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ENERGY EFFICIENCY OF SHIPS

Comments on documents MEPC 76/6/2 and MEPC 76/6/6 proposing draft amendments to MEPC.1/Circ.815 for verification of the wind propulsion system

Submitted by Comoros and RINA

SUMMARY

Executive summary:	This document provides comments on documents MEPC 76/6/2 and MEPC 76/6/6, which propose amendments to MEPC.1/Circ.815 in relation to wind assisted ship propulsion. Depending on the type and size of wind propulsors, as well as the ship design, the described methods may in some cases not yet be completely adequate. Joint developments towards a holistic approach are envisaged.
Strategic direction, if applicable:	3
Output:	3.5 and 3.7
Action to be taken:	Paragraph 24
Related documents:	MEPC.1/Circ. 815; MEPC 74/INF.39; MEPC 76/6/2, MEPC 76/6/6, MEPC 76/7/31 and MEPC 76/INF.30

Introduction

1 This document is submitted in accordance with the provisions of paragraph 6.12.5 of the document on *Organization and method of work of the Maritime Safety Committee and the Marine Environment Protection Committee and their subsidiary bodies* (MSC-MEPC.1/Circ.5/Rev.2) and comments on documents MEPC 76/6/2 (China, Germany and Japan) and MEPC 76/6/6 (Finland and Germany). The comments are supported by the work and knowledge developed in the WiSP Joint Industry Project referred to in documents MEPC 76/7/31 and MEPC 76/INF.30 (Comoros and RINA).

2 As stated in documents MEPC 76/7/31 and MEPC 76/INF.30, the present circular MEPC.1/Circ.815 is in need of further elaboration in relation to wind propulsion. It lacks a description of the methods required for a reliable performance prediction. Performance verification by means of sea trials has not been addressed. There is significant uncertainty in the accuracy of the predictions.

3 RINA and the Union of Comoros are of the opinion that Wind Assisted Propulsion deserves further attention from the industry and that further improvements to circular MEPC.1/Circ.815 could incentivise the technology. The proposed amendments in documents MEPC 76/6/2 and MEPC 76/6/6 are thus very welcome; some detailed remarks on these amendments are provided below.

Comments on document MEPC 76/6/2

4 The proposed wind tunnel method is deemed to be a valid one. The wind tunnel data used in documents MEPC 74/5/30 and MEPC 74/INF.39 (China), and referred to in document MEPC 76/6/2, were also used in the WiSP Joint Industry Project.

5 The wind tunnel method is attractive because it allows to determine the aerodynamic performance holistically, accounting directly for any interactional effects across multiple wind propulsors and with the hull and superstructure.

6 Document MEPC 76/6/2 proposes the use of the global wind probability matrix, proposed earlier by Germany in document MEPC 62/INF.34. However, note the following:

.1 previous submissions have been put forward, notably document MEPC.74/INF.39, pointing out that the global wind probability matrix accounts for routes with both low and high wind probabilities. In document MEPC.74/INF.39, it is proposed to allow the use of a route specific wind probability matrix; and

.2 an alternative formulation may be applied without the need for a global wind specification. As described in documents MEPC 76/7/31 and MEPC 76/INF.30, an investigation was carried out to determine the feasibility of using a limited number of fixed wind conditions as an alternative. Potentially, with this approach, the treatment of Wind Propulsion would be more aligned with other energy efficiency technologies (EETs).

7 Considering the above remarks, it would be beneficial to have a further evaluation of the use of a global or other wind specification.

8 Large passive lifting surfaces mounted on the deck of a ship will likely be treated properly with the methods proposed in document MEPC 76/6/2. However, the methods may not be (fully) suitable for other common types and arrangements of wind propulsors. To this end the following should be investigated:

.1 some wind propulsors have significantly different performance at the model scale in the wind tunnel compared to the full scale. This has been clearly shown, e.g. by Bordogna[*] for Flettner rotors and may be also applicable for other high-lift wind propulsors (the latter requiring more research). A wind tunnel does not allow to model rotors at sufficiently high Reynolds numbers, not with a ship model included; and

.2 wind propulsors with a limited height operating mostly in the zone influenced by the ship, or even mostly in the boundary layer above the sea surface, may need special considerations because the flow conditions in the wind tunnel may not be representative of the full-scale case.

9 Due to the control and operating height required, kites cannot be modelled in a wind tunnel under realistic conditions.

[*] G. Bordogna et al., "Experiments on a Flettner rotor at critical and supercritical Reynolds numbers," Journal of Wind Engineering & Industrial Aerodynamics, vol. 188, pp. 19–29, 2019.

10 Due to the limitations presented above, it is judged that other methods to derive the force matrix need to be defined as well, to allow for a better flexibility of circular MEPC.1/Circ.815 to account for different wind propulsion systems and the challenges in deriving the force coefficients in a reliable and practical manner.

11 It is noted that document MEPC 76/6/2 proposes to keep the paragraph pertaining to the final verification unchanged. It is deemed necessary, however, that circular MEPC.1/Circ.815 includes a detailed description of the methodology to be followed during sea trials to confirm the performance of a ship equipped with wind assisted propulsion technologies.

Comments on document MEPC 76/6/6

12 It is agreed that the use of the global wind probability matrix (MEPC 62/INF.34) may result in a conservative estimation of the gains and that this may be due to the representation of both high and low wind forces. It is also agreed that Wind Assisted Propulsion may benefit more from route optimization than other technologies, and that this feature may lead to potential higher gains in operation than the ones represented and captured by the global wind specification.

13 The proposed methodology entails a simplification of the calculation of wind assisted propulsion contribution in relation to EEDI.

14 Some wind propulsion systems are designed to be operated at low wind speeds and de-activated in higher wind speeds. The proposed methodology of including one half or one-third of the highest wind forces may be a disadvantage for such systems in comparison to other concepts that benefit from high wind speed conditions. Therefore, more evidence is needed to demonstrate that the proposed methodology can provide comparable results to a wide range of wind propulsion technologies.

15 It is noted that the proposed methodology allows deriving higher gains than the global wind probability matrix for the ship **MV SC CONNECTOR** fitted with Flettner rotors. This is positive, as the use of route optimization and local presence of strong winds on specific routes may lead to significantly higher gains than the use of the global wind probability matrix.

16 Nevertheless, the selection of one half or one-third of the highest wind forces has a major impact. As shown in the document, this results in a factor of 2 to 3 higher effective power contribution. The document presents the concept but does not yet show the suitability of the magnitude of the increase. It is recommended that a final selection of the method be supported with multiple case studies.

17 As a general comment, one of the challenges observed in ongoing R&D projects dealing with Wind Assisted Propulsion is that the reference speed of the ship (V_{ref}) does not change in the presence of higher power contribution from Wind Assisted Propulsion. Comprehensive calculations performed for ships fitted with a variety of wind assisted propulsion systems suggest that the gains from wind propulsion can be limited particularly when considering high wind forces. The reason is that the current EEDI formulation considers Wind Assisted Propulsion as a modest assistance to the main propulsion system:

.1 when the wind power contribution increases, one would expect V_{ref} to change as wind can provide a significant amount of additional power;

.2 as this is not allowed in the regulation, in technical terms it means that the main engine delivers less power (potentially much lower than 75% of MCR), resulting in the operation of the main engine and propeller in sub-optimal (off-design) conditions. As a result, when performing holistic calculations of ships fitted with wind propulsion, it is found that the forces delivered by the wind need to be limited to avoid excessive losses in the propulsive system; and

.3 if the V_{ref} would be allowed to vary with the increase of wind power, one could ensure operation of the main engine and propeller are at optimal conditions.

18 In conclusion, when considering ships that deliver a relatively high-power saving from wind propulsion (more than 40% of main engine power), the current EEDI formula may no longer be suitable and an alternative formulation may need to be found.

General comments

19 It is observed that the proposed amendments both in document MEPC 76/6/2 and document MEPC 76/6/6 still omit a number of aspects that can also (significantly) impact wind propulsion performance. This includes items such as treatment of near zero or even negative thrust on propellers, accounting for induced drag due to heel, leeway and rudder angle(s), thresholds on acceptable values for heel and rudder angle and more detailed specifications on how to conduct tests and calculations. The full list is contained in document MEPC 76/INF.30.

20 The section in circular MEPC.1/Circ.815 pertaining to final verification by means of sea trials needs to be improved, in particular by detailing how the current sea trial procedures (ISO 15016:2015) could be adapted to the specific case of ships fitted with Wind Assisted Propulsion.

Simplifications – tiered approach

21 Based on the findings in the WiSP project, it is suggested to introduce a tiered approach to assess wind propulsion performance, as described in documents MEPC 76/7/31 and MEPC 76/INF.30. This would mean that for a wind propulsion system delivering a relatively small amount of power in relation to the installed engine power, a simpler assessment methodology would suffice, while for a ship with a relatively high wind propulsion power, a more complex methodology would be required. The accuracy of these methods would be adequate for the respective cases to be considered.

22 Application of the tiered approach could lead to a faster adoption of wind propulsion technology, especially for cases with a modest amount of power delivered by wind.

Call for collaboration

23 In view of the technical and regulatory issues associated with wind propulsion and the potential to contribute to reducing GHG emissions from ships, it is recommended to consider the above remarks and to combine efforts to arrive at regulations that cover wind propulsion technology application to new and existing ships in a technically sound and practical manner. The parties associated with the work described in documents MEPC 76/7/31 and MEPC 76/INF.30 would welcome such collaboration going forward.

Action requested of the Committee

24 The Committee is invited to consider the above information and the recommendations provided in paragraph 23 and take action as appropriate.

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