Journal of Shipping and Ocean Engineering 9 (2019) 1-7
doi 10.17265/2159-5879/2019.01.001

Tanker Operators' Perspective, Vessel Performance Monitoring

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Abstract: Tanker operators are committed to full compliance with environmental regulations while remaining competitive, irrespective of the market conditions. The major challenges are (a) the need to improve tankers' operational performance and (b) how to evaluate tankers' performance to assist them with taking timely action and meeting Charterers' expectations. IMO's efficiency index and indicator (EEDI and EEOI respectively) are based on the fuel consumption per (cargo) ton mile. Is the EEOI the right indicator to demonstrate operational performance? Does any ship operator really understand how good their ship's performance is at any time? A constant increase in fuel consumption may prompt tanker operators to take action such as hull cleaning and propeller polishing. But what else can be measured? In their dialogue with Charterers, tanker operators discussed the need to find more appropriate and workable means to measure and demonstrate the ship's operational performance. These measures should be commonly acceptable and understood by both tanker operators and Charterers. This, together with ever-changing environmental and regulatory requirements, led INTERTANKO to establish a Working Group (WG) on Vessel Performance Monitoring. The WG is to investigate whether there could be a model for performance monitoring which is acceptable to both tanker operators, charterers and regulators. ISO 19030 inspires the WG to make such a search. The idea is to discuss whether it is possible to expand the concept of ISO 19030 beyond hull and propeller efficiency. The model must be an easy-to-understand, easy-to-implement tool.

Key words: performance monitoring, ISO 19030, efficiency measurements

1. Introduction

Within the tanker industry, "performance or efficiency monitoring" is already an integral part of a tanker company's organizational structure. In new buildings, the EEDI is a governing index. However, once in operation under a Charter Party agreement with a different governing performance criteria, the level of efficiency that was assumed through EEDI needs to be monitored. The INTERTANKO WG on Performance Monitoring is tasked with studying whether it is possible to develop such a tool or at least to provide a set of guidance in support of a tool that is most commonly accepted in the industry.

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2. Aspects to Be Considered for Tanker Operators

The origin of ISO 19030 is the paint manufacturers' initiative to develop a standard based on which to measure how different marine coating systems impact on the performance and efficiency of a ship, say, over the five-year period between two dockings. The ship's operator would then be able to make a sound judgement on the need to take action at the right time to improve the ship's efficiency whilst maintaining the ship's safety and environmental competitiveness in the eyes of the Charterer. The INTERTANKO WG finds that both ISO 19030 and the WG seek to achieve the same goal. Here are some thoughts behind the establishment of the WG.

2.1 New Building

The INTERTANKO WG views the energy

efficiency measurements at the stage of new building and the development of ISO 19030 as follows. ISO 15016 (sea trial standards) was put in place to assist owners/yards for their sea trial. However, there are a number of areas where different interpretations of the requirements are possible leading to lack of transparency, e.g. how a weather correction factor was devised and used, the usage of SOG (speed over ground) and the lack of clarity on the normalization of current effect.

There are cases where the sea trial results were good but actual performance after delivery was not as good as sea trial data. Fuel consumption and power per each speed are two important quantities for the ship operator. However, the speed-power curve does not always reflect the full spectrum of operating conditions of a ship in her life time. Measurement methodologies are certainly different or, better to say, measurements in operation are not standardized, i.e. for different loading conditions. As the ship ages, the operator needs a more accurate power-speed curve.

According to the IMO 2014 Guidelines on Survey and Certification of EEDI (MEPC.1/Circ.855/Rev.1, Oct. 2015), the verifier should use ISO 15016 as a verification tool when the attained EEDI is verified. ISO 15016:2015 applies to sea trials conducted on or after 1 Sept. 2015.

The ship operator can predict speed power relation in fully or partially loaded condition and for example M/E fuel consumption at 85% and 100% MCR. However, a question still remains as to how a ship would perform in real sea states and realistic operating conditions. Hence, ISO 19030 comes into play. Instead of speculating speed/power relations under specific ME load and draft, ship operators need to measure ship performance at any time of operation.

- What is the ship's Speed-Power curve at any time in different loading conditions?
- What is the ship's current fuel consumption as a function of speed and draft (and possibly trim)?

Fuel consumption is dependent, among many others, on how efficient the ship's M/E is and how good her antifouling is.

One way of examining this was to look at "speed loss" which is considered to be a core objective of ISO 19030. When fouling occurs, ships will move slower as time elapses. This raises the question of how the speed loss could be measured and quantified. There are two viewpoints in the case of fouling:

- If the ship wants to maintain a speed at a specific loading (draft/trim) condition, she needs more power and more fuel consumption.
- For a given power level generated by the M/E at a specific loading condition, the ship will travel at a lower speed.

After some period of operation, the ship can achieve approximately the same speed at the same power setting by means of hull cleaning and propeller polishing. To make an assessment on what power is required to propel a ship, a number of parameters need to be measured, including as a minimum:

- Torque
- RPM
- Speed through water

ISO 19030 considers that the M/E is assumed to be as efficient as when the ship is new and it has four KPIs on speed and power:

- Measurement of ship performance before and after a drydock;
- Measurement of in-service hull and propeller performance;
- A point at which maintenance is required, i.e. hull cleaning and propeller polishing, and
- Monitoring the impact of such maintenance.

A disadvantage of ISO 19030 is the assumption that the M/E efficiency is not considered. SFOC (specific fuel oil consumption) of the M/E in operation is never the same as the one obtained at the shop test when the M/E is new. Depending on the M/E and maintenance, the SFOC curve may change over time (it may go up). ISO corrected the M/E SFOC measurement and calculation is however a simpler task. This task can be easily solved by enlarging the scope of ISO 19030 by measuring fuel consumption and calculating SFOC ISO corrected for benchmarking, with the ones coming from the shop test taking into account actual ME load and RPM.

ISO 19030 does not clearly address all factors influencing fuel consumption changes over a certain period of time. The ship operator wants to look at how the ship performs over a given time, i.e. a reference period such as:

- Measure before dry-dock
- Measure when the ship leaves dry-dock

Several alternatives are left for building up a reference line (sea trial, a reference period and CFD analysis).

2.2 Charterer’s Needs

A standard Charter Party agreement would have the following clause:

“Unless otherwise ordered by Charterers, the Vessel shall perform all voyages at the service speed stated in the Questionnaire consuming a quantity of fuel per day up to Beaufort 5 in ballast and laden as per Bunker Delivery Note quantity.”

In theory, the Charterer wants to know how efficient the ship is at the time of chartering the ship. In practice, they cover the transportation cost with due regard to the ship’s draft (cargo loaded), weather factors (wind direction, waves and swell), the current, the ship traffic, the quality and specific energy of fuel and using the SOG.

Therefore, there is a need to find the most appropriate and workable means to measure and demonstrate the ship’s efficiency, bearing in mind that:

- ISO 19030’s default method is the assumption that one can do very high frequency measurements. Not many ships are equipped with such automated measurement systems.
- ISO 19030 Part 3 provides an alternative method for those who do not have a sophisticated data collection system. A frequency of 1-2 manual snapshot events is sufficient, though it takes longer to build up a baseline than sensors.

The Charterer’s need and the tanker operators’ responses to such needs are one of main drivers of the establishment of the WG.

2.3 Existing Ships

Under the mandatory SEEMP (Ship Energy Efficiency Management Plan), tanker operators are implementing energy efficiency monitoring and interventions one way or another. To provide assistance to the membership, INTERTANKO commissioned a study to UCL Energy Institute with the data collected over five years from 11 sister ships, all operated under the same management. The study, although not using full ISO 19030 methodology, investigated the impact of using various indicators to assess the performance of ships in operation. The study was submitted to MEPC 72 (April 2018) and discussed the IMO’s (additional) technical and operational energy efficiency measures for both new and existing ships [1]. It shows that the use of indicators (e.g. EEOI, EETI, SECT and AER) provided some results and revealed a large degree of incompatibility between the technical efficiency as defined through an indicator and the actual CO_2 emissions mainly affected by operational factors. All of these indicators are intended to represent “in-service” efficiency based on the actual activity and operation of a ship.

In a previous study commissioned by INTERTANKO [2], EETI was proposed as an alternative to EEOI. EETI is estimated by deducting the effects of speed and transport work (allocative and payload utilization) from the EEOI, a full derivation can be found in (MEPC 69/INF.26 and “Understanding the Energy Efficiency Operational Index: data analysis on ships tanker ships for INTERTANKO”, UCL Energy Institute). In a nutshell, EEOI is an operational efficiency indicator whereas EETI is a technical efficiency indicator in a reference condition. Both are expressed as g CO_2/Nm.

A given ship's EEOI or total emissions in one year provided little indication of its EEOI or total emissions in the following year. The main cause was attributable to parameters that are predominantly outside of the shipowner/manager's control and are more commonly determined by the commercial conditions (e.g. type and transportation requirements for the cargo) and contractual conditions (speed, payload, etc.) as well as environmental conditions with the former being the predominant element.

The usability of EEOI thus has limited relevance in the context of technical energy performance monitoring. If one measures and averages the EEOI over a long period, the EEOI would become less sensitive to voyage-related fluctuations that are beyond the control of the ship's operator. Even in this case, the EEOI would not be capable of capturing small energy efficiency improvements that the ship has taken, the so called technical efficiency.

EETI, a metric that corrects for the dominant sources of efficiency variability that are outside of the owner/manager's influence (speed and utilization), was shown to produce a more narrow-banded distribution than EEOI (consistent for a fleet of technically similar ships), and trends consistent over time with low average rates of performance deterioration (consistent for a fleet of aging ships). One issue which complicates EETI is its calculation and normalization, as the EETI must be determined for a reference condition, and requires a conversion relating speed and fuel consumption that if incorrect can misrepresent performance/efficiency at high or low speeds. As has been highlighted in many other publications, depending on the ship type and its machinery, the relationship between fuel consumption and speed is not always well captured by a simple cubic relationship. In such instances, the speed factor may be calculated using a more sophisticated mapping of the relationship between speed and fuel consumption—if the data are available. Similar consideration may be given to the adoption of Admiralty formula which is unable to monitor power changes due to large draft changes in modern hull shaped vessels.

INTERTANKO may try to further investigate EETI as a meaningful indicator. However, there are challenges since it is an indicator related to performance in a standard condition and it is directly linked to the "reference speed" which needs a better definition.

2.4 INTERTANKO WG's First Meeting, November 2017

The WG discussed the experience gained from applying ISO 19030 and possible improvements with a view to developing recommendations. Due to the complexities involved in the scope of work, the WG undertook a scoping exercise to identify achievable tasks with the limited resources available to them.

The WG identified the following fundamental questions:

- What kind of information the makers and the yards shall provide to the shipowner at the time of new building?
- Whether and how the shipowners can ensure the quality of data so provided?
- How the shipowners are expected to use their own tools and optimize efficiency?
- How the ship owners are expected to communicate with Charterers about the ship's performance efficiency when the former has limited information? Both the ship operators and Charterers need information transparency.
- There are concerns that the information on the ship's performance efficiency, if placed in the public domain, could be misused.

The above questions led the WG to address data accuracy and measurement uncertainties and to propose improvements to ISO 19030 in this regard. Even each sensor has its accuracy and uncertainty limits. It is important to highlight that contrary to the expectations from Charterers, ISO 19030 measures individual ships but does not compare different ships with the same model.

A possible outcome of this deliberation will be a guidance explaining the meaning of accuracy, data quality, uncertainty and their limitations. The tanker operator and the Charterer would then be able to communicate to each other with the same understanding of performance data accuracy and uncertainty.

In addition, the WG noted that the ISO 19030 applicability range is the speed range taken from sea trial (13-17 knots). This range is rather limited compared to actual sailing conditions. The WG is unaware of how more detailed service conditions are extrapolated. This is one of the areas where the WG finds that further studies with the ISO 19030 developers are needed.

The WG's next step will be an experience building and gathering exercise, i.e. how many INTERTANO Members are applying for ISO 19030, what their experiences are in terms of accuracy data filtering, data normalization and transmission and why there are outliers in the gathered data. Based on this exercise, the WG will identify a next step.

2.5 Regulatory Landscape for CO_2 Reductions from Ships

In 2016, IMO developed a Roadmap for developing a comprehensive IMO strategy on reduction of GHG emissions from ships. An initial GHG reduction strategy will be adopted in April 2018 (MEPC 72) [3]. This is in response to the 2015 Paris Agreement that global efforts be made to keep the world's average temperature rise well below 2 °C above pre-industrial levels within this century and given the grave risks, to strive for 1.5 °C. IMO's mandatory requirement for ocean-going vessels to collect and report their annual CO_2 emissions under MARPOL Annex VI/Regulation 23A will take effect from 2018 and the required first reporting will cover the period of Jan. 2019 to December 2019. The collected data will be taken into account by IMO's future GHG studies which aim to estimate the GHG emissions from international shipping. This will enable IMO to identify what additional measures should be introduced to contribute to the wider global efforts meeting the 2.0/1.5 degrees Celsius targets. Generally speaking, it is the ambition of IMO that the international shipping industry should move towards zero CO_2 emissions as quickly as the delivery of economically viable alternative fuels and new propulsion technology will allow, while in the interim taking advantage of other efficiency-enhancing technologies as and when they become available and economically viable.

Fig. 1 shows estimated effects of 40% energy efficiency improvement with 40% emissions reduction relative to BAU (Business As Usual) in 2030 and 50% from 2008 in 2060 (corresponding to 90% reduction from BAU) based on the data used in IMO's third GHG Study 2014. Note that the 2014 IMO GHG study estimated that GHG emissions from international shipping could grow by between 50% and 250% by 2050. Hence, the IMO's proposed alternatives for a vision statement indicate a commitment to reducing GHG emissions from international shipping "towards zero as soon as possible within this century" with a more specific option "by 2050".

It is expected that IMO's new strategy will build upon the annual CO_2 emissions data collection, EEDI and SEEMP. The EEDI and its 3-phase scheme are designed such that after the initial phase zero in 2015, new ships being built today are required to meet the reference line 10% higher than the previous phase. This level will be strengthened incrementally every five years. On top of this, IMO is now conducting an investigative study of whether to advance the remaining phase 3 by a few years in order to boost innovative technical design and alternative fuels.

Putting all this regulatory landscape into context, and examining the regulators' thinking ahead of time in a schematic view as shown in Fig. 1, a tanker operator would find it even more challenging to face such a strong commitment that regulates incremental improvement of

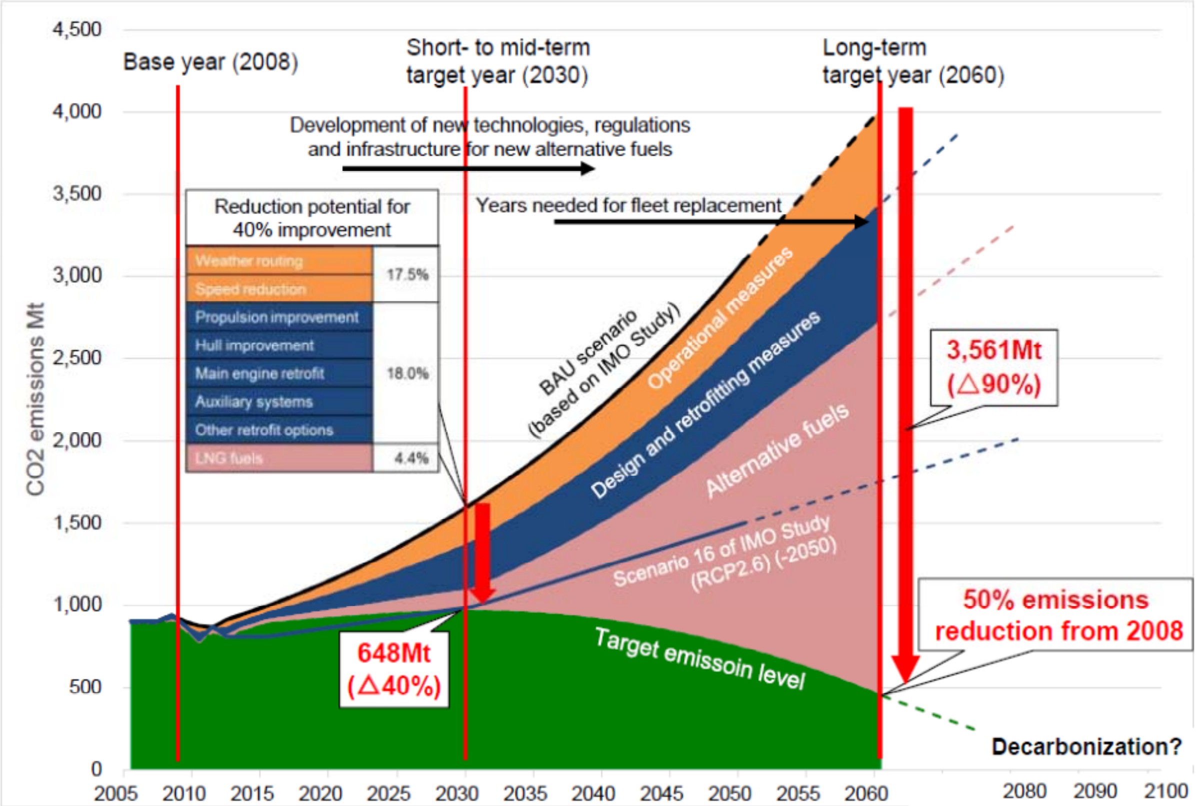

Fig. 1 Estimated emission pathways in accordance with the proposed goals, IMO (2017a).

the existing energy efficiency framework with EEDI and SEEMP [4]. It should also be noted that for IMO, the total CO_2 emitted by shipping matters while the practical fragmentation of responsibilities between technical operator and charterers needs to be properly addressed by regulators.

2.6 Maritime Autonomous Surface Ships (MASS)-IMO work output [5]

IMO (2017b) considered undertaking a regulatory scoping exercise to determine how the safe, secure and environmentally sound operation of Maritime Autonomous Surface Ships (MASS) shall be.

Ship automation is an emerging technology that is drawing upon the shipping industry. Reportedly, the new technology has the potential of a reduction to five or six crew members within the next 10 years. IMO will find it inevitable to lay down future regulations for autonomous vessels focusing on the remotely controlled and autonomous navigation and propulsion systems. In this context, the scope of monitoring will be much larger than that of energy performance. To achieve the level of high frequency data gathering required in ISO 19030, the ship needs to install a data logger and torque meter, to name just a few.

ISO 19030 and MASS evoke the notion of a continuum, on which the energy efficiency monitoring occupies an important segment, while autonomous vessel monitoring is located in its entire length. Though the effect of MASS may come to tankers in a slower speed than to other ship types, this new trend emerging on the horizon, no matter how distant it looks, bears close watch. For tanker operators, if they want to demonstrate full compliance with ISO 19030 with the ultimate goal of monitoring and controlling their fleet energy performance, a future demand of monitoring tools for automation will add another layer of variables to the immediate need for energy performance monitoring.

3. Summary

This paper indicates challenges facing the tanker operators and explains how these may be addressed through the tanker industry's self-driven initiative towards greener seaborne transportation, charterers' need, and regulatory landscapes reshaping the future industry. The work ahead of the INTERTANKO WG's task is more challenging. When the WG freely shares their experiences in their own energy efficiency monitoring based on ISO 19030, it will be able to achieve the objectives. The 2nd HullPIC Conference was brought to their attention only recently. The WG is well placed with the developers of ISO 19030 as well as tanker operators whose day-to-day job is to monitor their tanker fleet energy efficiency performance. It is hoped that the areas of improvement listed in item 2.3 above will be taken into consideration in the course of revision of ISO 19030.

References

[1] IMO. 2018. *Understanding CO_2 Emissions and Challengers in Assessing the Operational Efficiency for Ships*. INTERTANKO, MEPC 72/7/1.

[2] IMO. 2016. *Understanding the Energy Efficiency Operational Index: Data Analysis on Ships Tanker ships for INTERTANKO*. UCL Energy Institute, MEPC 69/INF.26.

[3] IMO. 2018. *Finalization of the Draft Initial IMO Strategy on Reduction of GHG Emissions from Ships.* ISWG-GHG 3/2.

[4] IMO. 2017. *Comments on the Draft Structure and Suggested Draft Text for Possible Inclusion in the Initial Strategy*. INTERTANKO et al, ISWG-GHG 2/2/1.

[5] IMO. 2017. *Maritime Autonomous Surface Ships, Proposal for a Regulatory Scoping Exercise.* Denmark et al, MSC 98/20/2.