INTERNATIONAL MARITIME ORGANIZATION

IMO

E

MARINE ENVIRONMENT PROTECTION COMMITTEE
58th session
Agenda item 4

MEPC 58/INF.7
28 July 2008
ENGLISH ONLY

# PREVENTION OF AIR POLLUTION FROM SHIPS

## Ship Efficiency Management Plan

**Submitted by ICS, BIMCO, Intercargo, Intertanko and OCIMF**


| SUMMARY | |
|---|---|
| ***Executive summary:*** | A draft Ship Efficiency Management Plan is forwarded for information. The draft plan set out in annex to this document represents the current status of work being undertaken by a coalition of maritime industry organizations and it is expected to be further refined in due course |
| ***Strategic direction:*** | 7.1 |
| ***High-level action:*** | 7.1.1 |
| ***Planned output:*** | 7.3.1.3 |
| ***Action to be taken:*** | Paragraph 5 |
| ***Related document:*** | MEPC 58/4 |


## Introduction

1 The co-sponsors note that paragraph 6.15 of document MEPC 58/4 encourages parallel work on ship efficiency management plans by IMO Member States and by the ship industry. This submission forwards a draft, indicating the current status of work being undertaken by a coalition of maritime industry organizations on a Ship Efficiency Management Plan (SEMP).

2 The main effort in the period after the first Intersessional Meeting of the Working Group on Greenhouse Gas Emissions from Ships, which took place in Oslo, Norway, from 23 to 27 June 2008, has been to further develop text in part three of the SEMP on specific fuel efficiency measures that all stakeholders in the maritime supply chain should consider and to provide an introductory section.

3 It should be noted that in an attempt to be as inclusive as possible, a wide range of possible efficiency measures has been included. However, not all measures can be applied to all ships; some are mutually exclusive and some depend upon the trading pattern of the voyage and/or ship.

4 The second section is designed to include the text finally agreed by the Committee on the ship $CO_2$ Operational Index.

**Action requested of the Committee**

5 The Committee is invited to note the draft Ship Efficiency Management Plan set out in the annex to this document and take action as appropriate.

***

# ANNEX

# DRAFT[1] SHIP EFFICIENCY MANAGEMENT PLAN

## 1 INTRODUCTION

1.1 There are around 70,000 ships engaged in international trade and this unique industry carries 90% of world trade. Sea transport has a justifiable image of conducting its operations in a manner that creates remarkably little impact on the global environment. Compliance with the MARPOL Convention and other IMO instruments and the actions that many companies take beyond the mandatory requirements serve to further limit the impact. It is nevertheless the case that efficiencies can be found to reduce fuel consumption and to produce directly related reductions in $CO_2$ emissions for individual ships. While the yield of individual measures may be small, the collective effect across the entire fleet will be significant.

1.2 The escalating price of fuel has been described, with justification, as an efficiency driver greater than any legislation and, in response, many owners and operators are concentrating considerable effort on finding more and more innovative ways to reduce fuel consumption and to improve efficiency across the supply chain.

1.3 In global terms it should be recognized that operational efficiencies delivered by a large number of ship operators will make an invaluable contribution to reducing global carbon emissions.

1.4 Provisions already exist in the ISM Code for owners and operators to monitor environmental performance and to establish a programme for continuous improvement. The Ship Efficiency Management Plan is designed merely to be an amplification of ISM requirements. It provides a possible mechanism for monitoring ship and fleet efficiency performance over time and some options to be considered when seeking to optimize the performance of the ship.

## 2 THE OPERATIONAL INDEX

**[This section is a placeholder for IMO text on the Operational Index]**

[1] 25 July 2008.

## 3 Guidance on Best Practices for Fuel-Efficient Operation of Ships

3.1 The search for efficiency across the entire transport chain takes responsibility beyond what can be delivered by the owner/operator alone. A list of all the possible stakeholders in the efficiency of a single voyage is long; obvious candidates are designers, shipyards and engine manufacturers for the characteristics of the ship, and charterers, ports and vessel traffic management services and so on for the specific voyage. All involved parties should consider the inclusion of efficiency measures in their operations both individually and collectively.

### Fuel-Efficient Operations

*Improved voyage planning*

3.2 The optimum route and improved efficiency can be achieved through the careful planning and execution of voyages. Thorough voyage planning needs time, but a number of different software tools are available for planning purposes for the company and the crew.

3.3 IMO resolution A.893(21) (25 November 1999) on voyage planning provides essential guidance for the ship's crew and voyage planners.

*Weather routeing*

3.4 Weather routeing has a high potential for efficiency savings on specific routes. It is commercially available for all types of ship and for many trade areas. Significant savings can be achieved even on single voyages but conversely weather routeing can also increase fuel consumption for a given voyage.

*Just in time*

3.5 Good early communication with the next port should be an aim in order to give maximum notice of berth availability and facilitate the use of optimum speed where port operational procedures support this approach.

3.6 Optimized port operation could involve a change in procedures involving different handling arrangements in ports. Port authorities should be encouraged to maximize efficiency and minimize delay.

*Speed optimization*

3.7 Speed optimization can produce significant savings. However, optimum speed means the speed at which the fuel used per tonne mile is at a minimum level for that voyage. It does not mean minimum speed; in fact sailing at less than optimum speed will burn more fuel rather than less. There has been some discussion on mandatory speed limits to promote efficiency but any such consideration needs to bear in mind optimum speed as well as the need to find a balance between voyage speed and the number of ships engaged in a particular trade route.

3.8 Speed optimization may lead to increased port congestion and be a new source of delay unless very carefully analysed. Reference should be made to the engine manufacturer's power/consumption curve and the ship's propeller curve. Further possible adverse consequences of slow speed operation include increased vibration and sooting and should be taken into account.

3.9 Finally, speed is usually in the control of the charterer and not the operator. Efforts should be made when agreeing charter party terms to permit the operator to implement $CO_2$ reduction measures.

*Optimized shaft power*

3.10 Operation at constant shaft RPM can be more efficient than continuously adjusting speed through engine power.

**Optimized ship handling**

*Optimum trim*

3.11 Most ships are designed to carry a designated amount of cargo at a certain speed for a certain fuel consumption. This implies the specification of set trim conditions. Loaded or unloaded, trim has a significant influence on the resistance of the ship through the water and optimizing trim can deliver significant fuel savings. For any given draft there is a trim condition that gives minimum resistance. In some ships it is possible to assess optimum trim conditions for fuel efficiency continuously throughout the voyage. Design or safety factors may preclude full use of trim optimization.

*Optimum ballast*

3.12 Ballast should be adjusted taking into consideration the requirements to meet optimum trim and steering conditions and optimum ballast conditions achieved through good cargo planning for both dry cargo ships and liquid cargo ships.

3.13 When determining the optimum ballast conditions, the limits, conditions and ballast management arrangements set out in the Ballast Water Management Plan, if applicable, are to be observed for that ship.

3.14 Ballast conditions have a significant impact on steering conditions and autopilot settings and it needs to be noted that less ballast water does not necessarily mean the highest efficiency.

*Optimum propeller considerations*

3.15 Selection of the propeller is normally determined at the design and construction stage of a ship's life but new developments in propeller design have made it possible for retro-fitting of new designs to deliver greater fuel economy. Whilst it is certainly for consideration, the propeller is but one part of the propulsion train and a change of propeller in isolation may have no effect on efficiency or at worst may increase fuel consumption.

*Optimal use of rudder and heading control systems (autopilots)*

3.16 Technology has created large improvements in automated heading and steering control systems. Whilst these were originally developed to make the bridge team more effective, modern autopilots can achieve much more. An integrated Navigation and Command System can achieve significant fuel savings by simply reducing the distance sailed "off track". The principle is simple; better course control through less frequent and smaller corrections will keep the resistance of the rudder blade smaller. Retro-fitting of a more efficient autopilot to existing ships could be considered.

3.17 During the approaches to ports and pilot stations the autopilot cannot always be used in efficient modes as the rudder has to respond quickly to given commands. Furthermore at certain stage of the voyage it may have to be de-activated or very carefully adjusted, i.e. heavy weather and approaches to ports.

3.18 Consideration may be given to the retrofitting of improved rudder blade design (e.g., “twist-flow” rudder).

*Hull maintenance*

3.19 Docking intervals should be integrated with ship operator’s ongoing assessment of ship performance. Hull resistance can be optimized by new-technology coating systems, possibly in combination with cleaning intervals. Regular in-water inspection of the condition of the hull is recommended.

3.20 Propeller cleaning and polishing or even appropriate coating may significantly increase fuel efficiency. The need for ships to maintain efficiency through in-water hull cleaning should be recognized and facilitated by port States.

3.21 Generally, the smoother the hull the better the fuel efficiency.

**Propulsion system**

3.22 Marine diesel engines have a very high thermal efficiency (~50%). This excellent performance is only exceeded by fuel cell technology with an average thermal efficiency of 60%. This is due to the systematic minimization of heat and mechanical loss.

*Propulsion system maintenance*

3.23 Maintenance in accordance with manufacturers’ instructions in the company’s planned maintenance schedule will also maintain efficiency. The use of engine monitoring can be a useful tool to maintain high efficiency.

*Waste heat recovery*

3.24 More efficient waste heat recovery is now a commercially available technology. Waste heat recovery systems use thermal heat losses from the exhaust gas for either electricity generation or additional propulsion with a shaft motor.

3.25 Those systems cannot always be retrofitted to a ship but can be a beneficial option for new ships. Shipbuilders should be encouraged to incorporate new technology into new designs.

**Improved fleet management**

3.26 Better utilization of fleet capacity can often be achieved by improvements in fleet planning. For example, it may be possible to avoid or reduce long ballast voyages through improved fleet planning. There is opportunity here for charterers to promote efficiency.

3.27 Efficiency, reliability and maintenance-oriented data sharing among company ships can be a tool to promote friendly competition among ships within the company and should be actively encouraged.

**Improved cargo handling**

3.28 Cargo handling is in most cases under the control of the port and optimum solutions matched to ship and port requirements should be explored.

**Energy management**

3.29 A review of electrical services on board can reveal some surprising efficiency gains. However care should be taken to avoid the creation of new safety hazards when turning off electrical services (e.g., lighting). Thermal insulation is an obvious means of saving energy. Also see comment below on shore power.

**Fuel Type**

3.30 Use of emerging alternative fuels may be considered as a $CO_2$ reduction method but availability will often determine the applicability.

**Other measures**

3.31 Development of programmes for the calculation of fuel consumption, for the establishment of an emissions "footprint", to optimize operations, and the establishment of goals for improvement and tracking of progress may be considered as incentive schemes.

3.32 Renewable energy sources, such as wind, solar (or Photovoltaic) cell technology, have improved enormously in the recent years and should be considered for onboard application.

3.33 In some ports shore power may be available for some ships but this is generally aimed at improving air quality in the port area. If the shore-based power source is carbon efficient, there may be a net efficiency benefit. Ships may consider using on-shore power if available.

3.34 Even wind assisted propulsion may be worthy of consideration.

**Compatibility of measures**

3.35 This document offers a brief overview of possibilities for $CO_2$ emission reduction for the existing fleet. While there are many options available, they are not cumulative, they are often area and trade dependent and are likely to require the agreement and support of a number of different stakeholders if they are to be utilized most effectively.

*Age and operational service life of a ship*

3.36 All measures identified in this document are potentially cost effective as a result of high oil prices. Measures previously considered unaffordable or commercially unattractive may now be feasible and worthy of fresh consideration. Clearly, this equation is heavily influenced by the remaining service life of a ship.

*Trade and sailing area*

3.37 The feasibility of some measures is dependent on the trade and sailing area and these factors need to be taken into account. Sometimes ships will change their trade areas as a result of a change in chartering requirements but this cannot be taken as a general assumption. For example wind enhanced power sources might not be feasible for short sea shipping as these ships generally sail in areas with high traffic densities or in restricted waterways. Another aspect is that the world's oceans and seas each have characteristic conditions and as a result ships are often designed for specific routes and trades. This can, by itself, reduce the effectiveness of some measures and combinations of measures. It is also likely that some measures will have a greater or lesser effect in different sailing areas.

3.38 The trade a ship is involved in will also determine the feasibility of some of the measures. Ships which perform services at sea (pipe laying, seismic survey, OSVs, dredgers, etc.) are likely to choose different methods of carbon reductions when compared to conventional cargo carriers. The length of voyage will also be an important parameter as will safety considerations imposed upon some vessels. As a result, it is likely that the pathway to the most efficient combination of measures will be unique to each vessel within each shipping company.

ANNEX 1

## 4 Model Ship Efficiency Management Plan

| | |
|---|---|
| Name of vessel:<br><br>Vessel type:<br><br>GRT: | Capacity(TEU/DWT/Pass./TLM):<br><br>$CO_2$ Operational Index (MEPC/Circ.471)<br><br>……………………………….. |

| **Energy Saving Option**<br><br>Management/Operational Measures | **Date of Implementation**<br><br>*Insert: Relevant date/Under consideration* | **Energy Saving**<br><br>*Insert: unit/time* | **Energy Saving Potential**<br><br>*Insert: unit/time* |
|---|---|---|---|
| Weather Routeing<br><br>*Remarks: Software available/weather charts* | | | |
| Routeing (Voyage optimization)<br><br>*Remarks: Optimized voyage planning – including consideration of current and tide optimization* | | | |

| | | | |
|---|---|---|---|
| Trim Optimization<br><br>*Remarks: Each draught has an assigned best trim/trim tables/best practice subject to the ballast water management plan* | | | |
| Improved Usage of Engine cooling water<br><br>*Remarks: (Generation of technical water or even drinking water), improvements* | | | |
| Pumps, Fans and electrical equipment<br><br>*Remarks: Cooling/ventilation systems not always under full load/rpm control. Installation of a speed/power control unit for engine-room pumps and fans will conserve electrical energy demand where pumps are not required to be operated at their full-speed rating* | | | |
| | | | |
| Hull resistance management<br><br>*Remarks: Performance monitoring for hull conditions and fouling* | | | |
| Propeller maintenance<br><br>*Remarks: Cleaning/polishing of propeller/maintenance* | | | |

| | | | |
|---|---|---|---|
| Optimizing autopilot function<br><br>*Remarks: Improved autopilot software for efficiency* | | | |
| Speed optimization<br><br>*Remarks: Speed reduction may reduce emissions* | | | |
| Engine Performance Optimization Programme<br><br>*Remarks: Good monitoring programme/functionality of parts/optimization of cylinder pressure* | | | |
| Energy Conservation Awareness training programme<br><br>*Remarks: Onboard training for energy efficient operation* | | | |
| VOCON<br><br>*Remarks: Implementation of VOCON operational procedure on board to reduce non-Methane VOC emissions* | | | |
| Efficient usage of an incinerator<br><br>*Remarks: Discharge ashore/minimized application but consider how disposal will occur ashore* | | | |

| | | | |
|---|---|---|---|
| Optimum use of bow thrusters<br><br>*Remarks: No stand-by action during safe passages but depends on type of thruster* | | | |
| Monitoring energy consumption<br><br>*Remarks: Monitoring for significant increases and trends* | | | |
| Fuel quality<br><br>*Remarks: Improvements in fuel quality/gas engines. Good quality fuel brings less wastage* | | | |

| **Energy Saving Option**<br><br>Technical or Equipment Modification | **Date of Implementation**<br><br>*Insert: Relevant date/Under consideration* | **Energy Saving**<br><br>*Insert: unit/time* | **Energy Saving Potential**<br><br>*Insert: unit/time* |
|---|---|---|---|
| Thermal Heat Recovery (WHR-systems)<br><br>*Remarks: Mainly applicable for newbuildings* | | | |
| Advanced hull coatings systems<br><br>*Remarks: Can increase hull smoothness and decrease drag* | | | |

| | | | |
|---|---|---|---|
| Shore power supply<br><br>*Remarks: Availability/efficiency of power generation* | | | |
| Shaft generator<br><br>*Remarks: Usually higher efficiency than separate diesel generators in new ships* | | | |
| Lighting<br><br>*Remarks: Savings generated by smart controls/energy saving bulbs on Cruise Ships* | | | |
| Air Condition systems/Cooling systems<br><br>*Remarks: Modern cooling systems/Adsorption refrigeration systems/better insulation/regular maintenance. Measures to eliminate refrigerant leakage should be incorporated into designs* | | | |
| Propeller boss fin caps (PBFC)<br><br>*Remarks: May improve propeller performance and efficiency by eliminating hub vortex* | | | |

ANNEX 2

## EVALUATION OF THE TABLE

1.1 In line with the objectives of the Ship Efficiency Management Plan, the table in Annex 1 provides a model to monitor and record a ship's performance and subsequent efficiency by listing the options that are:

- currently being utilized on board or under trial; and

- being considered for future implementation.

1.2 The table has therefore been split into two sections related to whether the energy efficiency options are management or operationally focused or whether there will be further requirements in terms of technical additions or equipment modifications. This separation is necessary as different departments of a shipping company will be involved in the decision making processes under each of the two sections.

1.3 As noted in section 3.35 of the Guidelines, 'Compatibility of measures', there are many options available but these are not cumulative, are often area and trade dependent and are likely to require the agreement and support of a number of different stakeholders if they are to be utilized effectively.

1.4 To provide guidance on the performance and efficiency of the vessel a quantitative element has also been provided in the table. Each measure however will likely require different methods and units of measurement. Relating to the two options listed in 1.1, the following categories of energy measurement have been incorporated for use with the reduction options in the table in Annex 1:

.1 **Energy Savings**: This relates to the efficiency options already in use and when measured against performance prior to that option's implementation; and

.2 **Energy Saving Potential (ESP)**: This measurement will apply to existing options already implemented and to those under trial as well as options being considered. The ESP may be a future target for Energy Saving or may relate to equipment being considered for future efficiency options.

1.5 Further explanation and background information should be added to the SEMP as appropriate.

___________