DSIC 大连船舶重工集团有限公司
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Findings on the EEDI assessment framework for wind propulsion systems

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Brief Introduction of New Vitality

First Aerofoil-Assisted VLCC in the World, Delivered in Nov 2018.

- Driven by aerodynamic lifting force
- Effective wind directions range reaches up to 320 degrees.
- Automatically lifted up/down and rotated to windward angle at which the sails provide maximum thrust.

For more Infor. MEPC 74/ INF. 39

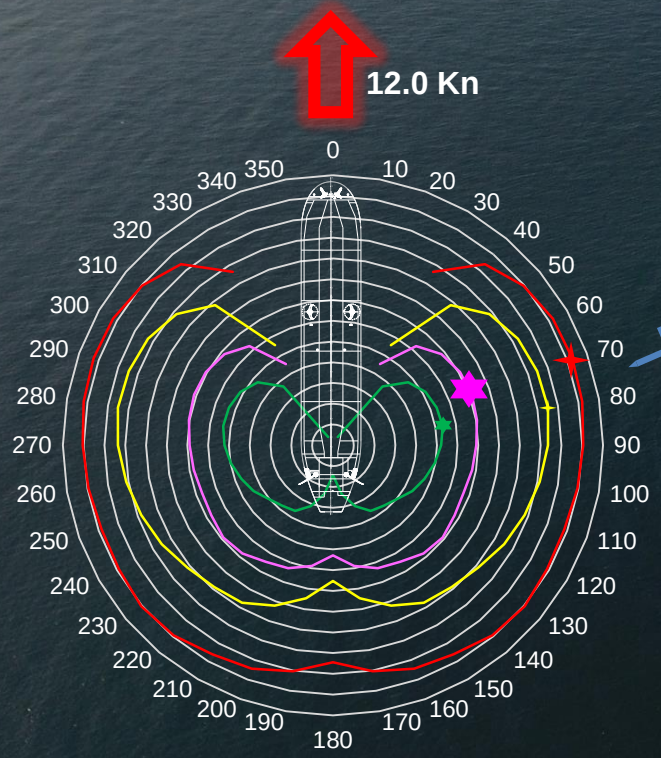
Energy Saving Effect

First Aerofoil-Assisted VLCC in the World, Delivered in Nov 2018.

- M/E POWER SAVING PROPORTION (%) IN ABSOLUTE WIND BEAUFORT SCALE 5 (9.4M/S)
- M/E POWER SAVING PROPORTION (%) IN ABSOLUTE WIND BEAUFORT SCALE 8 (19.0M/S)
- M/E FUEL CONSUMPTION SAVING (t/d) IN ABSOLUTE WIND BEAUFORT SCALE 5 (9.4m/s)
- M/E FUEL CONSUMPTION SAVING (t/d) IN ABSOLUTE WIND BEAUFORT SCALE 8 (19.0m/s)

16.1% 5.68 t/d

54.2% 19.2 t/d



Energy Saving Effect

Propulsion Force X Vessel Speed, makes the power saving

Power Saving $= F \times V \Longrightarrow$

$$\left(f_{eff} \cdot P_{eff}\right) = \left(\frac{0.5144 \cdot V_{ref}}{\eta_T} \sum_{i=1}^{m} \sum_{j=1}^{n} F(V_{ref})_{i,j} \cdot W_{i,j} \right) - \left(\sum_{i=1}^{m} \sum_{j=1}^{n} P(V_{ref})_{i,j} \cdot W_{i,j} \right)$$

Random Wind

Wind Probability

Force Matrix

MEPC Circ.815

- This technical guidance defines the available effective power of wind propulsion systems as the product of the reference speed and the sum of the wind propulsion system force and the global wind probability distribution.
- On request it is possible to perform an assessment of the EEDI for deviating operational patterns (local wind probability matrix)

Energy Saving Effect

First Aerofoil-Assisted VLCC in the World, Delivered in Nov 2018.

- 12knots, Full loaded
- From Middle East to Far East
- Considering the annual wind resource distribution
- Save 7.8% engine power and 2.8 ton/day fuel

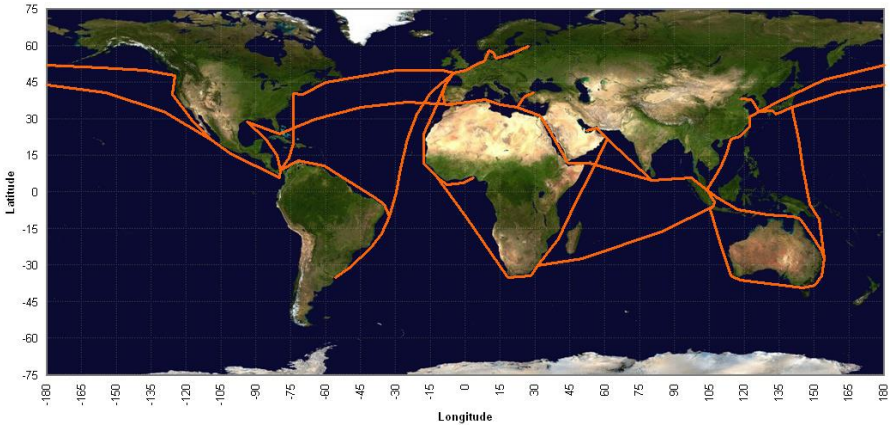
- 12knots, Ballast
- From Far East to Middle East
- Considering the annual wind resource distribution
- Save 2.7% engine power and 0.68 ton/day fuel

Finding No.1

The calculated EEDI contribution of wind propulsion system closely depends on the routes selected

- EEDI Calculated RES.MEPC.245(66)

Status	EEDI Calculated	Lower than BL	Phase
No foils	2.061	19.5%	Phase 1
With foils	2.027	21.1%	Phase 2



Appendix 2, MEPC Circ.815

5. The global wind probability matrix $W_{i,j}$

5.1 $W_{i,j}$ represents the probability of wind conditions. Each matrix element represents the probability of wind speed and wind angle relative to the ship coordinates. The sum over all matrix elements equals 1 and is non-dimensional. Table 2 shows the layout of the global wind probability matrix. The probability matrix shall be gained from the wind probability on the main global shipping routes.

Finding No.1

The calculated EEDI contribution of wind propulsion system closely depends on the routes selected

- What if deriving the wind probability matrix from a particular route

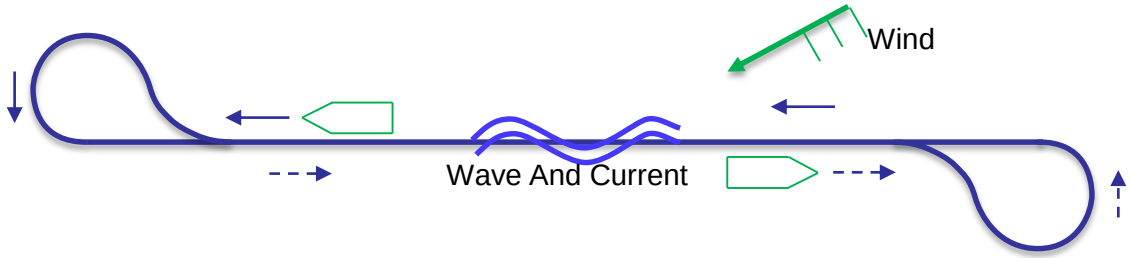
Status	EEDI Calculated	Lower than BL	Phase
No foils	2.061	19.5%	Phase 1
With foils	1.888	35.5%	Phase 3

- In practice, owners and shipbuilders will analyze in advance whether there are available wind resources in the intended operating routes of the ship, and then decide whether to install a wind propulsion system. Therefore, it is recommended to allow that a typical ship with wind propulsion system can adopt an alternative wind probability matrix for its EEDI calculation derived from the average weighted routes in which this typical ship can operate in. In this way, the calculated contribution of the wind propulsion system to the ship's EEDI will be more objective.

Finding No.2

Lack of procedures for verifying the wind propulsion system force matrix in sea trials for vessels with a wind propulsion system

- The procedures for EEDI speed trials in circular MEPC.1/Circ.855/Rev.1, as in ITTC Recommended Procedure 7.5-04-01-01.1 Speed and Power Trials Part 1 and/or ISO 15016:2015, are not applicable to the verification of the wind propulsion system force matrix since:
  - .1 the intended calm sea state during speed and power trials is not considered as a good condition for vessel with a wind propulsion system, which requires windy weather;
  - .2 the double run requirement during the speed trials results in no prerequisite for further comparison of the force matrix because of the large variation of the relative wind speed and relative wind direction within the double run.
- The speed trial data processing method, such as the correction for the wind, wave and current, shall be updated accordingly.



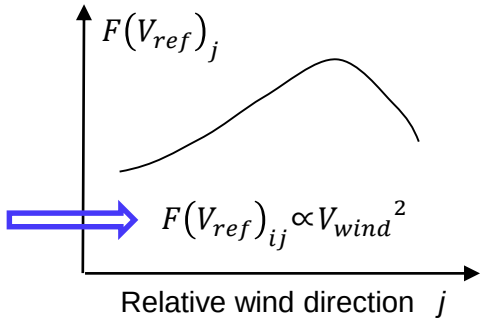
Finding No.2

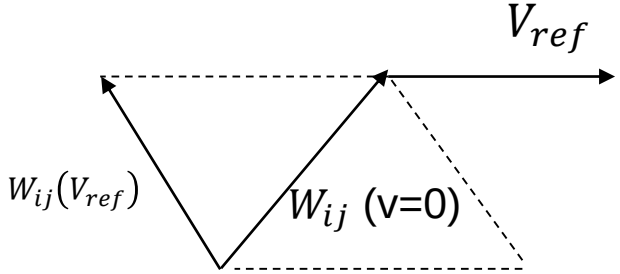
Lack of procedures for verifying the wind propulsion system force matrix in sea trials for vessels with a wind propulsion system

$$\left(f_{eff}\cdot P_{eff}\right)=\left(\frac{0.5144\cdot V_{ref}}{\eta_T}\sum_{i=1}^{m}\sum_{j=1}^{n}F(V_{ref})_{i,j}\cdot W_{i,j}\right)-\left(\sum_{i=1}^{m}\sum_{j=1}^{n}P(V_{ref})_{i,j}\cdot W_{i,j}\right)$$

$F(V_{ref})_{ij}$ → Relative wind speed i

Relative wind direction j				
	i1j1	i2j1	……	inj1
	i1j2	i2j2	……	……
	……	……	……	……
	i1jn	……	……	injn





$F(V_{ref})_{ij}\cdot W_{ij}$ ⇨ $F_{ij}\cdot W_{ij}(V_{ref})$

Finding No.2

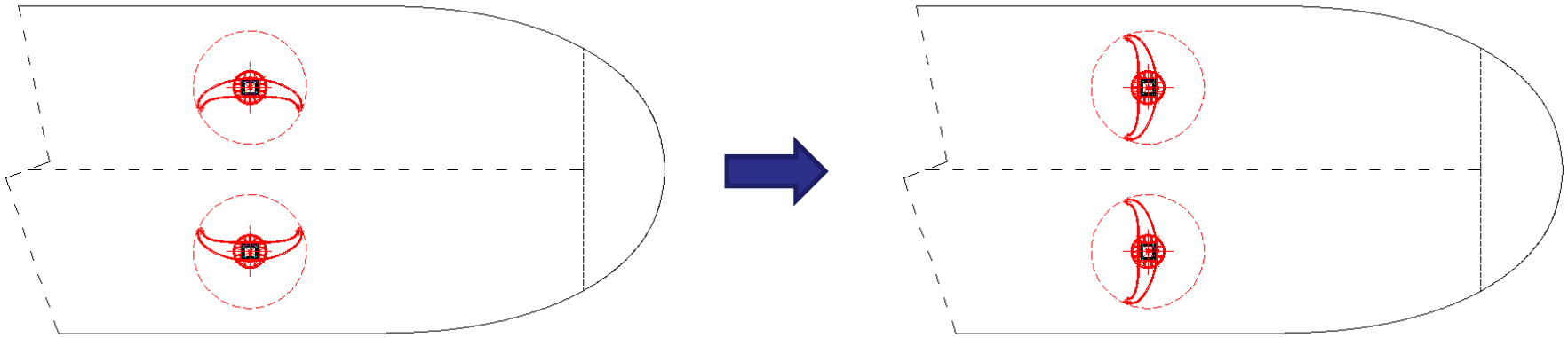
Lack of procedures for verifying the wind propulsion system force matrix in sea trials for vessels with a wind propulsion system

- Vref make no sense when verify the Fij in sea trial
- Single run for each relative wind direction, no double run
- Each run verifies a certain Relative Dir., more directions, the better.
- Still require correction to the status of “deep water, no wave, no current, no wind”, to compare

Finding No.3

The influence of wind propulsion system installation to the minimum propulsion power of a vessel in adverse sea conditions

- Noticing that the windage area of a vessel will increase after installing WPS, the increased windage area will result in an increase of the minimum propulsion power if it is assessed with LEVEL 2 - Simplified Assessment.
- In case of that the SMCR must be, there would be a conflict with "The wind propulsion system installation aims to supply additional propulsion and to reduce the main engine power".
- The increased SMCR will also result in additional cost, and is also a factor that would increase the attained EEDI.









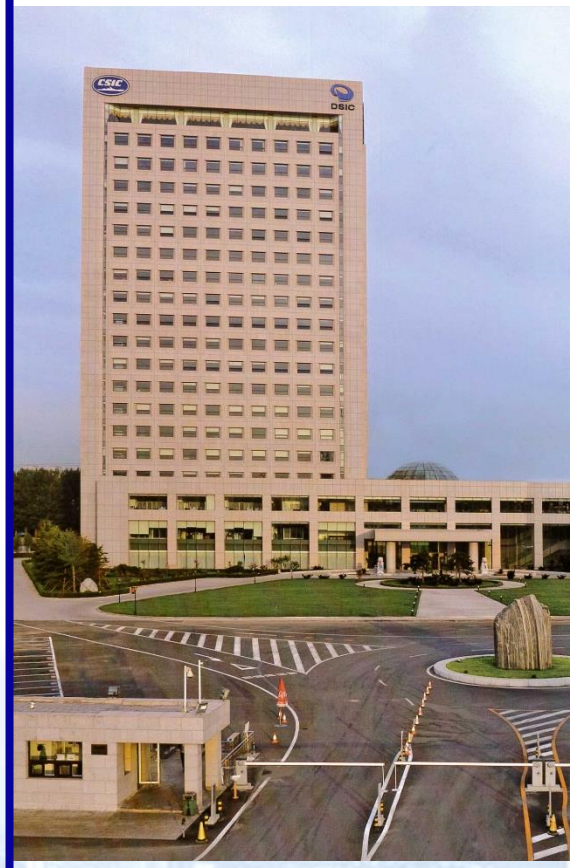
- **"In 2030, the market potential could amount to 3,700–10,700 installed systems on bulkers, tankers & container vessels, associated with approx. 3.5–7.5 Mt CO2 savings & 6,500–8,000 direct + 8,500–10,000 indirect jobs." EU Report 2017**

- **“Market potential for wind propulsion tech forecast to grow from €350 million per year (2020s) to €2.5 billion per year (2050s)” UK Maritime Plan July**

The Tri-partite are invited to pay attention to these findings
Transparent industry standards and regulations are requested.

DSIC Achievements

- Leading shipyard in China
- More than 70 breakthroughs in Chinese Shipbuilding history
- The “Best Asian Shipyard” by Seatrade Asia Awards in 2009
- First Chinese shipyard entering VLCC Contract (from 1990’s)
- Top 10 Yards and Fabricators for offshore Production by order book Nos.
- More than 3,000 deliveries in merchant and military vessels



Thank you !

谢谢！