Practical Application of Ship Energy Efficiency Management Plan

INTRODUCTION

All shipping companies primary objectives should be the prevention of damage to the environment by ensuring the company policy of Environmental Protection initiatives that requires taking an active approach to the prevention of environmental pollution using best practice to set and achieve environmental goals and targets. In the paper authors would like to present practical application of Ship Energy Efficiency Management Plan on the base of implemented SEEMP in one of tankership company. Due to the Energy Efficiency Plans is a new agenda for environmental protection, it seems to be necessary to discuss that subject.

In order to robust environmental protection in a practice, shipping company should establish Energy Management Policy as follows (tankership company as example):

1. The Company shall establish Ship Efficient Energy Management Plan (SEEMP) for both the Onshore and Onboard, which refers IMO MEPC.1/Circ.683 (SEEMP), OCIMF Energy Efficiency and Fuel Management (EEFM) and Intertanko Guide for a Tanker Energy Efficiency Management Plan (TEEMP).
2. The Plan shall be specific for individual vessels and reviewed regularly by both the vessel and the Company senior managements.
3. The Company shall set goals for energy management that shall be quantified Energy Efficiency Operational Index (EEOI) in accordance with IMO MEPC.1/Circ.684 [2].
4. The continuous improvement process for efficiency energy management shall be based on the Company HSEQ system (IMS) that complies latest ISO 14001.

Planning for measures

Planning is the most crucial stage of the SEEMP, in that it primarily determines both the current status of ship energy usage and the expected improvement of ship energy efficiency. It is important to establish ship specific measures. Below mentioned subjects to be taken into consideration.

1. Recognizing that there are a variety of options to improve efficiency – speed optimization, weather routing and hull maintenance, for example – and that the best package of measures for a ship to improve efficiency differs to a great extent depending upon ship type, cargoes, routes and other factors, the specific measures for the ship to improve energy efficiency should be identified in the first place. These measures should be listed as a package of measures to be implemented. The overview of the recommended actions is listed in after-mentioned matrix as “Best Practices”.
2. During this process, therefore, it is important to determine and understand the ship’s current status of energy usage. The SEEMP then identifies energy-saving measures that have been undertaken, and determines how effective these measures are in terms of improving energy efficiency. The SEEMP also identifies what measures can be adopted to further improve the energy efficiency of the ship.
3. Guidance on Best Practices for Fuel-Efficient Operation of Ships set out in the matrix below can be used to facilitate this part of the planning phase.[1].

The improvement of energy efficiency of ship operation does not necessarily depend on single ship management only. Rather, it may depend on many stakeholders including ship repair yards.

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shipowners, operators, charterers, cargo owners, ports and traffic management services. The better coordination among such stakeholders is, the more improvement can be expected. In most cases, such coordination or total management is better made by the Company rather than by a vessel. The SEEMP (On Shore) is established to manage the fleets and make necessary coordination among stakeholders, etc.

For effective and steady implementation of the adopted measures, raising awareness of and providing necessary training for personnel both on shore and on board are an important element. Such human resource development is encouraged and should be considered as an important component of planning as well as a critical element of implementation.

**Measures – Best practice guideline.**

Effective measures to be implemented in the various area of ship operation. In this chapter example of the measures is presented. Specific measures applied on board the vessel can be different and are not limited to measures given in the presented example.

1. **Voyage Planning:**
   - Vessel to optimise route plan by “avoid bad weather” or “strong adverse currents” while also maximising the use of “tidal streams” and “ocean currents”.
   - The above aspects shall be determined within the limitations of traffic separation scheme and safe navigation in line with the guidelines described in the publication of “Bridge Team Management (basis IMO Guideline for Voyage Planning (IMO resolution A.893(21)). Second Officer is responsible for Voyage Planning under supervision of the Master.

2. **Weather Routeing:**
   - Utilizing and, to monitor the weather and Hydrographic forecast and incorporate this data into the voyage plan. The Master is responsible for utilizing the weather routing.

3. **Just in Time (Ship-Shore liaison):**
   - Vessel should actively liaise with the operator/charterer/local agents/port authority to confirm required voyage schedule and set optimum speed under approval of the operator taking an appropriate safe margin into account. The Master is responsible to actively liaise with the operator/charterer for voyage schedule.
   - The Master is responsible to optimise vessel speed.

4. **Speed Optimisation:**
   - Vessel to optimise the speed, where practical, maintaining the most fuel efficient speed to minimise total fuel consumed throughout the entire voyage. 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 (IMO/SEEMP 4.7). The Master is responsible to optimise vessel speed.

5. **Optimised Shaft Power:**
   - Main engine power to be limited to 85% of the Maximum Continuous Rating (MCR) and to 90% thermal load. Vessel to reduce any Unnecessary load whenever possible. Chief Engineer is responsible for not to exceed 85% MCR and to 90% thermal load. Vessel to operation at constant shaft RPM which can be more efficient than continuously adjusting speed through engine power. The Master and Chief Engineer is responsible to set appropriate RPM taking fuel efficiency into account.

6. **Optimum Trim:**
   - Vessel to ensure the appropriate optimum trim. The optimum trim for the ballast passage should be tested and compared with other ballast conditions as per the procedure required by the Company. The Master and Chief Engineer is responsible to set appropriate RPM taking fuel efficiency into account.

7. **Optimum Ballast:**
   - Vessel to ensure adjusting Ballast taking into consideration on optimum trim and steering conditions and optimum ballast conditions achieved through good cargo planning. The Plan shall meet requirements of Ballast Water Management Plan. Chief Officer is responsible for cargo planning taking optimum ballast into account.
- Vessel to ensure that present ballast conditions does not have a negative impact on steering conditions and Auto-Pilot settings. Such condition may effect deterioration of fuel efficiency, as well as the safe navigation. The OOW (officer on watch) is responsible to constant monitoring on steering and Auto-Pilot conditions and report to the Master of any negative influence. The Master is responsible to verify steering and Auto-Pilot condition and does necessary adjustment on ballast or setting Auto-Pilot.

(8) Optimum use of Rudder and Heading control systems (Autopilots):

- Master and Officer on watch are responsible for this measures:
  - Vessel to ensure, when navigating open sea without obstruction for safe navigation, maintaining position on the course line through a close position check on “ECDIS” and the other available means
  - Vessel to ensure that the setting of Auto-Pilot is optimised considering the situation around. Especially, when the vessel is navigating open sea without obstruction for safe navigation, set in “Economical mode” as far as practicable
  - Vessel to ensure that the action to avoid a vessel is to be in ample time to avoid close-quarter situation. It is not only for the safety but also fuel efficiency, avoiding a quick load & changing engine revolution.
  - Vessel to ensure changing over from Auto-Pilot to Hand-Steering in ample time when approaching to ports and confined waters. It is not only for the safety but also fuel efficiency, since the Auto-Pilot cannot always be used efficiently as the rudder has to respond quickly to given commands.
  - Vessel to ensure changing over from Auto-Pilot to Hand-Steering at certain stage of heavy weather. This is not only the safety but also the fuel efficiency

(9) Maintenance General:

- Vessels to ensure number of outstanding tasks in Planned Maintenance System (PMS) 1 % (Year to date). The C/Engineer is responsible for PMS system with cooperation of Master

(10) Propulsion System Maintenance [3]:

- Chief Engineer is responsible to consider additional measures to improve engine efficiency:
  - Vessel to ensure Performance check of Maine Engine to make sure a balanced output from all cylinders. The check shall take place which interval should not be less than 10 propelling days (or once per each Ballast and Laden voyages)
  - Vessel to ensure optimizing Alpha Lubrication system by adjusting the feed rate according to the fuel quality.
  - Vessel to ensure optimisation of Propulsion system using additional means to improve engine efficiency, which may include: use of fuel additives, adjustment of cylinder lubrication oil consumption, torque analysis, automated engine monitoring systems

(11) Waste Heat Recovery:

- Chief Engineer is responsible for this measures.
  - Vessel to maintain the exhaust valves and associated piping system, etc. ensuring that the maximum amount of heat is recovered for steam and power generation
  - Vessel to ensure efficient operation of the main engine cooling water by the continued effective treatment of the cooling water to reduce scale, corrosion etc.
  - Vessel to ensure efficient operation EGE by soot blowing, which minimum twice a day while at sea in the circumstance is permit.
  - Soot blowing shall also be conducted, before entering and after sailing ports at an area where environmentally safe and ensure that the hot Water system is operated within the parameters required as per the SMS

(12) Energy Management:

- Chief Engineer is responsible for this measures.
  - Vessel to inspect the insulation of the exhaust gas trunk and maintain it in good condition
Steam Systems (Saturated and Super-heated) Vessel to ensure that all piping continues to be maintained no leaking and insulated to retain temperature efficiency.

Vessel to ensure the continued maintenance of the settling and service tanks etc. with particular regard to insulation, vent heads etc.

Vessel to ensure that all piping with the insulation continues to be maintained in a satisfactory condition, able to maintain the set pressures

Vessel to record daily consumption, speed, vessel condition (laden or ballast), weather, sea state and wind direction into voyage record.

Vessel to calculate on a daily basis the % power and thermal load compared to that at the MCR.

(13) Improved Fleet Management:
Vessel should hold Energy Efficient review committee at quarterly basis (Jan., Apr., Jul., and Oct.) for the following items. The Master is responsible to chair the committee and final evaluation.

(14) Fuel Management:
Vessel to ensure management of fuel on board in optimum operational condition in accordance with the Company “Fuel Management Procedure” to minimise sludge production and “keep the plant in optimum operational condition”. Vessel to accurately measure Fuel consumption of Main Engines, Boilers and Auxiliaries and record. Chief Engineer is responsible to maintain fuel on board in optimum condition.

(15) Power Generator Optimisation:
Chief Engineer is responsible for this measures.

- Vessel to utilize the diesel generator(s) at their optimum load, minimizing low load operation as much as possible.
- Vessel to ensure Performance check of diesel generator engine to make sure a balanced output from all cylinders
- Vessel to utilize the turbo generator as frequently as possible.

(16) Training:
Vessel to ensure awareness of crewmembers for efficient energy management using the SEEMP and the training materials. Awareness training shall take place before or after On board Management Committee Meeting. The Master id responsible for the awareness training.

Monitoring
The energy efficiency of a ship should be monitored quantitatively. The EEOI (Efficiency Energy Operational Index) developed by the Shipping Company as the primary monitoring tool is to be used as one of the internationally established tools based on IMO (MEPC.1/Circ.684) to obtain a quantitative indicator of energy efficiency of a ship and/or fleet in operation. The details to determine the EEOI is described below and calculation for EEOI is carried by the Shipping Company:

The Formula to determine EEOI is as following [4,5]:

- One year closest to the end of a voyage CO₂ Emission marked (CO₂) :
  \[ \text{CO}_2 = \frac{\text{CF} \cdot \text{FC}}{\text{CW} \cdot \text{DR}} \text{ [g / ton-mile]} \] (1)

- Voyage to Voyage calculation:
  \[ \text{CO}_2 = \frac{\text{CF} \cdot \text{FC}}{\text{CW} \cdot \text{DR}} \text{ [g / ton-mile]} \] (2)

- Laden Voyage:
  \[ \text{CO}_2 = \frac{\text{CF} \cdot \text{FC}}{\text{CW} \cdot \text{DR}} \text{ [g / ton-mile]} \] (3)

- Ballast Voyage:
  \[ \text{CO}_2 = \frac{\text{CF} \cdot \text{FC}}{\text{DR}} \text{ [g / mile]} \] (4)

where:
- CF : Coefficient Factor [-]
- FC: Fuel consumption [kg]
- CW: Cargo weight [ton]
- DR: Distains run [mile]
Monitoring System

The monitoring system, including the procedures for collecting data and the assignment of responsible personnel are described below;

(1) Data collecting procedure:

Calculation of fuel consumption shall be on a daily basis and entered into the Engine Room Log Book. Data collection (vessel speed, position, weather condition shall be on a daily basis by entering data into voyage log.

(2) Reporting procedure:

Voyage data collected by the above process shall be submitted to the Company after completion of every voyage.

Setting Targets

The purpose of setting targets is to serve as a signal which involved people should be conscious of, to create a good incentive for proper implementation, and then to increase commitment to the improvement of energy efficiency. It shall be a specific target of Energy Efficiency Operational Indicator (EEOI).

Procedures for Setting Targets:

(1) The Company shall determine the Target EEOI of the next year in every December.
(2) To determine the Target EEOI, the following elements should take into account.
   – Achievement of EEOI for One year closest to the end of a voyage
   – Design of the Vessel (Sister or same model)
   – Nature of Services
   – Trading Patterns
(3) Responsible person to determine Target EEOI is Company Management Representative.

Self-Evaluation and Improvement

(1) Purpose of Self-Evaluation

Self-evaluation and improvement is the final phase of the management cycle. This phase should produce meaningful feedback for the coming first stage, i.e. planning stage of the next improvement cycle.

The purpose of self-evaluation is to evaluate the effectiveness of the planned measures and of their implementation, to deepen the understanding on the overall characteristics of the ship’s operation such as what types of measures can/cannot function effectively, and how and/or why, to comprehend the trend of the efficiency improvement of that ship and to develop the improved SEEMP for the next cycle.[1,2].

(2) Procedure for Self-Evaluation (On Board)

Self-evaluation on board for Energy Efficiency shall take place as follows;

(a) Committee Meeting:
   Time of Evaluation : January, April, July and October (Every Quarter)
   Opportunity : Shipboard Management Committee Meeting
   Chairman : Master
   Participants : Deck and Engine Officers, as minimum.

(b) Agendas:
   – Evaluation of achieved EEOI against the Target.
   – Trends of achieved EEOI in passed year and the evaluated period.
   – Comparison with the Best Practices that will be provided by the Company.
   – Evaluations of the achievements on the vessel plan (Measures).
   – Evaluate what types of measures can/cannot function effectively, and how and/or why.
   – Develop the improved SEEMP for the next cycle.

(c) Recording:
Record of the Self-Evaluation shall be recorded. The Master is responsible for the record.

SUMMARY

Marine vessels are very large and efficient means of transport. At the same time, if an incorrect operation or failure are a great threat to the environment. This is particularly true in oil tankers. Therefore, oil tankers owners are leaders in the implementation of IMO for safe and effective operation for tankers. The concept of Ship Energy Efficiency Management Plan presented in the article, can bring planned effects only, if are closely applied. Crews of ships, shipowners and technical services of the shipowner must be prepared for it.

Abstract

In the paper authors would like to present practical application of Ship Energy Efficiency Management Plan on the base of implemented SEEMP in one of tankership company. Authors presented possible measures for improvement of energy efficiency, monitoring methods and on board vessel evaluation of effectiveness of SEEMP.

Praktyczne zastosowanie Planu Sprawnego Zarządzania Zasobami Energetycznymi Statku (Ship Energy Efficiency Management Plan – SEEMP)

Streszczenie

W artykule autorzy chcieliby przedstawić praktyczne zastosowanie Planu Sprawnego Zarządzania Zasobami Energetycznymi Statku (Ship Energy Efficiency Management Plan – SEEMP) na podstawie wprowadzonego w życie SEEMP w jednym z przedsiębiorstw armatorskich zbiornikowców. Autorzy przedstawili środki stosowane dla podniesienia sprawności zarządzania zasobami energetycznymi statku, ulepszenia metod monitoringu i oceny danych jak i ocenę rozwoju skutecznego stosowania SEEMP na burcie statku.

REFERENCES