ship, speed and the shape of hull form around the stem. The suction effect can be huge and the tug is unable to manoeuvre away. This can result in damage to the tug as it is dragged beneath the ship's counter (when the ship is in ballast) or towards the ship's propellers.

Another effect of interaction is water flow around larger moving vessels acting on the under hull of the tug. This can cause a decrease in effective stability and increases the possibility of the tug capsizing if the two vessels come into contact.

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Accidents occur if the tug and unit being assisted are not similar in size and the speeds are relatively high, in one case a tug with a 2 metres draught was making fast to the starboard bow of a ship with a draught of 3 metres. The tug was proceeding at about 4 knots parallel to the ship, gradually pulling ahead until about 6 metres abeam of the ship's forecastle. As the tow line was being passed the tug took a sudden shear to port and the two vessels touched before the tug master reacted. The impact was minimal in this case however, in seconds, the tug took a starboard list and capsized resulting in a fatality. Research confirms that the following consequences happen with hydrodynamic interaction:

- Interaction effects are increased in shallow water.
- Rudder effectiveness can be reduced in shallow water.
- Squat effects are increased in shallow water and the risk of grounding is enhanced.
- Transverse thrust of the propeller changes in shallow water.
- Changes in manoeuvring characteristics are experienced in shallow water.
- A large vessel or barge with small under keel clearance which is stopped in an enclosed basin can experience strong turning forces.

**Towing Equipment**

Towing equipment generally includes the equipment on the towing vessel and towed object which may include: towing winch, hook, drum, fairleads, towing pins or hydraulic jaws (if fitted) and towing gear. Towing gear includes tow lines, wire ropes, gob wire, bridles, chains, pennants, eye plates, towing rings and shackles.

**General**

Again, before every towing operation the towing gear should be visually inspected and tested. Towing arrangements and equipment should conform to the following:

- All the towing equipment and gear, towing hook and fittings should be strong enough to withstand all loads imposed during the tow and fully certified with up to date tests in place.
- Ideally the towing hook or towline should have a means of release which can operate in all conditions. The release mechanism should include both remote and local controls. The operation of this equipment is to be fully understood by the crew.
- Navigation lights are rigged and are capable of remaining alight during the hours of darkness for the duration of the voyage. Navigational shapes are to be made available for daylight navigation as appropriate.
To reiterate, for the equipment to be in good order there has to be a regime of inspection and maintenance on board the tug as part of a company planned maintenance system (PMS). It is not possible to operate a tug safely without an effectively operating PMS. The PMS should include other critical systems on board, such as the main engine and electrical power systems.

**Planned maintenance system (PMS)**

Planned maintenance systems can be sophisticated computer based, giving real-time data back to the technical office and sometimes these systems are approved by a classification society. Or, they can be simpler paper based systems, but no less effective. Whichever PMS is in place, it is important that maintenance of critical equipment is monitored and recorded and this includes the towing gear. If no records are kept and there is no reliable knowledge on what has been inspected or overhauled, in good or poor order.

The PMS should include:
- Towing hooks and arrangements.
- Towing hook quick release systems.
- Hydraulic systems, pins, shanks jaws or equivalent.
- Towing winches.
- Bollards, fairleads and sheaves.
- Ropes and wires.
- Ancillary equipment, i.e. shackles, thimbles, eyes, rings, plates.

All PMSs require a structure to ensure equipment inspections on a regular basis, weekly, monthly or annually – whatever is considered suitable by the company or by legislation. The time between inspections of equipment will depend on their criticality and their amount of usage. The PMS should also include the maintenance, testing and keeping of test certificates for the different equipment.

New lifting and towing equipment and wires should always be received on board with approved test certificates. It is important to maintain an ordered system for all test certificates including wires, pennants, stretchers, ropes, towing plates, shackles, rings, bridles and other towing or lifting equipment.

It should be noted that whenever accidents have occurred as a result of equipment failure it has been found that the equipment was not maintained correctly and/or was repaired incorrectly by an unauthorised or inexperienced person. The use and failure of welded fittings where the welding was carried out by unqualified staff or the welds were not inspected or tested by an appropriate person has often been the cause of personal injuries.
Many port and river authorities will require that inspections and testing of towing equipment should be regularly carried out and appropriate records maintained.

Testing and certificates

It is important that the company and tug master are aware of the regulations required for the testing and inspection of the towing gear and equipment. Regulations may differ depending on location and the following is usually an accepted guideline if no other guidance is available.

All towing gear, hooks, shackles, winches and wire ropes should always be provided with test certificates when new and kept as a record. All gear should be tested and re-certificated by an approved contractor every five years or after any significant repairs have been carried out. Mooring ropes also should be issued with certificates when they are new.

Keeping track of wires and shackles (with their certificates) is important and the PMS should allow for this. Apart from the visual inspection of all gear before a towing operation commences, all gear should be formally inspected annually by a competent person. This could include the tug master or experienced crew person.

In the event of an accident the ability to prove that the gear was in a good condition with all the certification and tests in order is a strong indication that the tug was operating to the correct standards and in addition assists the Club with the defence of any related claim.

All damaged equipment should be isolated and removed from operation. If it cannot be repaired properly by a competent person it should be condemned and discarded. Damaged equipment should never be used.

Towing winch

Towing winches come in different designs and sizes and the workings of winches should be understood by those using them. The manufacturer's manual should always be available on board to refer to. If the tug is provided with additional secondary winches these should also be included in the PMS.

Clear operating instructions in the appropriate language should be available near all the manual and emergency controls. The working of the winch emergency release system (ERS), if fitted, should always be understood by those operating the winch.

Checks on the towing winch should include:

- Effective operation of the braking system.
- Winch power and hydraulic systems.
- Signs of corrosion or fractures on the holding bolts, welds and supporting deck.
Effectiveness of the emergency release from the wheelhouse and/or the local activation point.

Effectiveness of the spooling mechanisms.

Connection end of the towline should always be fixed but with a force of less than 15% of the breaking load of the towline.

The towing winch brakes should provide a static holding capacity of at least 1.1 times the breaking load of the tow line.

There are no accepted international standards for tug tow line ERS. Following many accidents, particularly those that have been caused by girting, it has been found that the ERS for the towing winch or the towing hook failed or did not operate quickly enough to prevent the tug from capsizing. It is important for the crew to be aware of the operating limitations of the ERSs on board their vessel. There have been cases where some older types of manual ERSs have not released when there was an excessive load on the tow wire/hook. These should be tested at the earliest opportunity to ascertain the operating parameters and if necessary then prominent notices must be put up at the winch/towing hook and on the bridge that some weight must be taken off the tow line before the emergency release can be activated.

Towing hook

The maintenance of the towing hook should be included in the PMS and thus inspected regularly and visually before each tow. The towing hook release mechanisms should be tested and recorded to ensure that the hook releases properly.

Damage to the towing hook (or other essential equipment) must be reported and not used until the damage is rectified.

Generally it is not regarded as good practice to utilise towing hooks for ocean passages.

Bollards, fairleads and sheaves

Checks should include:

- Regular inspection for wear, excessive corrosion and wastage.
- Inspection for fractures to welds and supporting structures.
- Ensuring that all rotating sheaves are properly greased and free.

Towlines, wire and synthetic ropes

The care of wire and synthetic ropes, including stretchers, is an important part of the PMS. Formal guidance on how to inspect, stow and maintain ropes and wires should be provided.

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A major issue is trying to maximise the service life of rope and still maintain safety. All tug’s deck crew should be trained in rope inspection and gauging when a rope is damaged and is no longer fit for purpose and safe for use.

Maintenance guidance and checks on ropes should include:

- Pennants inspected prior to every use, annually and tested after a suitable period or five years.
- Main tow wire ‘end for end’ every year, and replaced when appropriate.
- Main tow wire physically inspected every month and/or before each tow.
- Main tow wire physically inspected after every deployment for damage and abrasions such as: Ultra violet (sunlight), heat or chemical degradation.
- Wear, broken, cut or fused strands.
- Overstretched rope (can reduce the effective diameter of the rope).
- Distortion and kinking of the rope, particularly wire rope indicating that the wire has been severely stressed.
- Rope not properly stowed can degrade, for example synthetic rope can deteriorate, become mouldy if stowed wet with no proper air flow.

All towing pennants should have the same lay as the tow wire with a Minimum Breaking Load (MBL) of not less than the tow wire.

The tow wire minimum breaking load should never exceed the breaking loads of the connecting points or equipment. A suggested general rule is that the tow wire and springs and towing hooks should have a Safe Working Load (SWL) of at least 2.5 times (some suggest 3 times) the bollard pull of the tug.

Ancillary equipment

Ancillary towage equipment, such as wire towage protectors and thimbles should be regularly inspected and form a part of the PMS.

Sufficient tow wire protectors should be on board to prevent the tow wire from excessive chafe. These can be in the form of custom-made polyurethane sleeves which are exceptionally durable/resilient and are usually employed as a protection on tow wires. The simpler method for short towing voyages is just by wrapping the chaffing part of the tow rope with a piece of hawser or gantline and coating it with a bit of grease. Care must be taken to not to overdo the grease in case it causes an oil sheen in water during adverse weather including rain.

A powered workboat which the administration may accept as being a part of the life saving equipment should be available for use as an inspection boat when towing a barge. The tug should be
fitted with adequate launching devices to lower the boat in open sea conditions. All personnel should be wearing appropriate PPE at all times and be trained in the launching of the boat.
An operational searchlight should be available to illuminate the tow at night.

Navigation lights and shapes

The tow shall carry the lights and shapes required by the International Regulation for Preventing Collisions at Sea, 1972 amended 1996 and any local regulations.
Navigation lights should be independently powered and the fuel or power source should be adequate for the maximum duration of the towage with reserve. It is also advisable for a searchlight to illuminate the tow to be available.
Towed objects where necessary should be fitted with a radar reflector mounted as high as practical.

Safety factors
There are no statutory international guidelines.
A tug master should always be aware of the condition of his tug and its equipment. As a guideline, steel and fibre tow wires/ropes should have a Safe Working Load (SWL) of at least two to three times the BP of the tug. This safety factor can also be used when considering the towing hooks and fittings.
PARTICIPANT 12

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REPLY TO QUESTION 1

As tugboats become more sophisticated in design, resulting in powerful and highly manoeuvrable tugs that are servicing larger ships with less assets, a superior standard of tugmaster competency and operational knowledge is required, especially when considering current Manning levels. Time and time again on my travels as a consultant, I see how tugmasters' skill-sets are insufficient to safely, effectively and competently operate today’s new generation of tugboats. By the very nature of the work, tugmasters tend to remain in a port and have little, if any, outside influence or stimulus, in effect becoming inwardly focused.

Only over the last decade or two have omni-directional tugboats become the norm in ports; to a large extent the original tugmasters were left to their own devices, with no formal or appropriate training to figure out how to operate omni-directional tugs effectively. This has resulted in mixed abilities, usually based on an adaptation of conventional twin-screw knowledge. This original generation of omni directional tugmasters, with the best of intentions but in ignorance, has then passed this inferior skill-set on to the next generation of omni-directional tugmasters.

Previously this was to some extent manageable, as the earlier classes of omni-directional tugs were more forgiving owing to their:

- heavy deadweight;
- higher length/width ratio, giving good course stability;
- relatively low horsepower; resulting in, by today’s standards, a slow-responding tug.

The new generation of highly manoeuvrable, lightly built and powerful tugs, commonly around 30m LOA or less and upwards of 6,000hp, are far less forgiving of inferior or inadequate skills and

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driving techniques. These tugs are best described as the ‘Ferraris of the sea’ and, as with any high-performance vehicle, require specialised skills, both to operate to their full potential and also to use safely at the same time. Literally every time the tugmaster moves the control levels, even minutely, the tug responds instantly, particularly in the case of individual controls.

Of the many variables the controls can create, there is only one correct combination and this changes all the time that the tug is operational. A tugmaster does not have the luxury of time to figure out how to get it right.

Added to this, tugs have now been de-manned to a point where tugmasters have a lot more on which to focus, and multi-function items with which to contend, than previously.

Given the varying and constantly changing forces, influences and requirements while operating in close proximity to a ship, the tugmaster is continually assessing and making alterations to control settings.

To do this correctly and effectively in a timely manner, say when it is 2am and you are tired, there is a howling gale and the pilot is demanding responses, requires competencies of an extremely high standard.

Remember that when a tugmaster gets it wrong, people can get hurt and assets damaged.

**REPLY TO QUESTION 2**

As with all industries, times and standards are changing. In ours, commercial pressures are demanding safe operations, higher skill-sets, lower operating costs but, at the same time, shorter training periods.

The first step to resolving any problem is recognising there is an issue to address; reassuringly things are improving as managers and authorities are now realising the need for proper professional competency based training for tugmasters, while accountants are realising training is an investment that pays dividends. This commercial need is further supported by Resolution 8 of STCW95 – promotion of technical knowledge, skills and professionalism of seafarers, which basically states: “A seafarer must not only be qualified to fulfil an operational role on board a vessel, but also be competent to perform the assigned role.”

Following investigations into a number of tug incidents, in 2005 the UK Marine Accident Investigation Branch (MAIB) strongly urged:

1. All tug operators review their training schemes to ensure that tugmasters receive comprehensive familiarisation training before taking control of a tug that is equipped with significantly different
propulsion systems. Such training should incorporate instruction and validation on all manoeuvres that the master is likely to undertake in their port or operations;

2. All harbour authorities, pilots and tug operators regularly review the capabilities and limitations of their harbour tugs and their crews.

TRAINING PROGRAMMES

Professional towage companies have come to the conclusion that the cost of training is an investment. There is no doubt that training is vastly more cost effective than repairing people, vessels, third party assets and the company’s reputation. Furthermore, in the event of a serious incident, companies are now being called upon in court to prove their operating standards are appropriate and their tugmasters are competent.

As an example of a professional training programme, the Seaways Tugmaster Training Program has six differing modules that clients can elect to take. All have unique skill-sets to suit differing towage operations, ie training for a harbour towage operation involves four streams of training taking place simultaneously:

- ASD Tug Handling;
- Undertaking Harbour Towage Operations;
- Learning the company’s Safety Management System (SMS) and procedures;
- Learning the management of the tug, including PMS, booking system, ordering system, crew management etc.

The process is about setting high competency standards and then having tugmasters operate on a day-to-day basis well within their skill-sets. This ensures that when operations start to become more challenging, the tugmasters remain within their skill-sets, resulting in appropriate and safer outcomes.

Humans are genetically programmed for ‘flight’ or ‘fight’ when overly challenged. In the tugmaster’s case this often results in the tugmaster, when scared, failing to respond at the controls (in some cases I’ve actually seen them taking their hands off the controls) or giving the controls fistfulls, and thus dramatically overdriving the tug. Both scenarios are equally dangerous.

Proper training helps to manage this. Importantly, having a highly developed and diverse skill-set helps prevent tugmasters going into sensory overload. Furthermore, if this should happen their reactive subconscious instinctive actions are the ones that have been preset via the training.

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TUGMASTER TRAINING

A good training system should:

- Lay out clearly in writing the whole structure of dos, don'ts, whys and wherefores;
- Design the structure to protect the rights of all parties concerned, ie:
  — the trainee;
  — the training master;
  — the competency check master;
  — the clients (pilot and ship-owner);
  — owners of third party assets (port authorities etc);
  — the towage company.
- Ensure competency-based training starts with the basic steps and works its way through listed and identified steps one by one, thus climbing a ladder of competency and confidence to an agreed predetermined standard;
- Use skilled, respected and qualified trainers who can 'walk the talk', who have empathy with the trainees and are adept at getting the message across to colleagues;
- Include repetitive training that fixes the basic moves in the subconscious minds of the trainees;
- Ensure trainees are trained to competently drive the tug before undertaking towage operations;
- Give equal emphasis to operational and procedural knowledge;
- Develop a tugmaster's professionalism in all facets of the job;
- Be designed to cope equally with timid, apprehensive trainees as well as over confident egomaniacs;
- Be based on an effective 'style' of tug driving using a combination of authority, control and finesse;
- Some of the inferior training programmes I have seen on my travels have included:
  - Attempting to train a tugmaster to undertake harbour towage without training him first on how to effectively and instinctively handle an omnidirectional tug to its fully capacity;
  - Training programmes that are time- or job-number governed;
  - Training given in-house by tugmasters who are passing on their own bad habits, albeit in good faith and intent, and who have no experience or qualifications as trainers;

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• Insufficient time given on controls to ensure base competency is firmly entrenched in the subconscious mind of the trainee;
• Training masters pushing the trainees way beyond their comfort zones and, in so doing, taking away their confidence and raising stress levels to an unacceptable level;
• Lack of formal structure and record keeping;
• Ad hoc, non-standardised training that has differing levels of skill, knowledge and competency outcomes between graduating trainees;
• Too much subjectivity in assessing whether a trainee is competent or not;
• Overestimating the benefits of simulator training, particularly in the case of trainers with questionable towing skills, experience, respect and qualifications;
• Not understanding or recognising the limitations of a simulator and the handling behaviour of tug models and that, as good as they may be, they do differ from real on-board operations.

COMPETENCY CHECKING

At the completion of training, and every 12 months thereafter, the Seaways Training Programme graduate has a formal competency assessment.

There are two parts to this assessment, operational competency and procedural competency.

A good competency checking system should include:

Operational competency

Driving the tug through a non-subjective competency circuit that comprises all the basic manoeuvres that an omni-directional tug can perform and in a style of driving that is based on a combination of:

— Authority: to ensure timely responses to the pilot’s orders and minimization of effects around a ship;
— Control: to ensure safe and effective operations at all times;
— Finesse: to ensure no damage or injury when touching down alongside or to push up;

Driving on the secondary steering system;
Driving on one engine;
Emergency response exercises;
Onboard equipment and systems operation;
If ‘Undertaking Harbour Towage’ is a component, observing a towage operation;
If ‘Undertaking Escort Towage’ is a component, observing an escort towage operation;
Driving standards and skills set at an appropriate level that all tugmasters can realistically achieve;

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Tug driving competency checks that are carried out in real time on board a tug, not in a simulator; issues which are identified, dealt with and remedied immediately by the competency check master.

Procedural competency

Recording the company’s SMS, which has been read and understood by the tugmaster, within the previous six months;
Nine questions from the SMS to ensure there is a thorough working knowledge;
Three questions from the Security Manual to ensure there is a thorough working knowledge;
The questions should be relative to issues that have occurred in the company during the previous 12 months, or likely to occur in the coming 12 months;
The nine questions should be chosen to bring focus, education and better understanding and, as such, time taken by the competency check master to fully explain incomplete or incorrect answers; Word-perfect answers are not a requirement, but a meaningful working knowledge is;
There is no failure involved; the process is about development of the tugmaster’s knowledge and understanding.

A sub-standard competency check system

- Overly subjective in assessment;
- Peer group self-assessment-based;
- Has no outside influence to establish industry best standards;
- Has no outside influence to stimulate broadening of experience and knowledge base;
- Has driving standards and skills set at a level that only the better tug-masters can achieve;
- Uses simulators for the operational tug driving assessment;
- Requires word-perfect answers, rather than a sensible, pragmatic working knowledge;
- Is used as a policing tool;
- Is driven or influenced by internal politics;
- Has competency checks that are not totally without ‘fear or favour’;
- Has too long between competency checks, allowing bad habits to become entrenched.

BENEFIT OF ANNUAL COMPETENCY CHECKING
Annual competency checks ensure standards and skills are maintained, especially those that are rarely used, ie driving on one engine. Furthermore, in the event of an incident, both the company and the tugmaster can clearly demonstrate they have been trained and assessed to operate competently and professionally to recognised industry best practice standards and these competencies have been regularly maintained via a structured, pragmatic and independent assessment.

In my experience, it is rare that a tugmaster can undertake an annual competency check without requiring some additional training to reset skill-sets or correct bad habits. Any issues can be dealt with immediately via training as part of the competency check. As such, there is never failure attached to competency checks, because training is given to correct the issues and then the competency check redone. The whole process is about development, education and growth, not about policing or penalising, and takes some eight to 10 hours per tugmaster. A number of marine authorities, organisations, and client companies are now starting to require towage companies to have proof of professional operating standards and competency of operational personnel. The very nature of a professionally developed and administrated tugmaster training and competency-checking programme ensures this can be readily established.

Critical to the success of any training programme is that it educates and develops individuals for the common good. Specifically, competency checking must never be used in a negative or penalising manner or it will become counterproductive owing to a loss of support, credibility and effectiveness. If a towing company decides to carry out annual competency checking internally, it is imperative it invests in training and qualifying its competency check master to ensure he is a skilled, respected and qualified trainer. The alternative is to engage an outside specialist consultant.

PROFESSIONAL DEVELOPMENT

- In many cases, tugmasters have a background either in the small boat industry, as a seaman or deckhand, or in the fishing industry. Personnel coming from this background have many enduring traits:
  - Can-do attitude;
  - Small boat handling experience;
  - Professional work ethic;
  - Small boat husbandry skills.
  - But some do not necessarily have a high degree of:
    - Safety culture;
    - Towage industry knowledge;
    - Personal presentation;

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• Administrative and computer skills;
• Crew management skills, particularly in a unionised environment.
• An effective and well thought-out training programme should endeavour to address these
  points so as to
• ensure a fully rounded, competent and professional tugmaster who has the mindset and skills to be the
• company's on-board line manager of the facility.
• A component of SeaWays Tugmaster Training Programme is specially designed to address
  this.

PSYCHOMETRIC TESTING

The basis of the SeaWays Tugmaster Training Programme came from my experience in the 1990s
while observing my son learning to fly F18 Hornet fighter jets. In my view, the process for
tugmaster selection can be similarly structured.
Candidates for fighter pilot training go through a rigorous selection process, including psychometric
testing of the natural abilities required to fly a jet fighter in stressful circumstances. We have all met
tugmasters whom we assess as 'naturals' or 'wired to drive tugs'.
Abhijit Singh is a Doctoral student with University of Petroleum and Energy Studies (UPES), Dehradun, India. He has done his Marine Engineering from Birla Institute Technology & Science, Pilani, India and MBA specialization in Maritime Management from University of Greenwich, London (UK); Post Graduate Diploma in Maritime Law from Lloyds Maritime Academy, London (UK). He is a Fellow member of Institute of Chartered Shipbrokers (ICS), London; Associate Fellow member of Nautical Institute, London; Member of Council committee for ICA(Indian Council of Arbitration, Government of India) as Maritime Arbitrator. He is Ex-Marine Engineer Officer under D.G. Shipping India and sailed widely onboard merchant tankers and bulk carriers.

He is accomplished maritime professional with more than a decade of multifaceted work experience in shipping, on-shore and as well at sea, which also includes full time initiative for higher academic credentials & various professional courses of Maritime industry. A Result oriented decisive leader, with proven success in operations, strategic planning and problem solving. He has been awardee of highly commended position in Lloyds List Awards 2015 (MEIS) in ‘Next generation shipping’ category. He is adept at carrying out Wet & Dry Chartering and Shipping operations with standard knowledge of International Trade practices, Port State policies & regulations and various statutory acts. He worked with many international maritime organizations of repute. As a Maritime consultant and researcher, he worked on a numerous consultancy projects including economic and environmental impact studies and market analyses.

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He has published research papers in journal of repute and has authored two case studies in related to commercial shipping. He has also presented papers at various international conferences held in India.

**Paper Publication**

- Published research paper “Hazards analysis of Routine Ship Towage operations in Indian Coastal Waters” in International Journal of E-navigation and Maritime Economy, July 2016
- Published research paper “Critical analysis of hazards associated with Routine Ship Towage operations: Survey of Cases from Indian Coastal Waters” at International Conference on Management of Infrastructure (ICMI) 2016. It has been awarded as best research paper in Transportation category.

**Paper/Case Study Presentation**


**Paper Under Review**


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