BACHELOR THESIS & COLLOQUIUM – ME184841

IMPLEMENTATION OF ENERGY EFFICIENCY OPERATIONAL INDICATOR (EEOI) FOR BENCHMARKING SHIP ENERGY EFFICIENCY BASED ON CO2 EMMISION IN INDONESIAN MERCHANT SHIP

SANDY NAUFAL HIBATULLAH
NRP. 04211541000004

SUPERVISOR :
Ir. Hari Prastowo, M.Sc.
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SKRIPSI – ME184841

IMPLEMENTASI *ENERGY EFFICIENCY OPERATIONAL INDICATOR (EEOI)* UNTUK *BENCHMARKING* EFISIENSI ENERGI KAPAL BERDASARKAN EMISI CO2 PADA KAPAL NIAGA INDONESIA

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2019

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APPROVAL FORM

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BACHELOR THESIS

Submitted to Comply One of the Requirements to Obtain Bachelor Engineering Degree

on

Marine Operational and Maintenance (MOM)
Bachelor Program Department of Marine Engineering
Faculty of Marine Technology
Institut Teknologi Sepuluh Nopember

Prepared by:
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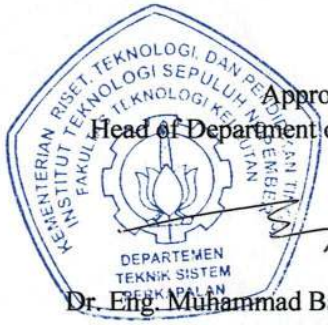

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DECLARATION OF HONOR

I hereby who signed below declare that:

This bachelor thesis has written and developed independently without any plagiarism act. All contents and ideas drawn directly from internal and external sources are indicated such as cited sources, literatures and other professional sources.

Name	: Sandy Naufal Hibatullah
NRP	: 04211541000004
Bachelor Thesis Title	: Implementation of Energy Efficiency Operational Indicator (EEOI) for Benchmarking Ship Energy Efficiency Based on CO2 Emission in Indonesian Merchant Ship
Department	: Marine Engineering

If there is plagiarism act in the future, I will responsible and receive the penalty given by ITS according to the regulation applied.

Surabaya, July 2019

Sandy Naufal Hibatullah

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IMPLEMENTATION OF ENERGY EFFICIENCY OPERATIONAL INDICATOR (EEOI) FOR BENCHMARKING SHIP ENERGY EFFICIENCY BASED ON CO2 EMISSION IN INDONESIAN MERCHANT SHIP

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ABSTRACT

Since the development of diesel engine, maritime industry always shows an upward trend. This has consequences of increasing the amount of air pollutant, specifically CO_2. As the global authorities, IMO taking an action written in MEPC 304(72) to reduce greenhouse gas emission. This research purpose to make implementation of Energy Efficiency Operational Indicator (EEOI), as written in MEPC 282(70) that part of Ship Energy Efficiency Management Plan (SEEMP) in MV Meratus Bontang and MV Meratus Benoa and benchmark the efficiency. Using fuel oil estimation method proposed by Trozzi, Jalkanen, Wang, and Mersin to estimate the fuel consumption and compare them with actual fuel monitoring by ship's bunker report, resulted error 100,53%, 24,3%, 18,44%, and 75889%. Mersin method then modified and resulted error 36,22%. Average EEOI index for MV Meratus Bontang is 0,000473 tonCO_2/TEUS.nm and MV Meratus Benoa 0,000630 tonCO_2/TEUS.nm. Result from benchmarking indicated that in MV Meratus Benoa has lower operational efficiency than MV Meratus Bontang. MV Meratus Bontang carried more average cargo in voyage route Surabaya-Semarang and Surabaya-Sampit. From average total fuel oil consumption, MV Meratus Benoa has more fuel oil consumption in voyage route Surabaya-Sampit, Surabaya-Kumai, and Semarang-Kumai. The proposed improvement in EEOI for MV Meratus Bontang and MV Meratus Benoa is by improving ship cargo management for shipping efficiency. While for MV Meratus Benoa, checking of operational aspect is needed especially on machinery system and hull conditions.

Keywords: EEOI, Efficiency Benchmarking, Fuel Oil Consumption Method Comparison

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ABSTRAK

Sejak pengembangan mesin diesel, industri maritim selalu menunjukkan tren kenaikannya. Hal tersebut memiliki konsekuensi peningkatan jumlah polutan di udara, khususnya CO_2. Sebagai otoritas internasional, IMO mengambil tindakan yang tertulis dalam MEPC 304(72) untuk mengurangi emisi gas rumah kaca. Penelitian ini bertujuan untuk mengimplementasikan *Energy Efficiency Operational Indicator* (EEOI), seperti yang tertulis dalam MEPC 282(70) yang merupakan bagian dari *Ship Energy Efficiency Management Plan* (SEEMP) pada MV Meratus Bontang dan MV Meratus Benoa dan membandingkan keefisiensian energinya. Menggunakan metode estimasi bahan bakar yang dirumuskan oleh Trozzi, Jalkanen, Wang, dan Mersin untuk memperkirakan konsumsi bahan bakar dan membandingkannya dengan laporan bahan bakar aktual, menghasilkan *error* 100,53%, 24,3%, 18,44%, dan 75889%. Metode Mersin kemudian dimodifikasi dan menghasilkan *error* 36,22%. Indeks EEOI rata-rata untuk MV Meratus Bontang adalah 0,000473 tonCO_2/TEUS.nm dan MV Meratus Benoa 0,000630 tonCO_2/TEUS.nm. Hasil dari *benchmarking* menunjukkan bahwa MV Meratus Benoa memiliki efisiensi operasional yang lebih rendah dari MV Meratus Bontang. MV Meratus Bontang mengangkut lebih banyak kargo rata-rata dalam rute pelayaran Surabaya-Semarang dan Surabaya-Sampit. Dari rata-rata konsumsi bahan bakar, MV Meratus Benoa mengonsumsi bahan bakar lebih banyak pada rute pelayaran Surabaya-Sampit, Surabaya-Kumai, dan Semarang-Kumai. Usulan peningkatan EEOI untuk MV Meratus Bontang dan MV Meratus Benoa adalah dengan memperbaiki pengelolaan manajemen kargo untuk efisiensi pengiriman. Sedangkan untuk MV Meratus Benoa, pengecekan terhadap aspek operasional diperlukan terlebih pada sistem permesinan dan kondisi lambung kapal.

Kata Kunci: EEOI, Benchmarking Efisiensi, Perbandingan Estimasi Konsumsi Bahan Bakar

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PREFACE

All praise I say to the Almighty God, because with all of his creations the author can start, work and finish this bachelor thesis.

For me, this bachelor thesis represent my desire to contribute to the maritime development for the sake of all humankind with their environment surroundings. Nowadays, global warming and climate change become an actual issue to be discussed in global forums. As humans, we have to realize that the earth is the only place we live. Because of that, we must understand the magnitude of our responsibility and this research is our small effort for our better living in future generation.

In truth, this thesis cannot be completed without the help of others. The author would like to acknowledge to the people who helped in the process of this bachelor thesisn among others:

1. Author's Parents, especially my Mother for all their unconditional love and support.
2. Ir. Hari Prastowo, M.Sc and Dr.Eng. Trika Pitana, S.T., M.Sc. as a supervisors for this research.
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11. All Marine Engineering Students batch 2015 (Salvage 2015) which is where the writer grows and develops, and batch 2016 (Voyage 2016) who always give their support to author.

As an author, I realized there were some shortcomings in the preparation of this thesis. But I hope this work can be useful for further research. I feel honored for this opportunity. Any criticisms and suggestions that are built from the readers will be very expected. Finally, thank you for being our readers and I hope you enjoy reading this bachelor thesis.

Surabaya, July 2019

Author

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CHAPTER I
INTRODUCTION

1.1. Background

The interaction between human and maritime world are began from ancient era. Maritime nowadays is the front guard of the global trading. Since the replacement of sails by steam in 19th century and diesel engine in 1912 created new trend by using diesel as prime mover, the development of the maritime industry always shows an upward trend. By Development of technology in shipping industry, made it growing faster with import increasing from 500 million tons in 1950 to 7 billion tons in 2005 as shown in figure 1.1 (Stopford, 2009).

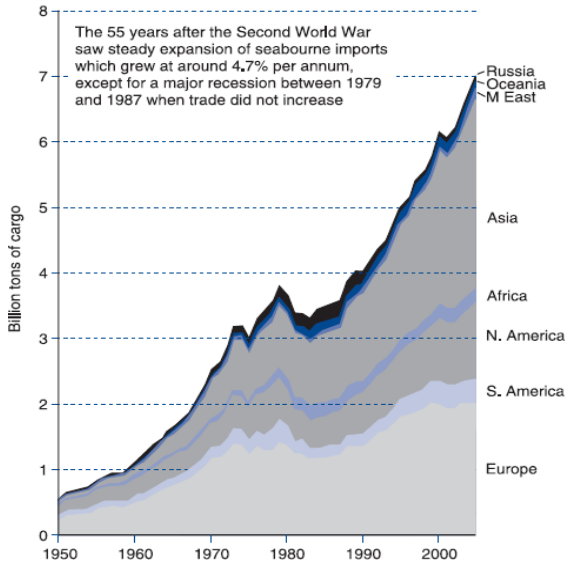

Figure 1.1 Development of Sea Trading by Region
Source: (Stopford, 2009)

In line with that causes, the increase in the number of ships has the consequence of increasing the amount of air pollution. IMO as global authorities for maritime activities published the research about greenhouse gas by the ship from international shipping for bulk carrier, container ship, tankers, vehicle carrier, Ro-Ro, general cargo, ferry, and cruise ship (International Maritime Organization, 2015).

Human good faith in environmental conditions makes IMO establish MEPC (Marine Environment Protection Committee) in purpose to control and prevent of ship-source pollution covered by the MARPOL treaty, including oil, chemicals carried in bulk, sewage, garbage and emissions from ships, including air pollutants and greenhouse gas emissions.

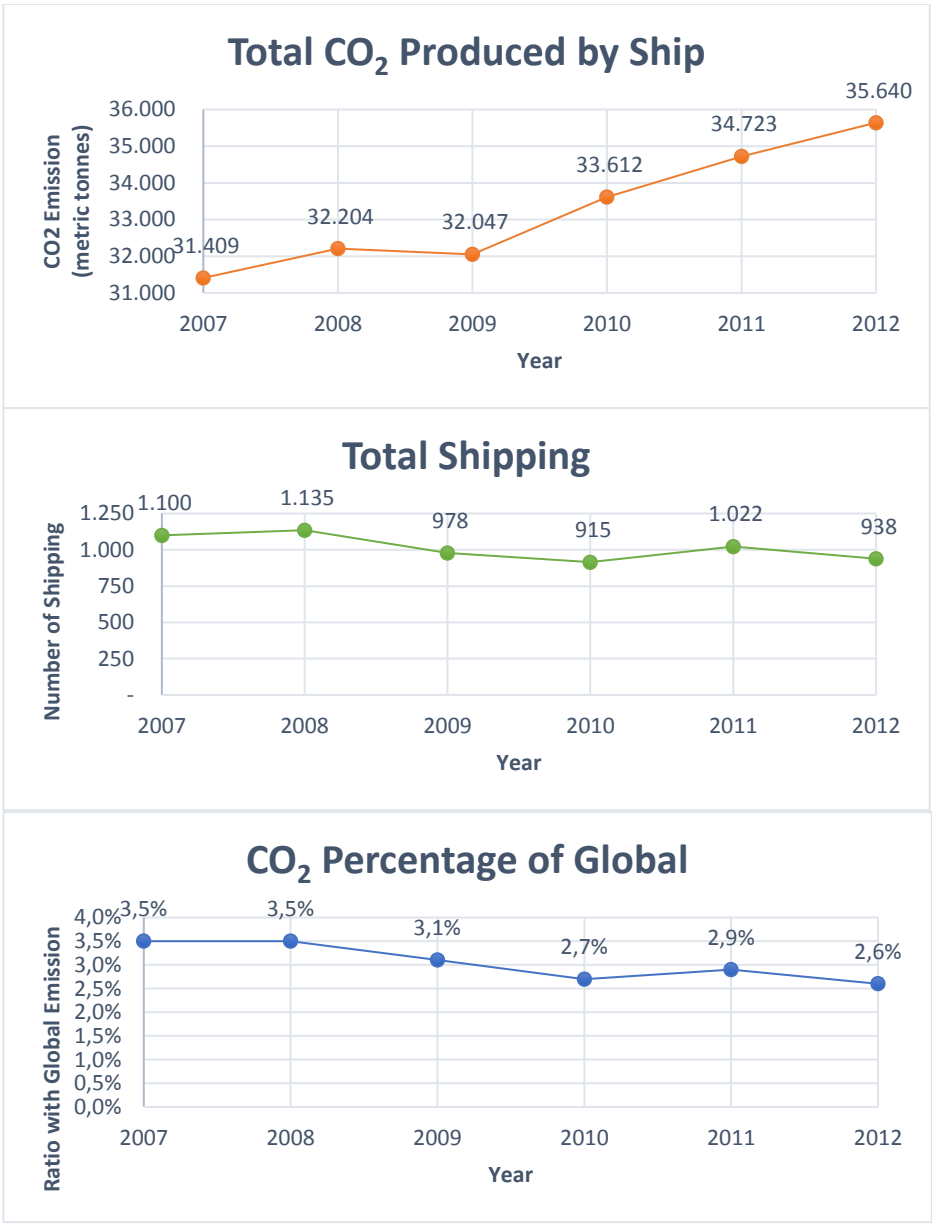

Figure 1.2 Condition of Greenhouse Gas Producing by Ship, Total Shipping, and Contribution of Ship Greenhouse Gas Compared to Global
Source: (International Maritime Organization, 2015)

IMO have a vision written in Resolution MEPC 304(72) to reduce GHG emission from international shipping and aims to phase them out as soon as possible in this century. IMO projected in 2050 total annual GHG emission at least 50% compared to 2008 following Paris Agreement about climate change. This resolution supported

with Resolution MEPC 282(70) which contains the guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP). The framework and structure of SEEMP contain *Planning*, *Implementation*, *Monitoring*, and *Self-evaluation and Improvement*. Specific on monitoring, there is a tool developed by MEPC: EEOI (Energy Efficiency Operational Indicator). EEOI developed to obtain a quantitative indicator of energy efficiency of a ship or fleet in operation.

In order to achieve the global desire for greenhouse gas reduction, subject of the shipping industry need to take a part to implement resolution by IMO. From MEPC 282(70) the implementation method is returned up to the subject of the shipping industry, because of that it requires support by the shipping company. The further of this research is to make implementation of EEOI in Indonesian shipping company to benchmark the efficiency of the energy and for the monitoring of shipping fleet.

1.2. Problem Analysis

Based from the background, the idea of problem that possible to be discussed for further research and study are:

1. How to do measurement of EEOI in merchant ships?
2. Which one the most accurate method to estimate fuel consumption?
3. What is current condition of ship efficiency based on EEOI index calculation?
4. How to do benchmarking the result of EEOI from ships?
5. What the possible improvement to rising efficiency based on EEOI index?

1.3. Scope and Limitation

This proposal of Bachelor Thesis needs some scoping for research with the consideration of the effectivity of the research by the fund, time, and limitation in interaction between scientific fields. The scopes of problems are:

1. Research based on monitoring method analysis of SEEMP focused on CO_2 production as an energy efficiency indicator.
2. Monitoring done in Container Ship.
3. Research will be carried out in MV. Meratus Bontang and MV. Meratus Benoa owned by PT. Meratus Line shipping company.
4. Fuel oil estimation method using formula proposed by Trozzi et al, Jalkanen et al, Wang et al, and Mersin et al.

1.4. Objective

The purpose that aimed from this Bachelor Thesis are:

1. Develop step method for calculating EEOI in merchant ship
2. To know the most accurate approach method for fuel consumption
3. Measuring the EEOI on merchant ship and analyze the index in scope of time
4. Implement EEOI for the Benchmarking ship efficiency condition
5. To propose possible improvement for rising efficiency of ship based on EEOI index

1.5. Benefit

The benefits from this Bachelor Thesis are to:

1. Method of calculation can be further implemented to be algorithm to calculate EEOI using integrated system
2. Reference for implementation of fuel oil consumption method in Container Ship
3. As a pioneer to implement EEOI and evaluation of ship GHG production in Indonesia
4. Can be used as a scientific reference about Energy Efficiency and Green House Gas production from a ship
5. As a reference in improving ship energy efficiency to reduce fuel oil consumption in ship operation
6. As a reference in improving operation efficiency to reduce CO_2 production by ship's machineries.

1.6. Systematics of Writing

The systematics of writing for this Bachelor Thesis are followings:

- **Chapter I : Introduction**
  Explanation of the background and reason why this research is reasonable to be done, problems formulation from the background, the objective to be achieved by doing this research, benefits, and scope of the research.
- **Chapter II : Literature Reviews and Basis Theory**
  This section explains the basic theory of the research
- **Chapter III : Writing Methodology**
  This section explains the steps for conducting research by flowchart and detailed arrangement of methodology to make the research systemically done
- **Chapter IV : Analysis of Result and Discussion**
  This section explains the result of the research
- **Chapter V : Closing**
  This section concludes the research based on the objective of the research

CHAPTER II
LITERATURE REVIEWS AND BASIC THEORY

2.1. Problem Overview

Paris Agreement which discuss about global climate change undertake ambitious effort to make movement against the rising temperature of earth. Paris Agreement central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century below 2 degrees Celsius above pre-industrial level and pursue efforts to limit the temperature increase even further to 1,5 degrees Celsius (United Nations Framework Convention on Climate Change, 2015). Paris agreement enter into force on 4 November 2016 and Indonesia, as the member of United Nations, ratified it at 31 October 2016.

This agreement forces the IMO as the global organization for maritime to give attention due to the greenhouse gas production from vessels. In response to that, IMO with MARPOL Annex VI regulation by MEPC (Maritime Environment Protection Committee) establish the program to reduce greenhouse gas by maritime industry, especially from ship operation.

IMO published Third IMO Greenhouse Gas Study in year 2014. Before this study, IMO already published Second Study in 2009. The aim of this study is to understand the up-to-date information to support IMO policy decision. The study conducted in two methods: top-down and bottom up. Top-down method approach is explicit in the fuel sales statistic from International Energy Agency (IEA). Bottom-up method using individual fuel consumption estimation in each operating ship.

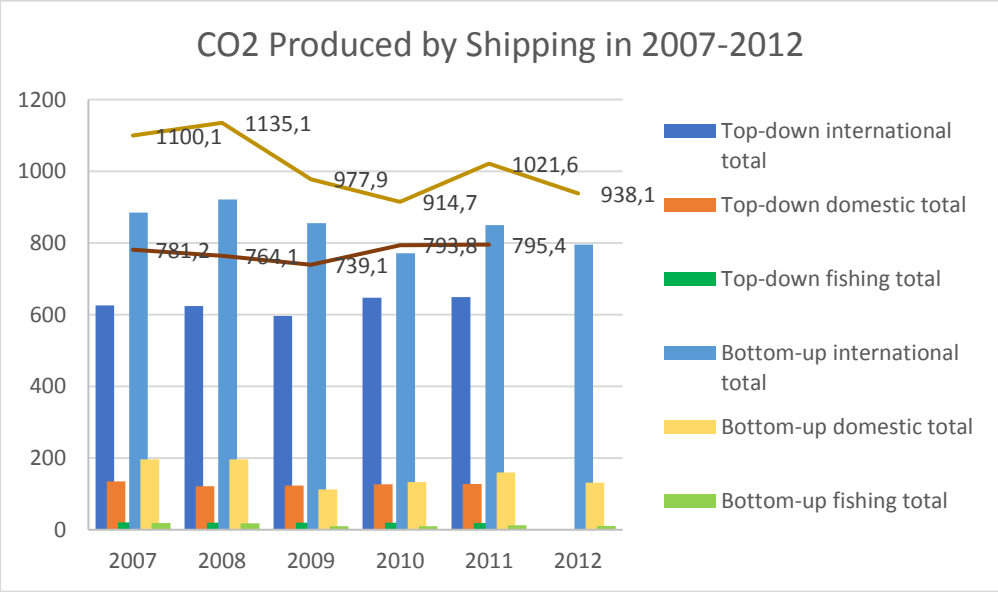

Figure 2.1 Graphic of CO2 Production, Study by IMO
Source: (International Maritime Organization, 2015)

By the data of greenhouse gas study, IMO establish regulation for monitoring ship performance. IMO stated that energy efficiency of ship should be monitored quantitatively. Energy Efficiency Operational Indicator (EEOI) introduced by IMO to internationally standard of efficiency calculation. EEOI need continuous data collection. Because of that, IMO give a mandate on this method to be implemented by shipping company.

2.2. Ship Operation Products

In general, ship operation disposes exhaust gas, sewage, garbage, bilge and oil sludge, and ballast. All these products by every single ship creates problems if there is no further treatment. In case of this problems, the International Maritime Organization (IMO) has made regulations in International Convention of Marine Pollution from Ships of 1973 Annex I – VI . Regulations from IMO apply internationally, and the mandate of implementation given to the several authorities in national and international: classification society, port-state, flag-state, and trade association.

IMO stated that exhaust emission is any substance which, if introduced into the sea or atmosphere, is liable to create hazards to human health, ecosystems, or marine life, to damage amenities, or to interfere with other legitimate uses of the sea (MARPOL 73/78 , 2005). Focused in air pollutant, there are many substances produced by ship that affect the air condition.

a. Carbon Dioxide (CO_2)
   Carbon dioxide produced by diesel engine by perfect combustion process. The carbon dioxide was formed from the fuel which contain carbon and hydrogen elements and reacted with oxygen. Energy release from the chemical reaction between fuel and oxygen (and heat as an energy) consequently produce carbon dioxide (CO_2) and water vapor (H_2O). This carbon monoxide is non-combustible substance and because of this CO_2 from combustion need to be taken of from the combustion chamber. The exhaust from this combustion which later become greenhouse gas for the atmosphere.
b. Carbon Monoxide (CO)
   Carbon monoxide is well known as the product of the unperfect combustion. CO substance generated by the combustion which has lack of air. It happens inside the combustion chamber which has a problem with the operation. The lack of oxygen forces the amount of fuel (C_xH_y) to combust with insufficient oxygen (O_2).
c. Sulphur Oxides (SO_x)
   Sulphur content comes from the fuel and develops by the combustion of the fuel with air. Sulphur oxides formed in SO2 and SO3. Sulphur oxides are not harmful for environment. The bad news from Sulphur oxide is can develop high-temperature corrosion. Sulphur oxide become harmful for environment when reacted with the water and the product is sulfuric acid.
d. Nitrogen Oxides (NO_x)
   The source of nitrogen in exhaust gas is from the intake air. Air in atmosphere contain 78% of nitrogen, 20% of oxygen, and 2% is another substance. The

oxidation of this nitrogen creates nitrogen oxides. The oxidation process supported by the high temperature. Inside the combustion chamber, the formation of nitrogen oxides depends on local temperature, local oxygen partial pressure, and the time available (Ackermann, 2009).

e. Hydrocarbons (HC)
Hydrocarbons content in exhaust gas formed because of the incomplete burned fuel. Some of hydrocarbon can be dissolved in lubricating oil but most of them flowed out from combustion chamber by exhaust gas. Hydrocarbons contains unburned fuel component and contain partially oxidized compounds for example is formaldehyde and acetaldehyde. At high concentration, this side product harms the health of the humans. The white smoke can signify the exhaust contain hydrocarbons.

f. Particulates
The other emission by exhaust gas is a particle. Common particle that exit from the exhaust gas is carbon, mineral constituent, ashes, and metals. Most of particle are in micron size and because of their light weight, it can be transported by air to several distances. The size and substance are depending on the fuel composition used by the engine and the quality of combustion.

2.3. Ship Engine

Every ship in nowadays using principal of energy conversion for operational. In early of shipping industry, engineers designed steam turbine as main engine for ship. In late technology they installed diesel engine as replacement for steam engine. In other specific case, gas turbine installed on ship in order to fulfil specification of the ship, especially for speed and reliability.

Nowadays, diesel engine is one typical prime mover installed on ship. The main principle of diesel engine using fuel ignition inside combustion chamber to produce energy. With mixture with oxygen, fuel can be ignited and produce energy by chemical reaction. In every perfect combustion will create chemical reaction as follow:

$$\mathbf{C_xH_y + O_2 \rightarrow CO_2 + H_2O + Energy}$$

In internal combustion process, the fuel will be injected and ignited inside combustion chamber by process of work. In four stroke diesel engine there are four step (stroke) are passed to make one cycle of engine energy conversion. Piston as an energy receiver from combustion process, move in four steps: suction, compression, expansion, and exhaust). Therefore, it takes two turn of the crankshaft to done one cycle of four stroke engine.

2.4. Energy Efficiency Operational Indicator (EEOI)

EEOI is the monitoring tool that can be performed to measure the fuel efficiency of a ship. Besides that, EEOI index also can be use as measuring tool for effect of any changes in operation. The EEOI is a tool developed by MEPC which is a part of Ship Energy Efficiency Management Plan (SEEMP).

Ship Energy Efficiency Management Plan is an operational measure that establishes a mechanism to improve the energy efficiency of a ship in cost-effective manner. SEEMP designed to be implemented both in a new and existing ship. Until the time this research was conducted, SEEMP mandatory to be utilized by shipping company.

The complexity of shipping operational effectivity encourages the IMO to establish the guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP) (MEPC.282(70), 2016). This guideline has been developed to assist the preparation of SEEMP required by regulation 22 or MARPOL Annex VI. SEEMP guidelines part I develop a framework and structure of SEEMP there are planning, implementation, monitoring, and self-evaluation & improvement.

Monitoring part in SEEMP framework, stated that energy efficiency of a ship should be monitored quantitatively. Which means there is some calculation needed to know the qualitative value of energy efficiency. The EEOI developed in purpose to make international standard for energy efficiency calculation. EEOI could be considered as the primary tool for monitoring, but other quantitative measure also may be appropriate. The EEOI calculation was based on Guidelines for voluntary use of the Ship Energy Efficiency Operational Indicator (EEOI) (MEPC.1/Circ.684, 2009).

Basic of EEOI defined the ratio of mass of CO_2 (M) emitted per unit of transport work**.** Detailed by the formula given by MEPC.1/Circ.684

$$\boldsymbol{EEOI} = \frac{\sum_j \boldsymbol{FC_j} \times \boldsymbol{C_{Fj}}}{\boldsymbol{m_{cargo}} \times \boldsymbol{D}} \quad (1)$$

$$\boldsymbol{Average\ EEOI} = \frac{\sum_i \sum_j (\boldsymbol{FC_{ij}} \times \boldsymbol{C_{Fj}})}{\sum_i (\boldsymbol{m_{cargo}} \times \boldsymbol{D})} \quad (2)$$

Where:

j = fuel type
i = voyage number
FC_{ij} = mass of consumed fuel j at voyage i
C_{Fj} = fuel mass to CO_2 mass conversion factor of fuel j
m_{cargo} = cargo carried, or work done (tonnes, TEU, passengers) or gross tonnage of passenger ships
D = distance travelled

2.5. Estimating Fuel Consumption Method

2.5.1.Trozzi's Method

Fuel oil consumption can be calculated by approaching method. Trozzi develop a methodology for estimating the ship fuel oil consumption (Trozzi & Vaccaro, 2006). Previous study using this estimation method shown that this method can be implemented to estimate fuel consumption of ship in Madura Strait, Indonesia (Pitana, et al., 2010). Shipping activity in a voyage can be divided based on sort time of working, among others:

1. Approaching and docking: this works starts when ship deceleration begins and ends at the moment of docking
2. Hoteling: this works starts when ship is berthing until the ship leaves the berth
3. Departing: this works starts with the departure of ship from berth and ends when cruising work reached.
4. Cruising: this work start after speed of cruising achieves by ship and ends if the ship starts for approaching and docking work

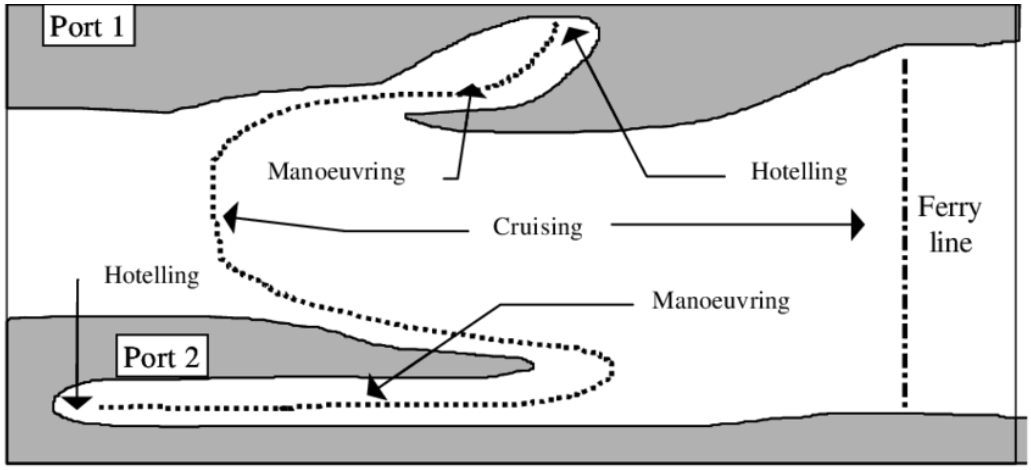

Figure 2.2 Ship Traffic Visualization
Source: (Trozzi & Vaccaro, 1999)

The effective fuel consumption for main engine can be obtained as:

$$\boldsymbol{S_{jkm}(GT) = C_{jk}(GT) \times P_m} \quad (3)$$

Where:

S_{jkm} (GT) = daily fuel oil consumption of fuel j in ship class k in operational mode m using gross tonnage function

C_{jk} (GT) = daily fuel oil consumption at full power of fuel j in ship class k as a function of gross tonnage

P_m = a fraction of maximum fuel consumption in mode m.

Table 2.1 Consumption at full power (ton/day) versus gross tonnage
Source: (Trozzi & Vaccaro, 2006)

Ship Types	**Consumption (Cjk)**
Solid bulk	12,0724+0,0012*GT-1,1501E-8*GT^2+4,6484E-14*GT^3
Liquid bulk	7,2194+0,0015*GT-9,1885E-9*GT^2+2,6803E-14*GT^3
General Cargo	-2,2602+0,0049*GT-1,6401E-7*GT^2+1,7394E-12*GT^3
Container	0,0919+0,0038*GT-6,1565E-8*GT^2+6,7917E-13*GT^3
Passenger/RoRo/Cargo	6,3501+0,0013*GT+1,6852E-7*GT^2-6,2691E-12*GT^3+5,699E-17*GT^4

Ship Types	Consumption (Cjk)
Passenger	$5{,}2159+0{,}0034*GT-3{,}373E\text{-}8*GT^2+2{,}062E\text{-}13*GT^3$
High Speed Ferry	$-9{,}735+0{,}0486*GT-4{,}6603E\text{-}6*GT^2+1{,}3911E\text{-}10*GT^3$
Inland cargo	$-2{,}2602+0{,}0049*GT-1{,}6401E\text{-}7*GT^2+1{,}7394E\text{-}12*GT^3$
Sail ship	.42682 + .00100 * GT
Tugs	$1{,}0857+0{,}0259*GT-1{,}0279E\text{-}5*GT^2+1{,}6828E\text{-}9*GT^3$
Fishing	$1{,}2744+0{,}0062*GT-6{,}4603E\text{-}7*GT^2+5{,}5193E\text{-}11*GT^3$
Other Ships	$1{,}2744+0{,}0062*GT-6{,}4603E\text{-}7*GT^2+5{,}5193E\text{-}11*GT^3$
All Ships	16.263 + 0.001 * GT

Table 2.2 Maximum Fraction (Pm) in Operational Mode fuel oil consumption
Source: (Trozzi & Vaccaro, 2006)

Mode	Fraction
Cruising	0,8
Maneuvering	0,4
Hoteling Default	0,2
passenger	0,32
tanker	0,2
other	0,12
Tug: ship assistance	0,2
Moderate activity	0,5
Under tow	0,8

2.5.2.STEAM2 - Jalkanen's Method

STEAM2 (Ship Traffic Emission Assessment Model) method originally uses to calculate estimation of ship emission. In the work of STEAM2 method there are several data needs and the data can be performed by multi-source. This method in general purpose is to provide data for ships emission distribution. STEAM2 is the second generation of STEAM that identical in the earlier version (Jalkanen, et al., 2012).

There are several data that must be available to do STEAM2 calculation, among others:

1. Ship technical data (hull dimension, powering, fuels)
2. Ship activity (speed, distance, sea condition, operational mode)

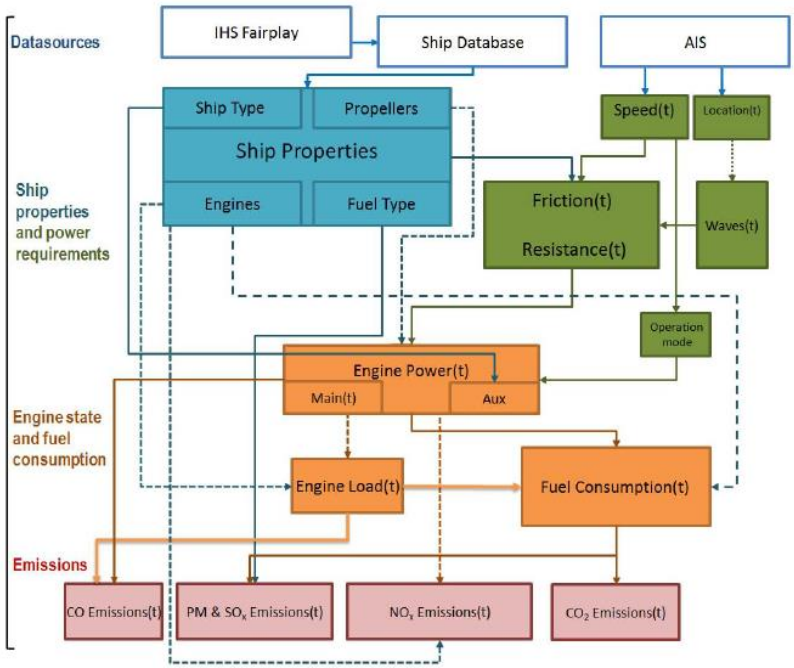

Figure 2.3 STEAM2 Entire Method Flowchart
Source: (Jalkanen, et al., 2012)

This method calculates fuel consumption from ship resistance and ship specifications. The total resistance of moving ship in kilo-Newton can be estimated with

$$\boldsymbol{R_{Total} \approx R_F + R_R} \quad (4)$$

Where;
R_F = frictional resistance acting on wet surface
R_R = Residual resistance

The other resistance can be neglected from the calculation such as the shallow water and air resistance because of small contribution for overall result. Then the frictional resistance (R_F) and residual resistance (R_R) can be calculated by:

$$\boldsymbol{R_F = C_F \frac{\rho}{2} v^2 S} \quad (5)$$

$$\boldsymbol{R_R = C_R \frac{\rho}{2} v^2 \left(\frac{BT}{10}\right)} \quad (6)$$

$$\boldsymbol{C_F = \frac{0{,}075}{(\log Rn - 2)^2}} \quad (7)$$

Where;

C_F = frictional resistant coefficient
C_R = residual resistant coefficient
Rn = Reynold's number
ρ = seawater density
v = ship's speed
B = ship's breadth
T = ship's draught
S = wet surface area

From the total resistance in kilo-Newton, the propelling power is obtained by:

$$\boldsymbol{P_{Propel} = R_{Total}.v} \quad (8)$$

For coefficient block, described by Watson (Watson, 1998) as follow

$$\boldsymbol{C_b = 0,7 + \frac{1}{8}\,\mathrm{atan}\left(\frac{23-100\,F_n}{4}\right)} \quad (9)$$

For unprovided data, Jalkanen et al method proposed formula given by Schneekluth and Bertram (Schneekluth & Bertram, 1998) and Hollenbach (Hollenbach, 1998). For wetted surface area, used formula

$$\boldsymbol{S_{total} = k\,.\,L\,.\,(B + 2\,.\,T)} \quad (10)$$

$$\boldsymbol{k = a_0 + a_1\,.\,L_{os}/L_{wl} + a_2\,.\,L_{wl}/L + a_3\,C_b + a_4\,.\,B/T + a_6\,.\,L/T + a_7\,.\,(T_A - T_F)/L + a_8\,.\,D_P/T + k_{Rudd}\,.\,N_{rudd} + k_{Brac}\,.\,N_{Brac} + k_{Boss}\,.\,N_{boss}} \quad (11)$$

Where;
D_P = propeller diameter
T_A = draft at aft perpendicular
T_F = draft at fore perpendicular
N_{Rudd} = number of rudders
N_{Brac} = number of brackets
N_{Boss} = number of bossings

Table 2.3 Coefficient for Wetted Surface in Hollenbach Method
Source: (Hollenbach, 1998)

	Single-screw		**Twin-screw**	
	design draft	**ballast draft**	**bulbous bow**	**no bulbous bow**
a_0	-0,6837	-0,8037	-0,4319	-0,0887
a_1	0,2771	0,2726	0,1685	0,0000
a_2	0,6542	0,7133	0,5637	0,5192
a_3	0,6422	0,6699	0,5891	0,5839
a_4	0,0075	0,0243	0,0033	-0,0130

	Single-screw		Twin-screw	
	design draft	**ballast draft**	**bulbous bow**	**no bulbous bow**
a_5	0,0275	0,0265	0,0134	0,0050
a_6	-0,0045	0,0061	-0,0006	-0,0007
a_7	-0,4798	0,2349	-2,7932	-0,9486
a_8	0,0376	0,0131	0,0072	0,0506
k_{Rudd}			0,0131	0,0076
k_{Brac}			-0,0030	-0,0036
k_{Boss}			0,0061	0,0049

To calculate residual coefficient, Hollenbach formulated as follows

$$\boldsymbol{L_{fn} = L_{OS}} \qquad L_{OS}/L < 1$$

$$\boldsymbol{L_{fn} = L + 2/3\,.\,(L_{OS} - L)} \qquad 1 \leq L_{OS}/L < 1{,}1 \qquad (12)$$

$$\boldsymbol{L_{fn} = 1{,}0667\,.\,L} \qquad 1{,}1 \leq L_{OS}/L$$

$$\boldsymbol{C_R = C_{R,Standard}\,.\,C_{R,Fnkrit}\,.\,k_L\,.\,(T/B)^{b1}\,.\,(B/L)^{b2}\,.\,(L_{os}/L_{wl})^{b3}\,.\,(L_{wl}/L)^{b4}\,.\,(1 + (T_A - T_F)/L)^{b5}\,.\,(D_P/T_A)^{b6}\,.\,(1 + N_{rudd})^{b7}\,.\,(1 + N_{Brac})^{b8}\,.\,(1 + N_{boss})^{b9}\,.\,(1 + N_{Thruster})^{b10}} \qquad (13)$$

Where $N_{Thruster}$ is the number of side thruster

$$\boldsymbol{C_{R,Standard} = c_{11} + c_{12}\,F_n + c_{13}\,F_n^2 + C_B\,.\,(c_{21} + c_{22}\,F_n + c_{23}\,F_n^2) + C_B^2\,.\,(c_{31} + c_{32}\,F_n + c_{33}\,F_n^2)} \qquad (14)$$

$$\boldsymbol{C_{R,Fnkrit} = max(1, 0;\ (F_n/F_{n,krit})^{f1})} \qquad (15)$$

$$\boldsymbol{F_{n,krit} = d_1 + d_2\,C_B + d_3\,C_B^2} \qquad (16)$$

$$\boldsymbol{k_L = e_1 L^{e2}} \qquad (17)$$

Table 2.4 Coefficient for Typical Resistance in Hollenbach Method
Source: (Hollenbach, 1998)

	Single-screw		Twin-screw
	design draft	**ballast draft**	
b1	-0,3382	-0,7139	-0,2748
b2	0,8086	0,2558	0,5747
b3	-6,0258	-1,1606	-6,7610
b4	-3,5632	0,4534	-4,3839
b5	9,4405	11,222	8,8158

	Single-screw		Twin-screw
	design draft	**ballast draft**	
b6	0,0146	0,4524	-0,1418
b7	0	0	-0,1258
b8	0	0	0,0481
b9	0	0	0,1699
b10	0	0	0,0728
c_{11}	-0,57420	-1,50162	-5,34750
c_{12}	13,3893	12,9678	55,6532
c_{13}	90,5960	-36,7985	-114,906
c_{21}	4,6614	5,55536	19,2714
c_{22}	-39,721	-45,8815	-192,388
c_{23}	-351,483	121,820	388,333
c_{31}	-1,14215	-4,33571	-14,3571
c_{32}	-12,3296	36,0782	142,738
c_{33}	459,254	-85,3741	-254,762
d_1	0,854	0,032	0,897
d_2	-1,228	0,803	-1,457
d_3	0,497	-0,739	0,767
e_1	2,1701	1,9994	1,8319
e_2	-0,1602	-0,1446	-0,1237
f_1	$F_n/F_{n,krit}$	$10.C_B.(F_n/F_{n,krit}-1)$	$F_n/F_{n,krit}$

To obtain the estimation of main engine power, the dimensionless quasi propulsive constant (η_{qpc}) is used to describe the effectiveness of converting the main engine power to actual propelling power.

$$\boldsymbol{\eta_{qpc} = 0,84 - \frac{N\sqrt{LBP}}{10000}} \tag{18}$$

Where;
N = rpm of the propeller
LBP = length between perpendiculars

Then the total required engine power can be described by:

$$\boldsymbol{P_{Total} = \frac{P_{Propel}}{\eta_{qpc}}} \tag{19}$$

For multi-engine setups, all engine can be assumed as identical. The number of operational engines and for all setups, the engine load (EL) can be determined from:

$$\boldsymbol{n_{OE} = \frac{P_{Total}}{P_E} + 1} \tag{20}$$

$$EL = \frac{P_{Total}}{P_E n_E} \quad (21)$$

Where;
P_E = maximum continuous rating of a single installed engine
n_E = number of installed engines

In STEAM2 method, parabolic function assumed for all engines. Using regression analysis of the comprehensive SFOC-measured data from Wartsila engine, a second-degree polynomial equation:

$$SFOC_{Relative} = 0,455EL^2 - 0,71EL + 1,28 \quad (22)$$

The absolute fuel consumption is estimated from

$$SFOC = SFOC_{Relative} SFOC_{Base} \quad (23)$$

2.5.3.Wang's Method

This method calibrates daily bunker consumption and relation with the sailing speed (Wang & Meng, 2012). Data obtained from calibration then uses for the further calculation. Calibration of bunker consumption and sailing speed function follows the formula

$$Q = a \times v^b \quad (24)$$

Where;
Q = daily fuel oil consumption
v = sailing speed
a & b = coefficient to be calibrated from data

That formula can be different on each ship. Data a and b from calculation are obtained from the collection fuel oil consumption in each speed and using regression method can be obtained the formula. The example as follows.

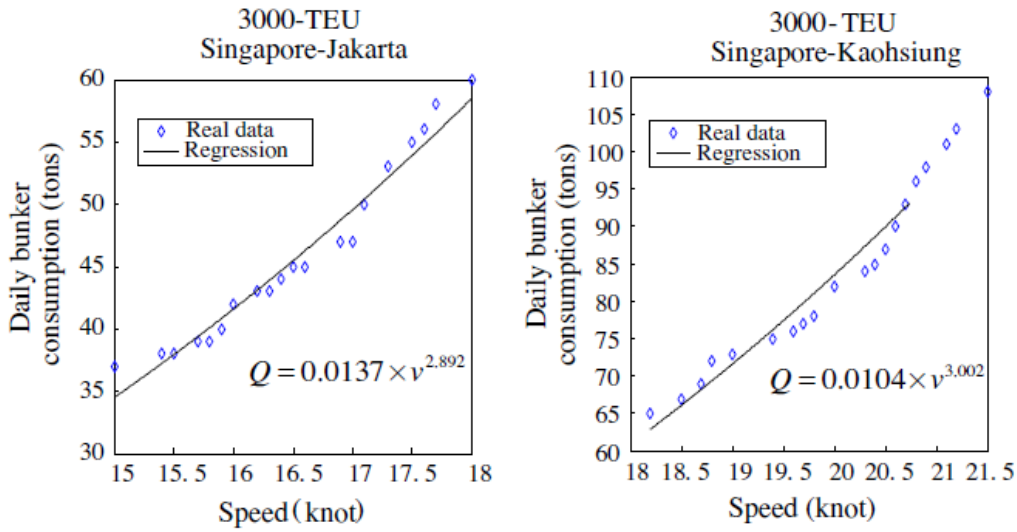

Figure 2.4 Bunker Consumption vs Sailing Speed Relation
Source: (Wang & Meng, 2012)

From each measurement of ship speed with fuel oil consumption, the approaching formula can be determined. The next step is just input the variable from the ship operational speed based on real time. Next, the ship speed can be calculated from Automatic Identification System (AIS).

2.5.4.Mersin's Method

Fuel consumption of ship is dependent with the sailing speed. Mersin, (Mersin, et al., 2017) develop a method by a formula that show the change of displacement of the ship according to the time. Based on Wang (2012) calculation, Mersin developed new method to estimate ship's fuel consumption.

$$\nabla(t) = \left[\sqrt[3]{V(0)} - \frac{\lambda v^3 t}{3}\right]^3 \qquad (25)$$

The displacement of the ship at any time is the sum of weight of the load on the ship and the weight in tonnes of fuel in the tank. Formula of $F(v) = v^3 \cdot \nabla^{2/3}$ is the formula of the fuel consumption in a day. So, $\Delta t \cdot F(c)$ tonnes of fuel will be consumed Δt moment later. If the displacement of the ship at a time t by $\nabla(t)$, the displacement will be as below Δt moment later

$$\nabla(t + \Delta t) = \nabla(t) - t.F\big(v(t)\big) = \nabla(t) - t.\lambda v^3[\nabla(t)]^{\frac{2}{3}} \qquad (26)$$

From the mathematical modelling, the formula stated by Mersin for estimating fuel consumption in an hour as follows:

$$\nabla(t) = \left[\sqrt[3]{V(0)} - \frac{\lambda v^3 t}{72}\right] \quad (27)$$

Where;
$\nabla(t)$ = volume displacement of the ship in a time
$\nabla(0)$ = initial displacement of ship
λ = ship engine coefficient
v = ship's speed
t = time of sailing in hour

Explained by Barras (Barras, 2004), λ value interpreted as

$$\lambda = 1/F_C \quad (28)$$

Where F_C is the fuel coefficient and described as

$$F_C = \frac{W^{\frac{2}{3}} \times V^3}{Fuel\ Cons/day} \quad (29)$$

Where W is the ship's displacement (ton) and V is ship's speed (knot). Then to calculate the amount of fuel remaining using formula

$$L(t) = \nabla(t) - W_{i,i+1} \quad (30)$$

Where;
L(t) = amount of remaining fuel
$W_{i,i+1}$ = weight of the cargo carried from port i to port (i+1)

To calculate the fuel consumption using formula

$$FC = L(0) - L(t) \quad (31)$$

Where;
FC = fuel consumption
L(0) = initial volume of fuel oil in tank

2.6. AIS (Automatic Identification System)

AIS is a navigation equipment that can be used for safety and evacuation activities. The International Convention of the Safety of Life at Sea (SOLAS) at 2002 obligate every ship over 300 GT on international voyages and all cargo ship over 500 GT to be equipped with AIS transponder. AIS is classified into 6 types: Class A, Class B, Bae station, Aids to navigation (AtoN), Search and Rescue Transponder (SART), and Specialist AIS Transponder.

2.7. Fuel Oil to CO_2 Conversion Factor

In calculation of CO_2 released by fuel oil burning, conversion factor is used as the approaching method. Each type of fuel has specific carbon chain and other chemical

properties. Conversion factor is non-dimensional factor to obtain the specific amount of CO_2 released by combustion in a specific volume of fuel burning. The IMO in EEOI guidelines release the amount of conversion factor for the CO_2 produced as follow.

Table 2.5 CO2 Mass Conversion Factors (Cf)
Source: (MEPC.1/Circ.684, 2009)

Type of fuel	Reference	Carbon content	Cf (ton-CO_2/ton-Fuel)
Diesel/Gas Oil	ISO 8217 Grades DMX through DMC	0,875	3,206000
Light Fuel Oil (LFO)	ISO 8217 Grades RMA through RMD	0,86	3,151040
Heavy Fuel Oil (HFO)	ISO 8217 Grades RME through RMK	0,85	3,114400
Liquified Petroleum Gas (LPG)	Propane	0,819	3,000000
	Butane	0,827	3,030000
Liquefied Natural Gas (LNG)		0,75	2,750000

Started from September 2018, Meratus ships use biodiesel as a fuel for HSD. Biodiesel uses by all Meratus vessel is B20, which contain 20% biofuel. Biodiesel contain FAME (Fatty Acid Methyl Ester) which represent in volume-per-volume percentage (%v/v). Which means, in 100% of fuel, FAME contain a-%. Table 2.7 explained fuel to CO_2 conversion factor for Indonesian biodiesel (Wijono, 2017).

Table 2.6 CO2 Emission Conversion Factor (Cf) for Biodiesel
Source: (Wijono, 2017)

B-XX	SO_2	NO_x	HC	PM	CO	CO_2
B0	16,119	9,292	11,125	2,383	36,852	2.013,025
B5	15,360	9,292	10,619	2,351	35,651	1.959,739
B10	14,475	9,229	9,924	2,301	34,513	1.900,533
B15	13,780	9,166	9,418	2,174	33,375	1.876,850
B20	12,895	9,102	8,913	2,054	32,364	1.847,247
B30	11,315	9,039	8,091	1,947	29,583	1.758,437
B50	8,091	8,850	6,384	1,726	24,083	1.586,738
B100		8,407	3,603	1,315	19,090	1.385,435

2.8. Ship Departure Report

Departure report is an internal document which is sent by ship's master to shipping company. Purposes to give information about ship condition during in port activities until set sailing. Information given in departure report among other when the ship is commencing discharge/loading and complete discharge/loading, how may cargo loaded/discharged, draft condition, amount of fuel inside tanks, total ballast on tanks and other specific port activities technical information.

```
DEPARTURE SURABAYA 01-MARET-2019
MBT/V.1908 N/SUB TO PKX/19
1. Comm.disch   : 27/19.00 LT
2. Compl.disch  : 28/01.12 LT  Delay recorded due to breakdowns :NIL
3. Cargo.disch  : 20'FT  FULL   : 7   BOX
                  20'FT  EMPTY  : 214 BOX
                    40'FT  EMPTY  : 17  BOX
4. Comm.load    : 28/09.30 LT
5. Compl.load   : 01/03.30 LT  Delay recorded due to breakdowns :NIL
6. Cargo.load   : 20'FT  FULL   : 206 BOX
                  40'FT  FULL   : 6   BOX
   TONNAGES     : 4457 TON
7. GM           : 3.00 M
8. Minimum GM   : 2.50 M
9. Draft: FWD/AFT   : 4.20 M/A: 4.60 M
10.Minimum AFT draft for propeller immersion : 3.0 M
11.Displacement     : 7688 TON
12.Total ballast on board : 624 TON
13.Vessel constant :  20 TON
14.Received: MFO: - KL, HSD: - KL, LO: - KL, FWT: 60 T
15.ROB: MFO: 89,095 KL, HSD: 33,357 KL, LO ME: 1,850 KL, LO AE: 320 Ltr, LO
Hydraulic: 3,240 KL,
        FWT: 155 T, LO Separator : 1 & 2 ON , FO Separator : 1 & 2 OFF , Boiler :
```

Figure 2.6 Ship's departure report
Source: author's document

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CHAPTER III
METHODOLOGY

3.1. Flowchart

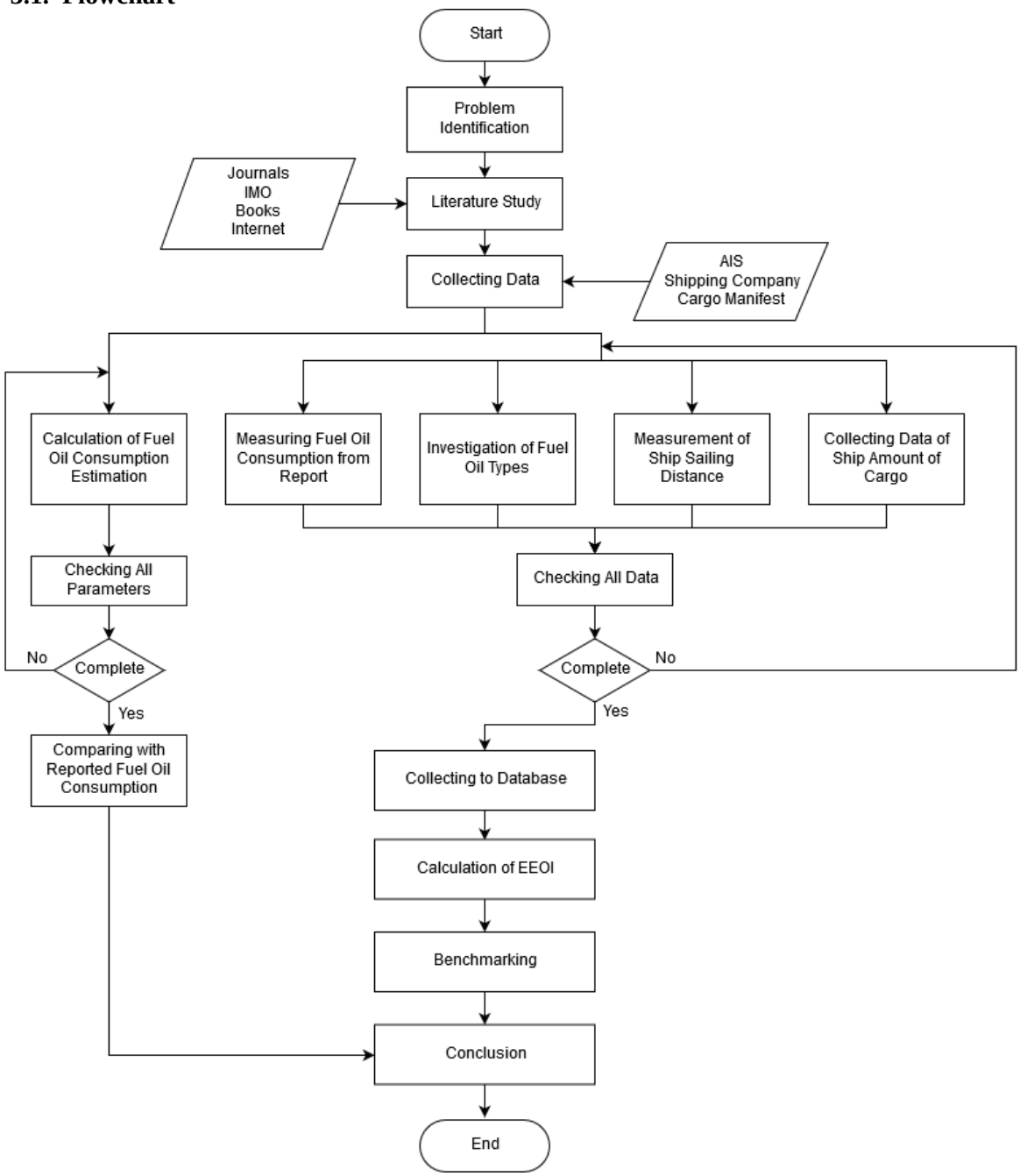

Figure 3.1 Research Flowchart

3.2. Problem Identification

Problem identification is the beginning step of this sequential writing method and from this process, research question is obtained from several background of existence condition compared with ideal condition. The main problem identified from the condition of global greenhouse gasses which led to the rising temperature of the earth. Following by that problems, international agreement forced the subject of maritime industry to take part for reducing causes for it. By that condition, the problem is identified and in this process the problem is determine for this research.

3.3. Literature Study

Next after knowing the problem, literature review needs to be done to obtain information related to the problem to support the analysis of the research. The literature review is done by comprehensively reading the IMO related regulations, science journals, books, and website.

3.4. Collecting Data

After literature study is done, data which are important for this research need to be obtain. Data collection come from actual condition of shipping operational performance. The data need to be collected for further calculation by EEOI formula to obtain index for ship energy efficiency.

a. Measurement Fuel Consumption
   Fuel consumption manifest the amount of fuel burned to reach several operations demands for the ship. Data for this fuel consumption planned to be gather from shipping company.
b. Investigation of Fuel Oil Types
   Fuel oil types manifest the condition of combustion process done by the ship's engine. Fuel oil types is needed to determine the CO_2 factor for the burned oil. This data planned to be gathered from the shipping company or from other sources.
c. Measurement of Ship Sailing Distance
   Ship distance data manifest the operational work of the ship. This parameter in further calculation need to compare the work emitted by the ship. This data obtained from ship Automatic Identification System (AIS) supported by FleetMon.
d. Measurement of Ship Amount of Cargo
   Shipping cargo data manifest the operational work of the ship. This parameter considered to the research to compare the effectivity of ship main function as goods transporter. This data plan to obtain from shipping company or another sources.

3.5. Data Checking

Data checking purposes to make sure all the data needed for calculation already obtained. All data checked by the researcher with assuring all calculation can be done by data.

3.6. Collecting to Database

Next step, data which are obtained from shipping company and other source need to be stored in the database due to the further record. The calculation of EEOI need data in window of time to evaluate performance index of the ship and benchmark one with another ship performance.

3.7. Calculation of EEOI

EEOI calculated with formula which has regulated by IMO. EEOI calculation result is an index for ship and this index are the objective variable to next process. The calculation by the formula planned to be done with software.

3.8. Benchmarking

Benchmarking process is the latest step before concluding the research. The benchmarking processes use index from EEOI by multiple identic/sister ship and evaluated to obtain list for chance of optimization can be done for shipping company and IMO in further time.

3.9. Calculation of Fuel Consumption Estimation

This process done using several methodologies developed for calculating estimation fuel consumption by ship. Calculating estimation needs all collected data from AIS, Company database, ship specification, cargo, etc. following the methods that used.

3.10. Comparing with Reported Fuel Oil Consumption

Result of estimation ship fuel consumption obtained from several methods than compared with reported fuel consumption obtained from shipping company data. The errors from every methods result's then calculated. After that, result from different methods of fuel estimation ranked based on the error.

3.11. Conclusion

Conclusion is the last sequence in this research. Conclusion chapter contains the summary to conclude the research and suggestion. Writing of conclusion and suggestion carried out by the purpose of this research.

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CHAPTER IV
DATA ANALYSIS

4.1. Data Collection

Data are collected as a basic information for conducting research. Various data collected from different sources among other from shipping company, AIS website, and journal literature.

4.1.1. Ship Particular

This research conducted in two ship. Detail information for each ship for general information and machinery can be obtained in ship particular document.

1. MV. Meratus Benoa

Table 4.1 MV Meratus Bontang Ship Particular
Source: Meratus Line Shipping Company

General		
Vessel Name	MV Meratus Bontang	
Type of Vessel	Container Ship	
Owner	PT. Meratus Line	
Flag	Indonesia	
IMO-Number	9569865	
MMSI	525025059	
GRT	3668	GT
DWT	5161	Ton
LOA	107,68	meter
LPP	99,11	meter
Breadth Moulded	20,60	meter
Depth Moulded	5,80	meter
Draft	4,215	meter
Service Speed	10	knots
Classification	NK/BKI	
Machinery		
Main Engine	Yanmar 6EY26 – 2 x 1440 KW / 681 rpm	
Propeller	Fixed; 4 blades; 2 x 2,7 m; pitch 0,61 m	
Auxiliary Engine	HND MWM Henan Diesel 4 x TBD 234 V8	

2. MV. Meratus Bontang

Table 4.2 MV Meratus Benoa Ship Particular
Source: Meratus Line Shipping Company

General		
Vessel Name	MV Meratus Benoa	
Type of Vessel	Container Ship	
Owner	PT. Meratus Line	
Flag	Indonesia	
IMO-Number	9509231	
MMSI	525025061	
GRT	3668	GT
DWT	5161	Ton
LOA	107,68	meter
LPP	99,09	meter
Breadth Moulded	20,60	meter
Depth Moulded	6	meter
Draft	4,20	meter
Speed	10	knots
Classification	NK/BKI	
Machinery		
Main Engine	Yanmar 6EY26 – 2 x 1440 KW / 681 rpm	
Propeller	Fixed; 4 blades; 2 x 2,7 m; pitch 0,61 m	
Auxiliary Engine	HND MWM Henan Diesel 4 x TBD 234 V8	

4.1.2. Window Time

Window time represent the time of ships are being operated. Window time of one trip started when ship commence loading in port of departure and ended when discharge completed in port of arrival. Data for window obtained from ship departure report. En-route window is duration when ship start to sail with sea-speed. En-route window started when ship's is exiting port area, and set sail from maneuvering phase to cruising phase. En-route window data obtained from ship's fuel oil consumption report.

Voyage number giving information about the times of ship perform a 'round-trip' from the company. Trip number indicates one of trip in each round-trip. Trip number given continuously from early round-trip. Trip number are developed by author to make trip grouping easier to understand.

MV. Meratus Bontang

Table 4.3 MV Meratus Bontang Operation Window
Source: Meratus Line Shipping Company

Voyage Number	En-route Window	Trip Number	Date		Port	
			Commenced Loading - Port of Departure	Complete Discharge - Port of Arrival	Departure	Arrived
1901	04/01/2019 16/01/2019	MBT-**1**	09/01/2019 22:30	13/01/2019 23:48	Semarang	Pontianak
		MBT-**2**	13/01/2019 21:54	18/01/2019 08:30	Pontianak	Semarang
1902	16/01/2019 24/01/2019	MBT-**3**	18/01/2019 08:36	21/01/2019 20:24	Semarang	Pontianak
		MBT-**4**	21/01/2019 16:00	26/01/2019 16:28	Pontianak	Semarang
1903	24/01/2019 01/02/2019	MBT-**5**	26/01/2019 16:48	30/01/2019 01:00	Semarang	Pontianak
		MBT-**6**	29/01/2019 20:48	02/02/2019 17:00	Pontianak	Surabaya
1904	01/02/2019 08/02/2019	MBT-**7**	03/02/2019 18:18	06/02/2019 11:54	Surabaya	Sampit
		MBT-**8**	06/02/2019 13:24	09/02/2019 01:00	Sampit	Surabaya
1905	08/02/2019 16/02/2019	MBT-**9**	09/02/2019 09:00	12/02/2019 17:12	Surabaya	Kumai
		MBT-**10**	12/02/2019 17:36	15/02/2019 14:24	Kumai	Semarang
		MBT-**11**	15/02/2019 09:36	17/02/2019 14:42	Semarang	Surabaya
1906	16/02/2019 21/02/2019	MBT-**12**	17/02/2019 18:42	20/02/2019 03:54	Surabaya	Sampit
		MBT-**13**	20/02/2019 04:00	22/02/2019 09:24	Sampit	Surabaya
1907	21/02/2019 27/02/2019	MBT-**14**	22/02/2019 09:18	26/02/2019 00:12	Surabaya	Sampit
		MBT-**15**	25/02/2019 20:24	28/02/2019 01:12	Sampit	Surabaya

Voyage Number	En-route Window	Trip Number	Date		Port	
			Commenced Loading - Port of Departure	Complete Discharge - Port of Arrival	Departure	Arrived
1908	27/02/2019 05/03/2019	MBT-**16**	28/02/2019 09:30	03/03/2019 16:42	Surabaya	Kumai
		MBT-**17**	03/03/2019 16:48	06/03/2019 13:12	Kumai	Surabaya
1909	05/03/2013 12/03/2019	MBT-**18**	06/03/2019 13:24	08/03/2019 07:18	Surabaya	Semarang
		MBT-**19**	08/03/2019 07:24	10/03/2019 11:24	Semarang	Kumai
		MBT-**20**	10/03/2019 11:30	14/03/2019 07:18	Kumai	Surabaya
1910	12/03/2019 21/03/2019	MBT-**21**	15/03/2019 02:00	17/03/2019 09:18	Surabaya	Semarang
		MBT-**22**	17/03/2019 09:24	19/03/2019 19:54	Semarang	Kumai
		MBT-**23**	19/03/2019 20:06	23/03/2019 03:12	Kumai	Surabaya

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Table 4.4 MV Meratus Benoa Operation Window
Source: Meratus Line Shipping Company

Voyage Number	En-route Window	Trip Number	Date		Port	
			Commenched Loading (Port of Departure)	Complete Discharge (Port of Arrival)	Departure	Arrived
1901	06/01/2019 15/01/2019	MBN-**1**	06/01/2019 20:18	11/01/2019 09:48	Surabaya	Kumai
		MBN-**2**	11/01/2019 09:36	14/01/2019 02:30	Kumai	Semarang
		MBN-**3**	14/01/2019 02:12	16/01/2019 12:00	Semarang	Surabaya
1902	17/01/2019 25/01/2019	MBN-**4**	16/01/2019 16:54	21/01/2019 08:48	Surabaya	Samarinda
		MBN-**5**	21/01/2019 08:54	25/01/2019 20:06	Samarinda	Surabaya
1903	25/01/2019 03/02/2019	MBN-**6**	26/01/2019 14:00	30/01/2019 05:24	Surabaya	Kumai

Voyage Number	En-route Window	Trip Number	Date		Port	
			Commenched Loading (Port of Departure)	Complete Discharge (Port of Arrival)	Departure	Arrived
		MBN-**7**	30/01/2019 03:00	02/02/2019 10:12	Kumai	Semarang
		MBN-**8**	02/02/2019 10:18	03/02/2019 01:30	Semarang	Surabaya
1904	03/02/2019 09/02/2019	MBN-**9**	04/02/2019 10:42	07/02/2019 08:48	Surabaya	Sampit
		MBN-**10**	07/02/2019 09:00	09/02/2019 20:00	Sampit	Surabaya
1905	09/02/2019 16/02/2019	MBN-**11**	10/02/2019 09:00	12/02/2019 05:18	Surabaya	Semarang
		MBN-**12**	12/02/2019 05:24	14/02/2019 04:42	Semarang	Kumai
		MBN-**13**	14/02/2019 05:00	16/02/2019 22:42	Kumai	Surabaya
1906	16/02/2019 22/02/2019	MBN-**14**	16/02/2019 21:00	20/02/2019 04:42	Surabaya	Kumai
		MBN-**15**	20/02/2019 03:36	23/02/2019 01:48	Kumai	Surabaya
1907	22/02/2019 28/02/2019	MBN-**16**	22/02/2019 22:18	26/02/2019 09:12	Surabaya	Kumai
		MBN-**17**	26/02/2019 02:00	02/03/2019 17:00	Kumai	Surabaya
1908	28/02/2019 10/03/2019	MBN-**18**	02/03/2019 14:06	06/03/2019 02:42	Surabaya	Kumai
		MBN-**19**	05/03/2019 20:00	08/03/2019 23:30	Kumai	Semarang
		MBN-**20**	08/03/2019 23:48	12/03/2019 01:36	Semarang	Surabaya
1909	10/03/2019 19/03/2019	MBN-**21**	12/03/2019 01:42	15/03/2019 09:30	Surabaya	Kumai
		MBN-**22**	15/03/2019 09:48	18/03/2019 07:48	Kumai	Semarang
		MBN-**23**	18/03/2019 08:30	21/03/2019 22:00	Semarang	Surabaya
1910	19/03/2019 28/03/2019	MBN-**24**	21/03/2019 21:00	25/03/2019 04:06	Surabaya	Kumai
		MBN-**25**	25/03/2019 04:00	27/03/2019 23:30	Kumai	Semarang

Voyage Number	En-route Window	Trip Number	Date		Port	
			Commenched Loading (Port of Departure)	Complete Discharge (Port of Arrival)	Departure	Arrived
		MBN-**26**	28/03/2019 00:24	30/03/2019 17:46	Semarang	Surabaya

4.1.3. Fuel Oil Consumption of Vessel

Data for fuel oil consumption obtained from shipping company internal document. In the document of fuel oil consumption report there are several information, among other: voyage number, en-route window time, type of fuel used, consumed fuel, amount of fuel on tanks, and the purpose of the fuel consumption.

In this research, obtained information about amount of fuel oil consumption by type and the period is highly used as an actual data.

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Table 4.5 MV Meratus Bontang Fuel Oil Consumption Report
Source: Meratus Line Shipping Company

Voyage Number	Trip Number	Fuel Oil Consumption (liter)					
		Auxiliary Engine		Main Engine		HSD	MFO
		HSD		HSD	MFO		
		At Port	At Sea	At Port*	At Sea		
1901	MBT-**1**	6,382	2,720	2,518	11,968	**11,620**	**11,968**
	MBT-**2**	2,767	2,365	3,221	10,406	**8,353**	**10,406**
1902	MBT-**3**	2,695	2,810	2,054	12,688	**7,559**	**12,688**
	MBT-**4**	1,953	2,250	2,694	9,900	**6,897**	**9,900**
1903	MBT-**5**	2,493	2,495	3,340	17,964	**8,328**	**17,964**
	MBT-**6**	1,840	2,660	2,666	11,704	**7,165**	**11,704**
1904	MBT-**7**	3,878	1,400	3,966	6,160	**9,244**	**6,160**
	MBT-**8**	2,020	1,225	3,286	5,390	**6,531**	**5,390**
1905	MBT-**9**	3,450	1,765	3,570	6,644	**8,785**	**6,644**
	MBT-**10**	3,947	1,480	3,820	6,512	**9,247**	**6,512**
	MBT-**11**	1,155	775	2,396	3,410	**4,326**	**3,410**
1906	MBT-**12**	2,710	1,350	4,898	5,940	**8,958**	**5,940**
	MBT-**13**	2,237	1,170	4,170	5,148	**7,577**	**5,148**
1907	MBT-**14**	1,995	966	4,740	4,246	**7,700**	**4,246**
	MBT-**15**	3,288	1,200	4,040	5,280	**8,528**	**5,280**

Voyage Number	Trip Number	Fuel Oil Consumption (liter)					
		Auxiliary Engine		Main Engine		HSD	MFO
		HSD		HSD	MFO		
		At Port	At Sea	At Port*	At Sea		
1908	MBT-**16**	3,405	1,550	4,140	6,820	**9,095**	**6,820**
	MBT-**17**	3,100	1,230	4,592	5,390	**8,922**	**5,390**
1909	MBT-**18**	2,520	1,005	3,478	4,422	**7,003**	**4,422**
	MBT-**19**	968	1,230	2,406	5,368	**4,604**	**5,368**
	MBT-**20**	2,595	1,150	4,000	5,060	**7,745**	**5,060**
1910	MBT-**21**	6,355	600	7,096	5,280	**14,051**	**5,280**
	MBT-**22**	670	1,415	1,528	6,006	**3,613**	**6,006**
	MBT-**23**	3,367	1,370	3,680	6,028	**8,417**	**6,028**

*for maneuvering

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Table 4.6 MV Meratus Benoa Fuel Oil Consumption Report
Source: Meratus Line Shipping Company

Voyage Number	Trip Number	Fuel Oil Consumption (liter)					
		Auxiliary Engine		Main Engine		HSD	MFO
		HSD		HSD	MFO		
		At Port	At Sea	At Port*	At Sea		
1901	MBN-**1**	5,233	1,886	2,520	6,915	**9,639**	**6,915**
	MBN-**2**	5,177	1,928	3,400	7,300	**10,505**	**7,300**
	MBN-**3**	797	1,147	1,900	5,134	**3,844**	**5,134**
1902	MBN-**4**	4,010	3,528	4,360	13,795	**11,898**	**13,795**
	MBN-**5**	3,881	3,740	6,600	23,028	**14,221**	**23,028**
1903	MBN-**6**	4,809	2,508	5,520	13,041	**12,837**	**13,041**
	MBN-**7**	4,013	1,959	3,720	7,988	**9,692**	**7,988**
	MBN-**8**	1,048	1,186	920	4,240	**3,154**	**4,240**
1904	MBN-**9**	3,288	1,612	4,520	11,047	**9,420**	**11,047**
	MBN-**10**	2,134	2,135	5,080	6,944	**9,349**	**6,944**
1905	MBN-**11**	4,223	1,278	5,640	5,150	**11,141**	**5,150**
	MBN-**12**	495	1,629	1,120	7,797	**3,244**	**7,797**
	MBN-**13**	3,577	1,690	3,560	6,553	**8,827**	**6,553**
1906	MBN-**14**	2,862	2,110	2,850	7,540	**7,822**	**7,540**

Voyage Number	Trip Number	Fuel Oil Consumption (liter)					
		Auxiliary Engine		Main Engine		HSD	MFO
		HSD		HSD	MFO		
		At Port	At Sea	At Port*	At Sea		
	MBN-**15**	3,839	1,754	4,890	6,594	**10,483**	**6,594**
1907	MBN-**16**	3,355	1,988	2,830	8,206	**8,173**	**8,206**
	MBN-**17**	3,809	1,992	3,480	6,864	**9,281**	**6,864**
1908	MBN-**18**	5,833	1,791	3,160	9,261	**10,784**	**9,261**
	MBN-**19**	4,762	1,778	3,680	11,894	**10,220**	**11,894**
	MBN-**20**	1,595	1,060	1,640	4,554	**4,295**	**4,554**
1909	MBN-**21**	5,522	1,500	3,490	12,194	**10,512**	**12,194**
	MBN-**22**	4,075	1,662	3,704	11,561	**9,441**	**11,561**
	MBN-**23**	1,356	1,120	2,028	4,534	**4,504**	**4,534**
1910	MBN-**24**	6,725	1,970	3,796	10,571	**12,491**	**10,571**
	MBN-**25**	3,030	2,264	3,150	8,139	**8,444**	**8,139**
	MBN-**26**	1,138	1,074	1,594	4,416	**3,806**	**4,416**

*for maneuvering

4.1.4. Cargo Loaded

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Table 4.7 MV Meratus Bontang Cargo Loaded
Source: Meratus Line Shipping Company

Voyage Number	Trip Number	Route		20 FT		40 FT		20 FT Reefer		40 FT Reefer		Total (TEUS)
		Depart	Arrived	Empty	Full	Empty	Full	Empty	Full	Empty	Full	
1901	**MBT-1**	Semarang	Pontianak	-	159	-	17	-	-	-	-	**193**
	MBT-2	Pontianak	Semarang	134	30	12	-	-	-	-	1	**190**
1902	**MBT-3**	Semarang	Pontianak	-	130	-	18	-	-	-	-	**166**
	MBT-4	Pontianak	Semarang	148	9	18	-	-	-	-	1	**195**
1903	**MBT-5**	Semarang	Pontianak	-	106	-	12	-	-	-	-	**130**
	MBT-6	Pontianak	Surabaya	88	39	18	-	-	-	-	-	**163**

Voyage Number	Trip Number	Route		20 FT		40 FT		20 FT Reefer		40 FT Reefer		Total (TEUS)
		Depart	Arrived	Empty	Full	Empty	Full	Empty	Full	Empty	Full	
1904	**MBT-7**	Surabaya	Sampit	-	190	-	19	-	-	-	-	**228**
	MBT-8	Sampit	Surabaya	134	14	-	-	-	-	-	-	**148**
1905	**MBT-9**	Surabaya	Kumai	-	197	-	19	-	2	-	-	**237**
	MBT-10	Kumai	Semarang	111	128	8	-	-	-	-	-	**255**
	MBT-11	Semarang	Surabaya	130	31	-	-	-	-	-	-	**161**
1906	**MBT-12**	Surabaya	Sampit	-	191	-	16	-	-	-	-	**223**
	MBT-13	Sampit	Surabaya	216	16	16	-	-	-	-	-	**264**
1907	**MBT-14**	Surabaya	Sampit	-	201	-	11	-	-	-	-	**223**
	MBT-15	Sampit	Surabaya	214	7	17	-	-	-	-	-	**255**
1908	**MBT-16**	Surabaya	Kumai	-	206	-	6	-	-	-	-	**218**
	MBT-17	Kumai	Surabaya	88	38	4	-	-	-	-	-	**134**
1909	**MBT-18**	Surabaya	Semarang	-	163	-	3	-	-	-	-	**169**
	MBT-19	Semarang	Kumai	-	199	-	3	-	-	-	-	**205**
	MBT-20	Kumai	Surabaya	80	94	4	-	-	-	-	-	**182**
1910	**MBT-21**	Surabaya	Semarang	-	174	-	9	-	-	-	-	**192**
	MBT-22	Semarang	Kumai	-	103	-	8	-	-	-	-	**119**
	MBT-23	Kumai	Surabaya	104	111	2	-	-	-	-	-	**219**

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Table 4.8 MV Meratus Benoa Cargo Loaded
Source: Meratus Line Shipping Company

Voyage Number	Trip Number	Route		20 FT		40 FT		20 FT Reefer		40 FT Reefer		Total (TEUS)
		Depart	Arrived	Empty	Full	Empty	Full	Empty	Full	Empty	Full	
1901	MBN-1	Surabaya	Kumai	-	146	-	8	-	-	-	-	**162**
	MBN-2	Kumai	Semarang	65	129	2	-	-	-	-	-	**198**
	MBN-3	Semarang	Surabaya	138	5	-	2	-	-	-	-	**147**
1902	MBN-4	Surabaya	Samarinda	-	163	-	12	-	-	-	-	**187**
	MBN-5	Samarinda	Surabaya	60	112	3	2	-	-	-	-	**182**
1903	MBN-6	Surabaya	Kumai	-	207	-	7	-	-	-	-	**221**
	MBN-7	Kumai	Semarang	82	178	4	-	-	-	-	-	**268**
	MBN-8	Semarang	Surabaya	153	10	-	-	-	-	-	-	**163**
1904	MBN-9	Surabaya	Sampit	-	193	-	11	-	-	-	-	**215**
	MBN-10	Sampit	Surabaya	77	1	17	-	-	-	-	-	**112**
1905	MBN-11	Surabaya	Semarang	-	164	-	7	-	-	-	-	**178**
	MBN-12	Semarang	Kumai	-	201	-	10	-	-	-	-	**221**
	MBN-13	Kumai	Surabaya	57	99	9	-	-	-	-	-	**174**
1906	MBN-14	Surabaya	Kumai	-	196	-	5	-	-	-	-	**206**
	MBN-15	Kumai	Surabaya	143	52	22	1	-	-	-	-	**241**
1907	MBN-16	Surabaya	Kumai	-	206	-	3	-	1	-	-	**213**
	MBN-17	Kumai	Surabaya	123	124	2	1	-	-	-	-	**253**

Voyage Number	Trip Number	Route		20 FT		40 FT		20 FT Reefer		40 FT Reefer		Total (TEUS)
		Depart	Arrived	Empty	Full	Empty	Full	Empty	Full	Empty	Full	
1908	MBN-18	Surabaya	Kumai	-	197	-	10	-	-	-	-	**217**
	MBN-19	Kumai	Semarang	61	177	5	-	-	-	-	-	**248**
	MBN-20	Semarang	Surabaya	12	23	1	-	-	-	-	-	**37**
1909	MBN-21	Surabaya	Kumai	-	209	-	3	-	-	-	-	**215**
	MBN-22	Kumai	Semarang	115	123	11	-	-	-	-	-	**260**
	MBN-23	Semarang	Surabaya	64	31	11	-	-	-	-	-	**117**
1910	MBN-24	Surabaya	Kumai	-	186	-	4	-	-	-	-	**194**
	MBN-25	Kumai	Semarang	94	102	8	-	-	-	-	-	**212**
	MBN-26	Semarang	Surabaya	74	3	8	-	-	-	-	-	**93**

4.1.5. Distance Sailing

Distance sailing data obtained from AIS data which is supported by FleetMon (JAKOTA Cruise Systems GmbH, 2019). AIS data provide latitude and longitude, speed, heading, course, turn, and navigational status data in each epoch. Epoch is one signal transmitted by AIS transmitter in vessel, to the terrestrial or satellite receiver. Epoch coded in *timestamp* format.

Each data transmitted by AIS provide latitude and longitude, which represent ship's location, speed, course, heading, and navigation status. Distance can be calculated using Spherical Law of Cosines and then verified with ArcGIS measurement.

$$\boldsymbol{d = \mathrm{acos}(sin\varphi_1 . sin\varphi_2 + cos\varphi_1 . cos\varphi_2 . cos\Delta\lambda) \; . \; R} \qquad (32)$$

Where;

d = distance between two points (km)
φ = latitude (radians)
λ = longitude (radians)
R = earth's radius (6371 km)

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Table 4.9 MV Meratus Bontang Sailed Distance
Source: FleetMon AIS

Voyage Number	Trip Number		Port		Distance	
			Departure	Arrived	kilo meter	nautical miles
1901	MBT-	1	Semarang	Pontianak	868.9179	469.1783
	MBT-	2	Pontianak	Semarang	847.4187	457.5696
1902	MBT-	3	Semarang	Pontianak	846.6044	457.13
	MBT-	4	Pontianak	Semarang	840.4497	453.8067
1903	MBT-	5	Semarang	Pontianak	856.5271	462.4878
	MBT-	6	Pontianak	Surabaya	1043.22	563.2942
1904	MBT-	7	Surabaya	Sampit	550.4193	297.2027
	MBT-	8	Sampit	Surabaya	520.4766	281.035
1905	MBT-	9	Surabaya	Kumai	585.1888	315.9768
	MBT-	10	Kumai	Semarang	507.6793	274.125
	MBT-	11	Semarang	Surabaya	357.198	192.8716
1906	MBT-	12	Surabaya	Sampit	511.8283	276.3653
	MBT-	13	Sampit	Surabaya	511.9749	276.4444
1907	MBT-	14	Surabaya	Sampit	516.2298	278.7419
	MBT-	15	Sampit	Surabaya	530.1295	286.2471
1908	MBT-	16	Surabaya	Kumai	541.681	292.4844
	MBT-	17	Kumai	Surabaya	544.3	293.8986
1909	MBT-	18	Surabaya	Semarang	347.4695	187.6186
	MBT-	19	Semarang	Kumai	503.1498	271.6792
	MBT-	20	Kumai	Surabaya	546.4188	295.0427
1910	MBT-	21	Surabaya	Semarang	352.5422	190.3576
	MBT-	22	Semarang	Kumai	503.7623	272.01
	MBT-	23	Kumai	Surabaya	536.4879	289.6804

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Table 4.10 MV Meratus Benoa Sailed Distance
Source: FleetMon AIS

Voyage Number	Trip Number		Port		Distance	
			Departure	Arrived	kilo meter	nautical miles
1901	MBN-	1	Surabaya	Kumai	547.2333	295.4824
	MBN-	2	Kumai	Semarang	503.6172	271.9316
	MBN-	3	Semarang	Surabaya	357.7142	193.1503
1902	MBN-	4	Surabaya	Samarinda	967.142	522.2151
	MBN-	5	Samarinda	Surabaya	965.9701	521.5823
1903	MBN-	6	Surabaya	Kumai	544.796	294.1664
	MBN-	7	Kumai	Semarang	508.779	274.7188
	MBN-	8	Semarang	Surabaya	352.769	190.4801
1904	MBN-	9	Surabaya	Sampit	532.7654	287.6704
	MBN-	10	Sampit	Surabaya	529.8058	286.0723
1905	MBN-	11	Surabaya	Semarang	354.8989	191.6302
	MBN-	12	Semarang	Kumai	512.5589	276.7598
	MBN-	13	Kumai	Surabaya	542.4089	292.8775
1906	MBN-	14	Surabaya	Kumai	541.504	292.3889
	MBN-	15	Kumai	Surabaya	539.4318	291.27
1907	MBN-	16	Surabaya	Kumai	540.6712	291.9392
	MBN-	17	Kumai	Surabaya	539.8389	291.4898
1908	MBN-	18	Surabaya	Kumai	542.0396	292.6781
	MBN-	19	Kumai	Semarang	508.3373	274.4803
	MBN-	20	Semarang	Surabaya	356.2515	192.3605
1909	MBN-	21	Surabaya	Kumai	540.9229	292.0751
	MBN-	22	Kumai	Semarang	506.5284	273.5035
	MBN-	23	Semarang	Surabaya	358.6467	193.6538
1910	MBN-	24	Surabaya	Kumai	542.8104	293.0943
	MBN-	25	Kumai	Semarang	506.5951	273.5396
	MBN-	26	Semarang	Surabaya	358.3841	193.512

4.2. Data Calculation Results

4.2.1. EEOI Calculation Method

Method of EEOI calculation formulated in flow-diagram. The purpose of formulating calculation method diagram is as a guide for calculating EEOI in this research.

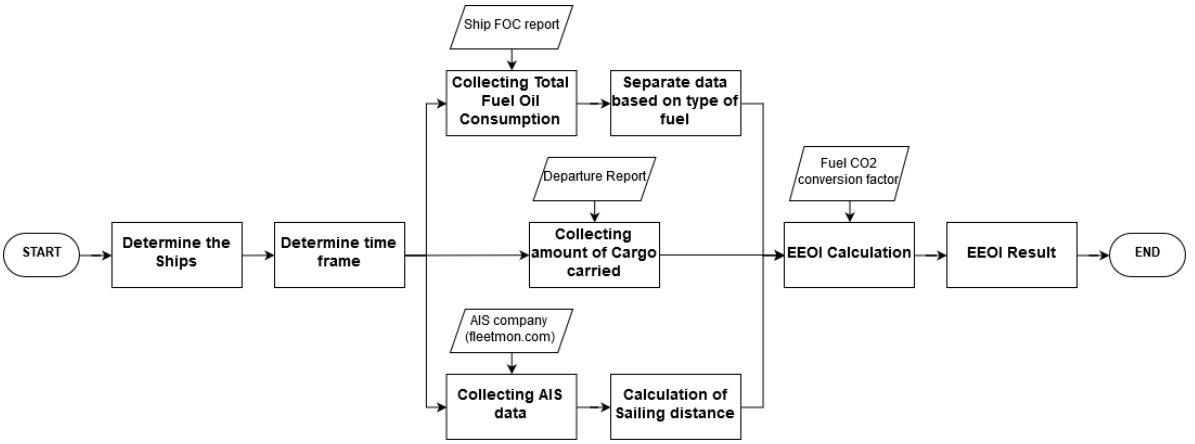

Figure 4.1 Flow Diagram from Calculating EEOI in MV Meratus Bontang and MV Meratus Benoa

4.2.2. Fuel Estimation Result

Fuel estimation method only calculate main engine fuel consumption during sailing mode. This methods only used for estimate consumption of MFO in MV Meratus Bontang and MV Meratus Benoa.

a. Trozzi's Method

MV Meratus Bontang and MV Meratus Benoa is a containership but it relatively has service speed (Vs) below common containership. Because of that with Trozzi's method, this container ship assumed as cargo ship. From formula (3) and Table 2.1, the result of Trozzi's method:

MV Meratus Bontang

Table 4.11 MV Meratus Bontang Trozzi Estimation Results

Voyage Number	Trip Number	Port		Time (hour)	Time Mode (hour)			P_{mtotal}	Sjkm (ton) Cargo
		Depart	Arrive		Cruis-ing	Maneu-vering	Hotell-ing		
1901	MBT-1	Semarang	Pontianak	97,3	55,850	-	-	1,86167	24,3631
	MBT-2	Pontianak	Semarang	106,6	48,983	-	-	1,63278	21,3677

Voyage Number	Trip Number	Port		Time (hour)	Time Mode (hour)			P_{mtotal}	Sjkm (ton) Cargo
		Depart	Arrive		Cruis-ing	Maneu-vering	Hotell-ing		
1902	MBT-3	Semarang	Pontianak	83,8	63,683	-	-	2,12278	27,7802
	MBT-4	Pontianak	Semarang	120,5	45,567	-	-	1,51889	19,8773
1903	MBT-5	Semarang	Pontianak	80,2	53,200	-	-	1,77333	23,2072
	MBT-6	Pontianak	Surabaya	92,2	57,700	-	-	1,92333	25,1702
1904	MBT-7	Surabaya	Sampit	65,6	36,617	-	-	1,22056	15,9731
	MBT-8	Sampit	Surabaya	59,6	27,733	-	-	0,92444	12,0980
1905	MBT-9	Surabaya	Kumai	80,2	43,250	-	-	1,44167	18,8667
	MBT-10	Kumai	Semarang	68,8	30,650	-	-	1,02167	13,3703
	MBT-11	Semarang	Surabaya	53,1	19,183	-	-	0,63944	8,3682
1906	MBT-12	Surabaya	Sampit	57,2	32,150	-	-	1,07167	14,0246
	MBT-13	Sampit	Surabaya	53,4	26,833	-	-	0,89444	11,7054
1907	MBT-14	Surabaya	Sampit	86,9	26,500	-	-	0,88333	11,5600
	MBT-15	Sampit	Surabaya	52,8	28,817	-	-	0,96056	12,5705
1908	MBT-16	Surabaya	Kumai	79,2	40,133	-	-	1,33778	17,5072
	MBT-17	Kumai	Surabaya	68,4	29,283	-	-	0,97611	12,7741
1909	MBT-18	Surabaya	Semarang	41,9	19,933	-	-	0,66444	8,6954
	MBT-19	Semarang	Kumai	52	28,033	-	-	0,93444	12,2288
	MBT-20	Kumai	Surabaya	91,8	24,033	-	-	0,80111	10,4839
1910	MBT-21	Surabaya	Semarang	55,3	19,700	-	-	0,65667	8,5936
	MBT-22	Semarang	Kumai	58,5	30,283	-	-	1,00944	13,2103
	MBT-23	Kumai	Surabaya	79,1	30,017	-	-	1,00056	13,0940

MV Meratus Benoa

Table 4.12 MV Meratus Benoa Trozzi Estimation Results

Voyage Number	Trip Number	Port		Time (hour)	Time Mode (hour)			P_{mtotal}	Sjkm (ton) Cargo
		Depart	Arrive		Cruising	Maneu-vering	Hotell-ing		
1901	MBN-1	Surabaya	Kumai	109,5	33,500	-	-	1,11667	14,6135

Voyage Number	Trip Number	Port		Time (hour)	Time Mode (hour)			P_{mtotal}	Sjkm (ton) Cargo
		Depart	Arrive		Cruising	Maneu-.	Hotell-ing		
	MBN-2	Kumai	Semarang	64,9	26,317	-	-	0,87722	11,4800
	MBN-3	Semarang	Surabaya	57,8	14,967	-	-	0,49889	6,5288
1902	MBN-4	Surabaya	Samarinda	111,9	63,433	-	-	2,11444	27,6712
	MBN-5	Samarinda	Surabaya	107,2	62,267	-	-	2,07556	27,1623
1903	MBN-6	Surabaya	Kumai	87,4	51,900	-	-	1,73000	22,6401
	MBN-7	Kumai	Semarang	79,2	35,667	-	-	1,18889	15,5587
	MBN-8	Semarang	Surabaya	40,2	20,283	-	-	0,67611	8,8481
1904	MBN-9	Surabaya	Sampit	70,1	30,150	-	-	1,00500	13,1522
	MBN-10	Sampit	Surabaya	59	28,983	-	-	0,96611	12,6432
1905	MBN-11	Surabaya	Semarang	44,3	24,183	-	-	0,80611	10,5494
	MBN-12	Semarang	Kumai	47,3	30,550	-	-	1,01833	13,3267
	MBN-13	Kumai	Surabaya	65,7	36,117	-	-	1,20389	15,7550
1906	MBN-14	Surabaya	Kumai	79,7	40,850	-	-	1,36167	17,8198
	MBN-15	Kumai	Surabaya	70,2	33,917	-	-	1,13056	14,7953
1907	MBN-16	Surabaya	Kumai	82,9	40,433	-	-	1,34778	17,6380
	MBN-17	Kumai	Surabaya	111	34,750	-	-	1,15833	15,1588
1908	MBN-18	Surabaya	Kumai	84,6	36,550	-	-	1,21833	15,9440
	MBN-19	Kumai	Semarang	75,5	29,767	-	-	0,99222	12,9850
	MBN-20	Semarang	Surabaya	73,8	19,900	-	-	0,66333	8,6809
1909	MBN-21	Surabaya	Kumai	79,8	31,517	-	-	1,05056	13,7483
	MBN-22	Kumai	Semarang	70	32,083	-	-	1,06944	13,9955
	MBN-23	Semarang	Surabaya	85,5	18,700	-	-	0,62333	8,1574
1910	MBN-24	Surabaya	Kumai	79,1	36,233	-	-	1,20778	15,8059
	MBN-25	Kumai	Semarang	67,5	31,033	-	-	1,03444	13,5375
	MBN-26	Semarang	Surabaya	65,4	17,483	-	-	0,58278	7,6267

b. STEAM2 - Jalkanen's Method

Jalkanen's method need assumption for many ships technical calculation. For coefficient block, formula (9), resulted

C_B **= 0,8487**

Then calculation of wetted surface area, formula (10), resulted

$\mathbf{S_{total}}$ **= 2450,58773 m²**

From formula (7) and (13) resulted resistance coefficient for friction (C_F) and residual (R_R).

$\mathbf{C_F}$ **= 0,001003068**

$\mathbf{C_R}$ **= 0,308219656**

Then calculated with formula (5) and (6), resulted frictional resistance (R_F) and residual resistance (R_R).

$\mathbf{R_F}$ **= 21192,06768 N**

= 21,19208 kN

$\mathbf{R_R}$ **= 23072,67889 N**

= 23,07268 kN

Total resistance (4) calculation resulted

$\mathbf{R_{Total}}$ **= 44,26475 kN**

Propelling power calculation using formula (8) calculation has result

$\mathbf{P_{Propel}}$ **= 181,55052 kW**

Quasi propulsive constant which represent the effective power transmitted from main engine to the propeller, calculated with formula (18).

$\boldsymbol{\eta_{qpc}}$ **= 0,598095972**

Then, total required engine power formula (19)

$\mathbf{P_{Total}}$ **= 303,54747 kW**

Based on Jalkanen, number of operating engine calculated to estimate the number of engine operated. Calculating with formula (20) and rounded down to integer.

$\mathbf{n_{oE}}$ **= 1,210796853**

$\mathbf{n_{oE} \approx 1}$

The engine load (EL) determined by formula (21)

EL = 0,210796853

STEAM2 assumed all engine has parabolic function of engine load (EL) and relative SFOC. SFOC relative calculated with formula (22) and SFOC or absolute calculated with formula (23). Base value of SFOC for installed engine 200 g/kWh.

$\mathbf{SFOC_{Relative}}$ **= 1,150552302**

SFOC = 230,1104603 g/kWh

When service speed, both MV Meratus Bontang and MV Meratus Benoa operated with average 1080 kW or 75% engine load. Calculated with formula (33)

$$FOC = SFOC \times Power \quad (33)$$

FOC = 230,11046 g/kWh ×1080 kW

FOC = 248519,2972 g/hour

FOC = 0,248519297 ton/hour

From FOC, Jalkanen's method calculated as follow

MV Meratus Bontang

Table 4.13 MV Meratus Bontang Jalkanen Estimation Results

Voyage Number	Trip Number	Port		Time (hour)		MFO FOC (Ton)
		Depart	Arrive	Total	Cruising	
1901	MBT-1	Semarang	Pontianak	97,30	55,850	13,8798
	MBT-2	Pontianak	Semarang	106,60	48,983	12,1733
1902	MBT-3	Semarang	Pontianak	83,80	63,683	15,8265
	MBT-4	Pontianak	Semarang	120,47	45,567	11,3242
1903	MBT-5	Semarang	Pontianak	80,20	53,200	13,2212
	MBT-6	Pontianak	Surabaya	92,20	57,700	14,3396
1904	MBT-7	Surabaya	Sampit	65,60	36,617	9,0999
	MBT-8	Sampit	Surabaya	59,60	27,733	6,8923
1905	MBT-9	Surabaya	Kumai	80,20	43,250	10,7485
	MBT-10	Kumai	Semarang	68,80	30,650	7,6171
	MBT-11	Semarang	Surabaya	53,10	19,183	4,7674
1906	MBT-12	Surabaya	Sampit	57,20	32,150	7,9899
	MBT-13	Sampit	Surabaya	53,40	26,833	6,6686
1907	MBT-14	Surabaya	Sampit	86,90	26,500	6,5858
	MBT-15	Sampit	Surabaya	52,80	28,817	7,1615
1908	MBT-16	Surabaya	Kumai	79,20	40,133	9,9739

Voyage Number	Trip Number	Port		Time (hour)		MFO FOC (Ton)
		Depart	Arrive	Total	Cruising	
	MBT-17	Kumai	Surabaya	68,40	29,283	7,2775
1909	MBT-18	Surabaya	Semarang	41,90	19,933	4,9538
	MBT-19	Semarang	Kumai	52,00	28,033	6,9668
	MBT-20	Kumai	Surabaya	91,80	24,033	5,9727
1910	MBT-21	Surabaya	Semarang	55,30	19,700	4,8958
	MBT-22	Semarang	Kumai	58,50	30,283	7,5260
	MBT-23	Kumai	Surabaya	79,10	30,017	7,4597

MV Meratus Benoa

Table 4.14 MV Meratus Bontang Jalkanen Estimation Results

Voyage Number	Trip Number	Port		Time (hour)		FOC MFO (Ton)
		Depart	Arrive	Total	Cruising	
1901	MBN-1	Surabaya	Kumai	109,5	33,500	8,3254
	MBN-2	Kumai	Semarang	64,9	26,317	6,5402
	MBN-3	Semarang	Surabaya	57,8	14,967	3,7195
1902	MBN-4	Surabaya	Samarinda	111,9	63,433	15,7644
	MBN-5	Samarinda	Surabaya	107,2	62,267	15,4745
1903	MBN-6	Surabaya	Kumai	87,4	51,900	12,8982
	MBN-7	Kumai	Semarang	79,2	35,667	8,8639
	MBN-8	Semarang	Surabaya	40,2	20,283	5,0408
1904	MBN-9	Surabaya	Sampit	70,1	30,150	7,4929
	MBN-10	Sampit	Surabaya	59	28,983	7,2029
1905	MBN-11	Surabaya	Semarang	44,3	24,183	6,0100
	MBN-12	Semarang	Kumai	47,3	30,550	7,5923
	MBN-13	Kumai	Surabaya	65,7	36,117	8,9757
1906	MBN-14	Surabaya	Kumai	79,7	40,850	10,1520
	MBN-15	Kumai	Surabaya	70,2	33,917	8,4289
1907	MBN-16	Surabaya	Kumai	82,9	40,433	10,0485
	MBN-17	Kumai	Surabaya	111	34,750	8,6360
1908	MBN-18	Surabaya	Kumai	84,6	36,550	9,0834
	MBN-19	Kumai	Semarang	75,5	29,767	7,3976
	MBN-20	Semarang	Surabaya	73,8	19,900	4,9455
1909	MBN-21	Surabaya	Kumai	79,8	31,517	7,8325

Voyage Number	Trip Number	Port		Time (hour)		FOC MFO (Ton)
		Depart	Arrive	Total	Cruising	
	MBN-22	Kumai	Semarang	70	32,083	7,9733
	MBN-23	Semarang	Surabaya	85,5	18,700	4,6473
1910	MBN-24	Surabaya	Kumai	79,1	36,233	9,0047
	MBN-25	Kumai	Semarang	67,5	31,033	7,7124
	MBN-26	Semarang	Surabaya	65,4	17,483	4,3449

c. Wang's Method

Plotting daily MFO consumption from MV Meratus Bontang and MV Meratus Benoa into the chart and estimating the power trendline.

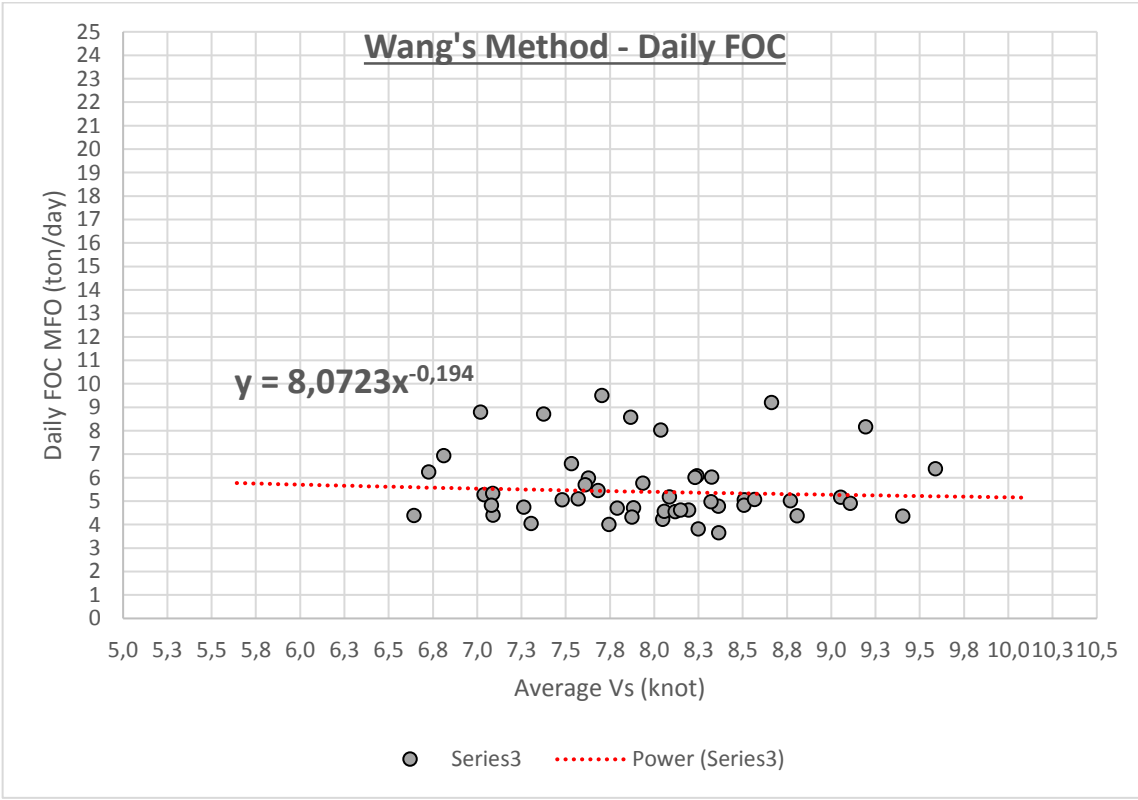

Figure 4.2 Daily FOC vs Average Sailing Speed for Wang Formula

From the trendline, resulted that formula (24) defined as

$$Q = 8{,}0723 \cdot v^{-0{,}194} \qquad (34)$$

Formula (34) then used for calculating daily fuel oil consumption from MV Meratus Bontang and Meratus Benoa. The result of using Wang's method as follows

MV Meratus Bontang

Table 4.15 MV Meratus Bontang Wang Estimation Results

Voyage Number	Trip Number		Port		Average Sail Speed (knot)	Est. MFO cons/day (Ton)	Est. MFO Cons (Ton)
			Departure	Arrived			
1901	MBT-	1	Semarang	Pontianak	7,570	5,4507	12,6842
	MBT-	2	Pontianak	Semarang	8,508	5,3286	10,8754
1902	MBT-	3	Semarang	Pontianak	7,263	5,4947	14,5800
	MBT-	4	Pontianak	Semarang	9,053	5,2648	9,9959
1903	MBT-	5	Semarang	Pontianak	8,036	5,3880	11,9433
	MBT-	6	Pontianak	Surabaya	8,506	5,3288	12,8113
1904	MBT-	7	Surabaya	Sampit	7,743	5,4268	8,2797
	MBT-	8	Sampit	Surabaya	8,193	5,3677	6,2027
1905	MBT-	9	Surabaya	Kumai	8,363	5,3463	9,6345
	MBT-	10	Kumai	Semarang	7,480	5,4634	6,9772
	MBT-	11	Semarang	Surabaya	8,048	5,3863	4,3053
1906	MBT-	12	Surabaya	Sampit	7,089	5,5206	7,3953
	MBT-	13	Sampit	Surabaya	8,057	5,3852	6,0209
1907	MBT-	14	Surabaya	Sampit	8,248	5,3607	5,9191
	MBT-	15	Sampit	Surabaya	9,403	5,2261	6,2750
1908	MBT-	16	Surabaya	Kumai	7,304	5,4887	9,1783
	MBT-	17	Kumai	Surabaya	8,806	5,2931	6,4583
1909	MBT-	18	Surabaya	Semarang	7,038	5,5284	4,5916
	MBT-	19	Semarang	Kumai	8,117	5,3774	6,2811
	MBT-	20	Kumai	Surabaya	8,768	5,2975	5,3049
1910	MBT-	21	Surabaya	Semarang	9,587	5,2065	4,2737
	MBT-	22	Semarang	Kumai	7,883	5,4081	6,8239
	MBT-	23	Kumai	Surabaya	8,361	5,3466	6,6869

MV Meratus Benoa

Table 4.16 MV Meratus Benoa Wang Estimation Results

Voyage Number	Trip Number		Port		Average sSail Speed (knot)	Est. MFO cons/day (Ton)	Est. MFO Cons (Ton)
			Departure	Arrived			
1901	MBN -	1	Surabaya	Kumai	9,106	5,2588	7,3404
1901	MBN -	2	Kumai	Semarang	7,532	5,4561	5,9828
1901	MBN -	3	Semarang	Surabaya	9,194	5,2490	3,2733
1902	MBN -	4	Surabaya	Samarinda	8,086	5,3815	14,2235
1902	MBN -	5	Samarinda	Surabaya	7,018	5,5313	14,3506
1903	MBN -	6	Surabaya	Kumai	7,627	5,4428	11,7700
1903	MBN -	7	Kumai	Semarang	7,087	5,5209	8,2047
1903	MBN -	8	Semarang	Surabaya	8,321	5,3516	4,5228
1904	MBN -	9	Surabaya	Sampit	7,375	5,4784	6,8823
1904	MBN -	10	Sampit	Surabaya	7,610	5,4452	6,5758
1905	MBN -	11	Surabaya	Semarang	8,567	5,3214	5,3621
1905	MBN -	12	Semarang	Kumai	8,240	5,3618	6,8251
1905	MBN -	13	Kumai	Surabaya	7,873	5,4094	8,1404
1906	MBN -	14	Surabaya	Kumai	6,642	5,5908	9,5160
1906	MBN -	15	Kumai	Surabaya	8,148	5,3734	7,5937
1907	MBN -	16	Surabaya	Kumai	7,081	5,5218	9,3028
1907	MBN -	17	Kumai	Surabaya	7,790	5,4205	7,8484
1908	MBN -	18	Surabaya	Kumai	8,323	5,3513	8,1496
1908	MBN -	19	Kumai	Semarang	7,703	5,4323	6,7375
1908	MBN -	20	Semarang	Surabaya	7,683	5,4351	4,5066
1909	MBN -	21	Surabaya	Kumai	8,663	5,3100	6,9730
1909	MBN -	22	Kumai	Semarang	7,867	5,4102	7,2324
1909	MBN -	23	Semarang	Surabaya	7,935	5,4012	4,2084
1910	MBN -	24	Surabaya	Kumai	6,810	5,5637	8,3997
1910	MBN -	25	Kumai	Semarang	6,726	5,5772	7,2116
1910	MBN -	26	Semarang	Surabaya	8,229	5,3631	3,9069

d. Mersins Method

From Barras formula (28), resulted that value of ship engine coefficient (λ)

λ = 0,000029

From formula (27), formula (30), and formula (31) result of Mersin's estimation method calculated as follows

MV Meratus Bontang

Table 4.17 MV Meratus Bontang Mersin Estimation Results

Voyage Number	Trip Number	Port		Time (hour)		Cargo (Ton)	Initial ∇ (Ton)	Initial MFO (Ton)	∇(*t*)	L(t)	F(t) (ton)
		Depart	Arrive	Total	Cruising						
1901	MBT-1	Semarang	Pontianak	97,3	55,85	4017,00	7313,00	74,22	7302,16	3285,16	-3210,94
	MBT-2	Pontianak	Semarang	106,6	48,98	980,00	4325,00	63,30	4315,50	3335,50	-3272,20
1902	MBT-3	Semarang	Pontianak	83,8	63,68	3324,00	6666,00	117,40	6655,74	3331,74	-3214,34
	MBT-4	Pontianak	Semarang	120,5	45,57	637,00	3999,00	104,82	3988,89	3351,89	-3247,07
1903	MBT-5	Semarang	Pontianak	80,2	53,20	2532,00	5881,00	95,48	5870,32	3338,32	-3242,85
	MBT-6	Pontianak	Surabaya	92,2	57,70	1054,00	4387,00	77,67	4375,71	3321,71	-3244,03
1904	MBT-7	Surabaya	Sampit	65,6	36,62	4408,00	78822,00	66,22	78784,89	74376,89	-74310,67
	MBT-8	Sampit	Surabaya	59,6	27,73	659,00	3845,00	60,12	3840,56	3181,56	-3121,44
1905	MBT-9	Surabaya	Kumai	80,2	43,25	4473,00	7749,00	94,76	7737,24	3264,24	-3169,48
	MBT-10	Kumai	Semarang	68,8	30,65	3500,00	6739,00	88,18	6733,57	3233,57	-3145,39
	MBT-11	Semarang	Surabaya	53,1	19,18	1066,00	4284,00	81,72	4280,87	3214,87	-3133,15
1906	MBT-12	Surabaya	Sampit	57,2	32,15	4480,00	7724,00	78,34	7718,69	3238,69	-3160,34
	MBT-13	Sampit	Surabaya	53,4	26,83	954,00	4153,00	72,65	4148,69	3194,69	-3122,04

Voyage Number	Trip Number	Port		Time (hour)		Cargo (Ton)	Initial ∇ (Ton)	Initial MFO (Ton)	∇(*t*)	L(t)	F(t) (ton)
		Depart	Arrive	Total	Cruising						
1907	MBT-14	Surabaya	Sampit	86,9	26,50	4468,00	7677,00	97,73	7670,13	3202,13	-3104,39
	MBT-15	Sampit	Surabaya	52,8	28,82	728,00	3933,00	93,53	3925,91	3197,91	-3104,39
1908	MBT-16	Surabaya	Kumai	79,2	40,13	4457,00	7688,00	88,29	7680,77	3223,77	-3135,47
	MBT-17	Kumai	Surabaya	68,4	29,28	1246,00	4373,00	81,53	4366,65	3120,65	-3039,12
1909	MBT-18	Surabaya	Semarang	41,9	19,93	3418,00	6759,00	106,78	6756,05	3338,05	-3231,27
	MBT-19	Semarang	Kumai	52	28,03	4376,00	7750,00	102,40	7743,03	3367,03	-3264,63
	MBT-20	Kumai	Surabaya	91,8	24,03	2512,00	5927,00	97,08	5920,70	3408,70	-3311,62
1910	MBT-21	Surabaya	Semarang	55,3	19,70	4058,00	7532,00	92,64	7524,08	3466,08	-3373,44
	MBT-22	Semarang	Kumai	58,5	30,28	3712,00	7166,00	87,40	7159,45	3447,45	-3360,05
	MBT-23	Kumai	Surabaya	79,1	30,02	3058,00	6485,00	81,45	6477,76	3419,76	-3338,30

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Table 4.18 MV Meratus Benoa Mersin Estimation Results

Voyage Number	Trip Number	Port		Time (hour)		Cargo (Ton)	Initial ∇ (Ton)	Initial MFO (Ton)	∇(*t*)	L(t)	F(t) (ton)
		Depart	Arrive	Total	Cruising						
1901	MBN-1	Surabaya	Kumai	109,5	33,50	3198,00	6245,32	76,59	6245,32	3047,32	-2960,54
	MBN-2	Kumai	Semarang	64,9	26,32	3047,90	6842,16	69,74	6842,16	3794,26	-3719,71
	MBN-3	Semarang	Surabaya	57,8	14,97	416,10	4511,92	62,51	4511,92	4095,82	-4029,54
1902	MBN-4	Surabaya	Samarinda	111,9	63,43	3484,00	7186,34	57,40	7186,34	3702,34	-3630,12
	MBN-5	Samarinda	Surabaya	107,2	62,27	256,80	6463,20	43,75	6463,2	6206,40	-6153,78

Voyage Number	Trip Number	Port		Time (hour)		Cargo (Ton)	Initial ∇ (Ton)	Initial MFO (Ton)	∇(*t*)	L(t)	F(t) (ton)
		Depart	Arrive	Total	Cruising						
1903	MBN-6	Surabaya	Kumai	87,4	51,90	4477,00	7524,32	60,57	7524,32	3047,32	-2976,25
	MBN-7	Kumai	Semarang	79,2	35,67	4271,40	7320,72	52,72	7320,72	3049,32	-2990,92
	MBN-8	Semarang	Surabaya	40,2	20,28	541,80	4848,73	48,27	4848,73	4306,93	-4254,68
1904	MBN-9	Surabaya	Sampit	70,1	30,15	4509,00	7560,32	35,53	7560,32	3051,32	-3010,26
	MBN-10	Sampit	Surabaya	59	28,98	268,50	4577,00	24,50	4577	4308,50	-4279,82
1905	MBN-11	Surabaya	Semarang	44,3	24,18	3366,00	6692,88	57,36	6692,88	3326,88	-3263,11
	MBN-12	Semarang	Kumai	47,3	30,55	4379,00	7427,02	52,25	7427,02	3048,02	-2988,04
	MBN-13	Kumai	Surabaya	65,7	36,12	2624,90	6271,56	44,56	6271,56	3646,66	-3594,98
1906	MBN-14	Surabaya	Kumai	79,7	40,85	4423,30	7470,62	37,74	7470,62	3047,32	-3004,15
	MBN-15	Kumai	Surabaya	70,2	33,92	1664,10	5225,10	30,27	5225,1	3561,00	-3524,17
1907	MBN-16	Surabaya	Kumai	82,9	40,43	4460,50	7511,82	73,36	7511,82	3051,32	-2971,42
	MBN-17	Kumai	Surabaya	111	34,75	3471,40	6728,14	65,23	6728,14	3256,74	-3184,56
1908	MBN-18	Surabaya	Kumai	84,6	36,55	4463,00	7493,00	58,43	7493	3030,00	-2961,99
	MBN-19	Kumai	Semarang	75,5	29,77	4102,00	7120,00	49,77	7120	3018,00	-2962,25
	MBN-20	Semarang	Surabaya	73,8	19,90	491,00	4704,00	38,06	4704	4213,00	-4171,93
1909	MBN-21	Surabaya	Kumai	79,8	31,52	4483,00	8038,00	83,10	8038	3555,00	-3462,14
	MBN-22	Kumai	Semarang	70	32,08	3043,90	6088,99	71,01	6088,99	3045,09	-2967,89
	MBN-23	Semarang	Surabaya	85,5	18,70	824,00	5068,00	59,56	5068	4244,00	-4181,16
1910	MBN-24	Surabaya	Kumai	79,1	36,23	3817,00	7114,58	55,36	7114,58	3297,58	-3237,19
	MBN-25	Kumai	Semarang	67,5	31,03	2503,00	5889,77	45,07	5889,77	3386,77	-3338,04
	MBN-26	Semarang	Surabaya	65,4	17,48	253,00	4271,60	37,07	4271,6	4018,60	-3978,49

From the result of using Mersin's method formula, the amount of consumed fuel become unrealistic. Negative number cannot represent the fuel oil consumption. Mersin formula (31) modified into

$$\boldsymbol{FC = (\nabla(0) - Wi) - L(t)} \quad (35)$$

That because, the example 2.1.1 for Mersin's method (Mersin, et al., 2017) stated that the initial fuel is 229000 tons and carried cargo 6000 tons with displacement 235000 tons. Because of that the assumption of initial fuel changed to the weight of initial displacement (ton) diminished by amount of initial cargo (ton).

With that modified formula (35), the calculation of 'Modified Mersin's' method become

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Table 4.19 MV Meratus Bontang Mersin Modified Estimation Results

Voyage Number	Trip Number	Port		Time (hour)		Cargo (Ton)	Initial ∇ (Ton)	Initial MFO (Ton)	∇(*t*)	L(t)	F(t)
		Depart	Arrive	Total	Cruising						
1901	MBT-1	Semarang	Pontianak	97,3	55,850	4017,00	7313,00	3296,00	7302,16	3285,16	10,8370
	MBT-2	Pontianak	Semarang	106,6	48,983	980,00	4325,00	3345,00	4315,50	3335,50	9,5046
1902	MBT-3	Semarang	Pontianak	83,8	63,683	3324,00	6666,00	3342,00	6655,74	3331,74	10,2580
	MBT-4	Pontianak	Semarang	120,5	45,567	637,00	3999,00	3362,00	3988,89	3351,89	10,1065
1903	MBT-5	Semarang	Pontianak	80,2	53,200	2532,00	5881,00	3349,00	5870,32	3338,32	10,6752
	MBT-6	Pontianak	Surabaya	92,2	57,700	1054,00	4387,00	3333,00	4375,71	3321,71	11,2931
1904	MBT-7	Surabaya	Sampit	65,6	36,617	4408,00	78822,00	74414,00	78784,89	74376,89	37,1136
	MBT-8	Sampit	Surabaya	59,6	27,733	659,00	3845,00	3186,00	3840,56	3181,56	4,4445
1905	MBT-9	Surabaya	Kumai	80,2	43,250	4473,00	7749,00	3276,00	7737,24	3264,24	11,7615
	MBT-10	Kumai	Semarang	68,8	30,650	3500,00	6739,00	3239,00	6733,57	3233,57	5,4341

Voyage Number	Trip Number	Port		Time (hour)		Cargo (Ton)	Initial ∇ (Ton)	Initial MFO (Ton)	∇(*t*)	L(t)	F(t)
		Depart	Arrive	Total	Cruising						
	MBT-11	Semarang	Surabaya	53,1	19,183	1066,00	4284,00	3218,00	4280,87	3214,87	3,1321
1906	MBT-12	Surabaya	Sampit	57,2	32,150	4480,00	7724,00	3244,00	7718,69	3238,69	5,3135
	MBT-13	Sampit	Surabaya	53,4	26,833	954,00	4153,00	3199,00	4148,69	3194,69	4,3055
1907	MBT-14	Surabaya	Sampit	86,9	26,500	4468,00	7677,00	3209,00	7670,13	3202,13	6,8720
	MBT-15	Sampit	Surabaya	52,8	28,817	728,00	3933,00	3205,00	3925,91	3197,91	7,0865
1908	MBT-16	Surabaya	Kumai	79,2	40,133	4457,00	7688,00	3231,00	7680,77	3223,77	7,2319
	MBT-17	Kumai	Surabaya	68,4	29,283	1246,00	4373,00	3127,00	4366,65	3120,65	6,3479
1909	MBT-18	Surabaya	Semarang	41,9	19,933	3418,00	6759,00	3341,00	6756,05	3338,05	2,9494
	MBT-19	Semarang	Kumai	52	28,033	4376,00	7750,00	3374,00	7743,03	3367,03	6,9719
	MBT-20	Kumai	Surabaya	91,8	24,033	2512,00	5927,00	3415,00	5920,70	3408,70	6,2998
1910	MBT-21	Surabaya	Semarang	55,3	19,700	4058,00	7532,00	3474,00	7524,08	3466,08	7,9195
	MBT-22	Semarang	Kumai	58,5	30,283	3712,00	7166,00	3454,00	7159,45	3447,45	6,5464
	MBT-23	Kumai	Surabaya	79,1	30,017	3058,00	6485,00	3427,00	6477,76	3419,76	7,2445

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Table 4.20 MV Meratus Benoa Mersin Modified Estimation Results

Voyage Number	Trip Number	Port		Time (hour)		Cargo (Ton)	Initial ∇ (Ton)	Initial MFO (Ton)	∇(*t*)	L(t)	F(t)
		Depart	Arrive	Total	Cruising						
1901	MBN-1	Surabaya	Kumai	109,5	33,500	3198,00	6245,32	3047,32	6235,14	3037,14	10,1839
	MBN-2	Kumai	Semarang	64,9	26,317	3047,90	6842,16	3794,26	6837,35	3789,45	4,8117
	MBN-3	Semarang	Surabaya	57,8	14,967	416,10	4511,92	4095,82	4508,15	4092,05	3,7711

Voyage Number	Trip Number	Port		Time (hour)		Cargo (Ton)	Initial ∇ (Ton)	Initial MFO (Ton)	∇(*t*)	L(t)	F(t)
		Depart	Arrive	Total	Cruising						
1902	MBN-4	Surabaya	Samarinda	111,9	63,433	3484,00	7186,34	3702,34	7171,52	3687,52	14,8210
	MBN-5	Samarinda	Surabaya	107,2	62,267	256,80	6463,20	6206,40	6454,33	6197,53	8,8674
1903	MBN-6	Surabaya	Kumai	87,4	51,900	4477,00	7524,32	3047,32	7513,82	3036,82	10,4968
	MBN-7	Kumai	Semarang	79,2	35,667	4271,40	7320,72	3049,32	7315,04	3043,64	5,6832
	MBN-8	Semarang	Surabaya	40,2	20,283	541,80	4848,73	4306,93	4844,75	4302,95	3,9753
1904	MBN-9	Surabaya	Sampit	70,1	30,150	4509,00	7560,32	3051,32	7554,79	3045,79	5,5311
	MBN-10	Sampit	Surabaya	59	28,983	268,50	4577,00	4308,50	4572,82	4304,32	4,1805
1905	MBN-11	Surabaya	Semarang	44,3	24,183	3366,00	6692,88	3326,88	6686,47	3320,47	6,4119
	MBN-12	Semarang	Kumai	47,3	30,550	4379,00	7427,02	3048,02	7419,29	3040,29	7,7250
	MBN-13	Kumai	Surabaya	65,7	36,117	2624,90	6271,56	3646,66	6264,44	3639,54	7,1160
1906	MBN-14	Surabaya	Kumai	79,7	40,850	4423,30	7470,62	3047,32	7465,19	3041,89	5,4315
	MBN-15	Kumai	Surabaya	70,2	33,917	1664,10	5225,10	3561,00	5218,54	3554,44	6,5595
1907	MBN-16	Surabaya	Kumai	82,9	40,433	4460,50	7511,82	3051,32	7505,28	3044,78	6,5368
	MBN-17	Kumai	Surabaya	111	34,750	3471,40	6728,14	3256,74	6721,19	3249,79	6,9512
1908	MBN-18	Surabaya	Kumai	84,6	36,550	4463,00	7493,00	3030,00	7483,42	3020,42	9,5801
	MBN-19	Kumai	Semarang	75,5	29,767	4102,00	7120,00	3018,00	7114,02	3012,02	5,9797
	MBN-20	Semarang	Surabaya	73,8	19,900	491,00	4704,00	4213,00	4700,99	4209,99	3,0082
1909	MBN-21	Surabaya	Kumai	79,8	31,517	4483,00	8038,00	3555,00	8028,24	3545,24	9,7606
	MBN-22	Kumai	Semarang	70	32,083	3043,90	6088,99	3045,09	6082,81	3038,91	6,1837
	MBN-23	Semarang	Surabaya	85,5	18,700	824,00	5068,00	4244,00	5064,73	4240,73	3,2731
1910	MBN-24	Surabaya	Kumai	79,1	36,233	3817,00	7114,58	3297,58	7109,55	3292,55	5,0264

Voyage Number	Trip Number	Port		Time (hour)		Cargo (Ton)	Initial ∇ (Ton)	Initial MFO (Ton)	∇(*t*)	L(t)	F(t)
		Depart	Arrive	Total	Cruising						
	MBN-25	Kumai	Semarang	67,5	31,033	2503,00	5889,77	3386,77	5886,11	3383,11	3,6567
	MBN-26	Semarang	Surabaya	65,4	17,483	253,00	4271,60	4018,60	4268,55	4015,55	3,0456

4.2.3. EEOI Calculation Results

Based on EEOI guidelines, fuel oil consumption, cargo carried, and distance travelled data calculated with formula (1). The result of EEOI calculation as follows:

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Table 4.21 MV Meratus Bontang EEOI Calculation Results

Voyage Number	Trip Number		Time (GMT +7)		Port		EEOI Index
			Depart	Arrive	Depart	Arrive	
1901	MBT-	1	09/01/2019 22:30	13/01/2019 23:48	Semarang	Pontianak	0,000517
	MBT-	2	13/01/2019 21:54	18/01/2019 8:30	Pontianak	Semarang	0,000451
1902	MBT-	3	18/01/2019 8:36	21/01/2019 20:24	Semarang	Pontianak	0,000601
	MBT-	4	21/01/2019 16:00	26/01/2019 16:28	Pontianak	Semarang	0,000411
1903	MBT-	5	26/01/2019 16:48	30/01/2019 1:00	Semarang	Pontianak	0,001040
	MBT-	6	29/01/2019 20:48	02/02/2019 17:00	Pontianak	Surabaya	0,000460
1904	MBT-	7	03/02/2019 18:18	06/02/2019 11:54	Surabaya	Sampit	0,000396
	MBT-	8	06/02/2019 13:24	09/02/2019 1:00	Sampit	Surabaya	0,000533
1905	MBT-	9	09/02/2019 9:00	12/02/2019 17:12	Surabaya	Kumai	0,000373
	MBT-	10	12/02/2019 17:36	15/02/2019 14:24	Kumai	Semarang	0,000400
	MBT-	11	15/02/2019 9:36	17/02/2019 14:42	Semarang	Surabaya	0,000457
1906	MBT-	12	17/02/2019 18:42	20/02/2019 3:54	Surabaya	Sampit	0,000421
	MBT-	13	20/02/2019 4:00	22/02/2019 9:24	Sampit	Surabaya	0,000306
1907	MBT-	14	22/02/2019 9:18	26/02/2019 0:12	Surabaya	Sampit	0,000316
	MBT-	15	25/02/2019 20:24	28/02/2019 1:12	Sampit	Surabaya	0,000322
1908	MBT-	16	28/02/2019 9:30	03/03/2019 16:42	Surabaya	Kumai	0,000451
	MBT-	17	03/03/2019 16:48	06/03/2019 13:12	Kumai	Surabaya	0,000615

Voyage Number	Trip Number		Time (GMT +7)		Port		EEOI Index
			Depart	Arrive	Depart	Arrive	
1909	MBT-	18	06/03/2019 13:24	08/03/2019 7:18	Surabaya	Semarang	0,000618
	MBT-	19	08/03/2019 7:24	10/03/2019 11:24	Semarang	Kumai	0,000368
	MBT-	20	10/03/2019 11:30	14/03/2019 7:18	Kumai	Surabaya	0,000413
1910	MBT-	21	15/03/2019 2:00	17/03/2019 9:18	Surabaya	Semarang	0,000772
	MBT-	22	17/03/2019 9:24	19/03/2019 19:54	Semarang	Kumai	0,000667
	MBT-	23	19/03/2019 20:06	23/03/2019 3:12	Kumai	Surabaya	0,000406

The average EEOI Index calculated with formula (2). Result of Average EEOI Index for MV Meratus Bontang is **0,000473 ton-CO_2/TEUS.nm**.

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Table 4.22 MV Meratus Benoa EEOI Calculation Results

Voyage Number	Trip Number		Time (GMT +7)		Port		EEOI Index
			Depart	Arrive	Depart	Arrive	
1901	MBN-	1	06/01/2019 20:18	11/01/2019 9:48	Surabaya	Kumai	0,000626
	MBN-	2	11/01/2019 9:36	14/01/2019 2:30	Kumai	Semarang	0,000593
	MBN-	3	14/01/2019 2:12	16/01/2019 12:00	Semarang	Surabaya	0,000679
1902	MBN-	4	16/01/2019 16:54	21/01/2019 8:48	Surabaya	Samarinda	0,000545
	MBN-	5	21/01/2019 8:54	25/01/2019 20:06	Samarinda	Surabaya	0,000883
1903	MBN-	6	26/01/2019 14:00	30/01/2019 5:24	Surabaya	Kumai	0,000796
	MBN-	7	30/01/2019 3:00	02/02/2019 10:12	Kumai	Semarang	0,000453
	MBN-	8	02/02/2019 10:18	03/02/2019 1:30	Semarang	Surabaya	0,000513
1904	MBN-	9	04/02/2019 10:42	07/02/2019 8:48	Surabaya	Sampit	0,000688
	MBN-	10	07/02/2019 9:00	09/02/2019 20:00	Sampit	Surabaya	0,000930

Voyage Number	Trip Number		Time (GMT +7)		Port		EEOI Index
			Depart	Arrive	Depart	Arrive	
1905	MBN-	11	10/02/2019 9:00	12/02/2019 5:18	Surabaya	Semarang	0,000759
	MBN-	12	12/02/2019 5:24	14/02/2019 4:42	Semarang	Kumai	0,000441
	MBN-	13	14/02/2019 5:00	16/02/2019 22:42	Kumai	Surabaya	0,000552
1906	MBN-	14	16/02/2019 21:00	20/02/2019 4:42	Surabaya	Kumai	0,000503
	MBN-	15	20/02/2019 3:36	23/02/2019 1:48	Kumai	Surabaya	0,000424
1907	MBN-	16	22/02/2019 22:18	26/02/2019 9:12	Surabaya	Kumai	0,000525
	MBN-	17	26/02/2019 2:00	02/03/2019 17:00	Kumai	Surabaya	0,000400
1908	MBN-	18	02/03/2019 14:06	06/03/2019 2:42	Surabaya	Kumai	0,000602
	MBN-	19	05/03/2019 20:00	08/03/2019 23:30	Kumai	Semarang	0,000674
	MBN-	20	08/03/2019 23:48	12/03/2019 1:36	Semarang	Surabaya	0,002516
1909	MBN-	21	12/03/2019 1:42	15/03/2019 9:30	Surabaya	Kumai	0,000749
	MBN-	22	15/03/2019 9:48	18/03/2019 7:48	Kumai	Semarang	0,000621
	MBN-	23	18/03/2019 8:30	21/03/2019 22:00	Semarang	Surabaya	0,000796
1910	MBN-	24	21/03/2019 21:00	25/03/2019 4:06	Surabaya	Kumai	0,000771
	MBN-	25	25/03/2019 4:00	27/03/2019 23:30	Kumai	Semarang	0,000564
	MBN-	26	28/03/2019 0:24	30/03/2019 17:48	Semarang	Surabaya	0,000947

The average EEOI Index calculated with formula (2). Result of Average EEOI Index for MV Meratus Benoa is **0,000630 ton-CO_2/TEUS.nm**.

4.2.4. EEOI Calculation with Estimated Fuel Oil Result

In estimated fuel oil consumption calculation of EEOI, the distance using only cruising distance.

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Table 4.23 MV Meratus Bontang EEOI Calculation using Estimation Method Results

Voyage Number	Trip Number		Port		MFO Consumption (Ton)					EEOI Index (MFO)				
			Depart	Arrive	Actual	Trozzi	Jalkanen	Wang	Mersin*	Actual	Trozzi	Jalkanen	Wang	Mersin*
1901	MBT-	1	Semarang	Pontianak	11,860	24,363	13,880	12,684	10,837	0,000447	0,000919	0,000523	0,000478	0,000409
	MBT-	2	Pontianak	Semarang	10,312	21,368	12,173	10,875	9,505	0,000377	0,000782	0,000446	0,000398	0,000348
1902	MBT-	3	Semarang	Pontianak	12,574	27,780	15,827	14,580	10,258	0,000519	0,001147	0,000653	0,000602	0,000423
	MBT-	4	Pontianak	Semarang	9,811	19,877	11,324	9,996	10,107	0,000352	0,000714	0,000407	0,000359	0,000363
1903	MBT-	5	Semarang	Pontianak	17,802	23,207	13,221	11,943	10,675	0,001002	0,001306	0,000744	0,000672	0,000601
	MBT-	6	Pontianak	Surabaya	11,599	25,170	14,340	12,811	11,293	0,000422	0,000917	0,000522	0,000467	0,000411
1904	MBT-	7	Surabaya	Sampit	6,105	15,973	9,100	8,280	37,114	0,000290	0,000760	0,000433	0,000394	0,001766
	MBT-	8	Sampit	Surabaya	5,341	12,098	6,892	6,203	4,445	0,000487	0,001103	0,000628	0,000565	0,000405
1905	MBT-	9	Surabaya	Kumai	6,584	18,867	10,748	9,635	11,761	0,000281	0,000804	0,000458	0,000411	0,000501
	MBT-	10	Kumai	Semarang	6,453	13,370	7,617	6,977	5,434	0,000331	0,000685	0,000390	0,000357	0,000278
	MBT-	11	Semarang	Surabaya	3,379	8,368	4,767	4,305	3,132	0,000409	0,001013	0,000577	0,000521	0,000379

Voyage Number	Trip Number		Port		MFO Consumption (Ton)					EEOI Index (MFO)				
			Depart	Arrive	Actual	Trozzi	Jalkanen	Wang	Mersin*	Actual	Trozzi	Jalkanen	Wang	Mersin*
1906	MBT-	12	Surabaya	Sampit	5,887	14,025	7,990	7,395	5,314	0,000336	0,000801	0,000457	0,000423	0,000304
	MBT-	13	Sampit	Surabaya	5,102	11,705	6,669	6,021	4,305	0,000241	0,000553	0,000315	0,000285	0,000204
1907	MBT-	14	Surabaya	Sampit	4,208	11,560	6,586	5,919	6,872	0,000267	0,000732	0,000417	0,000375	0,000435
	MBT-	15	Sampit	Surabaya	5,232	12,571	7,161	6,275	7,087	0,000248	0,000595	0,000339	0,000297	0,000336
1908	MBT-	16	Surabaya	Kumai	6,759	17,507	9,974	9,178	7,232	0,000348	0,000902	0,000514	0,000473	0,000373
	MBT-	17	Kumai	Surabaya	5,341	12,774	7,277	6,458	6,348	0,000471	0,001127	0,000642	0,000570	0,000560
1909	MBT-	18	Surabaya	Semarang	4,382	8,695	4,954	4,592	2,949	0,000553	0,001097	0,000625	0,000579	0,000372
	MBT-	19	Semarang	Kumai	5,320	12,229	6,967	6,281	6,972	0,000351	0,000806	0,000459	0,000414	0,000460
	MBT-	20	Kumai	Surabaya	5,014	10,484	5,973	5,305	6,300	0,000390	0,000815	0,000464	0,000412	0,000490
1910	MBT-	21	Surabaya	Semarang	5,232	8,594	4,896	4,274	7,919	0,000466	0,000765	0,000436	0,000380	0,000705
	MBT-	22	Semarang	Kumai	5,952	13,210	7,526	6,824	6,546	0,000637	0,001415	0,000806	0,000731	0,000701
	MBT-	23	Kumai	Surabaya	5,974	13,094	7,460	6,687	7,244	0,000323	0,000708	0,000403	0,000361	0,000392

MV Meratus Benoa

Table 4.24 MV Meratus Benoa EEOI Calculation using Estimation Method Results

Voyage Number	Trip Number		Port		MFO Consumption (Ton)					EEOI Index (MFO)				
			Depart	Arrive	Actual	Trozzi	Jalkanen	Wang	Mersin*	Actual	Trozzi	Jalkanen	Wang	Mersin*
1901	MBN-	1	Surabaya	Kumai	6,853	14,614	8,325	7,340	10,184	0,000545	0,001163	0,000662	0,000584	0,000810
	MBN-	2	Kumai	Semarang	7,234	11,480	6,540	5,983	4,812	0,000553	0,000878	0,000500	0,000457	0,000368
	MBN-	3	Semarang	Surabaya	5,088	6,529	3,720	3,273	3,771	0,000733	0,000941	0,000536	0,000472	0,000543
1902	MBN-	4	Surabaya	Samarinda	13,671	27,671	15,764	14,224	14,821	0,000480	0,000971	0,000553	0,000499	0,000520
	MBN-	5	Samarinda	Surabaya	22,821	27,162	15,474	14,351	8,867	0,000825	0,000981	0,000559	0,000518	0,000320
1903	MBN-	6	Surabaya	Kumai	12,924	22,640	12,898	11,770	10,497	0,000634	0,001111	0,000633	0,000577	0,000515
	MBN-	7	Kumai	Semarang	7,916	15,559	8,864	8,205	5,683	0,000356	0,000701	0,000399	0,000369	0,000256
	MBN-	8	Semarang	Surabaya	4,202	8,848	5,041	4,523	3,975	0,000475	0,001001	0,000570	0,000511	0,000450
1904	MBN-	9	Surabaya	Sampit	10,948	13,152	7,493	6,882	5,531	0,000652	0,000783	0,000446	0,000410	0,000329
	MBN-	10	Sampit	Surabaya	6,882	12,643	7,203	6,576	4,181	0,000795	0,001460	0,000832	0,000759	0,000483
1905	MBN-	11	Surabaya	Semarang	5,104	10,549	6,010	5,362	6,412	0,000513	0,001061	0,000604	0,000539	0,000645
	MBN-	12	Semarang	Kumai	7,727	13,327	7,592	6,825	7,725	0,000421	0,000726	0,000414	0,000372	0,000421
	MBN-	13	Kumai	Surabaya	6,494	15,755	8,976	8,140	7,116	0,000401	0,000972	0,000554	0,000502	0,000439

Voyage Number	Trip Number		Port		MFO Consumption (Ton)					EEOI Index (MFO)				
			Depart	Arrive	Actual	Trozzi	Jalkanen	Wang	Mersin*	Actual	Trozzi	Jalkanen	Wang	Mersin*
1906	MBN-	14	Surabaya	Kumai	7,472	17,820	10,152	9,516	5,431	0,000437	0,001043	0,000594	0,000557	0,000318
	MBN-	15	Kumai	Surabaya	6,535	14,795	8,429	7,594	6,560	0,000310	0,000702	0,000400	0,000360	0,000311
1907	MBN-	16	Surabaya	Kumai	8,132	17,638	10,048	9,303	6,537	0,000430	0,000932	0,000531	0,000491	0,000345
	MBN-	17	Kumai	Surabaya	6,802	15,159	8,636	7,848	6,951	0,000315	0,000701	0,000399	0,000363	0,000322
1908	MBN-	18	Surabaya	Kumai	9,178	15,944	9,083	8,150	9,580	0,000467	0,000810	0,000462	0,000414	0,000487
	MBN-	19	Kumai	Semarang	11,787	12,985	7,398	6,738	5,980	0,000640	0,000705	0,000402	0,000366	0,000325
	MBN-	20	Semarang	Surabaya	4,513	8,681	4,946	4,507	3,008	0,002349	0,004518	0,002574	0,002346	0,001566
1909	MBN-	21	Surabaya	Kumai	12,084	13,748	7,832	6,973	9,761	0,000634	0,000721	0,000411	0,000366	0,000512
	MBN-	22	Kumai	Semarang	11,457	13,996	7,973	7,232	6,184	0,000526	0,000643	0,000366	0,000332	0,000284
	MBN-	23	Semarang	Surabaya	4,493	8,157	4,647	4,208	3,273	0,000785	0,001426	0,000812	0,000736	0,000572
1910	MBN-	24	Surabaya	Kumai	10,476	15,806	9,005	8,400	5,026	0,000653	0,000985	0,000561	0,000523	0,000313
	MBN-	25	Kumai	Semarang	8,066	13,538	7,712	7,212	3,657	0,000543	0,000911	0,000519	0,000485	0,000246
	MBN-	26	Semarang	Surabaya	4,376	7,627	4,345	3,907	3,046	0,000962	0,001676	0,000955	0,000858	0,000669

4.3. Calculation Results Analysis

4.3.1. Error Calculation for Fuel Oil Consumption Estimation Method

Error calculated with absolute percentage error. Error formula described as follows

$$\boldsymbol{Abs\ Percentage\ Error} = \left(\frac{|A_t - F_t|}{A_t}\right) \times \mathbf{100}\% \quad (36)$$

$$\boldsymbol{Mean\ APE} = \sum_{t=1}^{n} \left(\frac{|A_t - F_t|}{A_t}\right) \times \frac{\mathbf{100}\%}{n} \quad (37)$$

Where;

A_t = actual value

F_t = forecast value

n = number of calculated values

a. Trozzi's Method

MV Meratus Bontang

Table 4.25 MV Meratus Bontang Trozzi's Method Error Results

Voyage Number	Trip Number	Port		MFO FOC (ton)		Error
		Depart	Arrive	Estimation	Actual	
1901	MBT-1	Semarang	Pontianak	24,3631	11,8603	105,42%
	MBT-2	Pontianak	Semarang	21,3677	10,3123	107,21%
1902	MBT-3	Semarang	Pontianak	27,7802	12,5738	120,94%
	MBT-4	Pontianak	Semarang	19,8773	9,8109	102,60%
1903	MBT-5	Semarang	Pontianak	23,2072	17,8023	30,36%
	MBT-6	Pontianak	Surabaya	25,1702	11,5987	117,01%
1904	MBT-7	Surabaya	Sampit	15,9731	6,1046	161,66%
	MBT-8	Sampit	Surabaya	12,0980	5,3415	126,49%
1905	MBT-9	Surabaya	Kumai	18,8667	6,5842	186,55%
	MBT-10	Kumai	Semarang	13,3703	6,4534	107,18%
	MBT-11	Semarang	Surabaya	8,3682	3,3793	147,63%
1906	MBT-12	Surabaya	Sampit	14,0246	5,8865	138,25%
	MBT-13	Sampit	Surabaya	11,7054	5,1017	129,44%
1907	MBT-14	Surabaya	Sampit	11,5600	4,2078	174,73%
	MBT-15	Sampit	Surabaya	12,5705	5,2325	140,24%
1908	MBT-16	Surabaya	Kumai	17,5072	6,7586	159,03%
	MBT-17	Kumai	Surabaya	12,7741	5,3415	139,15%

Voyage Number	Trip Number	Port		MFO FOC (ton)		Error
		Depart	Arrive	Estimation	Actual	
1909	MBT-18	Surabaya	Semarang	8,6954	4,3822	98,43%
	MBT-19	Semarang	Kumai	12,2288	5,3197	129,88%
	MBT-20	Kumai	Surabaya	10,4839	5,0145	109,07%
1910	MBT-21	Surabaya	Semarang	8,5936	5,2325	64,24%
	MBT-22	Semarang	Kumai	13,2103	5,9519	121,95%
	MBT-23	Kumai	Surabaya	13,0940	5,9737	119,19%

Mean absolute percentage error from MV Meratus Bontang using Trozzi's method is **123,33%**.

MV Meratus Benoa

Table 4.26 MV Meratus Benoa Trozzi's Method Error Results

Voyage Number	Trip Number	Port		MFO FOC (ton)		Error
		Depart	Arrive	Estimation	Actual	
1901	MBN-1	Surabaya	Kumai	14,6135	6,8528	113,25%
	MBN-2	Kumai	Semarang	11,4800	7,2343	58,69%
	MBN-3	Semarang	Surabaya	6,5288	5,0878	28,32%
1902	MBN-4	Surabaya	Samarinda	27,6712	13,6708	102,41%
	MBN-5	Samarinda	Surabaya	27,1623	22,8207	19,02%
1903	MBN-6	Surabaya	Kumai	22,6401	12,9236	75,18%
	MBN-7	Kumai	Semarang	15,5587	7,9161	96,54%
	MBN-8	Semarang	Surabaya	8,8481	4,2018	110,58%
1904	MBN-9	Surabaya	Sampit	13,1522	10,9476	20,14%
	MBN-10	Sampit	Surabaya	12,6432	6,8815	83,73%
1905	MBN-11	Surabaya	Semarang	10,5494	5,1037	106,70%
	MBN-12	Semarang	Kumai	13,3267	7,7268	72,47%
	MBN-13	Kumai	Surabaya	15,7550	6,4940	142,61%
1906	MBN-14	Surabaya	Kumai	17,8198	7,4721	138,48%
	MBN-15	Kumai	Surabaya	14,7953	6,5347	126,41%
1907	MBN-16	Surabaya	Kumai	17,6380	8,1321	116,89%

Voyage Number	Trip Number	Port		MFO FOC (ton)		Error
		Depart	Arrive	Estimation	Actual	
	MBN-17	Kumai	Surabaya	15,1588	6,8022	122,85%
1908	MBN-18	Surabaya	Kumai	15,9440	9,1777	73,73%
	MBN-19	Kumai	Semarang	12,9850	11,7870	10,16%
	MBN-20	Semarang	Surabaya	8,6809	4,5130	92,35%
1909	MBN-21	Surabaya	Kumai	13,7483	12,0843	13,77%
	MBN-22	Kumai	Semarang	13,9955	11,4570	22,16%
	MBN-23	Semarang	Surabaya	8,1574	4,4932	81,55%
1910	MBN-24	Surabaya	Kumai	15,8059	10,4759	50,88%
	MBN-25	Kumai	Semarang	13,5375	8,0657	67,84%
	MBN-26	Semarang	Surabaya	7,6267	4,3763	74,27%

Mean absolute percentage error from MV Meratus Benoa using Trozzi's method is **77,73%**.

Trozzi method showed relatively high error percentage. Because Trozzi method only using ship's gross tonnage (GT), operational mode and type of ship for calculation, potential error from this method caused by several variables that assumed for containerships is not suitable for MV Meratus Bontang and Meratus Benoa. For example, typical coefficient block (C_B) for containerships is 0,52 to 0,716 (Schneekluth & Bertram, 1998). Both MV Meratus Bontang and MV Meratus Benoa has coefficient block 0,8487. Both ships also have service speed relatively lower (6-8 knots) than general containerships design (>16 knots) (Wang & Meng, 2012). From this case, can be hypothesized that inter-Indonesian archipelago container shipping fleet has different characteristic compared with global container fleet.

b. Jalkanen's Method

MV Meratus Bontang

Table 4.27 MV Meratus Bontang Jalkanen's Method Error Results

Voyage Number	Trip Number	Port		MFO FOC (Ton)		Error
		Depart	Arrive	Estimated	Actual	
1901	MBT-1	Semarang	Pontianak	13,8798	11,8603	17,03%
	MBT-2	Pontianak	Semarang	12,1733	10,3123	18,05%
1902	MBT-3	Semarang	Pontianak	15,8265	12,5738	25,87%
	MBT-4	Pontianak	Semarang	11,3242	9,8109	15,42%

Voyage Number	Trip Number	Port		MFO FOC (Ton)		Error
		Depart	Arrive	Estimated	Actual	
1903	MBT-5	Semarang	Pontianak	13,2212	17,8023	25,73%
	MBT-6	Pontianak	Surabaya	14,3396	11,5987	23,63%
1904	MBT-7	Surabaya	Sampit	9,0999	6,1046	49,07%
	MBT-8	Sampit	Surabaya	6,8923	5,3415	29,03%
1905	MBT-9	Surabaya	Kumai	10,7485	6,5842	63,25%
	MBT-10	Kumai	Semarang	7,6171	6,4534	18,03%
	MBT-11	Semarang	Surabaya	4,7674	3,3793	41,08%
1906	MBT-12	Surabaya	Sampit	7,9899	5,8865	35,73%
	MBT-13	Sampit	Surabaya	6,6686	5,1017	30,71%
1907	MBT-14	Surabaya	Sampit	6,5858	4,2078	56,51%
	MBT-15	Sampit	Surabaya	7,1615	5,2325	36,87%
1908	MBT-16	Surabaya	Kumai	9,9739	6,7586	47,57%
	MBT-17	Kumai	Surabaya	7,2775	5,3415	36,24%
1909	MBT-18	Surabaya	Semarang	4,9538	4,3822	13,04%
	MBT-19	Semarang	Kumai	6,9668	5,3197	30,96%
	MBT-20	Kumai	Surabaya	5,9727	5,0145	19,11%
1910	MBT-21	Surabaya	Semarang	4,8958	5,2325	6,43%
	MBT-22	Semarang	Kumai	7,5260	5,9519	26,45%
	MBT-23	Kumai	Surabaya	7,4597	5,9737	24,88%

Mean absolute percentage error from MV Meratus Bontang using Jalkanen's method is **30,03%**.

MV Meratus Benoa

Table 4.28 MV Meratus Benoa Jalkanen's Method Error Results

Voyage Number	Trip Number	Port		MFO FOC (Ton)		Error
		Depart	Arrive	Estimated	Actual	
1901	MBN-1	Surabaya	Kumai	8,3254	6,8528	21,49%
	MBN-2	Kumai	Semarang	6,5402	7,2343	9,59%
	MBN-3	Semarang	Surabaya	3,7195	5,0878	26,89%
1902	MBN-4	Surabaya	Samarinda	15,7644	13,6708	15,31%
	MBN-5	Samarinda	Surabaya	15,4745	22,8207	32,19%
1903	MBN-6	Surabaya	Kumai	12,8982	12,9236	0,20%
	MBN-7	Kumai	Semarang	8,8639	7,9161	11,97%
	MBN-8	Semarang	Surabaya	5,0408	4,2018	19,97%

Voyage Number	Trip Number	Port		MFO FOC (Ton)		Error
		Depart	Arrive	Estimated	Actual	
1904	MBN-9	Surabaya	Sampit	7,4929	10,9476	31,56%
	MBN-10	Sampit	Surabaya	7,2029	6,8815	4,67%
1905	MBN-11	Surabaya	Semarang	6,0100	5,1037	17,76%
	MBN-12	Semarang	Kumai	7,5923	7,7268	1,74%
	MBN-13	Kumai	Surabaya	8,9757	6,4940	38,21%
1906	MBN-14	Surabaya	Kumai	10,1520	7,4721	35,86%
	MBN-15	Kumai	Surabaya	8,4289	6,5347	28,99%
1907	MBN-16	Surabaya	Kumai	10,0485	8,1321	23,56%
	MBN-17	Kumai	Surabaya	8,6360	6,8022	26,96%
1908	MBN-18	Surabaya	Kumai	9,0834	9,1777	1,03%
	MBN-19	Kumai	Semarang	7,3976	11,7870	37,24%
	MBN-20	Semarang	Surabaya	4,9455	4,5130	9,58%
1909	MBN-21	Surabaya	Kumai	7,8325	12,0843	35,18%
	MBN-22	Kumai	Semarang	7,9733	11,4570	30,41%
	MBN-23	Semarang	Surabaya	4,6473	4,4932	3,43%
1910	MBN-24	Surabaya	Kumai	9,0047	10,4759	14,04%
	MBN-25	Kumai	Semarang	7,7124	8,0657	4,38%
	MBN-26	Semarang	Surabaya	4,3449	4,3763	0,72%

Mean absolute percentage error from MV Meratus Bontang using Jalkanen's method is **18,57%**.

Jalkanen method resulted error averagely less then other methods. This because operational parameter that used to calculate estimation with Jalkanen method relatively complex and consider many variables. Using ship resistance for forecasting ship's engine power demands data for ship's hull dimension, propellers, and mechanical efficiency.

c. Wang's Method

MV Meratus Bontang

Table 4.29 MV Meratus Bontang Wang's Method Error Results

Voyage Number	Trip Number	Port		MFO FOC (Ton)		Error
		Departure	Arrived	Estimated	Actual	
1901	MBT-1	Semarang	Pontianak	12,6842	11,8603	6,95%
	MBT-2	Pontianak	Semarang	10,8754	10,3123	5,46%

Voyage Number	Trip Number	Port		MFO FOC (Ton)		Error
		Departure	Arrived	Estimated	Actual	
1902	MBT-3	Semarang	Pontianak	14,5800	12,5738	15,96%
	MBT-4	Pontianak	Semarang	9,9959	9,8109	1,89%
1903	MBT-5	Semarang	Pontianak	11,9433	17,8023	32,91%
	MBT-6	Pontianak	Surabaya	12,8113	11,5987	10,46%
1904	MBT-7	Surabaya	Sampit	8,2797	6,1046	35,63%
	MBT-8	Sampit	Surabaya	6,2027	5,3415	16,12%
1905	MBT-9	Surabaya	Kumai	9,6345	6,5842	46,33%
	MBT-10	Kumai	Semarang	6,9772	6,4534	8,12%
	MBT-11	Semarang	Surabaya	4,3053	3,3793	27,40%
1906	MBT-12	Surabaya	Sampit	7,3953	5,8865	25,63%
	MBT-13	Sampit	Surabaya	6,0209	5,1017	18,02%
1907	MBT-14	Surabaya	Sampit	5,9191	4,2078	40,67%
	MBT-15	Sampit	Surabaya	6,2750	5,2325	19,92%
1908	MBT-16	Surabaya	Kumai	9,1783	6,7586	35,80%
	MBT-17	Kumai	Surabaya	6,4583	5,3415	20,91%
1909	MBT-18	Surabaya	Semarang	4,5916	4,3822	4,78%
	MBT-19	Semarang	Kumai	6,2811	5,3197	18,07%
	MBT-20	Kumai	Surabaya	5,3049	5,0145	5,79%
1910	MBT-21	Surabaya	Semarang	4,2737	5,2325	18,32%
	MBT-22	Semarang	Kumai	6,8239	5,9519	14,65%
	MBT-23	Kumai	Surabaya	6,6869	5,9737	11,94%

Mean absolute percentage error from MV Meratus Bontang using Wang's method is **19,21%**.

MV Meratus Benoa

Table 4.30 MV Meratus Benoa Wang's Method Error Results

Voyage Number	Trip Number	Port		MFO FOC (Ton)		Error
		Departure	Arrived	Estimated	Actual	
1901	MBN -1	Surabaya	Kumai	7,3404	6,8528	7,12%
	MBN -2	Kumai	Semarang	5,9828	7,2343	17,30%
	MBN -3	Semarang	Surabaya	3,2733	5,0878	35,66%
1902	MBN -4	Surabaya	Samarinda	14,2235	13,6708	4,04%

Voyage Number	Trip Number	Port		MFO FOC (Ton)		Error
		Departure	Arrived	Estimated	Actual	
	MBN -5	Samarinda	Surabaya	14,3506	22,8207	37,12%
1903	MBN -6	Surabaya	Kumai	11,7700	12,9236	8,93%
	MBN -7	Kumai	Semarang	8,2047	7,9161	3,65%
	MBN -8	Semarang	Surabaya	4,5228	4,2018	7,64%
1904	MBN -9	Surabaya	Sampit	6,8823	10,9476	37,13%
	MBN -10	Sampit	Surabaya	6,5758	6,8815	4,44%
1905	MBN -11	Surabaya	Semarang	5,3621	5,1037	5,06%
	MBN -12	Semarang	Kumai	6,8251	7,7268	11,67%
	MBN -13	Kumai	Surabaya	8,1404	6,4940	25,35%
1906	MBN -14	Surabaya	Kumai	9,5160	7,4721	27,35%
	MBN -15	Kumai	Surabaya	7,5937	6,5347	16,21%
1907	MBN -16	Surabaya	Kumai	9,3028	8,1321	14,40%
	MBN -17	Kumai	Surabaya	7,8484	6,8022	15,38%
1908	MBN -18	Surabaya	Kumai	8,1496	9,1777	11,20%
	MBN -19	Kumai	Semarang	6,7375	11,7870	42,84%
	MBN -20	Semarang	Surabaya	4,5066	4,5130	0,14%
1909	MBN -21	Surabaya	Kumai	6,9730	12,0843	42,30%
	MBN -22	Kumai	Semarang	7,2324	11,4570	36,87%
	MBN -23	Semarang	Surabaya	4,2084	4,4932	6,34%
1910	MBN -24	Surabaya	Kumai	8,3997	10,4759	19,82%
	MBN -25	Kumai	Semarang	7,2116	8,0657	10,59%
	MBN -26	Semarang	Surabaya	3,9069	4,3763	10,72%

Mean absolute percentage error from MV Meratus Benoa using Wang's method is **17,66%**.

Wang method resulted averagely least error rather than other methods. This because Wang use historical data for forecasting formula for fuel oil consumption. The variable that must be concern was ship average speed and daily fuel oil consumption.

d. Mersin's Method

Original Mersin's Formula

MV Meratus Bontang

Table 4.31 MV Meratus Bontang Mersin's Method Error Results

Voyage Number	Trip Number	Port		MFO FOC (ton)		Error
		Depart	Arrive	Estimated	Actual	
1901	MBT-1	Semarang	Pontianak	-3210,94	11,8603	27173%
	MBT-2	Pontianak	Semarang	-3272,20	10,3123	31831%
1902	MBT-3	Semarang	Pontianak	-3214,34	12,5738	25664%
	MBT-4	Pontianak	Semarang	-3247,07	9,8109	33197%
1903	MBT-5	Semarang	Pontianak	-3242,85	17,8023	18316%
	MBT-6	Pontianak	Surabaya	-3244,03	11,5987	28069%
1904	MBT-7	Surabaya	Sampit	-74310,67	6,1046	1217398%
	MBT-8	Sampit	Surabaya	-3121,44	5,3415	58538%
1905	MBT-9	Surabaya	Kumai	-3169,48	6,5842	48238%
	MBT-10	Kumai	Semarang	-3145,39	6,4534	48840%
	MBT-11	Semarang	Surabaya	-3133,15	3,3793	92816%
1906	MBT-12	Surabaya	Sampit	-3160,34	5,8865	53788%
	MBT-13	Sampit	Surabaya	-3122,04	5,1017	61296%
1907	MBT-14	Surabaya	Sampit	-3104,39	4,2078	73877%
	MBT-15	Sampit	Surabaya	-3104,39	5,2325	59429%
1908	MBT-16	Surabaya	Kumai	-3135,47	6,7586	46492%
	MBT-17	Kumai	Surabaya	-3039,12	5,3415	56996%
1909	MBT-18	Surabaya	Semarang	-3231,27	4,3822	73836%
	MBT-19	Semarang	Kumai	-3264,63	5,3197	61469%
	MBT-20	Kumai	Surabaya	-3311,62	5,0145	66141%
1910	MBT-21	Surabaya	Semarang	-3373,44	5,2325	64571%
	MBT-22	Semarang	Kumai	-3360,05	5,9519	56553%
	MBT-23	Kumai	Surabaya	-3338,30	5,9737	55983%

Mean absolute percentage error from MV Meratus Bontang using Mersin's method is **102631%**.

MV Meratus Benoa

Table 4.32 MV Meratus Benoa Mersin's Method Error Results

Voyage Number	Trip Number	Port		MFO FOC (ton)		Error
		Depart	Arrive	Estimated	Actual	
1901	MBN-1	Surabaya	Kumai	-2960,54	6,8528	43302%
	MBN-2	Kumai	Semarang	-3719,71	7,2343	51518%
	MBN-3	Semarang	Surabaya	-4029,54	5,0878	79300%

Voyage Number	Trip Number	Port		MFO FOC (ton)		Error
		Depart	Arrive	Estimated	Actual	
1902	MBN-4	Surabaya	Samarinda	-3630,12	13,6708	26654%
	MBN-5	Samarinda	Surabaya	-6153,78	22,8207	27066%
1903	MBN-6	Surabaya	Kumai	-2976,25	12,9236	23130%
	MBN-7	Kumai	Semarang	-2990,92	7,9161	37883%
	MBN-8	Semarang	Surabaya	-4254,68	4,2018	101358%
1904	MBN-9	Surabaya	Sampit	-3010,26	10,9476	27597%
	MBN-10	Sampit	Surabaya	-4279,82	6,8815	62293%
1905	MBN-11	Surabaya	Semarang	-3263,11	5,1037	64037%
	MBN-12	Semarang	Kumai	-2988,04	7,7268	38771%
	MBN-13	Kumai	Surabaya	-3594,98	6,4940	55458%
1906	MBN-14	Surabaya	Kumai	-3004,15	7,4721	40305%
	MBN-15	Kumai	Surabaya	-3524,17	6,5347	54030%
1907	MBN-16	Surabaya	Kumai	-2971,42	8,1321	36639%
	MBN-17	Kumai	Surabaya	-3184,56	6,8022	46916%
1908	MBN-18	Surabaya	Kumai	-2961,99	9,1777	32374%
	MBN-19	Kumai	Semarang	-2962,25	11,7870	25232%
	MBN-20	Semarang	Surabaya	-4171,93	4,5130	92542%
1909	MBN-21	Surabaya	Kumai	-3462,14	12,0843	28750%
	MBN-22	Kumai	Semarang	-2967,89	11,4570	26005%
	MBN-23	Semarang	Surabaya	-4181,16	4,4932	93156%
1910	MBN-24	Surabaya	Kumai	-3237,19	10,4759	31001%
	MBN-25	Kumai	Semarang	-3338,04	8,0657	41485%
	MBN-26	Semarang	Surabaya	-3978,49	4,3763	91011%

Mean absolute percentage error from MV Meratus Benoa using Mersin's method is **49147%**.

Modified Mersin's Formula
MV Meratus Bontang

Table 4.33 MV Meratus Bontang Modified Mersin's Method Error Results

Voyage Number	Trip Number	Port		MFO FOC (ton)		Error
		Depart	Arrive	Estimated	Actual	
1901	MBT-1	Semarang	Pontianak	10,8370	11,8603	8,63%
	MBT-2	Pontianak	Semarang	9,5046	10,3123	7,83%
1902	MBT-3	Semarang	Pontianak	10,2580	12,5738	18,42%

Voyage Number	Trip Number	Port		MFO FOC (ton)		Error
		Depart	Arrive	Estimated	Actual	
	MBT-4	Pontianak	Semarang	10,1065	9,8109	3,01%
1903	MBT-5	Semarang	Pontianak	10,6752	17,8023	40,03%
	MBT-6	Pontianak	Surabaya	11,2931	11,5987	2,63%
1904	MBT-7	Surabaya	Sampit	37,1136	6,1046	507,97%
	MBT-8	Sampit	Surabaya	4,4445	5,3415	16,79%
1905	MBT-9	Surabaya	Kumai	11,7615	6,5842	78,63%
	MBT-10	Kumai	Semarang	5,4341	6,4534	15,79%
	MBT-11	Semarang	Surabaya	3,1321	3,3793	7,32%
1906	MBT-12	Surabaya	Sampit	5,3135	5,8865	9,73%
	MBT-13	Sampit	Surabaya	4,3055	5,1017	15,61%
1907	MBT-14	Surabaya	Sampit	6,8720	4,2078	63,32%
	MBT-15	Sampit	Surabaya	7,0865	5,2325	35,43%
1908	MBT-16	Surabaya	Kumai	7,2319	6,7586	7,00%
	MBT-17	Kumai	Surabaya	6,3479	5,3415	18,84%
1909	MBT-18	Surabaya	Semarang	2,9494	4,3822	32,69%
	MBT-19	Semarang	Kumai	6,9719	5,3197	31,06%
	MBT-20	Kumai	Surabaya	6,2998	5,0145	25,63%
1910	MBT-21	Surabaya	Semarang	7,9195	5,2325	51,35%
	MBT-22	Semarang	Kumai	6,5464	5,9519	9,99%
	MBT-23	Kumai	Surabaya	7,2445	5,9737	21,27%

Mean absolute percentage error from MV Meratus Bontang using modified Mersin's method is **44,74%**.

MV Meratus Benoa

Table 4.34 MV Meratus Benoa Modified Mersin's Method Error Results

Voyage Number	Trip Number	Port		MFO FOC (ton)		Error
		Depart	Arrive	Estimated	Actual	
1901	MBN-1	Surabaya	Kumai	10,1839	6,8528	48,61%
	MBN-2	Kumai	Semarang	4,8117	7,2343	33,49%
	MBN-3	Semarang	Surabaya	3,7711	5,0878	25,88%
1902	MBN-4	Surabaya	Samarinda	14,8210	13,6708	8,41%
	MBN-5	Samarinda	Surabaya	8,8674	22,8207	61,14%
1903	MBN-6	Surabaya	Kumai	10,4968	12,9236	18,78%
	MBN-7	Kumai	Semarang	5,6832	7,9161	28,21%

Voyage Number	Trip Number	Port		MFO FOC (ton)		Error
		Depart	Arrive	Estimated	Actual	
	MBN-8	Semarang	Surabaya	3,9753	4,2018	5,39%
1904	MBN-9	Surabaya	Sampit	5,5311	10,9476	49,48%
	MBN-10	Sampit	Surabaya	4,1805	6,8815	39,25%
1905	MBN-11	Surabaya	Semarang	6,4119	5,1037	25,63%
	MBN-12	Semarang	Kumai	7,7250	7,7268	0,02%
	MBN-13	Kumai	Surabaya	7,1160	6,4940	9,58%
1906	MBN-14	Surabaya	Kumai	5,4315	7,4721	27,31%
	MBN-15	Kumai	Surabaya	6,5595	6,5347	0,38%
1907	MBN-16	Surabaya	Kumai	6,5368	8,1321	19,62%
	MBN-17	Kumai	Surabaya	6,9512	6,8022	2,19%
1908	MBN-18	Surabaya	Kumai	9,5801	9,1777	4,39%
	MBN-19	Kumai	Semarang	5,9797	11,7870	49,27%
	MBN-20	Semarang	Surabaya	3,0082	4,5130	33,34%
1909	MBN-21	Surabaya	Kumai	9,7606	12,0843	19,23%
	MBN-22	Kumai	Semarang	6,1837	11,4570	46,03%
	MBN-23	Semarang	Surabaya	3,2731	4,4932	27,15%
1910	MBN-24	Surabaya	Kumai	5,0264	10,4759	52,02%
	MBN-25	Kumai	Semarang	3,6567	8,0657	54,66%
	MBN-26	Semarang	Surabaya	3,0456	4,3763	30,41%

Mean absolute percentage error from MV Meratus Benoa using modified Mersin's method is **27,69%**.

Method proposed by Mersin considering alteration of ship's displacement for estimating fuel oil consumption. By using this method, resulted average error in medium state rather than other methods. This method considering ship engine coefficient which calculated with displacement, speed, and fuel consumption per-day. Fuel oil consumption per-day data obtained by measuring actual history data.

4.3.2. EEOI Index Analysis per Voyage Route

Analyzing EEOI index of MV Meratus Bontang and MV Meratus Benoa using same voyage that can be assumed has relatively same distance. With the value of EEOI index, the variables that affect result of EEOI can be determined.

a. Voyage Route Surabaya – Semarang

MV Meratus Bontang

Table 4.35 MV Meratus Bontang Voyage Surabaya Semarang EEOI Index Results

Voyage Number	Trip Number	Port		Avg. Vs	FO Consumption (Ton)			Cargo (TEUs)	EEOI Index
		Depart	Arrive		MFO	HSD	Total		
1905	MBT-11	Semarang	Surabaya	6,998	3,3793	3,5257	6,9050	161	0,000457
1909	MBT-18	Surabaya	Semarang	6,717	4,3822	5,7074	10,0896	169	0,000618
1910	MBT-21	Surabaya	Semarang	9,001	5,2325	11,4516	16,6840	192	0,000772
			Average	**7,572**	**4,3313**	**6,8949**	**11,2262**	**174**	

Using formula (2) average EEOI of MV Meratus Bontang voyage Surabaya Semarang is **0,000625 ton-CO_2/TEUS.nm**.

MV Meratus Benoa

Table 4.36 MV Meratus Benoa Voyage Surabaya Semarang EEOI Index Results

Voyage Number	Trip Number	Port		Avg. Vs	FO Consumption (Ton)			Cargo (TEUs)	EEOI Index
		Depart	Arrive		MFO	HSD	Total		
1901	MBN-3	Semarang	Surabaya	7,779	5,0878	3,3058	8,3936	147	0,000679
1903	MBN-8	Semarang	Surabaya	6,484	4,2018	2,7124	6,9143	163	0,000513
1905	MBN-11	Surabaya	Semarang	8,142	5,1037	9,5813	14,6849	178	0,000759
1908	MBN-20	Semarang	Surabaya	6,016	4,5130	3,6937	8,2067	37	0,002516
1909	MBN-23	Semarang	Surabaya	6,442	4,4932	3,8734	8,3666	117	0,000796
1910	MBN-26	Semarang	Surabaya	7,450	4,3763	3,2732	7,6494	93	0,000947
			Average	**7,052**	**4,6293**	**4,4066**	**9,0359**	**112,5**	

Using formula (2) average EEOI of MV Meratus Benoa voyage Surabaya Semarang is **0,000807 ton-CO_2/TEUS.nm**.

b. Voyage Route Surabaya – Sampit

MV Meratus Bontang

Table 4.37 MV Meratus Bontang Voyage Surabaya Sampit EEOI Index Results

Voyage Number	Trip Number	Port		Avg. Vs	FO Consumption (Ton)			Cargo (TEUs)	EEOI Index
		Depart	Arrive		MFO	HSD	Total		
1904	MBT-7	Surabaya	Sampit	7,374	6,1046	7,5339	13,6384	228	0,000396
1904	MBT-8	Sampit	Surabaya	7,542	5,3415	5,3228	10,6643	148	0,000533
1906	MBT-12	Surabaya	Sampit	6,482	5,8865	7,3008	13,1873	223	0,000421
1906	MBT-13	Sampit	Surabaya	7,842	5,1017	6,1753	11,2769	264	0,000306
1907	MBT-14	Surabaya	Sampit	7,080	4,2078	6,2755	10,4833	223	0,000316
1907	MBT-15	Sampit	Surabaya	7,222	5,2325	6,9503	12,1828	255	0,000322
			Average	**7,257**	**5,3124**	**6,5931**	**11,9055**	**223,5**	

Using formula (2) average EEOI of MV Meratus Bontang voyage Surabaya Sampit is **0,000371 ton-CO_2/TEUS.nm.**

MV Meratus Benoa

Table 4.38 MV Meratus Benoa Voyage Surabaya Sampit EEOI Index Results

Voyage Number	Trip Number	Port		Avg. Vs	FO Consumption (Ton)			Cargo (TEUs)	EEOI Index
		Depart	Arrive		MFO	HSD	Total		
1904	MBN-9	Surabaya	Sampit	7,070	10,9476	8,1012	19,0488	215	0,000688
1904	MBN-10	Sampit	Surabaya	4,845	6,8815	8,0401	14,9216	112	0,000930
			Average	**5,958**	**8,9145**	**8,0707**	**16,9852**	**163,5**	

Using formula (2) average EEOI of MV Meratus Bontang voyage Surabaya Sampit is **0,000771 ton-CO_2/TEUS.nm.**

c. Voyage Route Surabaya – Kumai

MV Meratus Bontang

Table 4.39 MV Meratus Bontang Voyage Surabaya Kumai EEOI Index Results

Voyage Number	Trip Number	Port		Avg. Vs	FO Consumption (Ton)			Cargo (TEUs)	EEOI Index
		Depart	Arrive		MFO	HSD	Total		
1905	MBT-9	Surabaya	Kumai	8,038	6,5842	7,1598	13,7440	237	0,000373
1908	MBT-16	Surabaya	Kumai	7,247	6,7586	7,4124	14,1710	218	0,000451
1908	MBT-17	Kumai	Surabaya	7,784	5,3415	7,2714	12,6129	134	0,000615
1909	MBT-20	Kumai	Surabaya	7,870	5,0145	6,3122	11,3266	182	0,000413
1910	MBT-23	Kumai	Surabaya	8,051	5,9737	6,8599	12,8336	219	0,000406
			Average	**7,798**	**5,9345**	**7,0031**	**12,9376**	**198**	

Using formula (2) average EEOI of MV Meratus Bontang voyage Surabaya Kumai is **0,000437 ton-CO_2/TEUS.nm.**

MV Meratus Benoa

Table 4.40 MV Meratus Benoa Voyage Surabaya Kumai EEOI Index Results

Voyage Number	Trip Number	Port		Avg. Vs	FO Consumption (Ton)			Cargo (TEUs)	EEOI Index
		Depart	Arrive		MFO	HSD	Total		
1901	MBN-1	Surabaya	Kumai	8,447	6,8528	8,2895	15,1423	162	0,000626
1903	MBN-6	Surabaya	Kumai	6,922	12,9236	11,0398	23,9635	221	0,000796
1905	MBN-13	Kumai	Surabaya	6,933	6,4940	7,5912	14,0852	174	0,000552
1906	MBN-14	Surabaya	Kumai	6,357	7,4721	6,7269	14,1991	206	0,000503
1906	MBN-15	Kumai	Surabaya	7,441	6,5347	9,0154	15,5500	241	0,000424
1907	MBN-16	Surabaya	Kumai	6,849	8,1321	7,0288	15,1609	213	0,000525
1907	MBN-17	Kumai	Surabaya	6,891	6,8022	7,9817	14,7839	253	0,000400
1908	MBN-18	Surabaya	Kumai	7,950	9,1777	9,2742	18,4519	217	0,000602
1909	MBN-21	Surabaya	Kumai	7,665	12,0843	9,0403	21,1246	215	0,000749
1910	MBN-24	Surabaya	Kumai	6,838	10,4759	10,7423	21,2181	194	0,000771
			Average	**7,229**	**8,6949**	**8,6730**	**17,3680**	**209,6**	

Using formula (2) average EEOI of MV Meratus Benoa voyage Surabaya Kumai is **0,000589 ton-CO_2/TEUS.nm.**

d. Voyage Route Semarang – Kumai

MV Meratus Bontang

Table 4.41 MV Meratus Bontang Voyage Semarang Kumai EEOI Index Results

Voyage Number	Trip Number	Port		Avg. Vs	FO Consumption (Ton)			Cargo (TEUs)	EEOI Index
		Depart	Arrive		MFO	HSD	Total		
1905	MBT-10	Kumai	Semarang	7,357	6,4534	7,5363	13,9897	255	0,000400
1909	MBT-19	Semarang	Kumai	8,021	5,3197	3,7523	9,0719	205	0,000368
1910	MBT-22	Semarang	Kumai	7,615	5,9519	2,9446	8,8965	119	0,000667
			Average	**7,665**	**5,9083**	**4,7444**	**10,6527**	**193**	

Using formula (2) average EEOI of MV Meratus Bontang voyage Semarang Kumai is **0,000443 ton-CO_2/TEUS.nm.**

MV Meratus Benoa

Table 4.42 MV Meratus Benoa Voyage Semarang Kumai EEOI Index Results

Voyage Number	Trip Number	Port		Avg. Vs	FO Consumption (Ton)			Cargo (TEUs)	EEOI Index
		Depart	Arrive		MFO	HSD	Total		
1901	MBN-2	Kumai	Semarang	6,878	7,2343	9,0343	16,2686	198	0,000593
1903	MBN-7	Kumai	Semarang	6,625	7,9161	8,3351	16,2512	268	0,000453
1905	MBN-12	Semarang	Kumai	6,205	7,7268	2,7898	10,5167	221	0,000441
1908	MBN-19	Kumai	Semarang	7,550	11,7870	8,7892	20,5762	248	0,000674
1909	MBN-22	Kumai	Semarang	6,820	11,4570	8,1193	19,5762	260	0,000621
1910	MBN-25	Kumai	Semarang	6,649	8,0657	7,2618	15,3276	212	0,000564
			Average	6,788	9,0312	7,3883	16,4194	234,5	

Using formula (2) average EEOI of MV Meratus Bontang voyage Semarang Kumai is **0,000557 ton-CO_2/TEUS.nm.**

e. Summary Voyage Analysis

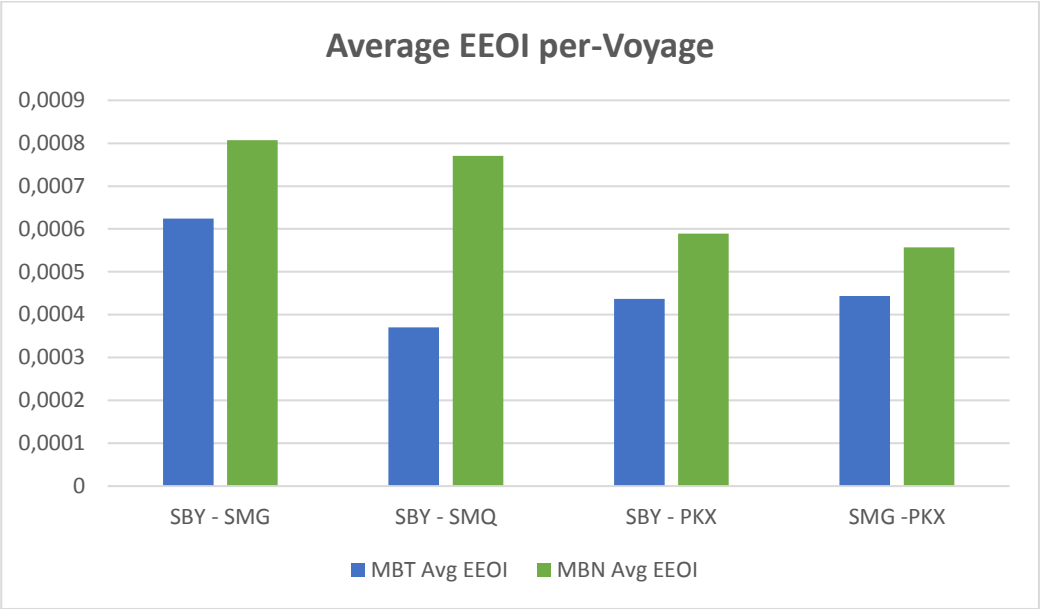

Figure 4.3 Average EEOI per-Voyage Graph

In figure 4.3 show that MV Meratus Benoa have higher EEOI index than MV Meratus Bontang. The causes of differences in the index can be described using EEOI formula (1) where the formula is a function of fuel oil consumption, distance and amount of loaded cargo. The distance assumed has same value in one voyage route. Then, the variable that influence EEOI index can be narrowed down by cargo and fuel oil consumption.

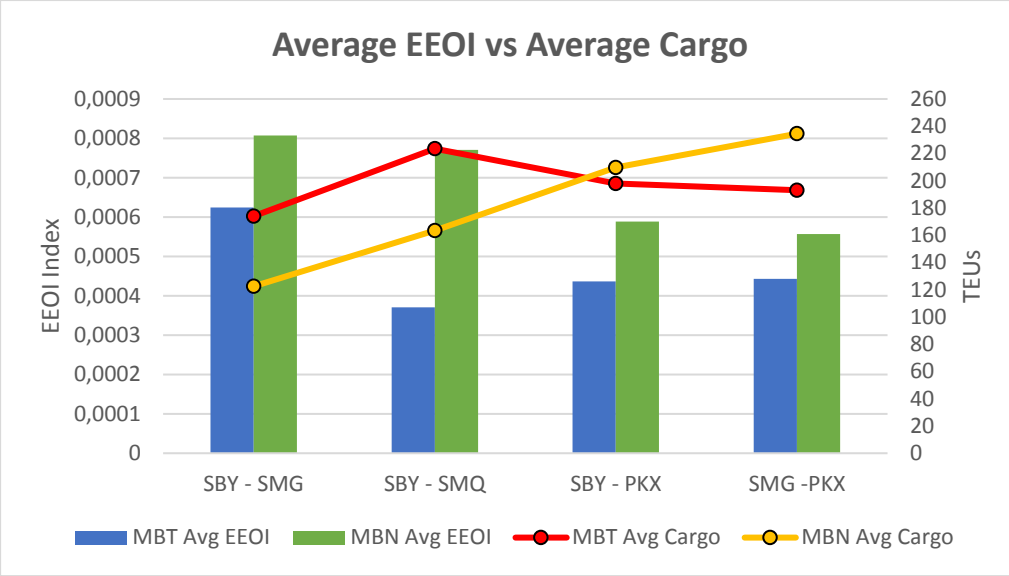

Figure 4.4 Average EEOI and Average Cargo Graph

From figure 4.4, can be analyze that in route Surabaya-Semarang MV Meratus Bontang has mean cargo carried **174 TEUs** with average EEOI **0,000625** and MV Meratus Benoa has mean cargo carried **122,5 TEUs** with average EEOI **0,000807**. For Surabaya-Sampit route, MV Meratus Bontang has average cargo carried **223,5 TEUs** with average EEOI **0,000371** and MV Meratus Benoa **163,5 TEUs**, with average EEOI **0,000771**. For Surabaya-Kumai route, MV Meratus Bontang has average cargo **198 TEUs** with average EEOI **0,000437** and MV Meratus Benoa has average cargo **209,6 TEUs** with average EEOI **0,000589**. For Semarang-Kumai route, MV Meratus Bontang has average cargo carried **193 TEUs** and average EEOI index **0,000443**. MV Meratus Benoa has average cargo **234,5** TEUs with average EEOI **0,000557**.

The highest average EEOI index for MV Meratus Benoa was at Surabaya-Semarang route and the lowest was at Semarang-Kumai route. At highest average EEOI index (Surabaya-Semarang), MV Meratus Benoa carried least of average cargo while at lowest average EEOI index (Semarang-Kumai) it carried most cargo. While MV Meratus Bontang carried most average cargo in route Surabaya-Sampit and has lowest average EEOI index. Although MV Meratus Benoa carried more average cargo than MV Meratus Bontang in route Surabaya-Kumai and Semarang-Kumai, but still has average EEOI index more than MV Meratus Bontang.

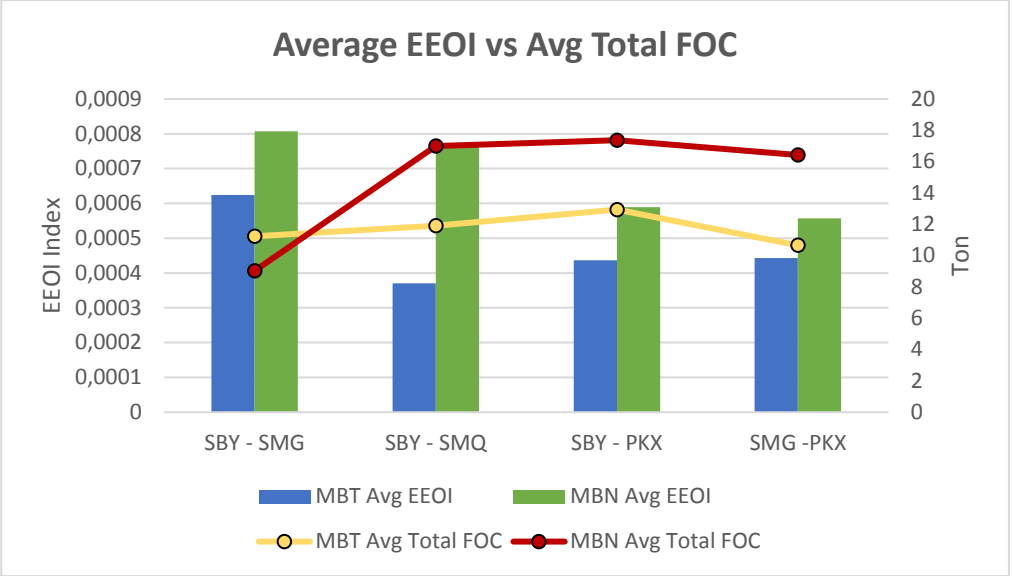

Figure 4.5 Average EEOI and Average Total Fuel Oil Consumption Graph

From figure 4.5 showed the relation between average EEOI and Average fuel oil consumption. At route Surabaya-Semarang, MV Meratus Bontang has average fuel oil consumption **11,2262 ton** with average EEOI **0,000625**, while MV Meratus Benoa has average fuel oil consumption **9,0359 ton** with average EEOI **0,000807**. At route Surabaya-Sampit, MV Meratus Bontang has average fuel oil consumption **11,9055 ton** with average EEOI **0,000371**, and MV Meratus Benoa average fuel oil consumption **16,9852 ton** with average EEOI **0,000771**. At route Surabaya-Kumai, MV Meratus Bontang average fuel oil consumption is **12,9376 ton** with average EEOI **0,000437**, while MV Meratus Benoa has average fuel oil consumption **17,3680 ton** with average EEOI **0,000589**. At Semarang-Kumai route, MV Meratus Bontang has average fuel consumption **10,6527 ton** with **0,000443** and MV Meratus Benoa average fuel oil consumption **16,4194 ton** with average EEOI **0,000557**.

Fuel oil consumption in MV Meratus Benoa is higher than MV Meratus Bintang. The lowest point of average fuel oil consumption for MV Meratus Benoa was at voyage route Surabaya-Semarang, but it has highest average EEOI index. In another route, average fuel oil consumption for MV Meratus Benoa is higher than MV Meratus Bontang. The average value of all EEOI index for MV Meratus Benoa is higher than MV Meratus Bontang.

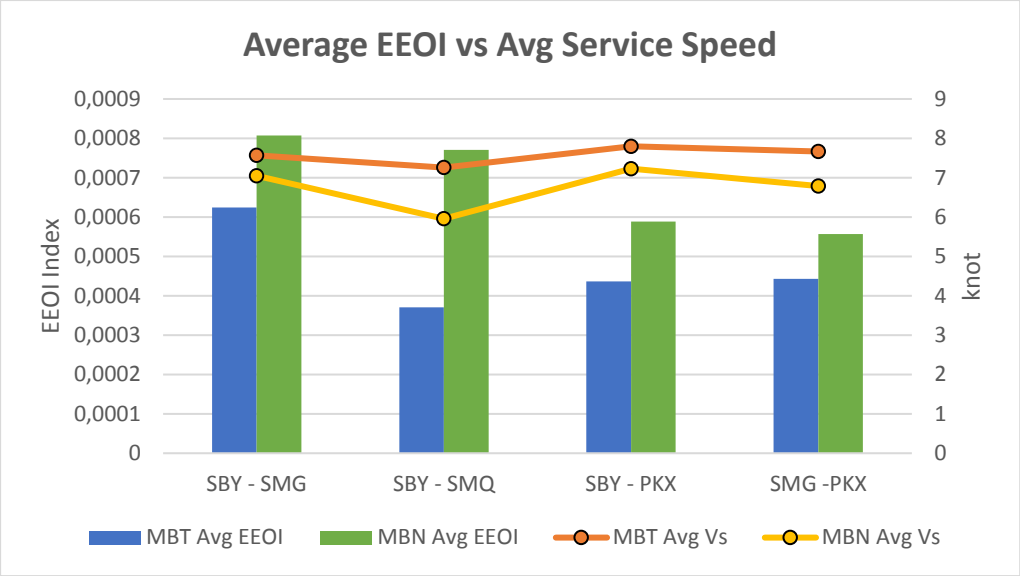

Figure 4.6 Average EEOI and Average Service Speed Graph

Fuel oil consumption is the function of resistance and speed of a ship. Resistance of ship can be happened by ship's variable and environment variable. Environment variable is the wind and current, while ship's variable is hull shape, hull condition, prime-mover condition, and ship technical efficiency. In this research, environment condition assumed didn't affect high differential for ship's fuel oil consumption. From ship's condition, by ship operational work creates two big variables there is wetted surface area and speed. Wetted surface area can be represented by the changing of ship's draught. Draught changing caused based on the load of cargo and ballast. While another variable is operational speed.

Can be analyze from figure 4.6 that the speed of MV Meratus Bontang is relative higher than MV Meratus Benoa. In all route MV Meratus Bontang has higher average service speed. At Surabaya-Semarang route, Surabaya-Sampit, Surabaya-Kumai, and Semarang-Kumai each has average service speed **7,572 knot**, **7,256 knot**, **7,798 knot**, and **7,664 knot**. While MV Meratus Bontang has average service speed **7,052 knot**, **5,957 knot**, **7,229 knot**, and **6,788 knot**.

4.3.3. Overall EEOI Index Analysis

a. MV Meratus Bontang

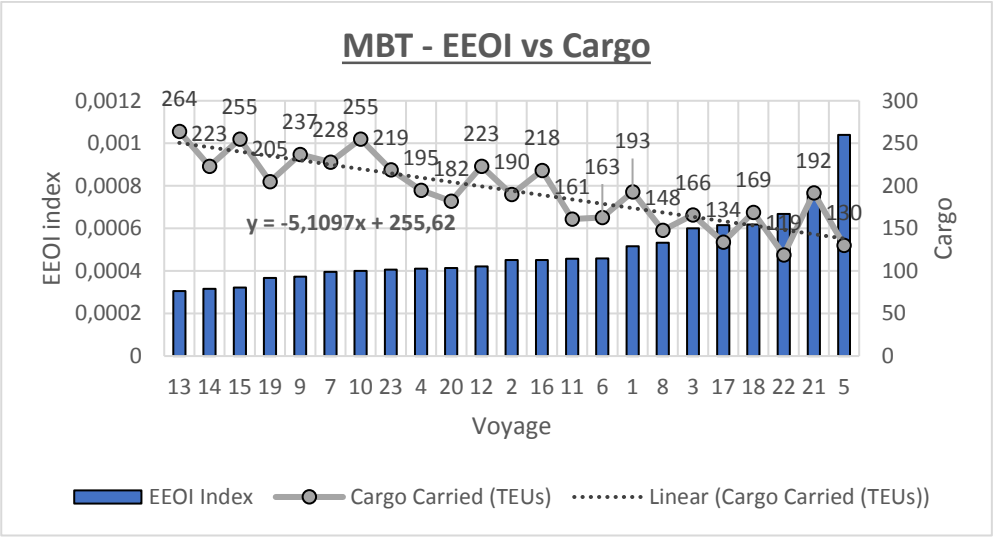

Figure 4.7 MV Meratus Bontang EEOI Index and Cargo Loaded Graph

From figure 4.7, MV Meratus Bontang EEOI index sorted from lowest to highest EEOI index, with amount of cargo represent as a line. The interaction between amount of loaded cargo and EEOI index show opposite relation. Trendline represent the linear function that has negative gradient from linear equation in figure 4.7.

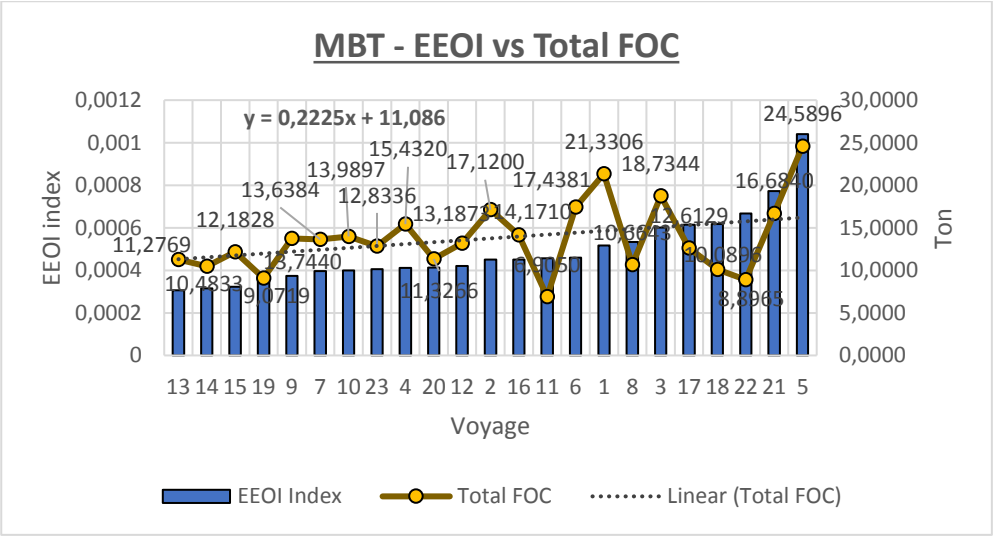

Figure 4.8 MV Meratus Bontang EEOI Index and Total Fuel Oil Consumption Graph

Figure 4.8 represent correlation EEOI index of MV Meratus Bontang with total fuel oil consumption. Showed on the graph, fuel oil consumption proportional with EEOI index. It shown by trendline with positive gradient. Analyze from the graph, the trendline increase with an insignificant increase.

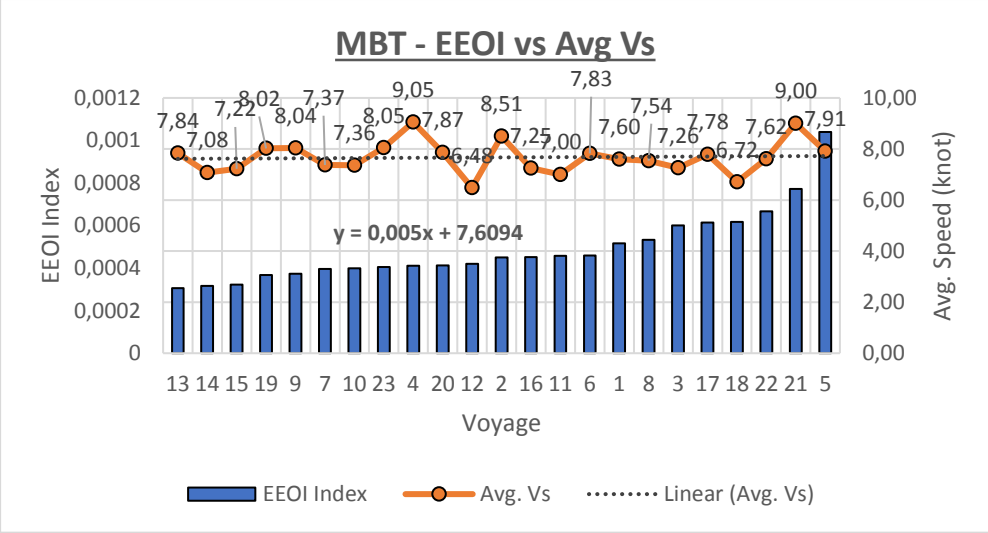

Figure 4.9 MV Meratus Bontang EEOI Index and Average Service Speed Graph

Figure 4.9 show the correlation between EEOI index and average ship service speed in any trip. Average service speed of MV Meratus Bontang didn't show significant increase correlated with EEOI index that significantly increase.

b. MV Meratus Benoa

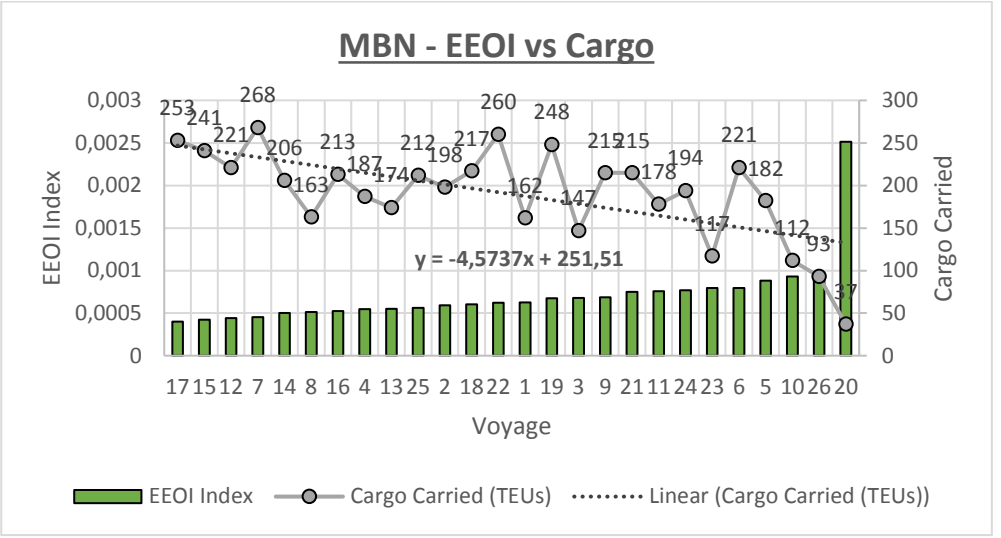

Figure 4.10 MV Meratus Benoa EEOI Index and Cargo Loaded Graph

EEOI index per trip of MV Meratus Benoa and amount of loaded cargo represent in graph figure 4.10. Relation between EEOI index and amount of loaded cargo in MV Meratus Benoa denote inversely proportional. The negative gradient shown in figure 4.10 linear equation formula indicate that the amount of cargo dramatically fall down with the rise of EEOI index value.

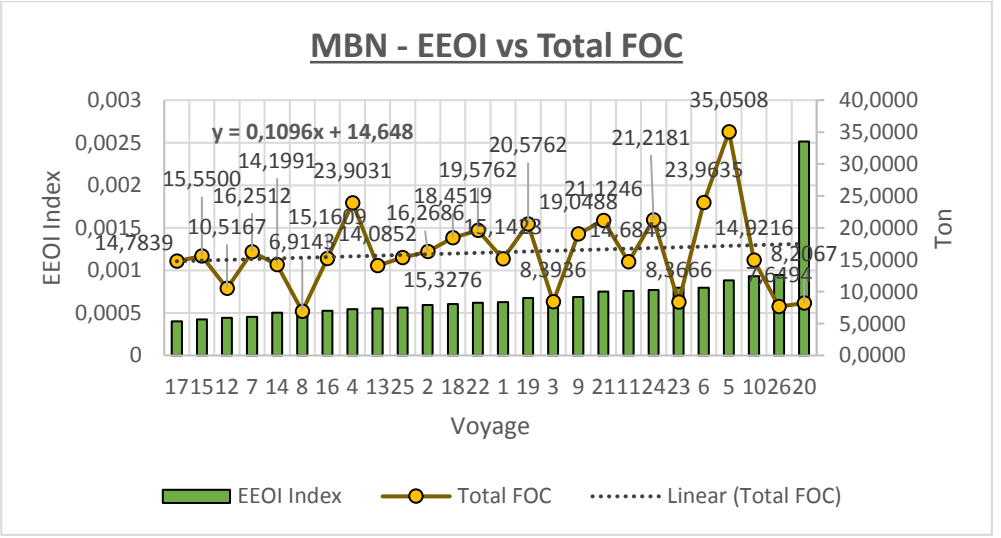

Figure 4.11 MV Meratus Benoa EEOI Index and Total Fuel Oil Consumption Graph

From figure 4.11 can be analyzed that the value of EEOI index has directly proportional with the total fuel oil consumption represent with trendline and its formula. The graph shown that the rising of EEOI index not dramatically followed by an increase of the fuel oil consumption.

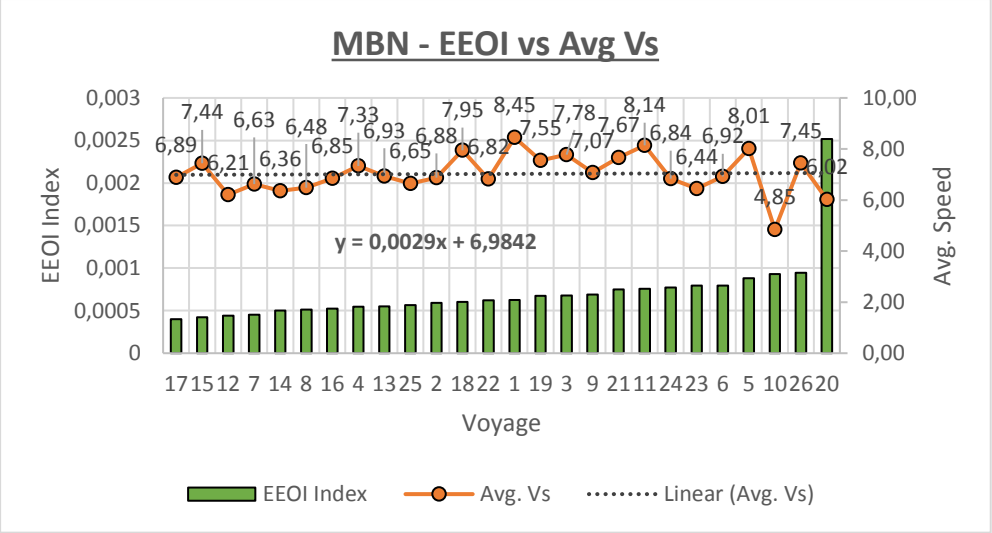

Figure 4.12 MV Meratus Benoa EEOI Index and Average Service Speed Graph

Figure 4.12 represent the correlation of EEOI index in MV Meratus Benoa with average sailing speed. The trendline shown that the gradient is positive. That means that, the increasing of sailing speed ini MV Meratus Benoa has influence in the rise of EEOI index. From the graph, can be concluded that rising of sailing speed not significantly affect the rising of EEOI index.

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CHAPTER V
CONCLUSION

5.1. Conclusion

The conclusion from this research are:

1. Step method for calculating EEOI in merchant ship

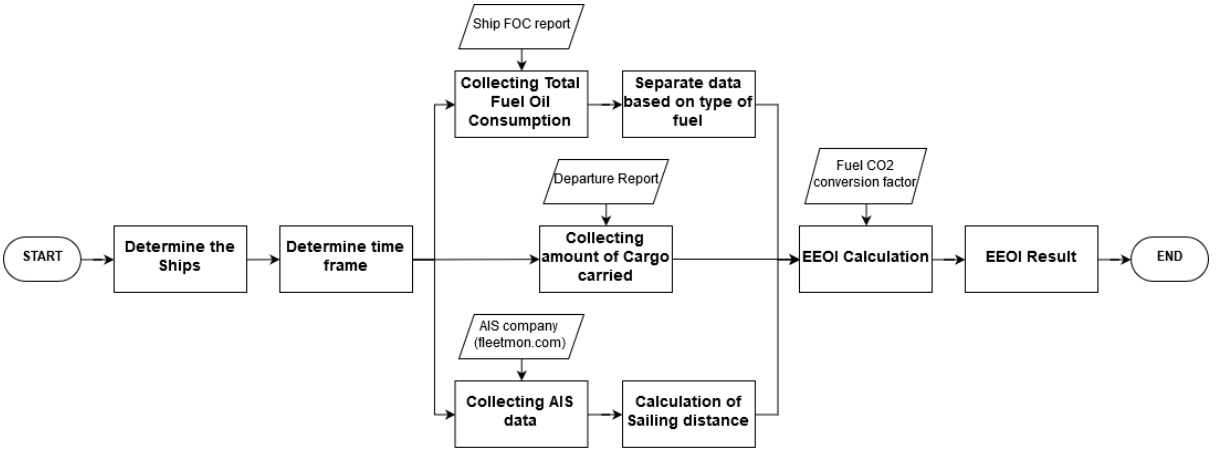

Figure 5.1 Step Method for Calculating EEOI in Merchant Ship

2. Fuel consumption estimating method resulted the fuel estimation. From the calculation, mean absolute percentage error of the fuel estimation as follows:
   a. Trozzi's Method
      - MV Meratus Bontang : 123,33%.
      - MV Meratus Benoa : 77,73%
      - Overall : 100,53%
   b. Jalkanen's Method
      - MV Meratus Bontang : 30,03%
      - MV Meratus Benoa : 18,57%
      - Overall : 24,3%
   c. Wang's Method
      - MV Meratus Bontang : 19,21%
      - MV Meratus Benoa : 17,66%
      - Overall : 18,44%
   d. Mersin's Method
      - MV Meratus Bontang : 102631%
      - MV Meratus Benoa : 49147%
      - Overall : 75889%
   e. Modified Mersin's Method
      - MV Meratus Bontang : 44,74%

- MV Meratus Benoa : 27,69%
- Overall : 36,22%

3. Energy Efficiency Operational Indicator (EEOI) index as follows:
   a. MV Meratus Bontang

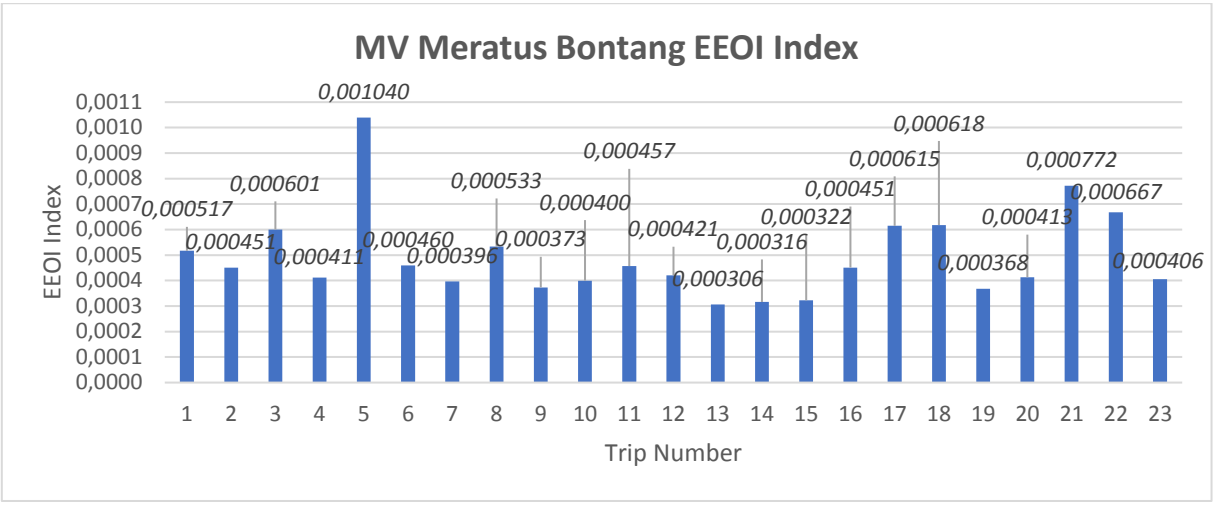

Figure 5.2 MV Meratus Bontang EEOI Index

Average EEOI for MV Meratus Bontang is **0,000472971 ton-CO_2/TEUS.nm.**

   b. MV Meratus Benoa

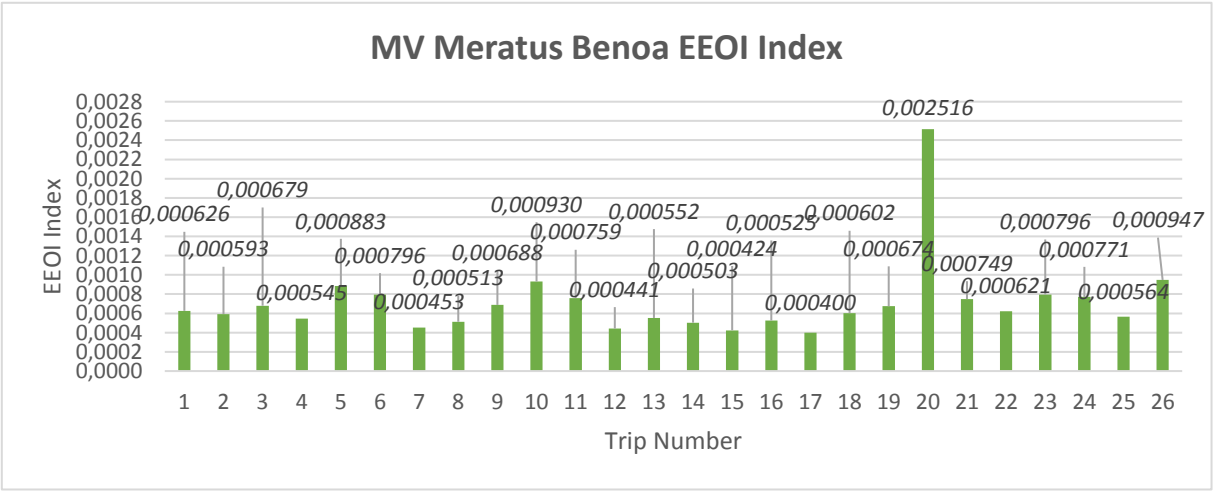

Figure 5.3 MV Meratus Benoa EEOI Index

Average EEOI for MV Meratus Benoa is **0,000630396 ton-CO_2/TEUS.nm.**

4. Benchmarking analysis done with comparing two EEOI result from MV Meratus Bontang and MV Meratus Benoa. To compare two ship's, same voyage route is chosen as base-assumption. The benchmarking process resulted the conclusion about correlation between variables. The variables that directly influence the EEOI result are fuel oil consumption and cargo carried. Another variable that indirectly influence EEOI result are ship service speed and wetted surface area (which caused by cargo weight and ballast). Benchmarking result from EEOI calculation as follows:
   a. MV Meratus Benoa has less efficient because it average EEOI index higher 33% than MV Meratus Bontang
   b. Average EEOI index value for the same voyage route result that MV Meratus Benoa has EEOI index higher than MV Meratus Bontang, decribed as follows:
      - MV Meratus Bontang for route voyage Surabaya-Semarang is **0,000625**, for route Surabaya-Sampit is **0,000371**, for route Surabaya-Kumai is **0,000437**, and for route Semarang-Kumai is **0,000443** EEOI index.
      - MV Meratus Benoa for route voyage Surabaya-Semarang is **0,000807**, for route Surabaya-Sampit is **0,000771**, for route Surabaya-Kumai is **0,000443**, and for route Semarang-Kumai is **0,000557** EEOI index.
   c. From cargo, MV Meratus Bontang carried more average cargo in voyage route Surabaya-Semarang (MBT: 174 TEUs, MBN: 122,5 TEUs) and Surabaya-Sampit (MBT: 223,5 TEUs, MBN: 163,5 TEUs) and MV Meratus Benoa carried more cargo in voyage route Surabaya-Kumai (MBT: 198 TEUs, MBN: 209,6 TEUs) and Semarang-Kumai (MBT: 193 TEUs, MBN: 234,5 TEUs).
   d. From average total fuel oil consumption, MV Meratus Bontang has more FOC in voyage route Surabaya-Semarang (MBT: 11,2262 ton, MBN: 9,0359 ton). MV Meratus Benoa has more FOC in voyage route Surabaya-Sampit (MBT: 11,9055 ton, MBN: 16,9852 ton), Surabaya-Kumai (MBT: 12,9376 ton, MBN: 17,3680 ton), and Semarang-Kumai (MBT: 10,6527 ton, MBN: 16,4194 ton).
   e. From average service speed, MV Meratus Bontang has average speed all above MV Meratus Benoa. Value of average speed are: Surabaya-Semarang (MBT: 7,572 knot, MBN: 7,052 knot), Surabaya-Sampit (MBT: 7,257 knot, MBN: 5,958 knot), Surabaya-Kumai (MBT: 7,798 knot, MBN: 7,229 knot), and Semarang-Kumai (MBT: 7,665 knot, MBN: 6,788 knot).
5. The proposed improvement in EEOI for MV Meratus Bontang and MV Meratus Benoa is by improving ship cargo management for shipping efficiency. While for MV Meratus Benoa, checking of operational aspect is needed especially on machinery system and hull conditions.

5.2. Suggestion

Based on the results of the research, some suggestions given to support further research are as follows:

1. For comparing Trozzi's method with actual fuel oil consumption, authors suggest using same assumption for global shipping fleet. Different assumptions about dimensions and ways of operating ships are possible variables that cannot be concluded from this research.
2. For Wang's method estimation, authors suggested for further research data that collected shall be more than three months window of ship operational data.
3. For Mersin's method, need further research to give some revision due to the miss-conception about ship displacement and initial fuel oil.
4. For further research conducting with same propose improvement of ship operational aspect using EEOI, better understanding data about operational and technical factor will be an input that supports conclusions from the calculation results of EEOI.

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APPENDIX

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APPENDIX 1

SHIP FUEL OIL CONSUMPTION REPORT

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1901**
Starting Date : **04/01/2019**
Ending Date : **16/01/2019**
Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
10/01/2019 10:00	Semarang	Pontianak	SB	54,40		**11.968**													
12/01/2019 16:24																			
14/01/2019 18:00	Pontianak	Semarang	PS	47,30		**10.406**													
16/01/2019 17:18																			
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						22.374,0	**-**		**-**		**-**		**-**		**-**		**-**	**-**	**-**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	22.374,0	Liter	LAST BUNKER STOCK	(40)	Date	04/01/2019	**75.366,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	-	Liter	FIRST REFUELING AT	(41)	Date			Liter
A/E Consumption during at Port	(37) = (34)	-	Liter	SECOND REFUELING *2) AT	(42)	Date			Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42)	(43)	Date	16/01/2019	**75.366,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**22.374,0**	Liter	BUNKER STOCK (43) - (39) *3)	(44)	Date	16/01/2019	**52.992,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44)	(45)	Date	16/01/2019	**472,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47)	(46)	Date	16/01/2019	**53.464,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:					
*3) Time of voyage's final port arrival									
*4) Data taken from voyage's final port arrival									

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 52	cm =	32.878,0	Liter	Settling Tk. :	7.046,0	Liter
Tank No.	: 1S	:	cm =		Liter	Servis I Tk. :	6.770,0	Liter
Tank No.	: C	:	cm =		Liter	Servis II Tk. :	6.770,0	Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**53.464,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 16/01/2019
Chief Engineer

Date : 16/01/2019
Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1901**
Starting Date : **04/01/2019**
Ending Date : **16/01/2019**
Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
04/01/2019 3:00	Semarang		PS		6,20		**1.013**	32,10	**803**	74,70	**1.868**	26,00	**650**	122,50	**3.062**				**6.382**
10/01/2019 10:00			SB		8,60		**1.505**												
10/01/2019 10:00	Semarang	Pontianak	PS	54,40								54,40	**1.360**	54,40	**1.360**			**2.720**	
12/01/2019 16:24			SB																
12/01/2019 16:24	Pontianak		PS		12,80		**1.934**	15,00	**375**	42,50	**1.062**	33,60	**840**	19,60	**490**				**2.767**
14/01/2019 18:00			SB		9,90		**1.287**												
14/01/2019 18:00	Pontianak	Semarang	PS	47,30				47,20	**1.183**	46,00	**1.150**			1,20	**33**			**2.365**	
16/01/2019 17:18			SB																
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**5.739,0**		**2.360,0**		**4.079,5**		**2.850,0**		**4.944,5**		**-**	**5.085,0**	**9.149,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	5.085,0	Liter	LAST BUNKER STOCK	(40)	Date	04/01/2019	**59.174,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	5.739,0	Liter	FIRST REFUELING AT	(41)	Date			Liter
A/E Consumption during at Port	(37) = (34)	9.149,0	Liter	SECOND REFUELING *2) AT	(42)	Date			Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42)	(43)	Date	16/01/2019	**59.174,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**19.973,0**	Liter	BUNKER STOCK (43) - (39) *3)	(44)	Date	16/01/2019	**39.201,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44)	(45)	Date	16/01/2019	**271,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47)	(46)	Date	16/01/2019	**39.472,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:					
*3) Time of voyage's final port arrival									
*4) Data taken from voyage's final port arrival									

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 76	cm =	8.236,0	Liter	Settling Tk. :		Liter
Tank No.	: 1S	: 146	cm =	5.701,0	Liter	Servis I Tk. :	4.009,0	Liter
Tank No.	: 2P	: 108	cm =	17.438,0	Liter	Servis II Tk. :	4.088,0	Liter
Tank No.	: 2S	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**39.472,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 16/01/2019

Chief Engineer

Date : 16/01/2019

Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1902**
Starting Date : **16/01/2019**
Ending Date : **24/01/2019**
Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
18/01/2019 19:00	Semarang		PS	56,20		**11.770**													
21/01/2019 3:12		Pontianak																	
21/01/2019 0:30	Semarang		SB	2,70		**918**													
21/01/2019 3:12		Pontianak																	
22/01/2019 13:00	Pontianak		SB	45,00		**9.900**													
24/01/2019 10:00		Semarang																	
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						22.588	-		-		-		-		-		-	-	-

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	22.588,0	Liter
M/E Consumption during Maneuvering	(36) = (22)	-	Liter
A/E Consumption during at Port	(37) = (34)	-	Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**22.588,0**	Liter

M/E : Main Engine A/E : Auxiliary Engine

*1) Please attached receipts/consumption node
*2) Please attached transfer note from/to other vessel
*3) Time of voyage's final port arrival
*4) Data taken from voyage's final port arrival

LAST BUNKER STOCK	(40)	Date	16/01/2019
FIRST REFUELING AT SEMARANG	(41)	Date	18/01/2019
SECOND REFUELING *2) AT	(42)	Date	
TOTAL STOCK (40) + (41) + (42)	(43)	Date	24/01/2019
BUNKER STOCK (43) - (39) *3)	(44)	Date	24/01/2019
CORRECTION (46) - (44)	(45)	Date	24/01/2019
LAST REMAINING BUNKER = (47)	(46)	Date	24/01/2019

53.464,00	Liter		
65.000,00	Liter		
	Liter		
118.464,00	Liter		
95.876,00	Liter		
468,00	Liter		
96.344,00	Liter		

Remarks:

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 7	cm =	7.801,0	Liter	Settling Tk. :	10.811,0	Liter
Tank No.	: 1S	: 110	cm =	65.000,0	Liter	Servis I Tk. :	6.366,0	Liter
Tank No.	: C	:	cm =		Liter	Servis II Tk. :	6.366,0	Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**96.344,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 24/01/2019
Chief Engineer

Date : 24/01/2019
Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1902**
Starting Date : **16/01/2019**
Ending Date : **24/01/2019**
Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
16/01/2019 17:18	Semarang		PS		8,50		**1.456**	28,40	**710**			45,20	**1.142**	33,70	**843**				**2.695**
18/01/2019 19:00			SB		4,60		**598**												
18/01/2019 19:00	Semarang		PS	56,20				35,20	**880**			21,00	**525**	56,20	**1.405**			**2.810**	
21/01/2019 3:12		Pontianak	SB																
21/01/2019 3:12	Pontianak		PS		8,50		**1.105**	13,30	**333**			33,00	**825**	31,80	**795**				**1.953**
22/01/2019 13:00			SB		10,70		**1.589**												
22/01/2019 13:00	Pontianak		PS	45,00				45,00	**1.125**	26,00	**650**			19,00	**475**			**2.250**	
24/01/2019 10:00		Semarang	SB																
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**4.748,0**		**3.048,0**		**650,0**		**2.492,0**		**3.518,0**		-	**5.060,0**	**4.648,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	5.060,0	Liter	LAST BUNKER STOCK	(40)	Date 16/01/2019	**39.472,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	4.748,0	Liter	FIRST REFUELING AT SEMARANG	(41)	Date 18/01/2019	**40.000,00**	Liter
A/E Consumption during at Port	(37) = (34)	4.648,0	Liter	SECOND REFUELING *2) AT	(42)	Date		Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42)	(43)	Date 24/01/2019	**79.472,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**14.456,0**	Liter	BUNKER STOCK (43) - (39) *3)	(44)	Date 24/01/2019	**65.016,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44)	(45)	Date 24/01/2019	**327,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47)	(46)	Date 24/01/2019	**65.343,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:				
*3) Time of voyage's final port arrival								
*4) Data taken from voyage's final port arrival								

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 266	cm =	28.236,0	Liter	Settling Tk. :		Liter
Tank No.	: 1S	: 110	cm =	11.572,0	Liter	Servis I Tk. :	4.009,0	Liter
Tank No.	: 2P	: 108	cm =	17.438,0	Liter	Servis II Tk. :	4.088,0	Liter
Tank No.	: 2S	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**65.343,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 24/01/2019 — Chief Engineer

Date : 24/01/2019 — Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1903**

Starting Date : **24/01/2019**

Ending Date : **01/02/2019**

Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
27/01/2019 3:24	Semarang	Pontianak	PS	49,9		**8.982**													
29/01/2019 5:18																			
27/01/2019 3:24	Semarang	Pontianak	SB	49,9		**8.982**													
29/01/2019 5:18																			
30/01/2019 13:00	Pontianak	Surabaya	PS	53,2		**11.704**													
01/02/2019 18:12																			
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						29.668	-		-		-		-		-		-	-	-

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	29.668,0	Liter
M/E Consumption during Maneuvering	(36) = (22)	-	Liter
A/E Consumption during at Port	(37) = (34)	-	Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**29.668,0**	Liter

M/E : Main Engine A/E : Auxiliary Engine

*1) Please attached receipts/consumption node

*2) Please attached transfer note from/to other vessel

*3) Time of voyage's final port arrival

*4) Data taken from voyage's final port arrival

LAST BUNKER STOCK	(40)	Date	24/01/2019
FIRST REFUELING AT	(41)	Date	
SECOND REFUELING *2) AT	(42)	Date	
TOTAL STOCK (40) + (41) + (42)	(43)	Date	01/02/2019
BUNKER STOCK (43) - (39) *3)	(44)	Date	01/02/2019
CORRECTION (46) - (44)	(45)	Date	01/02/2019
LAST REMAINING BUNKER = (47)	(46)	Date	01/02/2019

96.344,00	Liter		
	Liter		
	Liter		
96.344,00	Liter		
66.676,00	Liter		
147,00	Liter		
66.823,00	Liter		

Remarks:

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	:	cm =		Liter	Settling Tk. :	10.325,0	Liter
Tank No.	: 1S	: 70	cm =	42.958,0	Liter	Servis I Tk. :	6.770,0	Liter
Tank No.	: C	:	cm =		Liter	Servis II Tk. :	6.770,0	Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**66.823,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 01/02/2019

Chief Engineer

Date : 01/02/2019

Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1903**
Starting Date : **24/01/2019**
Ending Date : **01/02/2019**
Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
24/01/2019 10:00	Semarang		PS		9,80		**1.670**	23,70	**593**	15,00	**375**	61,00	**1.525**						**2.493**
27/01/2019 3:24			SB		6,80		**1.670**												
27/01/2019 3:24	Semarang	Pontianak	PS	49,9				32,60	**815**	8,60	**215**	41,30	**1.032**	17,30	**433**			**2.495**	
29/01/2019 5:18			SB																
29/01/2019 5:18	Pontianak		PS		10,50		**1.509**	11,70	**292**			30,20	**755**	31,70	**793**				**1.840**
30/01/2019 13:00			SB		8,90		**1.157**												
30/01/2019 13:00	Pontianak	Surabaya	PS	53,2				39,00	**975**			14,20	**355**	53,20	**1.330**			**2.660**	
01/02/2019 18:12			SB																
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**6.006,0**		**2.674,5**		**590,0**		**3.667,0**		**2.555,5**		-	**5.154,5**	**4.332,5**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	5.154,5	Liter	LAST BUNKER STOCK	(40)	Date	24/01/2019	**65.343,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	6.006,0	Liter	FIRST REFUELING AT	(41)	Date			Liter
A/E Consumption during at Port	(37) = (34)	4.332,5	Liter	SECOND REFUELING *2) AT	(42)	Date			Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42)	(43)	Date	01/02/2019	**65.343,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**15.493,0**	Liter	BUNKER STOCK (43) - (39) *3)	(44)	Date	01/02/2019	**49.850,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44)	(45)	Date	01/02/2019	**173,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47)	(46)	Date	01/02/2019	**50.023,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:					
*3) Time of voyage's final port arrival									
*4) Data taken from voyage's final port arrival									

DATA SOUNDING/TANKS CONDITION *4)			(47)					Total A/E Workhours Since O/H				Date : 01/02/2019	Date : 01/02/2019
Tank No.	: 1P	:	cm =		Liter	Settling Tk. :	Liter	A/E's Name		Hour		O/H Date	
Tank No.	: 1S	: 204	cm =	21.755,0	Liter	Servis I Tk. :	4.009,0 Liter						
Tank No.	: 2P	: 140	cm =	20.171,0	Liter	Servis II Tk. :	4.088,0 Liter						
Tank No.	: 2S	:	cm =		Liter	Settling Tk. :	Liter						
Tank No.		:	cm =		Liter	Settling Tk. :	Liter						
Tank No.		:	cm =		Liter	Settling Tk. :	Liter						
TOTAL FUEL ON BOARD							**50.023,0** Liter					Chief Engineer	Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1904**

Starting Date : **01/02/2019**

Ending Date : **08/02/2019**

Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
04/02/2019 12:00	Surabaya	Sampit	SB	28,0		**6.160**													
05/02/2019 16:00																			
07/02/2019 2:00	Sampit	Surabaya	SB	24,5		**5.390**													
08/02/2019 2:30																			
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						11.550,0	**-**		-		-		-		-		-	**-**	**-**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	11.550,0	Liter	LAST BUNKER STOCK (40)	Date 01/02/2019	**66.823,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	-	Liter	FIRST REFUELING AT (41)	Date		Liter
A/E Consumption during at Port	(37) = (34)	-	Liter	SECOND REFUELING *2) AT (42)	Date		Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42) (43)	Date 08/02/2019	**66.823,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**11.550,0**	Liter	BUNKER STOCK (43) - (39) *3) (44)	Date 08/02/2019	**55.273,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44) (45)	Date 08/02/2019	**346,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47) (46)	Date 08/02/2019	**55.619,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:			
*3) Time of voyage's final port arrival							
*4) Data taken from voyage's final port arrival							

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	:	cm =		Liter	Settling Tk. :	7.896,0	Liter
Tank No.	: 1S	: 55	cm =	34.587,0	Liter	Servis I Tk. :	6.568,0	Liter
Tank No.	: C	:	cm =		Liter	Servis II Tk. :	6.568,0	Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**55.619,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 08/02/2019

Chief Engineer

Date : 08/02/2019

Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1904**

Starting Date : **01/02/2019**

Ending Date : **08/02/2019**

Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
01/02/2019 18:12	Surabaya		PS		13,90		**1.807**	41,00	**1.025**			65,80	**1.645**	48,30	**1.208**				**3.878**
04/02/2019 12:00			SB		15,50		**2.159**												
04/02/2019 12:00	Surabaya		PS	28				24,00	**600**			26,00	**650**	6,00	**150**			**1.400**	
05/02/2019 16:00		Sampit	SB																
05/02/2019 16:00	Sampit		PS		11,20		**1.456**	32,30	**807**			14,50	**363**	34,00	**850**				**2.020**
07/02/2019 2:00			SB		12,90		**1.830**												
07/02/2019 2:00	Sampit		PS	24,5				2,50	**63**			22,00	**550**	24,50	**613**			**1.225**	
08/02/2019 2:30		Surabaya	SB																
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**7.252,0**		**2.495,0**		-		**3.207,5**		**2.820,5**		-	**2.625,0**	**5.898,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	2.625,0	Liter	LAST BUNKER STOCK	(40)	Date	01/02/2019	**50.023,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	7.252,0	Liter	FIRST REFUELING AT	(41)	Date			Liter
A/E Consumption during at Port	(37) = (34)	5.898,0	Liter	SECOND REFUELING *2) AT	(42)	Date			Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42)	(43)	Date	08/02/2019	**50.023,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**15.775,0**	Liter	BUNKER STOCK (43) - (39) *3)	(44)	Date	08/02/2019	**34.248,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44)	(45)	Date	08/02/2019	**355,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47)	(46)	Date	08/02/2019	**34.603,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:					
*3) Time of voyage's final port arrival									
*4) Data taken from voyage's final port arrival									

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	:	cm =		Liter	Settling Tk. :		Liter
Tank No.	: 1S	: 58	cm =	6.335,0	Liter	Servis I Tk. :	4.009,0	Liter
Tank No.	: 2P	: 140	cm =	20.171,0	Liter	Servis II Tk. :	4.088,0	Liter
Tank No.	: 2S	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**34.603,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 08/02/2019

Chief Engineer

Date : 08/02/2019

Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1905**
Starting Date : **08/02/2019**
Ending Date : **16/02/2019**
Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
10/02/2019 6:00	Surabaya	Kumai	PS	30,2		**6.644**													
11/02/2019 12:12																			
13/02/2019 18:30	Kumai	Semarang	PS	29,6		**6.512**													
15/02/2019 0:06																			
15/02/2019 20:00	Semarang	Surabaya	PS	15,5		**3.410**													
16/02/2019 11:30																			
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						16.566,0	**-**		-		-		-		-		-	**-**	**-**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	16.566,0	Liter	LAST BUNKER STOCK (40)	Date 08/02/2019	**55.619,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	-	Liter	FIRST REFUELING AT : SURABAYA (41)	Date 09/02/2019	**40.000,00**	Liter
A/E Consumption during at Port	(37) = (34)	-	Liter	SECOND REFUELING *2) AT (42)	Date		Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42) (43)	Date 16/02/2019	**95.619,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**16.566,0**	Liter	BUNKER STOCK (43) - (39) *3) (44)	Date 16/02/2019	**79.053,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44) (45)	Date 16/02/2019	**200,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47) (46)	Date 16/02/2019	**79.253,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:			
*3) Time of voyage's final port arrival							
*4) Data taken from voyage's final port arrival							

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 65	cm = 40.000,0	Liter	Settling Tk. : 9.839,0	Liter
Tank No.	: 1S	: 24	cm = 17.288,0	Liter	Servis I Tk. : 6.063,0	Liter
Tank No.	: C	:	cm =	Liter	Servis II Tk. : 6.063,0	Liter
Tank No.	:	:	cm =	Liter	Settling Tk. :	Liter
Tank No.		:	cm =	Liter	Settling Tk. :	Liter
Tank No.		:	cm =	Liter	Settling Tk. :	Liter
TOTAL FUEL ON BOARD					**79.253,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 16/02/2019
Chief Engineer

Date : 16/02/2019
Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1905**
Starting Date : **08/02/2019**
Ending Date : **16/02/2019**
Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
08/02/2019 2:30	Surabaya		PS		12,80		**1.888**	49,50	**1.238**			37,00	**925**	51,50	**1.288**				**3.450**
10/02/2019 6:00			SB		11,90		**1.682**												
10/02/2019 6:00	Surabaya	Kumai	PS	30,2				30,20	**755**			10,20	**255**	30,20	**755**			**1.765**	
11/02/2019 12:12			SB																
11/02/2019 12:12	Kumai		PS		14,00		**2.056**	49,30	**1.232**			54,80	**1.370**	53,80	**1.345**				**3.947**
13/02/2019 18:30			SB		12,60		**1.764**												
13/02/2019 18:30	Kumai	Semarang	PS	29,6				29,60	**740**			29,60	**740**					**1.480**	
15/02/2019 0:06			SB																
15/02/2019 0:06	Semarang		PS		9,00		**1.616**	6,20	**155**			20,00	**500**	20,00	**500**				**1.155**
15/02/2019 20:00			SB		5,20		**780**												
15/02/2019 20:00	Semarang	Surabaya	PS	15,5				15,50	**388**					15,50	**388**			**775**	
16/02/2019 11:30			SB																
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**9.786,0**		**4.507,0**		-		**3.790,0**		**4.275,0**		-	**4.020,0**	**8.552,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	4.020,0	Liter	LAST BUNKER STOCK (40)	Date	08/02/2019	**34.603,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	9.786,0	Liter	FIRST REFUELING AT : SURABAYA (41)	Date	09/02/2019	**30.000,00**	Liter
A/E Consumption during at Port	(37) = (34)	8.552,0	Liter	SECOND REFUELING *2) AT (42)	Date			Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42) (43)	Date	16/02/2019	**64.603,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**22.358,0**	Liter	BUNKER STOCK (43) - (39) *3) (44)	Date	16/02/2019	**42.245,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44) (45)	Date	16/02/2019	**212,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47) (46)	Date	16/02/2019	**42.457,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:				
*3) Time of voyage's final port arrival								
*4) Data taken from voyage's final port arrival								

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 186	cm =	19.854,0	Liter	Settling Tk. :		Liter
Tank No.	: 1S	: 28	cm =	3.166,0	Liter	Servis I Tk. :	4.102,0	Liter
Tank No.	: 2P	: 76	cm =	11.247,0	Liter	Servis II Tk. :	4.088,0	Liter
Tank No.	: 2S	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**42.457,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 16/02/2019
Chief Engineer

Date : 16/02/2019
Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1906**
Starting Date : **16/02/2019**
Ending Date : **21/02/2019**
Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
18/02/2019 8:00	Surabaya	Sampit	SB	27,0		**5.940**													
19/02/2019 11:00																			
21/02/2019 0:00	Sampit	Surabaya	PS	23,4		**5.148**													
21/02/2019 23:24																			
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						11.088,0	**-**		-		-		-		-		-	**-**	**-**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	11.088,0	Liter	LAST BUNKER STOCK (40)	Date	16/02/2019	**79.253,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	-	Liter	FIRST REFUELING AT : (41)	Date			Liter
A/E Consumption during at Port	(37) = (34)	-	Liter	SECOND REFUELING *2) AT (42)	Date			Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42) (43)	Date	21/02/2019	**79.253,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**11.088,0**	Liter	BUNKER STOCK (43) - (39) *3) (44)	Date	21/02/2019	**68.165,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44) (45)	Date	21/02/2019	**456,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47) (46)	Date	21/02/2019	**68.621,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:				
*3) Time of voyage's final port arrival								
*4) Data taken from voyage's final port arrival								

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 65	cm =	40.000,0	Liter	Settling Tk. :	9.475,0	Liter
Tank No.	: 1S	: 19	cm =	14.498,0	Liter	Servis I Tk. :	2.324,0	Liter
Tank No.	: C	:	cm =		Liter	Servis II Tk. :	2.324,0	Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**68.621,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 21/02/2019
Chief Engineer

Date : 21/02/2019
Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1906**
Starting Date : **16/02/2019**
Ending Date : **21/02/2019**
Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
16/02/2019 11:30	Surabaya		PS		15,30		**2.295**	26,70	**668**			42,60	**1.065**	39,10	**977**				**2.710**
18/02/2019 8:00			SB		16,70		**2.603**												
18/02/2019 8:00	Surabaya	Kumai	PS	27,0				23,00	**575**			4,00	**100**	27,00	**675**			**1.350**	
19/02/2019 11:00			SB																
19/02/2019 11:00	Kumai		PS		12,80		**1.920**	17,00	**425**			37,00	**925**	35,50	**887**				**2.237**
21/02/2019 0:00			SB		14,30		**2.250**												
21/02/2019 0:00	Kumai	Semarang	PS	23,4				23,40	**585**			23,40	**585**					**1.170**	
21/02/2019 23:24			SB																
																			-
																		-	
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**9.068,0**		**2.253,0**		**-**		**2.675,0**		**2.539,0**		**-**	**2.520,0**	**4.947,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	2.520,0	Liter	LAST BUNKER STOCK	(40)	Date	16/02/2019	**42.457,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	9.068,0	Liter	FIRST REFUELING AT :	(41)	Date			Liter
A/E Consumption during at Port	(37) = (34)	4.947,0	Liter	SECOND REFUELING *2) AT	(42)	Date			Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42)	(43)	Date	21/02/2019	**42.457,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**16.535,0**	Liter	BUNKER STOCK (43) - (39) *3)	(44)	Date	21/02/2019	**25.922,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44)	(45)	Date	21/02/2019	**226,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47)	(46)	Date	21/02/2019	**26.148,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:					
*3) Time of voyage's final port arrival									
*4) Data taken from voyage's final port arrival									

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 62	cm =	6.757,0	Liter	Settling Tk. :		Liter
Tank No.	: 1S	:	cm =		Liter	Servis I Tk. :	4.056,0	Liter
Tank No.	: 2P	: 76	cm =	11.247,0	Liter	Servis II Tk. :	4.088,0	Liter
Tank No.	: 2S	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**26.148,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 21/02/2019
Chief Engineer

Date : 21/02/2019
Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1907**
Starting Date : **21/02/2019**
Ending Date : **27/02/2019**
Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
23/02/2019 8:00	Surabaya	Sampit	PS	19,3		**4.246**													
24/02/2019 3:18																			
26/02/2019 14:00	Sampit	Surabaya	PS	24,0		**5.280**													
27/02/2019 14:00																			
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						9.526,0	**-**		-		-		-		-		-	-	-

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	9.526,0	Liter	
M/E Consumption during Maneuvering	(36) = (22)	-	Liter	
A/E Consumption during at Port	(37) = (34)	-	Liter	
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**9.526,0**	Liter	

M/E : Main Engine A/E : Auxiliary Engine

*1) Please attached receipts/consumption node
*2) Please attached transfer note from/to other vessel
*3) Time of voyage's final port arrival
*4) Data taken from voyage's final port arrival

LAST BUNKER STOCK	(40)	Date	21/02/2019	**68.621,00** Liter
FIRST REFUELING AT : SURABAYA	(41)	Date	22/02/2019	**30.000,00** Liter
SECOND REFUELING *2) AT	(42)	Date		Liter
TOTAL STOCK (40) + (41) + (42)	(43)	Date	27/02/2019	**98.621,00** Liter
BUNKER STOCK (43) - (39) *3)	(44)	Date	27/02/2019	**89.095,00** Liter
CORRECTION (46) - (44)	(45)	Date	27/02/2019	**499,00** Liter
LAST REMAINING BUNKER = (47)	(46)	Date	27/02/2019	**89.594,00** Liter

Remarks:

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 68	cm =	41.842,0	Liter	Settling Tk. :	4.616,0 Liter
Tank No.	: 1S	: 47	cm =	30.000,0	Liter	Servis I Tk. :	6.568,0 Liter
Tank No.	: C	:	cm =		Liter	Servis II Tk. :	6.568,0 Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :	Liter
Tank No.		:	cm =		Liter	Settling Tk. :	Liter
Tank No.		:	cm =		Liter	Settling Tk. :	Liter
TOTAL FUEL ON BOARD							**89.594,0** Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 27/02/2019
Chief Engineer

Date : 27/02/2019
Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1907**
Starting Date : **21/02/2019**
Ending Date : **27/02/2019**
Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
21/02/2019 23:24	Surabaya		PS		17,00		**3.140**	25,60	**640**			21,60	**540**	32,60	**815**				**1.995**
23/02/2019 8:00			SB		10,00		**1.600**												
23/02/2019 8:00	Surabaya	Kumai	PS	19,3				19,30	**483**			19,30	**483**					**966**	
24/02/2019 3:18			SB																
24/02/2019 3:18	Kumai		PS		13,00		**2.152**	50,70	**1.268**			30,00	**750**	50,80	**1.270**				**3.288**
26/02/2019 14:00			SB		11,80		**1.888**												
26/02/2019 14:00	Kumai	Semarang	PS	24				24,00	**600**			24,00	**600**					**1.200**	
27/02/2019 14:00			SB																
																			-
																		-	
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**8.780,0**		**2.990,0**		-		**2.373,0**		**2.085,0**		-	**2.165,5**	**5.282,5**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	2.165,5	Liter	LAST BUNKER STOCK	(40)	Date 21/02/2019	**26.148,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	8.780,0	Liter	FIRST REFUELING AT : SURABAYA	(41)	Date 22/02/2019	**30.000,00**	Liter
A/E Consumption during at Port	(37) = (34)	5.282,5	Liter	SECOND REFUELING *2) AT	(42)	Date		Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42)	(43)	Date 27/02/2019	**56.148,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**16.228,0**	Liter	BUNKER STOCK (43) - (39) *3)	(44)	Date 27/02/2019	**39.920,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44)	(45)	Date 27/02/2019	**155,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47)	(46)	Date 27/02/2019	**40.075,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:				
*3) Time of voyage's final port arrival								
*4) Data taken from voyage's final port arrival								

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	:	cm =	10.137,0	Liter	Settling Tk. :		Liter
Tank No.	: 1S	: 94	cm =	21.871,0	Liter	Servis I Tk. :	4.056,0	Liter
Tank No.	: 2P	: 158	cm =		Liter	Servis II Tk. :	4.011,0	Liter
Tank No.	: 2S	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**40.075,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 27/02/2019

Chief Engineer

Date : 27/02/2019

Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1908**
Starting Date : **27/02/2019**
Ending Date : **05/03/2019**
Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption							Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
01/03/2019 12:00	Surabaya	Kumai	SB	31,0		**6.820**													
02/03/2019 19:00																			
04/03/2019 18:00	Kumai	Surabaya	SB	24,5		**5.390**													
05/03/2019 18:30																			
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						12.210,0	-		-		-		-		-		-	-	-

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	12.210,0	Liter	LAST BUNKER STOCK (40)	Date 21/02/2019	**89.594,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	-	Liter	FIRST REFUELING AT : (41)	Date		Liter
A/E Consumption during at Port	(37) = (34)	-	Liter	SECOND REFUELING *2) AT (42)	Date		Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42) (43)	Date 27/02/2019	**89.594,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**12.210,0**	Liter	BUNKER STOCK (43) - (39) *3) (44)	Date 27/02/2019	**77.384,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44) (45)	Date 27/02/2019	**268,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47) (46)	Date 27/02/2019	**77.652,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:			
*3) Time of voyage's final port arrival							
*4) Data taken from voyage's final port arrival							

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 40	cm =	26.217,0	Liter	Settling Tk. :	7.289,0	Liter
Tank No.	: 1S	: 47	cm =	30.000,0	Liter	Servis I Tk. :	7.073,0	Liter
Tank No.	: C	:	cm =		Liter	Servis II Tk. :	7.073,0	Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**77.652,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 05/03/2019
Chief Engineer

Date : 05/03/2019
Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1908**

Starting Date : **27/02/2019**

Ending Date : **05/03/2019**

Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
27/02/2019 14:00	Surabaya		PS		11,70		**1.872**	46,00	**1.150**			44,20	**1.105**	46,00	**1.150**				**3.405**
01/03/2019 12:00			SB		13,50		**2.268**												
01/03/2019 12:00	Surabaya	Kumai	PS	31,0				31,00	**775**			31,00	**775**					**1.550**	
02/03/2019 19:00			SB																
02/03/2019 19:00	Kumai		PS		13,50		**2.160**	34,10	**853**			45,80	**1.145**	44,10	**1.103**				**3.100**
04/03/2019 18:00			SB		15,20		**2.432**												
04/03/2019 18:00	Kumai	Surabaya	PS	24,5				4,50	**113**			24,50	**613**	20,20	**505**			**1.230**	
05/03/2019 18:30			SB																
																			-
																		-	
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**8.732,0**		**2.890,0**		-		**3.637,5**		**2.757,5**		-	**2.780,0**	**6.505,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	2.780,0	Liter	LAST BUNKER STOCK	(40)	Date	21/02/2019	**40.075,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	8.732,0	Liter	FIRST REFUELING AT :	(41)	Date			Liter
A/E Consumption during at Port	(37) = (34)	6.505,0	Liter	SECOND REFUELING *2) AT	(42)	Date			Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42)	(43)	Date	27/02/2019	**40.075,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**18.017,0**	Liter	BUNKER STOCK (43) - (39) *3)	(44)	Date	27/02/2019	**22.058,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44)	(45)	Date	27/02/2019	**453,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47)	(46)	Date	27/02/2019	**22.511,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:					
*3) Time of voyage's final port arrival									
*4) Data taken from voyage's final port arrival									

DATA SOUNDING/TANKS CONDITION *4)	(47)					
Tank No. : 1P	:	cm =		Liter	Settling Tk. :	Liter
Tank No. : 1S	:	cm =		Liter	Servis I Tk. :	4.056,0 Liter
Tank No. : 2P	: 92	cm =	14.444,0	Liter	Servis II Tk. :	4.011,0 Liter
Tank No. : 2S	:	cm =		Liter	Settling Tk. :	Liter
Tank No.	:	cm =		Liter	Settling Tk. :	Liter
Tank No.	:	cm =		Liter	Settling Tk. :	Liter
TOTAL FUEL ON BOARD						**22.511,0** Liter

Total A/E Workhours Since O/H				
A/E's Name		Hour		O/H Date

Date : 05/03/2019

Chief Engineer

Date : 05/03/2019

Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1909**

Starting Date : **05/03/2013**

Ending Date : **12/03/2019**

Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
07/03/2019 6:00	Surabaya	Semarang	PS	20,1		**4.422**													
08/03/2019 2:06																			
08/03/2019 18:00	Semarang	Kumai	SB	24,4		**5.368**													
09/03/2019 18:24																			
11/03/2019 6:00	Kumai	Surabaya	SB	23,0		**5.060**													
12/03/2019 5:00																			
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						14.850,0	**-**		-		-		-		-		-	**-**	**-**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	14.850,0	Liter	LAST BUNKER STOCK (40)	Date 05/03/2019	**77.652,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	-	Liter	FIRST REFUELING AT : SURABAYA (41)	Date 06/03/2019	**30.000,00**	Liter
A/E Consumption during at Port	(37) = (34)	-	Liter	SECOND REFUELING *2) AT (42)	Date 06/03/2019	**598,00**	Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42) (43)	Date 12/03/2019	**108.250,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**14.850,0**	Liter	BUNKER STOCK (43) - (39) *3) (44)	Date 12/03/2019	**93.400,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44) (45)	Date 12/03/2019	**77,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47) (46)	Date 12/03/2019	**93.477,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:			
*3) Time of voyage's final port arrival							
*4) Data taken from voyage's final port arrival							

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 47	cm =	30.000,0	Liter	Settling Tk. :	7.289,0	Liter
Tank No.	: 1S	: 89	cm =	53.560,0	Liter	Servis I Tk. :	1.314,0	Liter
Tank No.	: C	:	cm =		Liter	Servis II Tk. :	1.314,0	Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**93.477,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 12/03/2019

Chief Engineer

Date : 12/03/2019

Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1909**

Starting Date : **05/03/2013**

Ending Date : **12/03/2019**

Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
05/03/2019 18:30	Surabaya		PS		11,40		**1.926**	33,80	**845**			31,50	**788**	35,50	**888**				**2.520**
07/03/2019 6:00			SB		9,70		**1.552**												
07/03/2019 6:00	Surabaya	Semarang	PS	20,1								20,10	**503**	20,10	**503**			**1.005**	
08/03/2019 2:06			SB																
08/03/2019 2:06	Semarang		PS		4,70		**752**	15,90	**397**			15,90	**398**	6,90	**173**				**968**
08/03/2019 18:00			SB		8,80		**1.654**												
08/03/2019 18:00	Semarang	Kumai	PS	24,4				4,50	**113**			24,50	**613**	20,20	**505**			**1.230**	
09/03/2019 18:24			SB																
09/03/2019 18:24	Kumai		PS		10,30		**1.648**	35,60	**890**			35,60	**890**	32,60	**815**				**2.595**
11/03/2019 6:00			SB		13,50		**2.352**												
11/03/2019 6:00	Kumai	Surabaya	PS	23,0				22,00	**550**			7,00	**175**	17,00	**425**			**1.150**	
12/03/2019 5:00			SB																
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**9.884,0**		**2.794,5**		-		**3.365,5**		**3.308,0**		-	**3.385,0**	**6.083,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	3.385,0	Liter	LAST BUNKER STOCK	(40)	Date 05/03/2019	**22.511,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	9.884,0	Liter	FIRST REFUELING AT : SURABAYA	(41)	Date 06/03/2019	**30.000,00**	Liter
A/E Consumption during at Port	(37) = (34)	6.083,0	Liter	SECOND REFUELING *2) AT	(42)	Date 06/03/2019	**200,00**	Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42)	(43)	Date 12/03/2019	**52.711,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**19.352,0**	Liter	BUNKER STOCK (43) - (39) *3)	(44)	Date 12/03/2019	**33.359,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44)	(45)	Date 12/03/2019	**134,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47)	(46)	Date 12/03/2019	**33.493,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:				
*3) Time of voyage's final port arrival								
*4) Data taken from voyage's final port arrival								

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	:	cm =		Liter	Settling Tk. :		Liter
Tank No.	: 1S	: 102	cm =	10.982,0	Liter	Servis I Tk. :	4.056,0	Liter
Tank No.	: 2P	: 92	cm =	14.444,0	Liter	Servis II Tk. :	4.011,0	Liter
Tank No.	: 2S	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**33.493,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 12/03/2019

Chief Engineer

Date : 12/03/2019

Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1910**
Starting Date : **12/03/2019**
Ending Date : **21/03/2019**
Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
16/03/2019 16:00	Surabaya	Semarang	PS	12,0		**2.640**													
17/03/2019 4:00																			
16/03/2019 16:00	Surabaya	Semarang	SB	12,0		**2.640**													
17/03/2019 4:00																			
17/03/2019 14:36	Semarang	Kumai	PS	27,3		**6.006**													
18/03/2019 17:54																			
20/03/2019 16:48	Kumai	Surabaya	PS	27,4		**6.028**													
21/03/2019 20:12																			
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						17.314,0	**-**		-		-		-		-		-	**-**	**-**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	17.314,0	Liter	
M/E Consumption during Maneuvering	(36) = (22)	-	Liter	
A/E Consumption during at Port	(37) = (34)	-	Liter	
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**17.314,0**	Liter	

M/E : Main Engine A/E : Auxiliary Engine

*1) Please attached receipts/consumption node
*2) Please attached transfer note from/to other vessel
*3) Time of voyage's final port arrival
*4) Data taken from voyage's final port arrival

LAST BUNKER STOCK	(40)	Date	12/03/2019	**93.477,00** Liter
FIRST REFUELING AT : SURABAYA	(41)	Date		Liter
SECOND REFUELING *2) AT	(42)	Date		**-** Liter
TOTAL STOCK (40) + (41) + (42)	(43)	Date	21/03/2019	**93.477,00** Liter
BUNKER STOCK (43) - (39) *3)	(44)	Date	21/03/2019	**76.163,00** Liter
CORRECTION (46) - (44)	(45)	Date	21/03/2019	**363,00** Liter
LAST REMAINING BUNKER = (47)	(46)	Date	21/03/2019	**76.526,00** Liter

Remarks:

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 47	cm =	30.000,0	Liter	Settling Tk. :	7.896,0 Liter
Tank No.	: 1S	: 34	cm =	22.868,0	Liter	Servis I Tk. :	7.881,0 Liter
Tank No.	: C	:	cm =		Liter	Servis II Tk. :	7.881,0 Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :	Liter
Tank No.		:	cm =		Liter	Settling Tk. :	Liter
Tank No.		:	cm =		Liter	Settling Tk. :	Liter
TOTAL FUEL ON BOARD							**76.526,0** Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 21/03/2019
Chief Engineer

Date : 21/03/2019
Master

FOCR-Bontang

Vessel : **Meratus Bontang**
Voyage : **1910**
Starting Date : **12/03/2019**
Ending Date : **21/03/2019**
Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	PS (liter)	A/E No: (hour)	PS CTR (liter)	A/E No: (hour)	STB CTR (liter)	A/E No: (hour)	STB (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
12/03/2019 5:00	Surabaya		PS		20,60		**3.548**	72,50	**1.813**			95,10	**2.378**	86,60	**2.165**				**6.355**
16/03/2019 16:00			SB		20,60		**3.548**												
16/03/2019 16:00	Surabaya	Semarang	PS	12,0								12,00	**300**	12,00	**300**			**600**	
17/03/2019 4:00			SB																
17/03/2019 4:00	Semarang		PS		5,40		**984**	5,60	**140**			10,60	**265**	10,60	**265**				**670**
17/03/2019 14:36			SB		3,40		**544**												
17/03/2019 14:36	Semarang	Kumai	PS	27,3				3,90	**98**			27,30	**683**	25,40	**635**			**1.415**	
18/03/2019 17:54			SB																
18/03/2019 17:54	Kumai		PS		11,50		**1.840**	46,90	**1.173**			46,90	**1.173**	40,90	**1.022**				**3.367**
20/03/2019 16:48			SB		11,50		**1.840**												
20/03/2019 16:48	Kumai	Surabaya	PS	27,4				4,20	**105**			23,20	**580**	27,40	**685**			**1.370**	
21/03/2019 20:12			SB																
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**12.304,0**		**3.327,5**		-		**5.377,5**		**5.072,0**		-	**3.385,0**	**10.392,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	3.385,0	Liter	LAST BUNKER STOCK	(40)	Date	12/03/2019	**33.493,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	12.304,0	Liter	FIRST REFUELING AT : SURABAYA	(41)	Date	14/03/2019	**50.000,00**	Liter
A/E Consumption during at Port	(37) = (34)	10.392,0	Liter	SECOND REFUELING *2) AT	(42)	Date	14/03/2019	**104,00**	Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42)	(43)	Date	21/03/2019	**83.597,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**26.081,0**	Liter	BUNKER STOCK (43) - (39) *3)	(44)	Date	21/03/2019	**57.516,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44)	(45)	Date	21/03/2019	**209,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47)	(46)	Date	21/03/2019	**57.725,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:					
*3) Time of voyage's final port arrival									
*4) Data taken from voyage's final port arrival									

DATA SOUNDING/TANKS CONDITION *4)	(47)						
Tank No. : 1P	: 136	cm =	14.573,0	Liter	Settling Tk. :		Liter
Tank No. : 1S	: 110	cm =	11.827,0	Liter	Servis I Tk. :	4.056,0	Liter
Tank No. : 2P	: 172	cm =	23.258,0	Liter	Servis II Tk. :	4.011,0	Liter
Tank No. : 2S	:	cm =		Liter	Settling Tk. :		Liter
Tank No.	:	cm =		Liter	Settling Tk. :		Liter
Tank No.	:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD						**57.725,0**	Liter

Total A/E Workhours Since O/H				
A/E's Name		Hour		O/H Date

Date : 21/03/2019
Chief Engineer

Date : 21/03/2019
Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1901**
Starting Date : **06/01/2019**
Ending Date : **15/01/2019**
Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
06/01/2019 0:00	Surabaya																		
08/01/2019 0:00																			
08/01/2019 20:24	Surabaya		SB	33,40		**6.915**													
10/01/2019 5:48		Kumai																	
10/01/2019 0:00	Kumai																		
12/01/2019 0:00																			
12/01/2019 13:24	Kumai		PS	32,00		**7.300**													
13/01/2019 21:24		Semarang																	
13/01/2019 0:00	Semarang																		
14/01/2019 0:00																			
14/01/2019 6:48	Semarang		PS	17,50		**5.134**													
15/01/2019 0:18		Surabaya																	
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						19.349,0	**-**		**-**		**-**		**-**		**-**		**-**	**-**	**-**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	19.349,0	Liter	LAST BUNKER STOCK (40)	Date	06/01/2019	**42.281,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	-	Liter	FIRST REFUELING AT SURABAYA (41)	Date	06/01/2019	**35.007,00**	Liter
A/E Consumption during at Port	(37) = (34)	-	Liter	SECOND REFUELING *2) AT (42)	Date			Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42)	(43)	Date	08/01/2019	**77.288,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**19.349,0**	Liter	BUNKER STOCK (43) - (39) *3)	(44)	Date	15/01/2019	**57.939,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44)	(45)	Date		-	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47)	(46)	Date	15/01/2019	**57.939,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:					
*3) Time of voyage's final port arrival									
*4) Data taken from voyage's final port arrival									

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 56	cm =	32.273,0	Liter	Settling Tk. :	7.073,0	Liter
Tank No.	: 1S	:	cm =		Liter	Servis I Tk. :	7.174,0	Liter
Tank No.	: 2C	:	cm =		Liter	Servis II Tk. :	11.419,0	Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**57.939,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 15/01/2019
Chief Engineer

Date : 15/01/2019
Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1901**
Starting Date : **06/01/2019**
Ending Date : **15/01/2019**
Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
06/01/2019 0:00	Surabaya		PS		6,30		**1.260**	58,90	**1.649**	58,90	**1.649**	58,90	**1.649**			13	286		**5.233**
08/01/2019 0:00			SB		6,30		**1.260**												
08/01/2019 20:24	Surabaya			33,40				33,40	**935**	0,60	**16**	33,40	**935**					**1.886**	
10/01/2019 5:48		Kumai																	
10/01/2019 0:00	Kumai		PS		7,90		**1.700**	53,10	**1.486**	46,40	**1.299**	55,60	**1.556**	23,60	**660**	8	176		**5.177**
12/01/2019 0:00			SB		7,90		**1.700**												
12/01/2019 13:24	Kumai			32,00				18,80	**526**	31,70	**887**	17,90	**501**	0,50	**14**			**1.928**	
13/01/2019 21:24		Semarang																	
13/01/2019 0:00	Semarang		PS		2,60		**900**	9,40	**263**	3,40	**95**	9,40	**263**			8	176		**797**
14/01/2019 0:00			SB		2,60		**900**												
14/01/2019 6:48	Semarang			17,50				5,20	**145**	17,50	**490**	8,00	**224**	10,30	**288**			**1.147**	
15/01/2019 0:18		Surabaya	SB		0,50		**100**												
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**7.820,0**		**5.004,0**		**4.436,0**		**5.128,0**		**962,0**		**638,0**	**4.961,0**	**11.207,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	4.961,0	Liter	LAST BUNKER STOCK	(40)	Date 06/01/2019	**33.697,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	7.820,0	Liter	FIRST REFUELING AT SURABAYA	(41)	Date 06/01/2019	**25.066,00**	Liter
A/E Consumption during at Port	(37) = (34)	11.207,0	Liter	SECOND REFUELING *2) AT	(42)	Date		Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)	90,0	Liter	TOTAL STOCK (40) + (41) + (42)	(43)	Date 08/01/2019	**58.763,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**24.078,0**	Liter	BUNKER STOCK (43) - (39) *3)	(44)	Date 15/01/2019	**34.685,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44)	(45)	Date	-	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47)	(46)	Date 15/01/2019	**34.685,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:				
*3) Time of voyage's final port arrival								
*4) Data taken from voyage's final port arrival								

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	:	cm =	4.781,0	Liter	Settling Tk. :	2.419,0	Liter
Tank No.	: 1S	: 43	cm =	11.247,0	Liter	Servis I Tk. :	2.419,0	Liter
Tank No.	: 2P	: 76	cm =	13.819,0	Liter	Servis II Tk. :		Liter
Tank No.	: 2S	: 89	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**34.685,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 15/01/2019

Chief Engineer

Date : 15/01/2019

Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1902**
Starting Date : **17/01/2019**
Ending Date : **25/01/2019**
Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
17/01/2019 0:00	Surabaya																		
19/01/2019 0:00																			
17/01/2019 7:30	Surabaya		PS	63,50		**13.795**													
19/01/2019 23:00	Samarinda																		
22/01/2019 0:00	Samarinda																		
25/01/2019 0:00																			
22/01/2019 10:00	Samarinda		PS	65,00		**8.580**													
25/01/2019 3:00		Surabaya	SB			**14.448**													
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						36.823,0	**-**		**-**		**-**		**-**		**-**		**-**	**-**	**-**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	36.823,0	Liter	LAST BUNKER STOCK	(40)	Date	15/01/2019	**57.939,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	-	Liter	FIRST REFUELING AT	(41)	Date			Liter
A/E Consumption during at Port	(37) = (34)	-	Liter	SECOND REFUELING *2) AT	(42)	Date			Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42)	(43)	Date	17/01/2019	**57.939,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**36.823,0**	Liter	BUNKER STOCK (43) - (39) *3)	(44)	Date	25/01/2019	**21.116,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44)	(45)	Date		-	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47)	(46)	Date	25/01/2019	**21.116,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:					
*3) Time of voyage's final port arrival									
*4) Data taken from voyage's final port arrival									

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 9	cm =	6.196,0	Liter	Settling Tk. :	4.850,0	Liter
Tank No.	: 1S	:	cm =		Liter	Servis I Tk. :	4.847,0	Liter
Tank No.	: 2C	:	cm =		Liter	Servis II Tk. :	5.223,0	Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**21.116,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 25/01/2019
Chief Engineer

Date : 25/01/2019
Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1902**
Starting Date : **17/01/2019**
Ending Date : **25/01/2019**
Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
17/01/2019 0:00	Surabaya		PS		9,70		**2.180**	43,80	**1.224**	53,70	**1.445**	8,40	**178**	35,30	**987**	8	176		**4.010**
19/01/2019 0:00			SB		9,70		**2.180**												
17/01/2019 7:30	Surabaya			63,50				62,50	**1.750**	52,50	**1.470**	11,00	**308**					**3.528**	
19/01/2019 23:00	Samarinda																		
22/01/2019 0:00	Samarinda		PS		14,70		**3.300**	11,40	**318**	28,20	**787**	58,80	**1.643**	35,60	**1.001**	6	132		**3.881**
25/01/2019 0:00			SB		14,70		**3.300**												
22/01/2019 10:00	Samarinda			65,00						1,60	**44**	66,00	**1.848**	66,00	**1.848**			**3.740**	
25/01/2019 3:00	Surabaya																		
																			-
																		-	
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**10.960,0**		**3.292,0**		**3.746,0**		**3.977,0**		**3.836,0**		**308,0**	**7.268,0**	**7.891,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	7.268,0	Liter	LAST BUNKER STOCK (40)	Date 15/01/2019	**34.685,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	10.960,0	Liter	FIRST REFUELING AT SURABAYA (41)	Date 15/01/2019	**25.006,00**	Liter
A/E Consumption during at Port	(37) = (34)	7.891,0	Liter	SECOND REFUELING *2) AT (42)	Date		Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)	125,0	Liter	TOTAL STOCK (40) + (41) + (42) (43)	Date 17/01/2019	**59.691,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**26.244,0**	Liter	BUNKER STOCK (43) - (39) *3) (44)	Date 25/01/2019	**33.447,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44) (45)	Date	-	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47) (46)	Date 25/01/2019	**33.447,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:			
*3) Time of voyage's final port arrival							
*4) Data taken from voyage's final port arrival							

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	:	cm =		Liter	Settling Tk. :	2.627,0	Liter
Tank No.	: 1S	: 79	cm =	8.559,0	Liter	Servis I Tk. :	2.765,0	Liter
Tank No.	: 2P	: 66	cm =	9.382,0	Liter	Servis II Tk. :		Liter
Tank No.	: 2S	: 70	cm =	10.114,0	Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**33.447,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 25/01/2019
Chief Engineer

Date : 25/01/2019
Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1903**
Starting Date : **25/01/2019** Ending Date : **03/02/2019** Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption								Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
25/01/2019 0:00	Surabaya																		
27/01/2019 0:00																			
27/01/2019 14:06	Surabaya		PS	45,70		**9.601**													
29/01/2019 11:48		Kumai	SB			**3.440**													
29/01/2019 0:00	Kumai																		
31/01/2019 0:00																			
31/01/2019 15:36	Kumai		PS	34,40		**7.288**													
02/02/2019 2:00		Semarang	SB			**700**													
02/02/2019 0:00	Semarang																		
02/02/2019 0:00																			
02/02/2019 15:06	Semarang		PS	21,20															
03/02/2019 12:18		Surabaya	SB			**4.240**													
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						25.269,0	-		-		-		-		-		-	-	-

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	25.269,0	Liter
M/E Consumption during Maneuvering	(36) = (22)	-	Liter
A/E Consumption during at Port	(37) = (34)	-	Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**25.269,0**	Liter

LAST BUNKER STOCK	(40)	Date	25/01/2019	**21.116,00**	Liter
FIRST REFUELING AT SURABAYA	(41)	Date	27/01/2019	**40.002,00**	Liter
SECOND REFUELING *2) AT	(42)	Date			Liter
TOTAL STOCK (40) + (41) + (42)	(43)	Date	27/01/2019	**61.118,00**	Liter
BUNKER STOCK (43) - (39) *3)	(44)	Date	03/02/2019	**35.849,00**	Liter
CORRECTION (46) - (44)	(45)	Date		-	Liter
LAST REMAINING BUNKER = (47)	(46)	Date	03/02/2019	**35.849,00**	Liter

M/E : Main Engine   A/E : Auxiliary Engine

*1) Please attached receipts/consumption node
*2) Please attached transfer note from/to other vessel
*3) Time of voyage's final port arrival
*4) Data taken from voyage's final port arrival

Remarks:

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	:	cm =		Liter	Settling Tk. :	10.927,0	Liter
Tank No.	: 1S	: 7	cm =	5.320,0	Liter	Servis I Tk. :	9.801,0	Liter
Tank No.	: 2C	:	cm =		Liter	Servis II Tk. :	9.801,0	Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**35.849,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 03/02/2019
Chief Engineer

Date : 03/02/2019
Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1903**
Starting Date : **25/01/2019**
Ending Date : **03/02/2019**
Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)			At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
25/01/2019 0:00	Surabaya		PS		13,80		**2.760**	51,90	**1.453**	26,10	**730**	54,50	**1.526**	33,00	**924**	8	176		**4.809**
27/01/2019 0:00			SB		13,80		**2.760**												
27/01/2019 14:06	Surabaya			45,70				10,00	**280**	33,80	**946**			45,80	**1.282**			**2.508**	
29/01/2019 11:48		Kumai																	
29/01/2019 0:00	Kumai		PS		9,30		**1.860**	48,10	**1.346**	55,20	**1.545**			33,80	**946**	8	176		**4.013**
31/01/2019 0:00			SB		9,30		**1.860**												
31/01/2019 15:36	Kumai			34,40				34,40	**963**	1,20	**33**			34,40	**963**			**1.959**	
02/02/2019 2:00		Semarang																	
02/02/2019 0:00	Semarang				2,30		**460**	15,10	**422**	2,60	**72**			15,10	**422**	6	132		**1.048**
02/02/2019 0:00					2,30		**460**												
02/02/2019 15:06	Semarang			21,20				21,20	**593**					21,20	**593**			**1.186**	
03/02/2019 12:18		Surabaya																	
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**10.160,0**		**5.057,0**		**3.326,0**		**1.526,0**		**5.130,0**		**484,0**	**5.653,0**	**9.870,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	5.653,0	Liter	LAST BUNKER STOCK (40)	Date 25/01/2019	**33.447,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	10.160,0	Liter	FIRST REFUELING AT SURABAYA (41)	Date 27/01/2019	**25.032,00**	Liter
A/E Consumption during at Port	(37) = (34)	9.870,0	Liter	SECOND REFUELING *2) AT (42)	Date		Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)	273,0	Liter	TOTAL STOCK (40) + (41) + (42) (43)	Date 27/01/2019	**58.479,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**25.956,0**	Liter	BUNKER STOCK (43) - (39) *3) (44)	Date 03/02/2019	**32.523,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44) (45)	Date	-	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47) (46)	Date 03/02/2019	**32.523,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:			
*3) Time of voyage's final port arrival							
*4) Data taken from voyage's final port arrival							

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	:	cm =		Liter	Settling Tk. :	4.057,0	Liter
Tank No.	: 1S	: 15	cm =	1.888,0	Liter	Servis I Tk. :	4.056,0	Liter
Tank No.	: 2P	: 77	cm =	11.440,0	Liter	Servis II Tk. :		Liter
Tank No.	: 2S	: 75	cm =	11.082,0	Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**32.523,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 03/02/2019
Chief Engineer

Date : 03/02/2019
Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1904**
Starting Date : **03/02/2019**
Ending Date : **09/02/2019**
Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
03/02/2019 0:00	Surabaya																		
05/02/2019 0:00																			
05/02/2019 8:54	Surabaya		PS	28,80		**6.359**													
06/02/2019 13:42		Sampit	SB		21,70	**4.688**													
06/02/2019 0:00	Sampit																		
07/02/2019 0:00																			
07/02/2019 19:18	Sampit		PS	29,30		**6.592**													
09/02/2019 0:36		Surabaya	SB		1,60	**352**													
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						17.991,0	**-**		**-**		**-**		**-**		**-**		**-**	**-**	**-**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	17.991,0	Liter	LAST BUNKER STOCK (40)	Date	03/02/2019	**35.849,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	-	Liter	FIRST REFUELING AT (41)	Date			Liter
A/E Consumption during at Port	(37) = (34)	-	Liter	SECOND REFUELING *2) AT (42)	Date			Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42)	Date	03/02/2019	**35.849,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**17.991,0**	Liter	BUNKER STOCK (43) - (39) *3) (44)	Date	09/02/2019	**17.858,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44) (45)	Date		-	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47) (46)	Date	09/02/2019	**17.858,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:				
*3) Time of voyage's final port arrival								
*4) Data taken from voyage's final port arrival								

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	:	cm =		Liter	Settling Tk. :	3.887,0	Liter
Tank No.	: 1S	: 14	cm =	8.919,0	Liter	Servis I Tk. :	2.526,0	Liter
Tank No.	: 2C	:	cm =		Liter	Servis II Tk. :	2.526,0	Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**17.858,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 09/02/2019
Chief Engineer

Date : 09/02/2019
Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1904**
Starting Date : **03/02/2019**
Ending Date : **09/02/2019**
Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)			At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(hour) (15)	(liter) (16)	(17)	(18)
03/02/2019 0:00	Surabaya		PS		11,30		**2.260**	42,10	**1.178**	42,10	**1.178**			28,60	**800**	6	132		**3.288**
05/02/2019 0:00			SB		11,30		**2.260**												
05/02/2019 8:54	Surabaya			28,80						28,80	**806**			28,60	**806**			**1.612**	
06/02/2019 13:42	Sampit																		
06/02/2019 0:00	Sampit		PS		12,70		**2.540**	22,60	**632**	29,60	**828**	4,80	**134**	13,00	**364**	8	176		**2.134**
07/02/2019 0:00			SB		12,70		**2.540**												
07/02/2019 19:18	Sampit			29,30						29,30	**820**	17,70	**495**	29,30	**820**			**2.135**	
09/02/2019 0:36	Surabaya																		
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**9.600,0**		**1.810,0**		**3.632,0**		**629,0**		**2.790,0**		**308,0**	**3.747,0**	**5.422,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	3.747,0	Liter	LAST BUNKER STOCK	(40)	Date 03/02/2019	**32.323,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	9.600,0	Liter	FIRST REFUELING AT SURABAYA	(41)	Date 03/02/2019	**35.082,00**	Liter
A/E Consumption during at Port	(37) = (34)	5.422,0	Liter	SECOND REFUELING *2) AT	(42)	Date		Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)	116,0	Liter	TOTAL STOCK (40) + (41) + (42)	(43)	Date 03/02/2019	**67.405,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**18.885,0**	Liter	BUNKER STOCK (43) - (39) *3)	(44)	Date 09/02/2019	**48.520,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44)	(45)	Date	-	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47)	(46)	Date 09/02/2019	**48.520,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:				
*3) Time of voyage's final port arrival								
*4) Data taken from voyage's final port arrival								

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 115	cm =	12.384,0	Liter	Settling Tk. :	3.550,0	Liter
Tank No.	: 1S	:	cm =		Liter	Servis I Tk. :	3.550,0	Liter
Tank No.	: 2P	: 77	cm =	11.440,0	Liter	Servis II Tk. :		Liter
Tank No.	: 2S	: 110	cm =	17.596,0	Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**48.520,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 09/02/2019
Chief Engineer

Date : 09/02/2019
Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1905**
Starting Date : **09/02/2019**
Ending Date : **16/02/2019**
Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
09/02/2019 0:00	Surabaya																		
11/02/2019 0:00																			
11/02/2019 4:00	Surabaya		PS	22,60		**5.040**													
12/02/2019 2:36		Semarang	SB		0,10	**110**													
12/02/2019 0:00	Semarang																		
12/02/2019 0:00																			
12/02/2019 9:30	Semarang		PS	28,80		**6.578**													
13/02/2019 14:18		Kumai	SB		5,30	**1.219**													
13/02/2019 0:00	Kumai																		
15/02/2019 0:00																			
15/02/2019 2:48	Kumai		PS	30,20	0,20	**44**													
16/02/2019 9:00		Surabaya	SB			**6.509**													
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						19.500,0	**-**		**-**		**-**		**-**		**-**		**-**	**-**	**-**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	19.500,0	Liter		
M/E Consumption during Maneuvering	(36) = (22)	-	Liter		
A/E Consumption during at Port	(37) = (34)	-	Liter		
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter		
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**19.500,0**	Liter		

M/E : Main Engine A/E : Auxiliary Engine

*1) Please attached receipts/consumption node
*2) Please attached transfer note from/to other vessel
*3) Time of voyage's final port arrival
*4) Data taken from voyage's final port arrival

LAST BUNKER STOCK	(40)	Date	09/02/2019	**17.558,00**	Liter
FIRST REFUELING AT	(41)	Date	09/02/2019	**40.026,00**	Liter
SECOND REFUELING *2) AT	(42)	Date			Liter
TOTAL STOCK (40) + (41) + (42)	(43)	Date	09/02/2019	**57.584,00**	Liter
BUNKER STOCK (43) - (39) *3)	(44)	Date	16/02/2019	**38.084,00**	Liter
CORRECTION (46) - (44)	(45)	Date		-	Liter
LAST REMAINING BUNKER = (47)	(46)	Date	16/02/2019	**38.084,00**	Liter

Remarks:

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 30	cm =	17.818,0	Liter	Settling Tk. :	5.456,0	Liter
Tank No.	: 1S	:	cm =		Liter	Servis I Tk. :	5.456,0	Liter
Tank No.	: 2C	:	cm =		Liter	Servis II Tk. :	9.354,0	Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**38.084,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 16/02/2019
Chief Engineer

Date : 16/02/2019
Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1905**
Starting Date : **09/02/2019**
Ending Date : **16/02/2019**
Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
09/02/2019 0:00	Surabaya		PS		13,30		**2.660**	41,70	**1.167**	49,10	**1.374**	10,50	**294**	43,30	**1.212**	8	176		**4.223**
11/02/2019 0:00			SB		14,90		**2.980**												
11/02/2019 4:00	Surabaya			22,60				22,60	**632**	0,50	**14**			22,60	**632**			**1.278**	
12/02/2019 2:36		Semarang																	
12/02/2019 0:00	Semarang		PS		2,80		**560**	3,90	**109**	6,90	**193**			6,90	**193**				**495**
12/02/2019 0:00			SB		2,80		**560**												
12/02/2019 9:30	Semarang			28,80				0,50	**14**	0,90	**25**	28,00	**784**	28,80	**806**			**1.629**	
13/02/2019 14:18		Kumai																	
13/02/2019 0:00	Kumai				8,90		**1.780**	32,80	**918**	36,30	**1.016**	15,90	**445**	36,50	**1.022**	8	176		**3.577**
15/02/2019 0:00					8,90		**1.780**												
15/02/2019 2:48	Kumai							30,20	**845**	30,20	**845**							**1.690**	
16/02/2019 9:00		Surabaya																	
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**10.320,0**		**3.685,0**		**3.467,0**		**1.523,0**		**3.865,0**		**352,0**	**4.597,0**	**8.295,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	4.597,0	Liter	LAST BUNKER STOCK (40)	Date 09/02/2019	**48.520,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	10.320,0	Liter	FIRST REFUELING AT SURABAYA (41)	Date 09/02/2019	**35.010,00**	Liter
A/E Consumption during at Port	(37) = (34)	8.295,0	Liter	SECOND REFUELING *2) AT (42)	Date		Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)	150,0	Liter	TOTAL STOCK (40) + (41) + (42) (43)	Date 09/02/2019	**83.530,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**23.362,0**	Liter	BUNKER STOCK (43) - (39) *3) (44)	Date 16/02/2019	**60.168,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44) (45)	Date	-	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47) (46)	Date 16/02/2019	**60.168,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:			
*3) Time of voyage's final port arrival							
*4) Data taken from voyage's final port arrival							

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	:	cm =		Liter	Settling Tk. :	3.596,0	Liter
Tank No.	: 1S	: 225	cm =	23.941,0	Liter	Servis I Tk. :	3.595,0	Liter
Tank No.	: 2P	: 77	cm =	11.440,0	Liter	Servis II Tk. :		Liter
Tank No.	: 2S	: 110	cm =	17.596,0	Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**60.168,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 16/02/2019
Chief Engineer

Date : 16/02/2019
Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1906**
Starting Date : **16/02/2019**
Ending Date : **22/02/2019**
Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
16/02/2019 0:00	Surabaya																		
17/02/2019 0:00																			
17/02/2019 18:48	Surabaya		PS	37,70															
19/02/2019 8:30		Kumai	SB			**7.540**													
19/02/2019 0:00	Kumai																		
21/02/2019 0:00																			
21/02/2019 2:24	Kumai		PS	30,90	0,50	**105**													
22/02/2019 9:18		Surabaya	SB			**6.489**													
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						14.134,0	**-**		**-**		**-**		**-**		**-**		**-**	**-**	**-**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	14.134,0	Liter
M/E Consumption during Maneuvering	(36) = (22)	-	Liter
A/E Consumption during at Port	(37) = (34)	-	Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**14.134,0**	Liter

M/E : Main Engine A/E : Auxiliary Engine

*1) Please attached receipts/consumption node
*2) Please attached transfer note from/to other vessel
*3) Time of voyage's final port arrival
*4) Data taken from voyage's final port arrival

LAST BUNKER STOCK	(40)	Date	16/02/2019	**38.084,00**	Liter
FIRST REFUELING AT	(41)	Date			Liter
SECOND REFUELING *2) AT	(42)	Date			Liter
TOTAL STOCK (40) + (41) + (42)	(43)	Date	16/02/2019	**38.084,00**	Liter
BUNKER STOCK (43) - (39) *3)	(44)	Date	22/02/2019	**23.950,00**	Liter
CORRECTION (46) - (44)	(45)	Date		-	Liter
LAST REMAINING BUNKER = (47)	(46)	Date	22/02/2019	**23.950,00**	Liter

Remarks:

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 10	cm =	6.601,0	Liter	Settling Tk. :	5.759,0 Liter
Tank No.	: 1S	:	cm =		Liter	Servis I Tk. :	5.759,0 Liter
Tank No.	: 2C	:	cm =		Liter	Servis II Tk. :	5.831,0 Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :	Liter
Tank No.		:	cm =		Liter	Settling Tk. :	Liter
Tank No.		:	cm =		Liter	Settling Tk. :	Liter
TOTAL FUEL ON BOARD							**23.950,0** Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 22/02/2019
Chief Engineer

Date : 22/02/2019
Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1906**
Starting Date : **16/02/2019**
Ending Date : **22/02/2019**
Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
16/02/2019 0:00	Surabaya		PS		5,60		**1.425**	30,80	**862**	29,60	**828**	4,00	**112**	30,80	**862**	9	198		**2.862**
17/02/2019 0:00			SB		5,60		**1.425**												
17/02/2019 18:48	Surabaya			37,70				37,70	**1.055**	37,70	**1.055**							**2.110**	
19/02/2019 8:30		Kumai																	
19/02/2019 0:00	Kumai		PS		11,70		**2.540**	14,70	**411**	41,90	**1.173**	37,40	**1.047**	36,10	**1.010**	9	198		**3.839**
21/02/2019 0:00			SB		10,50		**2.350**												
21/02/2019 2:24	Kumai			30,90				11,60	**324**	11,80	**330**	19,80	**554**	19,50	**546**			**1.754**	
22/02/2019 9:18		Surabaya																	
TOTAL				(19)	(20)	(21)	(22)	(23)	**2.652,0**		**3.386,0**		**1.713,0**		**2.418,0**		**396,0**	**3.864,0**	**6.701,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	3.864,0	Liter	LAST BUNKER STOCK (40)	Date 16/02/2019	**60.168,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	7.740,0	Liter	FIRST REFUELING AT SURABAYA (41)	Date 17/02/2019	**30.039,00**	Liter
A/E Consumption during at Port	(37) = (34)	6.701,0	Liter	SECOND REFUELING *2) AT (42)	Date		Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)	149,0	Liter	TOTAL STOCK (40) + (41) + (42) (43)	Date 16/02/2019	**90.207,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**18.454,0**	Liter	BUNKER STOCK (43) - (39) *3) (44)	Date 22/02/2019	**71.753,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44) (45)	Date	-	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47) (46)	Date 22/02/2019	**71.753,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:			
*3) Time of voyage's final port arrival							
*4) Data taken from voyage's final port arrival							

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 339	cm =	35.988,0	Liter	Settling Tk. :	3.364,0	Liter
Tank No.	: 1S	:	cm =		Liter	Servis I Tk. :	3.365,0	Liter
Tank No.	: 2P	: 77	cm =	11.440,0	Liter	Servis II Tk. :		Liter
Tank No.	: 2S	: 110	cm =	17.596,0	Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**71.753,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 22/02/2019
Chief Engineer

Date : 22/02/2019
Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1907**
Starting Date : **22/02/2019**
Ending Date : **28/02/2019**
Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
22/02/2019 0:00	Surabaya																		
23/02/2019 0:00																			
24/02/2019 2:18	Surabaya		PS	35,50	1,80	**396**													
25/02/2019 13:48		Kumai	SB			**7.810**													
25/02/2019 0:00	Kumai																		
26/02/2019 0:00																			
27/02/2019 2:42	Kumai		PS	31,20															
28/02/2019 9:54		Surabaya	SB			**6.864**													
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						15.070,0	**-**		**-**		**-**		**-**		**-**		**-**	**-**	**-**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	15.070,0	Liter
M/E Consumption during Maneuvering	(36) = (22)	-	Liter
A/E Consumption during at Port	(37) = (34)	-	Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**15.070,0**	Liter

M/E : Main Engine A/E : Auxiliary Engine
*1) Please attached receipts/consumption node
*2) Please attached transfer note from/to other vessel
*3) Time of voyage's final port arrival
*4) Data taken from voyage's final port arrival

LAST BUNKER STOCK	(40)	Date	22/01/2019
FIRST REFUELING AT SURABAYA	(41)	Date	22/02/2019
SECOND REFUELING *2) AT	(42)	Date	
TOTAL STOCK (40) + (41) + (42)	(43)	Date	22/02/2019
BUNKER STOCK (43) - (39) *3)	(44)	Date	28/02/2019
CORRECTION (46) - (44)	(45)	Date	
LAST REMAINING BUNKER = (47)	(46)	Date	28/02/2019

23.950,00	Liter		
50.081,00	Liter		
	Liter		
74.031,00	Liter		
58.961,00	Liter		
-	Liter		
58.961,00	Liter		

Remarks:
EOSV SUB VOY 1907 28/02/2019 09:54 LT

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 63	cm =	36.308,0	Liter	Settling Tk. :	5.860,0 Liter
Tank No.	: 1S	:	cm =		Liter	Servis I Tk. :	5.860,0 Liter
Tank No.	: 2C	:	cm =		Liter	Servis II Tk. :	10.933,0 Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :	Liter
Tank No.		:	cm =		Liter	Settling Tk. :	Liter
Tank No.		:	cm =		Liter	Settling Tk. :	Liter
TOTAL FUEL ON BOARD							**58.961,0** Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 28/02/2019
Chief Engineer

Date : 28/02/2019
Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1907**
Starting Date : **22/02/2019**
Ending Date : **28/02/2019**
Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)			At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
22/02/2019 0:00	Surabaya		PS		7,10		**1.415**	38,30	**1.072**	17,60	**492**	16,70	**467**	41,00	**1.148**	8	176		**3.355**
23/02/2019 0:00			SB		7,10		**1.415**												
24/02/2019 2:18	Surabaya			35,50						35,50	**994**			35,50	**994**			**1.988**	
25/02/2019 13:48		Kumai																	
25/02/2019 0:00	Kumai		PS		8,70		**1.740**	31,20	**873**	26,00	**728**	35,70	**999**	36,90	**1.033**	8	176		**3.809**
26/02/2019 0:00			SB		8,70		**1.740**												
27/02/2019 2:42	Kumai			31,20						8,80	**246**	31,20	**873**	31,20	**873**			**1.992**	
28/02/2019 9:54		Surabaya																	
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**6.310,0**		**1.945,0**		**2.460,0**		**2.339,0**		**4.048,0**		**352,0**	**3.980,0**	**7.164,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	3.980,0	Liter	LAST BUNKER STOCK	(40)	Date	22/01/2019	**71.753,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	6.310,0	Liter	FIRST REFUELING AT SURABAYA	(41)	Date	17/02/2019	**25.041,00**	Liter
A/E Consumption during at Port	(37) = (34)	7.164,0	Liter	SECOND REFUELING *2) AT	(42)	Date			Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42)	(43)	Date	22/02/2019	**96.794,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**17.454,0**	Liter	BUNKER STOCK (43) - (39) *3)	(44)	Date	28/02/2019	**79.340,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44)	(45)	Date		-	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47)	(46)	Date	28/02/2019	**79.340,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:					
*3) Time of voyage's final port arrival									
*4) Data taken from voyage's final port arrival									

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 339	cm =	24.871,0	Liter	Settling Tk. :	2.950,0 Liter
Tank No.	: 1S	: 183	cm =	19.533,0	Liter	Servis I Tk. :	2.950,0 Liter
Tank No.	: 2P	: 77	cm =	11.440,0	Liter	Servis II Tk. :	Liter
Tank No.	: 2S	: 110	cm =	17.596,0	Liter	Settling Tk. :	Liter
Tank No.		:	cm =		Liter	Settling Tk. :	Liter
Tank No.		:	cm =		Liter	Settling Tk. :	Liter
TOTAL FUEL ON BOARD							**79.340,0** Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 28/02/2019

Chief Engineer

Date : 28/02/2019

Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1908**
Starting Date : **28/02/2019**
Ending Date : **10/03/2019**
Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
28/02/2019 0:00	Surabaya																		
03/03/2019 0:00																			
03/03/2019 10:48	Surabaya		PS	31,40		**7.222**													
04/03/2019 18:12		Kumai	SB		9,30	**2.039**													
04/03/2019 0:00	Kumai																		
07/03/2019 0:00																			
07/03/2019 1:00	Kumai		PS	31,50		**7.245**													
08/03/2019 8:30		Semarang	SB		20,50	**4.649**													
08/03/2019 0:00	Semarang																		
09/03/2019 0:00																			
09/03/2019 6:30	Semarang		PS	20,20	0,50	**110**													
10/03/2019 2:42		Surabaya	SB			**4.444**													
TOTAL				(19)	(20)	(21) **25.709,0**	(22) -	(23)	(24) -	(25)	(26) -	(27)	(28) -	(29)	(30) -	(31)	(32) -	(33) -	(34) -

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	25.709,0	Liter	LAST BUNKER STOCK (40)	Date 28/02/2019	**58.961,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	-	Liter	FIRST REFUELING AT (41)	Date		Liter
A/E Consumption during at Port	(37) = (34)	-	Liter	SECOND REFUELING *2) AT SURABAYA (42)	Date 03/03/2019	**600,00**	Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42) (43)	Date 03/03/2019	**59.561,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**25.709,0**	Liter	BUNKER STOCK (43) - (39) *3) (44)	Date 10/03/2019	**33.852,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44) (45)	Date	-	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47) (46)	Date 10/03/2019	**33.852,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:			
*3) Time of voyage's final port arrival				EOSV SUB VOY 1907 28/02/2019 09:54 LT			
*4) Data taken from voyage's final port arrival							

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	:	cm =		Liter	Settling Tk. :	5.860,0	Liter
Tank No.	: 1S	: 26	cm =	15.572,0	Liter	Servis I Tk. :	5.860,0	Liter
Tank No.	: 2C	:	cm =		Liter	Servis II Tk. :	6.560,0	Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**33.852,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 10/03/2019
Chief Engineer

Date : 10/03/2019
Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1908**
Starting Date : **28/02/2019**
Ending Date : **10/03/2019**
Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)			At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
28/02/2019 0:00	Surabaya				7,90		**1.580**	54,30	**1.520**	55,80	**1.562**	30,10	**842**	61,90	**1.733**	8	176		**5.833**
03/03/2019 0:00					7,90		**1.580**												
03/03/2019 10:48	Surabaya		PS	31,40				31,40	**879**	1,00	**28**	0,20	**5**	31,40	**879**			**1.791**	
04/03/2019 18:12		Kumai	SB																
04/03/2019 0:00	Kumai				9,20		**1.840**	44,00	**1.232**	43,00	**1.204**	22,00	**616**	54,80	**1.534**	8	176		**4.762**
07/03/2019 0:00					9,20		**1.840**												
07/03/2019 1:00	Kumai		PS	31,50				31,50	**882**	31,50	**882**			0,50	**14**			**1.778**	
08/03/2019 8:30		Semarang	SB																
08/03/2019 0:00	Semarang				4,10		**820**	19,50	**546**	19,50	**546**	11,70	**327**			8	176		**1.595**
09/03/2019 0:00					4,10		**820**												
09/03/2019 6:30	Semarang		PS	20,20				5,50	**154**	20,20	**565**	4,50	**126**	7,70	**215**			**1.060**	
10/03/2019 2:42		Surabaya	SB																
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**8.480,0**		**5.213,0**		**4.787,0**		**1.916,0**		**4.375,0**		**528,0**	**4.629,0**	**12.190,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	4.629,0	Liter	LAST BUNKER STOCK (40)	Date	28/02/2019	**79.340,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	8.480,0	Liter	FIRST REFUELING AT (41)	Date			Liter
A/E Consumption during at Port	(37) = (34)	12.190,0	Liter	SECOND REFUELING *2) AT SURABAYA (42)	Date	03/03/2019	**300,00**	Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)	130,0	Liter	TOTAL STOCK (40) + (41) + (42) (43)	Date	03/03/2019	**79.640,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**25.429,0**	Liter	BUNKER STOCK (43) - (39) *3) (44)	Date	10/03/2019	**54.211,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44) (45)	Date		-	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47) (46)	Date	10/03/2019	**54.211,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:				
*3) Time of voyage's final port arrival								
*4) Data taken from voyage's final port arrival								

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	:	cm =		Liter	Settling Tk. :	3.364,0	Liter
Tank No.	: 1S	: 173	cm =	18.446,0	Liter	Servis I Tk. :	3.365,0	Liter
Tank No.	: 2P	: 77	cm =	11.440,0	Liter	Servis II Tk. :		Liter
Tank No.	: 2S	: 110	cm =	17.596,0	Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**54.211,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 10/03/2019
Chief Engineer

Date : 10/03/2019
Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1909**
Starting Date : **10/03/2019**
Ending Date : **19/03/2019**
Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
10/03/2019 0:00	Surabaya																		
13/03/2019 0:00																			
13/03/2019 9:42	Surabaya		PS	26,80		**6.164**													
14/03/2019 12:30		Kumai	SB			**6.030**													
14/03/2019 0:00	Kumai																		
16/03/2019 0:00																			
16/03/2019 13:18	Kumai		PS	29,70		**6.831**													
17/03/2019 19:00		Semarang	SB		21,00	**4.730**													
17/03/2019 0:00	Semarang																		
18/03/2019 0:00																			
18/03/2019 12:36	Semarang		PS	20,00		**4.534**													
19/03/2019 8:36		Surabaya	SB																
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						28.289,0	-		-		-		-		-		-	-	-

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	28.289,0	Liter	**33.852,00** Liter
M/E Consumption during Maneuvering	(36) = (22)	-	Liter	**50.000,00** Liter
A/E Consumption during at Port	(37) = (34)	-	Liter	Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	**83.852,00** Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**28.289,0**	Liter	**55.563,00** Liter

M/E : Main Engine A/E : Auxiliary Engine

*1) Please attached receipts/consumption node
*2) Please attached transfer note from/to other vessel
*3) Time of voyage's final port arrival
*4) Data taken from voyage's final port arrival

LAST BUNKER STOCK	(40)	Date	10/03/2019	
FIRST REFUELING AT SURABAYA	(41)	Date	12/03/2019	
SECOND REFUELING *2) AT	(42)	Date		Liter
TOTAL STOCK (40) + (41) + (42)	(43)	Date	12/03/2019	**83.852,00** Liter
BUNKER STOCK (43) - (39) *3)	(44)	Date	19/03/2019	**55.563,00** Liter
CORRECTION (46) - (44)	(45)	Date		- Liter
LAST REMAINING BUNKER = (47)	(46)	Date	19/03/2019	**55.563,00** Liter

Remarks:
EOSV SUB VOY 1907 28/02/2019 09:54 LT

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 65	cm =	36.991,0	Liter	Settling Tk. :	3.941,0	Liter
Tank No.	: 1S	:	cm =		Liter	Servis I Tk. :	3.941,0	Liter
Tank No.	: 2C	:	cm =		Liter	Servis II Tk. :	10.690,0	Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**55.563,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 19/03/2019
Chief Engineer

Date : 19/03/2019
Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1909**
Starting Date : **10/03/2019**
Ending Date : **19/03/2019**
Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
10/03/2019 0:00	Surabaya				8,30		**1.618**	8,00	**22**	79,00	**2.068**	45,70	**1.188**	79,00	**2.068**	8	176		**5.522**
13/03/2019 0:00					9,60		**1.872**												
13/03/2019 9:42	Surabaya		PS	26,80								26,80	**750**	26,80	**750**			**1.500**	
14/03/2019 12:30		Kumai	SB																
14/03/2019 0:00	Kumai				9,50		**1.852**	21,80	**610**	45,80	**1.206**	30,90	**865**	46,30	**1.218**	8	176		**4.075**
16/03/2019 0:00					9,50		**1.852**												
16/03/2019 13:18	Kumai		PS	29,70				29,70	**831**	29,70	**831**							**1.662**	
17/03/2019 19:00		Semarang	SB																
17/03/2019 0:00	Semarang				5,20		**1.014**	18,80	**526**	18,80	**526**	4,60	**128**			8	176		**1.356**
18/03/2019 0:00					5,20		**1.014**												
18/03/2019 12:36	Semarang		PS	20,00						20,00	**560**			20,00	**560**			**1.120**	
19/03/2019 8:36		Surabaya	SB																
TOTAL				(19)	(20)	(21)	(22)	(23)	**1.989,0**	(25)	**5.191,0**		**2.931,0**		**4.596,0**		**528,0**	**4.282,0**	**10.953,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	4.282,0	Liter	LAST BUNKER STOCK (40)	Date 10/03/2019
M/E Consumption during Maneuvering	(36) = (22)	9.222,0	Liter	FIRST REFUELING AT SURABAYA (41)	Date 12/03/2019
A/E Consumption during at Port	(37) = (34)	10.953,0	Liter	SECOND REFUELING *2) AT (42)	Date
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)	50,0	Liter	TOTAL STOCK (40) + (41) + (42) (43)	Date 12/03/2019
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**24.507,0**	Liter	BUNKER STOCK (43) - (39) *3) (44)	Date 19/03/2019
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44) (45)	Date
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47) (46)	Date 19/03/2019
*2) Please attached transfer note from/to other vessel				Remarks:	
*3) Time of voyage's final port arrival					
*4) Data taken from voyage's final port arrival					

DATA SOUNDING/TANKS CONDITION *4)	(47)						Total A/E Workhours Since O/H		
Tank No.	: 1P	: 316	cm =	33.569,0	Liter	Settling Tk. :	3.549,0	Liter	A/E's Name / Hour / O/H Date
Tank No.	: 1S	:	cm =		Liter	Servis I Tk. :	3.550,0	Liter	
Tank No.	: 2P	: 77	cm =	11.440,0	Liter	Servis II Tk. :		Liter	
Tank No.	: 2S	: 110	cm =	17.596,0	Liter	Settling Tk. :		Liter	
Tank No.		:	cm =		Liter	Settling Tk. :		Liter	
Tank No.		:	cm =		Liter	Settling Tk. :		Liter	
TOTAL FUEL ON BOARD							**69.704,0**	Liter	

Date : 19/03/2019
Chief Engineer

Date : 19/03/2019
Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1910**
Starting Date : **19/03/2019**
Ending Date : **28/03/2019**
Fuel Type : **MFO**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
19/03/2019 0:00	Surabaya																		
23/03/2019 0:00																			
23/03/2019 3:48	Surabaya		PS	35,20		**8.096**													
24/03/2019 15:00		Kumai	SB		11,00	**2.475**													
24/03/2019 0:00	Kumai																		
26/03/2019 0:00																			
26/03/2019 1:30	Kumai		PS	35,20	0,70	**219**													
27/03/2019 12:42		Semarang	SB			**7.920**													
27/03/2019 0:00	Semarang																		
28/03/2019 0:00																			
28/03/2019 4:24	Semarang		PS	19,20		**4.416**													
28/03/2019 23:36		Surabaya	SB																
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						23.126,0	-		-		-		-		-		-	-	-

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	23.126,0	Liter	LAST BUNKER STOCK (40)	Date 19/03/2019	**55.563,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	-	Liter	FIRST REFUELING AT (41)	Date		Liter
A/E Consumption during at Port	(37) = (34)	-	Liter	SECOND REFUELING *2) AT (42)	Date		Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)		Liter	TOTAL STOCK (40) + (41) + (42) (43)	Date 21/03/2019	**55.563,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**23.126,0**	Liter	BUNKER STOCK (43) - (39) *3) (44)	Date 28/03/2019	**32.437,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44) (45)	Date 28/03/2019	**550,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47) (46)	Date 28/03/2019	**32.987,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:			
*3) Time of voyage's final port arrival				EOSV SUB VOY 1907 28/02/2019 09:54 LT			
*4) Data taken from voyage's final port arrival							

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 31	cm =	18.517,0	Liter	Settling Tk. :	4.244,0	Liter
Tank No.	: 1S	:	cm =		Liter	Servis I Tk. :	4.244,0	Liter
Tank No.	: 2C	:	cm =		Liter	Servis II Tk. :	5.982,0	Liter
Tank No.	:	:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**32.987,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 28/03/2019

Chief Engineer

Date : 28/03/2019

Master

FOCR-Benoa

Vessel : **Meratus Benoa**
Voyage : **1910**
Starting Date : **19/03/2019**
Ending Date : **28/03/2019**
Fuel Type : **HSD**

Date	Vessel Position			Duration		M/E Fuel Consumption		A/E Fuel Consumption										Boiler		Total A/E Fuel Consumption	
	Origin	Destination	Engine	Sea Speed (hour)	Maneuvering (hour)	Sea Speed (liter)	Maneuvering (liter)	A/E No: (hour)	1 (liter)	A/E No: (hour)	2 (liter)	A/E No: (hour)	3 (liter)	A/E No: (hour)	4 (liter)	(hour)	(liter)	At Sea (liter)	At Port (liter)
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
19/03/2019 0:00	Surabaya				9,40		**1.846**	48,40	**1.355**	91,20	**2.553**	18,30	**513**	77,60	**2.172**	6	132		**6.725**
23/03/2019 0:00					10,00		**1.950**												
23/03/2019 3:48	Surabaya		PS	35,20						35,20	**985**	35,20	**985**					**1.970**	
24/03/2019 15:00		Kumai	SB																
24/03/2019 0:00	Kumai				8,30		**1.575**	34,50	**966**	34,50	**966**	34,50	**966**			6	132		**3.030**
26/03/2019 0:00					8,30		**1.575**												
26/03/2019 1:30	Kumai		PS	35,20				10,50	**294**	35,20	**985**	35,20	**985**					**2.264**	
27/03/2019 12:42		Semarang	SB																
27/03/2019 0:00	Semarang				4,10		**797**	4,60	**128**	15,70	**439**	15,70	**439**			6	132		**1.138**
28/03/2019 0:00					4,10		**797**												
28/03/2019 4:24	Semarang		PS	19,20				19,20	**537**	19,20	**537**							**1.074**	
28/03/2019 23:36		Surabaya	SB																
TOTAL				(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
						-	**8.540,0**		**3.280,0**		**6.465,0**		**3.888,0**		**2.172,0**		**396,0**	**5.308,0**	**10.893,0**

M/E + A/E Consumption during Sea speed	(35) = (21) + (33)	5.308,0	Liter	LAST BUNKER STOCK (40)	Date 19/03/2019	**69.704,00**	Liter
M/E Consumption during Maneuvering	(36) = (22)	8.540,0	Liter	FIRST REFUELING AT (41)	Date		Liter
A/E Consumption during at Port	(37) = (34)	10.893,0	Liter	SECOND REFUELING *2) AT (42)	Date		Liter
Non-Ship Fuel Consumption (stevedoring, etc) *1)	(38)	100,0	Liter	TOTAL STOCK (40) + (41) + (42) (43)	Date 21/03/2019	**69.704,00**	Liter
TOTAL FUEL CONSUMPTION	(39) = (35) + (36) + (37) + (38)	**24.841,0**	Liter	BUNKER STOCK (43) - (39) *3) (44)	Date 28/03/2019	**44.863,00**	Liter
M/E : Main Engine	A/E : Auxiliary Engine			CORRECTION (46) - (44) (45)	Date 28/03/2019	**200,00**	Liter
*1) Please attached receipts/consumption node				LAST REMAINING BUNKER = (47) (46)	Date 28/03/2019	**45.063,00**	Liter
*2) Please attached transfer note from/to other vessel				Remarks:			
*3) Time of voyage's final port arrival							
*4) Data taken from voyage's final port arrival							

DATA SOUNDING/TANKS CONDITION *4) (47)

Tank No.	: 1P	: 91	cm =	9.850,0	Liter	Settling Tk. :	3.089,0	Liter
Tank No.	: 1S	:	cm =		Liter	Servis I Tk. :	3.088,0	Liter
Tank No.	: 2P	: 77	cm =	11.440,0	Liter	Servis II Tk. :		Liter
Tank No.	: 2S	: 110	cm =	17.596,0	Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
Tank No.		:	cm =		Liter	Settling Tk. :		Liter
TOTAL FUEL ON BOARD							**45.063,0**	Liter

Total A/E Workhours Since O/H

A/E's Name		Hour		O/H Date

Date : 28/03/2019

Chief Engineer

Date : 28/03/2019

Master

APPENDIX 2

SHIP AIS VOYAGE MAP

MV MERATUS BONTANG

MBT-1

MBT-2

MV MERATUS BONTANG

MBT-3

MBT-4

MV MERATUS BONTANG

MBT-5

MBT-6

MV MERATUS BONTANG

MBT-7

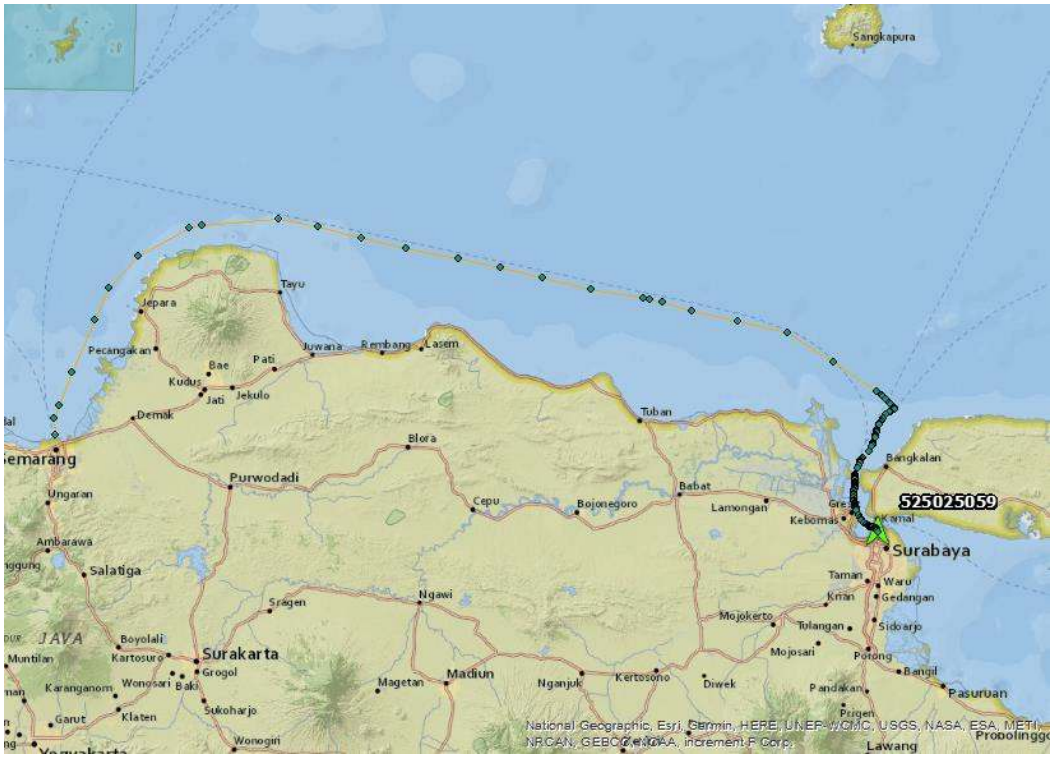
MBT-8

MV MERATUS BONTANG

MBT-9

MBT-10

MV MERATUS BONTANG



MBT-11

MBT-12

MV MERATUS BONTANG

MBT-13

MBT-14

MV MERATUS BONTANG

MBT-15

MBT-16

MV MERATUS BONTANG

MBT-17

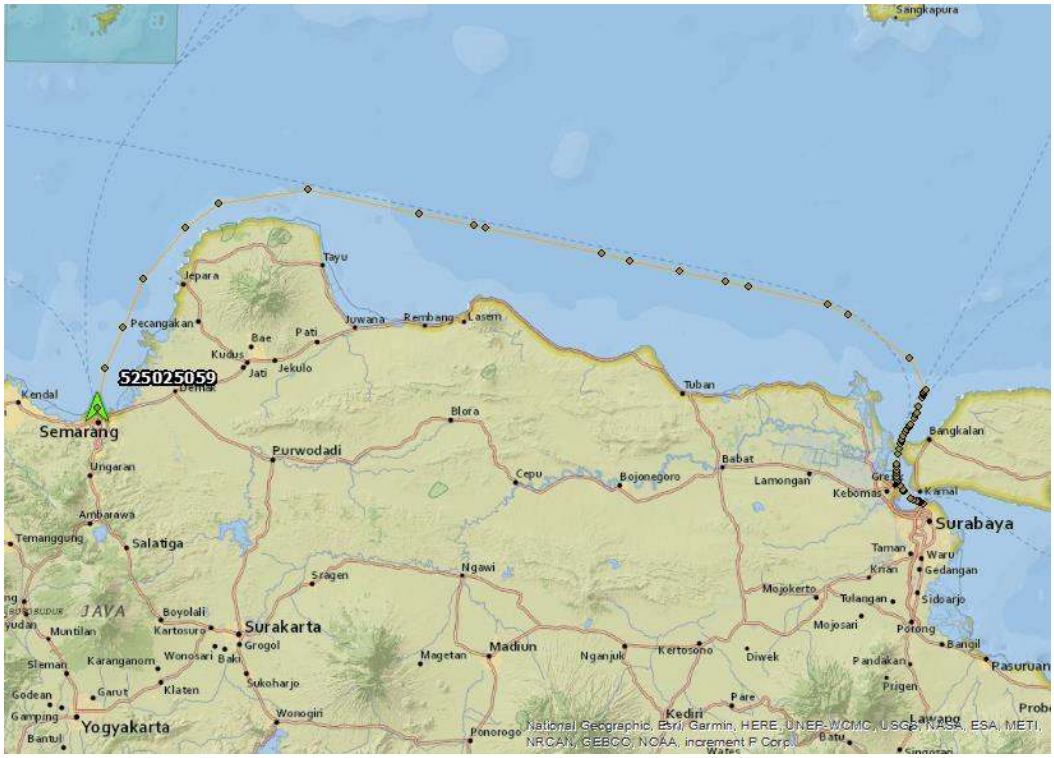
MBT-18

MV MERATUS BONTANG

MBT-19

MBT-20

MV MERATUS BONTANG



MBT-21

MBT-22

MV MERATUS BONTANG

MBT-23

MV MERATUS BENOA

MBN-1

MBN-2

MV MERATUS BENOA

MBN-3

MBN-4

MV MERATUS BENOA

MBN-5

MBN-6

MV MERATUS BENOA

MBN-7

MBN-8

MV MERATUS BENOA

MBN-9

MBN-10

MV MERATUS BENOA

MBN-11

MBN-12

MV MERATUS BENOA

MBN-13

MBN-14

MV MERATUS BENOA

MBN-15

MBN-16


Tanjungpandan
Sampit
Amuntai
Barabai
KALIMANTAN SELATAN
Kotabaru
Banjarmasin
Java Sea
Rengasdengklok
Pamanukan
Indramayu
Cikampek
Purwakarta
Jepara
Pekalongan
Cirebon
Tegal
Semarang
Purwodadi
Tuban
525025061
Pamekasan
Sumenep
Bandung
JAWA BARAT
Wonosobo
JAWA TENGAH
Java
Bojonegoro
Surakarta
Surabaya
Tasikmalaya
Purwokerto
Madiun
Kediri
Probolinggo
Situbondo
Cilacap
Kebumen
Bali Basin

MBN-17


525025061
Palangkaraya
Tanjungpandan
Sampit
Amuntai
Barabai
KALIMANTAN SELATAN
Kotabaru
Banjarmasin
Java Sea
Rengasdengklok
Pamanukan
Indramayu
Bekasi
Cikampek
Purwakarta
Jepara
Pekalongan
Cirebon
Tegal
Semarang
Purwodadi
Tuban
Pamekasan
Sumenep
Bandung
JAWA BARAT
Wonosobo
JAWA TENGAH
Java
Bojonegoro
Surakarta
Tasikmalaya
Purwokerto

MBN-18

MV MERATUS BENOA

MBN-19

MBN-20

MV MERATUS BENOA

MBN-21

MBN-22

MV MERATUS BENOA

MBN-23

MBN-24

MV MERATUS BENOA

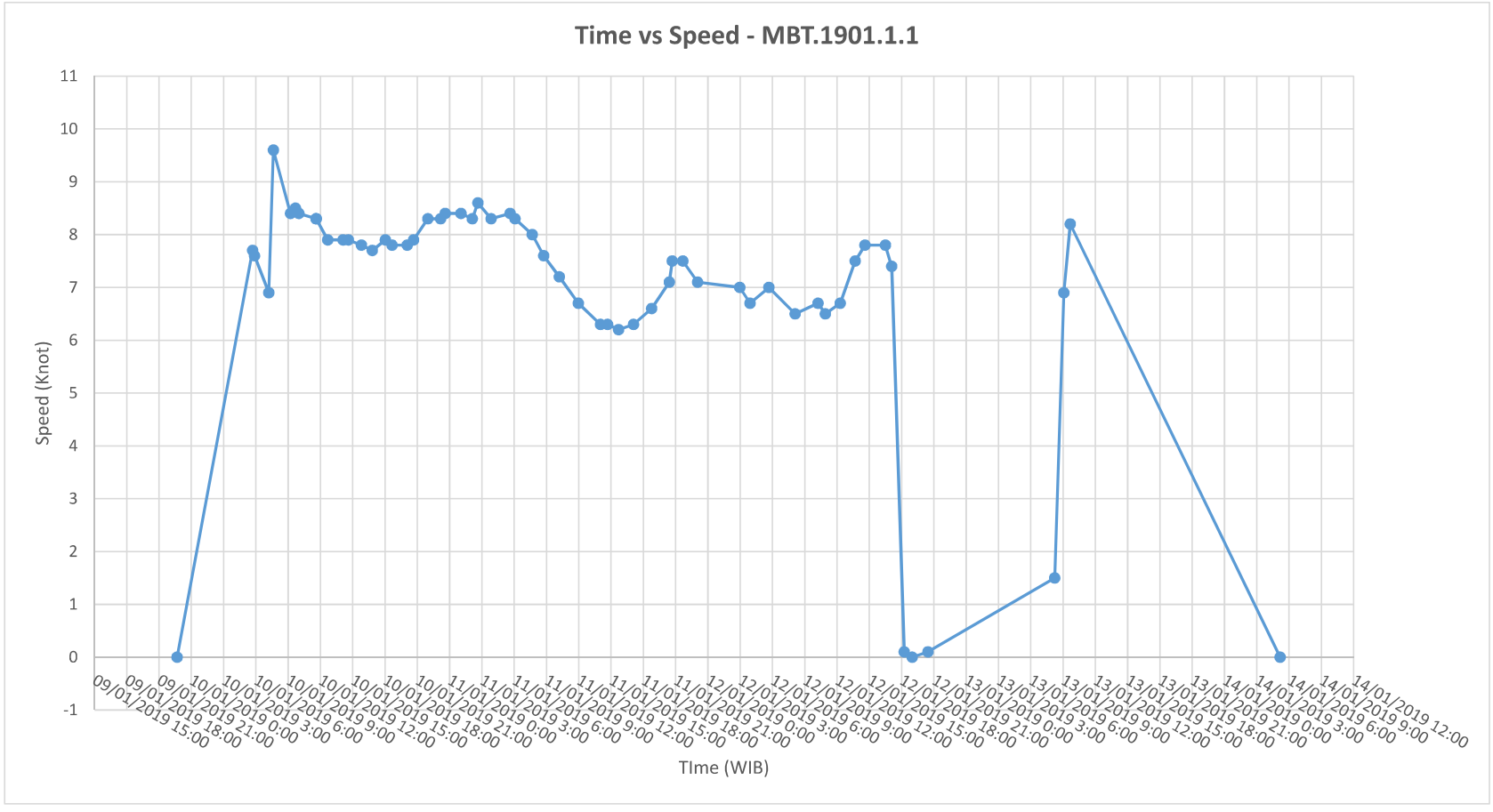
MBN-25

MBN-26

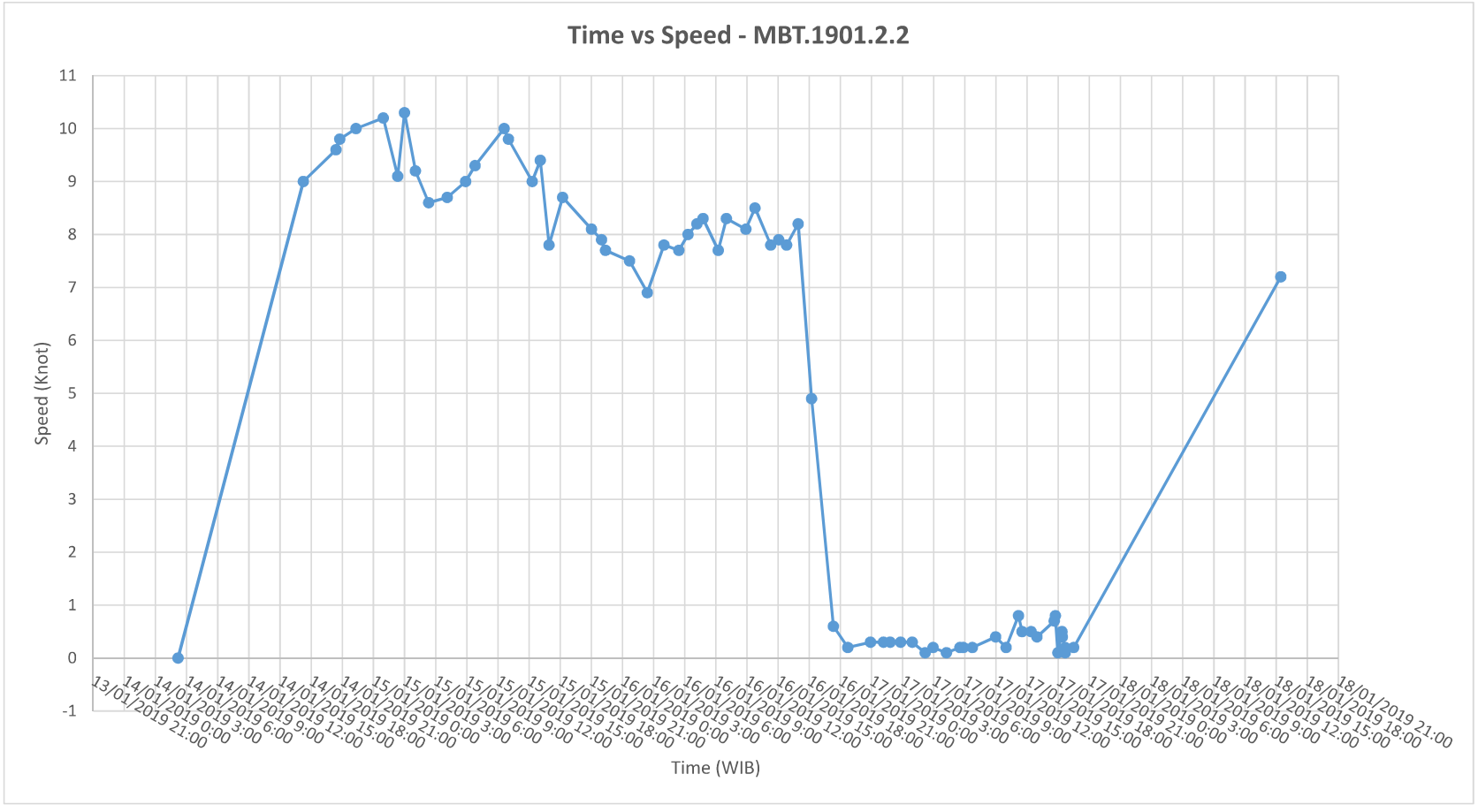
APPENDIX 3

SHIP'S SPEED AND TIME GRAPH

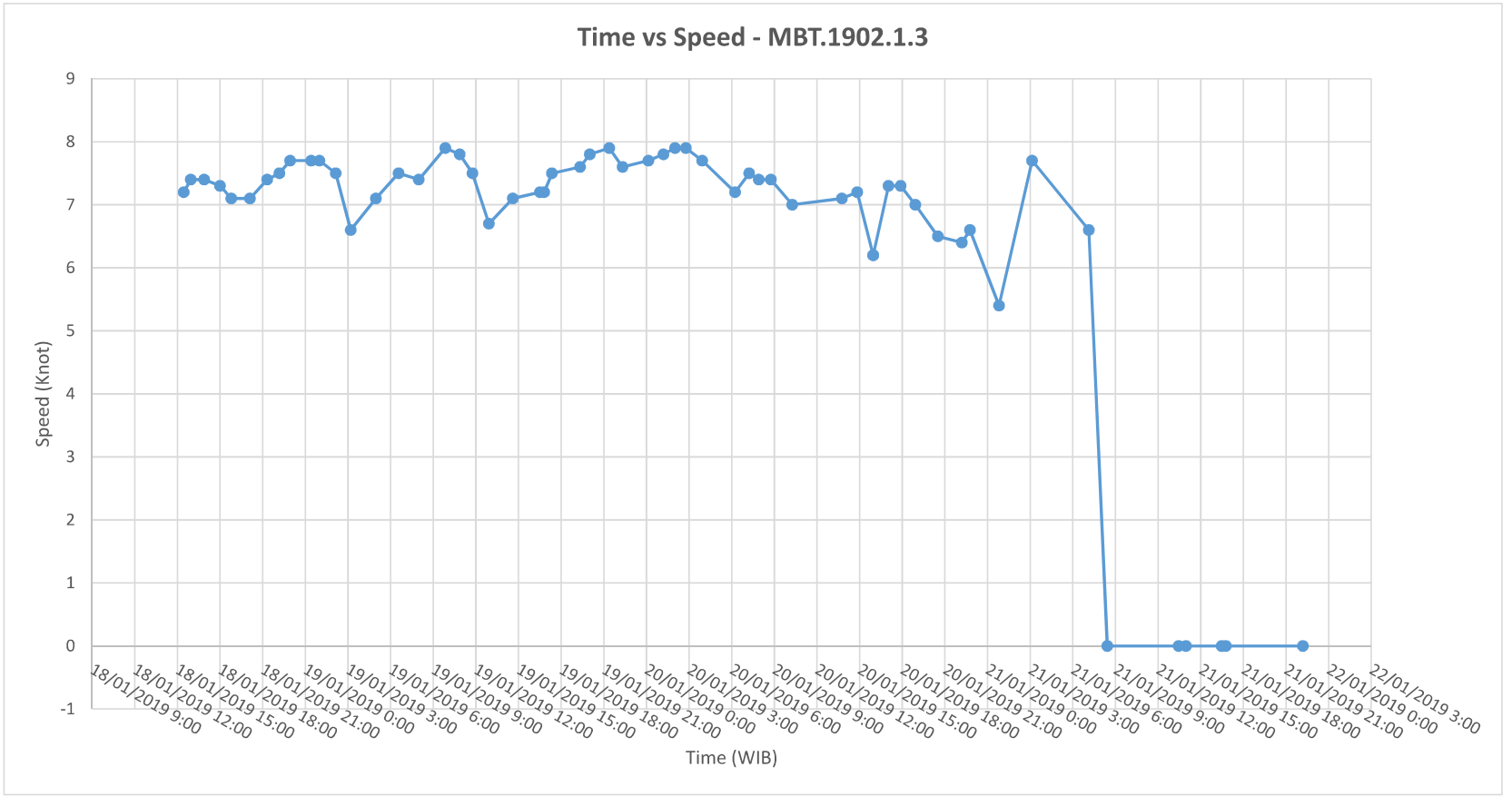
MV Meratus Bontang



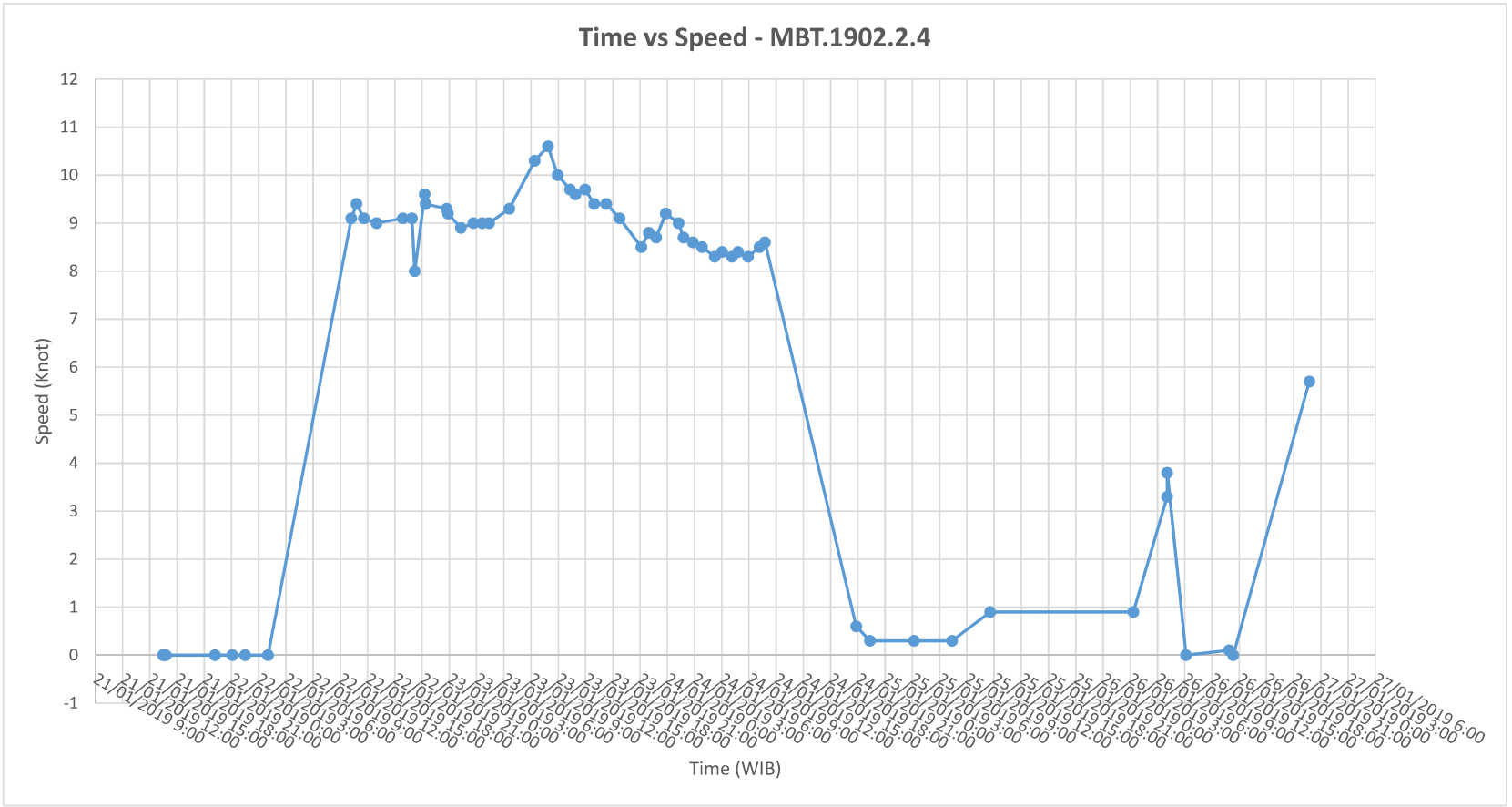
MV Meratus Bontang



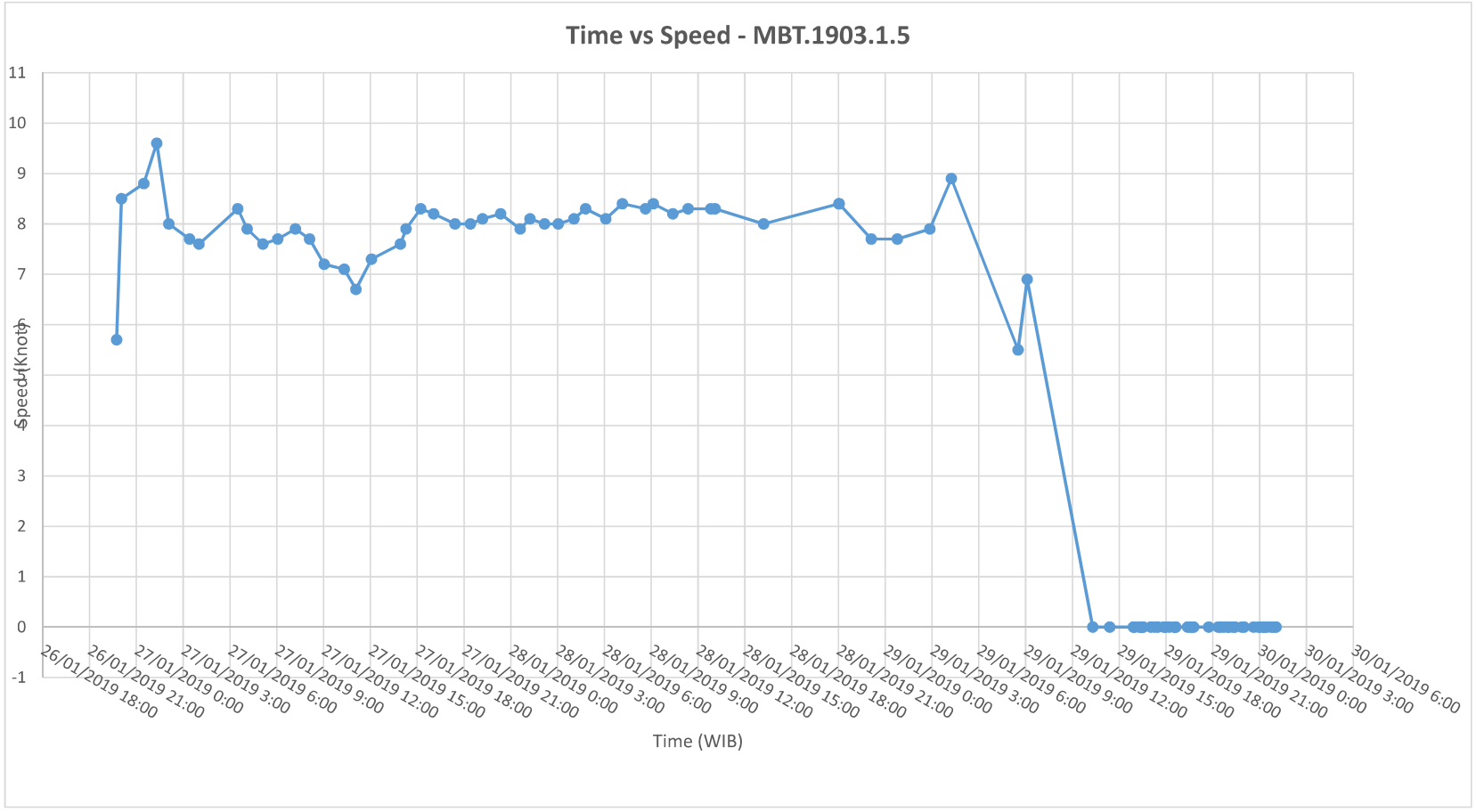
MV Meratus Bontang



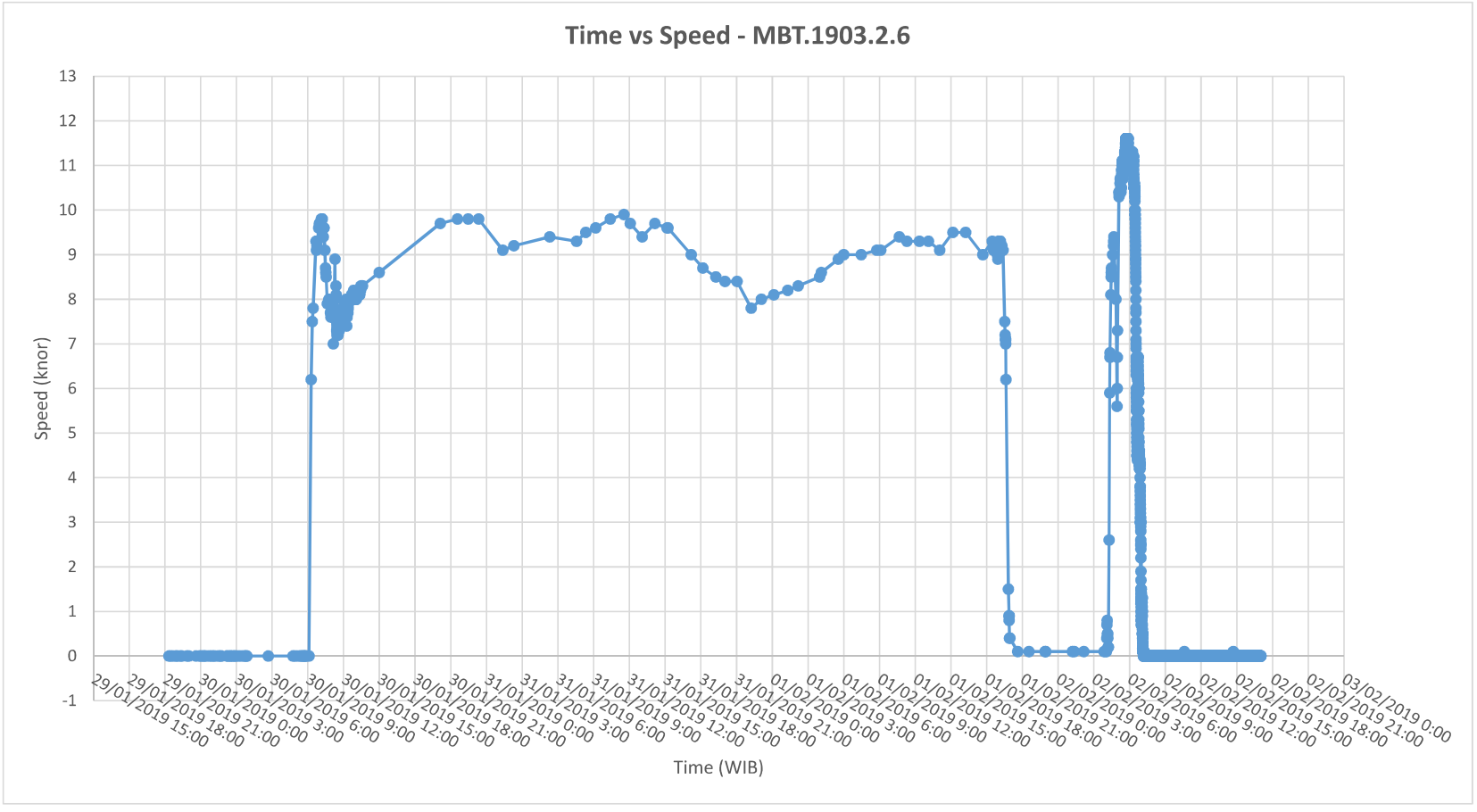
MV Meratus Bontang



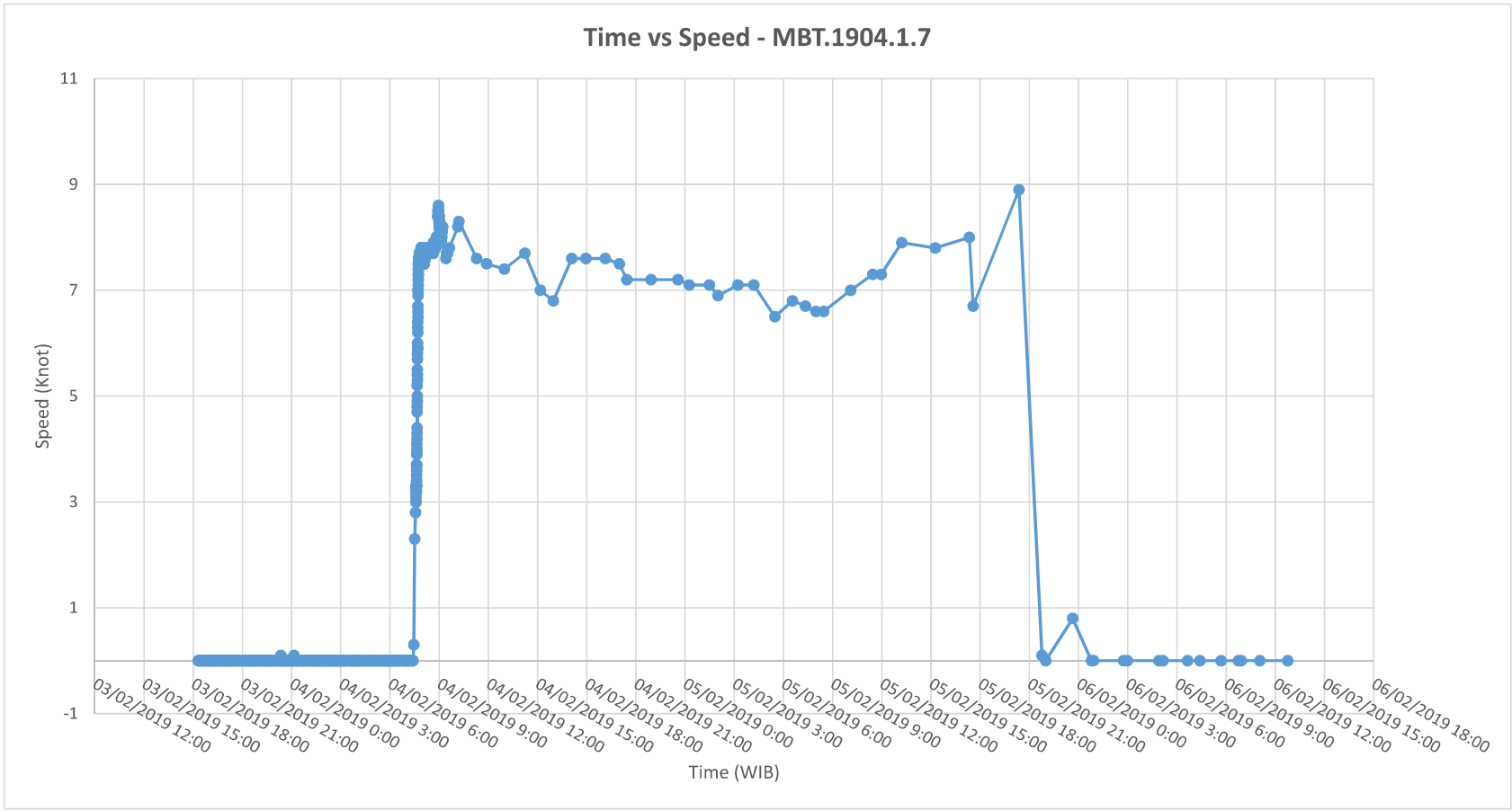
MV Meratus Bontang



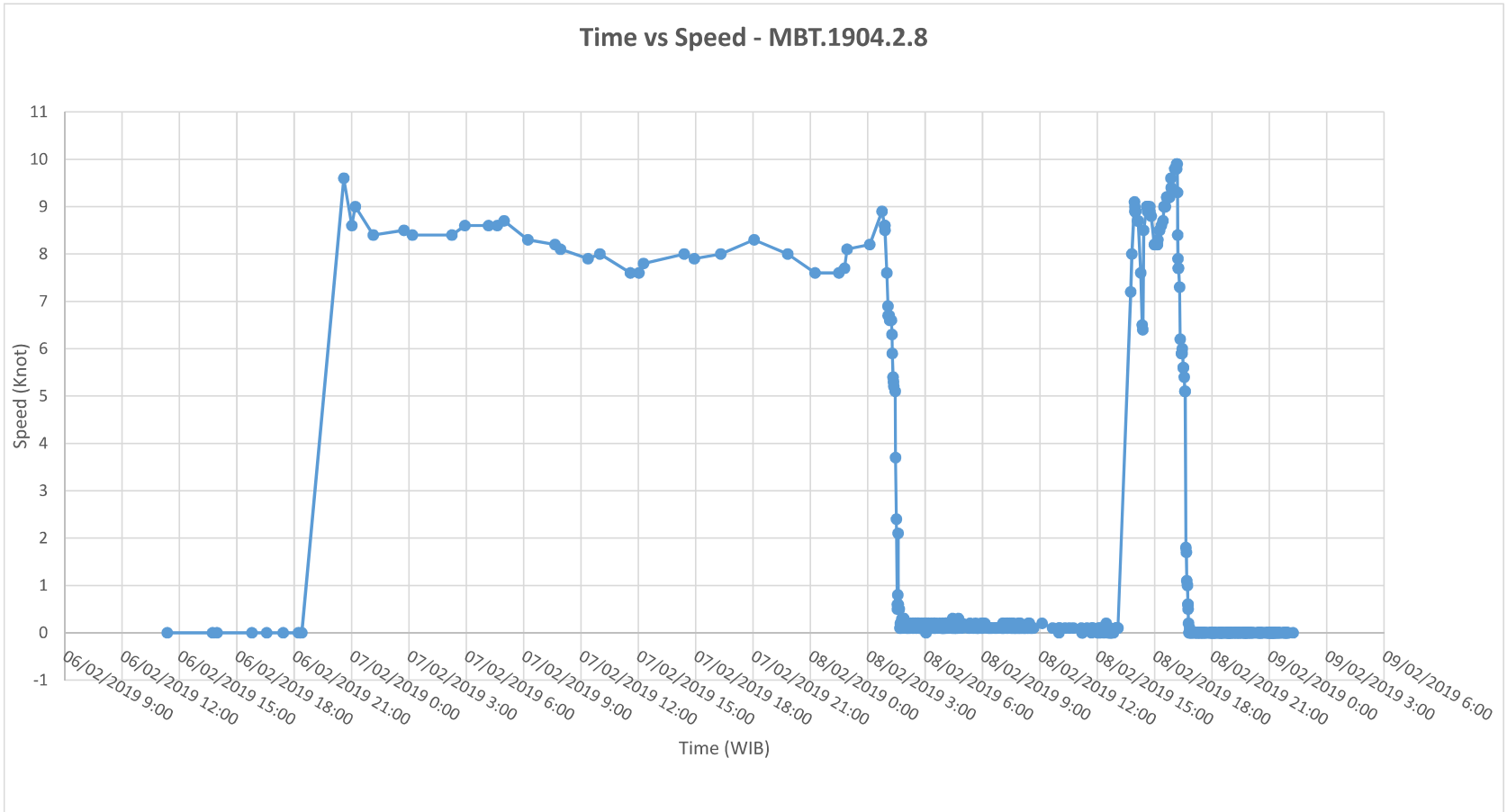
MV Meratus Bontang



MV Meratus Bontang



MV Meratus Bontang



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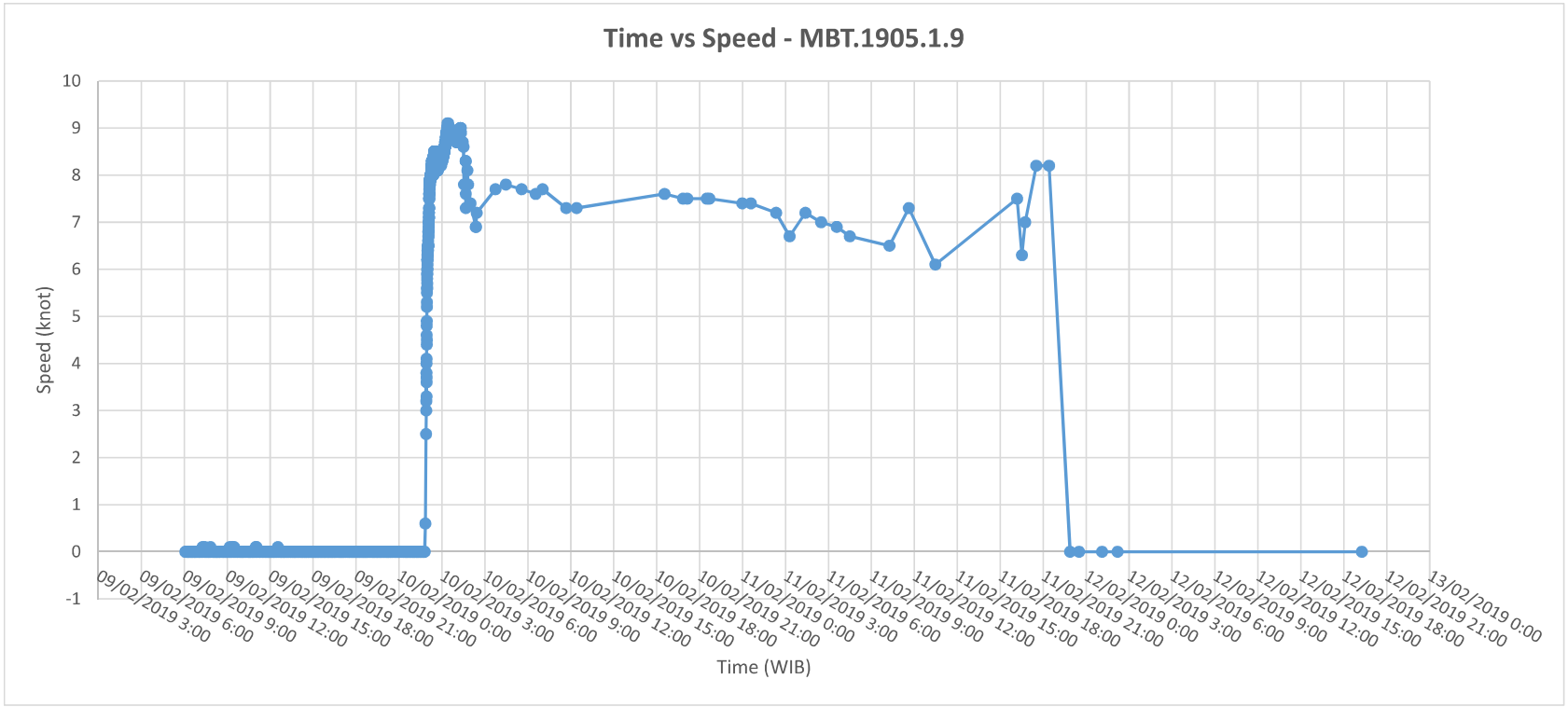

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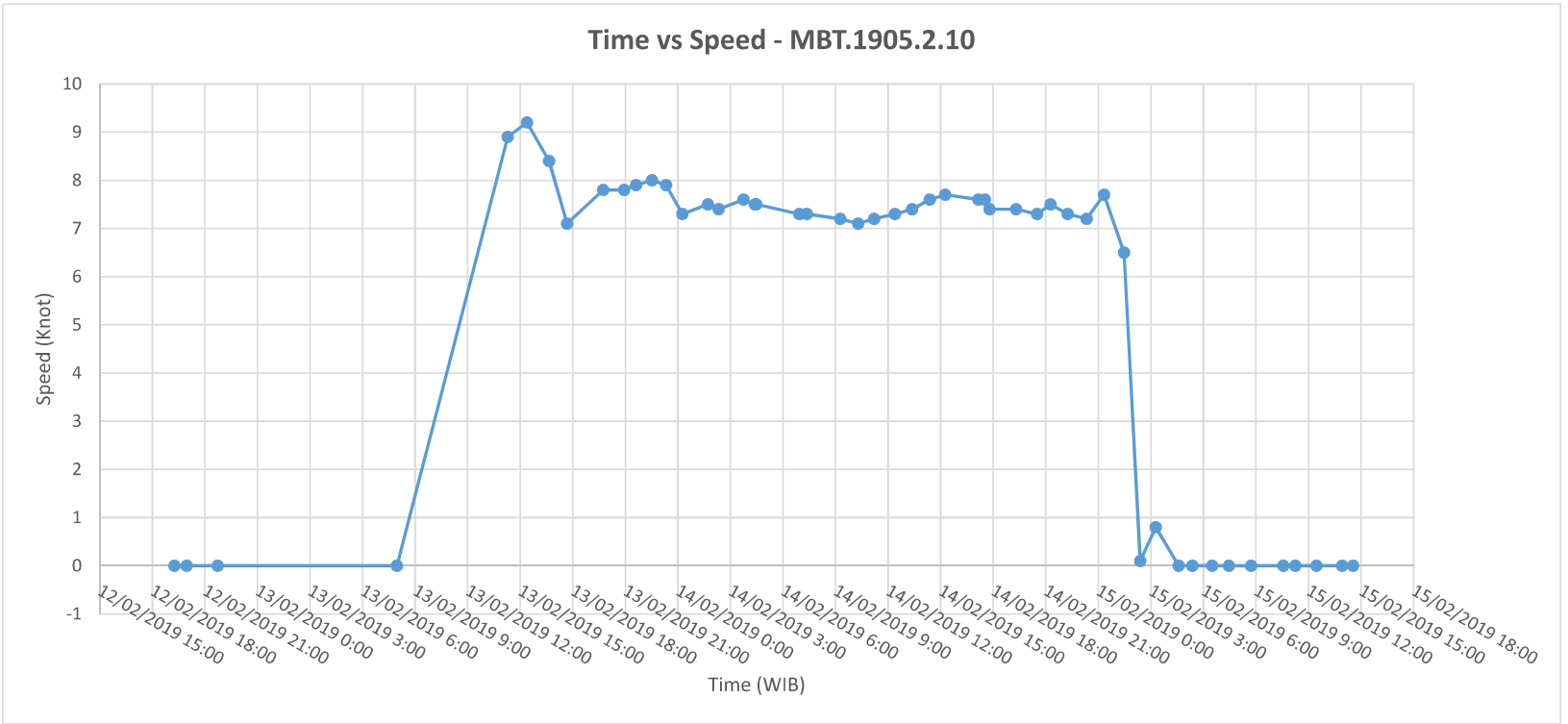

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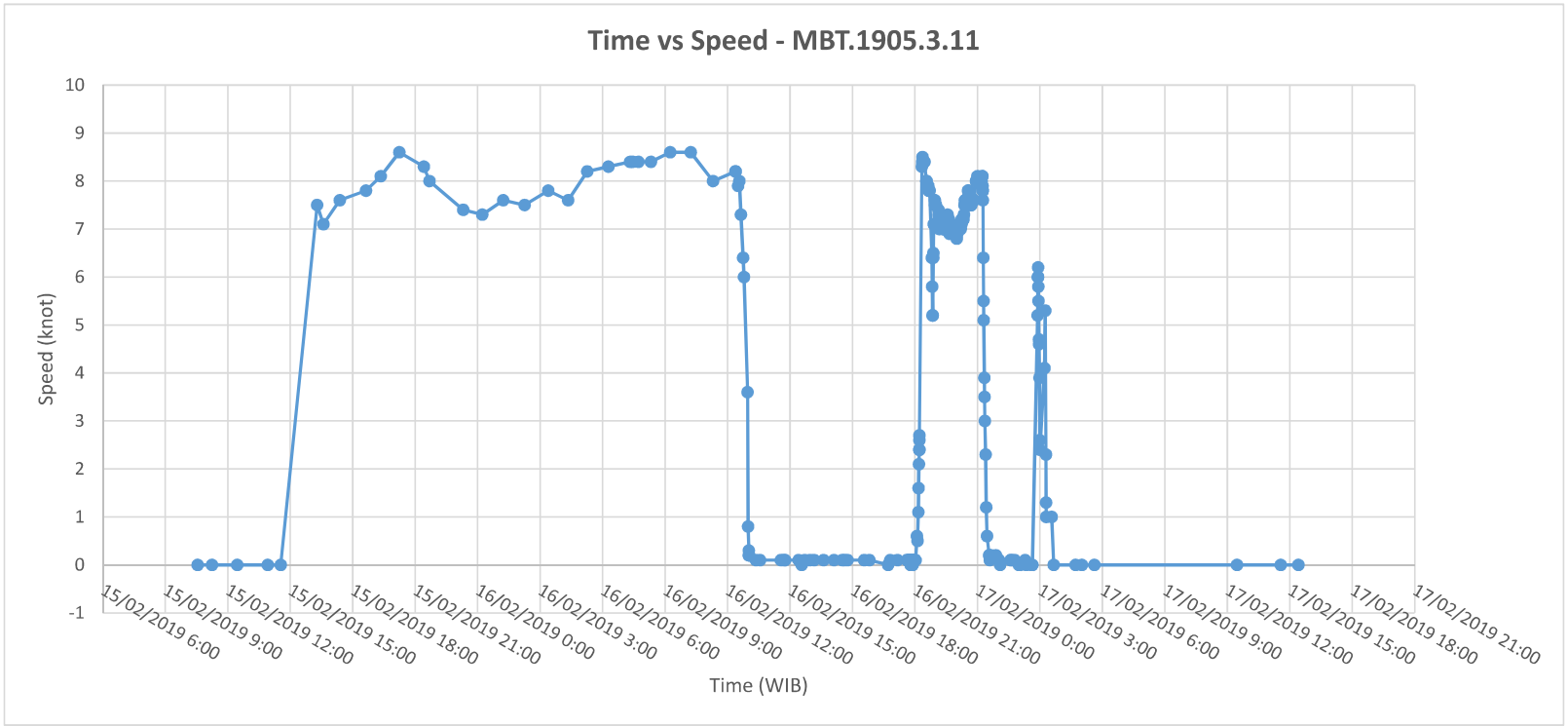

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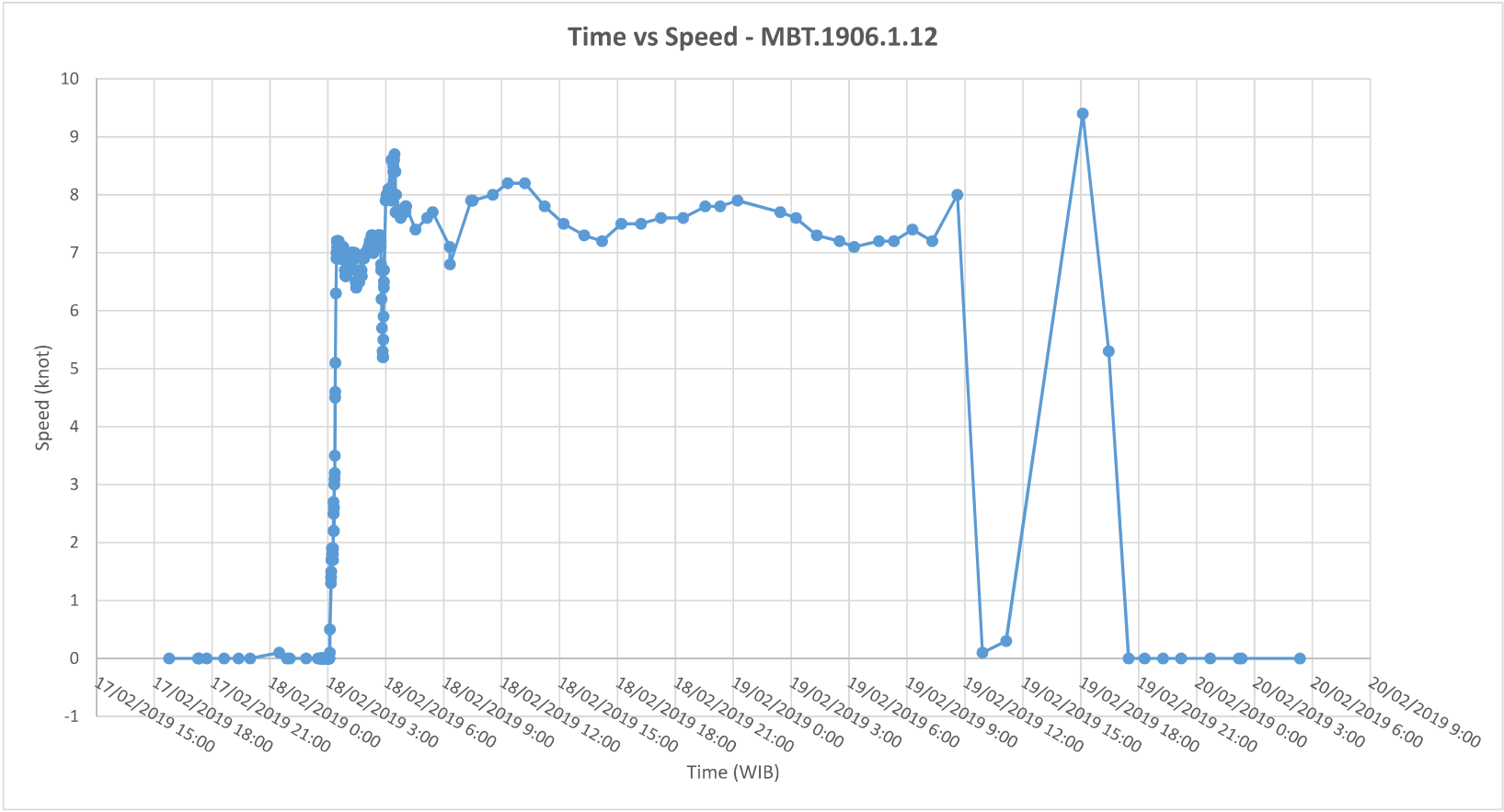

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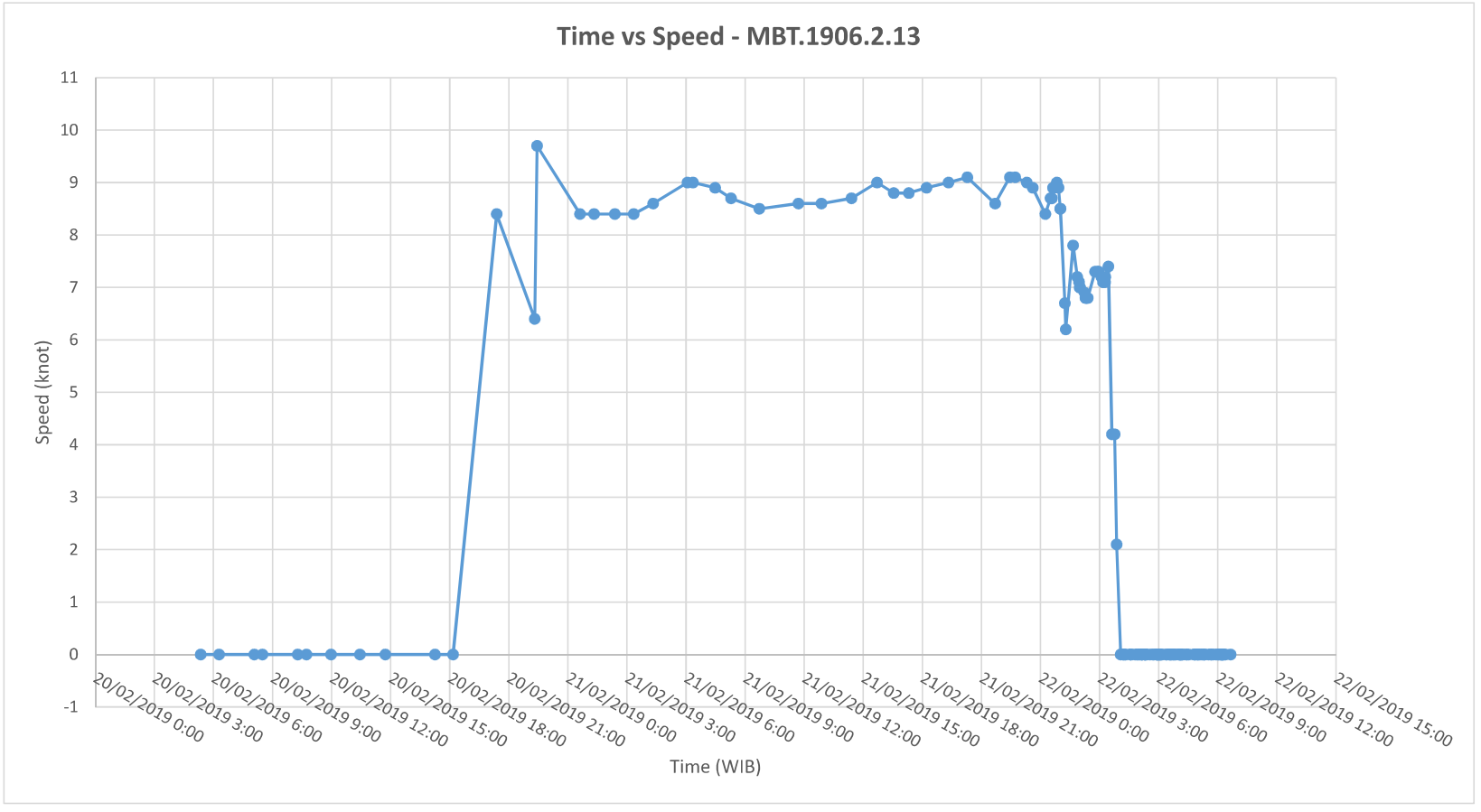

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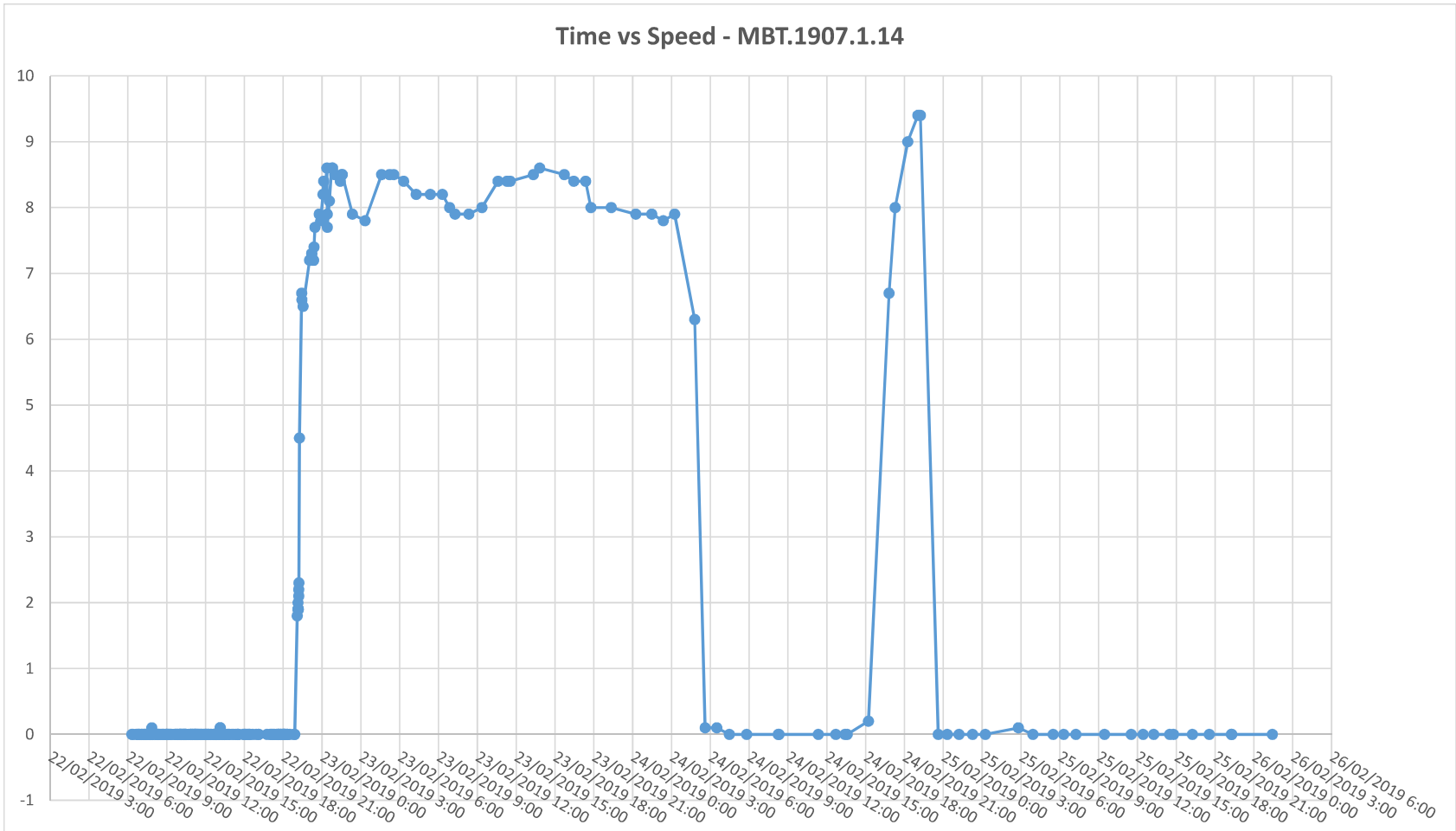

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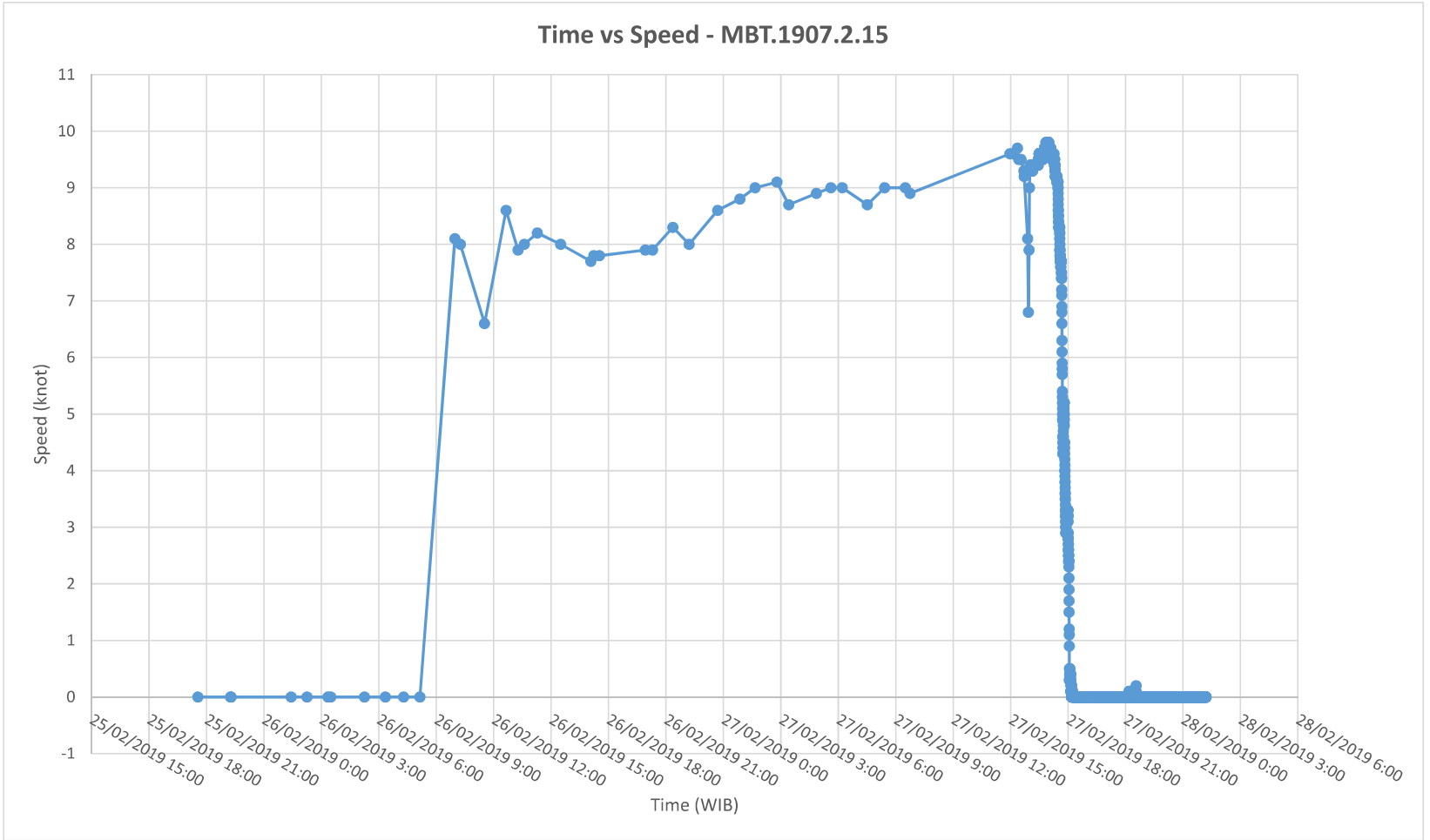

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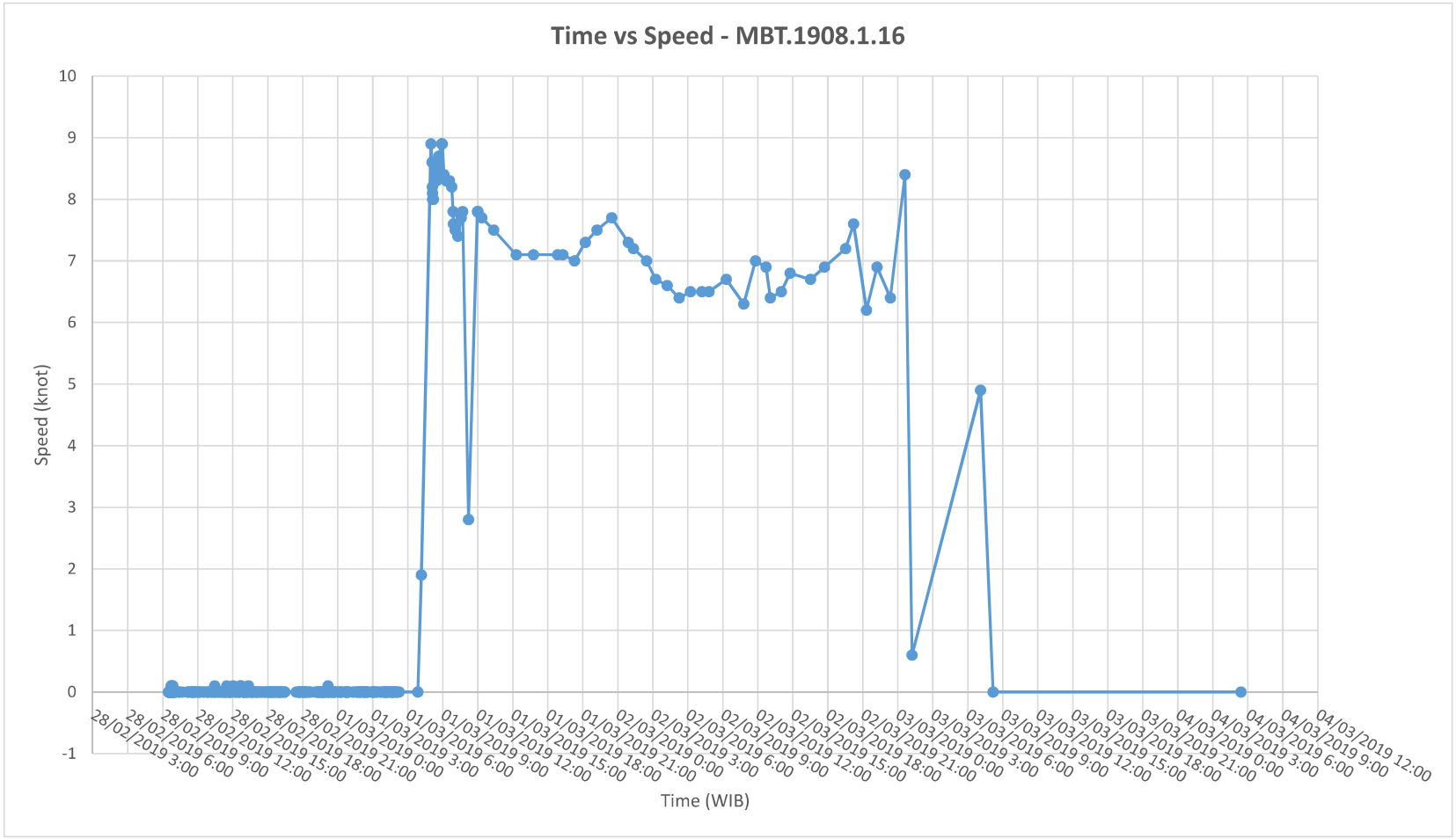

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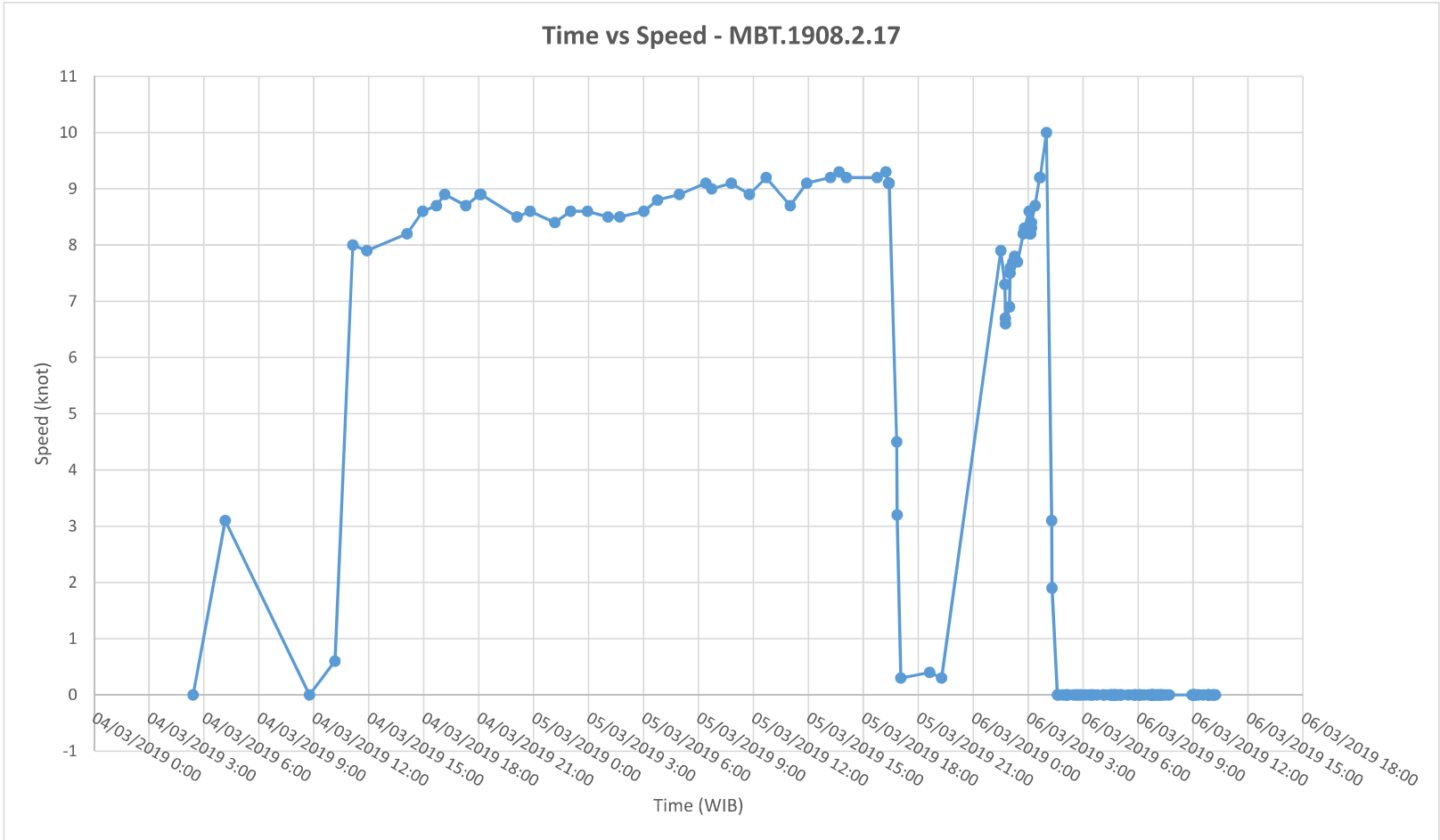

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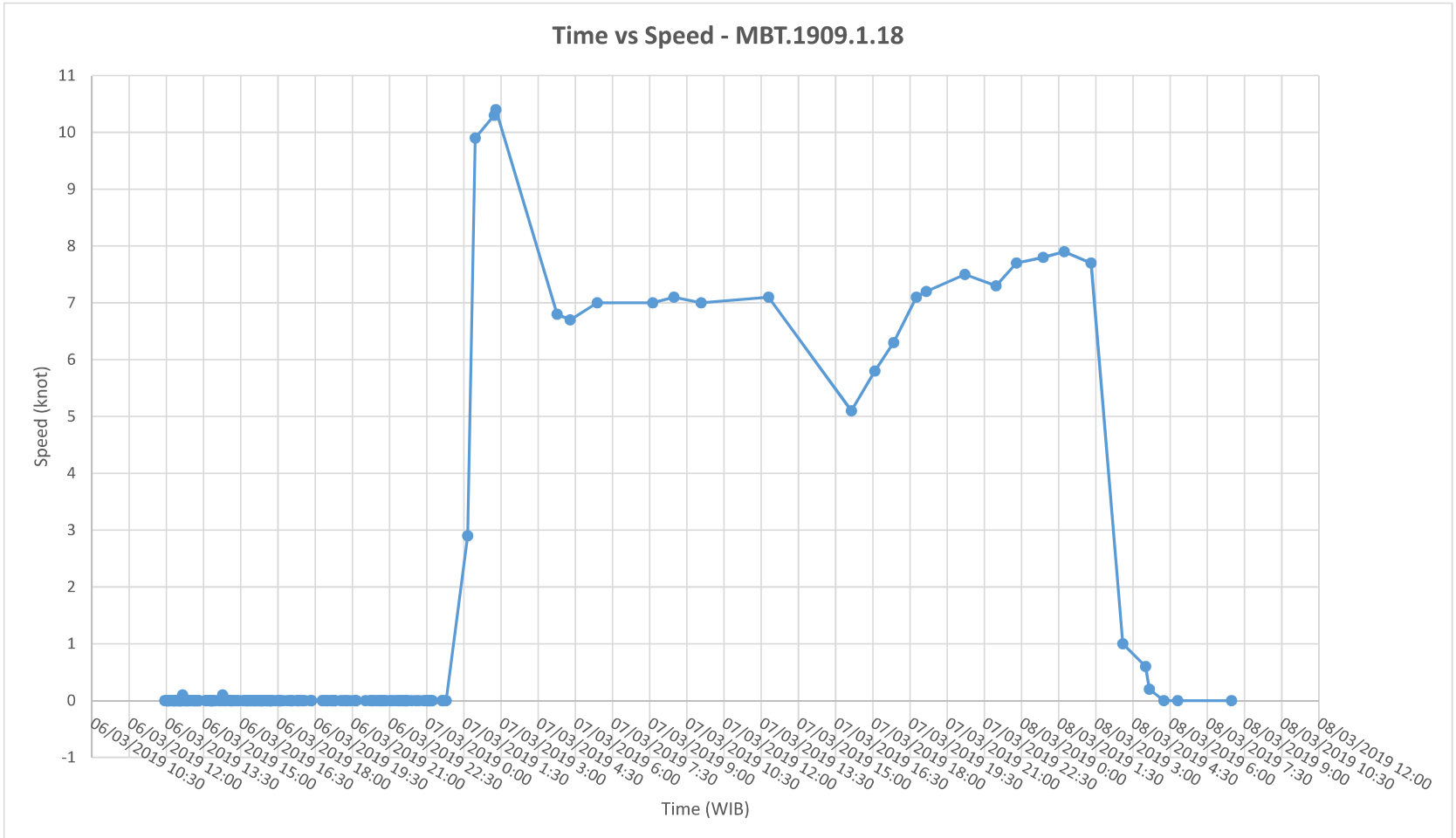

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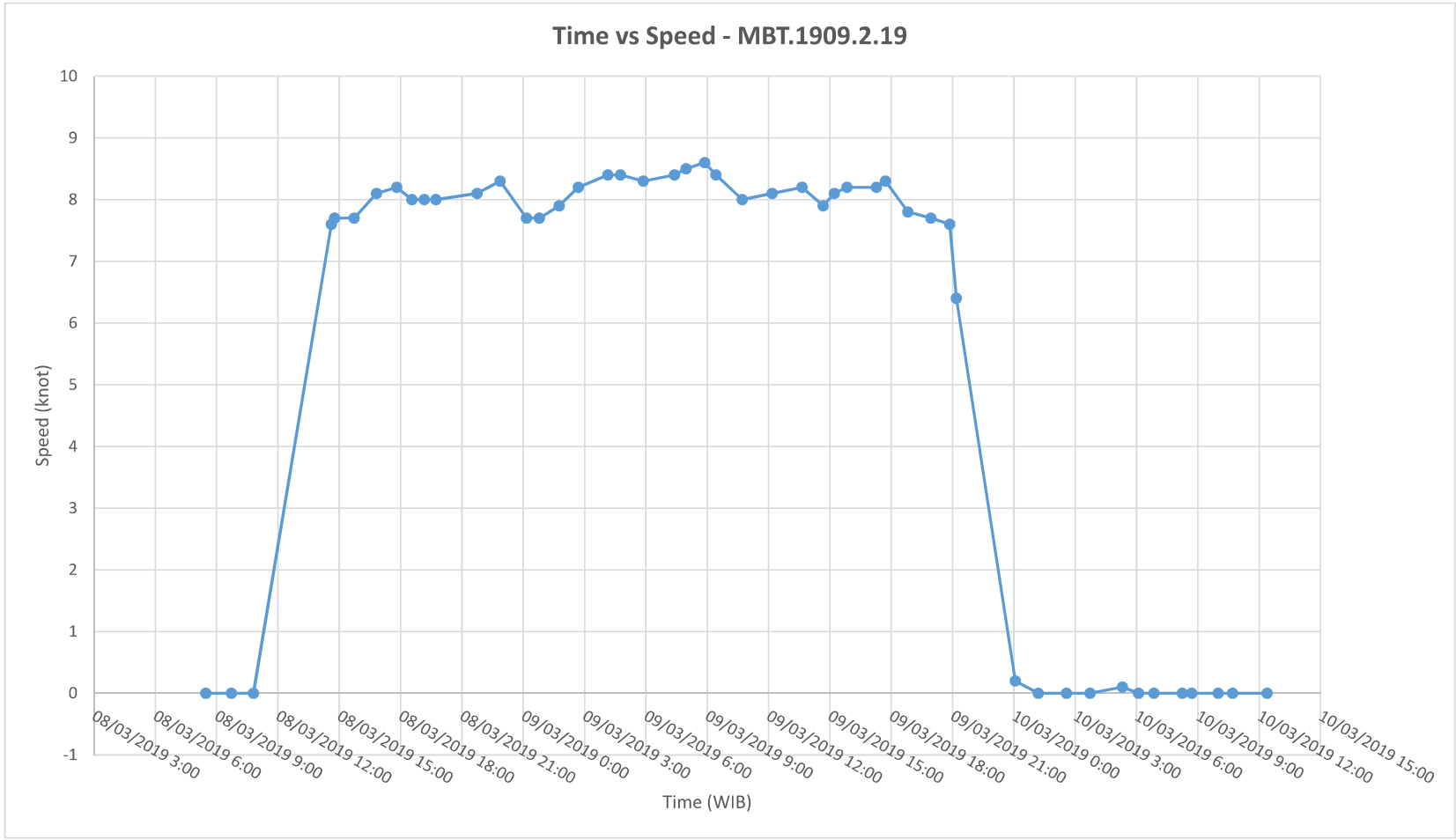

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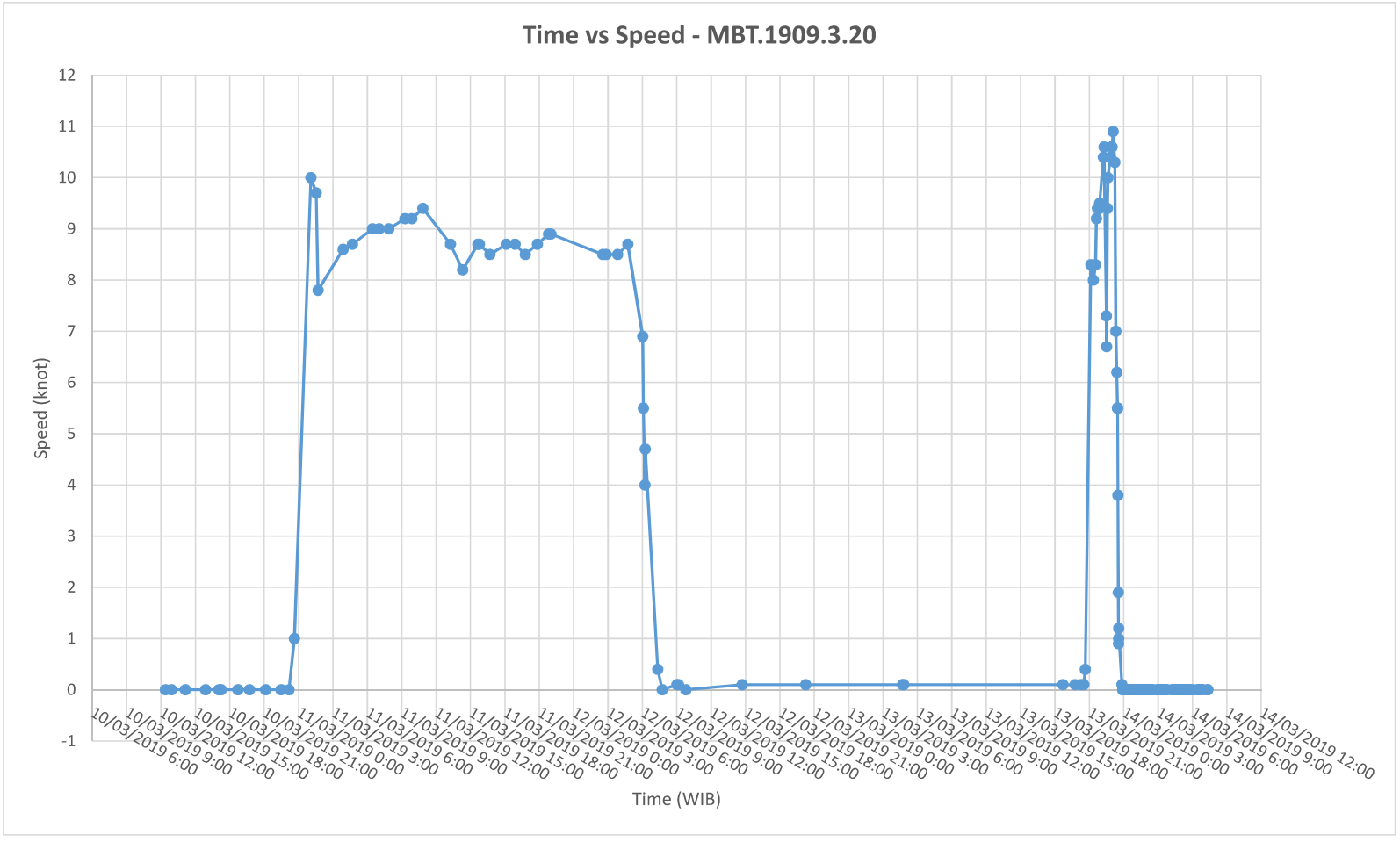

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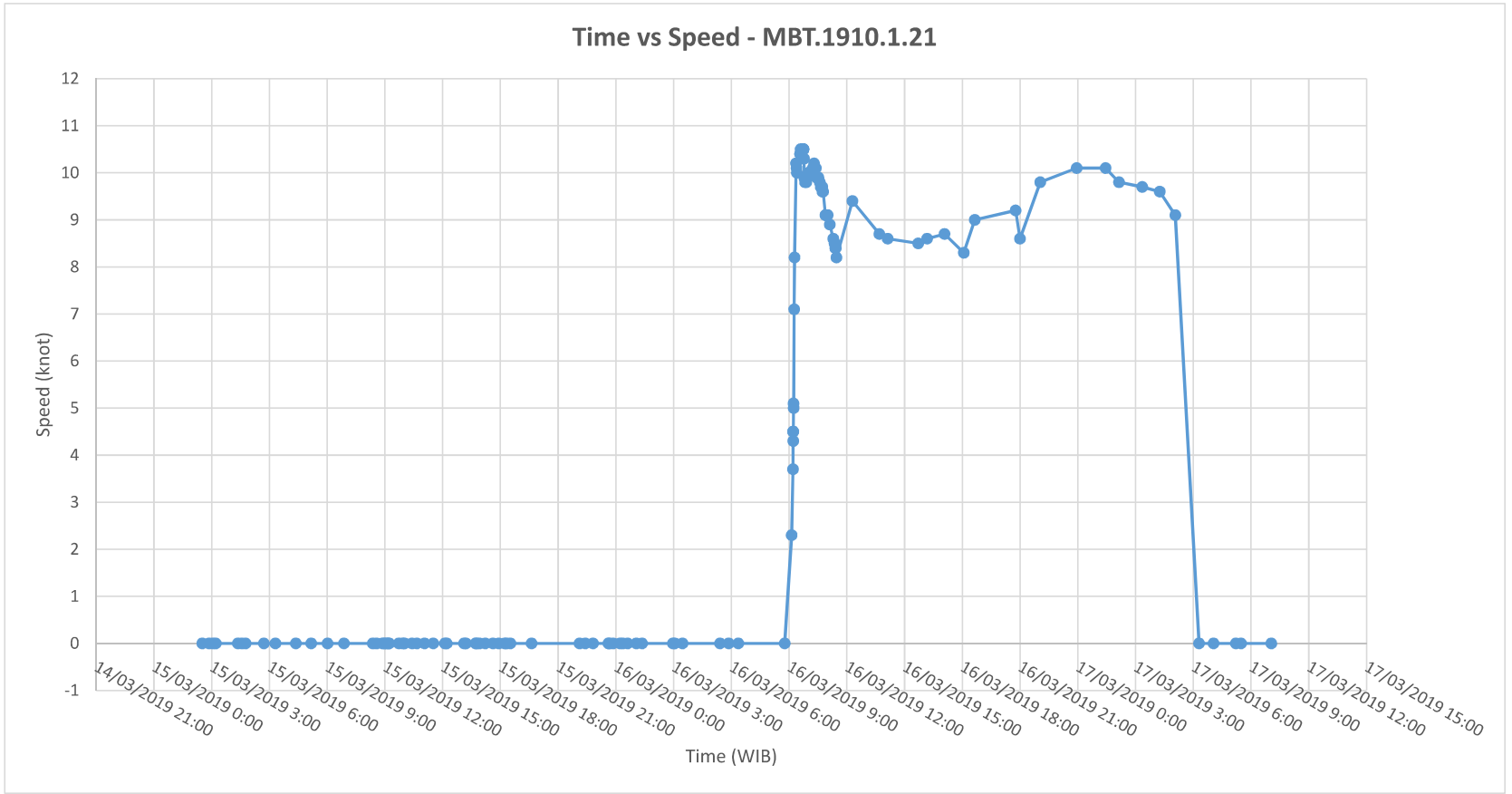

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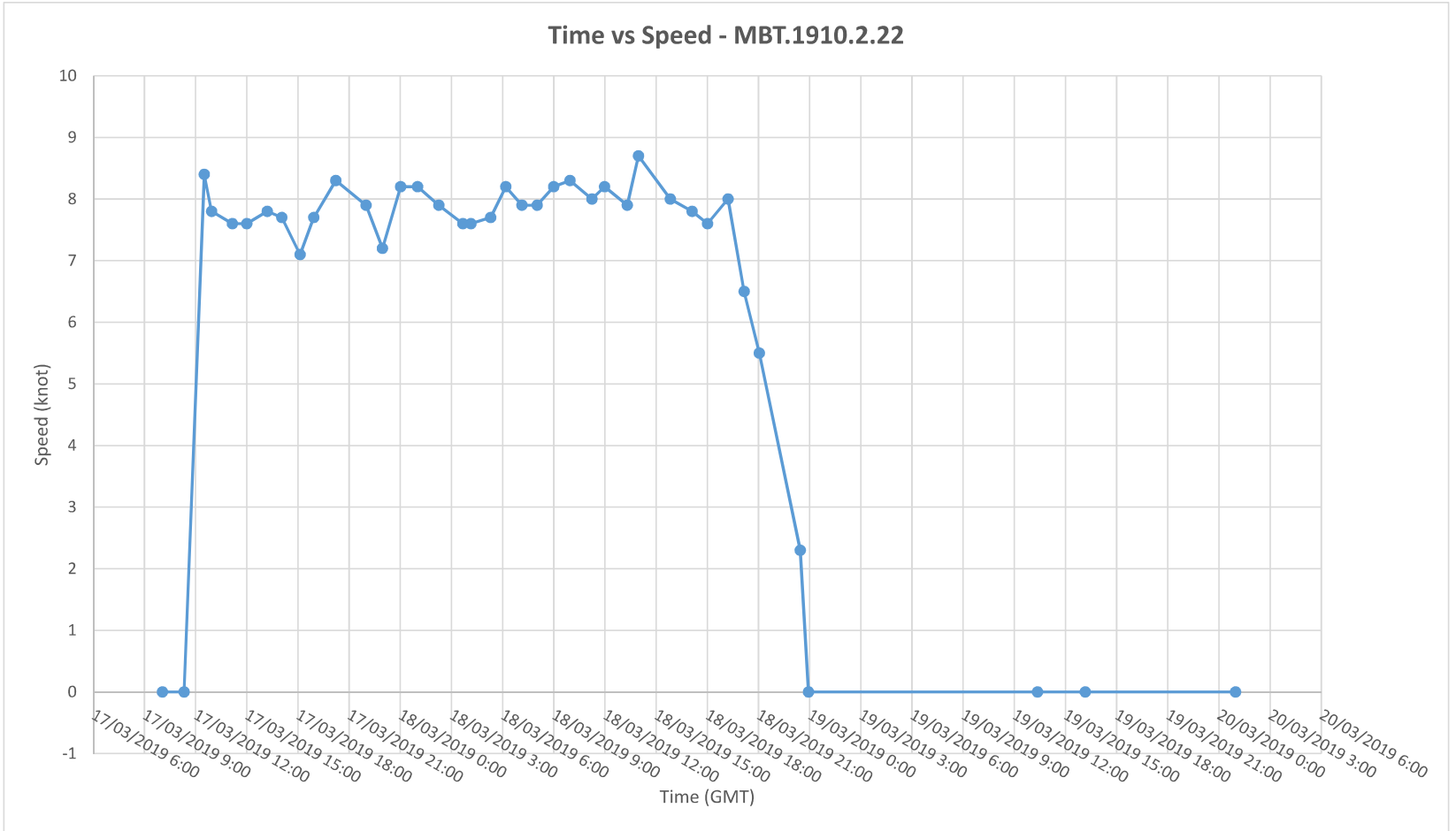

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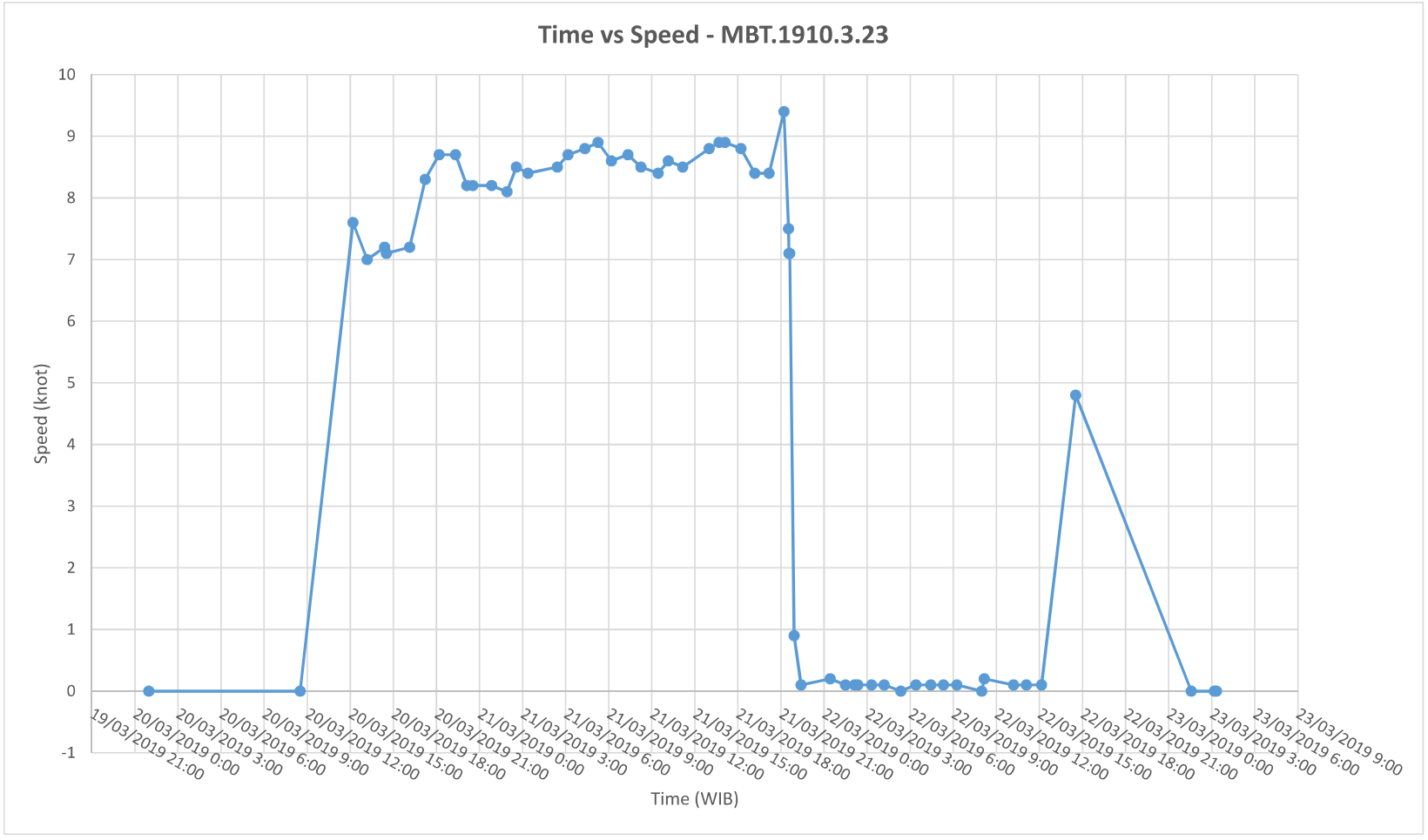

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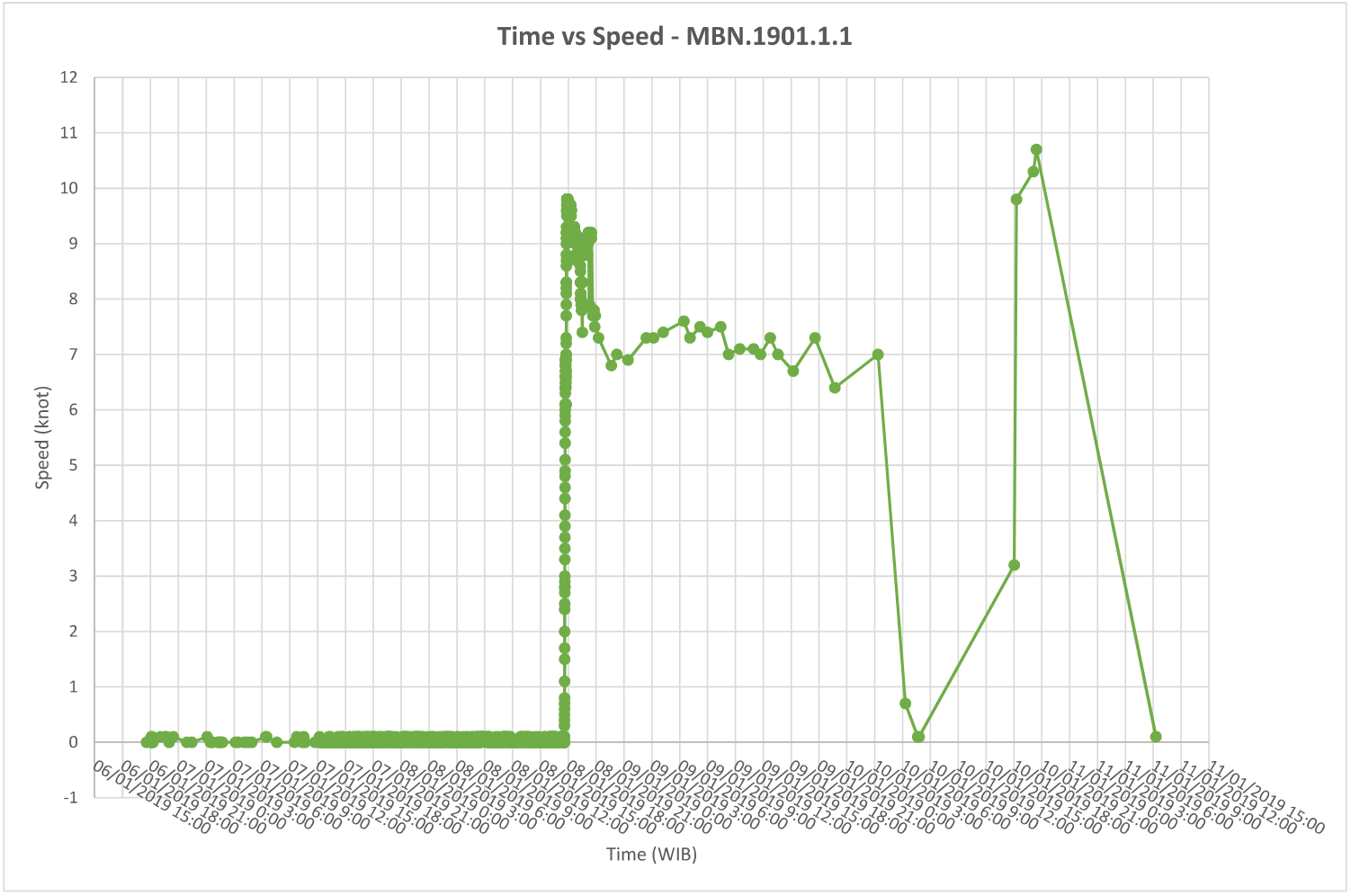

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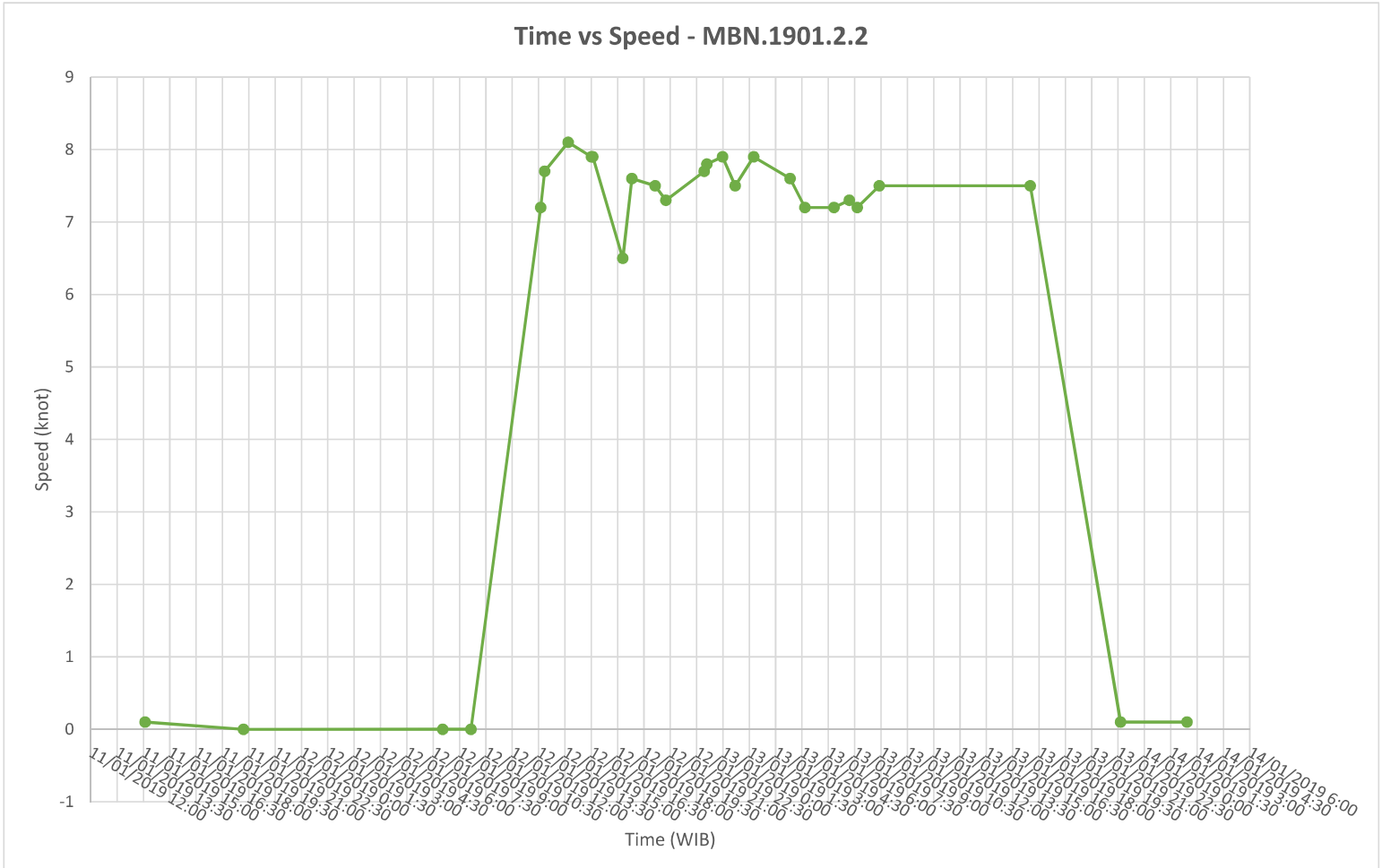

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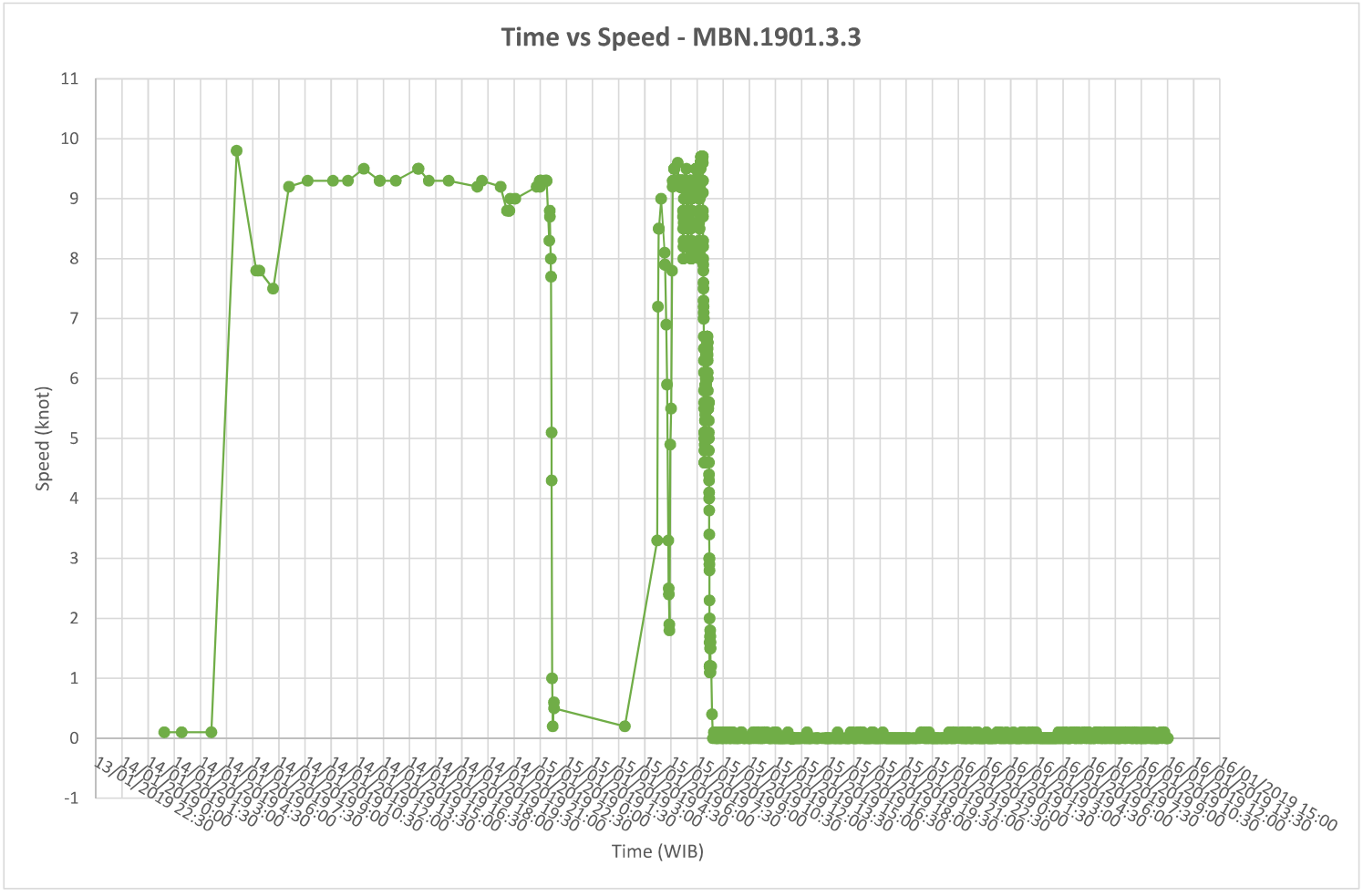

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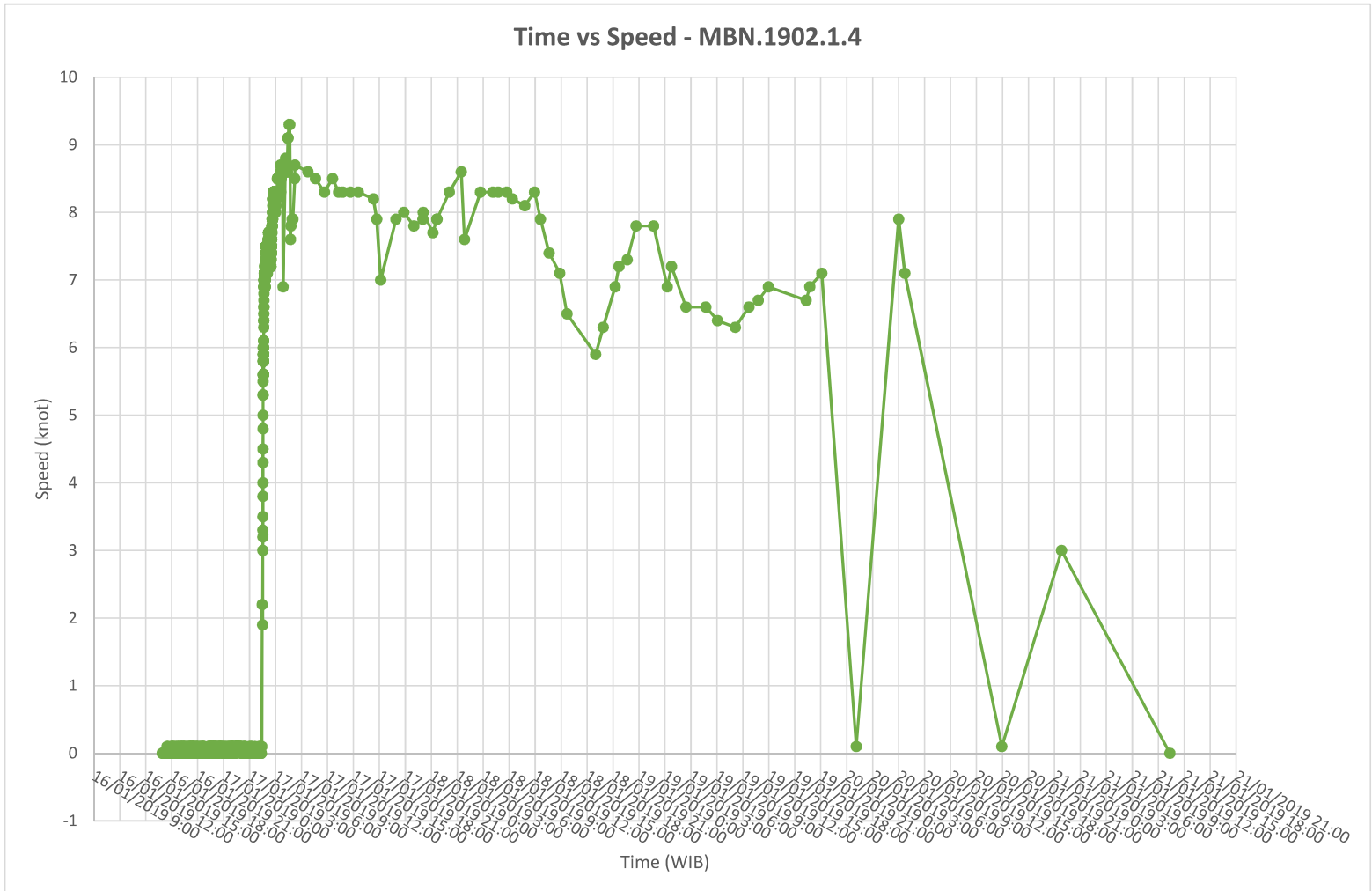

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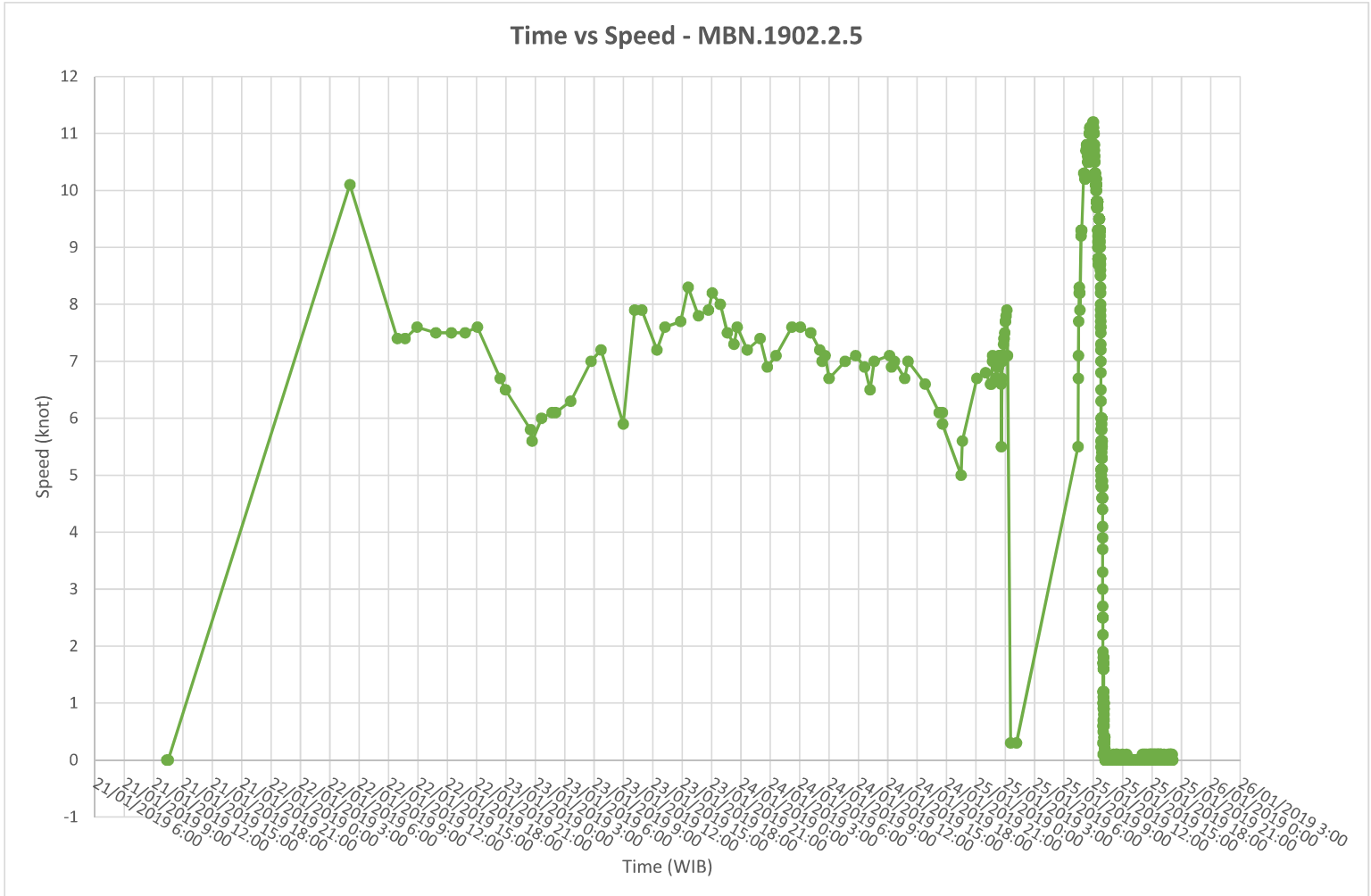

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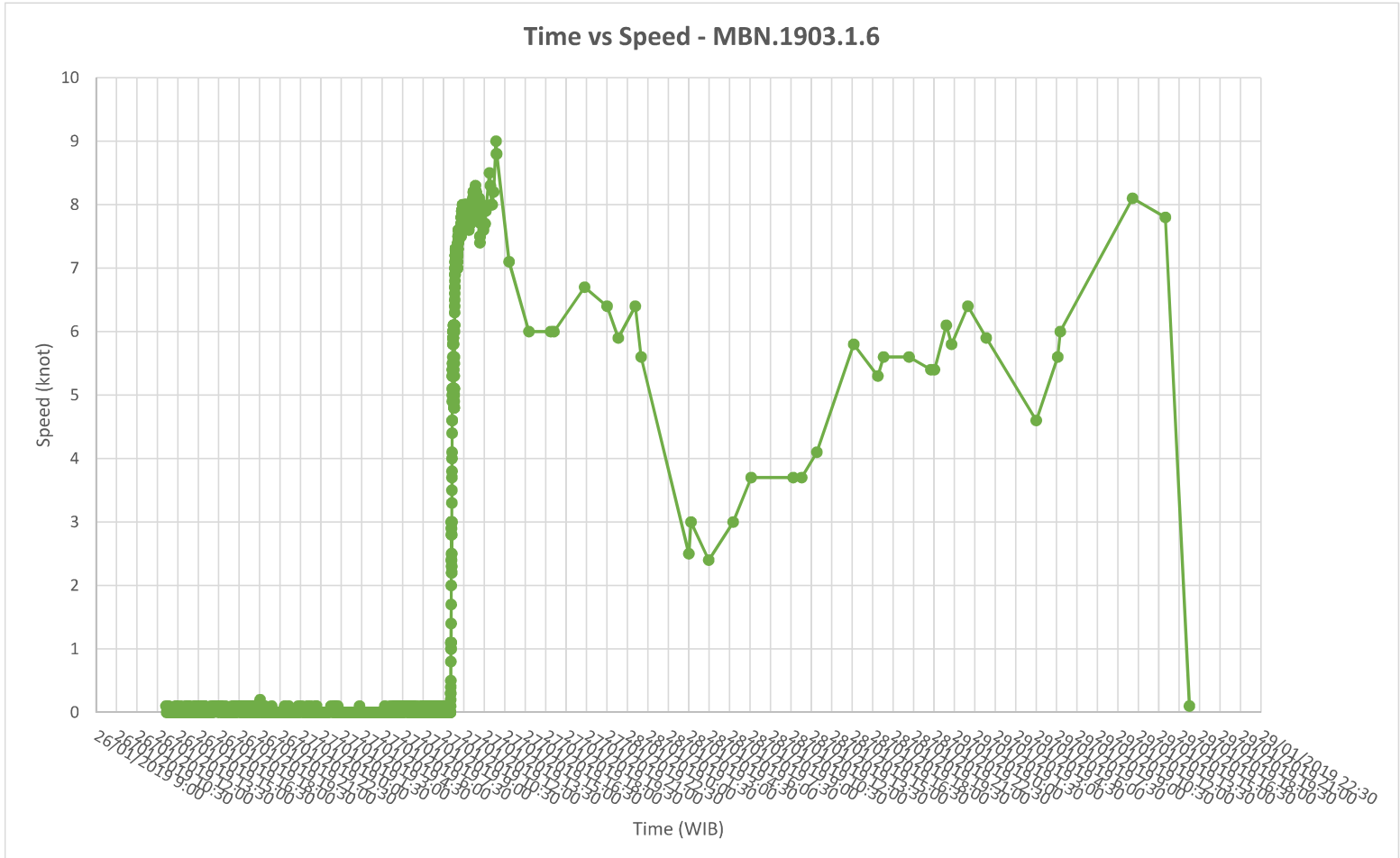

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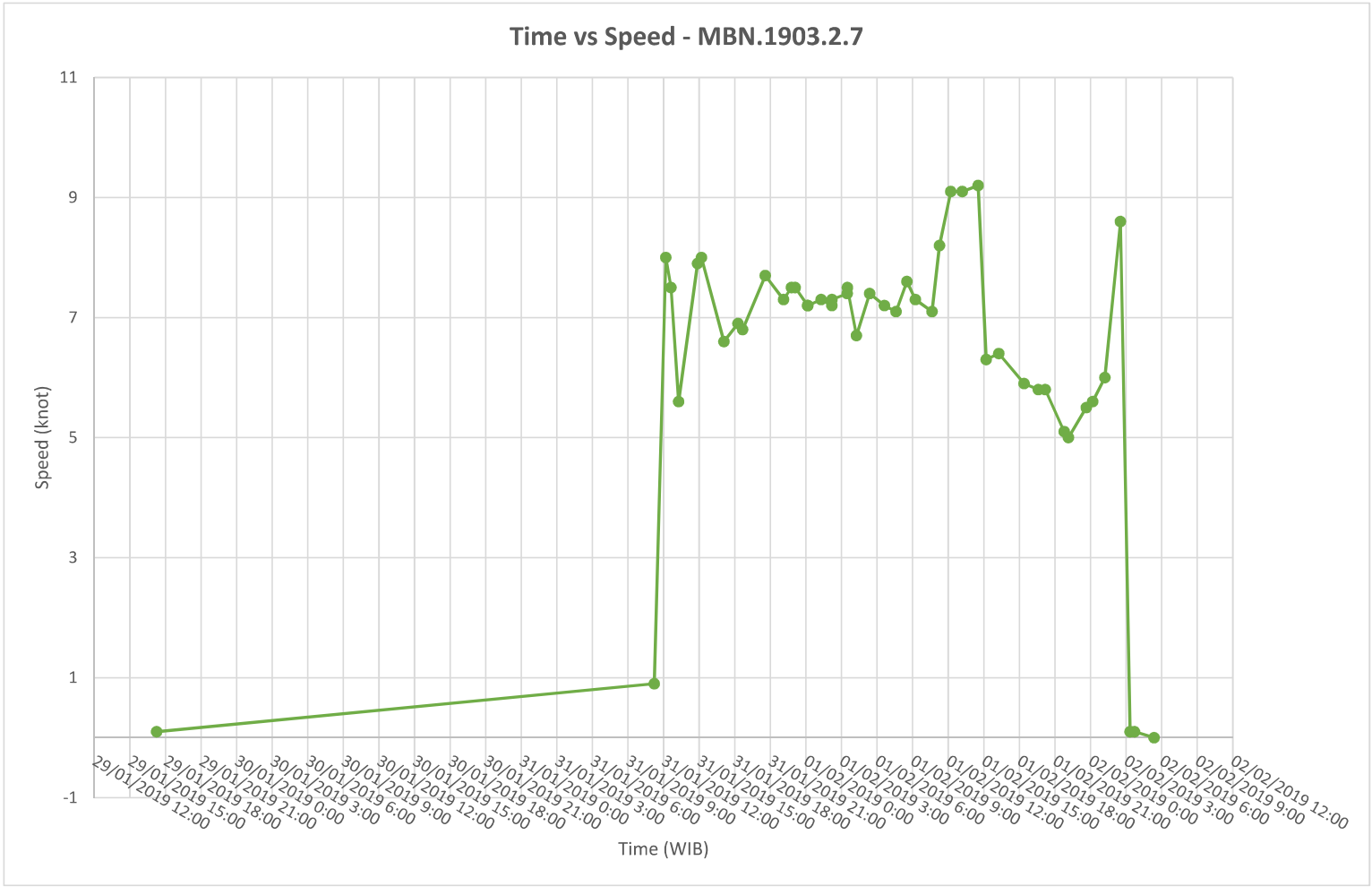

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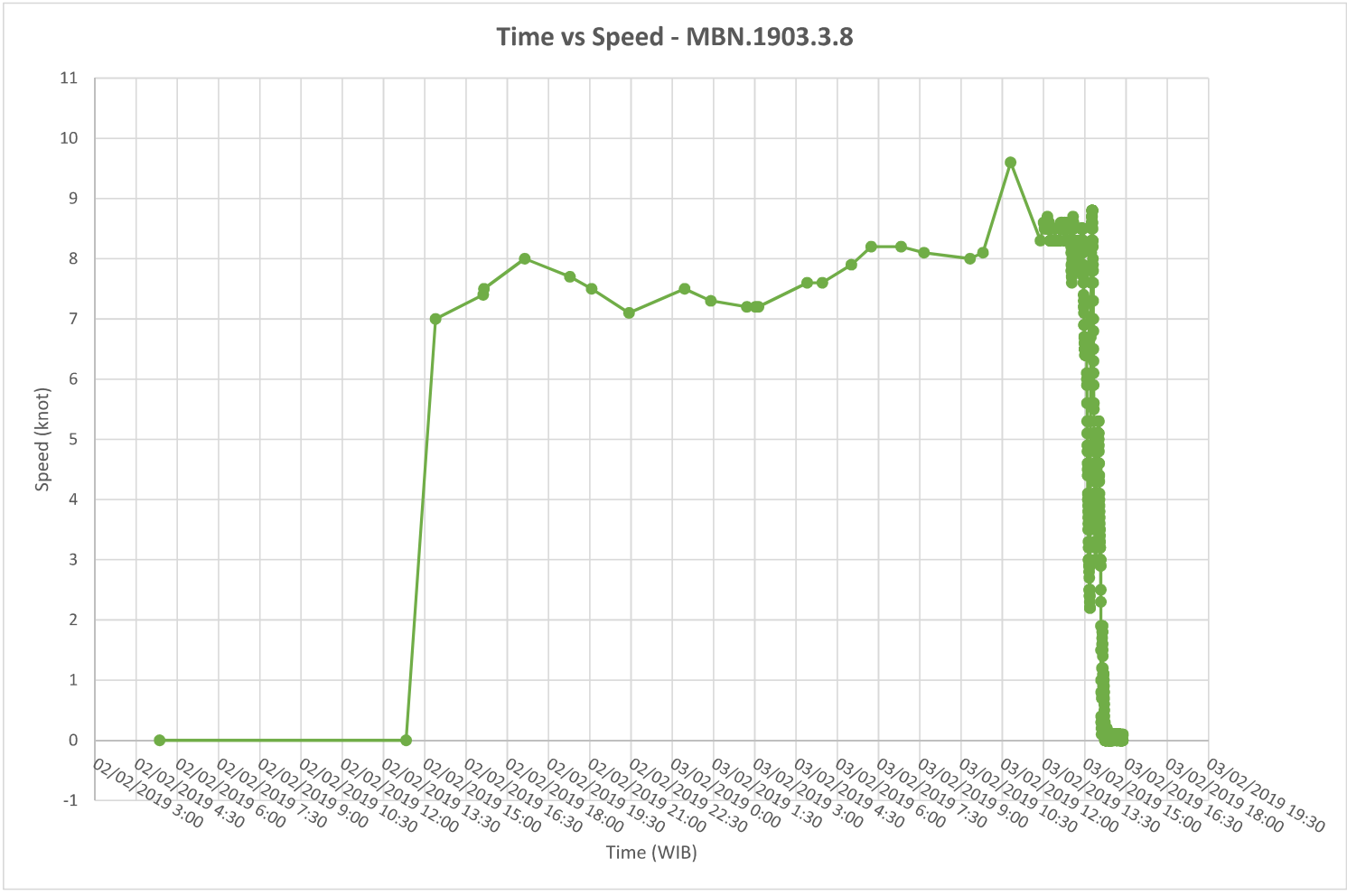

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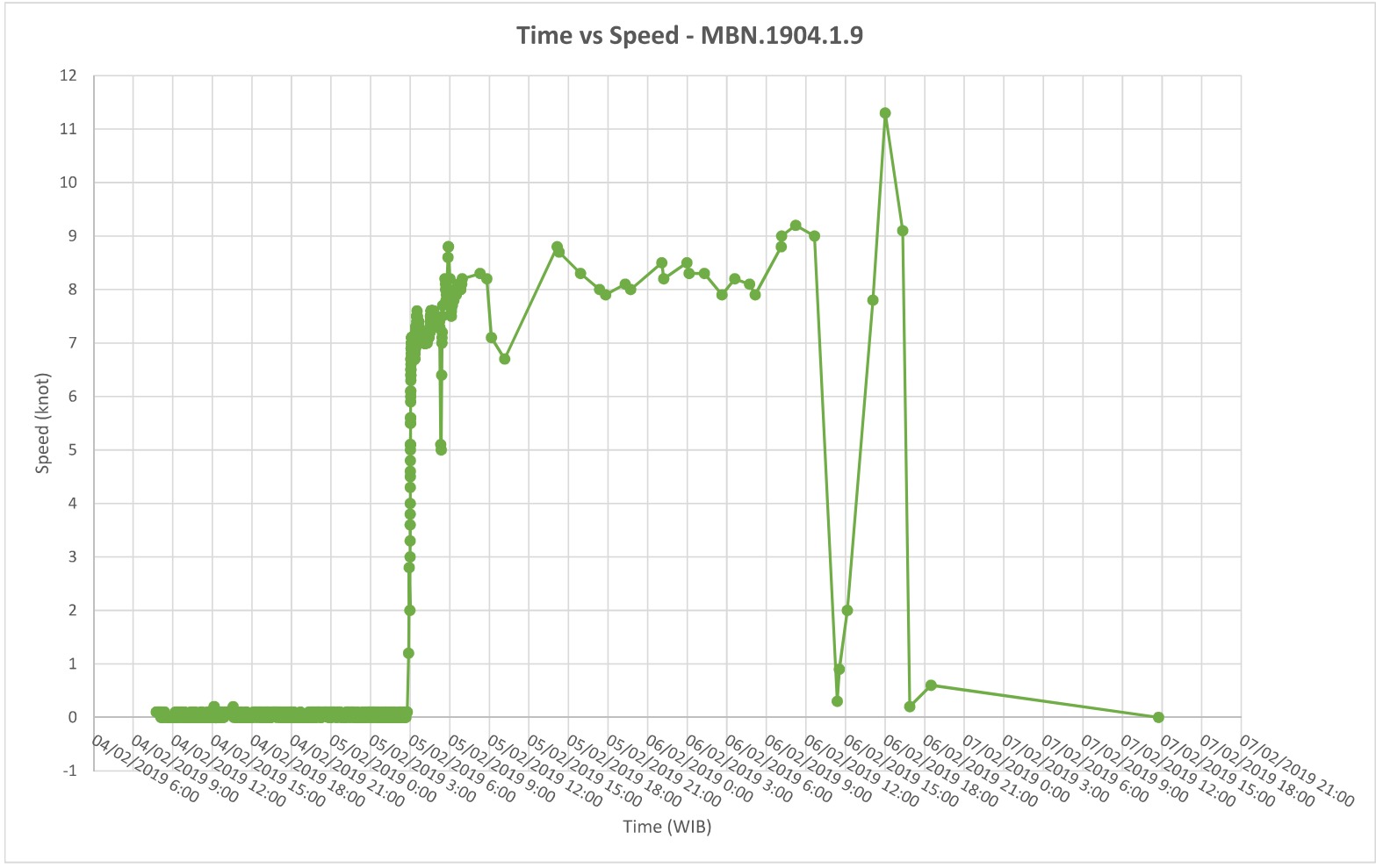

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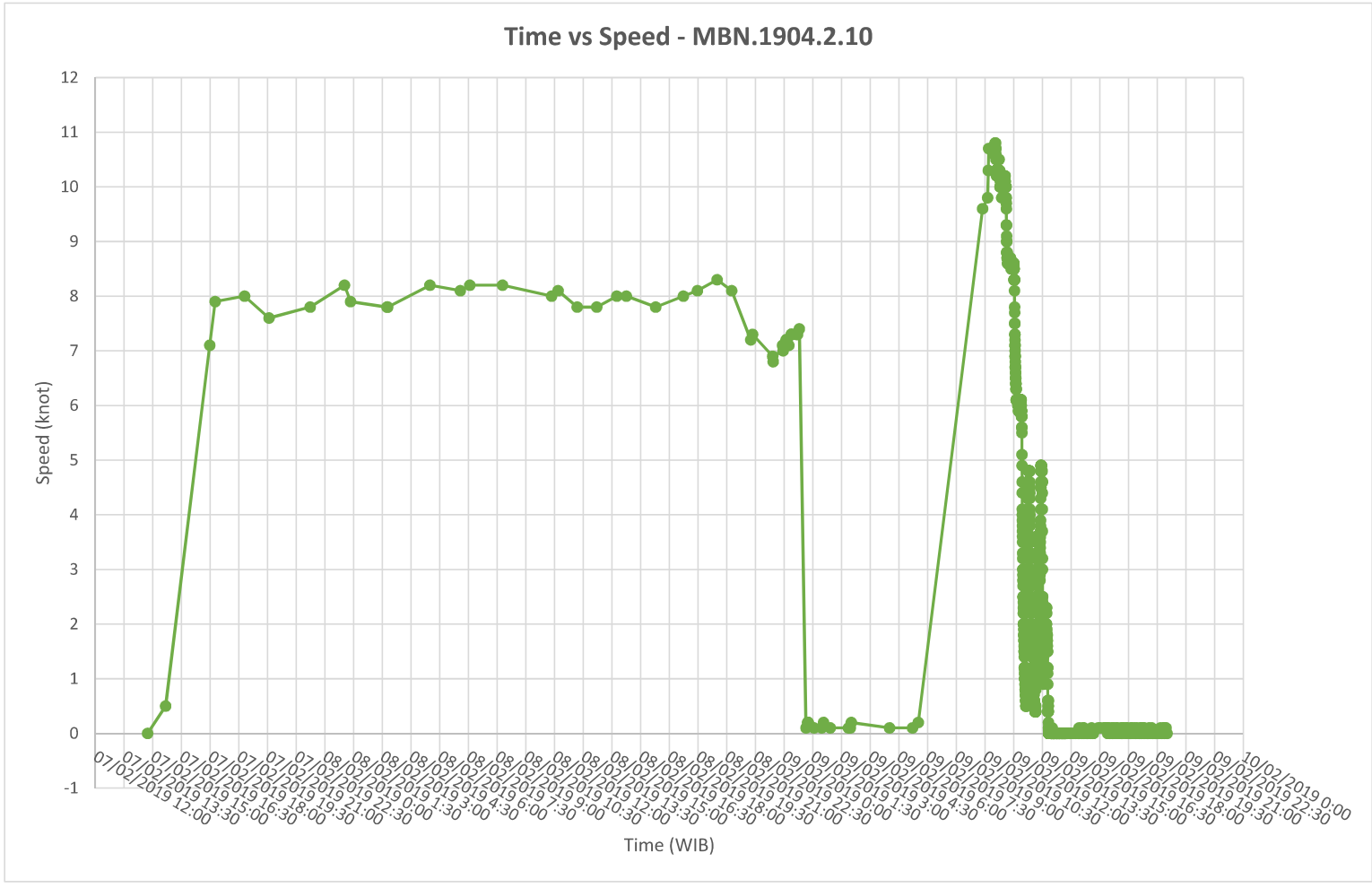

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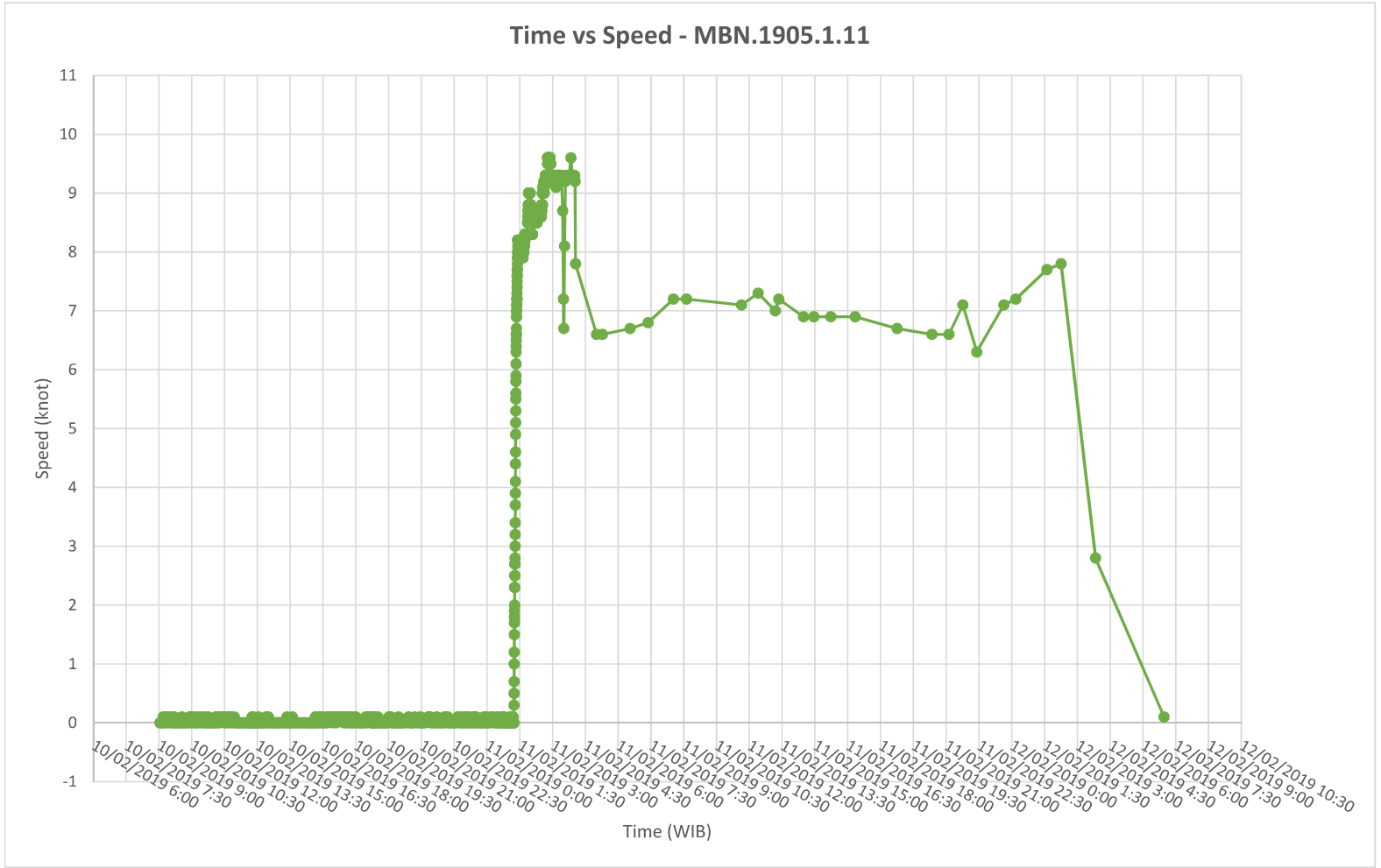

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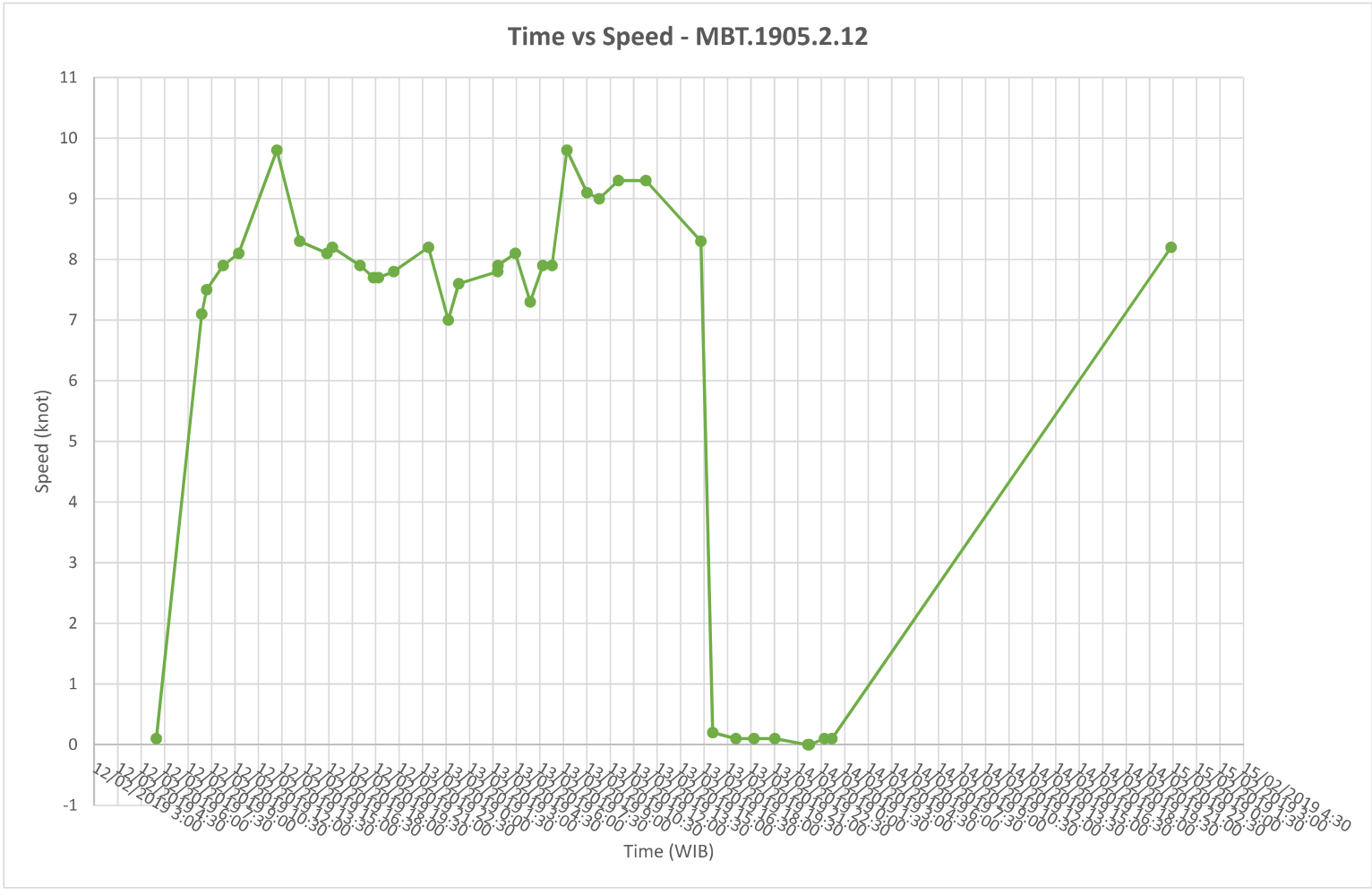

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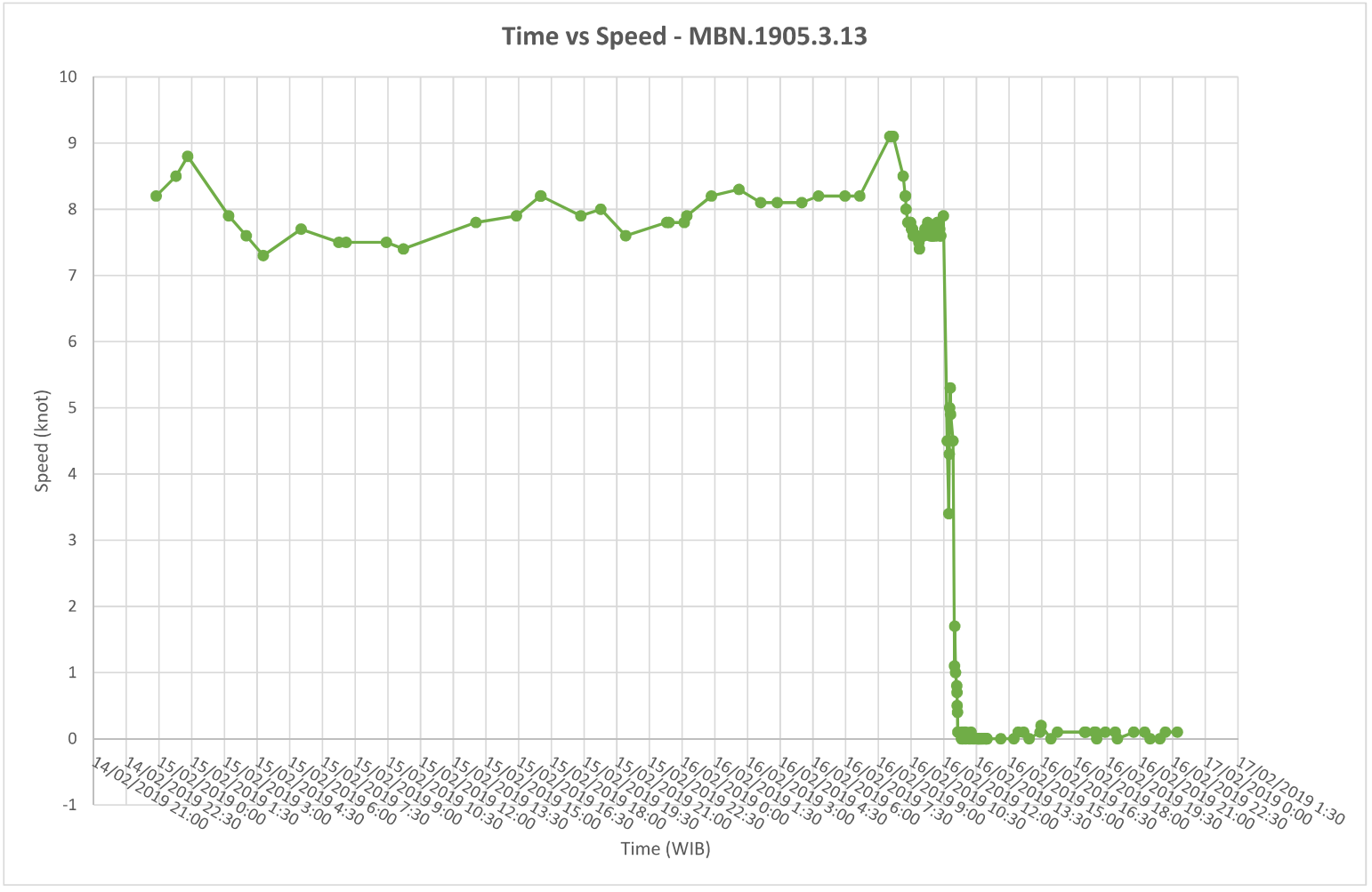

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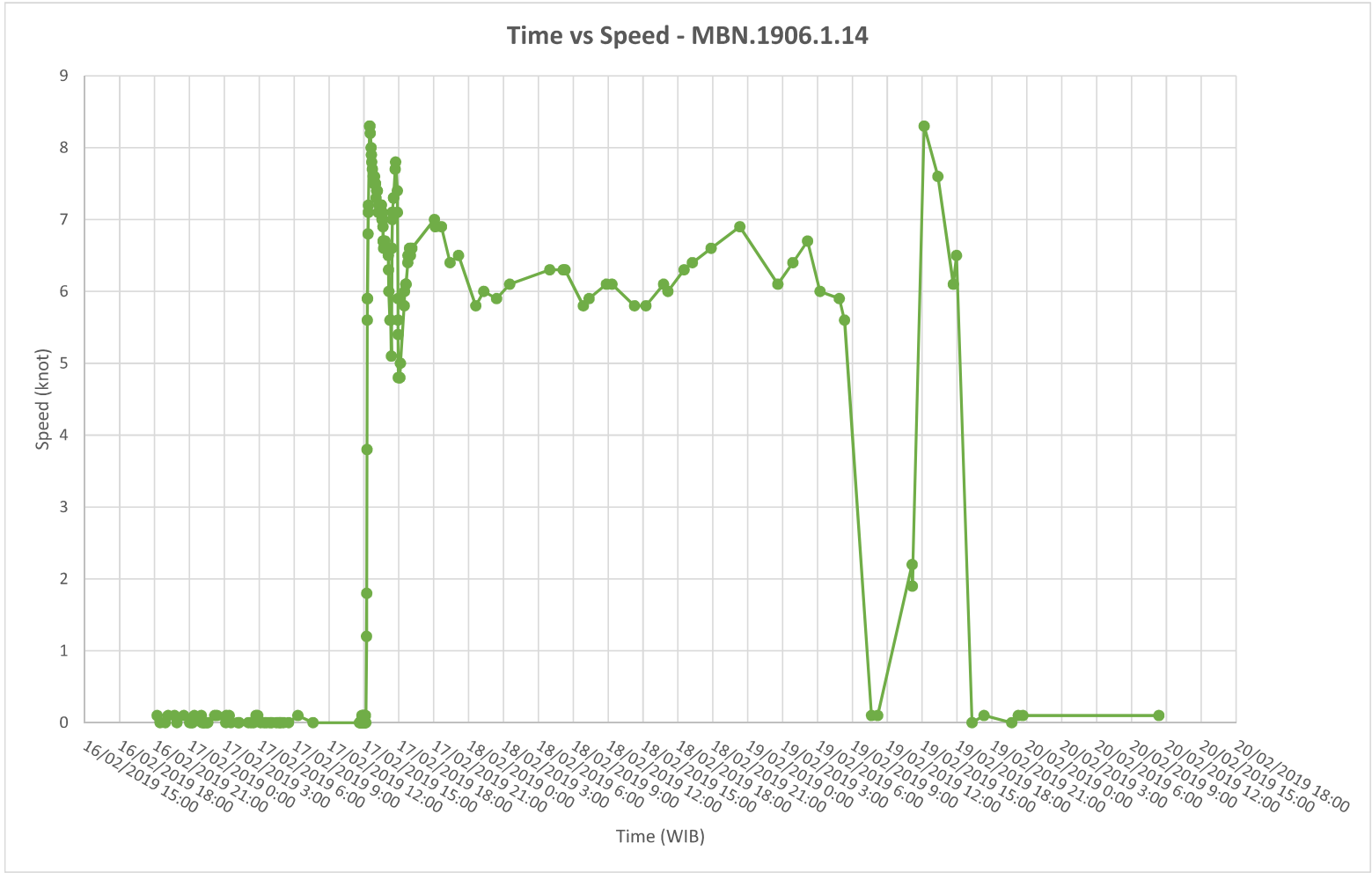

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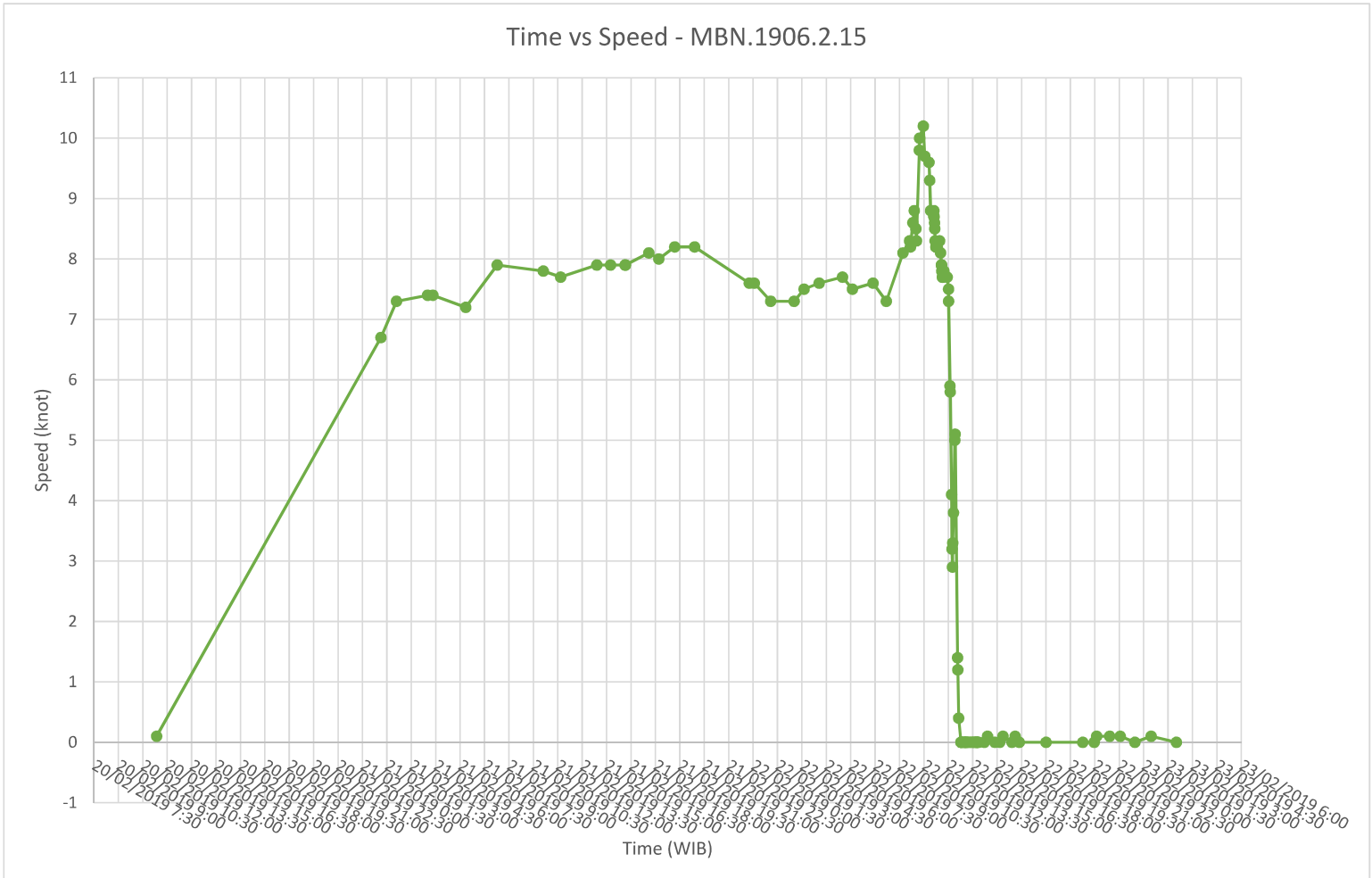

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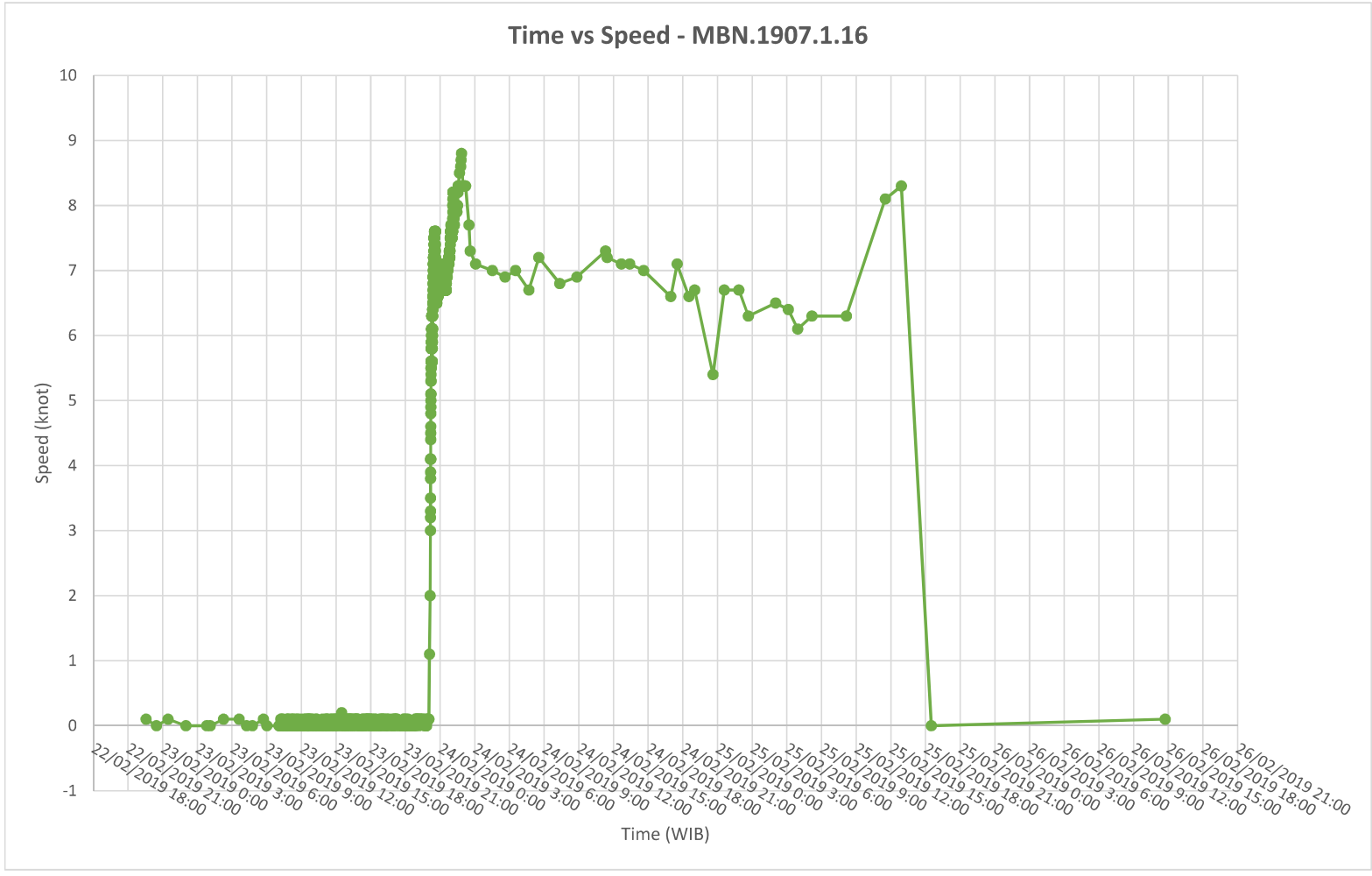

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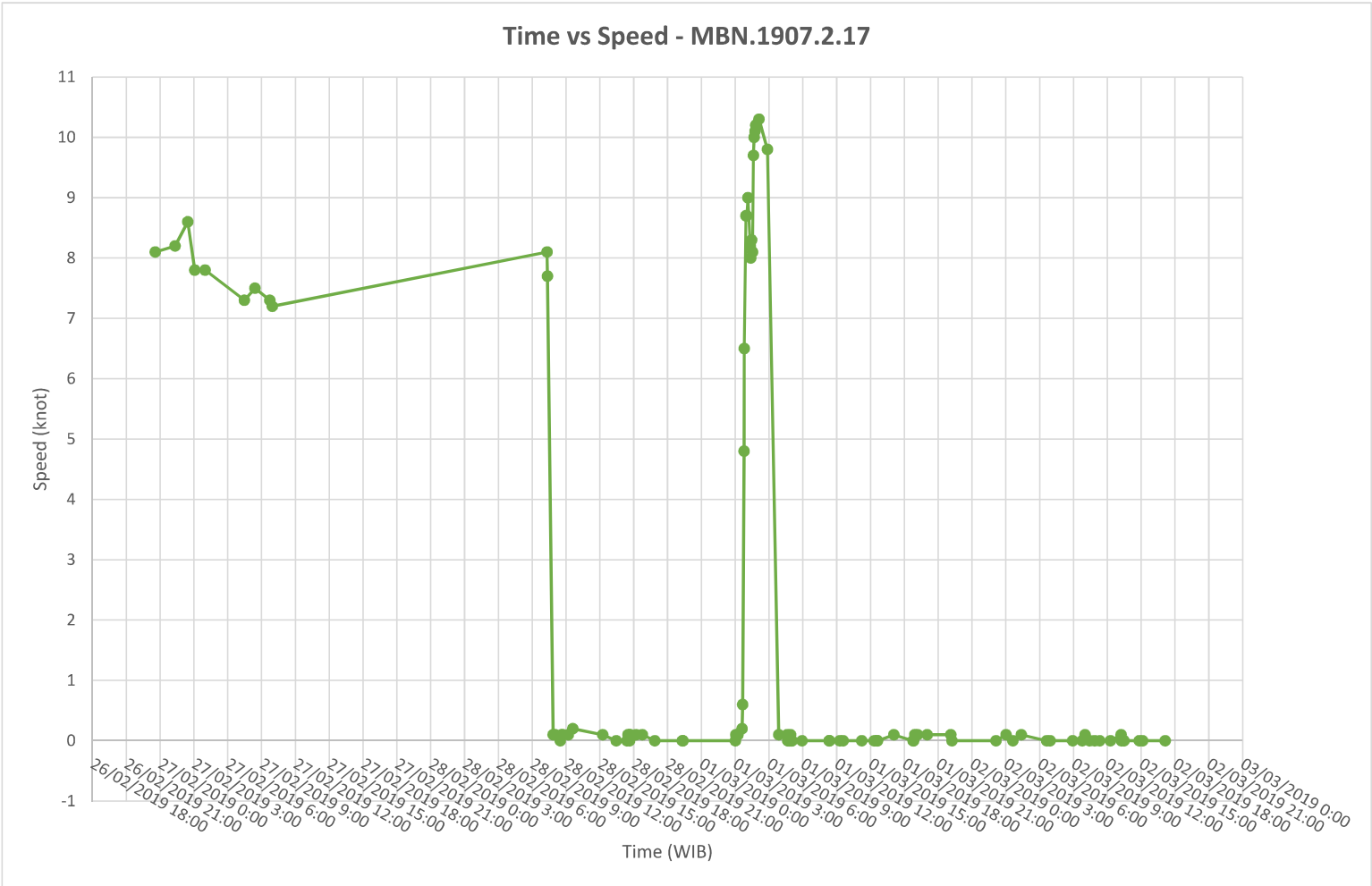

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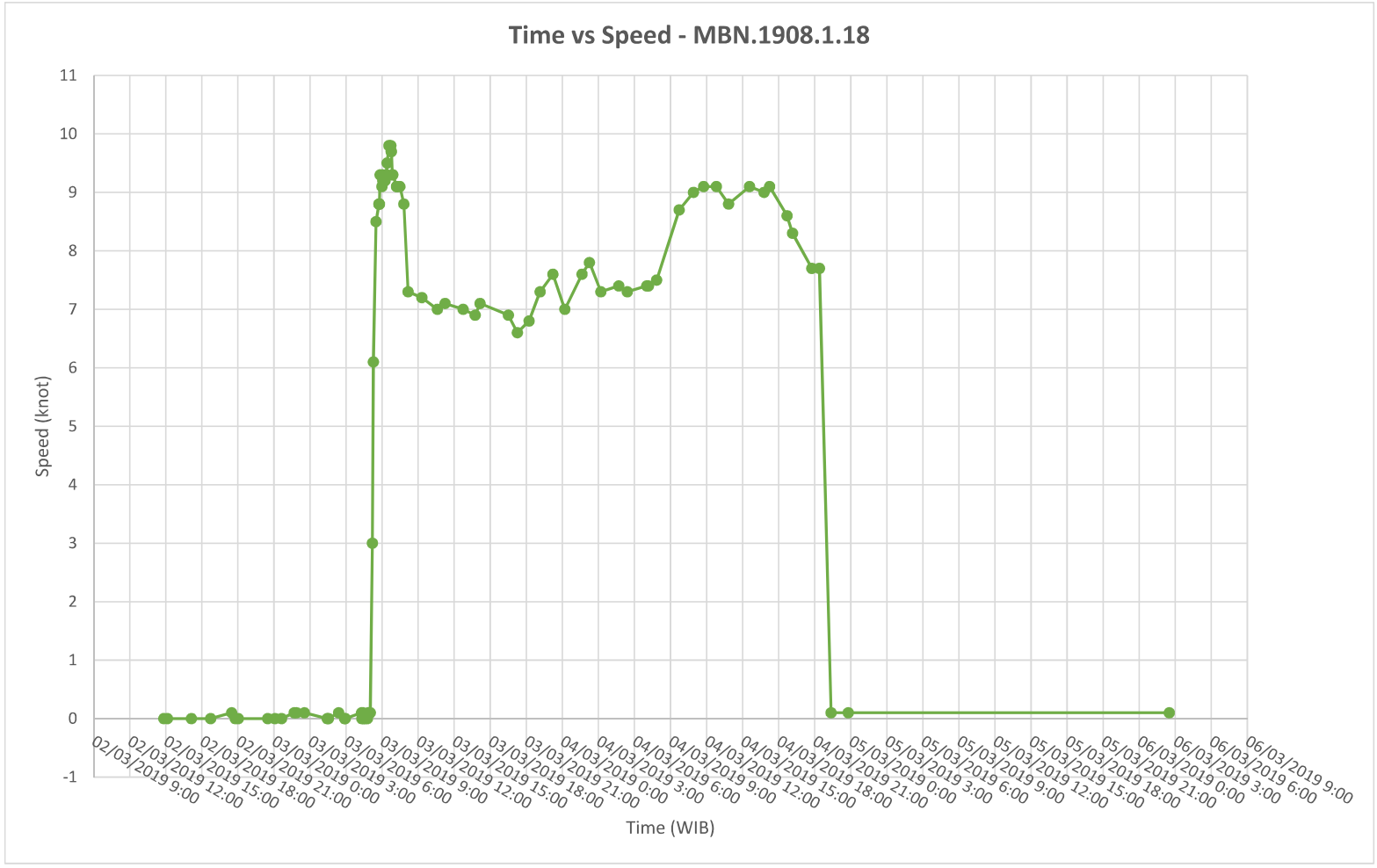

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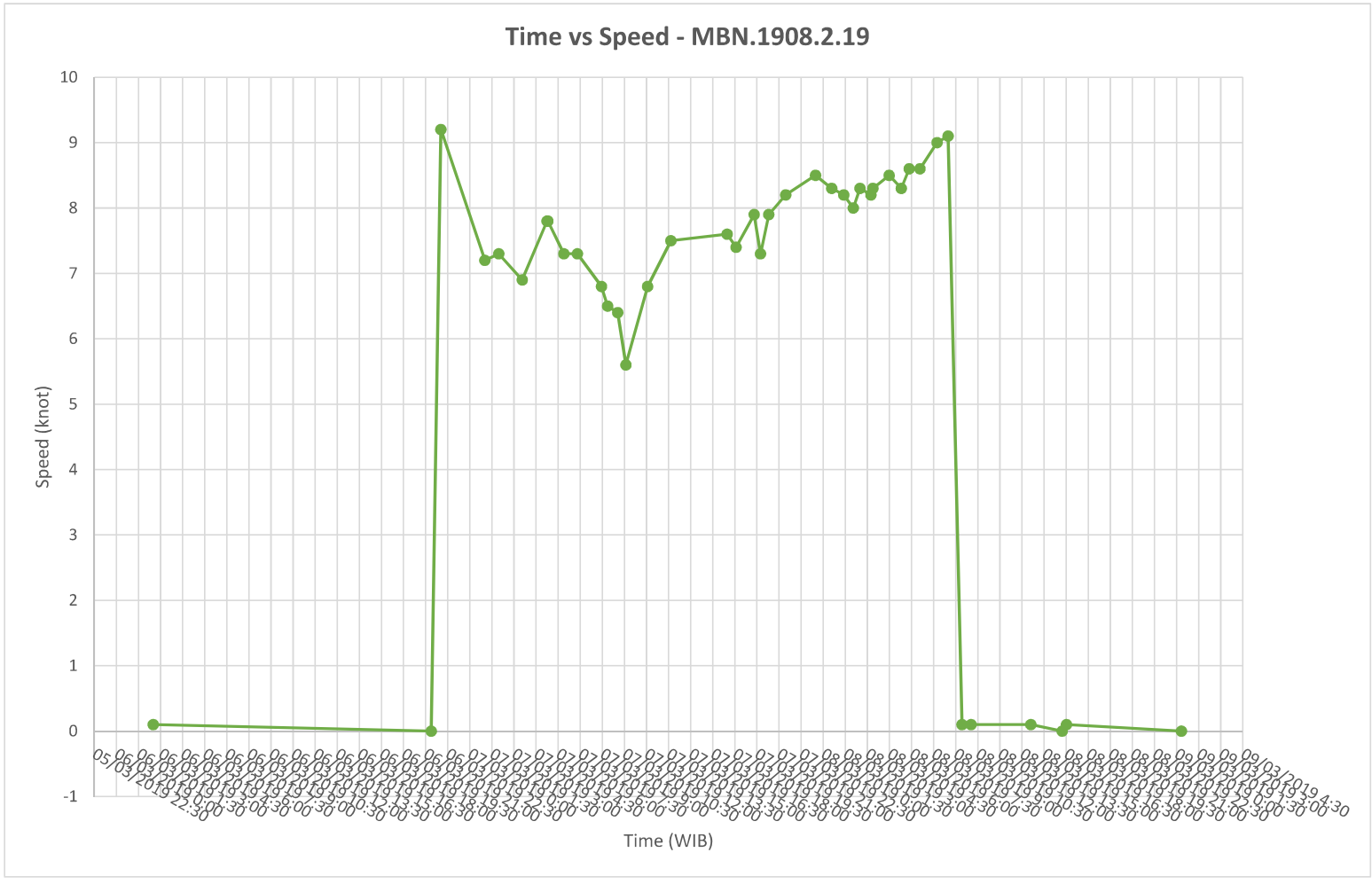

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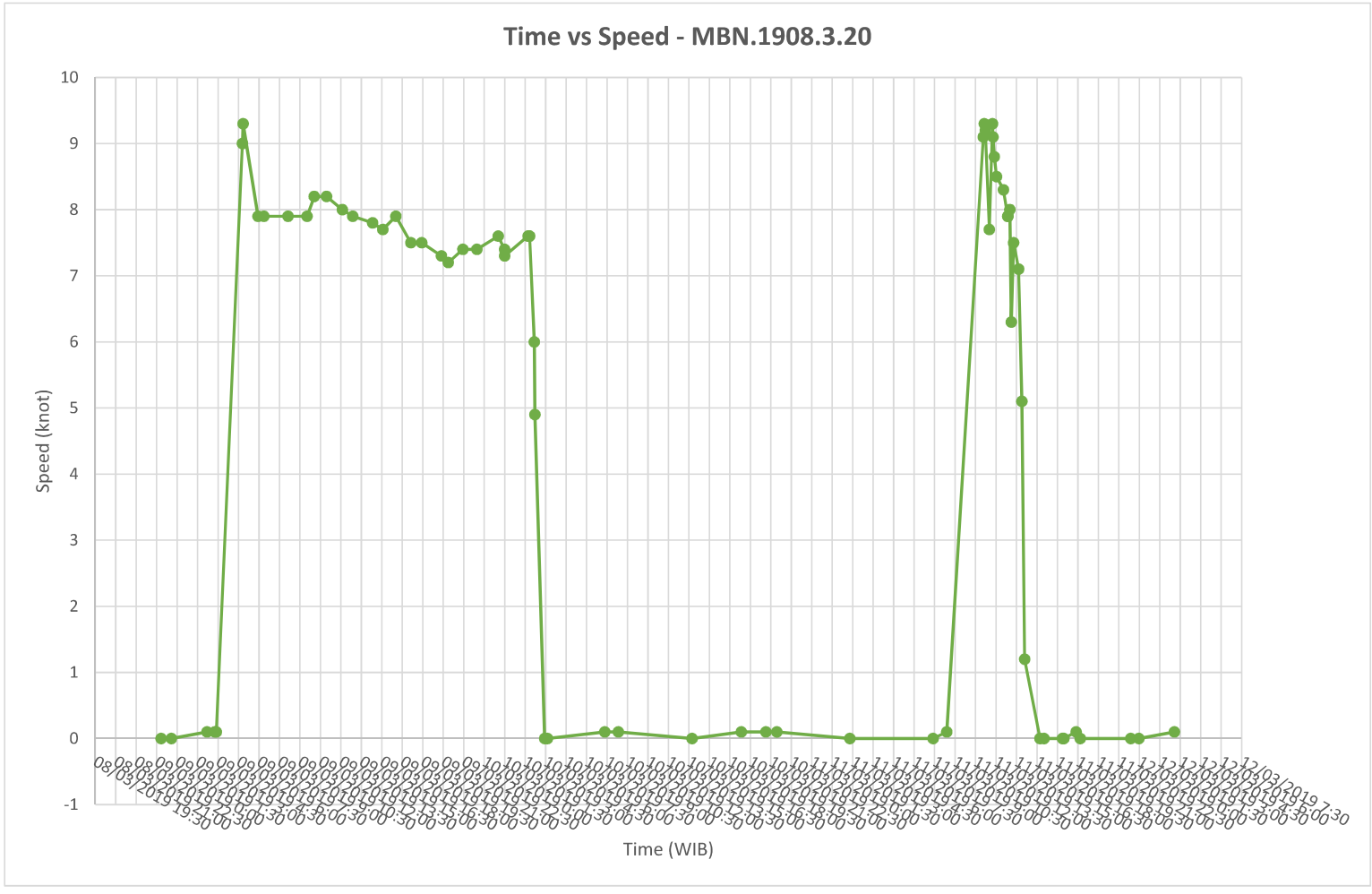

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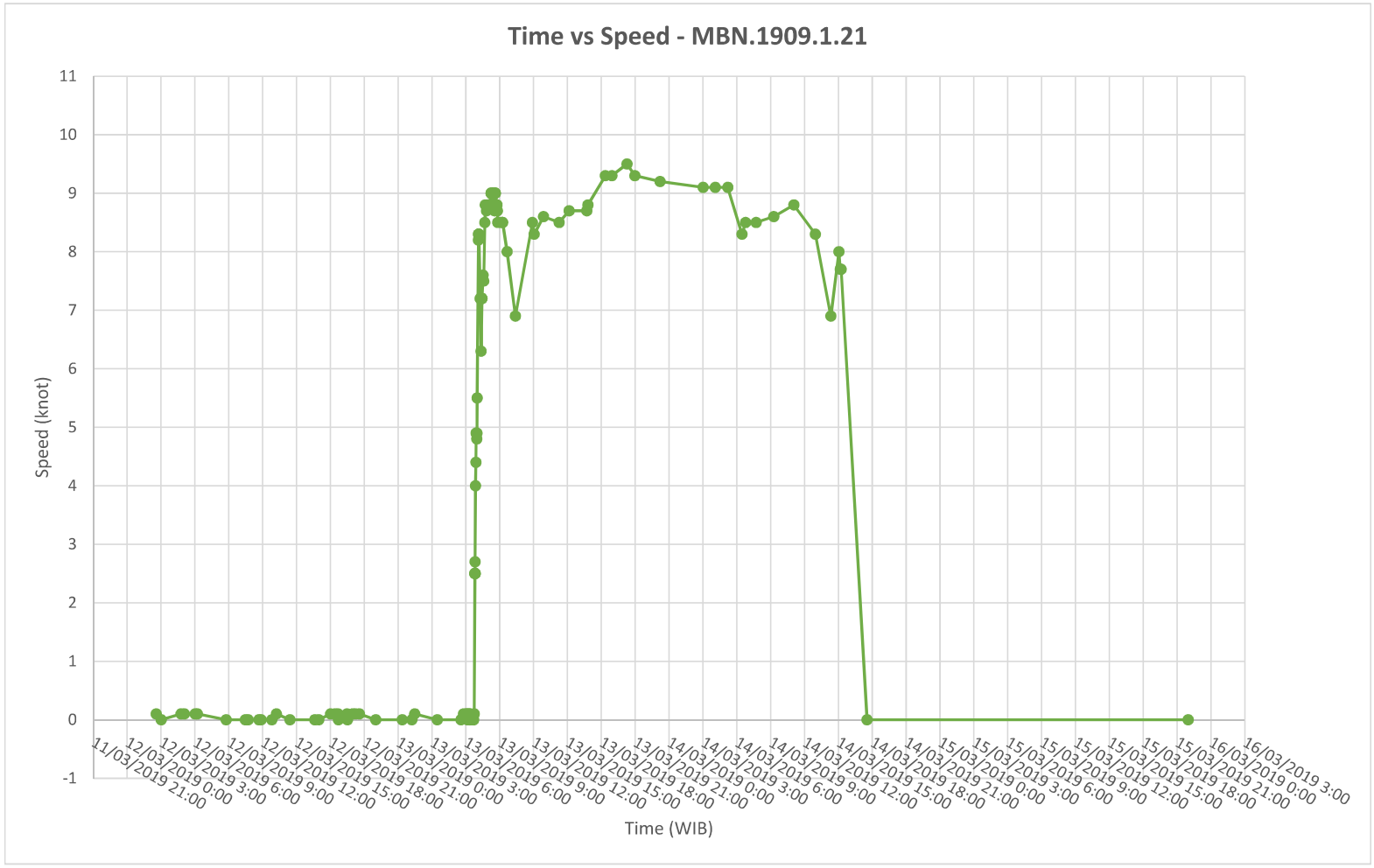

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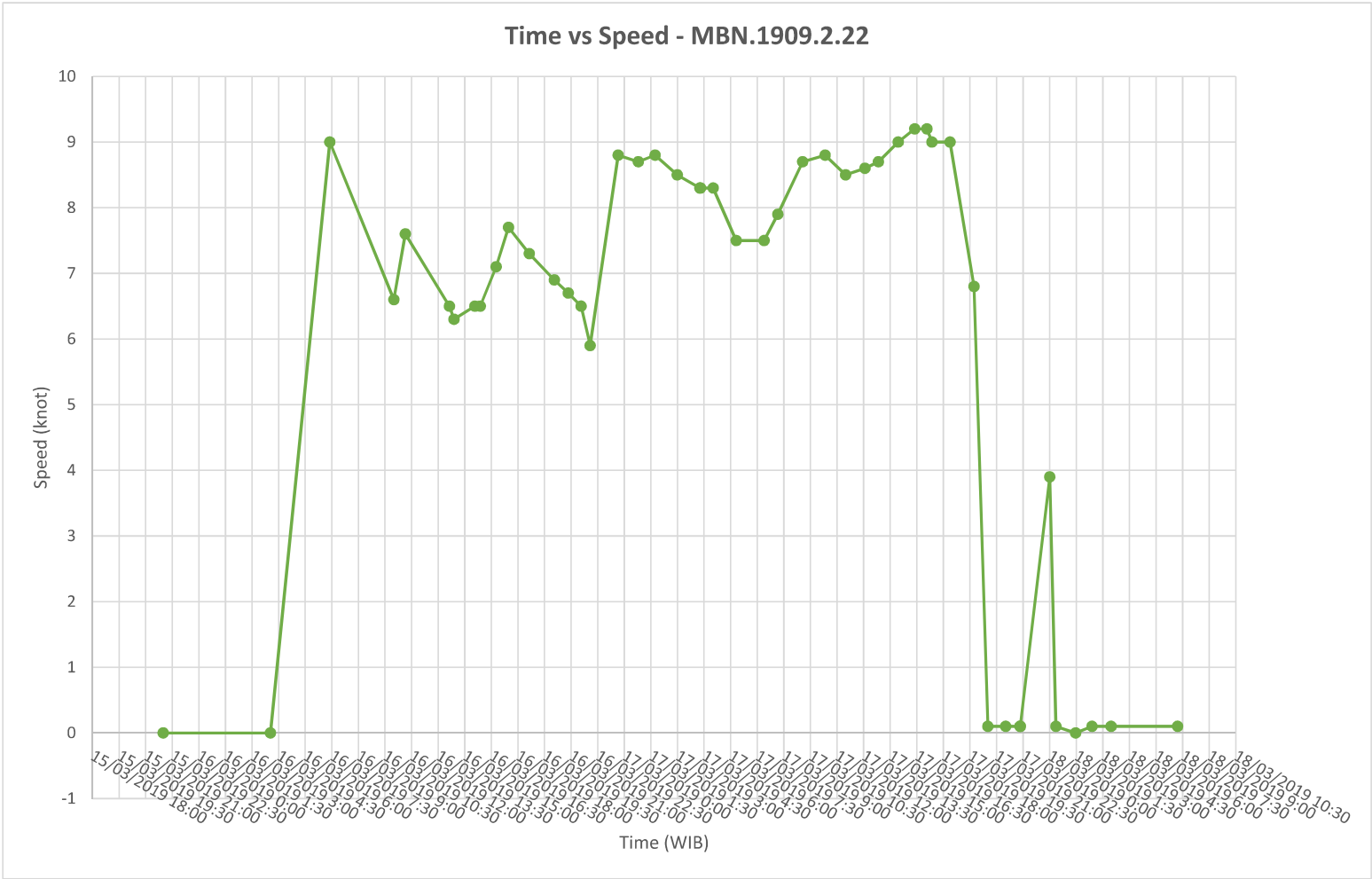

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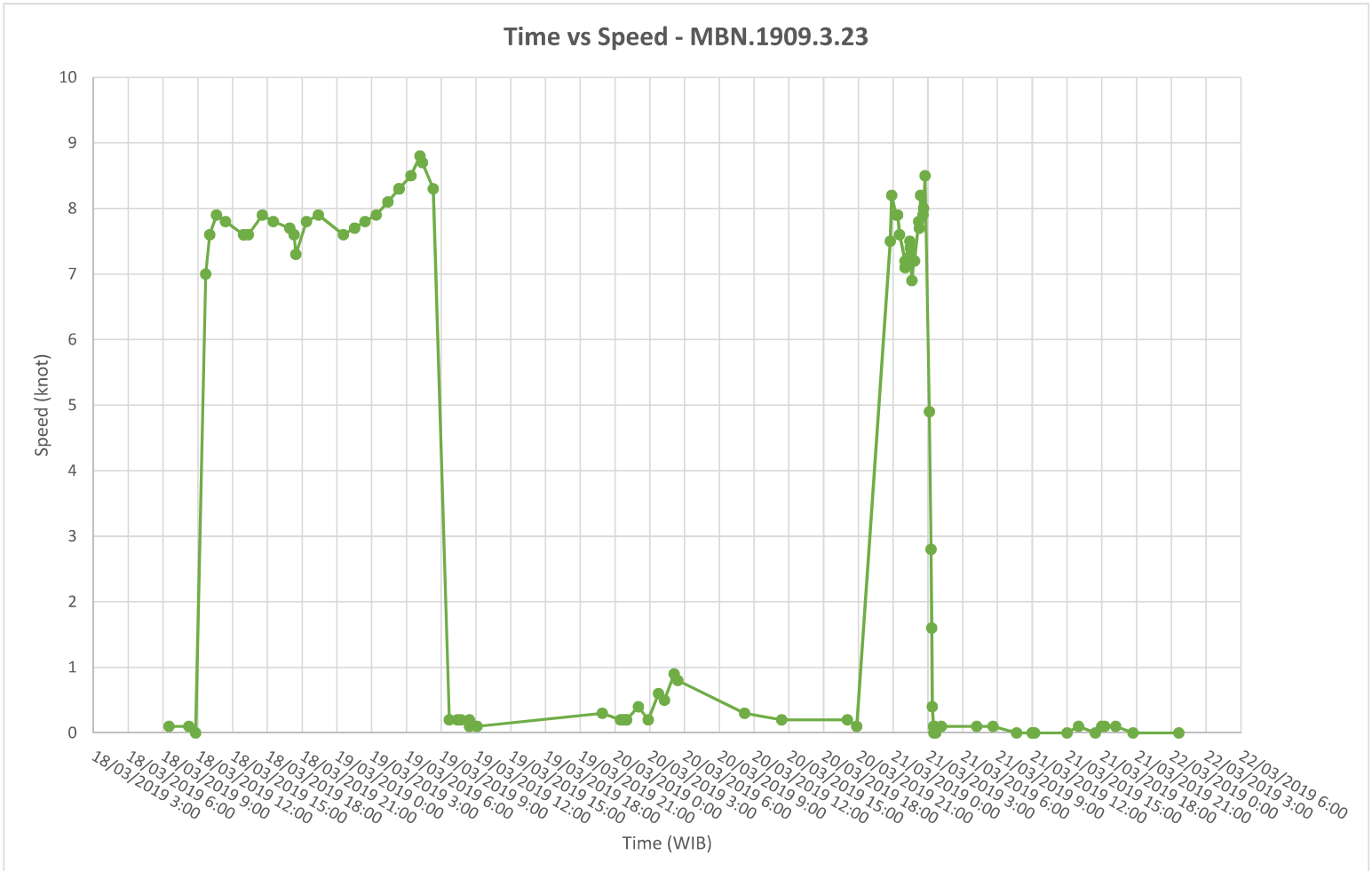

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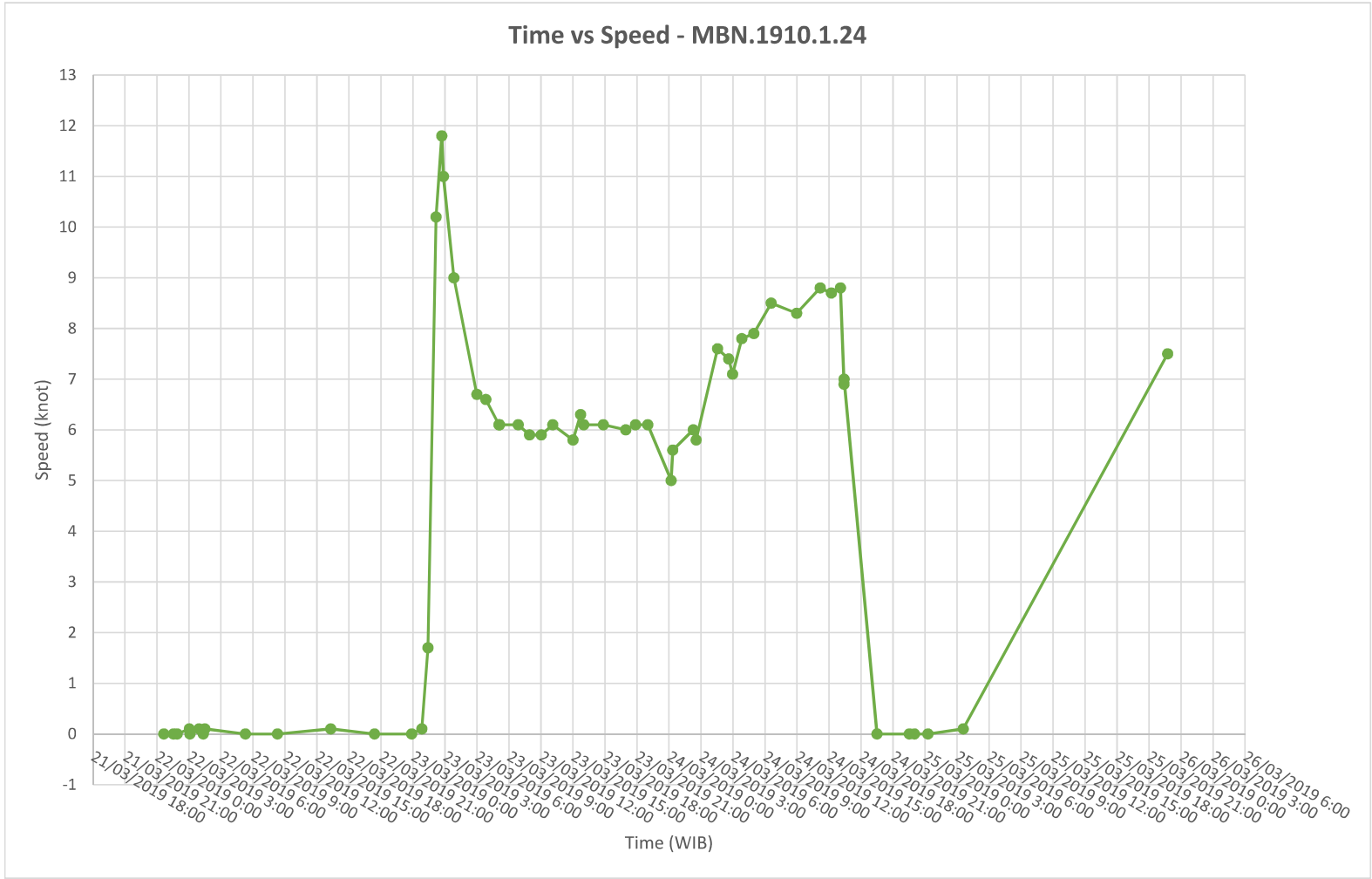

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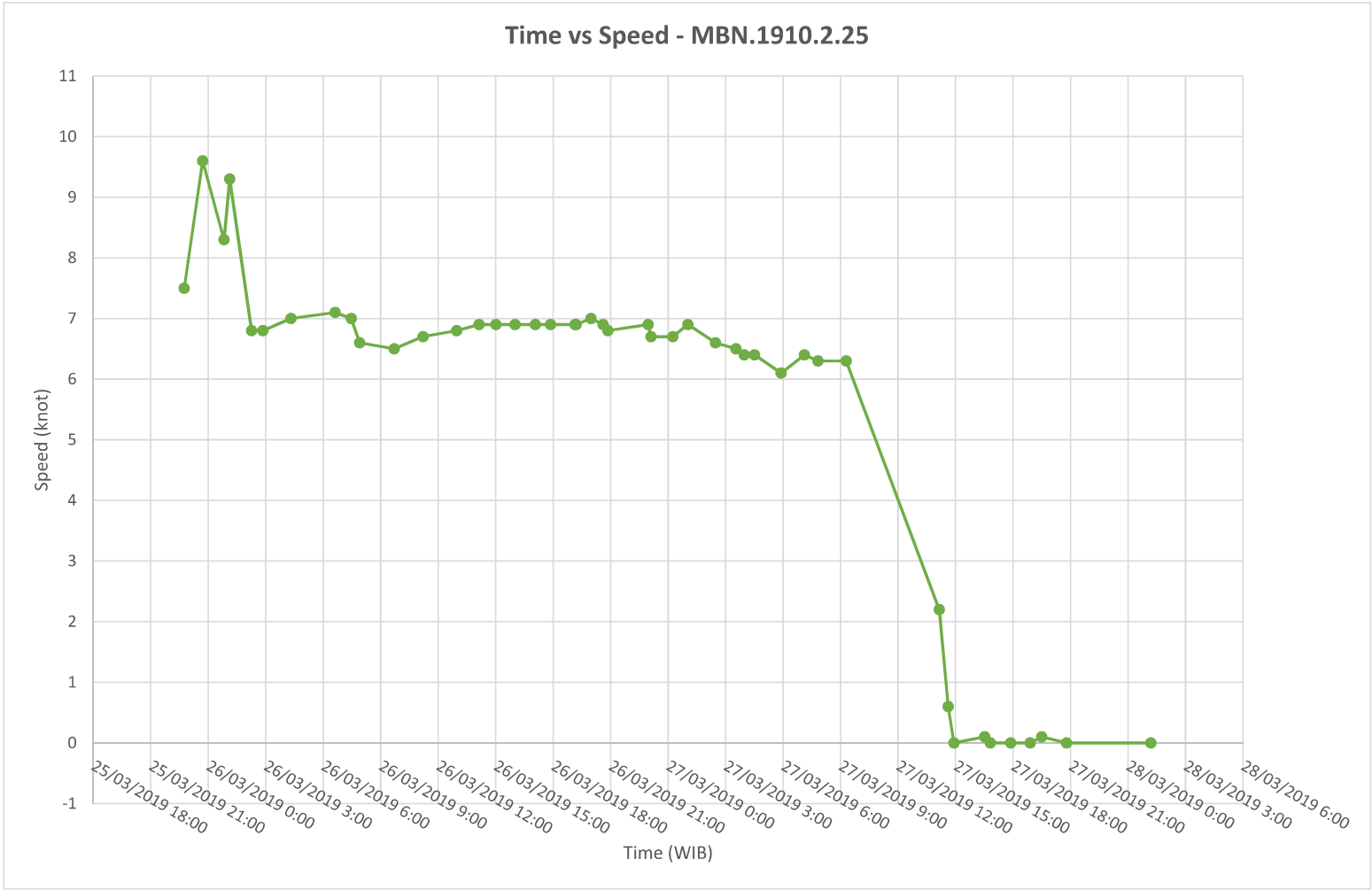

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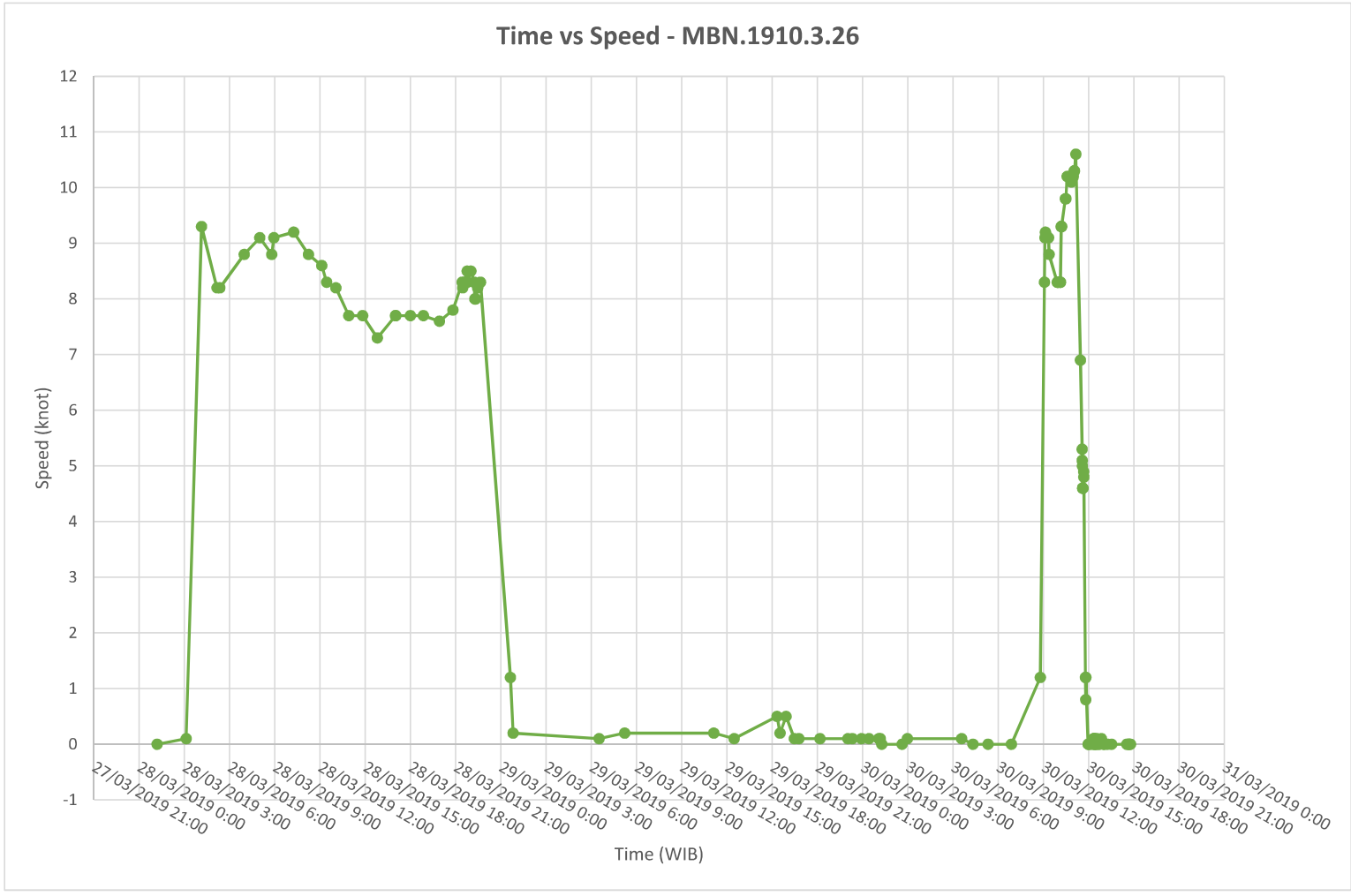


APPENDIX 4

SHIP FUEL OIL CONSUMPTION ESTIMATION CALCULATION

Trozzi Method Calculation
Ship's Operational Work

MV MERATUS BONTANG

Trip Numbe	Window		Port		Hotelling		Maneuvering		Cruising		Anchoring		Maneuvering		Hotelling	
	Depart	Arrive	Depart	Arrive	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End
MBT-1	09/01/2019 22:30	13/01/2019 23:48	Semarang	Pontianak	09/01/2019 22:30	10/01/2019 3:00	10/01/2019 3:00	10/01/2019 9:13	10/01/2019 9:13	12/01/2019 17:04	12/01/2019 17:04	13/01/2019 9:04	13/01/2019 9:04	13/01/2019 13:12	13/01/2019 13:12	13/01/2019 23:48
MBT-2	13/01/2019 21:54	18/01/2019 8:30	Pontianak	Semarang	13/01/2019 21:54	14/01/2019 2:06	14/01/2019 2:06	14/01/2019 17:14	14/01/2019 17:14	16/01/2019 18:13	-	-	16/01/2019 18:13	18/01/2019 4:24	18/01/2019 4:24	18/01/2019 8:30
MBT-3	18/01/2019 8:36	21/01/2019 20:24	Semarang	Pontianak	18/01/2019 8:36	18/01/2019 11:30	18/01/2019 11:30	18/01/2019 15:26	18/01/2019 15:26	21/01/2019 7:07	-	-	21/01/2019 7:07	21/01/2019 8:36	21/01/2019 8:36	21/01/2019 20:24
MBT-4	21/01/2019 16:00	26/01/2019 16:28	Pontianak	Semarang	21/01/2019 16:00	22/01/2019 4:01	22/01/2019 4:01	22/01/2019 13:11	22/01/2019 13:11	24/01/2019 10:45	24/01/2019 10:45	26/01/2019 7:03	26/01/2019 7:03	26/01/2019 8:30	26/01/2019 8:30	26/01/2019 16:28
MBT-5	26/01/2019 16:48	30/01/2019 1:00	Semarang	Pontianak	26/01/2019 16:48	26/01/2019 21:00	26/01/2019 21:00	26/01/2019 23:02	26/01/2019 23:02	29/01/2019 4:14	-	-	29/01/2019 4:14	29/01/2019 13:30	29/01/2019 13:30	30/01/2019 1:00
MBT-6	29/01/2019 20:48	02/02/2019 17:00	Pontianak	Surabaya	29/01/2019 20:48	30/01/2019 1:00	30/01/2019 1:00	30/01/2019 9:40	30/01/2019 9:40	01/02/2019 19:22	01/02/2019 19:22	02/02/2019 4:16	02/02/2019 4:16	02/02/2019 7:08	02/02/2019 7:08	02/02/2019 17:00
MBT-7	03/02/2019 18:18	06/02/2019 11:54	Surabaya	Sampit	03/02/2019 18:18	04/02/2019 7:24	04/02/2019 7:24	04/02/2019 7:44	04/02/2019 7:44	05/02/2019 20:21	-	-	05/02/2019 20:21	06/02/2019 0:54	06/02/2019 0:54	06/02/2019 11:54
MBT-8	06/02/2019 13:24	09/02/2019 1:00	Sampit	Surabaya	06/02/2019 13:24	06/02/2019 21:36	06/02/2019 21:36	07/02/2019 0:00	07/02/2019 0:00	08/02/2019 3:44	08/02/2019 3:44	08/02/2019 16:01	08/02/2019 16:01	08/02/2019 19:47	08/02/2019 19:47	09/02/2019 1:00
MBT-9	09/02/2019 9:00	12/02/2019 17:12	Surabaya	Kumai	09/02/2019 9:00	10/02/2019 1:47	10/02/2019 1:47	10/02/2019 2:09	10/02/2019 2:09	11/02/2019 21:24	-	-	11/02/2019 21:24	11/02/2019 22:52	11/02/2019 22:52	12/02/2019 17:12
MBT-10	12/02/2019 17:36	15/02/2019 14:24	Kumai	Semarang	12/02/2019 17:36	13/02/2019 13:42	13/02/2019 13:42	13/02/2019 17:40	13/02/2019 17:40	15/02/2019 0:19	-	-	15/02/2019 0:19	15/02/2019 4:35	15/02/2019 4:35	15/02/2019 14:24
MBT-11	15/02/2019 9:36	17/02/2019 14:42	Semarang	Surabaya	15/02/2019 9:36	15/02/2019 15:50	15/02/2019 15:50	15/02/2019 17:22	15/02/2019 17:22	16/02/2019 12:33	16/02/2019 12:33	16/02/2019 20:58	16/02/2019 20:58	17/02/2019 0:33	17/02/2019 0:33	17/02/2019 14:42
MBT-12	17/02/2019 18:42	20/02/2019 3:54	Surabaya	Sampit	17/02/2019 18:42	18/02/2019 3:06	18/02/2019 3:06	18/02/2019 3:27	18/02/2019 3:27	19/02/2019 11:36	19/02/2019 11:36	19/02/2019 14:08	19/02/2019 14:08	19/02/2019 20:30	19/02/2019 20:30	20/02/2019 3:54
MBT-13	20/02/2019 4:00	22/02/2019 9:24	Sampit	Surabaya	20/02/2019 4:00	20/02/2019 19:24	20/02/2019 19:24	21/02/2019 0:36	21/02/2019 0:36	22/02/2019 3:26	-	-	22/02/2019 3:26	22/02/2019 4:11	22/02/2019 4:11	22/02/2019 9:24
MBT-14	22/02/2019 9:18	26/02/2019 0:12	Surabaya	Sampit	22/02/2019 9:18	22/02/2019 22:00	22/02/2019 22:00	23/02/2019 0:44	23/02/2019 0:44	24/02/2019 3:14	24/02/2019 3:14	24/02/2019 18:13	24/02/2019 18:13	24/02/2019 22:13	24/02/2019 22:13	26/02/2019 0:12
MBT-15	25/02/2019 20:24	28/02/2019 1:12	Sampit	Surabaya	25/02/2019 20:24	26/02/2019 9:12	26/02/2019 9:12	26/02/2019 12:39	26/02/2019 12:39	27/02/2019 17:28	-	-	27/02/2019 17:28	27/02/2019 18:05	27/02/2019 18:05	28/02/2019 1:12
MBT-16	28/02/2019 9:30	03/03/2019 16:42	Surabaya	Kumai	28/02/2019 9:30	01/03/2019 7:12	01/03/2019 7:12	01/03/2019 8:28	01/03/2019 8:28	03/03/2019 0:36	-	-	03/03/2019 0:36	03/03/2019 8:00	03/03/2019 8:00	03/03/2019 16:42
MBT-17	03/03/2019 16:48	06/03/2019 13:12	Kumai	Surabaya	03/03/2019 16:48	04/03/2019 7:06	04/03/2019 7:06	04/03/2019 14:07	04/03/2019 14:07	05/03/2019 19:24	05/03/2019 19:24	05/03/2019 22:16	05/03/2019 22:16	06/03/2019 4:35	06/03/2019 4:35	06/03/2019 13:12
MBT-18	06/03/2019 13:24	08/03/2019 7:18	Surabaya	Semarang	06/03/2019 13:24	07/03/2019 1:36	07/03/2019 1:36	07/03/2019 6:52	07/03/2019 6:52	08/03/2019 2:48	-	-	08/03/2019 2:48	08/03/2019 5:44	08/03/2019 5:44	08/03/2019 7:18
MBT-19	08/03/2019 7:24	10/03/2019 11:24	Semarang	Kumai	08/03/2019 7:24	08/03/2019 13:30	08/03/2019 13:30	08/03/2019 14:46	08/03/2019 14:46	09/03/2019 18:48	-	-	09/03/2019 18:48	10/03/2019 1:11	10/03/2019 1:11	10/03/2019 11:24
MBT-20	10/03/2019 11:30	14/03/2019 7:18	Kumai	Surabaya	10/03/2019 11:30	10/03/2019 23:24	10/03/2019 23:24	11/03/2019 4:41	11/03/2019 4:41	12/03/2019 4:43	12/03/2019 4:43	13/03/2019 20:38	13/03/2019 20:38	13/03/2019 23:50	13/03/2019 23:50	14/03/2019 7:18
MBT-21	15/03/2019 2:00	17/03/2019 9:18	Surabaya	Semarang	15/03/2019 2:00	16/03/2019 9:12	16/03/2019 9:12	16/03/2019 9:22	16/03/2019 9:22	17/03/2019 5:04	-	-	17/03/2019 5:04	17/03/2019 6:17	17/03/2019 6:17	17/03/2019 9:18
MBT-22	17/03/2019 9:24	19/03/2019 19:54	Semarang	Kumai	17/03/2019 9:24	17/03/2019 12:10	17/03/2019 12:10	17/03/2019 12:56	17/03/2019 12:56	18/03/2019 19:13	-	-	18/03/2019 19:13	18/03/2019 23:55	18/03/2019 23:55	19/03/2019 19:54
MBT-23	19/03/2019 20:06	23/03/2019 3:12	Kumai	Surabaya	19/03/2019 20:06	20/03/2019 13:10	20/03/2019 13:10	20/03/2019 15:11	20/03/2019 15:11	21/03/2019 21:12	21/03/2019 21:12	22/03/2019 15:08	22/03/2019 15:08	22/03/2019 21:54	22/03/2019 21:54	23/03/2019 3:12

MV MERATUS BENOA

Trip Numbe	Window		Port		Hotelling		Maneuvering		Cruising		Anchoring		Maneuvering		Hotelling	
	Depart	Arrive	Depart	Arrive	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End
MBN-1	06/01/2019 20:18	11/01/2019 9:48	Surabaya	Kumai	06/01/2019 20:18	06/01/2019 17:35	06/01/2019 17:35	08/01/2019 17:51	08/01/2019 17:51	10/01/2019 3:21	10/01/2019 3:21	10/01/2019 18:16	10/01/2019 18:16	11/01/2019 9:17	11/01/2019 9:17	11/01/2019 9:48
MBN-2	11/01/2019 9:36	14/01/2019 2:30	Kumai	Semarang	11/01/2019 9:36	12/01/2019 9:45	12/01/2019 9:45	12/01/2019 15:11	12/01/2019 15:11	13/01/2019 17:30	-	-	13/01/2019 17:30	13/01/2019 22:38	13/01/2019 22:38	14/01/2019 2:30
MBN-3	14/01/2019 2:12	16/01/2019 12:00	Semarang	Surabaya	14/01/2019 2:12	14/01/2019 6:16	14/01/2019 6:16	14/01/2019 9:34	14/01/2019 9:34	15/01/2019 0:32	15/01/2019 0:32	15/01/2019 4:51	15/01/2019 4:51	15/01/2019 9:54	15/01/2019 9:54	16/01/2019 12:00
MBN-4	16/01/2019 16:54	21/01/2019 8:48	Surabaya	Samarinda	16/01/2019 16:54	17/01/2019 4:24	17/01/2019 4:24	17/01/2019 5:41	17/01/2019 5:41	19/01/2019 21:07	19/01/2019 21:07	20/01/2019 6:00	20/01/2019 6:00	21/01/2019 3:00	21/01/2019 3:00	21/01/2019 8:48
MBN-5	21/01/2019 8:54	25/01/2019 20:06	Samarinda	Surabaya	21/01/2019 8:54	22/01/2019 6:00	22/01/2019 6:00	22/01/2019 12:53	22/01/2019 12:53	25/01/2019 3:09	25/01/2019 3:09	25/01/2019 10:26	25/01/2019 10:26	25/01/2019 13:13	25/01/2019 13:13	25/01/2019 20:06
MBN-6	26/01/2019 14:00	30/01/2019 5:24	Surabaya	Kumai	26/01/2019 14:00	27/01/2019 11:00	27/01/2019 11:00	27/01/2019 11:35	27/01/2019 11:35	29/01/2019 15:29	-	-	29/01/2019 15:29	29/01/2019 17:15	29/01/2019 17:15	30/01/2019 5:24
MBN-7	30/01/2019 3:00	02/02/2019 10:12	Kumai	Semarang	30/01/2019 3:00	31/01/2019 11:10	31/01/2019 11:10	31/01/2019 14:51	31/01/2019 14:51	02/02/2019 2:31	-	-	02/02/2019 2:31	02/02/2019 3:19	02/02/2019 3:19	02/02/2019 10:12
MBN-8	02/02/2019 10:18	04/02/2019 2:30	Semarang	Surabaya	02/02/2019 10:18	02/02/2019 13:37	02/02/2019 13:37	02/02/2019 18:38	02/02/2019 18:38	03/02/2019 14:55	-	-	03/02/2019 14:55	03/02/2019 15:44	03/02/2019 15:44	04/02/2019 2:30
MBN-9	04/02/2019 10:42	07/02/2019 8:48	Surabaya	Sampit	04/02/2019 10:42	05/02/2019 5:49	05/02/2019 5:49	05/02/2019 6:30	05/02/2019 6:30	06/02/2019 12:39	06/02/2019 12:39	06/02/2019 14:31	06/02/2019 14:31	06/02/2019 19:52	06/02/2019 19:52	07/02/2019 8:48
MBN-10	07/02/2019 9:00	09/02/2019 20:00	Sampit	Surabaya	07/02/2019 9:00	07/02/2019 15:40	07/02/2019 15:40	07/02/2019 19:48	07/02/2019 19:48	09/02/2019 0:47	09/02/2019 0:47	09/02/2019 7:00	09/02/2019 7:00	09/02/2019 13:49	09/02/2019 13:49	09/02/2019 20:00
MBN-11	10/02/2019 9:00	12/02/2019 5:18	Surabaya	Semarang	10/02/2019 9:00	11/02/2019 1:13	11/02/2019 1:13	11/02/2019 1:25	11/02/2019 1:25	12/02/2019 1:36	-	-	12/02/2019 1:36	12/02/2019 4:42	12/02/2019 4:42	12/02/2019 5:18
MBN-12	12/02/2019 5:24	14/02/2019 4:42	Semarang	Kumai	12/02/2019 5:24	12/02/2019 8:54	12/02/2019 8:54	12/02/2019 11:14	12/02/2019 11:14	13/02/2019 17:47	-	-	13/02/2019 17:47	13/02/2019 18:33	13/02/2019 18:33	14/02/2019 4:42
MBN-13	14/02/2019 5:00	16/02/2019 22:42	Kumai	Surabaya	14/02/2019 5:00	14/02/2019 23:12	14/02/2019 23:12	14/02/2019 23:52	14/02/2019 23:52	16/02/2019 11:59	-	-	16/02/2019 11:59	16/02/2019 12:38	16/02/2019 12:38	16/02/2019 22:42
MBN-14	16/02/2019 21:00	20/02/2019 4:42	Surabaya	Kumai	16/02/2019 21:00	17/02/2019 15:11	17/02/2019 15:11	17/02/2019 15:28	17/02/2019 15:28	19/02/2019 8:19	19/02/2019 8:19	19/02/2019 11:10	19/02/2019 11:10	19/02/2019 19:17	19/02/2019 19:17	20/02/2019 4:42
MBN-15	20/02/2019 3:36	23/02/2019 1:48	Kumai	Surabaya	20/02/2019 3:36	20/02/2019 23:08	20/02/2019 23:08	21/02/2019 2:05	21/02/2019 2:05	22/02/2019 12:00	-	-	22/02/2019 12:00	22/02/2019 12:46	22/02/2019 12:46	23/02/2019 1:48
MBN-16	22/02/2019 22:18	26/02/2019 9:12	Surabaya	Kumai	22/02/2019 22:18	23/02/2019 23:03	23/02/2019 23:03	23/02/2019 23:28	23/02/2019 23:28	25/02/2019 15:54	-	-	25/02/2019 15:54	25/02/2019 18:29	25/02/2019 18:29	26/02/2019 9:12
MBN-17	26/02/2019 2:00	02/03/2019 17:00	Kumai	Surabaya	26/02/2019 2:00	26/02/2019 22:55	26/02/2019 22:55	26/02/2019 23:34	26/02/2019 23:34	28/02/2019 10:19	28/02/2019 10:19	01/03/2019 3:14	01/03/2019 3:14	01/03/2019 6:51	01/03/2019 6:51	02/03/2019 17:00
MBN-18	02/03/2019 14:06	06/03/2019 2:42	Surabaya	Kumai	02/03/2019 14:06	03/03/2019 8:07	03/03/2019 8:07	03/03/2019 8:50	03/03/2019 8:50	04/03/2019 21:23	-	-	04/03/2019 21:23	04/03/2019 22:21	04/03/2019 22:21	06/03/2019 2:42
MBN-19	05/03/2019 20:00	08/03/2019 23:30	Kumai	Semarang	05/03/2019 20:00	06/03/2019 21:32	06/03/2019 21:32	07/03/2019 1:58	07/03/2019 1:58	08/03/2019 7:44	-	-	08/03/2019 7:44	08/03/2019 9:25	08/03/2019 9:25	08/03/2019 23:30
MBN-20	08/03/2019 23:48	12/03/2019 1:36	Semarang	Surabaya	08/03/2019 23:48	09/03/2019 5:54	09/03/2019 5:54	09/03/2019 7:25	09/03/2019 7:25	10/03/2019 3:19	10/03/2019 3:19	11/03/2019 9:53	11/03/2019 9:53	11/03/2019 16:43	11/03/2019 16:43	12/03/2019 1:36
MBN-21	12/03/2019 1:42	15/03/2019 9:30	Surabaya	Kumai	12/03/2019 1:42	13/03/2019 6:44	13/03/2019 6:44	13/03/2019 7:43	13/03/2019 7:43	14/03/2019 15:14	-	-	14/03/2019 15:14	14/03/2019 17:32	14/03/2019 17:32	15/03/2019 9:30
MBN-22	15/03/2019 9:48	18/03/2019 7:48	Kumai	Semarang	15/03/2019 9:48	16/03/2019 6:54	16/03/2019 6:54	16/03/2019 11:38	16/03/2019 11:38	17/03/2019 19:43	17/03/2019 19:43	17/03/2019 22:20	17/03/2019 22:20	18/03/2019 0:21	18/03/2019 0:21	18/03/2019 7:48
MBN-23	18/03/2019 8:30	21/03/2019 22:00	Semarang	Surabaya	18/03/2019 8:30	18/03/2019 12:00	18/03/2019 12:00	18/03/2019 13:36	18/03/2019 13:36	19/03/2019 8:18	19/03/2019 8:18	20/03/2019 20:51	20/03/2019 20:51	21/03/2019 3:28	21/03/2019 3:28	21/03/2019 22:00
MBN-24	21/03/2019 21:00	25/03/2019 4:06	Surabaya	Kumai	21/03/2019 21:00	23/03/2019 1:19	23/03/2019 1:19	23/03/2019 3:50	23/03/2019 3:50	24/03/2019 16:04	-	-	24/03/2019 16:04	24/03/2019 19:29	24/03/2019 19:29	25/03/2019 4:06
MBN-25	25/03/2019 4:00	27/03/2019 23:30	Kumai	Semarang	25/03/2019 4:00	25/03/2019 22:20	25/03/2019 22:20	26/03/2019 2:15	26/03/2019 2:15	27/03/2019 9:17	-	-	27/03/2019 9:17	27/03/2019 14:55	27/03/2019 14:55	27/03/2019 23:30
MBN-26	28/03/2019 0:24	30/03/2019 17:48	Semarang	Surabaya	28/03/2019 0:24	28/03/2019 3:49	28/03/2019 3:49	28/03/2019 5:10	28/03/2019 5:10	28/03/2019 22:39	28/03/2019 22:39	30/03/2019 9:52	30/03/2019 9:52	30/03/2019 14:58	30/03/2019 14:58	30/03/2019 17:48

Trozzi Method Calculation
MV Meratus Bontang

Ship Name : MV Meratus Bontang
Ship Type : Container Ship
Gross Tonnage : 3668 GT

Trip Number	Window		Port		Time	Time Mode (hour)			P_{mtotal}	S_{jkm}					Measured	Error-S_{jkm}				
	Depart	Arrive	Depart	Arrive	(hour)	Cruising	Maneuvering	Hotelling		CC	GC/IC	P/R/C	OS	AS	FOC (Ton)	CC	GC/IC	P/R/C	OS	AS
MBT-1	09/01/2019 22:30	13/01/2019 23:48	Semarang	Pontianak	97,3	55,85	-	-	1,86167	24,6401	25,3042	24,3631	33,5993	37,1049	11,8603	107,75%	113,35%	105,42%	183,29%	212,85%
MBT-2	13/01/2019 21:54	18/01/2019 8:30	Pontianak	Semarang	106,6	48,98333333	-	-	1,63278	21,6106	22,1931	21,3677	29,4683	32,5429	10,3123	109,56%	115,21%	107,21%	185,76%	215,57%
MBT-3	18/01/2019 8:36	21/01/2019 20:24	Semarang	Pontianak	83,8	63,68333333	-	-	2,12278	28,0960	28,8532	27,7802	38,3118	42,3091	12,5738	123,45%	129,47%	120,94%	204,70%	236,49%
MBT-4	21/01/2019 16:00	26/01/2019 16:28	Pontianak	Semarang	120,5	45,56666667	-	-	1,51889	20,1033	20,6451	19,8773	27,4128	30,2730	9,8109	104,91%	110,43%	102,60%	179,41%	208,56%
MBT-5	26/01/2019 16:48	30/01/2019 1:00	Semarang	Pontianak	80,2	53,2	-	-	1,77333	23,4710	24,1035	23,2072	32,0050	35,3443	17,8023	31,84%	35,40%	30,36%	79,78%	98,54%
MBT-6	29/01/2019 20:48	02/02/2019 17:00	Pontianak	Surabaya	92,2	57,7	-	-	1,92333	25,4563	26,1424	25,1702	34,7122	38,3340	11,5987	119,48%	125,39%	117,01%	199,28%	230,50%
MBT-7	03/02/2019 18:18	06/02/2019 11:54	Surabaya	Sampit	65,6	36,61666667	-	-	1,22056	16,1547	16,5901	15,9731	22,0285	24,3269	6,1046	164,63%	171,76%	161,66%	260,85%	298,50%
MBT-8	06/02/2019 13:24	09/02/2019 1:00	Sampit	Surabaya	59,6	27,73333333	-	-	0,92444	12,2355	12,5652	12,0980	16,6843	18,4251	5,3415	129,07%	135,24%	126,49%	212,35%	244,94%
MBT-9	09/02/2019 9:00	12/02/2019 17:12	Surabaya	Kumai	80,2	43,25	-	-	1,44167	19,0812	19,5954	18,8667	26,0191	28,7339	6,5842	189,80%	197,61%	186,55%	295,17%	336,41%
MBT-10	12/02/2019 17:36	15/02/2019 14:24	Kumai	Semarang	68,8	30,65	-	-	1,02167	13,5223	13,8867	13,3703	18,4390	20,3628	6,4534	109,54%	115,18%	107,18%	185,73%	215,54%
MBT-11	15/02/2019 9:36	17/02/2019 14:42	Semarang	Surabaya	53,1	19,18333333	-	-	0,63944	8,4634	8,6915	8,3682	11,5407	12,7448	3,3793	150,45%	157,20%	147,63%	241,51%	277,14%
MBT-12	17/02/2019 18:42	20/02/2019 3:54	Surabaya	Sampit	57,2	32,15	-	-	1,07167	14,1841	14,5663	14,0246	19,3414	21,3594	5,8865	140,96%	147,45%	138,25%	228,57%	262,85%
MBT-13	20/02/2019 4:00	22/02/2019 9:24	Sampit	Surabaya	53,4	26,83333333	-	-	0,89444	11,8384	12,1575	11,7054	16,1429	17,8272	5,1017	132,05%	138,30%	129,44%	216,42%	249,44%
MBT-14	22/02/2019 9:18	26/02/2019 0:12	Surabaya	Sampit	86,9	26,5	-	-	0,88333	11,6914	12,0065	11,5600	15,9424	17,6057	4,2078	177,85%	185,34%	174,73%	278,88%	318,41%
MBT-15	25/02/2019 20:24	28/02/2019 1:12	Sampit	Surabaya	52,8	28,81666667	-	-	0,96056	12,7134	13,0561	12,5705	17,3361	19,1448	5,2325	142,97%	149,52%	140,24%	231,32%	265,88%
MBT-16	28/02/2019 9:30	03/03/2019 16:42	Surabaya	Kumai	79,2	40,13333333	-	-	1,33778	17,7062	18,1834	17,5072	24,1441	26,6632	6,7586	161,98%	169,04%	159,03%	257,23%	294,51%
MBT-17	03/03/2019 16:48	06/03/2019 13:12	Kumai	Surabaya	68,4	29,28333333	-	-	0,97611	12,9193	13,2675	12,7741	17,6168	19,4549	5,3415	141,87%	148,39%	139,15%	229,81%	264,22%
MBT-18	06/03/2019 13:24	08/03/2019 7:18	Surabaya	Semarang	41,9	19,93333333	-	-	0,66444	8,7943	9,0313	8,6954	11,9919	13,2430	4,3822	100,68%	106,09%	98,43%	173,65%	202,20%
MBT-19	08/03/2019 7:24	10/03/2019 11:24	Semarang	Kumai	52	28,03333333	-	-	0,93444	12,3678	12,7012	12,2288	16,8648	18,6244	5,3197	132,49%	138,76%	129,88%	217,03%	250,10%
MBT-20	10/03/2019 11:30	14/03/2019 7:18	Kumai	Surabaya	91,8	24,03333333	-	-	0,80111	10,6031	10,8889	10,4839	14,4584	15,9669	5,0145	111,45%	117,15%	109,07%	188,33%	218,42%
MBT-21	15/03/2019 2:00	17/03/2019 9:18	Surabaya	Semarang	55,3	19,7	-	-	0,65667	8,6913	8,9256	8,5936	11,8515	13,0880	5,2325	66,10%	70,58%	64,24%	126,50%	150,13%
MBT-22	17/03/2019 9:24	19/03/2019 19:54	Semarang	Kumai	58,5	30,28333333	-	-	1,00944	13,3605	13,7206	13,2103	18,2184	20,1192	5,9519	124,47%	130,52%	121,95%	206,09%	238,03%
MBT-23	19/03/2019 20:06	23/03/2019 3:12	Kumai	Surabaya	79,1	30,01666667	-	-	1,00056	13,2429	13,5998	13,0940	18,0580	19,9421	5,9737	121,68%	127,66%	119,19%	202,29%	233,83%
				Total Hour =	818,1333333				**Average**	**15,69335**	**16,11629**	**15,51696**	**21,39946**	**23,63220**	**7,22715**	**125,87%**	**131,96%**	**123,33%**	**208,00%**	**240,13%**

Table 2 Fraction of maximum fuel consumption by different mode

Mode	Default	Specific		
Cruising	0,80			
Maneuvering	0,40			
Hotelling		passenger	tanker	other
	0,20	0,32	0,20	0,12
Tug		ship assistance	moderate act	under tow
	0,50	0,20	0,50	0,80

Formula :

$S_{jkm} = C_{jk} \times P_m$

$S_{jkm} = (C_{jk} \times P_{m1} \times t_1/24) + (C_{jk} \times P_{m2} \times t_2/24) + (C_{jk} \times P_{m3} \times t_3/24)$

$S_{jkm} = C_{jk} \times [(P_{m1} \times t_1/24 + P_{m2} \times t_2/24 + P_{m3} \times t_3/24)]$

$S_{jkm} = C_{jk} \times P_{mtotal}$

Cjk : $C = [0{,}0919] + [0{,}0038 \times GT] - [(6{,}1565 \times 10^{-8}) \times GT^2] + [(6{,}7917 \times 10^{-13}) \times GT^3]$ *(for Container Ship)*

$C = [-2{,}2602] + [0{,}0049 \times GT] - [(1{,}6401 \times 10^{-7}) \times GT2] + [(1{,}7394 \times 10^{-12}) \times GT^3]$ *(for General Cargo Ship and Inland Cargo Ship)*

$C = [6{,}3501] + [0{,}0012 \times GT] + [(1{,}6852 \times 10^{-7}) \times GT^2] - [(6{,}2691 \times 10^{-12}) \times GT^3] + [(5{,}699 \times 10^{-17}) \times GT^4]$ *(for Passenger/Ro-Ro/Cargo Ship)*

$C = [1{,}2744] + [0{,}0062 \times GT] - [(6{,}4603 \times 10^{-7}) \times GT^2] + [(5{,}5193 \times 10^{-11}) \times GT^3]$ *(for Other Ship)*

$C = [16{,}263] + [0{,}001 \times GT]$ *(for All Ship)*

Trozzi Method Calculation
MV Meratus Bontang

Ship Name : MV Meratus Benoa
Ship Type : Container Ship
Gross Tonnage : 3668 GT

Trip Number	Window		Port		Time	Time Mode (hour)			P_{mtotal}	S_{jkm}					Measured	Error-S_{jkm}				
	Depart	Arrive	Depart	Arrive	(hour)	Cruising	Maneuvering	Hotelling		CC	GC/IC	P/R/C	OS	AS	FOC (Ton)	CC	GC/IC	P/R/C	OS	AS
MBN-1	06/01/2019 20:18	11/01/2019 9:48	Surabaya	Kumai	109,5	33,5	-	-	1,11667	14,7797	15,1780	14,6135	20,1535	22,2563	6,8528	115,67%	121,49%	113,25%	194,09%	224,78%
MBN-2	11/01/2019 9:36	14/01/2019 2:30	Kumai	Semarang	64,9	26,31666667	-	-	0,87722	11,6105	11,9234	11,4800	15,8321	17,4839	7,2343	60,49%	64,82%	58,69%	118,85%	141,68%
MBN-3	14/01/2019 2:12	16/01/2019 12:00	Semarang	Surabaya	57,8	14,96666667	-	-	0,49889	6,6030	6,7810	6,5288	9,0039	9,9434	5,0878	29,78%	33,28%	28,32%	76,97%	95,44%
MBN-4	16/01/2019 16:54	21/01/2019 8:48	Surabaya	Samarinda	111,9	63,43333333	-	-	2,11444	27,9857	28,7400	27,6712	38,1614	42,1430	13,6708	104,71%	110,23%	102,41%	179,14%	208,27%
MBN-5	21/01/2019 8:54	25/01/2019 20:06	Samarinda	Surabaya	107,2	62,26666667	-	-	2,07556	27,4710	28,2114	27,1623	37,4595	41,3679	22,8207	20,38%	23,62%	19,02%	64,15%	81,27%
MBN-6	26/01/2019 14:00	30/01/2019 5:24	Surabaya	Kumai	87,4	51,9	-	-	1,73000	22,8974	23,5145	22,6401	31,2229	34,4806	12,9236	77,17%	81,95%	75,18%	141,60%	166,80%
MBN-7	30/01/2019 3:00	02/02/2019 10:12	Kumai	Semarang	79,2	35,66666667	-	-	1,18889	15,7355	16,1596	15,5587	21,4570	23,6957	7,9161	98,78%	104,14%	96,54%	171,05%	199,34%
MBN-8	02/02/2019 10:18	04/02/2019 2:30	Semarang	Surabaya	40,2	20,28333333	-	-	0,67611	8,9487	9,1898	8,8481	12,2024	13,4756	4,2018	112,97%	118,71%	110,58%	190,41%	220,71%
MBN-9	04/02/2019 10:42	07/02/2019 8:48	Surabaya	Sampit	70,1	30,15	-	-	1,00500	13,3017	13,6602	13,1522	18,1382	20,0307	10,9476	21,50%	24,78%	20,14%	65,68%	82,97%
MBN-10	07/02/2019 9:00	09/02/2019 20:00	Sampit	Surabaya	59	28,98333333	-	-	0,96611	12,7870	13,1316	12,6432	17,4363	19,2556	6,8815	85,82%	90,82%	83,73%	153,38%	179,82%
MBN-11	10/02/2019 9:00	12/02/2019 5:18	Surabaya	Semarang	44,3	24,18333333	-	-	0,80611	10,6693	10,9568	10,5494	14,5487	16,0666	5,1037	109,05%	114,69%	106,70%	185,06%	214,81%
MBN-12	12/02/2019 5:24	14/02/2019 4:42	Semarang	Kumai	47,3	30,55	-	-	1,01833	13,4782	13,8414	13,3267	18,3788	20,2964	7,7268	74,43%	79,13%	72,47%	137,86%	162,67%
MBN-13	14/02/2019 5:00	16/02/2019 22:42	Kumai	Surabaya	65,7	36,11666667	-	-	1,20389	15,9341	16,3635	15,7550	21,7277	23,9947	6,4940	145,37%	151,98%	142,61%	234,58%	269,49%
MBN-14	16/02/2019 21:00	20/02/2019 4:42	Surabaya	Kumai	79,7	40,85	-	-	1,36167	18,0223	18,5081	17,8198	24,5753	27,1394	7,4721	141,19%	147,69%	138,48%	228,89%	263,21%
MBN-15	20/02/2019 3:36	23/02/2019 1:48	Kumai	Surabaya	70,2	33,91666667	-	-	1,13056	14,9635	15,3668	14,7953	20,4042	22,5331	6,5347	128,99%	135,16%	126,41%	212,25%	244,82%
MBN-16	22/02/2019 22:18	26/02/2019 9:12	Surabaya	Kumai	82,9	40,43333333	-	-	1,34778	17,8385	18,3193	17,6380	24,3246	26,8626	8,1321	119,36%	125,27%	116,89%	199,12%	230,33%
MBN-17	26/02/2019 2:00	02/03/2019 17:00	Kumai	Surabaya	111	34,75	-	-	1,15833	15,3311	15,7443	15,1588	20,9055	23,0867	6,8022	125,38%	131,46%	122,85%	207,33%	239,40%
MBN-18	02/03/2019 14:06	06/03/2019 2:42	Surabaya	Kumai	84,6	36,55	-	-	1,21833	16,1253	16,5598	15,9440	21,9884	24,2826	9,1777	75,70%	80,44%	73,73%	139,59%	164,58%
MBN-19	05/03/2019 20:00	08/03/2019 23:30	Kumai	Semarang	75,5	29,76666667	-	-	0,99222	13,1326	13,4865	12,9850	17,9076	19,7760	11,7870	11,42%	14,42%	10,16%	51,93%	67,78%
MBN-20	08/03/2019 23:48	12/03/2019 1:36	Semarang	Surabaya	73,8	19,9	-	-	0,66333	8,7796	9,0162	8,6809	11,9718	13,2209	4,5130	94,54%	99,78%	92,35%	165,27%	192,95%
MBN-21	12/03/2019 1:42	15/03/2019 9:30	Surabaya	Kumai	79,8	31,51666667	-	-	1,05056	13,9046	14,2794	13,7483	18,9604	20,9386	12,0843	15,06%	18,17%	13,77%	56,90%	73,27%
MBN-22	15/03/2019 9:48	18/03/2019 7:48	Kumai	Semarang	70	32,08333333	-	-	1,06944	14,1546	14,5361	13,9955	19,3013	21,3151	11,4570	23,55%	26,88%	22,16%	68,47%	86,05%
MBN-23	18/03/2019 8:30	21/03/2019 22:00	Semarang	Surabaya	85,5	18,7	-	-	0,62333	8,2501	8,4725	8,1574	11,2499	12,4237	4,4932	83,61%	88,56%	81,55%	150,38%	176,50%
MBN-24	21/03/2019 21:00	25/03/2019 4:06	Surabaya	Kumai	79,1	36,23333333	-	-	1,20778	15,9856	16,4164	15,8059	21,7979	24,0722	10,4759	52,59%	56,71%	50,88%	108,08%	129,79%
MBN-25	25/03/2019 4:00	27/03/2019 23:30	Kumai	Semarang	67,5	31,03333333	-	-	1,03444	13,6914	14,0604	13,5375	18,6696	20,6175	8,0657	69,75%	74,32%	67,84%	131,47%	155,62%
MBN-26	28/03/2019 0:24	30/03/2019 17:48	Semarang	Surabaya	65,4	17,48333333	-	-	0,58278	7,7134	7,9212	7,6267	10,5179	11,6153	4,3763	76,25%	81,00%	74,27%	140,34%	165,42%
				Total Hour =	861,5333333				**Average**	**14,6190**	**15,0130**	**14,4547**	**19,9345**	**22,0144**	**8,5859**	**79,75%**	**84,60%**	**77,73%**	**145,11%**	**170,68%**

Table 2 Fraction of maximum fuel consumption by different mode

Mode	Default	Specific		
Cruising	0,80			
Maneuvering	0,40			
Hotelling		passenger	tanker	other
	0,20	0,32	0,20	0,12
Tug		ship assistance	moderate act	under tow
	0,50	0,20	0,50	0,80

Formula :

$S_{jkm} = C_{jk} \times P_m$

$S_{jkm} = (C_{jk} \times P_{m1} \times t_1/24) + (C_{jk} \times P_{m2} \times t_2/24) + (C_{jk} \times P_{m3} \times t_3/24)$

$S_{jkm} = C_{jk} \times [(P_{m1} \times t_1/24 + P_{m2} \times t_2/24 + P_{m3} \times t_3/24)]$

$S_{jkm} = C_{jk} \times P_{mtotal}$

Cjk : $C = [0{,}0919 + 0{,}0038 \times GT] - [(6{,}1565 \times 10^{-8}) \times GT^2] + [(6{,}7917 \times 10^{-13}) \times GT^3]$ *(for Container Ship)*

$C = [-2{,}2602] + [0{,}0049 \times GT] - [(1{,}6401 \times 10^{-7}) \times GT2] + [(1{,}7394 \times 10^{-12}) \times GT^3]$ *(for General Cargo Ship and Inland Cargo Ship)*

$C = [6{,}3501] + [0{,}0012 \times GT] + [(1{,}6852 \times 10^{-7}) \times GT^2] - [(6{,}2691 \times 10^{-12}) \times GT^3] + [(5{,}699 \times 10^{-17}) \times GT^4]$ *(for Passenger/Ro-Ro/Cargo Ship)*

Jalkanen Method Calculation

Ship Data

L / Lpp =	99,1	m	Screw =	2	unit
Lwl =	101,3	m	Bulbous =	yes	
Loa =	106,68	m	Vs =	7,972619	knot
T =	4,215	m	=	4,10147	m/s
B =	20,6		$d_{propeller}$ =	2,7	m

Calculation

Reynold's number

based on Tahanan dan Propulsi Kapal lecture Presentation week 6

$R_n = VL/\upsilon$

where;

Vs = 4,10147

Lwl = 101,3

$\upsilon = \mu/\rho$

where;

μ = 0,00096 Ns/m^2

ρ = 1025 kg/m^3

υ = 9,37E-07 m^2/s

R_n = 443610267

Froude number

based on Tahanan dan Propulsi Kapal lecture presentation week 7

$F_n = V / (gL)^{1/2}$

where;

V = ship's velocity

g = acceleration of gravity

L = length between waterline

F_n = 0,1301733

Coefficient Block (C_b)

based on Jalkanen et al (2012)

$C_b = 0,7 + 1/8 \text{ atan } ((23-100.Fn)/4)$

C_b = 0,8487115

Wetted Surface Area (S)

based on Schneekluth and Bertram (1998) and Hollenbach (1998)

$S_{total} = k . L . (B + 2 . T)$

$k = a_0 + a_1 . L_{os}/L_{wl} + a_2 . L_{wl}/L + a3\, C_b + a_4 . B/T + a_6 . L/T + a_7 . (T_A - T_F)/L + a_8 . D_P/T + k_{Rudd} . N_{rudd} + k_{Brac} . N_{Brac} + k_{Boss} . N_{boss}$

Table 6.9 Coefficients for wetted surface in Hollenbach's method

	Single-screw		*Twin-screw*	
	design draft	*ballast draft*	*bulbous bow*	*no bulbous bow*
a_0	−0.6837	−0.8037	−0.4319	−0.0887
a_1	0.2771	0.2726	0.1685	0.0000
a_2	0.6542	0.7133	0.5637	0.5192
a_3	0.6422	0.6699	0.5891	0.5839
a_4	0.0075	0.0243	0.0033	−0.0130
a_5	0.0275	0.0265	0.0134	0.0050
a_6	−0.0045	−0.0061	−0.0006	−0.0007
a_7	−0.4798	0.2349	−2.7932	−0.9486
a_8	0.0376	0.0131	0.0072	0.0506
k_{Rudd}			0.0131	0.0076
k_{Brac}			−0.0030	−0.0036
k_{Boss}			0.0061	0.0049

L_{OS} = 101,3 m T_A = 4,215 m T_F = 4,215 m

k = 0,8518234

S_{total} = 2450,5877 m^2

Jalkanen Method Calculation

Frictional Resistance (R_f)

based on Jalkanen et al (2012)

Coefficient Friction (C_f)

C_f = $0{,}075/(\log R_n - 2)^2$

C_f = 0,0010031

Frictional Resistance (R_f)

R_f = $C_f \rho/2 \, v^2 S$

R_f = 21192,068 N

Residual Resistance (R_R)

based on Schneekluth and Bertram (1998) and Hollenbach (1998)

L_{OS}/L = 1,0221998

L_{fn} = $L + 2/3 \cdot (L_{OS} - L)$ for $1 < L_{OS}/L < 1{,}1$

L_{fn} = 100,56667

C_R = $C_{R,Standard} \cdot C_{R,Fnkrit} \cdot k_L \cdot (T/B)^{b1} \cdot (B/L)^{b2} \cdot (L_{os}/L_{wl})^{b3} \cdot (L_{wl}/L)^{b4} \cdot (1+(T_A-T_F)/L)^{b5} \cdot (D_P/T_A)^{b6} \cdot (1+N_{Rudd})^{b7} \cdot (1+N_{Brac})^{b8} \cdot (1+N_{Boss})^{b9} \cdot (1+N_{Thruster})^{b10}$

$C_{R,Standard}$ = $c_{11} + c_{12} F_n + c_{13} F_n^2 + C_B \cdot (c_{21} + c_{22} F_n + c_{23} F_n^2) + C_B^2 \cdot (c_{31} + c_{32} F_n + c_{33} F_n^2)$

$C_{R,Fnkrit}$ = $\max(1,0; (F_n/F_{n,krit})^{f1})$

$F_{n,krit}$ = $d_1 + d_2 C_B + d_3 C_B^2$

k_L = $e_1 L^{e2}$

Table 6.10 Coefficients for typical resistance in Hollenbach's method

	Single-screw		*Twin-screw*
	design draft	*ballast draft*	
$b1$	−0.3382	−0.7139	−0.2748
$b2$	0.8086	0.2558	0.5747
$b3$	−6.0258	−1.1606	−6.7610
$b4$	−3.5632	0.4534	−4.3834
$b5$	9.4405	11.222	8.8158
$b6$	0.0146	0.4524	−0.1418
$b7$	0	0	−0.1258
$b8$	0	0	0.0481
$b9$	0	0	0.1699
$b10$	0	0	0.0728
c_{11}	−0.57420	−1.50162	−5.34750
c_{12}	13.3893	12.9678	55.6532
c_{13}	90.5960	−36.7985	−114.905
c_{21}	4.6614	5.55536	19.2714
c_{22}	−39.721	−45.8815	−192.388
c_{23}	−351.483	121.820	388.333
c_{31}	−1.14215	−4.33571	−14.3571
c_{32}	−12.3296	36.0782	142.738
c_{33}	459.254	−85.3741	−254.762
d_1	0.854	0.032	0.897
d_2	−1.228	0.803	−1.457
d_3	0.497	−0.739	0.767
e_1	2.1701	1.9994	1.8319
e_2	−0.1602	−0.1446	−0.1237
f_1	$F_n/F_{n,\mathrm{krit}}$	$10 \cdot C_B \cdot (F_n/F_{n,\mathrm{krit}} - 1)$	$F_n/F_{n,\mathrm{krit}}$

$C_{R,Standard}$ = 0,5684383

$F_{n,krit}$ = 0,212906

$C_{R,Fnkrit}$ = 0,7402219

k_L = 1,0374984

C_R = 0,3082197

R_R = $C_R \rho/2 \, v^2 (BT/10)$

R_R = 23072,679 N

Total Resistance (R_T)

based on Jalkanen et al (2012)

Jalkanen Method Calculation

R_T = $R_F + R_R$

R_T = 44264,747 N

R_T = 44,264747 kN

Propelling Power (P_{Propel})

based on Jalkanen et al (2012)

P_{Propel} = $R_{Total} \cdot v$

P_{Propel} = 181,55052 kW

Quasi Propulsive Constant (η_{qpc})

based on Jalkanen et al (2012)

η_{qpc} = 0,84 - ((N . (LBP)^(-1/2))/10000)

η_{qpc} = 0,598096

Total Required Engine Power (P_{Total})

based on Jalkanen et al (2012)

P_{total} = P_{Propel} / η_{qpc}

P_{total} = 303,54747 kW

Number of Operational Engines (n_{oE})

based on Jalkanen et al (2012)

n_{oE} = $(P_{Total} / P_E) + 1$

n_{oE} = 1,2107969 ≈ 1

Engine Load (EL)

based on Jalkanen et al (2012)

EL = $(P_{Total} / P_E n_E)$

EL = 0,2107969

SFOC Relative ($SFOC_{Relative}$)

based on Jalkanen et al (2012)

$SFOC_{Relative}$ = $0{,}455\ EL^2 - 0{,}71\ EL + 1{,}28$

$SFOC_{Relative}$ = 1,150552

SFOC Absolute (SFOC)

based on Jalkanen et al (2012)

SFOC = $SFOC_{Relative} \cdot SFOC_{Base}$

$SFOC_{Base}$ = 200 g/kWh

SFOC = 230,11046 g/kWh

Fuel Oil Consumpption (FOC)

$P_{service}$ = 75% (assumed)

$P_{service}$ = 1080 kW

FOC = $SFOC \cdot P_{service}$

FOC = 248519,3 g/h

FOC = 250,77628 l/h

FOC = 0,2485193 ton/h

Jalkanen Method Calculation

Trip Number	Window		Port		Time (hour)		MFO FOC (Ton)		Error
	Depart	Arrive	Depart	Arrive	Total	Cruising	Estimated	Actual	
MBT-1	09/01/2019 22:30	13/01/2019 23:48	Semarang	Pontianak	97,30	55,850	13,8798	11,8603	17,03%
MBT-2	13/01/2019 21:54	18/01/2019 8:30	Pontianak	Semarang	106,60	48,983	12,1733	10,3123	18,05%
MBT-3	18/01/2019 8:36	21/01/2019 20:24	Semarang	Pontianak	83,80	63,683	15,8265	12,5738	25,87%
MBT-4	21/01/2019 16:00	26/01/2019 16:28	Pontianak	Semarang	120,47	45,567	11,3242	9,8109	15,42%
MBT-5	26/01/2019 16:48	30/01/2019 1:00	Semarang	Pontianak	80,20	53,200	13,2212	17,8023	25,73%
MBT-6	29/01/2019 20:48	02/02/2019 17:00	Pontianak	Surabaya	92,20	57,700	14,3396	11,5987	23,63%
MBT-7	03/02/2019 18:18	06/02/2019 11:54	Surabaya	Sampit	65,60	36,617	9,0999	6,1046	49,07%
MBT-8	06/02/2019 13:24	09/02/2019 1:00	Sampit	Surabaya	59,60	27,733	6,8923	5,3415	29,03%
MBT-9	09/02/2019 9:00	12/02/2019 17:12	Surabaya	Kumai	80,20	43,250	10,7485	6,5842	63,25%
MBT-10	12/02/2019 17:36	15/02/2019 14:24	Kumai	Semarang	68,80	30,650	7,6171	6,4534	18,03%
MBT-11	15/02/2019 9:36	17/02/2019 14:42	Semarang	Surabaya	53,10	19,183	4,7674	3,3793	41,08%
MBT-12	17/02/2019 18:42	20/02/2019 3:54	Surabaya	Sampit	57,20	32,150	7,9899	5,8865	35,73%
MBT-13	20/02/2019 4:00	22/02/2019 9:24	Sampit	Surabaya	53,40	26,833	6,6686	5,1017	30,71%
MBT-14	22/02/2019 9:18	26/02/2019 0:12	Surabaya	Sampit	86,90	26,500	6,5858	4,2078	56,51%
MBT-15	25/02/2019 20:24	28/02/2019 1:12	Sampit	Surabaya	52,80	28,817	7,1615	5,2325	36,87%
MBT-16	28/02/2019 9:30	03/03/2019 16:42	Surabaya	Kumai	79,20	40,133	9,9739	6,7586	47,57%
MBT-17	03/03/2019 16:48	06/03/2019 13:12	Kumai	Surabaya	68,40	29,283	7,2775	5,3415	36,24%
MBT-18	06/03/2019 13:24	08/03/2019 7:18	Surabaya	Semarang	41,90	19,933	4,9538	4,3822	13,04%
MBT-19	08/03/2019 7:24	10/03/2019 11:24	Semarang	Kumai	52,00	28,033	6,9668	5,3197	30,96%
MBT-20	10/03/2019 11:30	14/03/2019 7:18	Kumai	Surabaya	91,80	24,033	5,9727	5,0145	19,11%
MBT-21	15/03/2019 2:00	17/03/2019 9:18	Surabaya	Semarang	55,30	19,700	4,8958	5,2325	6,43%
MBT-22	17/03/2019 9:24	19/03/2019 19:54	Semarang	Kumai	58,50	30,283	7,5260	5,9519	26,45%
MBT-23	19/03/2019 20:06	23/03/2019 3:12	Kumai	Surabaya	79,10	30,017	7,4597	5,9737	24,88%
						Average	**8,8401**	**7,2271**	**30,03%**

Jalkanen Method Calculation

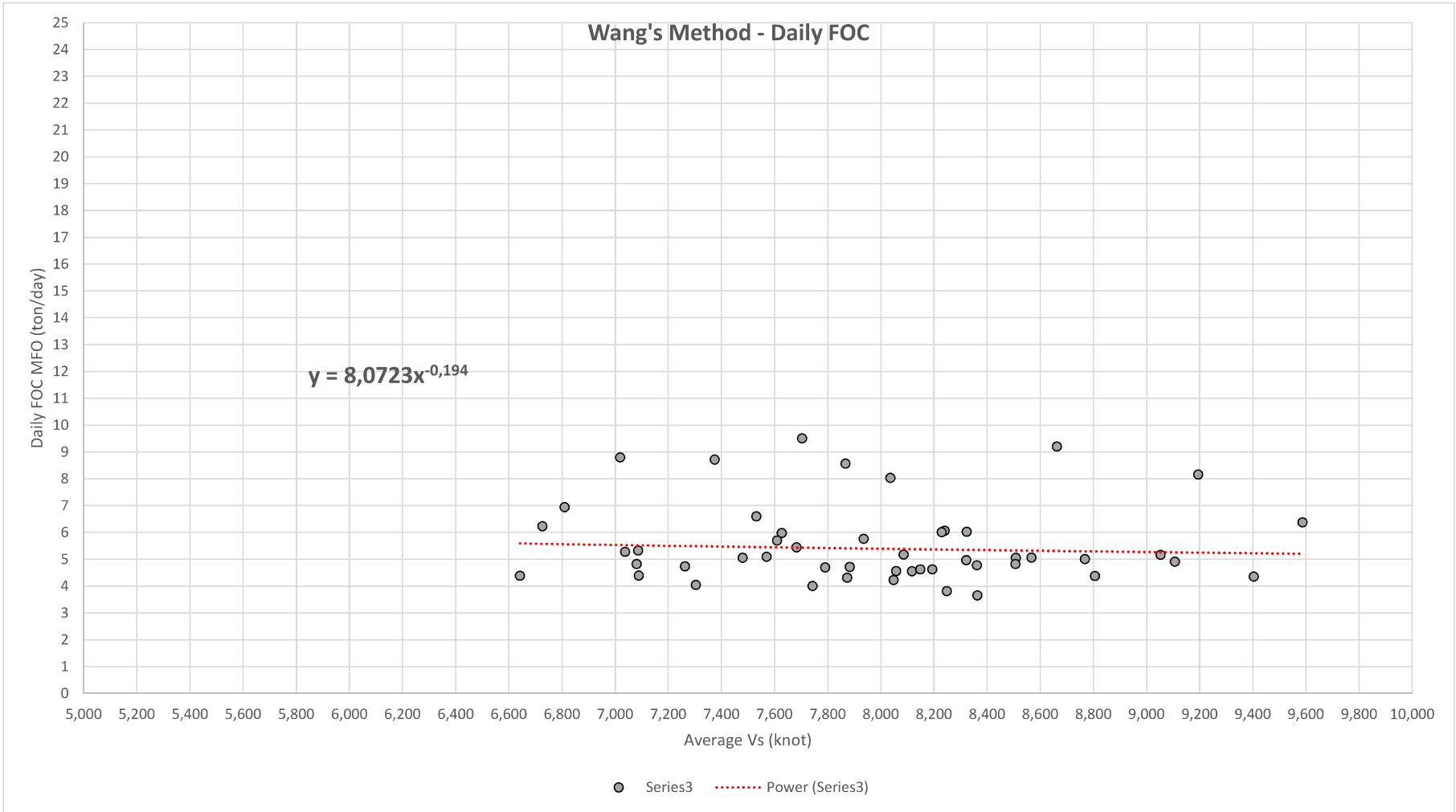
Trip Number	Window		Port		Time (hour)		FOC MFO (Ton)		Error
	Depart	Arrive	Depart	Arrive	Total	Cruising	Estimated	Actual	
MBN-1	06/01/2019 20:18	11/01/2019 9:48	Surabaya	Kumai	109,5	33,500	8,3254	6,8528	21,49%
MBN-2	11/01/2019 9:36	14/01/2019 2:30	Kumai	Semarang	64,9	26,317	6,5402	7,2343	9,59%
MBN-3	14/01/2019 2:12	16/01/2019 12:00	Semarang	Surabaya	57,8	14,967	3,7195	5,0878	26,89%
MBN-4	16/01/2019 16:54	21/01/2019 8:48	Surabaya	Samarinda	111,9	63,433	15,7644	13,6708	15,31%
MBN-5	21/01/2019 8:54	25/01/2019 20:06	Samarinda	Surabaya	107,2	62,267	15,4745	22,8207	32,19%
MBN-6	26/01/2019 14:00	30/01/2019 5:24	Surabaya	Kumai	87,4	51,900	12,8982	12,9236	0,20%
MBN-7	30/01/2019 3:00	02/02/2019 10:12	Kumai	Semarang	79,2	35,667	8,8639	7,9161	11,97%
MBN-8	02/02/2019 10:18	04/02/2019 2:30	Semarang	Surabaya	40,2	20,283	5,0408	4,2018	19,97%
MBN-9	04/02/2019 10:42	07/02/2019 8:48	Surabaya	Sampit	70,1	30,150	7,4929	10,9476	31,56%
MBN-10	07/02/2019 9:00	09/02/2019 20:00	Sampit	Surabaya	59	28,983	7,2029	6,8815	4,67%
MBN-11	10/02/2019 9:00	12/02/2019 5:18	Surabaya	Semarang	44,3	24,183	6,0100	5,1037	17,76%
MBN-12	12/02/2019 5:24	14/02/2019 4:42	Semarang	Kumai	47,3	30,550	7,5923	7,7268	1,74%
MBN-13	14/02/2019 5:00	16/02/2019 22:42	Kumai	Surabaya	65,7	36,117	8,9757	6,4940	38,21%
MBN-14	16/02/2019 21:00	20/02/2019 4:42	Surabaya	Kumai	79,7	40,850	10,1520	7,4721	35,86%
MBN-15	20/02/2019 3:36	23/02/2019 1:48	Kumai	Surabaya	70,2	33,917	8,4289	6,5347	28,99%
MBN-16	22/02/2019 22:18	26/02/2019 9:12	Surabaya	Kumai	82,9	40,433	10,0485	8,1321	23,56%
MBN-17	26/02/2019 2:00	02/03/2019 17:00	Kumai	Surabaya	111	34,750	8,6360	6,8022	26,96%
MBN-18	02/03/2019 14:06	06/03/2019 2:42	Surabaya	Kumai	84,6	36,550	9,0834	9,1777	1,03%
MBN-19	05/03/2019 20:00	08/03/2019 23:30	Kumai	Semarang	75,5	29,767	7,3976	11,7870	37,24%
MBN-20	08/03/2019 23:48	12/03/2019 1:36	Semarang	Surabaya	73,8	19,900	4,9455	4,5130	9,58%
MBN-21	12/03/2019 1:42	15/03/2019 9:30	Surabaya	Kumai	79,8	31,517	7,8325	12,0843	35,18%
MBN-22	15/03/2019 9:48	18/03/2019 7:48	Kumai	Semarang	70	32,083	7,9733	11,4570	30,41%
MBN-23	18/03/2019 8:30	21/03/2019 22:00	Semarang	Surabaya	85,5	18,700	4,6473	4,4932	3,43%
MBN-24	21/03/2019 21:00	25/03/2019 4:06	Surabaya	Kumai	79,1	36,233	9,0047	10,4759	14,04%
MBN-25	25/03/2019 4:00	27/03/2019 23:30	Kumai	Semarang	67,5	31,033	7,7124	8,0657	4,38%
MBN-26	28/03/2019 0:24	30/03/2019 17:48	Semarang	Surabaya	65,4	17,483	4,3449	4,3763	0,72%
						Average	**8,2349**	**8,5859**	**18,57%**

Wang Method Calculation

Voyage Number	Trip Number		Port		Distance		Average Speed (knot)	Cruising Time (hour)	MFO Cons (liter)	MFO Cons (Ton)	MFO cons/day (Ton)	Est. MFO cons/day (Ton)	Est. MFO Cons (Ton)	Error
			Departure	Arrived	kilo meter	nautical miles								
1901	MBT-	1	Semarang	Pontianak	868,918	469,178	7,570	55,850	11968	11,86029	5,096632	5,450675	12,68418	6,95%
	MBT-	2	Pontianak	Semarang	847,419	457,570	8,508	48,983	10406	10,31235	5,052664	5,328558	10,87544	5,46%
1902	MBT-	3	Semarang	Pontianak	846,604	457,130	7,263	63,683	12688	12,57381	4,738624	5,494697	14,58003	15,96%
	MBT-	4	Pontianak	Semarang	840,450	453,807	9,053	45,567	9900	9,8109	5,167409	5,264828	9,995861	1,89%
1903	MBT-	5	Semarang	Pontianak	856,527	462,488	8,036	53,200	17964	17,80232	8,031124	5,387958	11,94331	32,91%
	MBT-	6	Pontianak	Surabaya	1043,220	563,294	8,506	57,700	11704	11,59866	4,824401	5,328807	12,81134	10,46%
1904	MBT-	7	Surabaya	Sampit	550,419	297,203	7,743	36,617	6160	6,10456	4,001168	5,426824	8,279674	35,63%
	MBT-	8	Sampit	Surabaya	520,477	281,035	8,193	27,733	5390	5,34149	4,622443	5,367701	6,202676	16,12%
1905	MBT-	9	Surabaya	Kumai	585,189	315,977	8,363	43,250	6644	6,584204	3,653662	5,346319	9,634512	46,33%
	MBT-	10	Kumai	Semarang	507,679	274,125	7,480	30,650	6512	6,453392	5,053227	5,463367	6,977175	8,12%
	MBT-	11	Semarang	Surabaya	357,198	192,872	8,048	19,183	3410	3,37931	4,227807	5,386341	4,305332	27,40%
1906	MBT-	12	Surabaya	Sampit	511,828	276,365	7,089	32,150	5940	5,88654	4,394307	5,52062	7,39533	25,63%
	MBT-	13	Sampit	Surabaya	511,975	276,444	8,057	26,833	5148	5,101668	4,562983	5,385154	6,020902	18,02%
1907	MBT-	14	Surabaya	Sampit	516,230	278,742	8,248	26,500	4246	4,207786	3,810825	5,36069	5,919095	40,67%
	MBT-	15	Sampit	Surabaya	530,130	286,247	9,403	28,817	5280	5,23248	4,357878	5,226129	6,274984	19,92%
1908	MBT-	16	Surabaya	Kumai	541,681	292,484	7,304	40,133	6820	6,75862	4,0417	5,488705	9,178335	35,80%
	MBT-	17	Kumai	Surabaya	544,300	293,899	8,806	29,283	5390	5,34149	4,377772	5,293115	6,458336	20,91%
1909	MBT-	18	Surabaya	Semarang	347,470	187,619	7,038	19,933	4422	4,382202	5,27623	5,528383	4,591629	4,78%
	MBT-	19	Semarang	Kumai	503,150	271,679	8,117	28,033	5368	5,319688	4,554311	5,377396	6,281098	18,07%
	MBT-	20	Kumai	Surabaya	546,419	295,043	8,768	24,033	5060	5,01446	5,007505	5,297523	5,304881	5,79%
1910	MBT-	21	Surabaya	Semarang	352,542	190,358	9,587	19,700	5280	5,23248	6,374595	5,206549	4,273709	18,32%
	MBT-	22	Semarang	Kumai	503,762	272,010	7,883	30,283	6006	5,951946	4,717007	5,408063	6,823924	14,65%
	MBT-	23	Kumai	Surabaya	536,488	289,680	8,361	30,017	6028	5,973748	4,776345	5,346583	6,686941	11,94%
									Average	**7,227148**			**7,978204**	**19,21%**

Wang Method Calculation

Voyage Number	Trip Number		Port		Distance		Average Speed (knot)	Cruising Time (hour)	MFO Cons (liter)	MFO Cons (Ton)	MFO cons/day (Ton)	Est. MFO cons/day (Ton)	Est. MFO Cons (Ton)	Error
			Departure	Arrived	kilo meter	nautical miles								
1901	MBN -	1	Surabaya	Kumai	547,233	295,482	9,106	33,500	6915	6,852765	4,909444	5,258782	7,340383	7,12%
1901	MBN -	2	Kumai	Semarang	503,617	271,932	7,532	26,317	7300	7,2343	6,597462	5,456088	5,982753	17,30%
1901	MBN -	3	Semarang	Surabaya	357,714	193,150	9,194	14,967	5134	5,087794	8,158601	5,249017	3,273345	35,66%
1902	MBN -	4	Surabaya	Samarinda	967,142	522,215	8,086	63,433	13795	13,67085	5,172364	5,381469	14,22352	4,04%
1902	MBN -	5	Samarinda	Surabaya	965,970	521,582	7,018	62,267	23028	22,82075	8,796006	5,531287	14,35062	37,12%
1903	MBN -	6	Surabaya	Kumai	544,796	294,166	7,627	51,900	13041	12,92363	5,976246	5,442774	11,77	8,93%
1903	MBN -	7	Kumai	Semarang	508,779	274,719	7,087	35,667	7988	7,916108	5,326727	5,520895	8,204663	3,65%
1903	MBN -	8	Semarang	Surabaya	352,769	190,480	8,321	20,283	4240	4,20184	4,971775	5,351573	4,522823	7,64%
1904	MBN -	9	Surabaya	Sampit	532,765	287,670	7,375	30,150	11047	10,94758	8,714489	5,478423	6,882269	37,13%
1904	MBN -	10	Sampit	Surabaya	529,806	286,072	7,610	28,983	6944	6,881504	5,698313	5,445169	6,575798	4,44%
1905	MBN -	11	Surabaya	Semarang	354,899	191,630	8,567	24,183	5150	5,10365	5,064959	5,321431	5,362081	5,06%
1905	MBN -	12	Semarang	Kumai	512,559	276,760	8,240	30,550	7797	7,726827	6,070175	5,361761	6,825074	11,67%
1905	MBN -	13	Kumai	Surabaya	542,409	292,877	7,873	36,117	6553	6,494023	4,315364	5,409382	8,140368	25,35%
1906	MBN -	14	Surabaya	Kumai	541,504	292,389	6,642	40,850	7540	7,47214	4,389997	5,590782	9,515976	27,35%
1906	MBN -	15	Kumai	Surabaya	539,432	291,270	8,148	33,917	6594	6,534654	4,62403	5,373417	7,593683	16,21%
1907	MBN -	16	Surabaya	Kumai	540,671	291,939	7,081	40,433	8206	8,132146	4,826995	5,521841	9,302769	14,40%
1907	MBN -	17	Kumai	Surabaya	539,839	291,490	7,790	34,750	6864	6,802224	4,697939	5,420496	7,848426	15,38%
1908	MBN -	18	Surabaya	Kumai	542,040	292,678	8,323	36,550	9261	9,177651	6,026365	5,351336	8,149639	11,20%
1908	MBN -	19	Kumai	Semarang	508,337	274,480	7,703	29,767	11894	11,78695	9,503479	5,432274	6,737528	42,84%
1908	MBN -	20	Semarang	Surabaya	356,251	192,360	7,683	19,900	4554	4,513014	5,442831	5,435113	4,506615	0,14%
1909	MBN -	21	Surabaya	Kumai	540,923	292,075	8,663	31,517	12194	12,08425	9,202182	5,309971	6,973024	42,30%
1909	MBN -	22	Kumai	Semarang	506,528	273,504	7,867	32,083	11561	11,45695	8,570395	5,410207	7,232395	36,87%
1909	MBN -	23	Semarang	Surabaya	358,647	193,654	7,935	18,700	4534	4,493194	5,766666	5,401166	4,208408	6,34%
1910	MBN -	24	Surabaya	Kumai	542,810	293,094	6,810	36,233	10571	10,47586	6,938933	5,563739	8,399701	19,82%
1910	MBN -	25	Kumai	Semarang	506,595	273,540	6,726	31,033	8139	8,065749	6,237744	5,577183	7,211607	10,59%
1910	MBN -	26	Semarang	Surabaya	358,384	193,512	8,229	17,483	4416	4,376256	6,007444	5,363146	3,906903	10,72%
									Average	**8,585872**			**7,501553**	**17,66%**


Wang's Method - Daily FOC
y = 8,0723x-0,194
Daily FOC MFO (ton/day)
Average Vs (knot)
Series3
Power (Series3)

Mersin Method Calculation

Ship's Data

L / Lpp =	99,1		Δ =	7561 Ton
Lwl =	101,3			
Loa =	106,68			
T =	4,215			
B =	20,6			
Ton / cm =	18	ton/cm		
Avg Vs =	7,972619	knot		

Mersin's Formula

$$\nabla(t) = \left[\sqrt[3]{\nabla(0)} - \frac{\lambda v^3 t}{72}\right]^3$$

$$Fc = \frac{W^{2/3} \times V^3}{Fuel\ Cons/day}$$

where;	λ =	1/Fc	*(based on Barras (2004))*	W = Displacement
	Fc =	35.081,235405	*(for diesel machinery installation)*	V = Ship's speed
	λ =	0,000029		FOC/day = 5,564776 Ton/day

$$L(t) = \nabla(t) - W_{i,i+1}$$

$$F(t) = L(0) - L(t_{n-1})$$

Mersin Method Calculation

Operational Modes & Calculation

MV MERATUS BONTANG

Trip Number	Window		Port		Time (hour)		Avg. Vs (knot)	Cargo (Ton)	Initial ∇ (Ton)	Initial MFO (Ton)	∇(*t*)	L(t)	F(t)	Report MFO Cons (Ton)	Error
	Depart	Arrive	Depart	Arrive	Total	Cruising									
MBT-1	09/01/2019 22:30	13/01/2019 23:48	Semarang	Pontianak	97,3	55,850	7,570	4017,00	7313,00	74,22	7302,16297	3285,16	-3210,94	11,8603	27173%
MBT-2	13/01/2019 21:54	18/01/2019 8:30	Pontianak	Semarang	106,6	48,983	8,508	980,00	4325,00	63,30	4315,49541	3335,50	-3272,20	10,3123	31831%
MBT-3	18/01/2019 8:36	21/01/2019 20:24	Semarang	Pontianak	83,8	63,683	7,263	3324,00	6666,00	117,40	6655,742	3331,74	-3214,34	12,5738	25664%
MBT-4	21/01/2019 16:00	26/01/2019 16:28	Pontianak	Semarang	120,5	45,567	9,053	637,00	3999,00	104,82	3988,89348	3351,89	-3247,07	9,8109	33197%
MBT-5	26/01/2019 16:48	30/01/2019 1:00	Semarang	Pontianak	80,2	53,200	8,036	2532,00	5881,00	95,48	5870,32476	3338,32	-3242,85	17,8023	18316%
MBT-6	29/01/2019 20:48	02/02/2019 17:00	Pontianak	Surabaya	92,2	57,700	8,506	1054,00	4387,00	77,67	4375,70688	3321,71	-3244,03	11,5987	28069%
MBT-7	03/02/2019 18:18	06/02/2019 11:54	Surabaya	Sampit	65,6	36,617	7,743	4408,00	78822,00	66,22	78784,8864	74376,89	-74310,67	6,1046	1217398%
MBT-8	06/02/2019 13:24	09/02/2019 1:00	Sampit	Surabaya	59,6	27,733	8,193	659,00	3845,00	60,12	3840,55548	3181,56	-3121,44	5,3415	58538%
MBT-9	09/02/2019 9:00	12/02/2019 17:12	Surabaya	Kumai	80,2	43,250	8,363	4473,00	7749,00	94,76	7737,23853	3264,24	-3169,48	6,5842	48238%
MBT-10	12/02/2019 17:36	15/02/2019 14:24	Kumai	Semarang	68,8	30,650	7,480	3500,00	6739,00	88,18	6733,56588	3233,57	-3145,39	6,4534	48840%
MBT-11	15/02/2019 9:36	17/02/2019 14:42	Semarang	Surabaya	53,1	19,183	8,048	1066,00	4284,00	81,72	4280,86795	3214,87	-3133,15	3,3793	92816%
MBT-12	17/02/2019 18:42	20/02/2019 3:54	Surabaya	Sampit	57,2	32,150	7,089	4480,00	7724,00	78,34	7718,68648	3238,69	-3160,34	5,8865	53788%
MBT-13	20/02/2019 4:00	22/02/2019 9:24	Sampit	Surabaya	53,4	26,833	8,057	954,00	4153,00	72,65	4148,69451	3194,69	-3122,04	5,1017	61296%
MBT-14	22/02/2019 9:18	26/02/2019 0:12	Surabaya	Sampit	86,9	26,500	8,248	4468,00	7677,00	97,73	7670,12804	3202,13	-3104,39	4,2078	73877%
MBT-15	25/02/2019 20:24	28/02/2019 1:12	Sampit	Surabaya	52,8	28,817	9,403	728,00	3933,00	93,53	3925,91349	3197,91	-3104,39	5,2325	59429%
MBT-16	28/02/2019 9:30	03/03/2019 16:42	Surabaya	Kumai	79,2	40,133	7,304	4457,00	7688,00	88,29	7680,76806	3223,77	-3135,47	6,7586	46492%
MBT-17	03/03/2019 16:48	06/03/2019 13:12	Kumai	Surabaya	68,4	29,283	8,806	1246,00	4373,00	81,53	4366,65211	3120,65	-3039,12	5,3415	56996%
MBT-18	06/03/2019 13:24	08/03/2019 7:18	Surabaya	Semarang	41,9	19,933	7,038	3418,00	6759,00	106,78	6756,05055	3338,05	-3231,27	4,3822	73836%
MBT-19	08/03/2019 7:24	10/03/2019 11:24	Semarang	Kumai	52	28,033	8,117	4376,00	7750,00	102,40	7743,02809	3367,03	-3264,63	5,3197	61469%
MBT-20	10/03/2019 11:30	14/03/2019 7:18	Kumai	Surabaya	91,8	24,033	8,768	2512,00	5927,00	97,08	5920,70021	3408,70	-3311,62	5,0145	66141%
MBT-21	15/03/2019 2:00	17/03/2019 9:18	Surabaya	Semarang	55,3	19,700	9,587	4058,00	7532,00	92,64	7524,08053	3466,08	-3373,44	5,2325	64571%
MBT-22	17/03/2019 9:24	19/03/2019 19:54	Semarang	Kumai	58,5	30,283	7,883	3712,00	7166,00	87,40	7159,45357	3447,45	-3360,05	5,9519	56553%
MBT-23	19/03/2019 20:06	23/03/2019 3:12	Kumai	Surabaya	79,1	30,017	8,361	3058,00	6485,00	81,45	6477,75551	3419,76	-3338,30	5,9737	55983%
												Average	**-6298,11**	**7,23**	**87245%**

Mersin Method Calculation

MV MERATUS BENOA

Trip Number	Window		Port		Time (hour)		Avg. Vs (knot)	Cargo (Ton)	Initial ∇ (Ton)	Initial MFO (Ton)	∇(*t*)	L(t)	F(t)	Report MFO Cons (Ton)	Error
	Depart	Arrive	Depart	Arrive	Total	Cruising									
MBN-1	06/01/2019 20:18	11/01/2019 9:48	Surabaya	Kumai	109,5	33,500	9,106	3198,00	6245,32	76,592408	6235,13607	3037,14	-2960,54	6,8528	43302%
MBN-2	11/01/2019 9:36	14/01/2019 2:30	Kumai	Semarang	64,9	26,317	7,532	3047,90	6842,16	69,742616	6837,34832	3789,45	-3719,71	7,2343	51518%
MBN-3	14/01/2019 2:12	16/01/2019 12:00	Semarang	Surabaya	57,8	14,967	9,194	416,10	4511,92	62,508316	4508,14894	4092,05	-4029,54	5,0878	79300%
MBN-4	16/01/2019 16:54	21/01/2019 8:48	Surabaya	Samarinda	111,9	63,433	8,086	3484,00	7186,34	57,402684	7171,51896	3687,52	-3630,12	13,6708	26654%
MBN-5	21/01/2019 8:54	25/01/2019 20:06	Samarinda	Surabaya	107,2	62,267	7,018	256,80	6463,20	43,749677	6454,33256	6197,53	-6153,78	22,8207	27066%
MBN-6	26/01/2019 14:00	30/01/2019 5:24	Surabaya	Kumai	87,4	51,900	7,627	4477,00	7524,32	60,570911	7513,82318	3036,82	-2976,25	12,9236	23130%
MBN-7	30/01/2019 3:00	02/02/2019 10:12	Kumai	Semarang	79,2	35,667	7,087	4271,40	7320,72	52,718227	7315,03682	3043,64	-2990,92	7,9161	37883%
MBN-8	02/02/2019 10:18	04/02/2019 2:30	Semarang	Surabaya	40,2	20,283	8,321	541,80	4848,73	48,270619	4844,75467	4302,95	-4254,68	4,2018	101358%
MBN-9	04/02/2019 10:42	07/02/2019 8:48	Surabaya	Sampit	70,1	30,150	7,375	4509,00	7560,32	35,526359	7554,7889	3045,79	-3010,26	10,9476	27597%
MBN-10	07/02/2019 9:00	09/02/2019 20:00	Sampit	Surabaya	59	28,983	7,610	268,50	4577,00	24,496529	4572,81949	4304,32	-4279,82	6,8815	62293%
MBN-11	10/02/2019 9:00	12/02/2019 5:18	Surabaya	Semarang	44,3	24,183	8,567	3366,00	6692,88	57,363044	6686,46809	3320,47	-3263,11	5,1037	64037%
MBN-12	12/02/2019 5:24	14/02/2019 4:42	Semarang	Kumai	47,3	30,550	8,240	4379,00	7427,02	52,254439	7419,29499	3040,29	-2988,04	7,7268	38771%
MBN-13	14/02/2019 5:00	16/02/2019 22:42	Kumai	Surabaya	65,7	36,117	7,873	2624,90	6271,56	44,561306	6264,44397	3639,54	-3594,98	6,4940	55458%
MBN-14	16/02/2019 21:00	20/02/2019 4:42	Surabaya	Kumai	79,7	40,850	6,642	4423,30	7470,62	37,741244	7465,18854	3041,89	-3004,15	7,4721	40305%
MBN-15	20/02/2019 3:36	23/02/2019 1:48	Kumai	Surabaya	70,2	33,917	8,148	1664,10	5225,10	30,269104	5218,54048	3554,44	-3524,17	6,5347	54030%
MBN-16	22/02/2019 22:18	26/02/2019 9:12	Surabaya	Kumai	82,9	40,433	7,081	4460,50	7511,82	73,364721	7505,28322	3044,78	-2971,42	8,1321	36639%
MBN-17	26/02/2019 2:00	02/03/2019 17:00	Kumai	Surabaya	111	34,750	7,790	3471,40	6728,14	65,232575	6721,18877	3249,79	-3184,56	6,8022	46916%
MBN-18	02/03/2019 14:06	06/03/2019 2:42	Surabaya	Kumai	84,6	36,550	8,323	4463,00	7493,00	58,430351	7483,41987	3020,42	-2961,99	9,1777	32374%
MBN-19	05/03/2019 20:00	08/03/2019 23:30	Kumai	Semarang	75,5	29,767	7,703	4102,00	7120,00	49,770993	7114,02031	3012,02	-2962,25	11,7870	25232%
MBN-20	08/03/2019 23:48	12/03/2019 1:36	Semarang	Surabaya	73,8	19,900	7,683	491,00	4704,00	38,060346	4700,99176	4209,99	-4171,93	4,5130	92542%
MBN-21	12/03/2019 1:42	15/03/2019 9:30	Surabaya	Kumai	79,8	31,517	8,663	4483,00	8038,00	83,097332	8028,23939	3545,24	-3462,14	12,0843	28750%
MBN-22	15/03/2019 9:48	18/03/2019 7:48	Kumai	Semarang	70	32,083	7,867	3043,90	6088,99	71,014069	6082,8063	3038,91	-2967,89	11,4570	26005%
MBN-23	18/03/2019 8:30	21/03/2019 22:00	Semarang	Surabaya	85,5	18,700	7,935	824,00	5068,00	59,562073	5064,72691	4240,73	-4181,16	4,4932	93156%
MBN-24	21/03/2019 21:00	25/03/2019 4:06	Surabaya	Kumai	79,1	36,233	6,810	3817,00	7114,58	55,360233	7109,55356	3292,55	-3237,19	10,4759	31001%
MBN-25	25/03/2019 4:00	27/03/2019 23:30	Kumai	Semarang	67,5	31,033	6,726	2503,00	5889,77	45,073653	5886,11334	3383,11	-3338,04	8,0657	41485%
MBN-26	28/03/2019 0:24	30/03/2019 17:48	Semarang	Surabaya	65,4	17,483	8,229	253,00	4271,60	37,07	4268,55439	4015,55	-3978,49	4,3763	91011%
												Average	**-3530,66**	**8,59**	**41222%**

Mersin Method Calculation
Modified Calculation

From the example case in Mersin et al Paper, we conlcude that the asumption of 'Initial Fuel' is any Displacement (∇) except Cargo

So, the data previously:

Trip Number	Window		Port		Time (hour)		Avg. Vs (knot)	Cargo (Ton)	Initial ∇ (Ton)	Initial MFO (Ton)	∇(*t*)	L(t)	F(t)
	Depart	Arrive	Depart	Arrive	Total	Cruising							
MBT-1	09/01/2019 22:30	13/01/2019 23:48	Semarang	Pontianak	97,3	55,85	7,570213	4017	7313	74,21995	7302,163	3285,163	-3210,94

Become,

Trip Number	Window		Port		Time (hour)		Avg. Vs (knot)	Cargo (Ton)	Initial ∇ (Ton)	Initial MFO (Ton)	∇(*t*)	L(t)	F(t)
	Depart	Arrive	Depart	Arrive	Total	Cruising							
MBT-1	09/01/2019 22:30	13/01/2019 23:48	Semarang	Pontianak	97,3	55,85	7,570213	4017	7313	3296	7302,163	3285,16	10,84

initial MFO not based on the reported data, but from calculation:

Initial MFO = Initial Displacement (∇) - Cargo

then,

L (t) = ∇(*t*) - Cargo

F (t) = L(t) - Initial MFO

Modified Mersin Method Calculation

Ship's Data

L / Lpp =	99,1		Δ =	7561 Ton
Lwl =	101,3			
Loa =	106,68			
T =	4,215			
B =	20,6			
Ton / cm =	18	ton/cm		
Avg Vs =	7,972619	knot		

Mersin's Formula

$$\nabla(t) = \left[\sqrt[3]{\nabla(0)} - \frac{\lambda v^3 t}{72}\right]^3$$

$$Fc = \frac{W^{2/3} \times V^3}{Fuel\ Cons/day}$$

where;

λ =	1/Fc	*(based on Barras (2004))*	W =	Displacement
Fc =	35.081,235405	*(for diesel machinery installation)*	V =	Ship's speed
λ =	0,000029		FOC/day =	5,564776 Ton/day

$$L(t) = \nabla(t) - W_{i,i+1}$$

$$F(t) = L(0) - L(t_{n-1})$$

Modified Mersin Method Calculation

Operational Modes & Calculation

MV MERATUS BONTANG

Trip Number	Window		Port		Time (hour)		Avg. Vs (knot)	Cargo (Ton)	Initial ∇ (Ton)	Initial MFO (Ton)	∇(*t*)	L(t)	F(t)	Report MFO Cons (Ton)	Error
	Depart	Arrive	Depart	Arrive	Total	Cruising									
MBT-1	09/01/2019 22:30	13/01/2019 23:48	Semarang	Pontianak	97,3	55,850	7,570	4017,00	7313,00	3296,00	7302,16297	3285,16	10,84	11,8603	8,63%
MBT-2	13/01/2019 21:54	18/01/2019 8:30	Pontianak	Semarang	106,6	48,983	8,508	980,00	4325,00	3345,00	4315,49541	3335,50	9,50	10,3123	7,83%
MBT-3	18/01/2019 8:36	21/01/2019 20:24	Semarang	Pontianak	83,8	63,683	7,263	3324,00	6666,00	3342,00	6655,742	3331,74	10,26	12,5738	18,42%
MBT-4	21/01/2019 16:00	26/01/2019 16:28	Pontianak	Semarang	120,5	45,567	9,053	637,00	3999,00	3362,00	3988,89348	3351,89	10,11	9,8109	3,01%
MBT-5	26/01/2019 16:48	30/01/2019 1:00	Semarang	Pontianak	80,2	53,200	8,036	2532,00	5881,00	3349,00	5870,32476	3338,32	10,68	17,8023	40,03%
MBT-6	29/01/2019 20:48	02/02/2019 17:00	Pontianak	Surabaya	92,2	57,700	8,506	1054,00	4387,00	3333,00	4375,70688	3321,71	11,29	11,5987	2,63%
MBT-7	03/02/2019 18:18	06/02/2019 11:54	Surabaya	Sampit	65,6	36,617	7,743	4408,00	78822,00	74414,00	78784,8864	74376,89	37,11	6,1046	507,97%
MBT-8	06/02/2019 13:24	09/02/2019 1:00	Sampit	Surabaya	59,6	27,733	8,193	659,00	3845,00	3186,00	3840,55548	3181,56	4,44	5,3415	16,79%
MBT-9	09/02/2019 9:00	12/02/2019 17:12	Surabaya	Kumai	80,2	43,250	8,363	4473,00	7749,00	3276,00	7737,23853	3264,24	11,76	6,5842	78,63%
MBT-10	12/02/2019 17:36	15/02/2019 14:24	Kumai	Semarang	68,8	30,650	7,480	3500,00	6739,00	3239,00	6733,56588	3233,57	5,43	6,4534	15,79%
MBT-11	15/02/2019 9:36	17/02/2019 14:42	Semarang	Surabaya	53,1	19,183	8,048	1066,00	4284,00	3218,00	4280,86795	3214,87	3,13	3,3793	7,32%
MBT-12	17/02/2019 18:42	20/02/2019 3:54	Surabaya	Sampit	57,2	32,150	7,089	4480,00	7724,00	3244,00	7718,68648	3238,69	5,31	5,8865	9,73%
MBT-13	20/02/2019 4:00	22/02/2019 9:24	Sampit	Surabaya	53,4	26,833	8,057	954,00	4153,00	3199,00	4148,69451	3194,69	4,31	5,1017	15,61%
MBT-14	22/02/2019 9:18	26/02/2019 0:12	Surabaya	Sampit	86,9	26,500	8,248	4468,00	7677,00	3209,00	7670,12804	3202,13	6,87	4,2078	63,32%
MBT-15	25/02/2019 20:24	28/02/2019 1:12	Sampit	Surabaya	52,8	28,817	9,403	728,00	3933,00	3205,00	3925,91349	3197,91	7,09	5,2325	35,43%
MBT-16	28/02/2019 9:30	03/03/2019 16:42	Surabaya	Kumai	79,2	40,133	7,304	4457,00	7688,00	3231,00	7680,76806	3223,77	7,23	6,7586	7,00%
MBT-17	03/03/2019 16:48	06/03/2019 13:12	Kumai	Surabaya	68,4	29,283	8,806	1246,00	4373,00	3127,00	4366,65211	3120,65	6,35	5,3415	18,84%
MBT-18	06/03/2019 13:24	08/03/2019 7:18	Surabaya	Semarang	41,9	19,933	7,038	3418,00	6759,00	3341,00	6756,05055	3338,05	2,95	4,3822	32,69%
MBT-19	08/03/2019 7:24	10/03/2019 11:24	Semarang	Kumai	52	28,033	8,117	4376,00	7750,00	3374,00	7743,02809	3367,03	6,97	5,3197	31,06%
MBT-20	10/03/2019 11:30	14/03/2019 7:18	Kumai	Surabaya	91,8	24,033	8,768	2512,00	5927,00	3415,00	5920,70021	3408,70	6,30	5,0145	25,63%
MBT-21	15/03/2019 2:00	17/03/2019 9:18	Surabaya	Semarang	55,3	19,700	9,587	4058,00	7532,00	3474,00	7524,08053	3466,08	7,92	5,2325	51,35%
MBT-22	17/03/2019 9:24	19/03/2019 19:54	Semarang	Kumai	58,5	30,283	7,883	3712,00	7166,00	3454,00	7159,45357	3447,45	6,55	5,9519	9,99%
MBT-23	19/03/2019 20:06	23/03/2019 3:12	Kumai	Surabaya	79,1	30,017	8,361	3058,00	6485,00	3427,00	6477,75551	3419,76	7,24	5,9737	21,27%
												Average	**8,68**	**7,23**	**44,74%**

Modified Mersin Method Calculation

MV MERATUS BENOA

Trip Number	Window		Port		Time (hour)		Avg. Vs (knot)	Cargo (Ton)	Initial ∇ (Ton)	Initial MFO (Ton)	∇(*t*)	L(t)	F(t)	Report MFO Cons (Ton)	Error
	Depart	Arrive	Depart	Arrive	Total	Cruising									
MBN-1	06/01/2019 20:18	11/01/2019 9:48	Surabaya	Kumai	109,5	33,500	9,106	3198,00	6245,32	3047,32	6235,13607	3037,14	10,18	6,8528	48,61%
MBN-2	11/01/2019 9:36	14/01/2019 2:30	Kumai	Semarang	64,9	26,317	7,532	3047,90	6842,16	3794,26	6837,34832	3789,45	4,81	7,2343	33,49%
MBN-3	14/01/2019 2:12	16/01/2019 12:00	Semarang	Surabaya	57,8	14,967	9,194	416,10	4511,92	4095,82	4508,14894	4092,05	3,77	5,0878	25,88%
MBN-4	16/01/2019 16:54	21/01/2019 8:48	Surabaya	Samarinda	111,9	63,433	8,086	3484,00	7186,34	3702,34	7171,51896	3687,52	14,82	13,6708	8,41%
MBN-5	21/01/2019 8:54	25/01/2019 20:06	Samarinda	Surabaya	107,2	62,267	7,018	256,80	6463,20	6206,40	6454,33256	6197,53	8,87	22,8207	61,14%
MBN-6	26/01/2019 14:00	30/01/2019 5:24	Surabaya	Kumai	87,4	51,900	7,627	4477,00	7524,32	3047,32	7513,82318	3036,82	10,50	12,9236	18,78%
MBN-7	30/01/2019 3:00	02/02/2019 10:12	Kumai	Semarang	79,2	35,667	7,087	4271,40	7320,72	3049,32	7315,03682	3043,64	5,68	7,9161	28,21%
MBN-8	02/02/2019 10:18	04/02/2019 2:30	Semarang	Surabaya	40,2	20,283	8,321	541,80	4848,73	4306,93	4844,75467	4302,95	3,98	4,2018	5,39%
MBN-9	04/02/2019 10:42	07/02/2019 8:48	Surabaya	Sampit	70,1	30,150	7,375	4509,00	7560,32	3051,32	7554,7889	3045,79	5,53	10,9476	49,48%
MBN-10	07/02/2019 9:00	09/02/2019 20:00	Sampit	Surabaya	59	28,983	7,610	268,50	4577,00	4308,50	4572,81949	4304,32	4,18	6,8815	39,25%
MBN-11	10/02/2019 9:00	12/02/2019 5:18	Surabaya	Semarang	44,3	24,183	8,567	3366,00	6692,88	3326,88	6686,46809	3320,47	6,41	5,1037	25,63%
MBN-12	12/02/2019 5:24	14/02/2019 4:42	Semarang	Kumai	47,3	30,550	8,240	4379,00	7427,02	3048,02	7419,29499	3040,29	7,73	7,7268	0,02%
MBN-13	14/02/2019 5:00	16/02/2019 22:42	Kumai	Surabaya	65,7	36,117	7,873	2624,90	6271,56	3646,66	6264,44397	3639,54	7,12	6,4940	9,58%
MBN-14	16/02/2019 21:00	20/02/2019 4:42	Surabaya	Kumai	79,7	40,850	6,642	4423,30	7470,62	3047,32	7465,18854	3041,89	5,43	7,4721	27,31%
MBN-15	20/02/2019 3:36	23/02/2019 1:48	Kumai	Surabaya	70,2	33,917	8,148	1664,10	5225,10	3561,00	5218,54048	3554,44	6,56	6,5347	0,38%
MBN-16	22/02/2019 22:18	26/02/2019 9:12	Surabaya	Kumai	82,9	40,433	7,081	4460,50	7511,82	3051,32	7505,28322	3044,78	6,54	8,1321	19,62%
MBN-17	26/02/2019 2:00	02/03/2019 17:00	Kumai	Surabaya	111	34,750	7,790	3471,40	6728,14	3256,74	6721,18877	3249,79	6,95	6,8022	2,19%
MBN-18	02/03/2019 14:06	06/03/2019 2:42	Surabaya	Kumai	84,6	36,550	8,323	4463,00	7493,00	3030,00	7483,41987	3020,42	9,58	9,1777	4,39%
MBN-19	05/03/2019 20:00	08/03/2019 23:30	Kumai	Semarang	75,5	29,767	7,703	4102,00	7120,00	3018,00	7114,02031	3012,02	5,98	11,7870	49,27%
MBN-20	08/03/2019 23:48	12/03/2019 1:36	Semarang	Surabaya	73,8	19,900	7,683	491,00	4704,00	4213,00	4700,99176	4209,99	3,01	4,5130	33,34%
MBN-21	12/03/2019 1:42	15/03/2019 9:30	Surabaya	Kumai	79,8	31,517	8,663	4483,00	8038,00	3555,00	8028,23939	3545,24	9,76	12,0843	19,23%
MBN-22	15/03/2019 9:48	18/03/2019 7:48	Kumai	Semarang	70	32,083	7,867	3043,90	6088,99	3045,09	6082,8063	3038,91	6,18	11,4570	46,03%
MBN-23	18/03/2019 8:30	21/03/2019 22:00	Semarang	Surabaya	85,5	18,700	7,935	824,00	5068,00	4244,00	5064,72691	4240,73	3,27	4,4932	27,15%
MBN-24	21/03/2019 21:00	25/03/2019 4:06	Surabaya	Kumai	79,1	36,233	6,810	3817,00	7114,58	3297,58	7109,55356	3292,55	5,03	10,4759	52,02%
MBN-25	25/03/2019 4:00	27/03/2019 23:30	Kumai	Semarang	67,5	31,033	6,726	2503,00	5889,77	3386,77	5886,11334	3383,11	3,66	8,0657	54,66%
MBN-26	28/03/2019 0:24	30/03/2019 17:48	Semarang	Surabaya	65,4	17,483	8,229	253,00	4271,60	4018,60	4268,55439	4015,55	3,05	4,3763	30,41%
												Average	**6,48**	**8,59**	**27,69%**

BIOGRAPHY

Sandy Naufal Hibatullah, as an author for this bachelor thesis was born in Kediri at July 6th, 1997. Author was the eldest child of two brothers. Started his middle education in SMP Negeri 4 Surabaya and high school in SMA Negeri 21 Surabaya then continued study in double degree program at Department of Marine Engineering, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia with Hochschule Wismar, Wismar, Germany. Author's achieved Best Student GPA from Hochschule Wismar. Until the end of study, he achieved highest GPA in Marine Engineering with index 3,86 of 4,00. While studying in ITS, author be the part of student organization, among others in Institute Student Executive Board (BEM ITS) and Department Student Executive Board (Himasiskal FTK-ITS). Besides in the field of managerial organization, author also incorporated in the ITS Student Choir (PSM ITS). Author also participated in many event committees, some of which were Gerigi ITS, Marine Icon and ITS Student Choir Concert. While in high school, author was the Chairman of the Student Organization (OSIS SMAN 21) and become a representative in Surabaya Student Association. Reading books and discussing are routine activities carried out by the author. This bachelor written by author represent the author's concern for the conditions of maritime sector. The author has ambitions to be an influential person in the maritime sector, specifically to environmental issues and the prosperity of the people in relation to maritime affairs, either in Indonesia or global scope. Author will be very grateful if there are further questions about himself or his works, he can be contacted via email at sandynaufal67[at]gmail[dot]com.

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