Proposal for the Structure of Guidelines and Required Level 2 & Level 1 Developments

Vladimir Shigunov
DNV GL Maritime, Hamburg, Germany
Outline

• Background: 2012 and 2013 Minimum Power Guidelines
• Critics of the existing guidelines
• Proposal: Outline and structure of the SHOPERA Guidelines
• Action plan
2012 and 2013 Minimum Power Guidelines

- In 2012 Interim Guidelines for Determining Minimum Propulsion Power to Maintain the Manoeuvrability of Ship in Adverse Weather Conditions, three Levels of assessment were included:
  - Level 3, Comprehensive Assessment (model tests, high-fidelity numerical methods)
  - Level 2, Simplified Assessment (empirical methods, complexity of MS Excel)
  - Level 1, Minimum Power Lines (empirical methods, complexity of pocket calculator)

- In 2013 Interim Guidelines, the following changes were made:
  - Level 3 was removed: model tests too expensive, numerical methods not available
  - Level 2 was retained: numerical methods replaced with model tests
  - Level 1 was accepted without relation to propulsion and steering efficiency

- Now, 2013 Interim Guidelines are in force (prolongated for Phase 2 of EEDI implementation, starting on 1. January 2015)
Critics of the Existing Guidelines

• Absence of Level 3 assessment prevents development of innovative energy-efficient ships (alternative steering devices, propulsion, engine, ...)

• Requirement of model tests in Level 2 assessment does not make sense: this level of complexity fits Level 3 only

• Level 1 assessment does not contain either propulsion or steering characteristics or environmental forces (windage area etc.) of ships
Critics of the Structure of the Existing Guidelines

More important drawbacks, concerning fundamental structure of the Guidelines:

• Present structure of Guidelines is very inflexible: designers should use for ALL forces either expensive methods (they usually cannot) or over-simplified methods (they usually can do better)

• In reality, designers often improve particular parts of the design (steering, propulsion, engine etc.): in such cases, they know exactly hydrodynamics of this part (model tests) but do not have accurate results for other parts

• However, they cannot gain from such improvements unless they perform full expensive experimental program (Level 3) for all force components (wind, calm-water, wave drift forces etc.)
Proposal: Outline and Structure of the SHOPERA Guidelines

• Simple formulation: \( \text{CAPACITY} \geq \text{DEMAND} \)

• **DEMAND** shell include wind forces, wave drift forces, calm-water forces, forces due to overtaking, shallow-water and bank effects etc. (depending on criterion used)

• **CAPACITY** shell include rudder forces, propeller model, engine model etc.

• Designer:
  – free to choose methods separately for each of the contributions: model tests, numerical computations, empirical data or “simple” empirical formulae
  – can use different methods for different contributions: e.g. model tests for rudder forces and “simple” empirical formulae for other contributions, if it suits particular design

• **Task of SHOPERA**: to provide set of experimental methods, numerical methods, semi-empirical methods and “over-simplified” formulae for all contributions

• **In the future**, designers and Administrations can use these methods or allow alternatives, if they want, still remaining within the scope of the Guidelines
Advantages of Proposed Approach

• **For designers:** if ship is on the margin, designer has a freedom how to fulfill requirements using high-fidelity methods, without re-doing the entire assessment.

• **For Administrations:** if Administration is not satisfied, “suspicious” contributions can be verified separately in few model tests, instead of doing the full expensive test program or going to over-simplified methods for all contributions.

• **For rule developers:**
  – “simplified” methods (“Level 1”, “Level 2”) remain physical, even if simplified.
  – any outdated method, formula or model can be added or replaced when necessary without revising the entire Guidelines.

• **For WP6:** simplifies case studies: to re-assess the ship for different environmental conditions, results can be re-used: only wave drift forces have to be scaled with $h_s^2$ and wind forces with $v_w^2$, independently of the method that has been used earlier for their definition.
## Example of Proposed Approach for Course-Keeping and Minimum Advance Speed Criteria

<table>
<thead>
<tr>
<th>Contribution</th>
<th>Components</th>
<th>Proir.</th>
<th>High-Level</th>
<th>„Level 2“ (MS Excel)</th>
<th>„Level 1“ (pocket calc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DEMAND</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calm-water</td>
<td>X, Y, N</td>
<td>1</td>
<td>model tests, [CFD]</td>
<td>semi-emp. formulae</td>
<td>simple emp. formulae</td>
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<tr>
<td>Wave drift forces</td>
<td>X,Y,N</td>
<td>1</td>
<td>model tests, [potential methods,] [CFD]</td>
<td>semi-empirical formulae for RAOs</td>
<td>simple empir. formulae direct for irreg. waves</td>
</tr>
<tr>
<td>Wind forces</td>
<td>X,Y,N</td>
<td>1</td>
<td>model tests, CFD</td>
<td>semi-empir. formulae</td>
<td>empirical data, e.g. Blendermann</td>
</tr>
<tr>
<td>Shallow, bank, overtaking</td>
<td>Y,N</td>
<td>2</td>
<td>model tests, potential methods, CFD</td>
<td>semi-empirical formulae</td>
<td>simple empirical formulae</td>
</tr>
<tr>
<td><strong>CAPACITY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rudder forces</td>
<td>X,Y</td>
<td>1</td>
<td>model tests, CFD</td>
<td>semi-empirical method</td>
<td>further simplification</td>
</tr>
<tr>
<td>Propeller model</td>
<td>T -&gt; J,n,PD</td>
<td>1</td>
<td>model tests, potential methods, CFD</td>
<td>open-water propeller curves</td>
<td>simplified methods: difficult (prop. point)</td>
</tr>
<tr>
<td>Engine</td>
<td>PD available</td>
<td>1</td>
<td>?</td>
<td>static model (engine diagramm)</td>
<td>simple analytical model of engine diagramm</td>
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<tr>
<td><strong>CHECK</strong></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Putting forces together</td>
<td>X,Y,Z</td>
<td>1</td>
<td>equilibrium in horizontal plane</td>
<td>decoupled equations</td>
<td>reduced number of cases</td>
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**SHOPERA PLENARY MEETING**  
13:00-14:00, October 31st, 2014, Hamburg
Todo

• Drafting text of the SHOPERA Guidelines:
  – From experience, questions arise from drafting – to know problems beforehand, start now
  – Structure of the Guideline, assessment procedure, gaps

• Required developments:
  – Numerical methods
  – Semi-empirical methods (MS Excel-complexity, “Level 2”)
  – Simple empirical formulae (pocket calculator complexity, “Level 1”)

• Deadline: [September 2015]
## ToDo

### Work Distribution

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<td>empirical data: Blendermann</td>
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Proposal for the Structure of Guidelines
Energy Efficient Safe SHIp OPERAtion

WP4: Validation, Sensitivity Studies and Level 1 Methods
Proposal for the Structure of Guidelines

QUESTIONS

Vladimir Shigunov
vladimir.shigunov@dnvgl.com

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