CTV PERFORMANCE ASSESSMENT SEMINAR

Presented by
Stephen Phillips and
Hugh Maclean
of
Seaspeed Marine Consulting Ltd
The Carbon Trust - The Carbon Trust’s mission is to accelerate the move to a sustainable, low carbon economy.

CT Offshore Wind Accelerator – The CT OWA brings together nine offshore wind developers to work towards reducing the cost of renewable energy.”

Developers – O&M costs to be reduced. Lack of realistic performance data restricting accuracy of O&M modelling. Ability to specify and deploy more suitable vessels for each specific site.

CTV Industry – Designers/Builders/Owners/Operators of more capable vessels are not able to properly describe or prove performance benefits without better understanding and definition of current vessel performance.

Research programme instigated ……………
**RESEARCH AIMS**

**Improve Understanding** - To better understand the performance and limiting factors of current fast CTV’s in relation to environmental conditions.

- investigated catamarans, monohulls and SWATH
- in transit, approach and transfer modes
- computer simulation, model tests, sea trials and discussions with industry

**Information Presentation** - To provide a straightforward means of performance assessment and data presentation.

- gives the required availability data for O&M modelling
- provides the industry with the information needed to fully understand how their craft perform and are limited in relation to weather conditions
- presentation of research findings to enable benchmarking

Dissemination of findings is crucial ...............
Dissemination and Discussion of Research Findings

1. How CTV performance was, is and could be specified and assessed
2. Discuss the important performance parameters and influencing factors
3. Present benchmark data presentation (P-Plots)
4. Discuss performance thresholds
5. Describe design implications
6. Discuss the practical application of P-Plots
7. Discussion session
1. CTV SPECIFICATION

General Safety and Operability

• Class Rules and/or Operational Regulations

Functionality

• Technical Specification (speed/power/machinery/outfit etc) often assured by sea trials and acceptance documentation. i.e. Vessel capable of carrying X tonnes payload at Y knots

Availability

• Ability to handle local conditions (e.g. port limitations)

• Ability of the vessel to reach/work on the wind farm in weather conditions: Operational Performance

• Reliability, and ability to repair when required

Cost

• Newbuild cost, depreciation, running costs, charter rates.
1. CTV PERFORMANCE

**Traditional**

- contract to undertake calm water sea trials and define speed (and possibly power and fuel consumption) at contract payload

**Early CTV**

- in addition to above, include an operational sea states statement in the contract

**Emerging**

- sea trials assessing vessels capability and comparing to current baseline performance - leading to a more defined operability requirement/statement and assessment of vessels performance.

**Future**

- continuous monitoring of vessel performance, analysed and displayed on board and ashore allowing monitoring of performance by all parties
2. INFLUENCING FACTORS FOR TRANSIT

**Parameters**
- Safety limits
  - Personnel
  - Vessel
- Voluntary limits
  - Comfort, motion sickness
  - Avoidance of damage

**Influencing Factors**
- Vertical and Horizontal acceleration
- Vessel control (broaching)
- Speed
  - Vertical acceleration
  - Roll and pitch
  - Slamming and green-water

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Images of boats in the water, illustrating the effects of acceleration and control.
2. INFLUENCING FACTORS FOR TRANSFER

**Parameters**
- Safety
- Step across transfer
- Foredeck working
- Avoidance of damage

**Influencing Factors**
- Fender slips
- Loss of contact
- Impacts
- Roll/Lateral acceleration
- Slamming
- Green-water
3. PERFORMANCE PLOTS

Data gathering

- market sector study
3. PERFORMANCE PLOTS

Data gathering

• market sector study

• baseline vessel definition - computational studies and physical scale modelling to understand performance issues.

• sea trials on existing vessels / feedback from operators and technicians

• interaction with developers, designers, regulators and researchers regarding performance limitations
3. ENVIRONMENTAL CONDITIONS

Wave analysis

- Wave height; Hmax, Hsig
- Wave period; Zero up crossing period, Tz, modal, T0 and crest period, Tc
- Wind speed and direction
- Water depth
- Tide or current
# 3. PERFORMANCE THRESHOLDS

## Transit limiting criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical acceleration, rms</td>
<td>0.15g</td>
</tr>
<tr>
<td>Horizontal acceleration, rms</td>
<td>0.1g</td>
</tr>
<tr>
<td>Roll, rms</td>
<td>6.0 deg</td>
</tr>
<tr>
<td>Pitch, rms</td>
<td>5.0 deg</td>
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</tbody>
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## Transfer limiting criteria

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<tr>
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<td>-</td>
</tr>
<tr>
<td>Roll, rms</td>
<td>3.0 deg</td>
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<tr>
<td>Pitch, rms</td>
<td>-</td>
</tr>
<tr>
<td>Zero slip confidence level</td>
<td>95%</td>
</tr>
<tr>
<td>Slip size</td>
<td>0.3 m</td>
</tr>
</tbody>
</table>
3. TRANSIT P-PLOTS

22m Propeller Catamaran

- Head Sea
- Beam Sea
- Following Sea

**Hsig = 1.0m**

**Hsig = 1.5m**

**Hsig = 2.0m**

**Hsig = 2.5m**

- Long period limit line
- Standard period limit line
- Short period limit line

**Ship Speed, kts**
3. TRANSIT P-PLOTS

26m Propeller Catamaran – with sea trials data

Hsig = 1.0m

Hsig = 1.5m

Hsig = 2.0m

Ship Speed, kts

Seatrial results
21st April - Hsig 0.9m
28th April - Hsig 1.2m

Seatral results
3rd Dec - Hsig 1.6m

Seatrial results
1st Dec - Hsig 2.0m

- Long period limit line
- Standard period limit line
- Short period limit line
3. TRANSFER P-PLOTS

22m Propeller Catamaran

![Graph showing various limit curves for a 22m Propeller Catamaran](image-url)
3. TRANSFER P-PILOTS

26m Propeller Catamaran – with sea trials data
3. APPROACH MODE

Approach P-Plots - Under Discussion

- No P-Plots developed to date – uncertain parameters and thresholds
- Limited by ability to manoeuvre on to tower which is down to helmsman’s skill as much as vessel ability
- Vessel propulsion system response time
- Vessel’s manoeuvrability
## 4. PERFORMANCE THRESHOLDS

### Transit limiting criteria

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<th>Current value</th>
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<td>0.15g</td>
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<td>0.1g</td>
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<tr>
<td>Roll, rms</td>
<td>6.0 deg</td>
<td>6.0 deg</td>
</tr>
<tr>
<td>Pitch, rms</td>
<td>4.0 deg</td>
<td>5.0 deg</td>
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### Transfer limiting criteria

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<th>Current value</th>
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<td>-</td>
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<tr>
<td>Horizontal acceleration, rms</td>
<td>0.04g</td>
<td>-</td>
</tr>
<tr>
<td>Roll, rms</td>
<td>2.5 deg</td>
<td>3.0 deg</td>
</tr>
<tr>
<td>Pitch, rms</td>
<td>2.0 deg</td>
<td>-</td>
</tr>
<tr>
<td>Zero slip confidence level</td>
<td>90%</td>
<td>95%</td>
</tr>
<tr>
<td>Slip size</td>
<td>+/- 0.1 m</td>
<td>0.3 m</td>
</tr>
</tbody>
</table>
5. DESIGN FEATURES

Freeboard
Minimise wet deck slams in transit and transfer
5. DESIGN FEATURES

Thrust
Maximise transfer capability – and load carrying speed in transit

[Graph showing Transit P-Plot and Transfer P-Plot with various speed and height limits marked]
5. DESIGN FEATURES

Vessel size and type
Minimise vessel motions in transit

18m

22m

26m
5. DESIGN FEATURES

Propulsor arrangement
Position and type to avoid ventilation

Fixed pitch propeller

Controllable pitch propeller

Volvo Penta IPS

Waterjet
5. DESIGN FEATURES

Access systems
Increased safety and/or extended capability

TDD  V-Grip  MaXcess
TAS  Windgrip  Mobimar
6. PRACTICAL APPLICATION OF P-PLOTS

Practical Application of P-Plots

• no versatile means of comparing vessel performance was previously available

• these performance plots are designed to be the most appropriate representation of the operational performance CTV’s

• operational performance plots allow a vessel of any configuration to be compared to an industry benchmark (with respect to Transit and Transfer)

• there are validated vessel monitoring systems (VMS) available that can be fitted to provide the required data from normal operations.

• there are straightforward guidelines being developed to provide the required sea trial data to compare with the benchmark performance plots.
6. PRACTICAL PERFORMANCE TRIALS

Existing proposal outlined in “Conduct of offshore access performance evaluation trials” OWA-S2-A-Y2-1 October 2015 (to be updated with input from current research).

Summary of essential aspects

Transit
• Run for 5-10 minutes at each of 5 headings (Head, BQ, Beam, SQ, Following)
• Record Hsig, period and direction, and wind speed and direction
• Record displacement during trials (fuel, people, payloads)
• Measure rms vertical and horizontal accelerations along with pitch and roll
• For a range of speeds say 15, 20 and 25 knots or maximum and comfortable

Transfer
• 10 minute push on transfer
• Record number of slips, engine rpm, vessel motion (as above)
• Record Hsig, period and direction, and wind speed and direction
• Confidence of no-slip, % = [1 – (number of slips/number of waves)] x 100
7. DISCUSSION

National Workboat Association Questions

• How will the data be measured?
• What will it cost per vessel to measure the data to the highest standard?
• Who pays for the data monitoring equipment and for the data output?
• How long will the data collection be measured before the first bench-marks are written or presented?
• What will be the finalised slip accountability rate that will be measured against?
• How will the data be shared across the industry from Charterer to Charter and Operator to Operator?
• Who owns the data?
• What will happen to my data?
• How will OWA stop the ability for P-Plots to become part of a contractable performance measurement clause?
7. DISCUSSION

Discussion Period

Seminar Aims

1. How CTV performance was, is and could be specified and assessed
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CTV Performance Assessment Seminar - End

Thank you for your attention
## PERFORMANCE THRESHOLDS

Seakeeping performance criteria for human effectiveness – Limiting Criteria with regard to accelerations (vertical and lateral and roll motion) (NORDFORSK, 1987)

<table>
<thead>
<tr>
<th>Description</th>
<th>RMS Vertical Acceleration</th>
<th>RMS Lateral Acceleration</th>
<th>RMS Roll Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Manual Work</td>
<td>0.20 g</td>
<td>0.10 g</td>
<td>6.0 °</td>
</tr>
<tr>
<td>Heavy Manual Work</td>
<td>0.15 g</td>
<td>0.07 g</td>
<td>4.0 °</td>
</tr>
<tr>
<td>Intellectual Work</td>
<td>0.10 g</td>
<td>0.05 g</td>
<td>3.0 °</td>
</tr>
<tr>
<td>Transit Passengers</td>
<td>0.05 g</td>
<td>0.04 g</td>
<td>2.5 °</td>
</tr>
<tr>
<td>Cruise Liner</td>
<td>0.02 g</td>
<td>0.03 g</td>
<td>2.0 °</td>
</tr>
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