BACHELOR THESIS – ME 141502

FEASIBILITY STUDY OF REPLACING BARGE WITH BULK CARRIER AS COAL TRANSPORTATION OF POWER PLANT

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STUDI KELAYAKAN PENGGANTIAN KAPAL TONGKANG DENGAN KAPAL CURAH SEBAGAI TRANSPORTASI BATUBARA PEMBANGKIT LISTRIK

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APPROVAL FORM

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Submitted to Fulfill One of the Requirement
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S-1 Program Department of Marine Engineering
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FEASIBILITY STUDY OF BARGE REPLACEMENT WITH BULK CARRIER AS COAL TRANSPORTATION OF POWER PLANT

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ABSTRACT

Indonesia contains abundant reserves in medium and low-quality coal, especially in Kalimantan and Sumatra. Coal as power energy for steam power plant. Because the price is the same as other fossil fuels. Transportation of coal from location to power plant site is very far When using the land route, the most effective transportation is to use the ship. This thesis is used to find out which is more effective transporting coal from coal mine to jetty Abc power plant, using tugboat-barge 7.500 dwt or 40.000 dwt bulk carrier. and jetty feasibility analysis if using bulk carrier vessel.

The coal needs at PT. Abc is 70,754 tons per month. There are two choices to transport coal from coal terminal or coal jetty to Abc power plant. The existing transportation is using tugboat-barge with 7,500 DWT and the other transportation is using bulk carrier with 40,000 DWT. The consideration is fuel oil consumption, charter cost and some other cost. To fulfill coal needed at PT. Abc with using a tugboat-barges it will requires cost IDR 10.062.526.904 and using bulk carrier requires cost IDR 9.854.647.181. For the depth of the jetty should be dredged with a volume of 1635.9 m3 to be able to meet the load laden of bulk carrier.

Keywords: Coal, Tugboat, Bulk Carrier, Power Plant.

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STUDI KELAYAKAN PENGGANTIAN KAPAL TONGKANG DENGAN KAPAL CURAH SEBAGAI TRANSPORTASI BATUBARA PEMBANGKIT LISTRIK

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ABSTRAK

Indonesia memiliki cadangan yang melimpah di batubara kualitas menengah dan rendah, terutama di Kalimantan dan Sumatra. Batubara banyak digunakan sebagai sumber daya energy untuk pembangkit listri tenaga uap. Karna harganya yang murah dibanding dengan bahan bakar fosil lainnya. Transportasi batubara dari tambang ke lokasi pembangkit listrik sangat jauh jika melalui jalur darat, sehingga transportasi yang paling efektif ialah menggunakan kapal. Tesis ini digunakan untuk mengetahui mana yang lebih efektif dalam mengangkut batubara dari tambang batu bara ke dermaga Abc Power Plant, menggunakan kapal tugboat-7.500dwt atau 40.000dwt bulk carrier. Dan juga analisis kelayakan jetty jika menggunakan kapal bulk carrier.

Kebutuhan batubara di PT. Abc adalah 70.754 ton per bulan. Ada dua pilihan untuk mengangkut batubara dari terminal batubara atau dermaga batu bara ke pembangkit listrik Abc. Transportasi yang ada menggunakan tongkang tugboat dengan 7.500 DWT dan transportasi lainnya menggunakan bulk carrier dengan 40.000 DWT. Pertimbangannya adalah konsumsi bahan bakar minyak, biaya charter dan beberapa biaya lainnya. Untuk memenuhi kebutuhan batubara di PT. Abc dengan menggunakan tugboat-tongkang membutuhkan biaya Rp 10.062.526.904 dan menggunakan bulk carrier membutuhkan biaya Rp 9.854.647.181. Untuk kedalaman dermaga harus dikeruk dengan volume 1635,9 m3 untuk dapat memenuhi beban muatan kapal curah.

Kata Kunci: Batubara, Tugboat, Bulk Carrier, Power Plant.

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PREFACE

First and foremost, I would like to thank God for his bless and presence might this study can be finished to the fullest. Thank God for giving me the strength, knowledge, ability, and opportunity to undertake this research study and to persevere and complete it satisfactorily. Second to my parents, Budi Haryono and Wisminingrum, who supported me emotionally and financially. I would not be where I am today without your help and support.

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I must thank all of my lectures. Each of you have given of your time, energy, and expertise and I am richer for it. For the most inspiring, the Head of Marine Engineering Department, Dr. Eng Muhammad Badrus Zaman ST., MT. Also, to my academic advisor, Mr. Aguk Zuhdi Muhammad Fathallah Ir., M.Eng, PhD. You have been one of the highlights of studying at this college. I wish I can express how proud I am to be one of your student.

Completing this study would have been all the more difficult were it not for the support and friendship provided by the other members of the Institut Teknologi Sepuluh Nopember and the Department of Marine Engineering. I am indebted to them for their help.

A special thanks to Tungga Yulinda Putri, for her continued support, reminder, and encouragement. Thank you for being part of me, of my life with its ups and downs. I was continually amazed by your willingness to always help me.

The last, I wish to thank for those who I cannot mentioned here. This does not mean that I have forgotten your help. You guys know who you are. Again, thank you. Words will never be sufficient.

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CHAPTER I

INTRODUCTION

1.1. BACKGROUND

Energy resources are decreasing daily. Alternative energy is attracting increasing attention worldwide for diesel fuel in automotive and in industry. The potential alternative energy resources are coal, in Indonesia coal is very abundant, especially in Kalimantan Island and Sumatra Island. Coal is an important source of energy and raw material for electric power production. Although coal has a negative impact of having high levels of pollution, but coal is a reliable energy source, abundant, easily transported, easily traded and competitive in terms of price compared to other fossil fuels.

Coal is the dominating force in power generation. At least 27 percent of the world's total energy output and more than 39 percent of all electricity is produced by coal-fired power plants due to coal's abundance, its relatively easy and low-cost extraction, and less expensive infrastructure requirements compared to other energy resources.

Table 1.1. Indonesian Production, Export, Consumption & Price of Coal
(Source: Indonesian Coal Mining Association & Ministry of Energt and Mineral Resources)

	2012	2013	2014	2015	2016	2017
Production (Million tons)	412	474	458	461	456	461
Export (Million tons)	345	402	382	375	365	364
Domestic (Million tons)	67	72	76	86	91	97
Price (HBA) (USD/ton)	95.5	82.9	72.6	60.1	61.8	n.a.

In the table above that the production of coal in Indonesia from year to year is increasing, so is the use of coal. In period of time, we seem long enough to be highly dependent on coal as an energy source.

Coal obtained from the mining process located outside Java island as in Kalimantan and Sumatra. Transportation from coal mining to coal use industry by ship, because the distance of coal mining resources with industrial coal users lies quite far. The most effective transportation is by sea with ships. This day, currently used ships are tug barge with current capacity size of 7500 Metric Ton, 10.000 Metric Ton, and 12.000 Metric Ton. Based on the monthly trend, the merit order tends to increase in value due to the increase in cost of goods sold due to the increase in component C (fuel price). The price of coal is regulated by law so that

what can be reduced to increase the competitive value of power plant is to reduce transportation costs.

By using the principle of economic of scale in the hypothesis of transportation cost per ton will decrease along with the increase of cargo capacity of ship. On the other hand, it should also be studied about the capability of harbor pool for maneuvering vessels with size and depth exceeding capacity that can be accommodated with the existing operation pattern. Jetty capabilities, the unloading speed of the equipment should also be noted, so as not to become a bottle neck in the movement of the mother vessel.

1.2. STATEMENT OF PROBLEMS

Based on the description above the statement of problem of this thesis are:

1. How the jetty conditions at PT. Abc Power Plant?
2. How the assessment of unloading speed of PT. Abc Power Plant unloading equipment?
3. How the comparation of the fuel consumption for coal transportation from existing transportation between barge-tugboat and bulk carrier?

1.3. RESEARCH LIMITATIONS

The limitations of this thesis are;

1. This thesis is use PT. Abc Power Plant as a consideration of the replacing barge with bulk carrier vessel to as coal transportation of power plant.
2. The supply coal is from Balikpapan Coal Terminal.

1.4. RESEARCH OBJECTIVES

The objectives of this thesis are;

1. To know jetty conditions, on the PT. Abc Power Plant.
2. Obtained Assessment of unloading speed from unloading equipment PT. Abc Power Plant condition of equipment.
3. Obtain the comparation of the fuel consumption for coal transportation from existing transportation between barge-tugboat and bulk carrier.

1.5. RESEARCH BENEFITS

The benefits of this thesis are;

1. Obtain a technical recommendation on the feasibility of using the docks, harbor pools and unloading equipment at PT. Abc Power Plant
2. With the implementation of this activity, PT. Abc Power Plant is expected to obtain a comprehensive description of the cost required in calculating fuel transportation costs by using bulk carrier coal using Indonesian flag.

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CHAPTER II
LITERATURE REVIEW

2.1. Power Plant

The power generation industry, taken as whole, is the world's biggest industry and it has the largest impact of any industry on the environmental on earth. A power plant is assembly of systems or subsystems to generate and deliver mechanical or electrical energy. The power plant must be efficient, economic, and environmental friendly to the society. The main pieces of equipment for the generation of electric power in a power plant are prime mover and generator. A prime mover runs the generator and the electricity is generated. The type of prime mover determines the type of power plants.[1] The power plant may be classified as:

1. Hydroelectric Power Plant (PLTA)

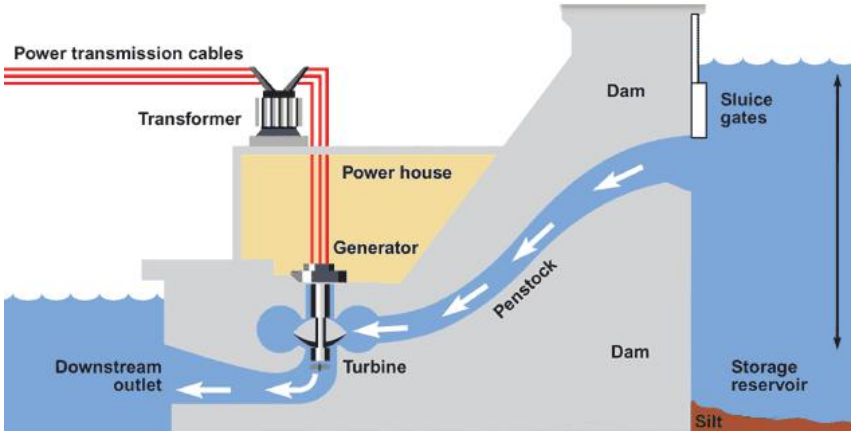

Figure 2.1 Hydroelectric Power Plant
(Source: https://water.usgs.gov)

The Greek word *hydro* means water. Hydroelectricity is electricity made from moving water. People use rivers, ocean tides, and ocean waves to make hydroelectricity. In short, hydroelectric power plant uses water to drive the turbine and it's usually made in a water source that has a large debit (Q) and a sufficient height altitude (h). The water cycle makes hydropower a never-ending source of energy. Water evaporates from oceans, lake, and rivers into a gas. The gas condenses into clouds. Later, it falls as rain and snow. Rain and snow refill rivers

[1] Manoj Gupta, *Power Plant Engineering* (New Delhi: PHI Learning Pvt. Ltd, 2012), 5.

and lakes.[2]

2. Steam Power Plant (PLTU)

Figure 2.2. Steam Power Plant
(Source: https://www.indonesiapower.co.id/id/produk-dan-layanan/produk/Pages/UJP-PLTU-Barru.aspx)

It is the power plant which is used to generate electricity by the use steam turbine. This steam can be generated by coal or fuel processed inside the boiler. The major components of this power plant are boiler, steam turbine, condenser, and water feed pump.

3. Gas-Turbine Power Plant (PLTG)

Natural gas is the second most important fossil for generating electricity after coal. Its exploitation as an energy source for electrical power generation dates from the early part of the 20th century. However, it was in the latter part of the century that capacity accelerated alongside the development of efficient gas turbine-based power stations.

The exploitation of natural gas for power generation began with the use of gas in boilers to raise steam for a steam turbine. Where natural gas was readily

[2] Josepha Sherman, *Hydroelectric Power* (Minnesota: Capstone Press, 2004), 6.

available this offered a cheap and reliable means of generating electricity, particularly in oil producing countries that had large volumes of natural gas available for which there was no obvious use. Such boilers are similar to coal-fired boilers but without the necessity for coal handling and preparation. While this offered a viable option where it was available, coal was the fuel of choice for most large fossil-fuel power stations.[3]

4. Geothermal Power Plant (PLTP)

Geothermal power plants use hydrothermal resources that have both water (hydro) and heat (thermal). Geothermal power plants require high-temperature (300°F to 700°F) hydrothermal resources that come from either dry steam wells or from hot water wells. People use these resources by drilling wells into the earth and then piping steam or hot water to the surface. The hot water or steam powers a turbine that generates electricity. Some geothermal wells are as much as two miles deep.[4]

5. Nuclear Power Plant

Many power plants, including nuclear power plants, heat water to produce electricity. These power plants use steam from heated water to spin large turbines that generate electricity. Nuclear power plants use heat produced during nuclear fission to heat water.

6. Diesel Electric Power Plant (PLTD)

A generating station in which diesel engine is used as the prime mover for the generation of electrical energy is known as diesel power station. For generating electrical power, it is essential to rotate the rotor of an alternator by means of a prime mover. The prime mover can be driven by different methods. Using diesel engine as prime mover is one of the popular methods of generating power. When prime mover of the alternators is diesel engine, the power station is called diesel power station. The mechanical power required for driving alternator comes from combustion of diesel. As the diesel costs high, this type of power station is not suitable for producing power in large scale in our country. But for small scale

[3] Paul Breeze, *Gas-Turbine Power Generation* (London: Academic Press, 2016), 1 & 5.
[4] The U.S. Energy Information Administration, "Geothermal Power Plants". Retrieved from https://www.eia.gov/energyexplained/index.php?page=geothermal_power_plants (July 11, 2018)

production of electric power, and where, there is no other easily available alternatives of producing electric power, diesel power station are used.[5]

7. Combined-Cycle Gas and Steam Turbine Power Plant (PLTGU).

According to Kehlhofer et al (2009) *combined cycle* can be defined as a combination of two thermal cycles in one plant. When two cycles are combined, the efficiency that can be achieved is higher than that of one cycle alone. Thermal cycle with the same or with different working media can be combined: however, a combination of cycles with different working media is more interesting because their advantages can complement one another. Normally, when two cycles are combined, the cycle operating at the higher temperature level is called the *topping cycle*. The waste heat it produces is then then used in a second process that operates at a lower temperature level, and is therefore called the *bottoming cycle*.

In short, a combined-cycle power plant uses both a gas and a steam turbine together to produce up to 50 percent more electricity from the same fuel than a traditional simple-cycle plant. The waste heat from the gas turbine is routed to the nearby steam turbine, which generates extra power.

2.2. Coal

Coal is an organic material derived from dead plants, and is formed through a complex process, takes a very long time and influenced factors include comics, physics and geology. The main elements of coal consist of carbon, hydrogen and oxygen. Coal was first used by humans to fuel around the 18th century by the Chinese. Along with the development of industry, coal is used for fuel in industrial activities (nylon fiber fabrics, synthetic rubber, plastic mixed materials), power plants, railway fuels and ships. one of the most important uses of coal is in power generation. Power plants use steam coal or also known as thermal coal.

Indonesia is one of the world's largest producers and exporters of coal. Since 2005, when it overtook Australia, the country is the leading exporter in terms of thermal coal. A significant portion of its exported thermal coal consists of the medium-quality type (between 5100 and 6100 cal/gram) and the low-quality type (below 5100 cal/gram) for which large demand originates from China and India. According to information presented by Indonesia's Ministry of Energy and Mineral Resources, Indonesian coal reserves are estimated to last around 83 years if the current rate of production is to be continued.

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[5] Patil, Nitin S. "Diesel Electric Power Plant". Retrieved from: http://www.sgipolytechnic.in/Notes/Electrical/SE_05.pdf (July, 11 2018)

Regarding global coal reserves, Indonesia currently ranks 9th, containing roughly 2.2 percent of total proven global coal reserves according to the most recent BP Statistical Review of World Energy. Around 60 percent of Indonesia's total coal reserves consists of the cheaper lower quality (sub-bituminous) coal that contains less than 6100 cal/gram.

Coal Production in Indonesia year 2010-2015 this increase in production is inseparable from the increasing demand for energy available, where the level of energy demand doubled positively correlated with increased use of increased coal. Most of the country's coal reserves are spread over three provinces wich is; South Sumatra (39%), East Kalimantan (34%), and South Kalimantan (16%). Coal can be classified by its quality; low quality coal, medium quality coal and highquality coal. Specifically the distribution of coal is based on the following criteria:

1. Low Calorie Coal is the lowest rank coal type, is soft-hard, easy to knead, contains high water content (10-70%), shows the wood structure, calorific value <5100 cal / gr (adb).
2. Calorie Coal Medium is a higher rank coal type, harder, easier to squeeze - cannot be kneaded, water content is relatively lower, generally wood structure is still visible, calorific value is 5,100-6,100 cal / gr (adb).
3. High Calorie Coal is a higher rank coal type, harder, not easily crushed, relatively lower water content, generally invisible wooden structure, calorific value of 6,100-7,100 cal / gr (adb).
4. Very High Calorie Coal is the highest rank of coal, generally influenced by intrusions of igneous or tectonic rocks, very low water content, calorific value> 7100kal / gr (adb).

Indonesian coal quality is dominated by Medium Calorie Coal (66.39%), followed by Low Calorie Coal (20.22%), High Calorie Coal (12.43%), and Very Low Calorific Coal with very small amount (0.96).

2.3. Port

According to Law no.17 of 2008 concerning shipping, the port is a place consisting of land and or waters with certain boundaries as a place of government and corporate activity. Physically, the port is used as a place to ship anchored, up and down passengers and / or unloading of goods. Thus, the ports are generally terminal and ship berths equipped with safety and security facilities for shipping and other port supporting activities.

Figure.2.3. Port
(Source: http://pltupaiton12.blogspot.co.id/2011/06/pltu-paiton-jatim.html)

Ports have social and economic functions. Economically, the port serves as one of the drivers of the economy because it becomes a facility that facilitates the distribution of the products. Socially, the port becomes a public facility where interaction between users (community), including interactions that occur due to economic activity

Conceptually, the port has three strategic functions. First, as links or links. That is, the port is one of the transportation process link from the place of origin of goods / people to the destination. Secondly, as the interface, the port as a meeting place of two modes of transportation, such as sea transportation and land transportation. Third, as a gateway, the port as the gate of a region / country. In regard to its function as a gateway, it is not surprising that every ship visiting a region / country then the ship is obliged to comply with the rules and procedures applicable in the region / country where the port is located.

2.4. Mooring Dolphin and Breasting Dolphin

Dolphin is a construction used for ship berths commonly used along with a dock to shorten the length of the building. The fastening tool is planned to withstand the horizontal force caused by a collision of ships, wind, impulse currents of the hull when moored. Dolphin can be divided into two kinds: Breasting Dolphin (BD) and Mooring Dolphin (MD).

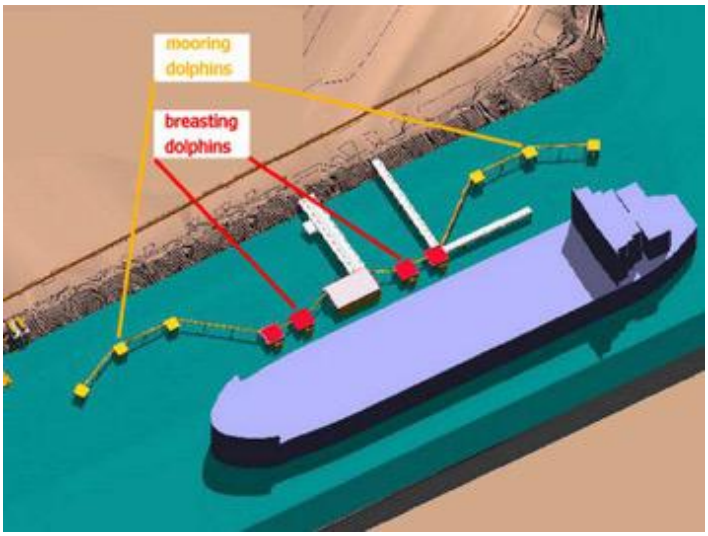

Figure 2.4. Breasting Dolphin and Mooring Dolphin
(Source: https://oceanandairtechnology.com/2013/05/dolphins-image1.jpg)

Breasting Dolphin has a larger size, because it plans to withstand the marital impact of the vessel and withstand the pull of the ship due to wind, currents and waves. This device is equipped with a fender to hold the vessel and bolt lumps to place the rope of the ship, in order to move the ship along the pier and withstand the pull of the ship. Mooring Dolphin is not used to withstand the impact, but only as a fastening.

Mooring and Breasting dolphin settings are as follows:
The mooring of the vessel to the inner MD must be perpendicular to the ship's side. In the center and outer MDs should form an angle <150 to the perpendicular line of the ship's plane, the angle formed when roping the rope on the boulder should not exceed 100.

For all MD it is best to use easily removable hooks. The MD structure is placed at a certain distance behind the berthing line. Distance MD of 35-50 m from BD. The location of MD is usually by aligning the axis of the rope with the direction of the current. If the direction of the water current is weak, the location of the mooring is made parallel to the wind direction.

2.5. Crane

Crane is one of the heavy equipment used as a lifter in a construction project. Cranes work by lifting the material that will be moved, move in a horizontal way, then lower the material in the desired place. This tool has a large lift and shape and can rotate up to 360 degrees and reach up to several tens of meters, Crane is generally used in project work jobs, ports, workshop, industry, warehousing and others. there are several types of cranes:

2.5.1 Crane ship (ship gear)

For practicality, cargo ships are generally equipped with ship cranes (ship gear). Crane ship must be able to be used in doing stevedoring activities both for goods type container, as well as bag cargo (using the mesh).

2.5.2 Tower crane

Tower crane is a tool used to lift material vertically and horizontally somewhere high in limited space. This type of crane is divided based on the way the crane stands, namely free standing cranes, rail mounted cranes, tied-in tower cranes and climbing cranes.

2.5.3 CC (Container gantry Crane)

Container loading and unloading equipment installed permanently on the dock by using a rail so that it can be shifted that works for loading and unloading container with a considerable range / row.

The main parts are Boom, Gantry, Spreader, and Trolley. Trolley is a part of Container Crane which consists of wheels moving on the rails. The function of the Trolley is to move the container that has a very heavy load to the 12orto r to the ground quickly. Mechanism of motion by using the motor

2.5.4 RTGC (Rubber Tyred Gantry Crane)

A container loading and unloading tool that can move in a stacking field that serves to raise / lower the container from and to the top of the trailer or vice versa in the stack area according to the block, slot, row and tier.

2.5.5 HMC (Harbour Mobile Crane)

loading and unloading equipment in ports / cranes that can move and have flexible properties so that it can be used for loading / unloading container and general cargo goods with lift capacity / SWL (safety weight load) up to 100 tons.

2.5.6 KC (Kangooro Crane)

It is another type of loading and unloading tool at the port. shaped like a ship's crane, yet located on the dock. Some use rails or wheels as a means to move places. This tool can be used for various types of cargo, such as grab, bag carge, and dry bulk (with the addition of certain tools).

2.6. Types of Vessel Charter

There are some type vessel charter that commonly used time charter and freight charter.

2.6.1. Time Charter

in time charter, the ship owner grants Charterer the freedom to use his ship and sail for a specified period of time agreed upon in C / P. For example, for six months, a year, two years and sometimes up to ten years. In this type of charter, the Skipper and the ABK are provided by the Ship Owner all the costs of the Skipper and ship crew, Floating Repair, lubricants, ship surveys and insurance to the responsibility of the Ship Owner.

While the costs of fuel oil, disbursement at the port, stevedoring, boiler water, drinking water and other exploitation costs, become the burden of Charterer. Unless otherwise arranged in C / P the cost of drinking water for Skipper and ABK is borne by the Ship Owner. Charter Fee in Time Charter is not covered by the amount of goods transported, but based on time.

Things to consider in a T / C contract are:

- The date, name, and address of the ship owner and the tenant
- Details of the vessel, such as name, place of registration, ton size, capacity, draft, horse power, engine power, speed, fuel consumption, loading and unloading equipment, pumps,
- The state of the ship and its class
- Shipping limits
- Rents, payment limits, and currency used
- Damages / slowness that can be worn off-hire
- Lease time starts
- Right of tenants to express objections and possibilities for replace the master or chief engineer
- Actions to be taken at the time of damage
- Implementation of arbitration in case of inconsistency of understanding

2.6.1. Bareboat / Demise Charter

The vessel is rented as a ship's body only. The charterer provides the captain himself and the crew and operates the ship as if it belongs to his self.

2.6.2. Voyage Charter

The charte fee on freight charter is based on the amount of goods trasported, not based on time. In this type of charter, the Skipper and the ABK are provided by the Ship Owner all the costs of the Skipper and ship crew, Floating Repair, lubricants, fuel oil, ship surveys and insurance to the responsibility of the Ship Owner. Charterer are only obliged to pay the charter fee by the amount of goods for one transport route which has been agreed in C / P.

Things to consider in a V / C contract are:

- Date and identity of ship owner and tenant
- Details of the ship
- Type of load to load and how to load it
- Locations where loading and unloading
- Schedule loading and unloading, if too late, then the lease agreement the charter party can be canceled
- The time lay (lay time), freight rate (freight rate) and currency used
- The amount of premium slowness and speed of loading and unloading (demurrage and despatch)
- Agent or guardianship to be used
- How to resolve strikes, congestion at the port, shortcomings charge

2.6.3. Consecutive Voyage Charter

Also known as the contract of offreighment (CoA), which is the leasing of vessels for several voyages in a row. Operationally, each cruise stands alone and the lease is also completed per-voyage, the same requirement as the voyage charters.

2.7. Cost of Sea Transportation

The optimum assessment in the distribution of coal in this discussion is what kind of distribution pattern that can meet the main objectives of the region that wants to meet the needs of coal and requires the lowest cost. For that it must be known what costs arise due to the distribution of coal and cost components that shape it. Since the distribution channel used is by sea, there must be a clear definition of the cost of sea transportation. On the voyage there is no standard cost classification that can be accepted internationally, so used the approach to classify it, this cost is divided into 3 categories:

1. Capital cost
2. Operational costs
3. Cargo handling cost

2.7.1. Capital cost

Capital Cost is the price of the vessel when purchased or built or charter. Cost capital is included in the cost calculation to cover loan interest payments and return on capital depending on how the vessel procures. Return in the cost calculation to cover loan interest payments and return on capital depending on how the vessel procures. The return of this capital value is reflected as an annual payment.

2.7.2. Operasional Cost

Operational Cost is the fixed costs incurred for the everyday operational aspects of the ship to make the ship is always in a state ready to sail. Including operational costs are maintenance and repair and lubricating oil.

Voyage Cost is the variable costs issued the vessel for the needs during the voyage. The components of shipping costs are fuel for parent and auxiliary machines, port fare, guidance and snooze.

$$VC = FC + PD \quad \text{..... (2.1)}$$

Where:
VC = voyage cost
PD = port dues (port costs)
FC = fuel cost

- fuel cost

Ship fuel consumption depends on several variables such as size, shape and condition of the hull, loaded voyage or ballast, speed, weather (wave, ocean current, wind), type and capacity of parent and auxiliary motor, fuel type and quality. Fuel depends on daily consumption of fuel during sailing at sea and at port and fuel prices. To calculate the fuel cost, first have to know the fuel oil consumption of the ship. Based on Lecture on ship design and ship theory by Herald Peolhs the formula to calculate the fuel consumption is:

$$wfo = (Pxbme)\ x\ \frac{t}{v} x\ 10^{-6} \quad \text{..... (2.2)}$$

where;
wfo = Fuel Consumption (ton)
P = Engine Continous Rating (kw),
Bme = Spesific fuel oil consumption (gr/kwh),
t = Distance (Nm)
v = Ship speed (Kn)

- port cost

At the time the vessel at the port costs incurred include ports dues and service chargers. Port dues are fees charged on the use of port facilities such as docks, moorings, port pools and other infrastructure depending on the volume of cargo, cargo weight, GRT, NTR and DWT vessels. Port cost arranged by the regulation of the minister of transportation of the republic of Indonesia number PM 72 of 2017 about the type, structure, class and mechanism of tariff determination services port (Peraturan Menteri Perhubungan Republik Indonesia Nomor PM 72 Tahun 2017 tentang jenis, struktur, golongan dan mekanisme penetapan tarif jasa kepelabuhan, 'pasal 9'). For vessel with length more than 70meter sail in seaport have to be pilotage by 2 ttugboats with 1600-3400 PK.

- Pilotage calculate based on gross tonnage (GT) the formula is:
  ((GT x variable rate) + main rate) x moving.
- Tugboat servce calculate based on how many tugboat used multiplied with gross tonnage. The formula is:
  ((GT x variable rate) + main rate) x hour x unit tugboat

2.7.3. Cargo handling cost

By knowing the arrival system it will be easy to plan queuing system used. Cargo handling costs also affect shipping costs that must be incurred by shipping companies. Activities undertaken in loading and unloading consist of stevedoring, cargodoring, receiving / delivery. This activity is carried out by a loading and unloading company (PBM) that employs workforce loading and unloading (TKBM). According to the Minister of Transportation's Decree NO: KM 14 of 2002 concerning the Organization and Exploitation of Loading and Unloading of Goods and to Ships, the meaning of the term is as follows:

- Stevedoring is the work of unpacking goods from ship to dock / barge / truck or loading goods from the dock / barge / truck into the ship until it is arranged in a hatch using a tow vessel or a land crane.
- Cargodoring is the work of removing goods from ropes (ex tackle) on the dock and hauling from the docks of the cache / field of conglomeration of goods further composing in warehouse / field of stockpiling or vice versa.
- Receiving / delivery is the work of moving goods from a heap / stacking place in a warehouse / stacking field and handing them up on a vehicle at the door warehouse / field buildup or otherwise.
- Loading & unloading Company (PBM) is a Legal Entity Indonesia is specifically established to organize and cultivate loading and unloading activities from and to the vessel.
- Loading and unloading labor is all workers registered at the local port that is carrying out loading and unloading work at the port.

CHAPTER III

METHODOLOGY

3.1. Flow Chart Methodology

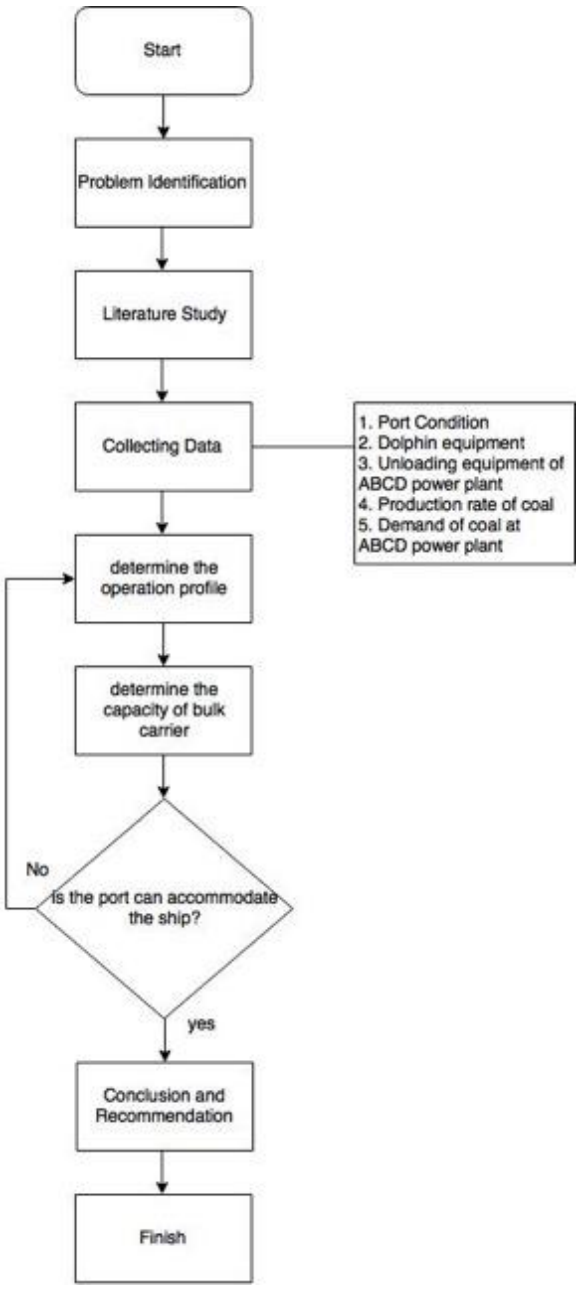

Figure.3.1. flowchart
Source: writer

3.2. Definition of Methodology Flowchart

Here is an explanation of the steps of the flowchart in this thesis:

3.2.1. Problem identification

Problem identification is the first stage to determine the problem. By formulating the existing background with the current problem solution will be obtained. At this phase the method will be implicated. in this thesis is the analysis of the feasibility of the port for the replacement of barges with bulk carriers as coal transportation.

3.2.2. Literature study

The second stage is a study literature intends to collect the literature related to the thesis. the literature collection can use previous journals, books, and thesis that existed before.

3.2.3. Collecting Data

The third stage is to collect the data needed for comparative analysis of data that has been obtained such as port condition, dolphin equipment, unloading equipment at port, the production rate of coal and the demand of coal at Abc Power Plant.

3.2.4. Determine the operation profile

In determaining the operation profile, there will be some factors should be consider such as the production of coal, the demand of the coal at the Abc Power Plant and the distance from the coal mine. Those factors will be consider to choose the effectife operation profile.

3.2.5. Determine the capacity of bulk carrier

From the operation profile that alrady choose before, will be determine the capacity of bulk carrier. in the determine of bulk carrier to be considered is the distance from the coal mine to the port of ABCD, the condition of the port of ABCD, and the ratio of ship prices.

3.2.6. Conclusion and Recomendation

After all the step is done the final step is conclusion of the analysis and recommendation which ship is more effective to be use for Abc Power Plant.

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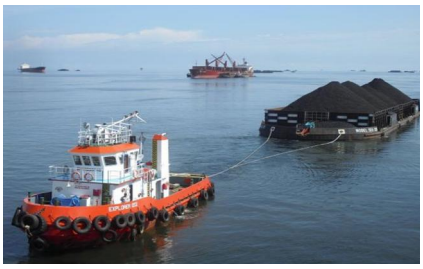
CHAPTER IV

Analysis and Discussion

4.1. Feasibility study plans in general

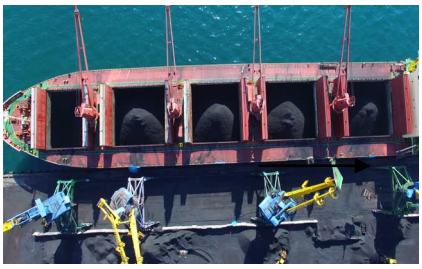
In general, plans to replace coal transportation, previously used tugboat-barge vessels into bulk carrier vessels require some analysis to determine whether facilities at Abc Power Plant can be accommodate the ship. There are some analyze that has been done: jetty condition, coal requirement, availability of coal, operation profile of coal transportation.

Tugbot-Barge



become

Bulk Carrier



4.1.1. Jetty condition

Function of jetty is to reduce the occurrence of transplanting of sediment due to sediment carried by the current up to the coastline. Sedimentary may disrupt the traffic of ships that will pass in the cruise line.

Jetty PT. Abc Power Plant has a length of 162.2 meters. For the current jetty condition PT. Abc Power Plant is designed to accommodate 12.500 DWT of coal, the future will be expanded with a capacity of 40.000 DWT. The following picture is the expansion plan from 12.500 DWT to 40.000 DWT.

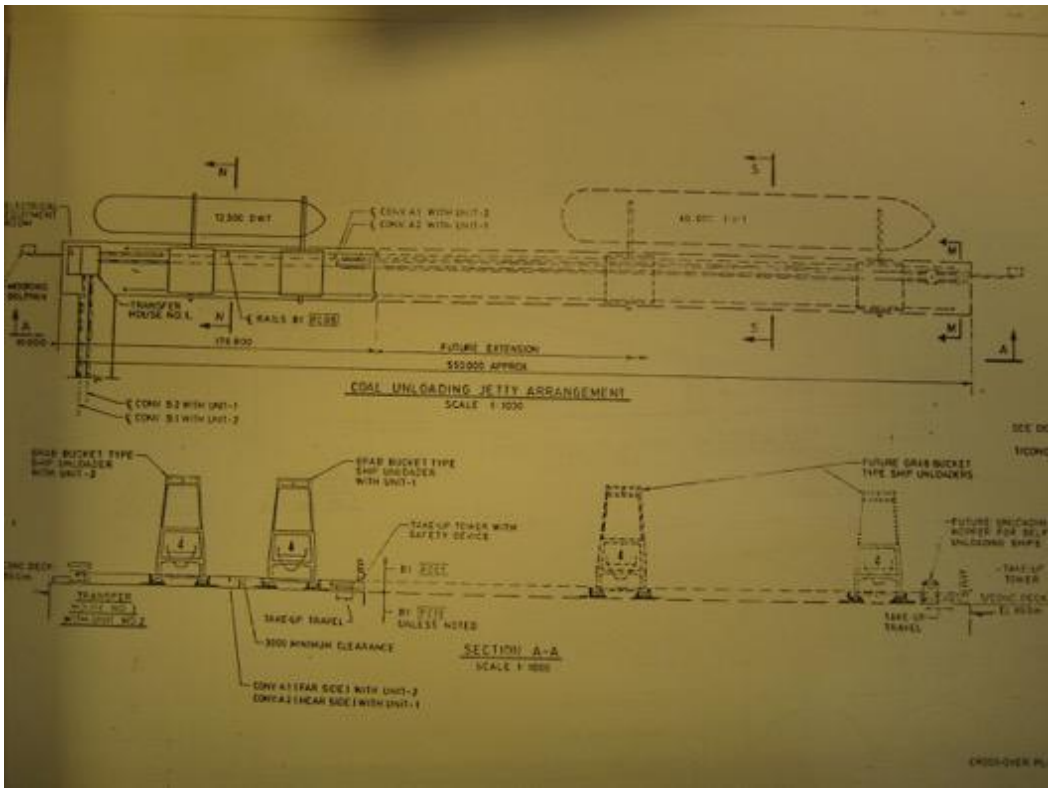


Figure 4.1. Expansion plan
(Source: Coal drawing paiton)

The vessel length with a capacity of f 40,000 dwt is 189,5 meters. With length of the jetty 162.2 meter so we can know the length of Abc Power Plant jetty is not sufficient to lean the vessel. The reason why the jetty is not sufficient is because the length of the jetty is not suitable with the length of the vessel.

4.1.2. Bathymetry survey

Since it operates until now, the jetty pool has a fairly high sedimentation of -17m when the plan is to be -10m (7m sedimentation). the main cause of sedimentation is coal spills during the unloading activity of the vessel. Bathymetry or also often called sounding to measure the depth of the sea, the results of bathymetry survey will be obtained relief the seabed.

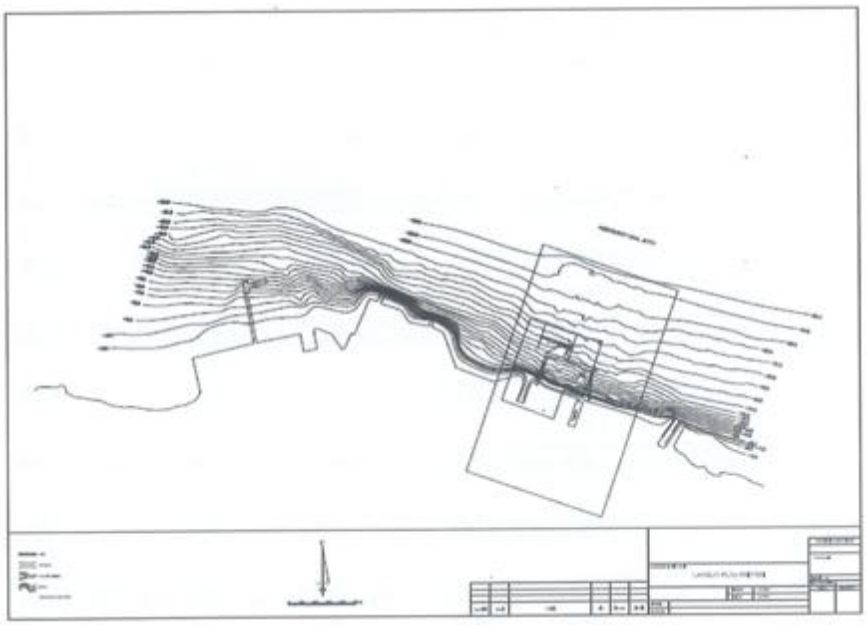


Figure 4.2. Data Bathymetry jetty PT. Abc Power Plant
(Source: Laporan akhir jasa assessment sedimen coal jetty)

To know the depth of Abc Power Plant jetty then conducted bathymetry survey. Based on the results of jetty sediment assessment in 2015, bathymetry of Abc Power Plant jetty data:

Table 4.1. bathymetry of Abc Power Plant
Source: Laporan akhir jasa assessment sedimen coal jetty

No.	Station	Width	Wide	Interval	Volume
		(M^2)	(M^2)	(M)	(M^3)
1	1	4,2	4,1	9,8	40,1
2	2	3,9	4,1	9,8	39,7
3	3	4,2	8,3	9,8	80,9
4	4	12,4	12,7	9,8	124,2
5	5	12,9	12,6	9,8	123,1
6	6	12,2	12,5	9,8	121,9
7	7	12,8	13,2	9,8	128,9
8	8	13,6	13,2	9,8	128,9
9	9	12,8	12,6	9,8	123,5
10	10	12,5	12,3	9,8	120,6
11	11	12,2	12,2	9,8	119,1
12	12	12,2	11.4	9,8	111,7

13	13	10,7	9,9	9,8	97,8
14	14	9,3	5,9	9,8	57,2
15	15	2,4	2,4	9,8	23,5
16	16	2,4	2,4	9,8	23,2
17	17	2,3	2,3	9,8	22,8
18	18	2,3		9,8	0
Total					1487,2
Siltation 10%					148,7
Volume Total					1635,9

Table 4.2. Result calculation dregging volume
Source: Laporan akhir jasa assessment sedimen coal jetty

Calculation Volume			
No.	Description	Unit	Total
1.	Wide	Meter	3
2.	Length	Meter	175
3.	Depth Design	M LWS	-18
4.	Dregging Volume	M^3	1635,9

To meet the required depth PT. Abc Power Plant will be dredging until it reaches the required depth. From the data it can be seen that dregging volume at jetty PT. Abc Power Plant is 1635,9 m^3.

4.2. Calculation Loading Unloading time

4.2.1. Loading Time

For loading coal from Balikpapan Coal Terminal to vessel is using crane from terminal. The specification of ship unloading berth at the table below:

Table 4.3. Shiploading Berth at Balikpapan Coal Terminal
(Source: https://www.bayan.com.sg/index.php/en/business-info/ports-shipping)

SHIPLOADING BERTH	
Loading Rate	: 1x 4000 tonnes / hour
Type	: Travelling Luffing
Max Throw	: 43m
Max Ship Air Draft	: +19m LWD
Draft at berth	: -15m LWD

So, for loading coal to ship is using crane from Balikpapan Coal Terminal.

- For Bulk Carrier with 42842 DWT

$$N = \frac{W1}{W2\ x\ 75\%}$$

Where:

N = total time
W1= Capacity of coal that have to unload (40909 ton)
W2= Capacity of the crane (4000 ton/hour)
Safety factor 75-80%

So, the result

$$N = \frac{40909}{4000\ x\ 75\%}$$

N = 13,63 hours

- For Barge-Tugboat with 7500 DWT

$$N = \frac{W1}{W2}$$

Where:

N = total time
W1= Capacity of coal that have to unload (7500 ton)
W2= Capacity of the crane (4000 ton/hour)
Safety factor 75-80%

So, the result

$$N = \frac{7500}{4000\ x\ 75\%}$$

N = 2,5 hours

4.2.2. Unloading

There are two options for unloading coal from the ship to conveyor at Abc Power Plant, first is using crane at jetty (Ship Unloader) and second is using ship crane (for bulk carrier).

1. Ship Unloader

Ship Unloader (SU) is an equipment used for unloading coal from a ship that does not have its own unloading equipment. This equipment is equipped with Grab (bucket) with unloading capacity of 500 tons / hour for each ship unloader. Working process of ship unloader is to take coal from barge or coal vessel using grab then unload coal material to hopper ship unloader which then in feed to belt conveyor.

Abc Power Plant has 2 ships unloader which can operate normally, maximum range for 2 ships unloader are 95.4 meter, however for 1 ship unloader is 68.4 meter.

- For Barge-Tugboat

$$N = \frac{W1}{W2}$$

Where:

N = total time
W1= Capacity of coal that have to unload (7500 ton)
W2= Capacity of the crane (700 ton/hour)

The result if using 1 crane

N = 7500 / 700
N = 10.7 hours

- For Bulk Carrier

A. Simulation with 2 ships unloader

Length of the ship is exceed length of the jetty, so some of the vessel enter area jetty PT YTL ± 62 meter

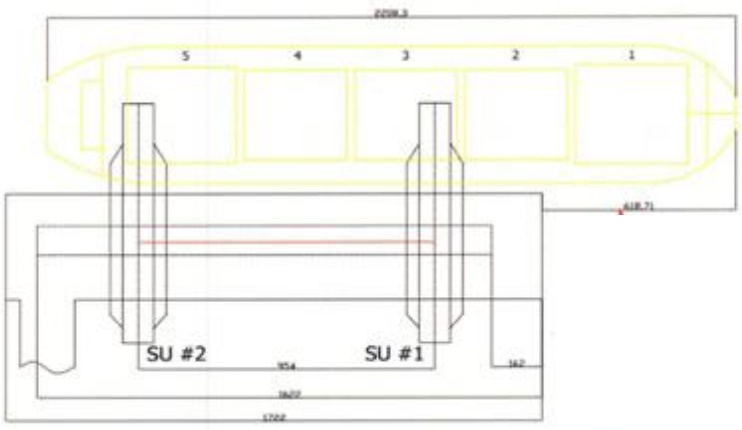


Figure 4.3. ship unloading coal from ship to conveyor

The posisition of hatch No.1 and 2 cannot be unload because out of range the ship unloader. The process of unloading coal fron the vessel as follows:

1) Unloading process from west side (hatch No. 5 and 4 first) and then both of the ship unloader shifted to the east. SU #2 at the end of the reel stopper to unloading coal fron hatche 5 and SU #1 approaching SU #2 to unload hatch No. 4
2) After hatch No. 5 and 4 finished unloading, then shifted the both of ship unloader to unload hatch No.3
3) After finish unload hatch No. 5, 4 and 3 the vessel shifted to the west side to unload coal from hatch 1 and 2

B. Simulation with 1 ship unloader

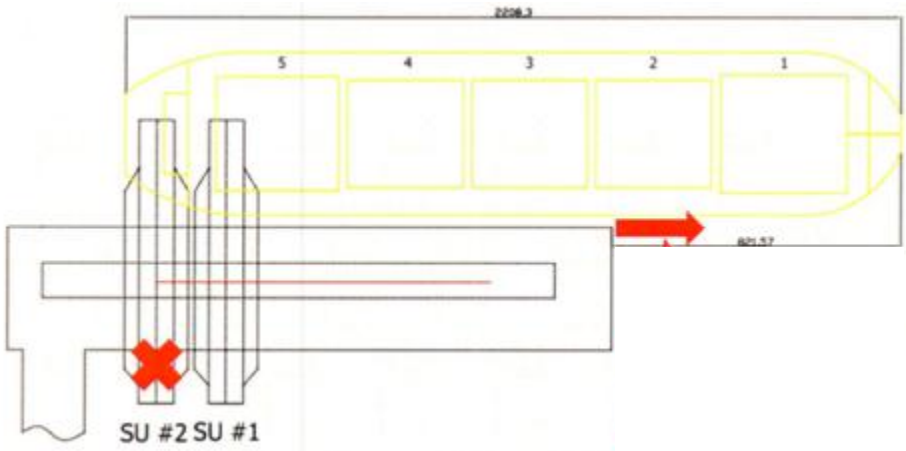


Figure 4.4. ship unloading coal from ship to conveyor

When SU #2 not ready, position of vessel shifted to the east side ± 82 meter (enter the area jetty PT YTL), so it is need coordination with PT. YTL when shifting vessel.

- Position SU #2 will be parked at the end of reel stopper west side
- Position SU #1 approaching SU #2 to unload coal hatch No. 5 and 4 first and then after hatch No. 5 and 4 finish, vessel shifted ± 80 meter to west side and unload the rest of coal at hatch No. 3, 2 and 1

So, for total time to unloading coal from ship to the conveyor using ship unloader:

$$N = \frac{W1}{W2}$$

Where:

N = total time
W1= Capacity of coal that have to unload (40909 ton)
W2= Capacity of the crane (500 ton/hour)

The result if using 1 crane

N = 40909/700
N = 58,441 hours or 59 hour

The result if using 2 cranes

N = 58,441/2
N = 29,22 hours or 30 hour

4.3. Prospects of Coal

Indonesia's coal production reached 461 million tons in 2015, a six-fold increase over the past 15 years. This coal production grows an average of 14 percent per year. For the amount of resources and coal reserves, Data Directorate General 2016 shows the region with the largest coal wealth concentrated in 2 islands namely Sumatra (50 percent) and Kalimantan (49.5 percent), the rest is spread over other islands.

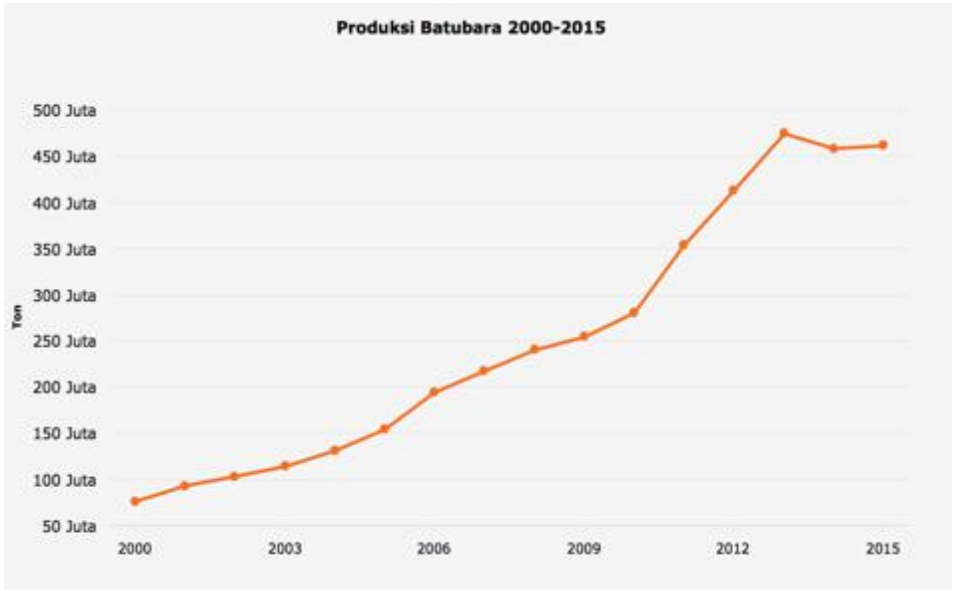


Figure 4.5. Coal Production rate
(Source: databoks.katadata.co.id/datapublish/2016/10/07/15-tahun-produksi-batubara-indonesia-naik-6-kali-lipat)

One the largest coal terminals in Indonesia is Balikpapan Coal Terminal (BCT) located in Balikpapan, East Kalimantan. BCT is managed by PT Dermaga Perkasa Pratama, the subsidiary of PT Bayan Resources Tbk, and equipped with shiploading and unloading berths. BCT has a handling throughput capacity of 15.0 million tonnes per annum and a stockpiling capacity of approximately one million tons across 16 stockpiles. It is also able to serve handy, panamax and capesize vessels. BCT also has a loading facility with capacity of 4,000 tonnes per hour, enabling it to load a Panamax size vessel in one day. Other than that, BCT also has unloading facility with 5,000 tonnes per hour capacity and is able to unload coal from 2 barges simultaneously. BCT is facilitated to mix coals from 4 stockpiles with computerized system to meet customer specifications.

4.4. Operation Profile of Coal Transportation

Abc Power Plant power plant has a generating unit capable to generate power of 800 MW. boilers need 98,27 tons / hour of coal to operate. Coal amounts are used to generate electricity at peak loads. The steam power plant should be able to operate steadily at all times, so at least 98,27 tonnes of coal should be available every hour. So, the amount of coal needed by ABC Power Plant per day is: 98,27 ton × 24 hours x 30 day = 70.754,4 ton/month

However, there are consideration of choosing the transportation of coal supply from the coal terminal to the jetty terminal of Abc Power Plant. The

transportation of the coal is used with barge-tugboat with 7.500 ton. The other consideration of analysis is using bulk carrier as the transportation of coal supply with capacity of 40.000 ton.

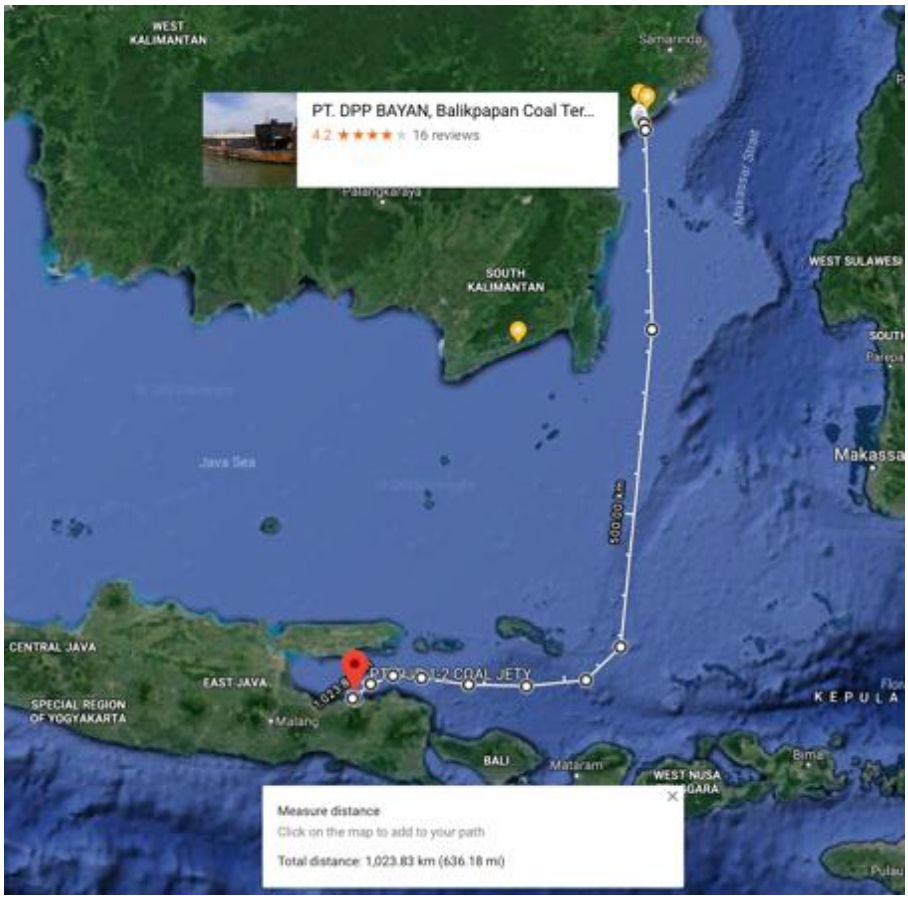


Figure 4.6. Balikpapan Coal Terminal to Jetty Paiton
(Source: Google earth)

The distance between Balikpapan Coal Terminal to jetty Abc Power Plant is 1023,83 Km or 552,8239741 Nm

- Tug boat-Barge TB. Manolia

Table 4.4. Tugboat-barge specification
(Source: https://www.glsship.com)

	DWT
	7.500 MT
Barge	
Length	91,44 meter
Draft	4,3 meter
Tug Boat	
Speed	10 knots

- BulkCarrier MV. Azzahra

Table 4.5. Bulk Carrier specification
(Source: https://www.glsship.com)

	DWT
	42.842 MT
Length	189,5 meter
Draft	10,9 meter
Speed	12 Knot

4.3.1. Charter Cost

The type of charter in this thesis is using time charter. So, the cost of fuel oil, dringking water and other exploitation cost become the burden of charterer. Based on Simpson Spence Young the bulk carrier time charter rates from February 2018 until July 2018 is USD 12,854 or IDR 185,328,972 per day. For tugboat the time charter rate take from CV. Global Mitra Persada is USD 54,000 or IDR 777,659,400 per month.

So, the cost of charter bulk carrier for one month is IDR 5,559,869,160 and for tugboat to fulfill the needs of coal at PT. Abc is need 3 tugboat. So, the cost for 3 tugboat is IDR 777,659,400 x 3 = IDR 2,332,978,200.

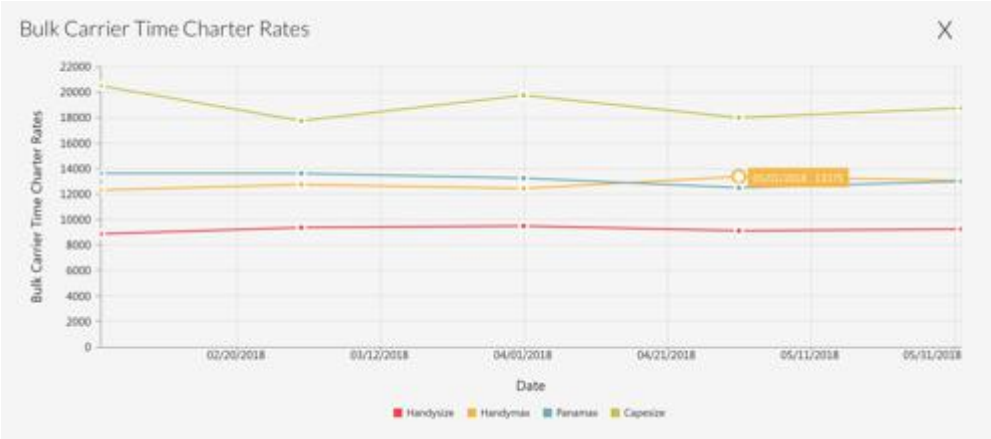


Figure 4.7. Bulk Carrier time charter rates
(Source: SimpsonSpenceYoung)

4.3.2. Port Cost

The port cost is using rates from PT. Pelabuhan Cilegon Mandiri

- Sea pilotage

Guiding services of vessels when entering the cruise line to the dock or harbor pool to dock.

Table 4.6. Sea pilotage cost

	Pilotage rates	Description
Main rates	Rp. 46,200	/moving
Additional rates	Rp. 13	/GT/moving

So, the rates for bulk carrier 42,842 dwt is:
46,200 + (13 x 42,842) x 2 = Rp. 1,206,292

- Seaport service

Carrying out the work to bind and release ropes of motion-driven vessels will lean on or off from or one dock, bridge, buoy, dolphin and others

Table 4.7. Seaport service

	Seaport rates	Description
Main rates	Rp. 1,650,000	/ship/hour
Additional rates	Rp. 3,3	/GT/Ship/hour

The estimate time is 2 hours. So, the rates for bulk carrier 42,842 dwt is:
(1,650,000 x 2) + (3.3 x 42,842 x 2) x 2 = Rp. 7,165,514.4

- Assist tugboat

Table 4.8. Assit tugboat cost

	Seaport rates	Description
Main rates	Rp. 24,000,000	/set

So, the port cost is

= 1,206,292 +7,165,514.4 + (24,000,000 x 2)

= Rp. 56,371,806.4

4.3.3. Transshipment cost

Transshipment is the act of shipping goods to an intermediate destination prior to reaching their ultimate end-use. Transshipment is a common practice with logistic benefit. Transshipment is commonly used for loading coal from tugboat to mother vessel. The price for transshipment coal from pulau laut is USD 2 per ton. So, to loading bulk carrier 40.000 ton is: 40.000 x 2 = USD 80.000 or 1.153.440.000 for one trip.

The thing to consider in the transhipment process is:

- Ensure the transport of coal from the port to the trashipment point runs on time
- Determine the nomination tug boat and barge that will be done barging
- Monitoring and controlling Tug boat, Barge and Mother Vessel
- Perform a document management. PEB, Customs, Trade Service etc.

4.3.4. Voyage

a) Bulk Carrier

Table 4.9. Bulk Carrier voyage time Balikpapan to Paiton

Start	Manouver max 5 mill	Sailing	Manouver max 5 mil	Berthing
Distance	5	543	5	Berthing
V	4.8	12	4.8	Berthing
Time	1.042	45.250	1.402	Berthing

Total voyage time from Balikpapan to Paiton is 47.33 hours and estimation loading time 72 hours.

Table 4.10. Bulk Carrier voyage time Paiton to Balikpapan

Start	Manouver max 5 mill	Sailing	Manouver max 5 mil	Berthing
Distance	5	543	5	Berthing
V	5	12.5	5	Berthing
Time	1.042	45.250	1.402	Berthing

Total voyage time from Paiton to Balikpapan is 45.44 hours and estimation loading time 72 hours.

So, the total voyage time with loading unloading for 1 trip is 236.773 hours or 10 days. To fulfill the needs of coal in PT. Abc Power Plant for one month with bulk carrier is need:

$$t = \frac{X1}{X2}$$

Where:

t = how many times
x1 = coal needed in PT. Abc Power Plant
x2 = capacity of tugboat

$$t = \frac{70754{,}4}{42842}$$

t = 1,65 or 2 times

b) Tugboat

For tugboat loading coal not at terminal so the distance estimate plus 100 nm from the terminal.

Table 4.11. Tugboat voyage time Balikpapan to Paiton

Start	Manouver max 5 mill	Sailing	Manouver max 5 mil	Berthing
Distance	20	628	5	Berthing
V	4	6	4	Berthing
Time	5	104.66	1.25	Berthing

Total voyage time from Balikpapan to Paiton is 110,9 hours and estimation loading time 24 hours.

Table 4.12. Tugboat voyage time Paiton to Balikpapan

Start	Manouver max 5 mill	Sailing	Manouver max 5 mil	Berthing
Distance	5	628	20	Berthing
V	4	6	4	Berthing
Time	1.250	104.66	5	Berthing

Total voyage time from Paiton to Balikpapan is 110,9 hours and estimation loading time 24 hours.

So, the total voyage time with loading unloading for 1 trip is 269.833 hours or 8 days. To fulfill the needs of coal in PT. Abc Power Plant for one month with 3 Tugboat is need:

$$t = \frac{X1}{X2}$$

Where:

t = how many times
x1 = coal needed in Abc Power Plant
x2 = capacity of tugboat

$$t = \frac{70.754{,}4}{7500x3}$$

t = 3.14 or 4 times

4.3.5. Calculation fuel Oil consumption for bulk carrier

Fuel oil consumption for bulk carrier is already known from the specification of the ship below:

Table 4.13. Fuel oil consumption for bulk carrier

	Wfo per day	Required	
Loaded voyage	23.5 mt	47.33	46.34 ton
Ballast voyage	23.5 mt	45.44	44.49 ton
AE consumption at sea	2 mt	92.73	7.73 ton
AE consumption at port	• Working 3.2 mt • Idle 1.2 mt	• Loading 3 days • Unloading 3 days	• Loading 9.6 ton • Unloading 3.6 ton
Total for 1 trip			111.772 Ton

4.3.6. Calculate volume of fuel oil consumption for Tugboat

The formula to calculate fuel oil consumption for tugboat is:

$$wfo = (P\ x\ bme)\ x\ \frac{t}{v} x\ 10^{-6} \quad \text{..... (2.2)}$$

where:

wfo = Fuel Consumption (ton)
P = Engine Continous Rating (kw),
Bme = Spesific fuel oil consumption (gr/kwh),
t = Distance (Nm)
v = Ship speed (Kn)

Table 4.14. Fuel oil consumption from Balikpapan to Paiton

	Tugboat	
v	10	Kn
t	653	Nm
P	1518	kw
Sfoc	223	gr/kwh
wfo	22.104	ton

Table 4.15. Fuel oil consumption from Paiton to Balikpapan

	Tugboat	
v	10	Kn
t	653	Nm
P	1290.3	kw
Sfoc	223	gr/kwh
wfo	18.789	ton

Table 4.16. Fuel oil consumption for auxiliary engine

	Tugboat	
v	10	Kn
t	653	Nm
P	83	kw
Sfoc	222	gr/kwh
wfo	1.203	ton

So, in one trip Tugboat need 8 days and the total needed of fuel oil for one trip is

T = 22.104 + 18.789 +(1.203x 2)

T = 43.3 Ton

T = 129.9 ton (3 tugboat)

4.3.7. Fuel oil cost

- Bulk carrier

Table 4.17. Fuel oil cost for bulk carrier

	Fuel oil consumption (ton)	Price/ton	Price/trip
Main engine (IFO 180)	90.841	7,203,800	654,397,194
Auxiliary engine (MDO)	20.93	14,875,747	311,365,913
Total 1 trip	139.2259		965,763,107
Fuel oil cost for 2 trip			1,931,526,215

- Tugboat

Table 4.18. Fuel oil cost for tugboat

	ton	Price/ton	Price/trip
1 tugboat	43.3	14,875,747	644,129,059
3 Tugboat	129.9	14,875,747	1,932,387,176
Total fuel oil for 4 trip			7,729,548,704

The comparation coal transportation cost of bulk carrier and tugboat in one month is:

Table 4.19. Cost comparation

	Bulk carrier	Tugboat
Units	1	3
Time Charter Rates	5,559,869,160	2,332,978,200
Transshipment rate	2,306,880,000	-
Fuel oil cost	1,931,526,215	7,729,548,704
Port cost	56,371,806.4	-
Total	9,854,647,181.4	10,062,526,904

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CHAPTER V

CONCLUSION & SUGGESTION

5.1. Conclusion

Based on the calculation analysis that has been done about the replacement of coal transportation from tugboat to bulkcarrier vessel, there are several conclusions, including:

The Jetty of Abc is used for the coal unloading process that later will be used by Abc Power Plant. In the early stages of planning, jetty Abc has a 17 meters depth, but the sedimentation silted 10 meters the pool at the Jetty of Abc Power Plant. In order to replace the coal transport using bulk carrier, then dredging at the Jetty of Abc Power Plant is necessary so the ship doesn't run aground when the seawater has the lowest temperature. Based on the bathymetry result, the dredging volume is about 1.635.9 m^3.

For coal unloading process from ship to jetty conveyor at Abc Power Plant is using the crane on jetty or ship unloader crane. By using 1 (one) crane, takes 59 hours to unload the 40.000 dwt bulk carrier vessel and by using 2 (two) cranes takes 30 hours for coal unload process from ship to the conveyer. Furthermore, it takes 10,7 hours by 1 (one) ship unloader to unload the 7.500 dwt tugboat

There is also comparison of the cost between tugboat and bulk carrier for one month, it is cheaper using bulk carrier than using tugboat. The cost if using tugboat with 7.500 DWT is IDR 10,062,526,904 and if using bulk carrier with 40.000 DWT is IDR 9,806,647,081. So, it will reduce cost of coal transportation up to IDR 255,879,822.6for one month.

5.2. Suggestion

Based on the process of technical analysis of barge replacement with bulk carrier which has been done, there are several recommendations to be done in further research:

1. To facilitate the retrieval of ship data.
2. To facilitate the retrieval of data, needed assistance from the direct party concerned with Abc Power Plant.
3. In this final project still not enough detail and still can be done more detail calculation for port feasibility.

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ATTACHMENT

TUGBOAT-BARGE

PT.PERUSAHAAN PELAYARAN
PT. GURITA LINTAS SAMUDERA
See Beyond The Sea

Jl. Tomang Raya 47E, Jakarta-11440
Ph. 021-5686369 Fax. 021-5600983
TELEX 43335 LINTAS IA
Cable Address: Lintasship JKT
www.lintassamudera.co.id

Name of vessel	: **TB. MAGNOLIA**
Nationality	: Indonesia
Port of registry	: Jakarta
When build	: 2006
Hull No.	: PPS 259
Builder	: PT Palma Progress Shipyard, Batam
Gross Tonnage	: 251
Net Tonnage	: 76
Length, Overall	: 28.05 m
Length, between perpendiculars	: 26.04 m
Breadth, moulded	: 8.60 m
Depth, moulded	: 4.30 m
Designed loaded draft	: 3.30 m
Draft Maximum	
Class	: BKI
IMO Number	: 9411393
Call Sign	: Y D A 4208
Main Engine	: Mitsubishi S6R2 - MTK3L (2 x 759 KW / 1406 rpm)
Gear Box	: Reintjes WAF562L ratio 5.05 : 1
TurboCharges	: Mitsubishi TF15M-67QVRC Serial No. (F33887)
Auxiliary Engine	: VOLVO PENTA D5A-T (77 KW, 1500 Rpm)
Generator Set	: Leroy Somer LSA M44 2VS 3J6/4
Propeller	: 2 Units x 4 Blades manganese bronze
Tank Capacity	
Fuel Oil Tank	: ± 224 m3
Fresh Water Tank	: ± 54 m3
Speed	: 10 knots (free running)

Navigation Equipment	
SSB radio	: 1 unit ICOM ICM - 710
VHF / FM Radio	: 1 unit FURUNO FM 3000
Radar	: 1 unit FURUNO 1721
Navtex	: 1 unit DAIKO
GPS	: 1 unit FURUNO GP 32
Echo Sounder	: 1 unit FURUNO FCV 620
Accomodation	
Crew	: 12 Men
Cabin	: Three Units
Galley	: One Units
Window & Scutties	: Marine windows & Scuttles
Room & Cabin Plywood Paneling and Centrall A/C	
Life Saving Equipments	
Safety Equipments	: as Class Requirement
Life Raft	: 2 x 10 persons, China made
Life Jackets	: 17 pieces
Life Bouy	: 8 pieces
Parachute Rockets	: 12 pieces
Machinery and Deck Equipment	
Bollard Pull	: 20 tons (approx)
Steering Gear	: one set Palmarine Electro-hydraulic steering gear 2.5 ton suitable 2 x 35 degrees rudder angle c/w emergency hand hydraulic steering pump
Windlass	: one set China brand 2A electric anchor windlass 2G/2W suitable 19 mm diamtr
Anchor	: two unit of 480 kg stockless
Anchor Chain	: 220m long, type U2, 19mm dia
Towing Hook	: 1 set 25ts mechanical release

PT.PERUSAHAAN PELAYARAN
PT. GURITA LINTAS SAMUDERA
See Beyond The Sea

Jl. Tomang Raya 47E, Jakarta-11440
Ph. 021-5686369 Fax. 021-5600983
www.glsship.com

Barges

Name of vessel / Hull No.	: **BG. FITRIA 302**
Size	: 300 ft x 80 ft x 18 ft
Nationality	: Indonesia
Port of registry	: Jakarta
When build	: 2005
Builder	: PT. Palma Progress Shipyard, Batam
Class	: BKI

Side board height	: 3600 mm (12ft)
Dead Weight (DWT)	: Approx 7500 tons
Gross Tonnage	: 3142
Net Tonnage	: 943
Length overall (LOA)	: 91.44 m
Breadth	: 24.38 m
Moulded depth amidship to upper deck	: 5.49 m
Deck load	: 7 tons/m2

BULK CARRIER

PT.PERUSAHAAN PELAYARAN
PT. GURITA LINTAS SAMUDERA
See Beyond The Sea

Jl. Tomang Raya 47E, Jakarta - 11440
Ph. 021-5686369 Fax. 021-5600983
www.gtship.com

Name of vessel	: **MV AZZAHIRA**
Official Number	: 2009 Pst No.5616/L
Call Sign	: P M S Z
Nationality	: Indonesia
Type of Vessel	: Bulk Carrier
IMO Number	: 8 3 0 9 2 3 2
Port of Registry	: Jakarta
Keel Laid	: July 31st 1984
Data Launched	: Feb 15th 1985
Build / Delivery Date	: July 9th 1985
Builder	: Mitsubishi Heavy Industries Ltd, Nagasaki Shipyard
Builder's Hull No.	: 1 9 3 9
GRT (Int/Suez/Pnma)	: 24,943 / 25,948 / 26,815
NRT (Int/Suez/Pnma)	: 14,148 / 22,514 / 20,424
DWT (summer/tropic/winter/)	: 42,842 / 44,005 / 41,681
Draft (Summer/tropic/winter)	: 10,994 / 11,472 / 10,765
Displacement (smr/tpc/wint)	: 50,620 / 51,783 / 49,459
Light ship weight	: 7778 mt
Classification	: Nippon Kaiji Kyokai (NKK)
Number	: 8 5 2 5 0 8
Length Over All	: 189.500 m
Length B.P Moulded	: 181.00 m
Breadth Moulded	: 30.000 m
Depth Moulded	: 15.700 m
Hatches	: 5 (Five)
Hatches Dimensions #1	: 19.20 m x 15.00 m
Allowable Load Strength	:
Double Bottom No.1 & 5	: 19.879 ts / m2
No.2 & 4 Hold	: 13.253 ts / m2
No.3 Hold	: 21.793 ts / m2
No.4 Hold	: 13.253 ts / m2
Upper Deck	: 3.850 ts / m2
Cargo Hatch Cover	: 2.400 ts / m2
Hatch Cover	: Macgregor Folding Hydraulic
Deck Crane	: 4 x Mitsubishi Electro Hydraulic
	Hoisting Cap 25 ts x 14.5 m/min General Cargo
	Slewing Radius 22 m at 25 deg, 3.0 m at 81 deg 42 min
	Hoist Load 25 ts / Luffing time 44 m/min
	Slewing Speed 0.75 rpm
Consumption per day	: Loaded voyage abt 12.0 knots @ 23.50 mt IFO 180 cst
	Ballast voyage abt 12.5 knots @ 23.50 mt IFO 180 cst
	AE Cons at Sea 2.0 mt MDO
	AE Cons at Port working: 3.2 mt / idle: 1.2 mt MDO
	ME Cylinder Oil abt 230 ltr / System Oil abt 25 ltr
	FW Cons abt 10 mt

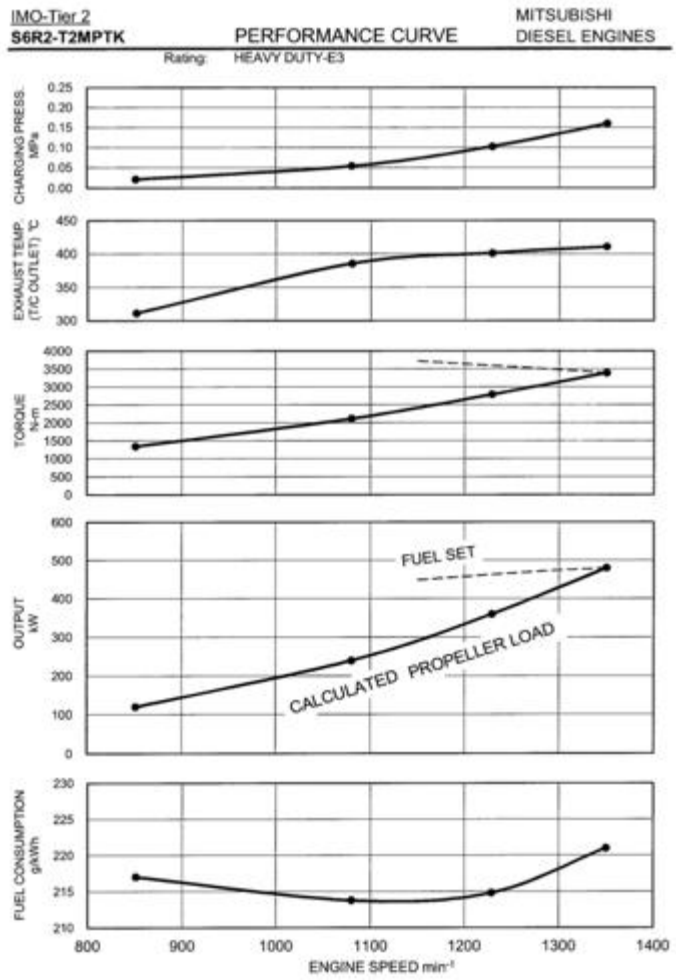
P & I Club	: The Standard
H & M Insurance	: PT Asuransi Jasa Indonesia (Jasindo)
MMSI	: 5 2 5 0 1 6 3 5 5
IMN C Tlx No.	: 4 5 2 5 0 1 2 1 7
Fleet F33 for telp	: 870 764 903 961
Fleet F33 for fax	: 870 764 903 962
Fleet F33 for email	: azzahra@skyfile.com
Main Engine	: Mitsubishi MHI Sulzer 6RTA58 x 1 set
Output max rating	: 9,370 BHP x 109 rpm
Output min rating	: 7,965 BHP x 103 rpm
Aux. Engines (2 set)	: 6 DL 20 (Daihatsu) x 3 set
Prime Mover	: Four Stroke, 450 Kw@ 720 RPM 6 Cylinders, Bore 200 mm
Generator	Mitsubishi Electric x 3 set AC 450V 60Hz 562.5 KVA
Emergency	Emergency Battery fitted
Aux Boiler	: Vertical cylindrical (composite type)
	Oil burning / Exhaust gas heating
Pressure	6 kg/cm2 / 6 kg/cm2
Evaporation	1,200 kg/h / 700 kg/h
Propeller	: 5 (Five) blades solid keyless type
Material	: Ni-AL-Bronze
Diameter	5,800 mm (pitch 4,390 mm)
Ballast Pump	: 2 x Japanese Shinko Centrifugal pump
	Electric Motor driven 250/100 m3/hr @ 35 m/70 m
	45 Kw x 1800 rpm, with Air Ejector

Capacity of Cargo Hold	Capacity	
GRAIN		
	CBM	CBF
Frame 179-215 Hold #1	9994.80	352,963
Frame 143-179 Hold #2	11153.90	393,897
Frame 107-143 Hold #3	11180.80	394,847
Frame 71-107 Hold #4	11265.80	397,848
Frame 35-71 Hold #5	10474.20	369,893
Cargo Hold Grand Total	54069.50	1,909,448

BALE		
	CBM	CBF
Frame 179-215 Hold #1	9799.70	346,073
Frame 143-179 Hold #2	10970.20	387,409
Frame 107-143 Hold #3	10995.50	388,302
Frame 71-107 Hold #4	11080.20	391,364
Frame 35-71 Hold #5	10316.30	364,317
Cargo Hold Grand Total	53161.90	1,877,465

Fuel Oil (SG 0.99) capa = 1,534.00 cbm / 90% = 1,370 mt
Diesel Oil (SG 0.87) capa = 232.80 cbm / 90% = 183 mt
Lub Oil (SG 0.90) capa = 77.90 cbm
Fresh Water capa = 284.30 cbm / 285 mt
Water Ballast (SG 1.025) tank = 24,715.20 cbm / 25,334 mt

MAIN ENGINE FOR TUGBOAT



AUXILIRARY ENGINE FOR TUGBOAT

Technical Data Engine

Engine designation	D5A T	
No. of cylinders and configuration	in-line 4	
Method of operation	4-stroke, direct-injected, turbocharged	
	diesel engine	
Bore, mm	108	
Stroke, mm	130	
Displacement, l	4.76	
Compression ratio	17.5:1	
	1500 rpm	1800 rpm
Crankshaft Power HE Cooling, kW	77	81
Crankshaft Power RC Cooling, kW	73	74
Crankshaft Power KC Cooling, kW	77	81
Specific fuel consumption, g/kWh	219 (50%)	219 (50%)
	217 (75%)	217 (75%)
	222 (100%)	222 (100%)
Recommended fuel to conform to	MDO-DMX or MDO-DMA acc. to ISO 8217	

10% overload available acc. to class requirements. Fuel temperature 40°C (104°F). Technical data according to ISO 3046 Fuel Stop Power with a tolerance ±4%. Fuel with a lower calorific value of 42700 kJ/kg and density of 840 g/liter at 15°C (60°F). Merchant fuel may differ from this specification which will influence engine power output and fuel consumption.

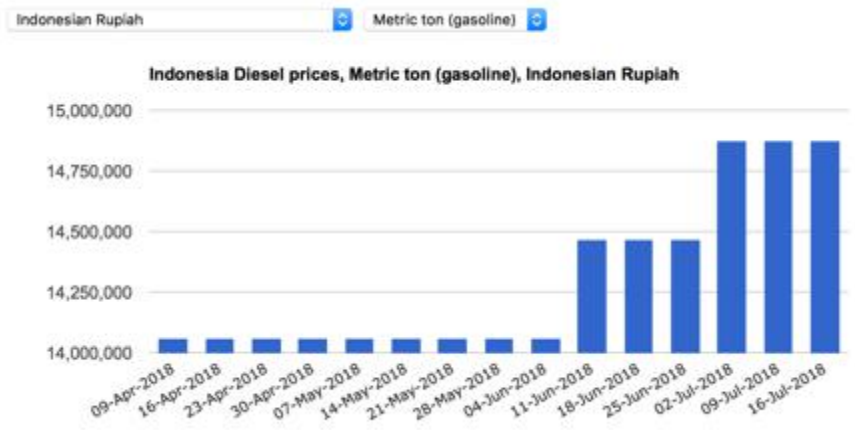
FUEL OIL PRICE

Prices

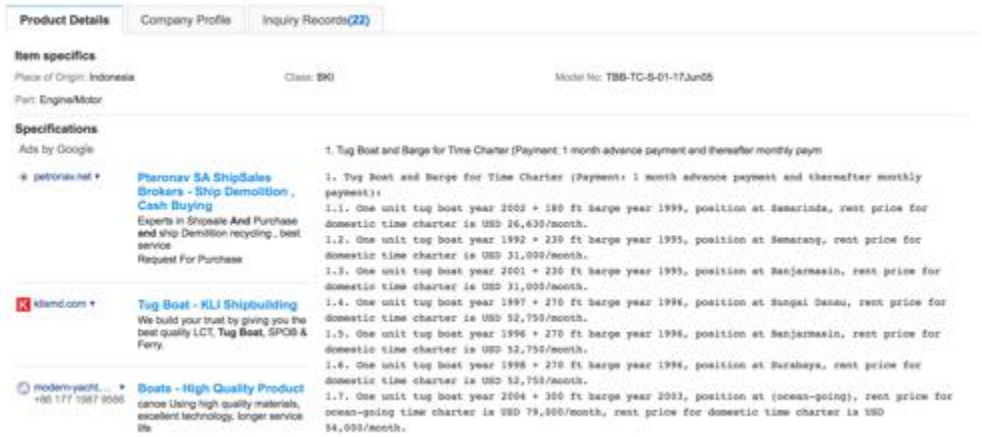
Port	IFO 380	IFO 180	MGO	Date
Singapore	465.50 ↑+13.50	497.50 ↑+13.50	643.00 ↑+15.00	2018-07-20
Rotterdam	425.00 ↑+10.00	450.00 ↑+10.00	621.00 ↑+12.00	2018-07-20
Fujairah	452.50 ↑+12.50	530.00 ↑+5.00	715.00 ↓-7.50	2018-07-20
Busan	470.00 ↓-6.50	490.00 ↓-1.50	670.00 ↓-15.00	2018-07-20

Regional Prices: Asia & Oceania | Caribbean & Central America | Europe | Middle East & Africa | North America | South America |

1 USD = IDR 14,401



PRICE OF TIME CHARTER FOR TUGBOAT



Product Details | Company Profile | Inquiry Records(22)

Item specifics

Place of Origin: Indonesia | Class: BKI | Model No: TBB-TC-S-01-17Jun05

Part: Engine/Motor

Specifications

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Tug Boat - KLI Shipbuilding

We build your trust by giving you the best quality LCT, **Tug Boat**, SPOB & Ferry.

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Boats - High Quality Product

canoe Using high quality materials, excellent technology, longer service life

1. Tug Boat and Barge for Time Charter (Payment: 1 month advance payment and thereafter monthly paym

1. Tug Boat and Barge for Time Charter (Payment: 1 month advance payment and thereafter monthly payment):
1.1. One unit tug boat year 2002 + 180 ft barge year 1999, position at Samarinda, rent price for domestic time charter is USD 26,630/month.
1.2. One unit tug boat year 1992 + 230 ft barge year 1995, position at Semarang, rent price for domestic time charter is USD 31,000/month.
1.3. One unit tug boat year 2001 + 230 ft barge year 1995, position at Banjarmasin, rent price for domestic time charter is USD 31,000/month.
1.4. One unit tug boat year 1997 + 270 ft barge year 1996, position at Sungai Danau, rent price for domestic time charter is USD 52,750/month.
1.5. One unit tug boat year 1996 + 270 ft barge year 1996, position at Banjarmasin, rent price for domestic time charter is USD 52,750/month.
1.6. One unit tug boat year 1998 + 270 ft barge year 1996, position at Surabaya, rent price for domestic time charter is USD 52,750/month.
1.7. One unit tug boat year 2004 + 300 ft barge year 2003, position at (ocean-going), rent price for ocean-going time charter is USD 79,000/month, rent price for domestic time charter is USD 54,000/month.

PORT COST

1. Tarif dasar jasa pemanduan

NO	URAIAN	TARIF PEMANDUAN DAN PENUNDAAN KAPAL	KETERANGAN
1	Tarif jasa pemanduan untuk kapal bendera Indonesia		
	a. Tarif pokok	Rp.46.200,00	/gerakan
	b. Tarif tambahan	Rp.13,00	/GT /gerakan
2	Tarif jasa pemanduan untuk kapal bendera asing		
	a. Tarif pokok	US$ 37,40	/gerakan
	b. Tarif tambahan	US$ 0,011	/GT /gerakan

2. Tarif jasa penundaan untuk kapal berbendera Indonesia di perairan wajib pandu

NO	URAIAN	TARIF(Rp)	KETERANGAN
1	Kapal s/d 3.500 GT		
	a. Tarif tetap	495.000,00	/kapal yang ditunda/jam
	b. Tarif variabel	3,30	/GT/kapal yang ditunda/jam
2	Kapal 3.501 s/d 8.000 GT		
	a. Tarif tetap	577.500,00	/kapal yang ditunda/jam
	b. Tarif variabel	3,30	/GT/kapal yang ditunda/jam
3	Kapal 8.001 s/d 14.000 GT		
	a. Tarif tetap	825.000,00	/kapal yang ditunda/jam
	b. Tarif variabel	3,30	/GT/kapal yang ditunda/jam
4	Kapal 8.001 s/d 14.000 GT		
	a. Tarif tetap	1.031.250,00	/kapal yang ditunda/jam
	b. Tarif variabel	3,30	/GT/kapal yang ditunda/jam
5	Kapal 18.001 s/d 26.000 GT		
	a. Tarif tetap	1.650.000,00	/kapal yang ditunda/jam
	b. Tarif variabel	3,30	/GT/kapal yang ditunda/jam
6	Kapal 26.001 s/d 40.000 GT		
	a. Tarif tetap	1.650.000,00	/kapal yang ditunda/jam
	b. Tarif variabel	3,30	/GT/kapal yang ditunda/jam
7	Kapal 40.001 s/d 75.000 GT		
	a. Tarif tetap	1.650.000,00	/kapal yang ditunda/jam
	b. Tarif variabel	3,30	/GT/kapal yang ditunda/jam
8	Kapal di atas 75.000 GT		
	a. Tarif tetap	2.227.500,00	/kapal yang ditunda/jam
	b. Tarif variabel	3,30	/GT/kapal yang ditunda/jam

THE REGULATION OF THE MINISTER OF TRANSPORTATION OF THE REPUBLIC OF INDONESIA NUMBER PM 72 OF 2017 ABOUT THE TYPE, STRUCTURE, CLASS AND MECHANISM OF TARIFF DETERMINATION SERVICES PORT.

(PERATURAN MENTERI PERHUBUNGAN REPUBLIK INDONESIA NOMOR PM 72 TAHUN 2017 TENTANG JENIS, STRUKTUR, GOLONGAN DAN MEKANISME PENETAPAN TARIF JASA KEPELABUHAN).

MENTERI PERHUBUNGAN
REPUBLIK INDONESIA

PERATURAN MENTERI PERHUBUNGAN REPUBLIK INDONESIA
NOMOR PM 72 TAHUN 2017
TENTANG
JENIS, STRUKTUR, GOLONGAN DAN MEKANISME PENETAPAN
TARIF JASA KEPELABUHANAN

DENGAN RAHMAT TUHAN YANG MAHA ESA

MENTERI PERHUBUNGAN REPUBLIK INDONESIA,

Menimbang : a. bahwa dalam mendorong iklim investasi dan menciptakan tarif jasa kepelabuhanan yang efisien dan kompetitif, perlu dilakukan penataan kembali jenis, struktur, golongan dan mekanisme penetapan tarif jasa kepelabuhanan;

b. bahwa berdasarkan pertimbangan sebagaimana dimaksud dalam huruf a, perlu menetapkan Peraturan Menteri Perhubungan tentang Jenis, Struktur, Golongan dan Mekanisme Penetapan Tarif Jasa Kepelabuhanan;

Mengingat : 1. Undang-Undang Nomor 17 Tahun 2008 tentang Pelayaran (Lembaran Negara Republik Indonesia Tahun 2008 Nomor 64, Tambahan Lembaran Negara Republik Indonesia Nomor 4849);

Pasal 9

Tatanan waktu dan satuan ukuran dari setiap jenis pelayanan jasa kepelabuhanan sebagaimana dimaksud dalam Pasal 7 ditetapkan sebagai berikut:

a. pelayanan jasa Kapal, terdiri atas:
   1. labuh, dihitung berdasarkan ukuran Kapal dalam *Gross Tonnage* (GT) dengan satuan GT per kunjungan Kapal;
   2. pemanduan, dihitung berdasarkan ukuran Kapal yang dipandu dalam *Gross Tonnage* (GT) dengan satuan GT per gerakan dikaitkan dengan jarak pemanduan dan tingkat resiko dengan rumusan: ((GT x tarif variabel) + tarif tetap) x gerakan;
   3. penundaan, dihitung berdasarkan jumlah Kapal yang menunda dikali ukuran Kapal yang ditunda dalam *Gross Tonnage* (GT) dengan satuan GT per jam, dengan rumusan: ((GT x tarif variabel) + tarif tetap) x jam x unit kapal tunda));

THE PRESIDENTIAL DECREE OF THE REPUBLIC OF INDONESIAN REPUBLIC OF INDONESIA 66 YEAR 1994OF THE MINING SERVICES FOR OUTPUT SEA TRANSPORT IN SEA PORT

(KEPUTUSAN PRESIDEN REPUBLIK INDONESIA NOMOR 66 TAHUN 1994 TENTANG TARIF JASA KEPELABUHAN UNTUK KAPAL ANGKUTAN LAUT LUAR DI PELABUHAN LAUT YANG DIUSAHAKAN)

KEPUTUSAN PRESIDEN REPUBLIK INDONESIA
NOMOR 66 TAHUN 1994
TENTANG
TARIF JASA KEPELABUHAN UNTUK KAPAL ANGKUTAN LAUT LUAR DI PELABUHAN LAUT YANG DIUSAHAKAN

MENTERI PERHUBUNGAN

Menimbang :

a. bahwa dalam rangka menjamin penyediaan fasilitas pelabuhan guna peningkatan pelayanan jasa kepelabuhan dan kelancaran lalu lintas kapal dan barang perlu dilakukan penataan serta penyesuaian tarif jasa kepelabuhan untuk kapal angkutan laut Luar Negeri;

b. bahwa sehubungan dengan huruf a di atas perlu menetapkan Keputusan Menteri Perhubungan tentang Tarif Jasa Kepelabuhan untuk kapal angkutan laut Luar Negeri pada Pelabuhan Laut yang diusahakan;

Mengingat :

1. Undang-undang Nomor 21 Tahun 1992 tentang Pelayaran (Lembaran Negara Tahun 1992 Nomor 98, Tambahan lembaran Negara Nomor 3493);

2. Peraturan Pemerintah Nomor 11 Tahun 1983 tentang Pembinaan Kepelabuhan (Lembaran Negara Tahun 1983 Nomor 14, Tambahan Lembaran Negara Nomor 3251) sebagaimana telah diubah terakhir dengan Peraturan Pemerintah Nomor 23 Tahun 1985 (Lembaran Negara Tahun 1985 Nomor 31, Tambahan Lembaran Negara Nomor 3290);

3. Peraturan Pemerintah Nomor 17 Tahun 1988 tentang Penyelenggaraan dan Pengusahaan Angkatan Laut (Lembaran Negara Tahun 1988 Nomor 37, Tambahan Lembaran Negara Nomor 3378);

4. Peraturan Pemerintah Nomor 56, 57, 58 dan 59 Tahun 1991 tentang Pengalihan Bentuk Perusahaan Umum (Perum) Pelabuhan I, II, III, dan IV menjadi Perusahaan Perseroan (Persero) Pelabuhan Indonesia I, II, III dan IV (Lembaran Negara Tahun 1991 Nomor 74, 75, 76 dan 77);

(1) Kapal dengan panjang lebih dari 70 meter yang berolah gerak di daerah perairan pelabuhan, untuk pertimbangan keselamatan pelayaran dalam menggunakan jasa penundaan berpedoman pada ketentuan sebagai berikut :

a. panjang 71 meter sampai dengan 100 meter dapat ditunda dengan 1 (satu) kapal tunda yang mempunyai daya minimal 600 PK;

b. panjang 101 meter sampai dengan 150 meter dapat ditunda dengan minimal 2 (dua) kapal tunda yang mempunyai daya 1600 PK sampai dengan 3400 PK;

c. panjang 151 meter sampai dengan 200 meter dapat ditunda dengan minimal 2 (dua) kapal tunda yang mempunyai daya 3400 PK sampai dengan 5000 PK;

d. panjang 201 meter sampai dengan 300 meter dapat ditunda dengan minimal 3 (tiga) kapal tunda yang mempunyai daya 5000 PK sampai dengan 10.000 PK;

e. panjang 301 meter ke atas dapat ditunda minimal 4 (empat) kapal tunda yang mempunyai daya 10.000 PK.

(2) Jam pemakaian kapal tunda dihitung selama menunda kapal sejak mulai sampai dengan selesai menunda ditambah jumlah jam keberangkatan dari dan kembali ke pangkalan.

(3) Jam keberangkatan dari pangkalan dan jam kembali ke pangkalan bagi kapal tunda secara rata-rata ditetapkan oleh Direksi.

(4) Direksi dapat menetapkan jam rata-rata pemakaian kapal tunda secara lumpsum.

(5) Pengenaan tarif jasa penundaan kapal di daerah lingkungan kerja perairan pelabuhan ditetapkan sebagai berikut :

a. pemakaian kapal tunda dikenakan tarif jasa penundaan sebesar tarif dasar;

b. pembatalan permintaan kapal tunda yang telah dikirim ke lokasi kapal, dikenakan tarif jasa penundaan sesuai tarif dasar minimal untuk pemakaian 1 (satu) jam.

(6) Pembulatan jam pemakaian kapal tunda ditetapkan sebagai berikut :

a. penggunaan kapal tunda kurang dari 1 (satu) jam dihitung menjadi 1 (satu)

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THE AUTHOR'S BIODATA

The author, Putra Triharyono, was born on June 29, 1996 in Jakarta. The author received bachelor's degree in Marine Engineering from Institut Teknologi Sepuluh Nopember - Surabaya and Hochschule Wismar - Germany. The issue of increasing the need for marine superintendent with current international qualifications also the limited availability of marine human resources in developed countries especially in Indonesia, makes the author motivated to learn more about marine life. Growing up in ITS, the author always felt a strong connection to the shipping and marine technology and developed a passion for maritime business. During his time as an undergraduate student, the author took On The Job Training (OJT) at PT Bandar Abadi – Batam and at PT Pelindo III - Surabaya where he gained experience and understanding in ship building, technical survey & inspection, and ship repair. The author can be contacted from