**Ship Energy Efficiency**

**Management Plan (SEEMP)**

|  |
| --- |
| **Part Ⅱ - Ship Fuel Oil Consumption Data Collection Plan** |
| (\*\*\* Shipping ) |

|  |  |
| --- | --- |
| Name of Ship |  |
| IMO NO. |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Ver. No | Date | History | Remark |
|  |  |   |  |

**Explanatory notes**

This guidance was developed to assist in the preparation of the Ship Energy Efficiency Management Plan ("SEEMP") required by regulation 22 of MARPOL Annex VI and was prepared in accordance with Resolution MEPC.282 (70).

We have made every effort to ensure that the information contained in this guidance is accurate, but please note that there is possibility of unintended mistranslations and errors in the content, and the content in this plan should be written and modified to suit the actual situation of the ship.

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1. **Introduction**
	1. **Background**

With growing concerns of Environment, the International Maritime Organization (IMO), the main regulatory body for shipping, has developed technical and operational measures below in order to regulate shipping energy efficiency and thereby control the marine GHG emissions.

* Energy Efficiency Design Index (EEDI)
* Energy Efficiency Operational Index (EEOI)
* Ship Energy Efficiency Management Plan Part I & Part II (SEEMP)

SEEMP Part II (Ship Fuel Oil Consumption Data Collection System) applies to ships in the case of 5,000 gross tonnage and above. The SEEMP shall be amended to include data collection systems by 31 December 2018 as a result of the MEPC 70th session, and each ship shall comply with the methodology specified in the SEEMP part II from 1st January, 2019.

* 1. **Purpose**

This plan is designed to participate and implement the Ship Fuel Oil Consumption Data Collection System, which will be enforced by International Maritime Organization from 2019, in order to improve the efficiency of the energy used in the activities of the ship, to reduce costs, to reduce GHG (green house gas) emissions and to protect the natural environment.

Also, this plan provides for the construction of a standard ship fuel consumption collection plan, which not only allows the workplace to prepare for the IMO international conventions, but also enables users to operate the best way of ship energy efficiency.

* 1. **Implementation**

For the implementation of SEEMP, in general, shipping companies need to organize two groups: A Company Management Team and an Onboard Management Team.

Firstly, the Company Management Team will be responsible for developing the plan; assessing the appropriate measures to be introduced within the fleet; collecting the information from the fleet; and monitoring and assessing the effectiveness of those implemented measures.

Secondly, the Onboard Management Team, ship’s crews, will be involved in applying selected energy saving measures into practice. In order to implement the SEEMP effectively, crew familiarization will be essential and, the burden of the crews should be kept to a minimum.

This plan should be written in the common language of the crew. If it is not English, French or Spanish, the plan must be translated into one of these languages.

* 1. **Definition**
1. Ship fuel oil consumption datameans the data required to be collected in annual basis and reported as specified in appendix IX to MARPOL Annex VI.
2. Safety management system means a structured and documented system enabling company personnel to implement effectively the company safety and environmental protection policy.
3. Fuel oilmeans any fuel delivered to and intended for combustion purposes for propulsion or operation on board a ship, including gas, distillate and residual fuels.
4. Emissionmeans any release of substances, subject to control by MARPOL Annex VI, from ships into the atmosphere or sea.
5. Conversion Factor(Cf) means non-dimensional conversion factor between fuel oil consumption and CO2 emission.
6. Voyagemeans the period between a departure from a port to the departure from the next port. Alternative definitions of a voyage could also be acceptable.
7. Company means the owner of the ship or any other organization or person such as the manager, or the bareboat charterer, who has assumed the responsibility for operation of the ship from the owner of the ship and who on assuming such responsibility has agreed to take over all the duties and responsibilities imposed by the International Management Code for the Safe Operation of Ships and for Pollution Prevention, as amended.
8. Calendar year means the period from 1st January until 31st December of a year.
9. Hours underway means the duration while the ship is underway under its own propulsion.
10. Distance travelled means a distance travelled over ground in nautical miles(should be recorded in log-book).
	1. **Relation between SEEMP Part I and Part II**

The SEEMP is consist of two parts. Part I provides a possible approach for monitoring ship and fleet efficiency performance over time and some options to be considered to optimize the performance of the ship. Part II provides the methodologies for ships of 5,000 gross tonnage and above about collecting the required data pursuant to regulation 22A of MARPOL Annex VI and reporting the data to the ship’s Administration or any Organization duly authorized by it. Ultimately, GHG emissions can be calculated through Part II, and since this series of activities is closely related to the energy efficiency activities of Part I, it is essential to carry out activities to improve energy efficiency of Part I.

* 1. **Fuel Consumption Data Collection Process**
1. **Ship fuel oil consumption data collection**
	1. **Ship particulars**

|  |  |
| --- | --- |
| Name of ship |  |
| IMO number |  |
| Company |  |
| Flag |  |
| Ship type |  |
| Gross tonnage |  |
| NT |  |
| DWT\* |  |
| EEDI (if applicable) |  |
| Ice class |  |
|  |  |

***\**** DWT means the difference in tonnes between the displacement of a ship in water of relative density of 1,025 kg/m3 at the summer load draught and the lightweight of the ship. The summer load draught should be taken as the maximum summer draught as certified in the stability booklet approved by the Administration or an Organization recognized by it.

* 1. **Ship fuel oil consumption data collection**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Fuel oil consumers | Type/Model | Quantity | Power | Fuel oil types |
| 1 | Main engine  |  |  |  |  |
| 2 | Auxiliary engine  |  |  |  |  |
| 3 | Composite boiler  |  |  |  |  |
| 4 | Auxiliary boiler |  |  |  |  |
| 5 | Inert gas generator |  |  |  |  |
| 6 |  |  |  |  |  |
| 7 |  |  |  |  |  |
| 8 |  |  |  |  |  |
| 9 |  |  |  |  |  |
| 10 |  |  |  |  |  |
|  |  |  |  |  |  |
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|  |  |  |  |  |  |

* 1. **Emission factor**

CF is a non-dimensional conversion factor between fuel oil consumption and CO2 emission in the 2014 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships (resolution MEPC.245(66)), as amended. The total annual amount of CO2 is calculated by multiplying annual fuel oil consumption and CF for the type of fuel.

|  |  |
| --- | --- |
| Fuel oil Type | CF (t-CO2 / t-Fuel)  |
| Diesel/Gas oil (e.g. ISO 8217 grades DMX through DMB)  | 3.206  |
| Light fuel oil (LFO) (e.g. ISO 8217 grades RMA through RMD) | 3.151 |
| Heavy fuel oil (HFO) (e.g. ISO 8217 grades RME through RMK) | 3.114  |
| Liquefied petroleum gas (LPG) (Propane) | 3.000  |
| Liquefied petroleum gas (LPG) (Butane)  | 3.030  |
| Liquefied natural gas (LNG)  | 2.750  |
| Methanol  | 1.375  |
| Ethanol  | 1.913  |
| Other (………)  |  |

***\* Conversion factor CF***

If fuels are used that do not fall into one of the above categories, fuel supplier should provide a *CF*-factor for the respective product supported by documentary evidence. (e.g. some "hybrid fuels", “non-fossil fuels”)

* 1. **Method to measure fuel oil consumption**

Fuel oil consumption should include all the fuel oil consumed on board including but not limited to the fuel oil consumed by the main engines, auxiliary engines, gas turbines, boilers and inert gas generator, for each type of fuel oil consumed, regardless of whether a ship is underway or not. Methods for collecting data on annual fuel oil consumption in metric tonnes include as below (in no particular order):

|  |  |
| --- | --- |
| Method | Description |
| A | * Method using bunker delivery notes (BDNs)
 |
| B | * Method using flow meters
 |
| C-1 | * Method using fuel oil tank monitoring (indirect measurement)
 |
| C-2 | * Method using fuel oil tank monitoring (direct measurement)
 |

|  |  |  |
| --- | --- | --- |
|  | Fuel consumer | Method to measure |
| 1 | Main engine | Choose A / B / C-1 / C-1  |
| 2 | Auxiliary engine | Choose A / B / C-1 / C-1 |
| 3 | Composite boiler | Choose A / B / C-1 / C-1 |
| 4 | Auxiliary boiler | Choose A / B / C-1 / C-1 |
| 5 | Inert gas generator | Choose A / B / C-1 / C-1 |
| 6 | (If applicable) |  |
| 7 |  |  |
| 8 |  |  |
| 10 |  |  |

1. Method “A” : using bunker delivery notes(BDNs)

This method determines the annual total amount of fuel oil used based on BDNs, which are required for fuel oil for combustion purposes delivered to and used on board a ship in accordance with regulation 18 of MARPOL Annex VI. Annual fuel oil consumption(Q) would be calculated as follows.

**Q = T1 + R - S - T2**

Q = Annual fuel oil consumption

T1 = Amount of remaining tank oil at the beginning of the year

R = Total amount of bunkering for calendar year

S = Total amount of fuel oil offloaded for calendar year

T2 = Amount of remaining tank oil at the end of the year

Fuel oil tank readings should be carried out by appropriate methods such as automated systems(remote reading), soundings and dip tapes. Details of the equipment is as follows;

|  |  |  |
| --- | --- | --- |
| Equipment | Applied to | Details |
| e.g.) sounding tape | e.g.) emissionsources, tanks | e.g.) Measurement equipment specification, maintenance intervals |
|  |  |  |
|  |  |  |
|  |  |  |

The amount of any fuel oil loaded or offloaded should be based on the records of the ship's oil record book. Any supplemental data used for closing identified difference in bunker quantity should be supported with documentary evidence.

In case of a voyage that extends across the data reporting period, the tank reading should occur by tank monitoring at the ports of departure and arrival of the voyage and by statistical methods such as rolling average using voyage days. The Bunker Delivery Note(BDN) is to be included at least the following information in accordance with MAROL Annex VI Appendix 5.

* Name and IMO number of receiving ship
* Port of bunkering
* Date of commencement of delivery
* Name, address and telephone number of fuel oil supplier
* Delivered product name
* Quantity in metric tons
* Density at 15ºC
* Sulfur content, %m/m

Based on the quantities in metric tons above, the total annual amount of oil supply and demand can be calculated.

1. Method “B” : using flow meters

This method determines the total annual amount of fuel oil consumption by measuring fuel oil flows on board with flow meters. Annual fuel oil consumption may be the sum of daily fuel oil consumption data of all relevant fuel oil consuming processes on board measured by flow meters. The flow meters applied to monitoring should be located so as to measure all fuel oil consumption on board and should be identified in this plan. In case of flow meter malfunction, manual tank readings or other alternative methods shall be conducted instead. It should not be necessary to correct this fuel oil measurement method for sludge if the flow meter is installed after the daily tank as sludge will be removed from the fuel oil prior to the daily tank.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Flow meters | Location | Type/Model | Fuel consumer | Fuel oil type |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |

 <Information of flow meters>

|  |  |  |  |
| --- | --- | --- | --- |
|  | Fuel consumer | Fuel oil types | Method to measure |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |
| 4 |  |  |  |

< In case for consumer not monitored with a flow meter >

1. Method “C-1” : using fuel oil tank monitoring(indirect measurement)

This method determines the total annual fuel oil consumption by measuring the remaining amount of the fuel oil tank through indirect reading using an automation systems(remote reading). The total annual consumption is calculated by summing up the measured daily fuel consumption. The measurement of the remaining amount of the tank is normally carried out daily and every time the ship is receiving or discharging fuel oil. A summary of the measurement data, including a record of the measured fuel consumption, shall be provided on board. When a fuel oil purifier is installed, the amount of sludge generated can be reduced from fuel oil consumption.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Equipment | Location | Type | Emission source | Fuel types used |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |

<Information of measuring equipment>

1. Method “C-2” : using fuel oil tank monitoring(direct measurement)

This method determines the residual amount of the fuel oil tank and the total annual consumption of the fuel oil by directly measuring the tank using sounding or dip tapes. Details of the equipment is as follows;

|  |  |  |
| --- | --- | --- |
| Equipment | Applied to | Details |
| e.g.) sounding tape | e.g.) emission sources, tanks | e.g.) Measurement equipment specification, maintenance intervals |
|  |  |  |
|  |  |  |
|  |  |  |

The total annual consumption is calculated by summing up the daily measured fuel consumption. The measurement of the remaining amount of the tank is normally carried out daily and every time the ship is receiving or discharging fuel oil. A summary of the measurement data, including a record of the measured fuel consumption, shall be provided on board. When a fuel oil purifier is installed, the amount of sludge generated can be reduced from fuel oil consumption.

* 1. **Method to measure distance travelled**
1. The distance travelled while the ship is underway under its own propulsion should be included into the aggregated data of distance travelled for the calendar year.
2. Distance travelled over ground in nautical miles should be recorded in the log-book in accordance with SOLAS regulation V/28.13;
3. When the distance travelled is measured using a satellite data, the devices used are as below.

|  |  |  |  |
| --- | --- | --- | --- |
| Device | Location | Type/Model | Alternative method |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |

1. Other methods to measure distance travelled accepted by the Administration may be applied. In any case, the method applied should be described this plan.
	1. **Method to measure hours underway**
2. Hours underway should be an aggregated duration while the ship is underway under its own propulsion.
3. The hours underway should be recorded in the log-book.
	1. **Procedure that will be used to report the data to the Administration**
4. The Master is responsible for reporting the data collected from ship to the company management team.
5. The collected data can be reported in company with the Abstract-LOG(AB-LOG) when the voyage is finished, or it can be reported collectively after the end of the calendar year to the company management team, and the documentary evidence for verification of the data should be reported together.
6. Within three months after the end of each calendar year, the company management team shall report the aggregated value of each data specified in appendix I to its Administration by a standardized format which will be developed by the organization.
7. In the event of the transfer of a ship from one Administration to another, the company management team shall on the day of completion of the transfer or as close as practical thereto report to the losing Administration, the aggregated datum for the period of the calendar year corresponding to that Administration, as specified in appendix I and, upon prior request of that Administration, the disaggregated data.
8. In the event of a change from one Company to another, the company management team before change shall on the day of completion of the change or as close as practical thereto report to its Administration, the aggregated data for the portion of the calendar year corresponding to the Company, as specified in appendix I and, upon request of its Administration, the disaggregated data.
9. In the event of change from one Administration to another and from one Company to another concurrently, paragraph 4 of this regulation shall apply.
	1. **Data quality**

Refer to the following procedure as a measure of controlling data quality.

**(State the identifiable name or number of relevant procedure, if applicable)**

1. Measurement of fuel oil consumption
2. When using method “A”(method of using bunker delivery notes)
3. The tank reading should be carried out at the beginning and the end of the bunkering.
4. The sounding tape to be used is of sufficient length for the height of the tank to be gauged and markings are to be visible. It is not to be kinked or spliced.
5. During a bunkering, even keel should be kept as possible.
6. If fuel oil supplied and actual received differs by more than OO%, process according to the procedure and maintain related records.
7. BDNs are required to be retained on board for three years after the fuel oil has been delivered.
8. In the event of a data gap due to unexpected conditions, the performance manager (shore) communicates its existence to the Chief Engineer who fills the gap once arrival established using the average of the ROB difference between arrival and departure ROBs. He then records the value as an error to the engine log book and communicates this to the Performance Manager (shore).
9. When using method “B”(method of using flow meters)
10. Flow meters shall be periodically calibrated by a specialist at intervals not exceeding OO months.
11. Calibration and maintenance records of the flow meters shall be available on board and shall be kept for a minimum of OO months.
12. The standard error range of the flow meters shall be within O%.
13. In ​​case of failure of the flowmeter, it is possible to replace it by using historical log records in the log-book.
14. When the related data is missing, the Chief Engineer requests to perform as soon as possible tank sounding in order to close the gap. In the case where the missing data is not immediately identified then the responsible Superintended closes the gap manually by using the average fuel consumption of the previous and the next day.
15. When using method “C-1”(method of using indirect measurement for fuel oil tank)
16. The remote reading device shall be periodically calibrated by a specialist at intervals not exceeding OO months.
17. The standard error range of the remote reading device shall be within O%.
18. Calibration and maintenance records of the remote reading device shall be available on board and shall be kept for a minimum of OO months.
19. Fuel oil tanks shall be measured directly on a regular basis to verify the validity of the remote reading device.
20. Measures shall be taken to ensure the validity of the measurements in case of heavy weather.
21. When using method “C-2”(method of using direct measurement for fuel oil tank)
22. The sounding tape to be used is of sufficient length for the height of the tank to be gauged and markings are to be visible. It is not to be kinked or spliced.
23. Measures shall be taken to ensure the validity of the measurements in case of heavy weather.
24. Measurement of distance travelled
25. The distance travelled may be calculated by the two (2) Electronic Chart Display and Information System (ECDIS) which are installed on board per vessel and connected with the two (2) GPS apparatus. The Master reports distance travelled through the daily messages (departure/noon/arrival) and records distance travel on the Log Book.
26. In the event of a data gap related to distance traveled, while using an automated/electronic chart navigation system, the master can fill the gap by means of back-up methods such as terrestrial or celestial navigation being documented in the Deck Log Book.
27. Measurement of hours underway
28. The Master reports the time as per the GPS indications (or the Master Clock(s) / local time zone or GMT) in the Deck Log Book and in the Daily Noon Reports, Arrival and Departure. Time spent at sea is calculated at the end of each voyage and recorded in the voyaged documents.
29. In the event of a data gap related to time spent at sea, the responsible Operator must immediately communicate with the Master and raise the existence of it and close it using the data from the Statement of Facts documents. The data gap can be filled by using the average of the time difference in hours between Arrival and Departure.
30. The data gap can be filled by using the average of the time difference in hours between Arrival and Departure.
	1. **Direct CO2 Emissions Measurement**

Direct CO2 emission measurement is not required by regulation 22A of MARPOL Annex VI, but if direct CO2 emission measurement is used, it should be as follows.

1. This method is based on the determination of CO2 emission flows in exhaust gas stacks by multiplying the CO2 concentration of the exhaust gas with the exhaust gas flow. In case of the absence or/and breakdown of direct CO2 emissions measurement equipment, manual tank readings will be conducted instead.
2. The direct CO2 emissions measurement equipment applied to monitoring is located exhaustively so as to measure all CO2 emissions in the ship.
3. The measurement device shall be periodically calibrated by a specialist at intervals not exceeding OO months.
4. The standard error range of the measurement device shall be within O%.
5. Calibration and maintenance records of the measurement device shall be available on board and shall be kept for a minimum of OO months.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Device | Location | Model/Type | Fuel Consumer | Fuel oil used |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |

<Information of CO2 measurement device>

# **APPENDIX I**

**A STANDARDIZED DATA REPORTING FORMAT**

|  |  |
| --- | --- |
| Method used to measure fuel oil consumption9  |  |
| Fuel oil consumption (t)  | Other (……….)  |  |
| (Cf ;…..)  |  |
| Ethanol (Cf: 1.913)  |  |
| Methanol (Cf: 1.375)  |  |
| LNG (Cf: 2.750)  |  |
| LPG (Butane) (Cf: 3.030)  |  |
| LPG (Propane)  |  |
| HFO (Cf: 3.114)  |  |
| LFO (Cf: 3.151)  |  |
| Diesel/Gas Oil (Cf: 3.206)  |  |
| Hours underway (h)  |  |
| Distance Travelled (nm)  |  |
| Power output(rated power) of M.E. and A.E.(kW)8  | Auxiliary Engine(s)  |  |
| Main Propulsion Power  |  |
| Ice class7 (if applicable)  |  |
| EEDI (if applicable)6 (gCO2/t.nm)  |  |
| DWT5  |  |
| NT4  |  |
| GT3  |  |
| Ship type2  |  |
| IMO number1  |  |
| End date (dd/mm/yyyy)  |  |
| Start date (dd/mm/yyyy)  |  |

Note:

1. In accordance with the IMO Ship Identification Number Scheme, adopted by the Organization by resolution A.1078(28).
2. As defined in regulation 2 of MARPOL Annex VI or other (to be stated).
3. Gross tonnage should be calculated in accordance with the International Convention on Tonnage Measurement of Ships, 1969.
4. NT should be calculated in accordance with the International Convention on Tonnage Measurement of Ships, 1969. If not applicable, note "N/A".
5. DWT means the difference in tonnes between the displacement of a ship in water of relative density of 1025 kg/m3 at the summer load draught and the lightweight of the ship. The summer load draught should be taken as the maximum summer draught as certified in the stability booklet approved by the Administration or an Organization recognized by it.
6. EEDI should be calculated in accordance with the 2014 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships, as amended, adopted by resolution MEPC 245(66). If not applicable, note "N/A".
7. Ice class should be consistent with the definition set out in the International Code for ships operating in polar waters (Polar Code), adopted by resolutions MEPC.264(68) and MSC.385(94)). If not applicable, note "N/A".
8. Power output (rated power) of main and auxiliary reciprocating internal combustion engines over 130 kW (to be stated in kW). Rated power means the maximum continuous rated power as specified on the nameplate of the engine.
9. Method used to measure fuel oil consumption: 1: method using BDNs, 2: method using flow meters, 3: method using bunker fuel oil tank monitoring.

# **APPENDIX II**

**Resolution MEPC.282(70)**

**Refer to the attached document**