IJSSR
International Journal of Social Service and Research

Vol. 03, No. 09, September 2023
e-ISSN: 2807-8691 | *p*-ISSN: 2807-839X

Design and Manufacture of 3 Phase Electric Engine Hydrophore Control System

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Keywords
Hydrophore, Electric machine, control

ABSTRACT
On board there is a temporary water reservoir called a hydrophore? Hydrophore serves to distribute fresh water that will flow to all parts of the ship's hull or accommodation on the ship, the hydrophore pressure tank cannot work for a long time if the ship is in black out condition. This research method is a type of Experimental research. Data collection techniques carried out are observation, design, making, measurement and documentation. The analysis method uses a descriptive analysis method by describing the working principle of the 3 Phase Electric Machine Hydrophore Control System that has been designed and made by the Research Team. The results of the study produced a 3 Phase Electric Machine Hydrophore Control System trainer we made with the hope that it can be a material or learning tool for students studying at the Polytechnic of Shipping Sciences, especially cadets / cadets of Diploma IV Shipping students who have not carried out sea practice so that when they carry out sea practice there is already an idea they get about the Hydrophore control system Although the tool we made is only a miniature because the tank we use is on a small size scale.

INTRODUCTION

Theera of ships as a means of transportation is very important andhelps smooth transportation from one place to another. In this development, it takes the ability of sailors to maintain, maintain, and operate ships to safely reach their destination. In the course of the ship, in traveling from the place of origin to the destination, the crew needed fresh water for their activities.

On board there is a temporary water reservoir called a hydrophore. Hydrophore serves to distribute fresh water that will be flowed to all parts of the ship's body or accommodation on the ship. To get this pressure, the hydrophore requires water and air that has the pressure of both media will be inserted into the tank. And when the pressure is sufficient, what if the faucet that is accommodated is open, the water will flow, this is because the pressure has been fulfilled.

Water and air were previously compressed by compressors and *fresh water pumps*. With the help of pressure from the air, it is expected that the water coming out of the vessel will have high pressure and be able to reach all parts of the ship's body without having to lose air pressure. On board, hydrophore generally there is only one piece, namely *fresh water hydrophore*, which is in the engine room and placed in an area that is easy to reach without disturbing or hindering the activities of the engine *crew* in carrying out maintenance or repair on the *main engine* or other auxiliary aircraft.

However, the *hydrophore pressure tank* cannot work for a long time if the ship is *in black out* condition. This happens because the pump supplying water to the *hydrophore pressure tank* does not

https://doi.org/10.46799/ijssr.v3i9.533

get electricity supply so that the pump will automatically stop working. Similarly, the air compressor will not work if there is no electricity that functions to drive the motor on the air compressor. This is what makes the author want to create a teaching aid to be used as learning material for other students. Based on the results of research from Ridho Rahmadianto, entitled Design and Build *Hydrophore Pressure Tank Trainers* in MV.

Mutiara Perindo I, and Journal at the National Seminar on Aviation Innovation and Technology, about Design and Build a Prototype Control and Monitoring of a PLC-Based Centralized Clean Water Distribution System at the Surabaya Aviation Polytechnic. From the Journal the author was motivated to make the Design and Design of the *Hydrophore* Control System, this design the author developed by utilizing used Oxygen Gas Cylinders as tubes, functioning for water storage tanks and compressed air while Oxygen Gas Cylinders are used as the main material and are prototypes in the construction of hydrophore pressure tank designs.

The designer chose Used Oxygen Gas Cylinders as the main material for the tubes, because it has several reasons, one of which is to use Oxygen gas cylinders that are no longer used. In addition, gas cylinders are easy to get and the construction is in accordance with water storage tubes, the author takes the title: "Design and Design of 3 Phase Electric Engine Hydrophore Control System" This will be very useful if it can be applied in educational institutions, especially in PIP MAKASSAR as teaching aids or practices will add insight to students who have never previously been ship crews or crew members, so that at the time of the prala on the ship already have an idea of the Hydrophore control system. Both regarding the *electric* control and the *Enggine* control

The problem addressed in this study pertains to the design and fabrication of a 3 Phase Electric Machine Hydrophore Control Tool intended for educational purposes among students. The research aims to achieve two primary objectives: first, to develop a practical tool and demonstration model for illustrating the functioning of the 3 Phase Electric Machine Hydrophore control system, and second, to provide educational material to enhance the understanding of students, particularly those in Engineering programs, about this specific system. The research's significant benefits include the advancement of students' knowledge, particularly those enrolled in engineering programs, by offering a deeper comprehension of the operational principles of the 3 Phase Electric Machine Hydrophore control system. Additionally, it serves as a practical resource for students, specifically those pursuing a Diploma IV in Shipping Engineering, to facilitate their learning and experimentation with the 3 Phase Electric Machine Hydrophore control system.

LITERATURE REVIEW

A. Understanding System Design Design is the drawing, planning and sketching or arrangement of various separate elements into a whole and functioning unit (Syifaun Nafisah, 2003: 2).

Understanding design according to experts include:

According to Varzello/John Reuter III design is the stage after analysis of the system developer cycle: Defining the functional requirements and preparation for design implementation: "Describing how a system is formed."

According to John Buch &; Gary Grudnitski, design can be defined as the drawing, planning and sketching or arrangement of several separate elements into a whole and functioning whole.

1. According to George M. Scott planning is determining how the system will accomplish what it must accomplish; This stage involves configuring the software and hardware components of a system, so that after installation of the system it will be completely satisfactory to the design that has been established at the end of the system analysis stage.

   When creating a system to create a system that will be used in a company, each application developer is required to make a design of the system to be created. This design aims to provide an overview of the system that will run later to each stakeholder.

   There are also theories about the understanding of system design according to experts including:

   According to Satzinger, Jackson and Burd (2012: 5) system design is a set of activities that describe in detail how the system will run. It aims to produce software products that suit user needs.

2. According to Kenneth and Jane (2006: G12) system design is the activity of designing and determining how to process information systems from the results of system analysis so that the system is in accordance with the requirements
3. According to O'Brien and Marakas (2009: 639) system design is an activity to design and determine how to process information systems from the results of system analysis so that it can meet the needs of users including user interface design, data and process activities.

From some of the theories above, it can be concluded that system design is a design process to design a new system or improve an existing system so that the system becomes better and usually this process consists of the process of designing inputs, outputs and files.

B. Hydrophore or *Pressure Tank*, serves to relieve the work of the pump from start-stop conditions that are too frequent. Working principle of *hydrophore*. Water that has been collected in the lower tank is pumped into a closed tank which results in the air being compressed so that water with sufficient initial pressure is available to be distributed to plumbing equipment throughout the planned building. The pump working is automatically regulated by the pressure detector, which opens and closes the instigator switch of the pump drive electric motor. The pump will stop working if the tank pressure has reached the set maximum limit and start working if the set minimum pressure limit has been reached.

According to the Instruction manual book, hydrophore tank is a water pressure tank also called a pressurized water tank, the function of the *hydrophore tank* is to accumulate pressure on the pump until it reaches a certain pressure or pressure required for installation. For example, for fresh water system installations where fresh water can only work perfectly at pressures of 3 kg / cm2 to 6 kg / cm2, with the *hydrophore tank*, the pressure can be maintained at the level of 3kg / cm2 to 6 kg / cm2. Another function of the *hydrophore tank* is to store water in the fire protection system and lighten the work of the pressure pump or pressure pump so that its economic life is longer.

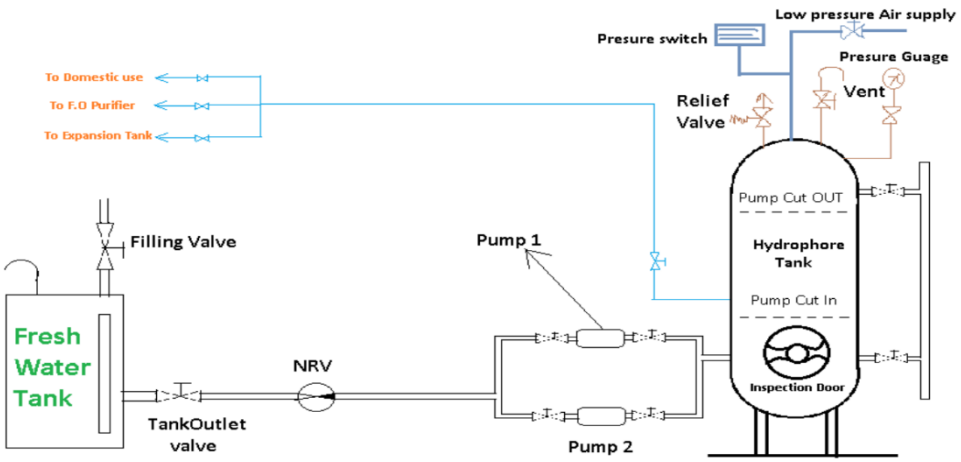


Figure 1. Working System Principle and Hydrophore Tank Components
Source:http.www. https://shipfever.com/hydrophore-system-ship/

Pressure tank systems are usually designed so that the volume of air is no more than 30% of the volume of the tank 70% of the volume of the tank filled with water. Then to serve large water needs, a large pressure tank will be needed. The advantage of this pressure tank system is that it is more advantageous in terms of aesthetics because it is not too flashy compared to the roof tank, besides that maintenance is very easy because it can be *installed* in the engine room with other pumps and the initial price is lower than the tank that must be installed on top of the tower. The market provides hydrophore tanks ranging from a capacity of 24 liters to 1000 liters with a working pressure of 10 bar to 16 bar.

Hydrophore tank is an important equipment in supplying water which is placed on two supporting steel in the weld and both ends are convex. The tank is equipped with a stub and hole

pipe assembly that allows internal inspection and repair, all elements of the tank have been made of steel coated with anti-rust paint.

A *tank hydrophore* system used in tall buildings and ship accommodation, an on-ship hydrophore system is designed to meet the demand for fresh water on board. The system is complete with electronic controls and monitoring equipment to measure water quality and counters to measure water consumption. All connections on one side can lower costs and facilitate installation on ships. Such a system will consist of one or more chambers with valves, sensors and pipes.

The foundation of this theory contains the source of the theory which will then become the basis of writing. The source of the theory will later become a framework or basis for understanding the background of a problem systematically. On the basis of this theory, the author will explain the causes of the lack of hydrophore tank pressure on the freshwater supply on board.

The system is complete with electronic controls and monitoring equipment to measure water quality and counters to measure water consumption. All those connections on the one hand, can lower costs and facilitate installation on ships. Such a system will consist of one or more chambers with valves, sensors and pipes.

Components and working principle of hydrophore tank:

1. Pressure controller to control the start and stop of the water pump. When the pressure in the tank is below 3 bar, the water pump will start moving fresh water into the tank until the pressure reaches 6 bar, and the pump will stop after the tank pressure reaches 6 bar.
2. The safety valve is when the pressure in the tank is more than 0.6Mpa, the safety valve opens to release the pressure in the tank.
3. The air valve is to fill the compressed air into the tank
4. Drain valve is to empty the water in the tank when draining or flushing the tank.
5. The control box is a box designed with two control modes, manual control and automatic control.

The hydrophore tank is equipped with a main water pump, backup water pump and SA3 over switch change. If choose main water pump, over switch SA2 is enabled to "manual", the main water pump or backup water pump will start working manually. When the SA2 change over switch is enabled to "auto", the device will enter into auto work. When the high pressure controller detects the pressure in the tank has reached 0.6Mpa, the main water pump or backup water pump will stop working.

Daily inspection and operation for *Hydrophore* Unit system:

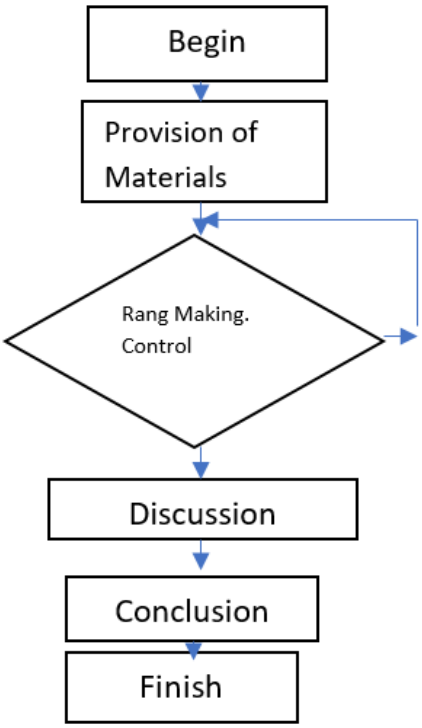
1. Inspection to measure the water level.
2. Close the air filling valve and open the drain valve to check the pipe connected with water, then close the water filling valve.
3. Open the air filling valve to check the pipe connected with compressed air.
4. Close the drain valve and open the water filling valve to check the water level in normal position.

C. *HYDROPHORE* FILLING PRESSURE TO TANK:

1. Manually start the service pump to fill water into the tank, stop the pump until working pressure, then close the outlet valve to temporarily stop the water supply.
2. Adjust the compressed air pressure to 0.1Mpa higher than working pressure, open the air valve charge, to fill the compressed air into the tank.
3. Draining excess water through the discharge valve, when the pressure reaches the working pressure of the tank, and the water level is in the full position, close the air charge valve and drain valve (drain valve). If the air filling is too much, the air can be discharged through the air exhaust valve on the tank.
4. Employing all valves are in normal condition and the pump is in the automatic service position.

D. RESEARCH FLOW CHART

The flow chart from our research is:



TYPES OF RESEARCH

Based on the research focus that has been described in the problem formulation, the type of research to be used is the type of experimental research by designing a 3 Phase Electric Engine *Hydrophore* Control System.

E. Research Location

The research location is at the Makassar Shipping Science Polytechnic This research is planned for 6 (six) months starting from April 2022 to September 2022.

F. Types and Sources of Research Data

1. Data Primer
   Primary data is research data obtained directly from observations, designs produced when carrying out research.
2. Secondary Data
   Secondary data is data obtained from manual *books* that are the object of research and literature study.

G. Data Collection Methods

Data collection methods carried out in this study are:

1. Designing Tools
2. Namely carrying out the Design of Hydrophore control system tools.3 Phase Electric Machine
3. Making a 3 Phase Electric Engine Hydrophore Control System Tool.
4. Documentation
5. Namely in the form of report data including documents when carrying out research both in the form of written documents and pictures taken when carrying out research.
6. Literature Study

That is a data collection technique based on experiments and direct data collection on the object of research and references related to the research title.

H. Data Analysis Techniques

By Designing and Making a 3 Phase Electric Engine *Hydrophore Control* System and analyzing whether it is in accordance with Theory and is feasible to be used as a practical tool for students or cadets Diploma IV Shipping, especially Engineering Study Program.

How to make a hydrophore pressure tank praga design The first step that needs to be done is to design and select the materials that will be used in making hydrophore pressure tank props after getting the appropriate materials, then proceed with cutting the pahan according to needs and then

assembling it into a single unit in accordance with the design that has been made previously Design *hydrophore pressure tank* Simpler by using materials that are easily available and affordable.

I. Variable Operational Definition

The Variable Operational Conventions used are:

1. *Clamp Amper Meter* is a tool used to measure AC electric current
2. *Megger Test* is a tool to measure resistance
3. Multimeter is an Equipment To measure Voltage, Resistance and Current.
4. *Breaket* Holder of the hydrophore control device made
5. MCB (*mini Circuit Breaker*) a safety device equipped with a fuse.

J. Research Results

The list of materials used in the Design of the 3 Phase Electric Engine Hydrophore Control System is:

No.	Component/Material Name
1.	Contactor Schneider tipe LC 1 D09 , AC current 220 volt (Water pump) b. Schneider type LC 1 D12 , AC current 220 volt (Air pump)
2.	T O R (thermal overload relay) a. Schneider tipe LRD 14 , AC current 220 volt (Water pump) b. Schneider tipe LRD 21 , AC current 220 volt (Air pump)
3.	W L C (water level control) OMRON type 61F-G-AP, Source 220 volts
4.	WATER PUMP Shimizu type PS-128 BIT
5.	COMPRESSOR LAKONI Type BASIC 9s max pressure 8 bar, ac current
6.	INDICATOR LIGHT Tipe led ac current
7.	BUZZER + LAMP Tipe led ac current
8.	RELAY a. OMRON Tipe MK3 P – I , 250 VAC ,10 A (Water pump) b. OMRON Tipe MK3 P – I , 250 VAC ,10 A(Air pump)
9.	RELAY TIMER Autonics tipe AT8N 220 VAC ,5 A Autonics tipe AT8N 220 VAC ,5 A
10.	SWICTH ON / OFF HANYOUNG TIPE CR-253 , 250 VAC , 5 A
11.	MCB 3 PHASE a. SCHNEIDER TIPE C32 , 250 VAC , 32 A b. SCHNEIDER TIPE C16 , 250 VAC , 16 A
12.	MCB 1 PHASE SCHNEIDER TIPE C16, 250 VAC , 16 A
13.	CABLE a. NYYHY TYPE ETERNA CABLE 2.5 mm b. 2.5 MM NYAF TYPE ETERNA CABLE c. NYAF TYPE ETERNA CABLE 4 mm
14.	PRESSURE GAUGE TORA CAPACITY 0 – 16 BAR
15.	PRESSURE SWICTH SAGINOMIYA CAPACITY 0 – 10 BAR
16.	HIGH PRESSURE HOSE ORIENTFLEX 8 X 12 , 150 Psi
17.	KRAN AIR DOZ'RO 1/4 IN
18.	WAX ELECTRODES

DC CURRENT

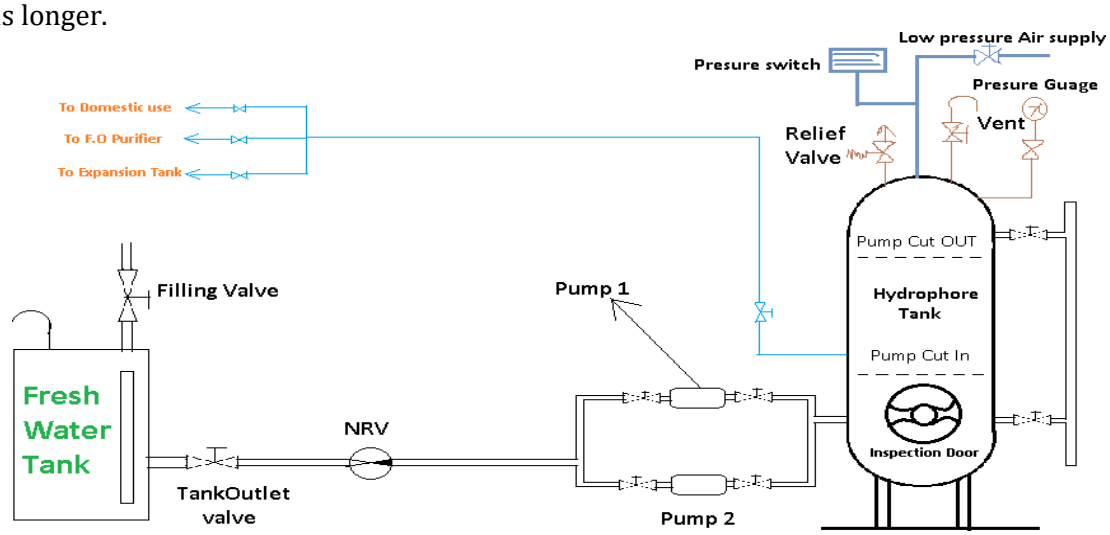
19. VOLTAGE INDICATOR
    TIPE LED 250 VAC
20. N F B (NO FUSE BREAKER)
    ABB TIPE SACE AT 250 VAC , 50 A

RESULTS

From the component data mentioned above, a series of all materials was made starting from the design of the control system later, making the signaling lamp and the Power circuit for controlling the 3 Phase Electric Engine Hydrophore. We can see this from the results of making the Hydophore Control System Electric Machine that has been produced which is expected to be a learning material for cadets and training participants, especially for Diploma IV Shipping Cadets who will carry out Sea Practice so that when Prala there is a shadow that can be seen and learned the working principle of the Hydrophore Control System using an Electric Machine, In this research we used a 1 Phase Electric Machine because it was constrained by funds so the machine that we could buy was only one Phase, but the control system was already using the 3 Phase system.

Hydrophore Tank

Hydrophore Tank is a water pressure tank also called pressurized water tank, the function of *hydrophore tank* is to accumulate pressure on the pump until it reaches a certain pressure or pressure required by the installation. For example, for fresh water *system* installations where *fresh water* can only work perfectly at a pressure of 3 bar to 6 bar, with the *hydrophore tank* the pressure can be maintained at the level of 3 bar to 6 bar. Another function of the *hydrophore tank* is to store water in the fire protection system and lighten the work of the pressure pump or pressure pump so that its economic life is longer.



Here is the working principle of one of the *hydrophore* systems*:*

Pressure tank systems are usually designed so that the volume of air is no more than 30% of the volume of the tank 70% of the volume of the tank filled with water. Then to serve large water needs, a large pressure tank will be needed. The advantage of this pressure tank system is that it is more advantageous in terms of aesthetics because it is not too flashy compared to the roof tank, besides that maintenance is very easy because it can be installed in the engine room with other pumps and the initial price is lower than the tank that must be installed on top of the tower.

Hydrophore tank is an important equipment in supplying water which is placed on two supporting steel in the weld and both ends are convex

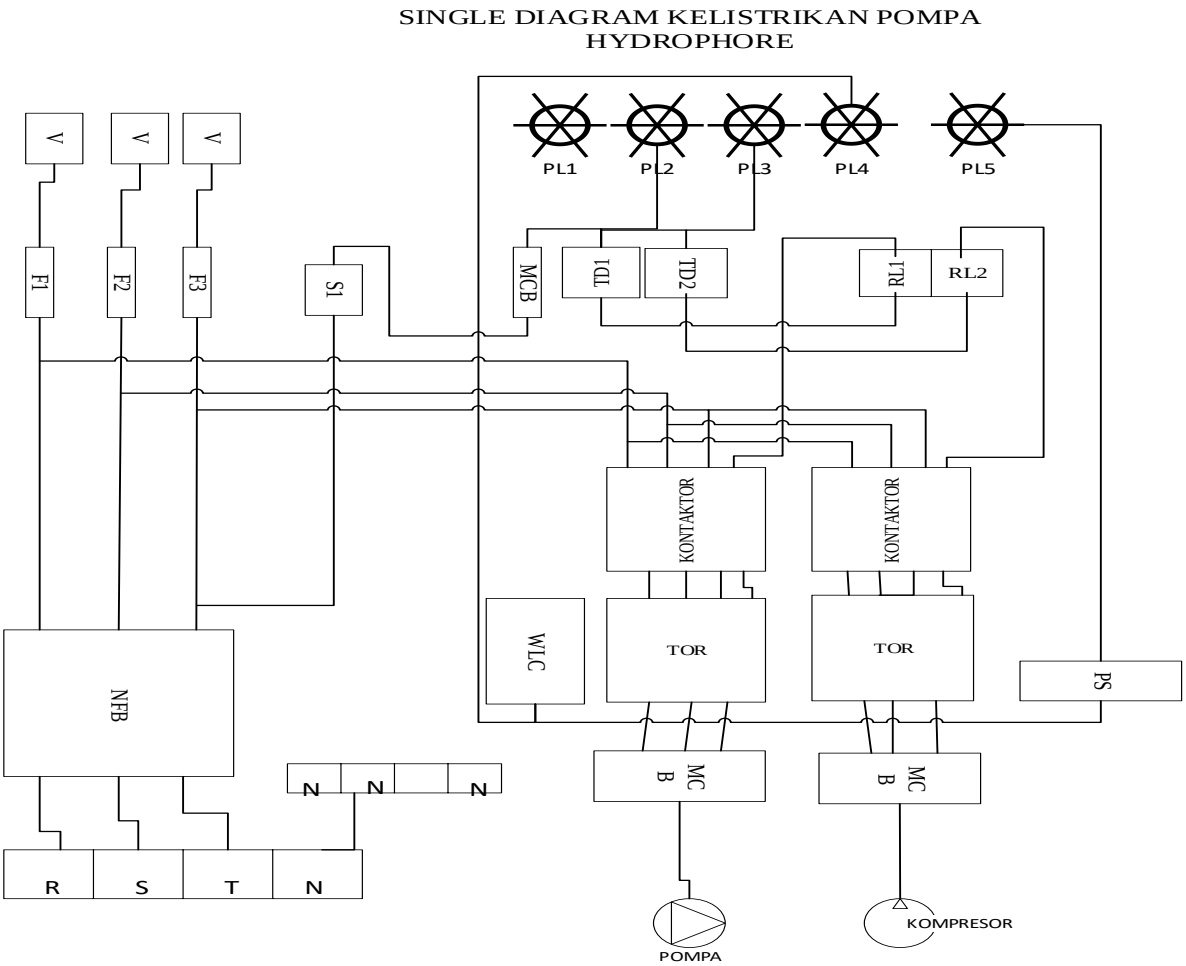
A tank hydrophore system is used on ship accommodation, a *hydrophore* system on board is designed to meet the demand for fresh water on board.

Components and working principle of *hydrophore tank* :

1. *Pressure controller* to control the start and stop of the water pump. When the pressure in the tank is below 3 bar, the water pump will start to move fresh water into the hydrophore tank until the

pressure reaches 6 bar, and the pump will stop after the tank pressure reaches 6 bar.

2. The air valve *is for filling compressed air into the tank*
3. *Drain valve is to empty the water in the tank when draining or flushing the tank.*
4. *Water Level Control* (WLC) is a device placed in a box designed to control the water level in the groundtank.

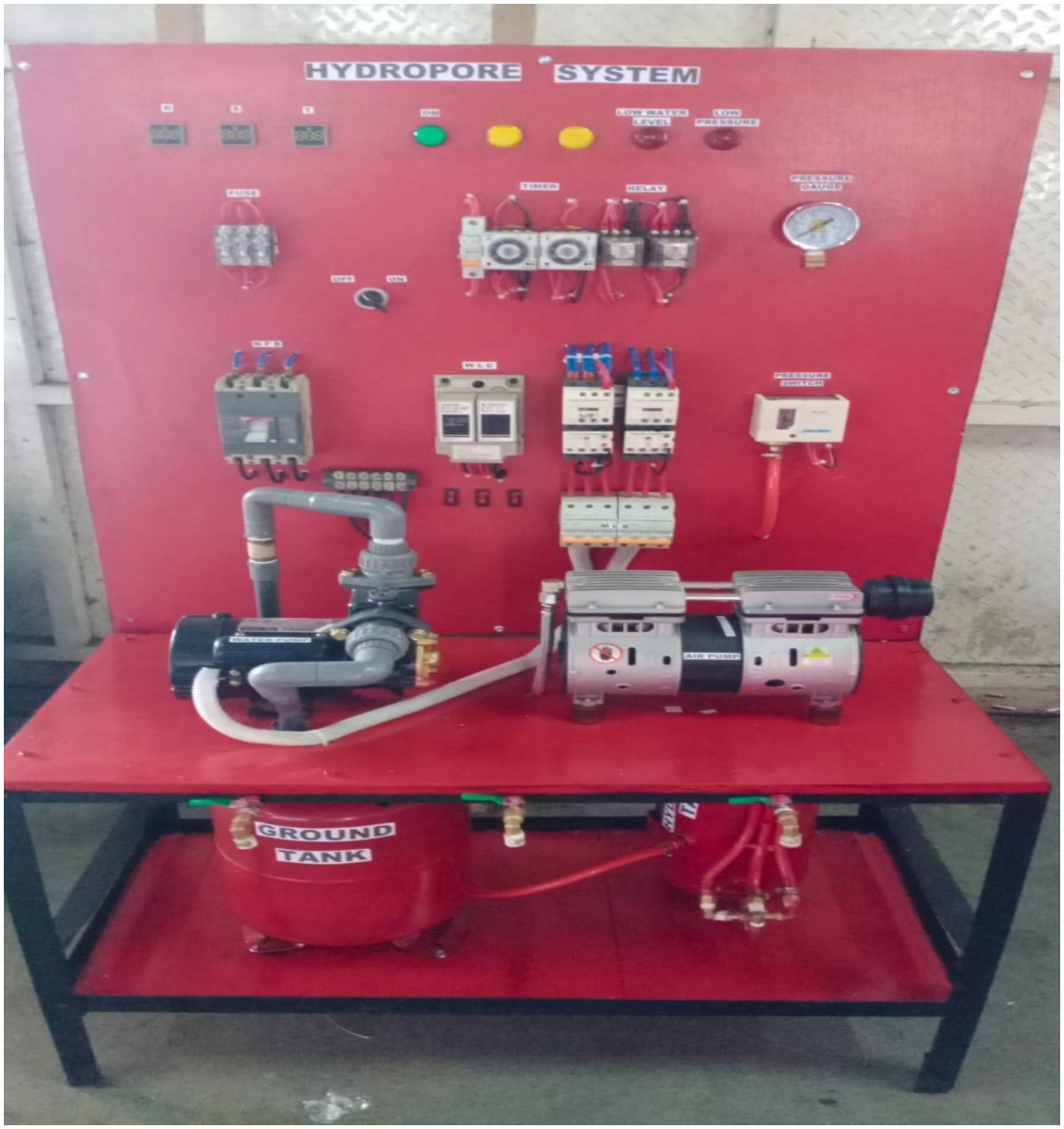


Gambar : Single Diagram Pompa Hydrophore

Below is the Hydrophore Control System that our team has made where we can see in principle the voltage of 3 Phase is available we can see with the availability of phases R, S, T on the panel board and as a safety we use fuse every phase after from the Fuse we use NFB (No Fuse Breaker) to then go to the pump. The on/off switch allows controlling when the pressure of the pressure pump is not as required, in this study the signal light will turn on when the pressure is smaller or equal to 3 Bar (≤ 3 Bar) it will give a signal to fill the pressure pump up to 6 Bar. Signaling on the lamp occurs about 5 seconds then the light will stop turning on and flashing, for timing using Timer.

The Pressure Controler controls the start and stop of the water pump. When the pressure in the tank is below 3 bar, the water pump will start to move fresh water into the hydrophore tank until the pressure reaches 6 bar, and the pump will stop after the tank pressure reaches 6 bar.

Air valve serves to fill compressed air into the tank, *Drain valve* is to empty the water in the tank when draining or flushing the tank. While Water Level Control (WLC) is a tool to control the water level in the groundtank.



WORKING PRINCIPLE OF FRESH WATER HYDROPHORE:

1. The flow of electricity from the input enters through NFB
2. After the NFB, it enters the voltage indicator and is forwarded to the on-off switch
3. From the on-off switch forwarded to the MCB 1 phase as a safety hydrophore control system
4. After the mcb, the electricity is forwarded to the relay
5. From the relay it is forwarded again to the delay timer after that it goes to the contactor
6. The flow from the contractor is forwarded to the tor and then to the water pump and compressor
7. When the water pump turns on there is a pause of 8 seconds before the compressor turns on
8. Thesystem works when the pressure in the pressure tube is at 3 bar accompanied by the buzzer lights up as a pressure low indicator.
9. When the pressure in the pressure tube reaches 6 bar then automatically the system will stop working or stand by
10. Similarly, when the water in the groundtank runs out, the system automatically stops working and the buzzer sign low water level lights up
11. Thesystem will work again when the water in the groundtank is filled again (E1, E2 and E3 candle electrodes are submerged in water)
13.Theright in the hydrophore tube is set 3 bar so that there is a spare pressure, if the electricity goes out, we can still use the spare water without a pump

CONCLUSION

From the results of this research we can conclude that we made this 3 Phase Electric Machine Hydrophore Control System with the hope that it can be a material or learning tool for students studying at the Polytechnic of Shipping Sciences, especially cadets / cadets of Diploma IV Shipping students who have not carried out sea practice so that when they carry out sea practice there is already an image they get about the Hydrophore control system even though the tool we made is only It is miniature because the tank we use is on a small size scale.

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