Reducing emissions through innovative tug design

The new Wärtsilä Eco-Friendly tug

Asian Tug Technology & Salvage Conference
18th-19th September 2017
Reducing Emission

Eco Friendly in Tug Industry

Factor Trends: Environment

- Greenhouse effect: Under evaluation by IMO
- Acid rains: Tier II, Tier III
- Sulphur content in fuel: SECA
- CO₂: Greenhouse effect, Under evaluation UMO, EEDI
- NOₓ: Acid rain, Tier II
- SO₂: Local, Acid rain, Local regulations
Wärtsilä HYTug Series

Operation Features:
- To assist in the berthing and un-berthing operation of vessels calling at ports/terminals
- To perform towing, ship handling operation in Ports/terminals
- Escorting at high speed (for escort tug version)
- Fire-Fighting (optional)
Optimized Hull:
- Low Hull resistance
- High towing/escort performance
- Good sea keeping
- High Maneuverability

**DESIGN HIGHLIGHTS**

- Optimizing of hull shape & appendages with the use of CFD for:
  1. Improving hull resistance
  2. High towing/escort performance
- Verification with model test.
Construction:
• Distinctive design outlook
• Safety & comfort for crew
• Building & maintenance friendliness
High visibility wheelhouse design
DESIGN HIGHLIGHTS

Side Shoulders

Semi-enclosure for bow winch
**Design Highlights**

**Mechanical-Hybrid**

- Main engine with clutch
- In-line shaft generator/motor
- Energy storage system
- DC link and power drives
- Energy Management System

**Electrical-Hybrid**

- Generating set
- Energy storage system
- DC link and power drives
- Energy Management System
- Thrusters, thruster motors & propulsion controls

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Modular Hybrid propulsion
DESIGN HIGHLIGHTS

Class Approval-in-Principle

Notation for Harbour Tug

* A1, Towing Vessel, FFV1, * AMS, * ABCU, BATTERY-Li

Notation for Escort Tug

* A1, Towing Vessel, Escort Vessel, FFV1, * AMS, * ABCU, BATTERY-Li

Notation for Harbour Tug

I *HULL, MACH, Tug, Fire-fighting Ship 1, AUT-CCS, ELECTRIC HYBRID, Unrestricted Navigation

Notation for Escort Tug

I *HULL, MACH, Escort Tug, Fire-fighting Ship 1, AUT-CCS, ELECTRIC HYBRID, Unrestricted Navigation

Lloyd's Register

Notation for Harbour Tug

*100A1, *LMC, Tug, CCS, Fire-fighting Ship 1

Notation for Escort Tug

*100A1, *LMC, Escort Tug, CCS, Fire-fighting Ship 1

With MLC2006 compliance
WÄRTSILÄ HYTUG SERIES

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• High Maneuverability

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DESIGN HIGHLIGHTS

Summary

New high visibility wheelhouse design
Semi-enclosure for bow winch
Modular Hybrid propulsion
Side shoulders
MLC2006 compliance
Class Approval-in-Principle:

Lloyd’s Register

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12.10.2017

Wärtsilä Eco-Friendly Tug/ Ngoh
<table>
<thead>
<tr>
<th></th>
<th>WÄRTSILÄ HYTug 50H</th>
<th>WÄRTSILÄ HYTug 75H</th>
<th>WÄRTSILÄ HYTug 75E</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Harbour</td>
<td>Harbour</td>
<td>Escort</td>
</tr>
<tr>
<td><strong>Bollard Pull</strong></td>
<td>50t BP</td>
<td>75t BP</td>
<td>75t BP</td>
</tr>
<tr>
<td><strong>Length Over All</strong></td>
<td>28.00 m</td>
<td>29.50 m</td>
<td>35.40 m</td>
</tr>
<tr>
<td>(Excluding Fenders)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Beam</strong></td>
<td>10.80 m</td>
<td>11.60 m</td>
<td>14.00 m</td>
</tr>
<tr>
<td>(Excluding Fenders)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Depth, moulded</strong></td>
<td>4.70 m</td>
<td>5.54 m</td>
<td>6.70 m</td>
</tr>
<tr>
<td><strong>Draught, Design</strong></td>
<td>3.50 m</td>
<td>4.00 m</td>
<td>4.60 m</td>
</tr>
<tr>
<td><strong>Complement (Max)</strong></td>
<td>8 pax</td>
<td>10 pax</td>
<td>12 pax</td>
</tr>
<tr>
<td><strong>Gross Tonnage (GRT)</strong></td>
<td>&lt; 400</td>
<td>&lt; 500</td>
<td>&gt; 500</td>
</tr>
<tr>
<td><strong>Service Speed</strong></td>
<td>12 knots</td>
<td>13 knots</td>
<td>13 knots</td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------------</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Main engines</td>
<td>2 x W6L20E</td>
<td>2 x W8L20</td>
<td>2 x W8L20E</td>
</tr>
<tr>
<td></td>
<td>[2 x 1320kW @ 1200rpm]</td>
<td>[2 x 1520kW @ 1000rpm]</td>
<td>[2 x 1760kW @ 1200rpm]</td>
</tr>
<tr>
<td>Energy storage</td>
<td>300 kWh [3C rating]</td>
<td>500 kWh [3C rating]</td>
<td>400 kWh [3C rating]</td>
</tr>
<tr>
<td>Propulsion</td>
<td>2 x WST-16 CPP</td>
<td>2 x WST-24 FPP</td>
<td>2 x WST-24 CPP</td>
</tr>
<tr>
<td></td>
<td>[Dia. 2.20m]</td>
<td>[Dia. 2.80m]</td>
<td>[Dia. 2.80m]</td>
</tr>
<tr>
<td>Shore connection</td>
<td>80 kWe</td>
<td>80 kWe</td>
<td>80 kWe</td>
</tr>
<tr>
<td>Auxiliary gensets</td>
<td>1 x 99 kW [High Speed, Non-Wärtsilä supply]</td>
<td>-</td>
<td>1 x 250 kW [High Speed, Non-Wärtsilä supply]</td>
</tr>
</tbody>
</table>

Bollard pull range & design requirement are customisable according to different customers needs.
HARBOUR TUG TYPICAL OPERATING PROFILE

<table>
<thead>
<tr>
<th>Mode</th>
<th>Annual Time (%)</th>
<th>Annual Time (Hours/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steaming Max (13 knots)</td>
<td>0.1</td>
<td>3</td>
</tr>
<tr>
<td>Transit high (12 knots)</td>
<td>3</td>
<td>94</td>
</tr>
<tr>
<td>Transit Eco 1 on Battery (10 knots)</td>
<td>11</td>
<td>343</td>
</tr>
<tr>
<td>Transit Eco 2 on Battery (8 knots)</td>
<td>11</td>
<td>343</td>
</tr>
<tr>
<td>Peak Load (Max BP)</td>
<td>2</td>
<td>62</td>
</tr>
<tr>
<td>Medium Assist</td>
<td>12</td>
<td>374</td>
</tr>
<tr>
<td>Low Assist</td>
<td>25</td>
<td>780</td>
</tr>
<tr>
<td>Loitering- Standby/ Loitering-on Battery</td>
<td>25.9</td>
<td>808</td>
</tr>
<tr>
<td>Harbour – Standby/ Harbour-Standby on battery</td>
<td>10</td>
<td>312</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>100%</strong></td>
<td><strong>3120</strong></td>
</tr>
</tbody>
</table>
All-electric mode

Both engines off, all power from batteries: Zero Emission
Green mode

Both engines off, all power from batteries: Zero Emission
Start & stop

Low state of charge: engine provides power and recharges batteries
Peak shaving

Both engines providing power, batteries taking sudden load peaks, Instant Load taking
Power boost

Batteries and engines providing power simultaneously
<table>
<thead>
<tr>
<th>WÄRTSILÄ Conventional Tug</th>
<th>Conventional Tug</th>
<th>WÄRTSILÄ HYTug</th>
<th>WÄRTSILÄ HYTug</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM Medium Speed</td>
<td>DM High Speed</td>
<td>DM W8L20E + 400 kWh</td>
<td>DE W8L20 + 500 kWh</td>
</tr>
</tbody>
</table>

- **Total Installed Mechanical Power**
  - Similar to Ref
  - Less -16.8%

- **Power boost**
  - Similar to Ref
  - +1200 kW

- **Duration of Max BP with Power boost**
  - Similar to Ref
  - Min. 15 mins

- **Response**
  - Similar to Ref
  - Instant

- **Smoke**
  - Similar to Ref
  - Zero

- **Green mode**
  - Similar to Ref
  - Yes

- **Duration of Eco Transit Mode**
  - Similar to Ref
  - 20 - 45 mins

- **Main Engines Running Hours**
  - Similar to Ref
  - -32.9%

- **Maintenance costs**
  - Similar to Ref
  - Less -cyl-hours, longer TBOs

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**75T BP HARBOUR TUG COMPARED PERFORMANCE**

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[Wärtsilä Eco-Friendly Tug/ Ngoh]
The efficiency comparison has been performed based on fuel consumption per kW of power delivered to the thrusters, and all losses (mechanical and electrical) in the different alternatives are taken into account.
WÄRTSILÄ HYTUG SERIES CUSTOMER VALUES

Performance
- Continuous EMS tuning
- Easy EMS expansion

Weight & Volume
- Less cylinders
- GA flexibility

Bollard pull
- Power boost for higher tbp from energy storage

Safety & Reliability
- Built-in redundancy
- Back-up logics
- Instant load taking

Operational costs
- Reduced maintenance costs (less cylinder-hours, reduced stress to components)
- Reduced fuel consumption

Green image
- Green mode (zero emission)
- Start & stop
- Smokeless operations

Interfaces with supplier
- Wärtsilä as the single supplier
- In-house integration
- Single set of documentation
- Reduced interfaces
- Less commissioning days
- Guaranteed performance

Life-Cycle Support
- Service agreements
Wärtsilä LNGTug 55H

**MAIN DATA**
- LOA: 28.80 m
- Bollard Pull: 55 T
- GRT: 495
- Speed: 12 knots
- LNG Tank Capacity: 25 m³
- Accommodation: 4

**WÄRTSILÄ SUPPLY**
- Main Engine (Dual Fuel): 2 x 1665 kW
- Thruster: 2 x WST-18
- Wärtsilä LNG Pac

Approval-in-Principle:

LNGTug **main particulars** and **bollard pull** range are **customisable** according to different customers requirement.
• Optimised hull for high performance
• Safety and comfort for crew
• High manoeuvrability
• Good sea keeping
• Integrated ‘State-of-the-Art’ & proven Wärtsilä LNG propulsion system
• Significant improvement regarding lower emission with Tier III compliance
• Wärtsilä as full integrator, guaranteed performance & life-cycle support
Reducing Emission with Wärtsilä ECO-Friendly Tug series