Analysis of Technical Specifications of 180 GT Purse Seine Vessel in Fishing Line III Fisheries Management Area (FMA) 572

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***Abstract*— fishing vessels for catching small pelagic fish resources in fishing line III FMA 572 are dominated by vessels with a capacity of <30 GT. The capacity of vessels and fishing gear for pelagic types is 180 GT purse vessels. The research is study development of technical specifications of 180 GT purse seine vessel. The research method is a research design of 180 GT fishing vessels with Autocad and Maksurf software. The findings of the technical specifications of purse seine vessels are 180 GT with a length of 35.30 m with a speed of 8 knots. This fishing vessel uses purse seine fishing gear with a length of 600 m and a width of 150 m, which is equipped with a power block and fish pump, which can increase crew efficiency by 40% to 46% and the time for setting net purse seine, hauling and brailing is faster by 16, 67% to 42.86%. This 180 GT purse seine vessel can operate for 50 days with 27 crews with a fuel tank capacity of 44,525 tons. In the shipbuilding process, it is recommended to use domestic components and material products to increase the speed of the production process and ease the supply of spare parts.**

Keywords— technical specifications of 180 GT purse seine vessel, small pelagic, fishing line III FMA 572.

I. INTRODUCTION

This technical specification research is a continuation of research on the Analysis of Owner Requirements of Purse Seine Vessel 180 GT for Fishing Activities on Fishing Line III-Fisheries Management Area (FMA) 572 [1]. Preparing technical specifications for fishing vessels is determined by the potential of fish resources to be managed. The total fish resource management quota in FMA 572 at the central government level is 82,573 tons of small pelagic species. Preparing the vessel's technical specifications is based on the results of the selection of vessel capacity and fishing gear for small pelagic fish resources on fishing line III FMA 572, namely the 180 GT purse seine vessel. From the owner's requirements, small pelagic fishing vessels on fishing line III FMA 572 are purse seine 180 GT vessels. In preparing the ship's technical specifications, it also takes into account fish landing sites, applicable regulations, maintenance systems, and construction sites. The fishing vessels' technical specifications are influenced by fish resource potential [2], water conditions, and operational requirements [2-4].

The technical specifications of the 180 GT purse seine vessel will provide an opportunity to increase the number of vessels operated on fishing line III WPPNRI 572. The increase in the number of fishing vessels requires industrial premises for the construction of fishing vessels, supporting industries, shipyards for ship repair, and maintenance, environmental conditions sea, ship building sites, supply of ship building materials, government policies related to permits, support for ship operational needs such as fuel, logistics to maintain the quality of the catch and logistics for crew members. The addition of vessels with a capacity of 180 GT for fishing operations in FMA 572 is essential, considering the number of vessels currently dominated by boats without motors, boats with outboard motors, and motorized vessels with a capacity of < 30 GT.

The technical specifications of the vessel is carried out by calculating the resistance of the vessel, planning the power of the propulsors, the need for electricity for fishing and lighting activities, the power requirements for cargo hold freezers, fishing mechanical equipment and preparing the general design of the ship-general arrangement along with all the rooms. The technical specifications of 180 GT purse seine vessel takes into account the number of crews, fuel tank capacity to support endurance operations and the availability of material products and ship components.

The purpose of this study was to compile technical specifications of 180 GT purse seine vessels that can be operated efficiently and effectively for catching small pelagic fish in line III WPPNRI 572 [1]. For fishing business actors the preparation of technical specifications for 180 GT purse seine vessels provides benefits in building vessels for increased catch. For the world fishing ship industry, preparing of these technical specifications provides benefits for planning the materials and components of the ship to be installed. Supporting industries and suppliers, it will provide benefits for the preparation of ship components and

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equipment products needed by ships. For the government, preparing the technical specifications for the 180 GT purse seine vessel provides benefits in increasing non-tax state revenue from ship construction. The research method is the design of a 180 GT fishing boat supported by Autocad and Maxsurf software.

II. METHOD

A. *Research design*

Research to build a purse seine vessel technical specifications 180 GT using a 180 GT fishing boat design with the help of Autocad and Maksurf software. This research was conducted to obtain information on the technical specifications of the fishing vessels to be built in accordance with the capacity of the vessels and small pelagic fishing gear at FMA 572.

B. *Ship design*

1) Total *Resistance and Sea Margin*

The resistance value from the model test results is the total resistance value of the ship (Rt) in the experimental voyage, which is an ideal condition where the ship is in calm waters without wind and currents, and the condition of the hull is very smooth (clean hull). Therefore, additional leeway must be given to the ship's resistance to accommodate these conditions. The average allowance for official shipping is called the sea margin. For East Asian shipping routes including Indonesian waters, the sea margin value is in the range of 15-20% [5, 6]. The value of the sea margin is taken as 20%, so the total ship resistance value is:

$$Rt_{service} = (1 + 20\%) \times Rt \qquad (1)$$

This research is supported by secondary data in the form of technical data on fishing vessels, components, equipment currently used, and primary data from survey results and interviews with respondents. The survey and interview objects related to: ship hull material, ship main dimensions (ship length, ship width, ship height, ship draft, ship block coefficient, ship capacity, and ship speed), propulsion engine, auxiliary engine, fishing equipment, auxiliary equipment fishing gear, navigation equipments, safety equipments, number of crews, fish storage systems and equipment, fish landing sites, endurance, and sea trial, Figure 1.

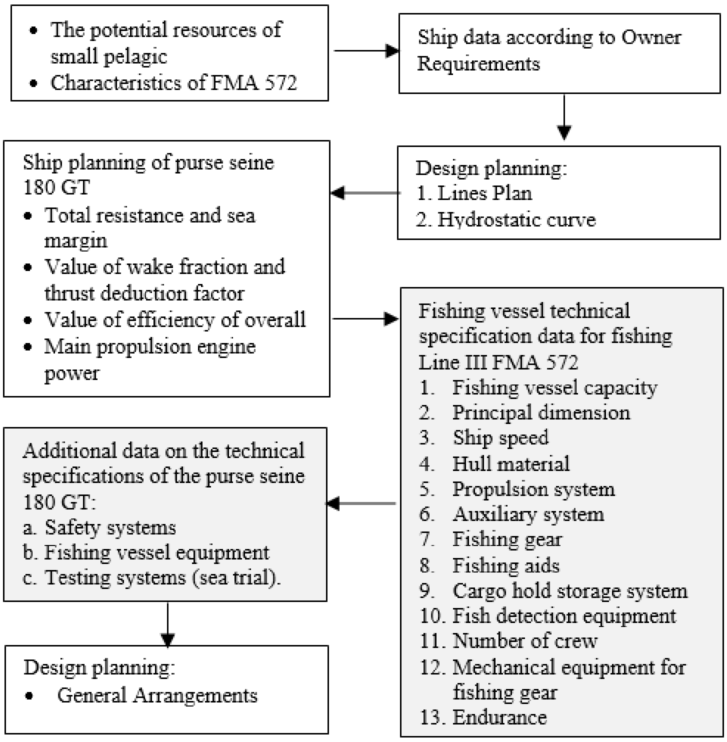

Figure. 1. DesiFishing vessel technical specification data for fishing Line III FMA 572

2) Wake *Fraction and Thrust Deduction Factor*

To calculate the thrust deduction factor, the value of the wake fraction must first be determined.Wake fraction (w) is defined based on Taylor's experiments for single-ABK ships, producing data on wake fraction values that are correlated with block coefficients [7]. The ship's wake fraction (w) can be determined by interpolation as follows:

$$w=((0.234-w))/((0.230-w)) \qquad (2)$$

Thrust deduction factor (t) for a single-screw ship is determined by the following formula:

$$t = k * w \qquad (3)$$

$k = 0.9 \sim 1.05$.

For ships equipped with old = 0.231 (single plate rudder style), the value of k = 1.05 is taken.

3) Efficiency Of Overall

Efficiency of Overall is used to calculate the thrust losses that occur throughout the hull. The overall efficiency is the sum of all power efficiency to propel the ship, the efficiency of which is efficiency of hull, efficiency of relative rotative, and efficiency of propeller open water [8]. The third product of this efficiency is often referred to as the Propulsive Coefficient (PC), which is the efficiency that occurs due to the interaction between the hull and the propeller. In addition, there are also power losses from the transmission system, namely losses from the bearing, stern tube and gearbox. The calculation due to these losses is represented by the efficiency of bearing and stern tube and efficiency of gearbox.

1. *Calculation of hull efficiency (ηH)*. Hull efficiency is the comparison value between the effective horse power (EHP) and the thrust hose power (THP).
   $\eta H = (1-t)/(1-w)$ (4)

   t is the thrust deduction factor and w is the wake fraction.

2. *Calculation of propeller efficiency (ηo)*. From the propeller characteristic data, the propeller efficiency (ηo) is 0.4.

3. *Calculation of the relative efficiency of rotation (ηrr)*. The relative efficiency value of rotative ranges from 1.02 to 1.05.

4. *Calculation of the efficiency of the stern tube and bearing*. For ships with engine room at the front, the losses value is 3%, so the efficiency price of bearing and stern tube (ηS-ηB) is: ηS-ηB = 0.97

5. *Calculation of gearbox efficiency*. The planned gear system uses a Single reduction gear with losses of 1.5% for the forward direction, and Reversing gear with 1% losses for the reverse direction, so that the ηG (Gearing efficiency including thrust bearing) system is:

   ηG single reduction gear : 0.985
   ηG Reversing gear : 0.99

4) Main Propulsion Engine Power
To push the ship so that it can go at service speed, thrust is needed to fight against the resistance acting on the ship's hull, this power is also known as the ship's effective power or effective horse power (EHP). Effective power is the multiplication between total resistance and service speed (Vs). This Effective Power can be calculated as follows:

$$PE = Rt_{design} \times Vs \quad (5)$$

In calculating the power of the ship propulsion engine, power must be added to overcome the loss of power due to passing through the mechanical and propeller transmission components and their interaction with the ship's hull. These losses are represented by the values of efficiencies which in aggregate are called overall efficiency. The main propulsion engine power requirements (brake horse power) (BHP) can be calculated as follows:

$$BHP = EHP/(\text{Overall Efficiency}) \quad (6)$$

To provide concessions to the operation of the main engine, it is necessary to add additional power (sea margin) of around 15-30% [9, 10]. Fishing vessels are planned with an additional sea margin of 20%, so that to reach the speed of the ship, the main engine is sufficiently run at the Service Continuous Rating (SCR), so as not to burden the main engine too heavily and there is also a power reserve to maintain the ship's performance at its planned conditions. when the ship is in operation. This additional power is the engine margin.

$$BHP_{Eng.margin} = (1+20\%) \times BHP \quad (7)$$

5) Electric Power on Ship
The ship's electrical power requirements are adjusted to the cumulative use of electrical equipment on the ship. Equipment that uses electricity on board includes steering gear, anchor windlass, stern winch, mechanical winch, power block, fish pump, cargo hold freezer, pump, engine room fan, accommodation room fan, davits, stove, lamp, window wiper, radio communication, echosounder, wind direction, battery charging. To support the need for electric power on board, two sets of auxiliary motors are installed, of the single acting 4 stroke diesel motor type. The need for electrical power to support auxiliary systems on fishing vessels. With a power factor (cos φ) of 0.8, the motor generator is installed with the following power requirements:

$$P_{Auxiliary\ Engine} = P_{Equipment} \times \cos \varphi \quad (8)$$

C. Planning technical specifications for fishing vessels.

Purse seine ship planning and owner requirements data are the initial data in preparing the technical specifications for the 180 GT purse seine ship. Preparing technical specifications for fishing vessels is influenced by the potential of fishery resources [2], water conditions and operational requirements [2-4]. From the initial owner requirement data, data can be planned: ship propulsion, required electrical power, ship safety systems, and ship testing.

Ship technical specifications also consider fish landing sites, applicable regulations, maintenance systems and ship building sites and the socio-cultural conditions of the community [2, 3]. From the priority selection of capacity and fishing gear, it can be done to prepare technical specifications for fishing vessels including: vessel capacity, fishing gear, main size of the vessel, hull material, vessel speed, fish storage system, ABPI, fish detection equipment, crew quantity, fishing gear, towing mechanical equipment, Endurance. The initial owner requirement data can plan ship propulsion, required electrical power, ship safety system and ship testing. Preparing technical specifications for ships also takes into account the fish landing sites, applicable regulations, maintenance systems and shipbuilding sites and the socio-cultural conditions of the community [2, 3].

D. Data analysis

Determination of technical specifications for fishing vessels for fishing line III FMA 572. Data analysis was carried out on data and information obtained from data collection from respondents related to ship hull material, main size of the ship, main engine, auxiliary engine, fishing gear, Fish aggregating devices (FAD) fishing tools, navigation equipment, equipment safety, number of crew, fish storage systems and equipment, fish landing sites, endurance and sea trials.

III. RESULTS AND DISCUSSION

A. Ship design and ship building regulations

1) Ship design

Purse seine fishing vessel 180 GT is designed for the area of operation in the waters of lane III WPPNRI 572 for catching small pelagic fish. Hull material of steel (mild steel). The ship is driven by 1 (one) unit of marine diesel engine in board. The ship's technical specifications are equipped with a lines plan and a general arrangement intended to complement the explanation of the ship's technical specifications. Details of design, fabrication, installation, supervision and workmanship are not covered in technical specifications and approval drawings, must be carried out according to applicable standards. The main sizes of 180 GT purse seine vessels are as follows:

- Loa : 35.3 m
- Lwl : 33.4 m
- Lpp : 31.9 m
- B : 7.6 m
- H : 2.95 m
- T : 2.35 M
- Speed (Vs): 8 Knot

2) Ship building regulations

The ship was built in accordance with the regulations of the Indonesian Classification Bureau (BKI) with Notation ✠ A 100 (I) and SM with the following information:

✠ The ship's hull and engine installations are built under supervision and in accordance with classification rules other than BKI which are recognized and then classified under BKI.

A 100 The hull of the ship is entirely in accordance with the requirements of the BKI construction regulations or other regulations that are considered equivalent

(I) Vessels whose anchor equipment, namely anchors, anchor chains and anchor engines fully meet the requirements of BKI construction

SM Machine installations and all installations covered by the classification meet the requirements of the BKI construction regulations or other regulations deemed equivalent.

B. Lines plan of 180 GT purse seine vessels

The 180 GT purse seine vessel size data is designed in the lines plan to determine the shape of the fishing vessel to be built, Figure 2. The lines plan design is the basis for determining various ship hydrostatic data. Line plan data is used to calculate the volume of each room.

C. Hydrostatic data of 180 GT purse seine vessels

To perform hydrostatic calculations for purse seine 180 GT, maxurf stability software is used. The hydrostatic curve is drawn up to the ship's draft and does not apply to ships in trim.

- *Displacement* (D) is the weight of the ship's shape, including the ship's skin (unit in tons).
- *Displacement Molded* is the weight of the ship without skin (units in tons).
- *Wetted Surface Area* (WSA) is the surface area of the hull that is submerged for each ship's draft
- *Water Plan Area* (WPA) is the area of the planned water line.
- *Prismatic Coefficient* (CP) is the ratio of the shape content to the volume of the prism with the cross-sectional area amidships and the length L.
- *Block Coefficient* (CB) is the ratio of the shape content to a beam with length L, width B, and height T
- *Midship Coefficient* (CM) is the ratio between the cross-sectional area amidships and the area of a cross-section with width B and height T.
- *Coefficient of Waterline* (CWl) is the ratio between the waterline area of each WL and a rectangle with length L and width B.
- *Longitudinal Center of Bouyancy* (LCB) is the distance of the bouyancy pressure point to the midship section for each ship's draft. Units in meters
- *Longitudinal Center of Floatation* (LCF) is the distance of the center of gravity of the waterline to the midship section for each ship's draft.
- *Longitudinal Center of Bouyancy to Metacenter* (LBM) is the distance of the bouyancy pressure point lengthwise to the metacenter point.
- *Keel to Center of Bouyancy* (KB) is the distance from the hydrostatic pressure point to the keel of the ship.
- *Transverse Center of Bouyancy to Metacentre* (TBM) TBM is the distance of the transverse bouyancy pressure point to the meta-centre point. Units in meters (m).
- *Ton Per Centimetre immersion* (TPC) is the number of tons needed to change the ship's draft by 1 cm.
- *Midship of Sectional Area* (MSA) is the area amidships for each draft of the ship.
- *Displacement Due to One Centimeter of Trim by Stern* (DDT) is a large change in ship displacement caused by a 1 cm change in ship trim.
- *Transverse of Keel to Metacenter* (TKM) is the location of the transverse metacenter to the keel of the ship for each ship's draft.
- *Longitudinal of Keel to Metacenter* (LKM) is the location of the metacenter extending to the keel of the ship for each ship's draft.
- *Moment to Change Trim One Centimeter* (MTC) is the moment needed to trim the ship by 1 cm.

Hydrostatic calculation results can be analyzed from the simulation results of the 180 GT purse seiner ship model with maxsurf software. Purse seine ship planning 180 GT with maxurf software obtained a ship draft of 2.35 m, ship displacement of 361.0 tons, ship width of 7.586 m, and block coefficient of 0.514, according to the planning results in Table 1, Figure 2 and Figure 3.

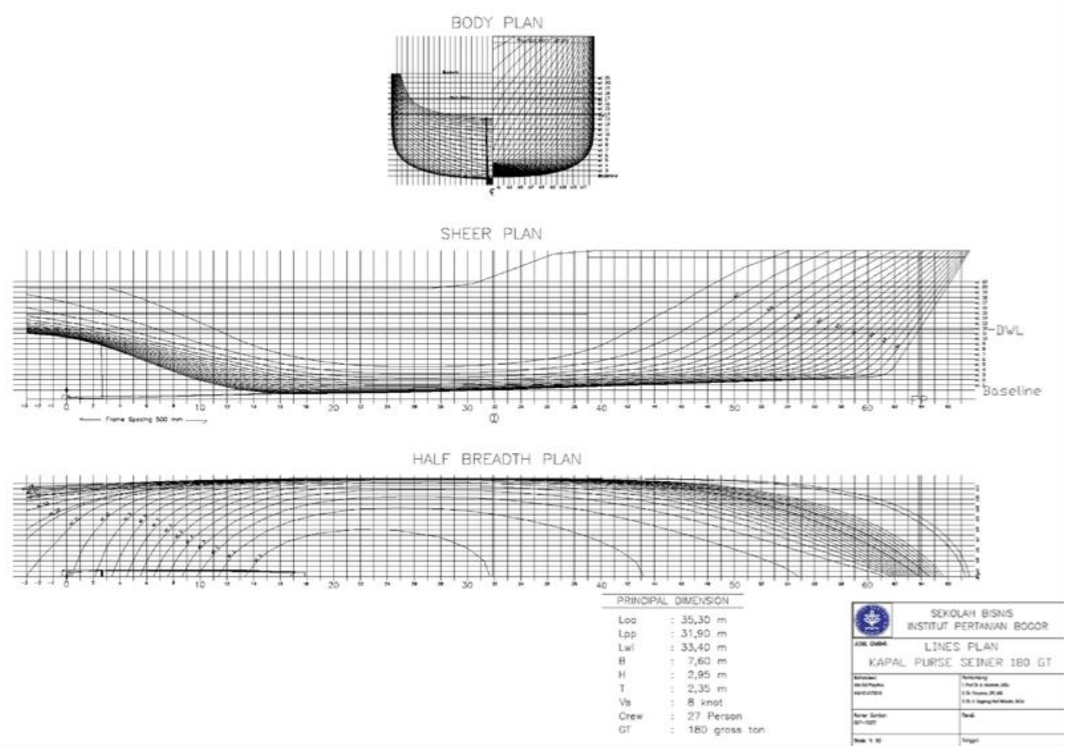

Figure. 2. Lines plan purse seine 180 GT

TABLE 1.
HYDROSTATIC DATA FOR 180 GT PURSE SEINE VESSELS

Draft Amidships m	0.000	0.235	0.470	0.705	0.940	1.175	1.410	1.645	1.880	2.115	2.350
Displacement t	2.482	14.66	37.21	67.21	101.5	138.9	178.8	221.0	265.2	311.7	361.0
Heel deg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Draft at FP m	0.000	0.235	0.470	0.705	0.940	1.175	1.410	1.645	1.880	2.115	2.350
Draft at AP m	0.000	0.235	0.470	0.705	0.940	1.175	1.410	1.645	1.880	2.115	2.350
Draft at LCF m	0.000	0.235	0.470	0.705	0.940	1.175	1.410	1.645	1.880	2.115	2.350
Trim (+ve by stern) m	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WL Length m	14.505	21.289	28.130	29.465	29.676	29.838	29.996	30.154	30.853	32.301	33.408
Beam max extents on WL m	3.645	5.501	6.403	6.919	7.236	7.424	7.515	7.555	7.574	7.582	7.586
Wetted Area m^2 (WSA)	32.505	80.562	123.411	150.894	172.006	191.523	210.276	228.883	247.627	269.004	292.378
Waterpl. Area m^2 (WPA)	27.986	73.030	112.266	134.623	149.155	160.838	170.622	179.373	187.869	198.412	209.849
Prismatic coeff, (Cp)	0.528	0.482	0.464	0.513	0.557	0.589	0.615	0.636	0,645	0,637	0,636
Block coeff. (Cb)	0.129	0.207	0.244	0.304	0.356	0.400	0.439	0.473	0,496	0,503	0,514
Max Sect. area coeff. (Cm)	0.675	0.728	0.749	0.768	0.787	0.817	0.836	0.854	0,869	0,882	0,893
Waterpl. area coeff. (Cwp)	0.529	0.624	0.623	0.660	0.695	0.726	0.757	0.787	0,804	0,810	0,828
LCB from zero pt. (+ve fwd) m	8.615	11.725	13.414	14.370	14.812	15.025	15.124	15.157	15,146	15,091	14,980
LCF from zero pt. (+ve fwd) m	10.666	13.423	15.252	15.676	15.669	15.539	15.379	15.194	14,965	14,556	14,067
KB m	-0.074	0.100	0.258	0.406	0.548	0.685	0.821	0.956	1,091	1,226	1,364
KG m	2.350	2.350	2.350	2.350	2.350	2.350	2.350	2.350	2,350	2,350	2,350
BMt m	8.775	9.272	7.586	6.054	4.981	4.212	3.631	3.182	2,832	2,561	2,351
BML m	109.747	101.718	106.106	83.095	66.013	56.005	49.484	45.124	42.354	41.997	42.582
GMt m	6.352	7.022	5.494	4.111	3.179	2.547	2.102	1.788	1.572	1.437	1.365
GML m	107.323	99.468	104.013	81.152	64.211	54.340	47.955	43.730	41.095	40.873	41.596
KMt m	8.702	9.372	7.844	6.461	5.529	4.897	4.452	4.138	3.922	3.787	3.715
KML m	109.673	101.818	106.363	83.502	66.561	56.690	50.305	46.080	43.445	43.223	43.946
Immersion (TPc) tonne/cm	0.287	0.749	1.151	1.380	1.529	1.649	1.749	1.839	1.926	2.034	2.151
MTc tonne.m	0.083	0.457	1.213	1.709	2.043	2.366	2.688	3.029	3.416	3.993	4.706
RM at 1deg = GMt.Disp.sin(1) tonne.m	0.275	1.797	3.568	4.822	5.632	6.175	6.562	6.898	7.278	7.817	8.598
Max deck inclination deg	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Trim angle (+ve by stern) deg	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

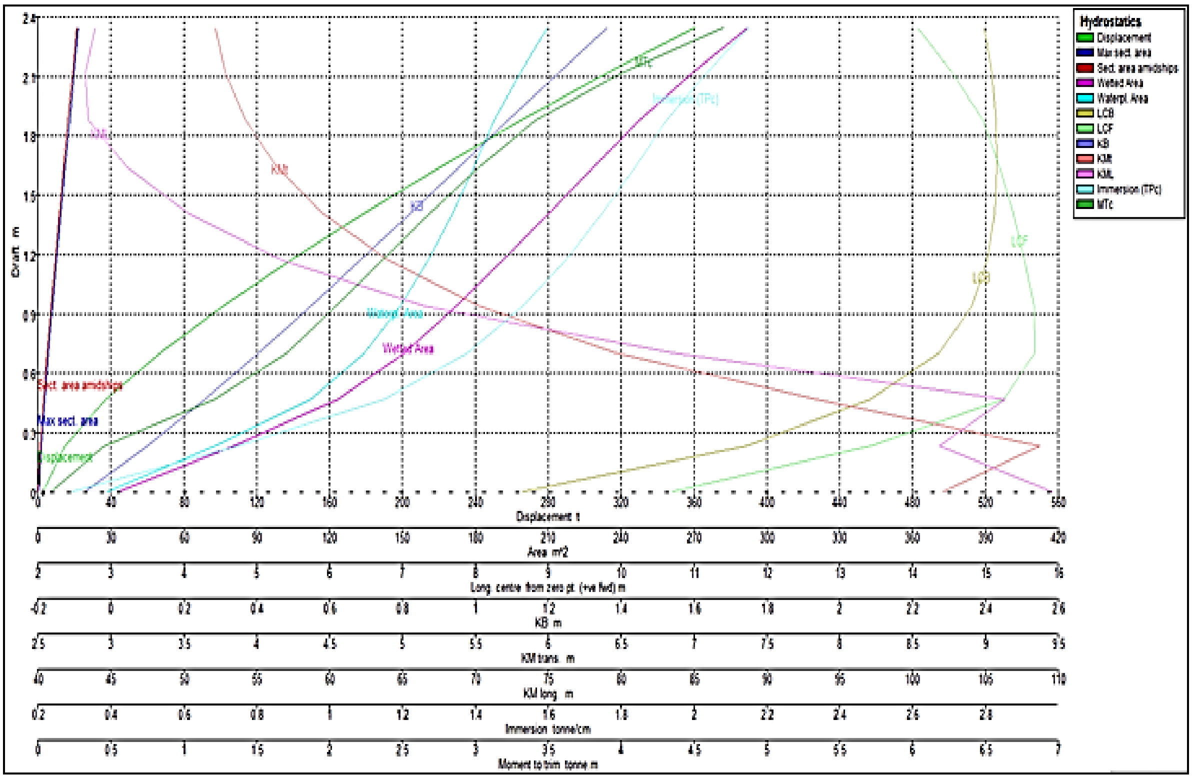

Figure. 3. Hydrostatic curve for purse seiner 180 GT

C. Ship capacity planning

From the design lines plan and general arrangement, it is possible to plan the room/tank capacity of sea water (SW), fresh water (FW), fuel oil (FO), lubrication oil (LO), black water (sewage), sludge – bilge, and fish. cargo hold. Ship Capacity Plan calculations are carried out with the help of Maxsurf Stability software. Capacity calculation simulation is described in each compartment.

The 180 GT purse seine ship is built with a skeg construction, a single propeller and rudder supported by a high shoe (solepiece). Compartment rooms and tanks are built on the general plan drawings that have been made. Weight Volume of each room is calculated based on the specific gravity (SG) of the load. Size and placement being entered into the ship model, Figure 3.

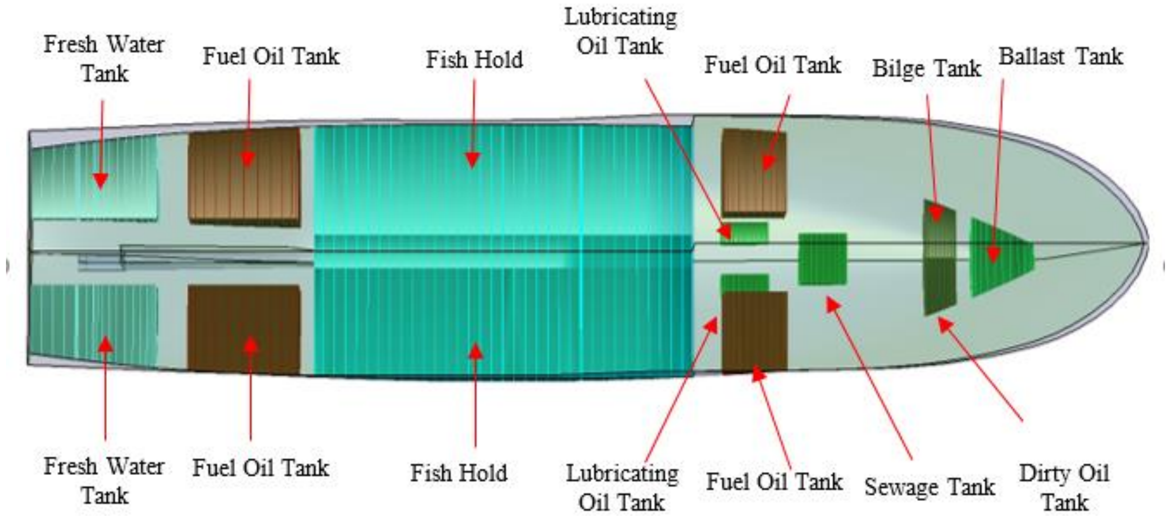

Figure. 4. Placement of the room according to the capacity plan of the purse seiner 180 GT

Weight Volume of each room is described as follows:

1. Sea water tank (SW), (SG=1.025 ton/m3, 98% full load condition). A sea water tank is planned with a capacity of 1,650 tons which functions as a ballast tank to support the ship's stability on voyages.
2. Fresh water (FW) tank (SG=1,000 ton/m3, 98% full load condition). A fresh water tank is planned with a capacity of 13,220 tons which is prepared to support the needs of fresh water for cooking, drinking, sanitary water and main engine and auxiliary engine cooling water.
3. Fuel oil (FO) tank (SG=0.865 ton/m3, 98% full load

condition). The fuel oil tank is planned with a capacity of 44,525 tons which is prepared to support the operation of the main engine and auxiliary engine during shipping operations.

4. Lube oil tank (LO) (SG=0.92 ton/m3, condition 98% full load). The lubricating oil tank is planned with a capacity of 1.575 tons which is prepared to support the needs of lubricating oil for main engine and auxiliary engine operations.
5. Black water tank (Sewage) (SG= 1.2 ton/m3, 98% full load condition). Tanks to accommodate sewage (sewage) are planned with a capacity of 1,952 tons which are prepared to accommodate sewage to prevent pollution in the sea
6. Sludge and bilge tank (SG=0.98 tons/m3, 98% full load condition). A tank to accommodate sludge and bilge is planned with a capacity of 1,317 tons which is prepared to accommodate sewage to prevent pollution at sea.
7. Cargo space (Fish) (SG=0.6 ton/m3, condition 98% full load). A room for storing fish cargo (fish cargo hold) is planned with a capacity of 143.146 tons which is prepared to accommodate fish caught during operations

D. Calculation of ship resistance

Calculation of ship resistance is done with the help of Maxsurf Resistance software. To calculate the resistance of the Purse Seiner 180 GT ship, the ship resistance calculation method is used for low to medium speed displacement vessels [11]. The speed of the ship is taken at 8 knots, with the assumption that this speed is the speed of a ship moving in calm weather conditions. The ship speed of 8 knots is the planned ship speed (design speed). Resistance calculation simulation, modeled in 3 dimensions using Maxsurf Modeler software. Model purse seiner 180 GT with modeling facilities in Maxsurf Modeler software.

The calculation of the first ship resistance was carried out through a simulation with the help of the Maxsurf Resistance software. The simulation was carried out at a design draft of 2.35 m. The simulation results obtained the value of the ship's resistance at each speed variation from 0-10 knots according to Table 2.

TABLE 2
DATA OF SHIP RESISTANCE AT VARIATION OF SPEED 0-10 KNOTS

Ship Speed (Knot)	Resistance (kN)
1	0,2
2	0,6
3	1,4
4	2,3
5	3,5
6	5,0
7	7,0
8	10,0
9	14,5
10	22,8

The data from the simulation results of the resistance calculation above, it is obtained that the ship's resistance at 8 knots, which is a design speed, is ± 10 kN, as the total resistance (Rt).

1) Total resistance with additional Sea Margin
The resistance value from the model test results above is the total resistance value of the ship in the experimental voyage, which is an ideal condition where it is assumed that the ship is in calm waters without wind and currents and the condition of the hull is very smooth (clean hull). This is of course very different from the actual condition of the ship at sea. Therefore, additional leeway must be given to the ship's detention to accommodate these conditions. The average allowance for official shipping is called the sea margin. For East Asian shipping routes, including Indonesian waters, the sea margin value is in the range of 15-20% % [5, 6], a value of 20% is taken, so the total ship resistance value is:

$$Rt_{service} = (1 + 20\%) \times Rt$$
$$= 12 \text{ kN}$$

2) Calculation of Wake Fraction and Thrust Deduction Factor
The ship is planned with a speed (Vs) of 8 Knots (4.115 m/s) which is the design speed, with a block coefficient (Cb) of 0.514. To calculate the thrust deduction factor, the value of the wake fraction (w) must be determined first, according to Table 3. Wake fraction is defined based on Taylor's experiments for single-screw ships, producing data on wake fraction values that are correlated with block coefficients [7].

TABLE 3
SHIP WAKE FRICTION MODELING IN MAXSURF SOFTWARE

Cb	w
0,50	0,230
0,55	0,234
0,60	0,243
0,65	0,260
0,70	0,283

So that the ship's wake fraction (w) with Cb=0.514 can be determined by interpolation.

$$w = \frac{(0{,}234 - w)}{(0{,}230 - w)} = \frac{(0{,}550 - 0{,}514)}{(0{,}500 - 0{,}514)}$$

w = 0,231

Thrust deduction factor (t) for single-screw ship is determined by the following formula:

t = k * w, k = 0.9~1.05

For ships equipped with old = 0.231 (single plate rudder style), the value of k = 1.05.

t = 1.05 x 0.231
t = 0.2425

E. Calculation of Overall Efficiency

Efficiency of Overall is used to calculate the thrust losses that occur throughout the hull. The overall efficiency is the sum of all power efficiency to propel the ship, the efficiency of which is efficiency of hull, efficiency of relative rotative, and efficiency of propeller open water [8].

1) Calculation of hull efficiency (ηH)
Price comparison between EHP effective horsepower (EHP) to thrust horse power (THP).

ηH = (1-t)/(1-w)

The thrust deduction factor (t) is 0.242255, while the wake fraction (w) is 0.231.

ηH = (1-0.242255)/(1-0.231)

ηH = 0.985

2) Calculation of propeller efficiency (ηo)
From the propeller characteristic data, the propeller efficiency is 0.4.

3) Calculation of relative rotative efficiency (ηrr)
The relative efficiency value of rotative ranges from 1.02 to 1.05. Taken value: 1.02; so that the propulsive coefficient (PC) is calculated as follows:

PC = ηH x ηrr x ηo
= 0.985 x 1.02 x 0.4
= 0.4018

4) Calculation of stern tube and bearing efficiency
For ships with engine room at the front, the losses value is 3%, so the efficiency price of bearing and stern tube (ηS-ηB) is:

ηS-ηB = 0.97.

5) Calculation of gearbox efficiency
The planned gear system uses Single reduction gear with losses of 1.5% for the forward direction, and Reversing gear with 1% losses for the reverse direction, so that the ηG (Gearing efficiency including thrust bearing) system is:

ηG single reduction gear : 0.985
ηG Reversing gear : 0.99
ηG =0.985 x 0.99 : 0.97515

So that the overall efficiency can be calculated as follows:

= ηH x ηrr x ηo x ηSηB x ηG
= 0.985 x 01.02 x 0.4 x 0.97 x 0.97515
= 0.380

F. Analysis of the power requirements of the prime mover engine

To push the ship so that it can go at speed (Vs), thrust is needed to fight against the resistance acting on the ship's hull, this power is also called the effective power of the ship or effective power (EHP). Effective power is the multiplication between total resistance and speed (Vs). This Effective Power can be calculated as follows:

PE = Rtservice x Vs
= 12 x 4.115
= 49.38 kW

The power value of 49.38 kW is the driving force of the ship, to calculate the power of the propulsion engines of the ship, power must be added to overcome the loss of power due to passing through the mechanical and propeller transmission components and their interaction with the ship's hull. These losses are represented by the values of efficiencies which in aggregate are called overall efficiency. The main propulsion engine power requirements can be calculated as follows:

BHP = EHP/Overall Efficiency
= 129.947 kW

The power value of 129.947 kW is the main engine's Brake Power which operates at the Maximum Continuous Rating (MCR). This power has not taken into account the flexibility in the operation of the main engine (main engine), which can be described if this power is a reference for selecting the main engine, which operates at maximum load continuously. To provide concessions to the operation of the main engine, it is necessary to add additional power (sea margin) of around 15-30% (ITTC, 2017; Magnussen, 2017).

The 180 GT purse seine ship is planned with the assumption of an additional sea margin of 20%, so that to reach the ship's speed, the main engine is sufficient to run at Service Continuous Rating (SCR), so as not to burden the main engine too heavily and there is also a power reserve to maintain the ship's performance. on its planning conditions, when the ship is in operational activities. This additional power is the engine margin:

$BHP_{Eng,\ margin}$ = (1+20%) x BHP
= 155.93 kW
= 209.132 hp

This power value is then used as a reference for selecting the main engine to be installed on the ship.

1) Main engine
The main engine is designed to cope with torque and other vibrations. A set of marine diesel engine with diesel fuel, starter with electric motor. The cooling system is fresh water cooled by sea water, and meets the speed under full load conditions of not less than 8 knots at 85% maximum continuous rating (MCR).

The motion control of the main engine is carried out through a remote control system from the wheelhouse, and with an electronic control type. In an emergency, the main engine can also be operated locally in the engine room, and commands for maneuvering are made via the electronic engine telegraph, voice tube and intercom. The main engine and auxiliary engines in the engine room must be equipped with control instruments and an alarm system including an RPM indicator.

Control instruments and indicators in the engine room shall be linked to the maneuvering control center in the wheelhouse. Technical specifications of the driving motor (main engine):

- Type : 4 Cylinders, Vertical turbocharged, single acting trunk piston, direct injection type, electronic control system, marine diesel engine
- Number of machines: 1 set
- MCR : ± 220 HP
- RPM : 1700 – 1800RPM
- Fuel : Diesel oil (A oil)

- Fuel Use : ± 170 gr/ps.h ± 3 %
- Starting method: Electric motor starting
- Cooling system : Close cooling system
- Lubrication system: Pressure lubrication with gear pump.
- Reduction gear : 1 set (1 : 4)
- Accessories For Main Machines
  - Turbocharged Exhaust Gas: 1
  - Flywheels : 1
  - Fresh water cooling pump : 1
  - Thermometer with shielded tube : 1
  - Governor and motor governor : 1
  - Cooling air : 1
  - Fresh water cooler : 1

G. Shaft, Stern tube and Propeller.

1) Shaft

The propeller shaft is made of stailess steel and the classification standard. The bearing portion of the shaft becomes slightly larger than the diameter of the shaft. The propeller shaft should be easily pulled out during survey time.

2) Stern tube

The stern tube must be made of cast iron and lubricated with seawater, Lignum vitae/rubber is used as a bearing part and a stern seal type gland packing.

3) Propeller

Fixed pitch type propeller, rotating clockwise as seen from the stern. The blades are made of manganese bronze with 4 leaves, and must be good at dynamical and static balance. The diameter, pitch of the propeller and so on must be determined by in-depth study

H. Distribution of electric power on the ship

To support the need for electric power on the ship, two sets of auxiliary motors were installed, a single acting 4 stroke diesel engine. The need for electric power to support the auxiliary system on the 180 GT purse seine ship is 120.39 kW, Table 4.

Assuming that the power factor (cos φ) is 0.8, the generator motor is installed with the following power requirements:

$$P_{\text{auxiliary engine}} = \Sigma P \text{ equipment} \times \cos \varphi$$
$$= 120.39 \text{ kW} \times 0.8$$
$$= 150.488 \text{ Kva}$$

1) Auxiliary engine

To support the need for electric power on the ship, two sets of auxiliary motors were installed, a single acting 4 stroke diesel engine. The auxiliary motor is installed in the engine room. Diesel oil fueled engine with electric motor start and fresh water cooling. The fresh water coolant pump and oil pump for the engine are directly driven by the engine and each part must be lubricated automatically. The technical specifications of the two auxiliary motor units and the electrical generator are as follows:

Diesel Generators No. 1 and 2

- Quantity: 2 units
- Type : Vertical, 4 stroke, water cooling, inline, piston rod, direct injection, mechanical control system
- Number of sets: 2 sets
- Output Rate: 150 Hp
- Rotation: 1500rpm
- Number of cylinders: 4
- Fuel : Diesel Oil (A oil)
- Start systems : Electric motor starting (DC 24V)
- Cooling systems : Fresh water cooling.

Generators No. 1 and 2

- Quantity: 2 units
- Type : Self ventilated, drip proof, brushless
- Output : 150 KVA (120 Kw) x 1500 rpm
- Voltage : 220 V AC
- Phases: 3 phases
- Frequency : 50 Hz
- Power Factor: 0.

TABLE 4
THE DEMAND FOR ELECTRIC POWER ON A 180 GT PURSE SEINE SHIP

No	Item	Electric Power	Unit	Total Electric Power
1.	Steering Gear	3 kW	1 unit	3 kW
2.	Anchor wichlass	4 kW	1 unit	4 kW
3.	Stern winch	2 kW	1 unit	2 kW
4.	Mechanical wich	2 kW	1 unit	2 kW
5.	Power block	5 kW	1 unit	5 kW
6.	Fish pump	2 kW	1 unit	2 kW
7.	Cargo hold freezer	45 kW	1 unit	45 kW
8.	Pump			
	a. General service pump	3 kW	1 unit	3 kW
	b. Sanitary pump	2 kW	1 unit	2 kW
	c. Bilge pump	2 kW	1 unit	2 kW
	d. Dirty oil pump	2 kW	1 unit	2 kW
	e. Sewage pump	2 kW	1 unit	2 kW
	f. Sea water cooling pump (main engine)	1,5 kW	2 unit	3 kW
	g. Sea water cooling pump (auxiliary engine)	1,5 kW	2 unit	3 kW
	h. Fuel oil transfer pump	2 kW	1 unit	2 kW

No	Item	Electric Power	Unit	Total Electric Power
	i. Separator fuel pump	1,1 kW	1 unit	1,1 kW
	j. Fresh water pump	1,5 kW	1 unit	1,5 kW
	k. Fresh water generator pump	1,5 kW	1 unit	1,5 kW
	l. Submersible pump	0,5 kW	1 unit	0,5 kW
	m. Lubricating oil pump	1,1 kW	2 unit	2,2 kW
9.	Engine room Fan	0,75 kW	2 unit	1,5 kW
10.	Accommodation room fan	0,6 kW	8 unit	4,8 kW
12.	Davits	5 kW	1 unit	5 kW
13.	Stove	1,5 kW	1 unit	1,5 kW
14.	Lamp			
	a. lighting	0,015 kW	50 unit	0,75 kW
	b. Searchlight	0,5 kW	2 unit	1 kW
	c. FADs fishing tools	1 kW	16 unit	16 kW
	d. Mast head light	0,04 kW	1 unit	0,04 kW
	e. Navigation light	0,05 kW	2 unit	0,1 kW
	f. Stern light	0,05 kW	1 unit	0,05 kW
	g. Anchor light	0,02 kW	1 unit	0,02 kW
	h. Hauling light	0,04 kW	1 unit	0,04 kW
	i. Around light	0,015 kW	6 unit	0,09 kW
15.	Window wiper	0,1 kW	2 unit	0,2 kW
16.	Communication radio	0,05 kW	2 unit	0,1 kW
17.	Echosounder	0,1 kW	1 unit	0,1 kW
18.	Wind direction	0,05 kW	1 unit	0,05 kW
19.	Battery charging	0,5 kW	1 unit	0,5 kW
	Total			120,39 kW

I. Fishing equipment (fishing gear)

1) Type of fishing gear
Fishing gear using a purse seine. Purse seine fishing gear is used to catch schooling fish, which include small pelagic.

2) Purse seine fishing gear materials
Purse seine fishing gear is used with a length of 600 meters, Figure 5. This equipment consists of the following components:

1. *Webbing*. The material commonly used is nylon PA 210d/9 thread with a mesh size of 1.25 inches. The length of the purse seine is usually ± 3-4 times the depth of the net. For purse seine fishing gear with a length of 600 meters, the net width is 150 meters. The number of eyes down or deep depends on the depth of water where the tool will be operated.
2. *Selvedge*. Selvedge is a reinforcing mesh that serves to protect the edges of the main net so that it is not easily damaged or torn when pulled, the selvedge is located around the main net. Selvedge material is usually stiffer than the main mesh material such as polyethylene (PE) 380d/12 with a mesh size of 1.5 inches or larger. The size of the selvedge eye is always larger than the webbing, as well as the number of threads used.
3. *Upper ris line*. The ris rope is a life vest line. The upper ris line uses the opposite direction of spinning with the float and sinker line. Shrinkage is generally around 10%.
4. *Floating line*. The float rope serves to place the buoy and serves as a link to the net on the upper edge.
5. *Float*. The float serves to hold the net part of the net so that it remains afloat, so that the net forms a wall as a barrier for fish so that fish are trapped in the net. The material used is a material whose specific gravity is less than the density of sea water.
6. *Under ris line*. The under ris line serves as a sinker line fastener. The under ris line uses the opposite direction of spinning with the float and sinker line. Shrinkage in general ranges from 30% - 15%. The under ris line will be longer than the top ris strap.
7. *Sinker line*. The sinker line serves to place the weights and links with the net on the bottom edge.
8. *Sinker*. The sinker functions so that the bottom net sinks quickly when operated. Sinker materials generally use tin or lead (lead). The sinker used is generally cylindrical with a length of + 3 cm with a diameter of 5 cm. But sometimes the weights and ring line are made of iron chain material.
9. *Ring line*. The ring line is the line used to hang the ring. The ring line hangs on the under ris line. The ring line is made using polyethylene material with a diameter of 10 mm. And the length is ± 150 cm. There are three types of ring line, namely:
   - Single leg shape.
   - Double leg shape.
   - Tie shape.
10. *Rings*. The function of the ring is to pass the corrugated line when it is pulled so that the bottom of the net can be collected. The ring material is usually brass or copper or sometimes iron is used which is coated with brass. The ring used usually has a diameter of 10 cm and weighs about 400 grams.
11. *Purse line*. Serves to unite the ring at the bottom, so that the fish inside will be trapped in a bag-shaped net. The line is also known as the drawstring. Purse seine line material from polyethylene (PE) or kuralon (PVA). The diameter of the purse seine line is around 25 mm. Purse seine lines require considerable

strength when compared to other lines.

12. *Sheet line*. The sling strap is the strap for the upper and lower ris straps. The line is made of polyethylene (PE) with a diameter of 15 mm. This line is used to tie the entire construction of the purse seine fishing gear to the winch towing the fishing gear.

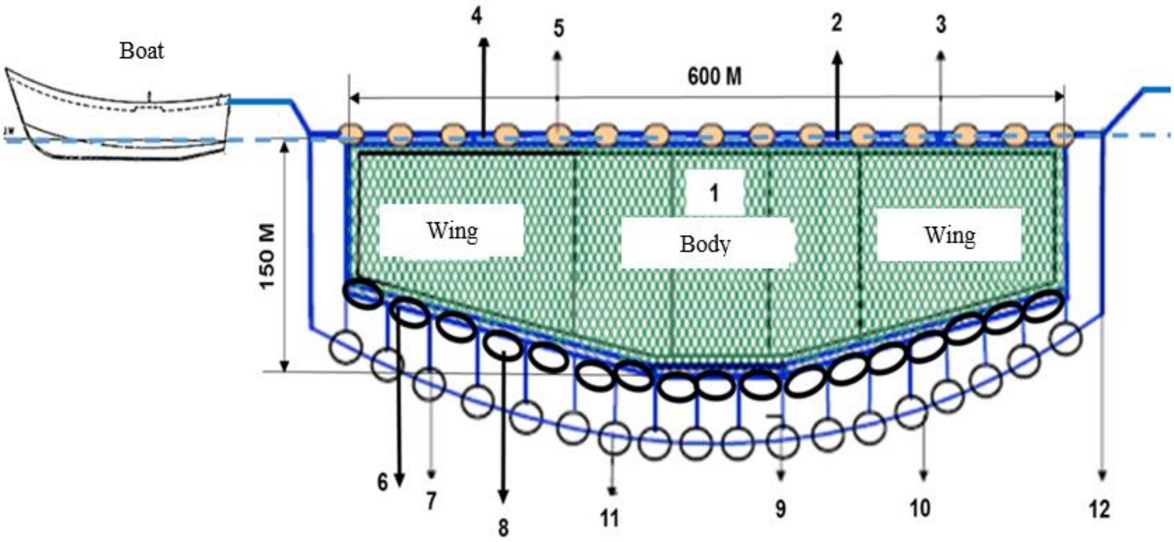

Figure. 5. Construction of purse seine

J. Fishing aids

To increase the production of caught fish, fishing aids are needed. The fishing aids used on the 180 GT purse seine fishing boat consists of lights and fish aggregating device (FAD). Lights are used for fishing aids at night and FADs as fishing aids during the day, Tabel 5.

TABLE 5
FISHING AIDS

No	Item	Technical specification	Unit
1.	Lamp	- Power 1000 Watt - Lumen 58.000 lm	16 unit
2.	Fish aggregating device (FAD)	- Sinker 50 kg - Line 3000 M - Float - Cloth sheet	3 unit

TABLE 6.
PERSONNEL STRUCTURE ON PURSE SEINE VESSEL 180 GT

No	Field	Position	Number
1.	Captain	Captain	1 person
2.	Deck department	Mates I and II	2 Person
		Bosun	1 Person
		Helmsman I and II	2 Person
		Class I and II	2 Person
3.	Engineering department	Engineer I and II	2 Person
		Foreman	1 Person
		Oiler I and II	2 Person
		Engine Class I and II	2 Person
4.	Operation department	Fishing Master	1 Person
		Fishing gear operator	5 Person
5.	Catering department	Chief steward	1 Person
		Cook	1 Person
		Servant I and II	2 Person
6.	Operator	Radio officer	1 Person
		Electrician	1 Person

K. Fish storage systems and equipment

Fish cargo hold. Fish holds as shown in the general plan drawings, consisting of four fish holds. The fish hold is divided by portable wooden partitions as shown on the general plan. The hatch covers are provided with tight gaskets and clamping devices. Fish Holds shall be coated with fiberglass (FRP) for easy cleaning and maintenance. Residual ice water in the fish hold to be discharged overboard using a portable pump on the main deck.

1) Isolation

Isolate all fish holds covered with polyurethane foam and covered with fiberglass reinforced plastic (FRP) or similar material. The thickness and details of the insulation are determined based on the heat calculation of the fish hold.

2) Fish hatch cooling system

The fish cooling system used by the 180 GT purse seine ship uses Refrigerated Sea Water (RSW) cooling system. Fish are stored in fish holds with a temperature of -1.10 C (minus 1.1 degrees Celsius).

L. The number of crews

A purse seine fishing vessel with a capacity of 180 GT is manned by 27 crew members (ABK). ABK's contentment affects the duties and functions of ship operations and fishing activities. The organizational structure on fishing vessels consists of 3 departments consisting of the deck department, engine department, operations department, catering department and operators, Table 6.

M. Fishing operation (Endurance)

Fishing vessel with a capacity of 180 GT are operated for 50 days. To support the need for fuel for the operation of the main engine and auxiliary engine, fuel is needed.

- Fuel tank with capacity to support fuel needs for main engine and auxiliary engine.
- Food ingredients warehouse for crew members with refrigerator room facilities to store meat and vegetables.

N. Navigation and Communication equipment

Material and quantity of internal communications and navigational equipment based on Indonesian government rules and regulations. Navigation equipment that must be installed to assist the movement of purse seine fishing vessels, Table 7. Positioning of navigation equipment of purse seine 180 GT as shown in Figure 6 general arrangement.

TABLE 7.
NAVIGATION EQUIPMENT

No	Item	Type and Capacity	Amount	Technical Specification
1.	Steering gear	Type ±150 mm	1	Integrated with autopilot navigation system
2.	Steering stand	Hydraulic	1	With angle indicator
3.	Radar	Peak power :4 kW Range :28 NM	1	
4.	Echo Sounder	Depth range max 320 m	1	
5.	Clear view screen	Diameter 250 mm	1	
6.	Horn	Type electric	1	
7.	Sextant	With lamp	1	
8.	Deck watch		1	
9.	Navigation satellite	Receiving frequency 399,986 MHz ± 10 KHz Standard size	1	
10.	Automatic direction finder	Autotype Receiving system: superhete heterodyne Beacon band : 190-420 KHz B.C Band : 550-1600 KHz MF Band : 1600-4500KHz	1	Power supply 24 V DC Loop antenna : 800mm dia.
11.	Navigation aid Autopilot	Consist of: - Steering unit - Control amplifier - Remote control - Valve unit	1	
12.	Binocular		1	
13.	Thermo pilot	Digital	1	

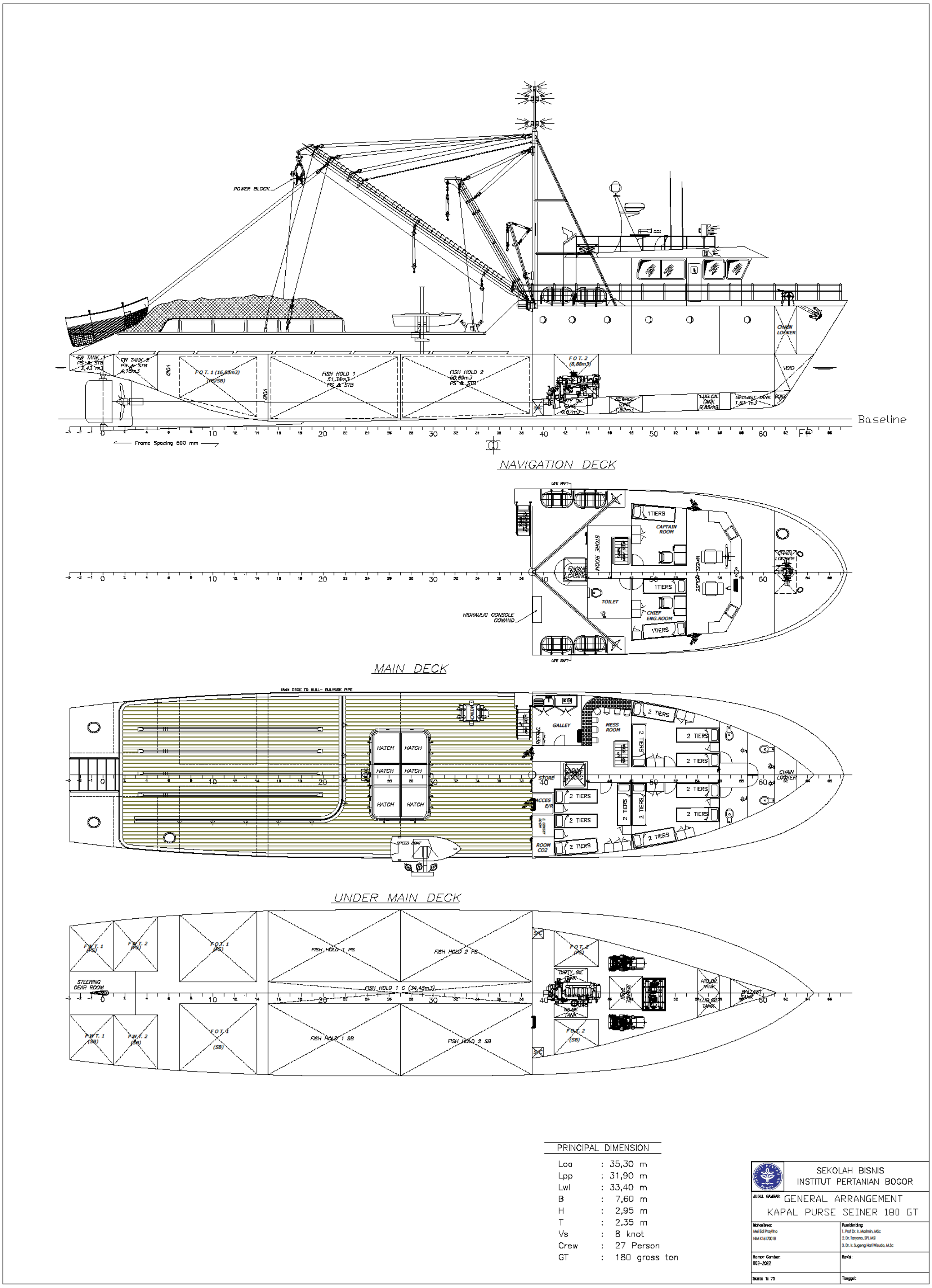

Figure. 6. General arrangement of purse seine 180 GT

O. Fishing gear and hauling mechanical equipment

Mechanical equipment for catching fish mounted on purse seine fishing vessels is prepared to lower the purse seine net and withdraw the catch of small pelagic fish, Table 8.

This mechanical equipment is to help work effectiveness in lowering purse seine nets, attracting, and moving fish from the nets to the fish holding hatch. The use of this mechanical equipment will increase the efficiency of fishing vessels.

TABLE 8
PURSE SEINE MECHANICAL EQUIPMENT

No	Item	Technical specification	Unit	Location
1.	Boom	Steel pipe	2 unit	Top deck
2.	Pulley block	Steel	2 unit	
3.	Mechanical Winch	- Electric AC 220V/4P/ - phase/50Hz/7.5 kw x 140 pm	1 unit	*Main deck*
4.	Power block	Steel	1 unit	
5.	Fish pump	Diameter 18 inch	1 Unit	*Main deck*

P. Discussion

1) Propulsion System
To get the speed of the purse seine ship 180 GT at 8 knots, the main engine power of 155.93 kW (209.132 hp) is needed. The service speed is obtained from the main engine performance of 85% of the maximum continuous power rating (MCR). A 180 GT purse seine fishing vessel is planned with a main engine from the marine use engine classification..

- Power 154 – 169 kW(209 – 230 Hp)
- Direct injection, heat exchanger cooling.
- Turbocharger + intercooler.
- Durable hydraulic marine gear.
- 6CH-WDTE conform to IMO Tier ll emissions regulations

2) Auxiliary Engine
To support the need for electric power on the ship, two sets of auxiliary motors were installed, a single acting 4 stroke diesel engine. The need for electric power to support the auxiliary system on the 180 GT purse seine boat is 120 kW (150 kVA). From the need for electricity to support fishing operations, two units of electric generators were installed [14].

Room capacity of Purse Seine 180 GT. The planning results for a 180 GT purse seine ship with a fish loading capacity of 30% of the total volume (Gross tonnage). To determine the ship's capacity, the Ministry of Maritime Affairs and Fisheries (KKP) uses the formula, Capacity = 0.25 x Total Room Volume. Thus, the ship's capacity is = 0.25 x 722.654 M3 = 180.68 GT. The volume of fish loading is 33.01 % of the total volume of the ship, Table 9.

TABLE 9.
ROOM CAPACITY

No	Room	Capacity		Percentage
1.	Sea water tank	1.610	M^3	0.22%
2.	Fresh water tank	13.220	M^3	1.83%
3.	Fuel oil tank	51.474	M^3	7.12%
4.	Lube Oil tank	1.712	M^3	0.24%
5.	Black Water (Sewage) tank	1.627	M^3	0.23%
6.	Sludge and bilge tank	1.344	M^3	0.19%
7.	Wheel room	9.280	M^3	1.28%
8.	Engine room	115.510	M^3	15.98%
9.	Void Fr-7 (Coverdam)	10.340	M^3	1.43%
10.	Void (shaft)	18.150	M^3	2.51%
11.	Void Fr 14-15 (Coverdam)	9.230	M^3	1.28%
12.	Void Fr 61-64 (Coverdam)	2.080	M^3	0.29%
13.	Fore Peak tank	6.05	M^3	0.84%
14.	Cargo hold (Fish)	238.575	M^3	33.01%
15.	Crew room (Main deck)	82.720	M^3	11.45%
16.	Bathroom/toilet (Main deck)	27.367	M^3	3.79%
17.	Electrical Genset, CO_2 & Store (Main deck)	13.290	M^3	1.84%
18.	Galley& mess room	35.595	M^3	4.93%
19.	Chain locker room	3.600	M^3	0.50%
20.	Crew room (Nav. deck)	33.150	M^3	4.59%
21.	Wheelhouse	28.750	M^3	3.98%
22.	Bathroom/toilet (Nav. deck)	7.420	M^3	1.03%
23.	Store (Nav. deck)	10.560	M^3	1.46%

No	Room	Capacity		Percentage
	Total	722.654	M^3	100.00%

3) Fishing Equipment (Fishing Gear)
Selection of purse seine fishing gear for small pelagic species in line III WPPNRI 572 to achieve catch productivity. Vessels with API purse seines are effective vessels for catching schools of fish (fish schooling) near the surface [12]. The use of purse seine fishing gear for small pelagic fish has several advantages in terms of productivity. The results of the study in Lhok Pawoh Aceh on purse seine vessels measuring 23 – 60 GT, from 15 vessels it was found that the catch for large pelagic fish was the highest on average 2,458.8 kg/GT and the lowest was 209.3 kg/GT, while for small pelagic fish, the highest average yield was 2,630.7 kg/GT and the lowest was 418.3 kg/GT [13]. The productivity of purse seine fishing gear is 1.03, will provide benefits in the management of small pelagic fish resources in WPPNRI 572.

Catching small pelagic fish with purse seine fishing gear needs to be regulated and adjusted to the number and capacity of vessels with potential fish resources, to prevent overfishing [15]. In addition, it is also necessary to provide guidance to fishermen to prevent fish resources from being disposed of due to dead conditions and having a low price value for sardines (Pilchardus spp.) (42.6%) and even mackerel (picturatus spp.) (14.2%) [16].

4) Fishing gear pulling mechanical equipment
On a 180 GT fishing vessel, mechanical equipment consisting of a boom, pulley, mechanical winch, power block and fish pump is used to remove and haul purse seine nets and move fish from purse siene fishing gear. The use of power block and fish pump equipment can reduce human labor by 43.3% [17]. Transfer of fish using a fish pump must ensure that the quality of the fish is maintained and not damaged [18].

The planned power block from the Marco Puretic Power Block brand, which has the following specifications:

- Diameter: 30 inches
- Model : Standard (ST)
- Shaved: with replaceable rubber cleats (RC).

For fish transfer, a fish pump is used [19], it is planned to use a fish pump with a diameter of 14 inches. The transfer of fish with a fish pump uses a hydraulic system.

- Capacity : up to 2000 tonnes per hour
- Lightweight : 430kg
- Manufactured : Marine grade Aluminum and Stainless Steel

5) Fish storage systems and equipment
To maintain the quality of fish caught, it is necessary to pay attention to space and storage systems. The fish storage room is related to the use of hold material so that the temperature of the fish is maintained, so that the fish stays fresh. In planning the fish hatch cover is equipped with tight gaskets and clamping devices, the fish hatch walls must be coated with fiberglass (FRP) to facilitate cleaning and maintenance.

In terms of insulation, all fish holds are covered with polyurethane foam and coated with fiberglass reinforced plastic (FRP) or similar material with the thickness of the insulation walls determined based on the heat calculation of the fish hold.

In the fish cooling system, it is intended to keep the quality of fish fresh until it reaches consumers [20]. The fish cooling system used by purse seine ships uses a refrigerant sea water (RSW) cooling system, where fish are stored in fish holds filled with sea water with a temperature of -1.10 C. The cooling machine data is as follows:

- Compressor : Ammonia-NH3 refrigerant media
- Drivers/motors: 45 kW/ 380 V/3 phase/ 50 HZ
- Condenser & Receiver : CR60235
- Accumulator : ACC3540 Heat exchange type
- Hairpin shape Coil : 20A SGP dia 27.2 mm galvanized steel pipe
- Electronic Expansion Valve : SHC 220 M
- Digital Temperature Sensor : DMR-6, HGP -700 C~ +500 C (0,10C) AC 100V 60 Hz.

To preserve the environment, the use of environmentally friendly refrigerant media [20] such as Freon (R22), Hydrofluorocarbons-HFCs (R404A, R410A, R134a, R32, R1234yf and R1234ze), Ammonia (R717), Carbondioxide-CO2 (R744) and Propane (R290) [21].

6) Fish detection equipment
Fish detection equipment provides assistance in detecting the number, presence and depth of fish assemblage locations. The installation of fish detection affects the ability to know the number and number of groups of fish to be caught [22]. By utilizing technology, it can reduce operational costs which in turn can increase the yield and income of fishery business actors.

Currently, the use of fish detection technology has developed rapidly, including using smartphones [23]. The detection equipment installed on the purse seine ship is used by the Fishfinder Brand Garmin type 560C Part Number 010-01197-00 with the following specifications:

- Frequency : 200/50 kHz
- Transmission power: 600W (RMS)/4,800W (peak to peak)
- Voltage range : Input 8V - 28V
- Maximum depth: 1,500 feet of sea water.

7) Fishing operation (Endurance)
The fishing operation time is influenced by the fuel capacity on board and fuel consumption from the main engine and auxiliary engine as well as the availability of food logistics for the ship's crew. Fishing boats with a capacity of 180 GT are operated for 50 days. To support the need for fuel for the operation of the main engine and auxiliary engine, fuel is needed. The use of fuel for the

main engine and auxiliary engine can be explained as follows:

1. Use of fuel for the main engine. Economically, fuel consumption data main engine (60% of MCR) is 15 l/h, Figure 4.17. Thus, from the use of fuel for 50 days, it can be explained that the fuel capacity for the main engine is:
   = 15 liters x 24 hours x 50 days = 18,000 liters.
2. Use of fuel for the auxiliary engine. Fuel consumption data from the Perkins Brand main engine type 1106A-70TGI economically (50% of MCR) is 15.9 l/h. Thus, from the use of fuel for 50 days, it can be explained that the fuel capacity for the auxiliary engine is:
   = 15.9 lt x 24 hours x 50 days = 19,080 lt

From the fuel consumption data for the main engine and auxiliary engine during fishing operations for 50 days, a fuel capacity of 37,080 lt (18,000 lt and 19,080 lt) is required.

8) Bench marking for purse seine vessels 180 GT
The 180 GT purse seine design has several bench markings which include:

1. Purse seine vessels for catching small pelagic fish on line III WPPNRI 572 are designed using electric hydraulic and mechanical electric fishing equipment in the form of power blocks and fish pumps that can increase the efficiency of crew members, with the need for as many as 27 people. The results of interviews with 6 fishing vessel businessmen with purse seine fishing gear, for vessels with a capacity of around 180 GT require 45-50 crew members with duties covering ship operations, catching and storing fish and operating fishing equipment. Thus the new 180 GT purse design has a crew efficiency of 40% to 46%. The installation of equipment such as multi-purpose cranes, hydraulic systems, power blocks, fish pumps and fish cooling systems will reduce the workforce (Edwin, 2019), specifically reducing the workforce by around 43.33% [17].
2. In the fishing process, starting from setting the fishing gear, pulling the corrugated rope along with the net body (hauling) using a power block and raising the catch (brailing) using a fish pump, one operation takes 2 hours to 2.5 hours. The results of interviews with 6 business actors catching purse seine fish takes 3 hours to 3.5 hours. Thus the design of the new 180 GT purse has an efficiency of operating time of 16.67% to 42.86%.

Q. Managerial Implications of Purse Seine 180 GT Vessel Technical Specifications on Fishing Efficiency.

The technical specifications of the vessel are prepared based on data from owner requirements by considering the potential of fish resources and the characteristics of the waters of fishing locations. The ship's technical specification data includes: 180 GT capacity with mild steel hull material, 35.30 meters long ship (Loa), 8 knots service speed, propulsion system type I line engine model 220 Hp, auxiliary system (auxiliary engine) for the ship's electrical needs using a 150 Kva dual engine model, fish storage system using a cargo hold freezer system, Fishing Aids using FADs and lights, the number of crew members is 27 crew members, fish detection equipment using fish finder equipment, API withdrawal mechanical equipment using Winch Mechanical and Power block and endurance for 50 days. The relationship between design and technical specifications of 180 GT purse seine vessels on fishing efficiency.

R. Research limitation

The technical specifications for the 180 GT purse seine ship were carried out using maxsurf software and did not use a model test.

IV. CONCLUSION

A. Conclusion

Technical specifications of the purse seine 180 GT with a Loa length of 35.30 m and a speed of 8 knots. This 180 GT purse seine ship uses the main engine with an engine power of 220 hp and an auxiliary engine with a capacity of 150 kVA. This 180 GT purse seine ship can be operated for 50 days with 27 crews with a fuel tank capacity of 44,525 tons. This fishing boat uses a purse seine fishing gear with a length of 600 m and a width of 150 m, which is equipped with a power block and fish pump which can increase crew efficiency by 40% to 46% and the time for setting purse seine nets, hauling and brazing is faster by 16.67% to 42.86% of conventional purse ships.

B. Recommendation

In the shipbuilding process, it is recommended to use domestic component and material products to increase the speed of the production process and ease the supply of spare parts.

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