

# SHIP ENERGY EFFICIENCY MANAGEMENT PLAN

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**KEYWORDS--Exergy, energy, efficiency, losses, energy conversion, design, operation, procedures, flow sheet, analysis, waste heat recovery, engine optimisation, fuel oil system, cooling system, lube oil system, lube oil purification system.**

## I. INTRODUCTION

In the modern Shipping we are concerned with sustainable and environmental friendly transportation of goods through ships. Thus, saving of fuel is the main prospect to meet all the environmental challenges faced by modern Shipping industry . SEEMP or Ship Energy Efficiency Management Plan provide various measures and aspects to save fuel in each of the systems which are contributing towards propulsion of ocean going vessels. Therefore we are here to create an environmental awareness.

Energy saving technologies keep improving faster than they are applied, so efficiency is an ever larger and cheaper resource available.

As far as shipping is concerned the objective so far was : Safe ships & Clean oceans. As world is upgrading the vision of IMO at present : Safe, secure, environmently sound, efficient and sustainable shipping through co-operation. Which is now achieved by SEEMP as an energy efficient tool for ship owners.

Going through the content we deal with how SEEMP being applied on ships with case study and with energy analysis of MAN B&W engine, ending with conclusion and references.

*Ship energy efficiency*



In this we define the framework of basic concepts and challenges related to ship energy efficiency and improvement in energy conversion of the input we have applied and the output produced by the various systems onboard.

*Pathways to improve efficiency*

As the modern ships more complex the pathways towards increase in efficiency also its complexity and are interrelated. Thus the pathways towards increase in efficiency are divided into three sectors which are DESIGN , OPERATION and PROCEDURE under which various aspects are as follows-

1] HULL OPTIMISATION-

Which can be done by Air lubrication also known as BUBBLE TECHNOLOGY.

2] PROPULSION EFFICIENCY DEVICES-

By the use of HI-FN which is used by HUYNDAI HEAVY INDUSTRIES already on 1,62,000 meter cube LNG CARRIER

3] DC GRID SYSTEMS-

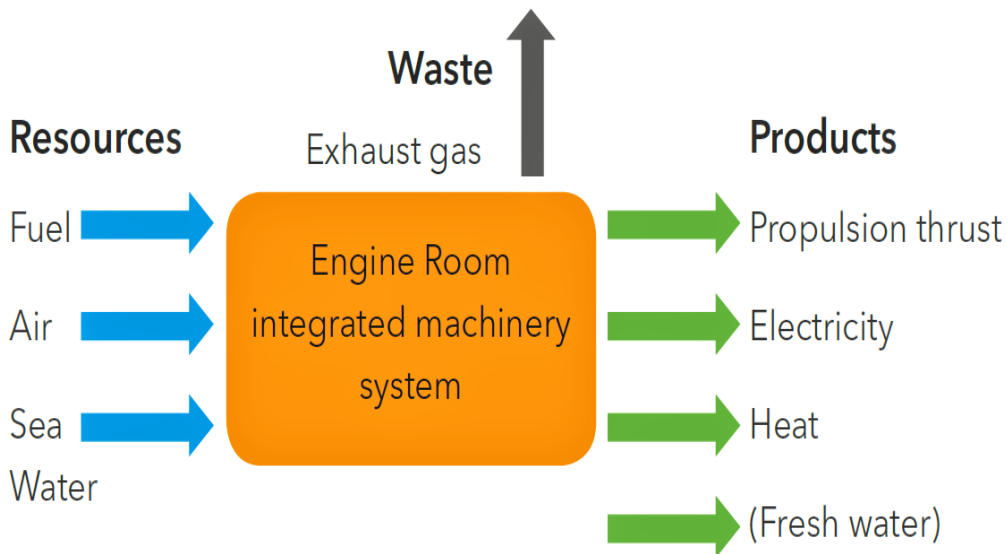
Which allows the engine to run at variable speed depending upon load.

#### 4] SPEED CONTROL OF PUMPS AND FANS-

Can be achieved by VFD coupled with IE3 motors.

The other aspects are as crew awareness, aux. engine economisers ETC.

#### *BLACK BOX DIAGRAM OF ENGINE ROOM MACHINERY*



The black box diagram or functional diagram of an engine room machinery system excluding cargo equipment and accommodation which include resources such as fuel, air and seawater in order to obtain products such as propulsion, electrical, heat used for heat exchangers and coolers and freshwater.

#### *NEXT GENERATION ENERGY MANAGEMENT SYSTEM*

With reference to the example given before we have 7 methodological steps regarding next generation energy management plan. The steps which include in this system are :

- 1] IDENTIFY THE SHIP SYSTEM TO BE ANALYSED.
- 2] CREATE SYSTEM DATA FLOWSHEET.
- 3] EXCESS DATA AVAILABILITY AND IDENTIFY GAPS.
- 4] RECONCILE DATA USING LATEST SOFTWARE CALLED DNV COSMOS.
- 5] PERFORM EXERGY AND ENERGY ANALYSIS.
- 6] COMPONENT, PROCESS AND SYSTEM METRICS.
- 7] MAP EXERGY LOSSES & IDENTIFY IMPROVEMENT AREAS.

#### *WASTE HEAT RECOVERY SYSTEMS COUPLED WITH DNV COSMOSS*

The WHR or waste heat recovery system are the most promising solutions for efficient, cost effective and environment friendly solutions for propulsion and power generation on ocean going vessels. Many simulation, techno-economical and modelling have been done to develop a new WHR system coupled with latest software called DNV-COSMOSS.

This software is developed by DNV GL strategic research & innovation. This computer platform that models, simulates and optimises complex and integrated ship machinery systems with respect to energy efficiency, emissions, costs and safety. With this software we would be able to analyse alternative configuration in new vessels, perform assessment & optimisation in ships in operating systems and evaluate the potential of new technologies.

## EXERGY AND ENERGY ANALYSIS OF THE MAIN ENGINE SUBSYSTEMS OF AN AFRAMAX TANKER

If 85 MW of fuel input is being given than we obtain the following data :

- 1] 39.6 MW of energy is being used for propulsion.
- 2] 38.7MW is the EXERGY destroyed .
- 3] 3.1 MW is used for electricity generation .
- 4] 3.5 MW is the losses in the environment.

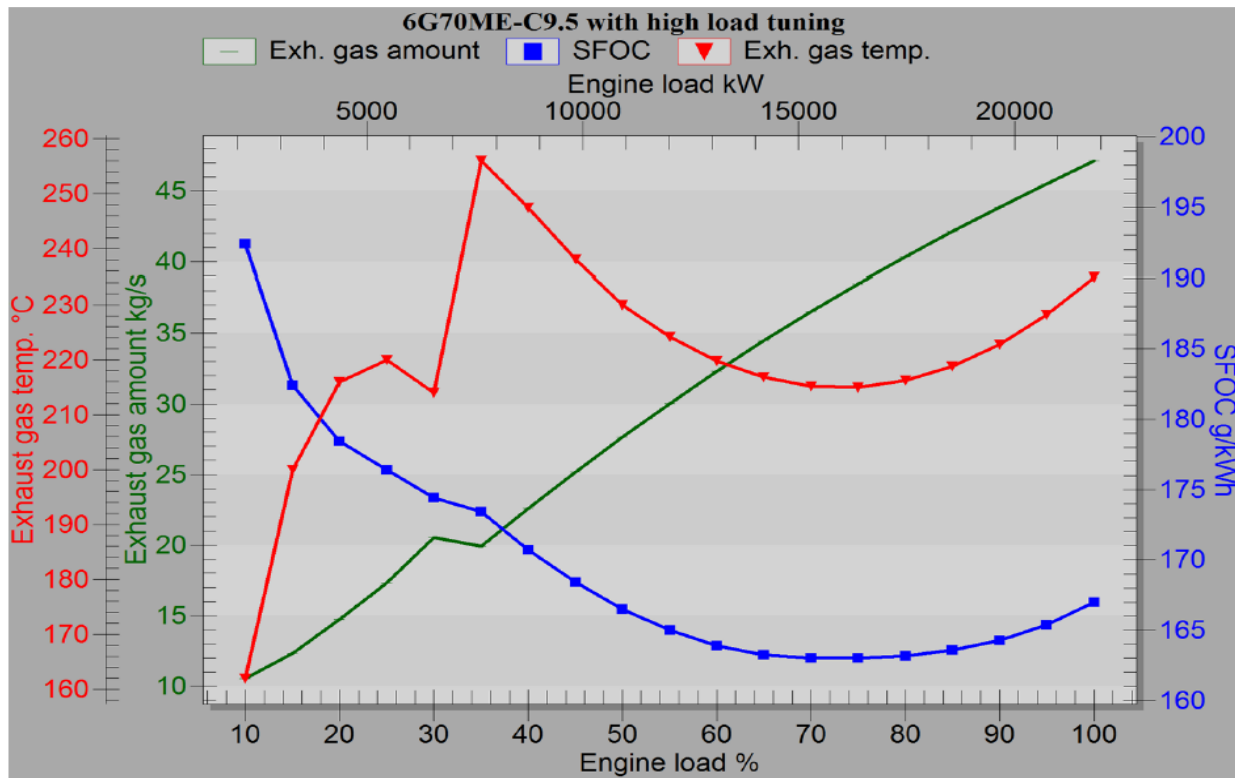
The top 5 components which contribution towards EXERGY losses are as follows –

- 1] Combustion block: 81.78%
- 2] Exhaust gas systems: 6.11%
- 3] Turbocharger: 3.68%
- 4] Charger air cooler: 2.20%
- 5] Steam turbines: 1.69%

NOTE = further optimisation of turbocharger with engine matching gives us the further fuel saving of +1% .

### MAN B&W ANALYSIS

ENERGY ANALYSIS OF MAN B&W 6G70ME-C9.5 ENGINE. Her we discuss how to optimise main engine. A report made by Computerised Engine Application System shows in detail various aspects of the main engine, and the specifications of various system adopted with this engine. As we are more concerned about SFOC , our motive is to conserve energy and to optimise the operation of the engine we should operate the engine between 60-85% of engine load to minimise SFOC.



Load % SMCR	Power kW	Speed r/min	SFOC g/kWh	Exh. gas kg/s	Exh. gas <sup>1)</sup> °C	Steam <sup>2)</sup> kg/h
100	21,840	83.0	167.0	47.1	235	3,550
95	20,748	83.0	165.4	45.5	228	2,950
90	19,656	83.0	164.3	43.9	223	2,470
85	18,564	83.0	163.6	42.1	219	2,110
80	17,472	83.0	163.2	40.4	216	1,850
75	16,380	83.0	163.0	38.5	215	1,690
70	15,288	83.0	163.0	36.5	215	1,620
65	14,196	83.0	163.2	34.5	217	1,610
60	13,104	83.0	163.9	32.3	220	1,670
55	12,012	83.0	165.0	30.0	224	1,760
50	10,920	83.0	166.5	27.7	230	1,870
45	9,828	83.0	168.4	25.2	238	2,020
40	8,736	83.0	170.7	22.6	248	2,150
35	7,644	83.0	173.4	19.9	256	2,160
30	6,552	83.0	174.4	20.5	214	870
25	5,460	83.0	176.4	17.3	220	900
20	4,368	83.0	178.4	14.7	216	670
15	3,276	83.0	182.4	12.3	200	250
10	2,184	83.0	192.4	10.6	162	0

### IMPROVED CENTRAL COOLING WATER SYSTEM

The efficiency improvements in a typical central cooling system gives us the total savings of 84 tons per year by adopting VFD operated sea water pump.

By adopting 5% higher mechanical efficiency devices gives us the total savings of 26 tons per year.

By using 2.3% higher efficiency motors we saved 10 tons per year.

By adopting VFD drives in both the pumps we saved 144 tons per year.

### IMPROVED MAIN ENGINE FUEL OIL SERVICE SYSTEM

The various efficiency improvements in typical main engine fuel oil service system saves us the total saving of 6 tons per year by adopting VFD operated supply pump.

By using two speed VFD operated circulating pump gives us the total savings of 1 tons per year.

By using VFD operated circulating pump depending upon the main engine FO consumption gives us the total savings of 7 tons per year.

By adopting VFD drives in both the pumps we saved 12 tons per year.

### IMPROVED MAIN ENGINE LUBE OIL SYSTEM

The energy efficiency improvements in typical lube oil system is by compact designing and laying pipeline by reducing bends ,thus reducing the pressure head in the system. Also by adopting higher efficiency pump and premium efficiency IE3 motor drive for lube oil pump our total annual HFOC saving would be 48 ton per year. Improvements are also brought up in lube oil purification system by installing a lube oil pre heater in addition to lube oil steam heater, where the dirty lube oil is heated by the clean lube coming after purification at 95 degree celcius. Thus the requirement of steam is reduced drastically since the lube oil is pre heated. By this method we save 39 ton of HFO per year. Therefore the total HFOC saving in lube oil system is 87 ton per annum.

## CONCLUSION

IMO stresses on energy analysis on onboard vessels.

SEEMP act as an effective and energy efficient and effective tool for ship owners .

Saving every KW ensures lower carbon-dioxide emissions.

Objective is to achieve SAFE , GREENER and SMARTER SHIP ENERGY SYSTEMS.

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## ACKNOWLEDGEMENT

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We hereby thank DNV , MAN B&W and all our faculty members of Vels University – School Of Maritime Studies , for providing an essence of effort in getting us prepared.We also thank a lot to TOLANI MARITIME INSTITUTE for giving us an opportunity to deliver our paper presentation work.

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## REFERENCE

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DNV.GL George Dimopoulos, PhD - Nikolaos Kakalis, PhD LONDON, 9 APRIL 2014.

MAN DIESEL & TURBO ( using CEAS a report done by us) [www.mandieselturbo.com](http://www.mandieselturbo.com)

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