MP 2.24.3.3/Pesawat Bantu
Lecture 2: Marine System

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BADAN RISET DAN SUMBER DAYA MANUSIA KELAUTAN DAN PERIKANAN
POLITEKNIK KELAUTAN DANPERIKANAN SORONG

Sistem Perpipaan Kapal

Pada setiap kapal yang memiliki perlengkapan permesinan yang terdiri dari Mesin Induk , Mesin Bantu dan pompa-pompa atau kapal yang tidak dilengkapi Mesin Penggerak namun memiliki permesinan lain dan pompa-pompa, selalu dilengkapi dengan instalasi perpipaan.

Instalasi pipa dikapal diganakan untuk mengalirkan fluida dari satu tanki/kompartment ke tanki lain, atau dari satu tangki ke peralatan permesinan dikapal, atau mengalirkan fluida dari kapal keluar kapal atau sebaliknya. Selain itu terdapat instalasi pipa yang lain berfungsi mengalirkan gas non cair seperti pipa gas buang, pipa sistim CO2, atau instalasi pipa yang mengalirkan udara dan uap bertekanan.

Jenis pipa yang terdapat dikapal memiliki beragam senis ditinjau dari material pipa sesuai dengan kegunaannya. Material pipa dikapal pada umumnya terbuat dari baja galvanis, baja hitam, baja campuran, stainless steel, kuningan, tembaga ataupun alumunium. Pada kegunaan tertentu terdapat pula pipa yang terbuat dari bahan non metal seperti rubber hose , gelas dan PVC. *4

PIPING MATERIAL LEGEND

SYMBOL	DESCRIPTION
	PIPELINE
	CONCENTRIC REDUCER
	ECCENTRIC REDUCER
	PIPE WITH FLANGE
	PIPE CAP
	UNION JOINT
	FULL COUPLING JOINT
	ORIFICE
F	FILTER
L	LUBRICATOR
BW	BILGE WELL
	ROSEBOX STRAINER
	FIRE HOSE WITH REEL OR RACK
WDH	WASHDOWN HOSE WITH REEL OR RACK
	DUPLEX STRAINER
S	SIMPLEX STRAINER
	Y–STRAINER
	FLEXIBLE HOSE
	FLEXIBLE HOSE WITH QUICK DISCONNECT COUPLING
	EXPANSION JOINT
SG	SIGHT GLASS
	LEVEL GAUGE
	STEAM TRAP WITH Y–STRAINER
	SPECTACLE FLANGE
	FOG APPLICATOR
	QUICK DISCONNECT COUPLING
FM	FLOWMETER
	VICTAULIC COUPLING
	STRAUB COUPLING
	DRESSER COUPLING

PIPING MATERIAL LEGEND

SYMBOL	DESCRIPTION
	GATE VALVE
	GLOBE VALVE
	GLOBE STOP CHECK VALVE
	SWING CHECK VALVE OR DUO CHECK VALVE
	BUTTERFLY VALVE
	BALL VALVE
	ANGLE VALVE
	ANGLE STOP CHECK VALVE
	PET COCK
	NEEDLE VALVE
	SELF CLOSING VALVE
	QUICK CLOSING VALVE
	HYDRANT VALVE WITH CAP AND CHAIN
	FOOT VALVE
	3–WAY VALVE
	RELIEF VALVE OR SAFETY VALVE
	FLUSHING VALVE
	VENT CHECK
	PLUG VALVE
	DIAPHRAGM VALVE
	KNIFE VALVE
	SCUPPER VALVE
	PRESSURE REDUCING VALVE (REGULATOR)
S	SOLENOID OPERATED VALVE
	VALVE WITH ACTUATOR
	TEMPEATURE CONTROL VALVE (REGULATE–BYPASS)
	VALVE WITH REACH–ROD (EXTENDED SPINDLE)
	STEAM TEMTERATURE CONTROL VALVE

INSTRUMENT LEGEND

SYMBOL	DESCRIPTION
PS	PRESSURE SWITCH
PG	PRESSURE GAUGE
CG	COMPOUND GAUGE
PE	PRESSURE REMOTE READOUT
PC	PRESSURE CONTROL
TI	TEMPERATURE INDICATOR
TE	TEMPERATURE REMOTE READOUT
TC	TEMPERATURE CONTROL
TW	WORKING THERMOSTAT
TS	SAFETY THERMOSTAT
TA	TEMPERATURE ALARM
SA	SALINITY ALARM
LA	LEVEL ALARM
LAH	LEVEL ALARM HIGH
LAL	LEVEL ALARM LOW
LI	LEVEL INDICATOR

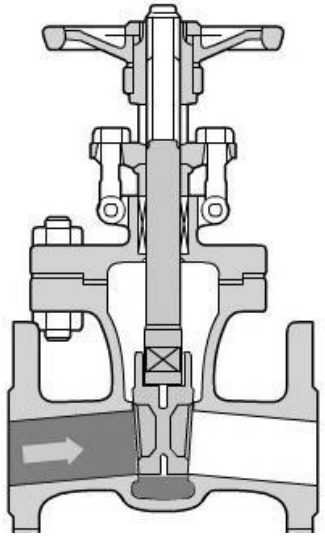
VALVE

Valve atau yang biasa disebut katup adalah sebuah perangkat yang mengatur, mengarahkan atau mengontrol aliran dari suatu cairan (gas, cairan, padatan terfluidisasi) dengan membuka, menutup, atau menutup sebagian dari jalan alirannya.

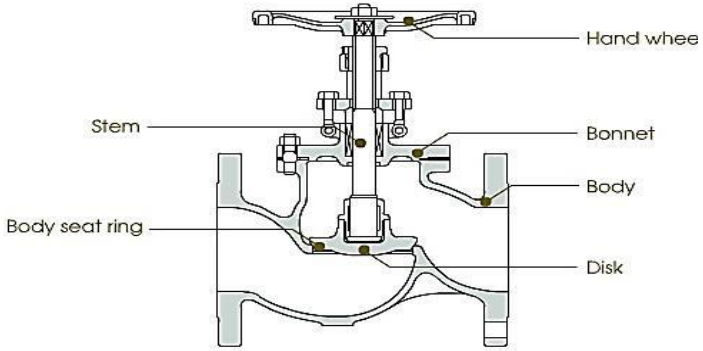
Pemilihan jenis valve bergantung pada:

- Jenis fluida yang mengalir
- Jumlah aliran
- Tujuan/fungsi valvenya

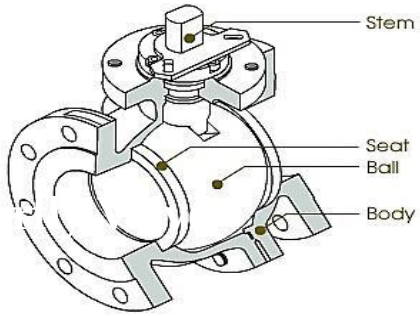
VALVE



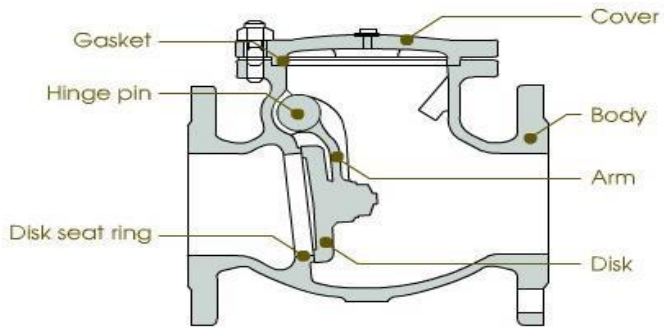
Gate valve.



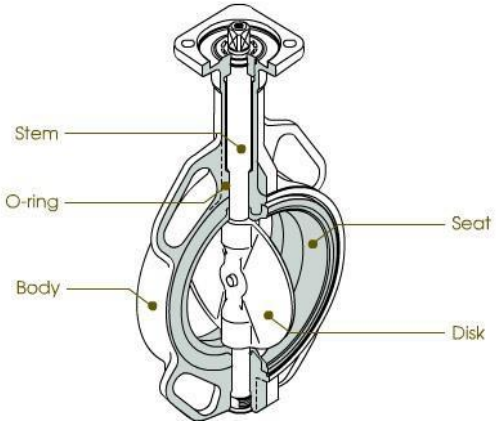
Globe Valve



Ball valve.

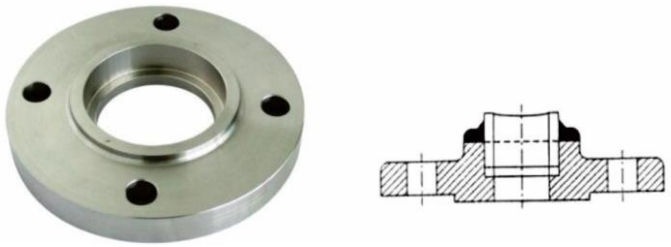


Swing Check Valve

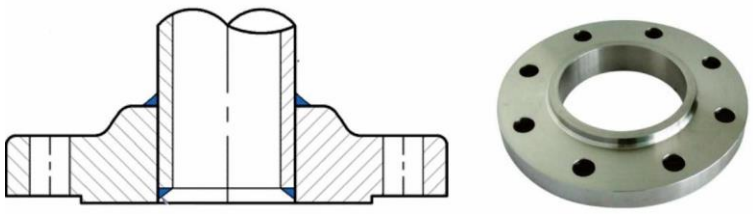


Butterfly Valve

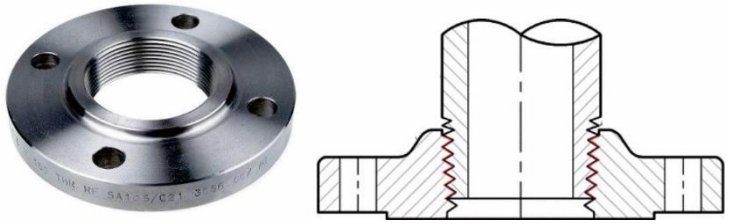
FLANGE



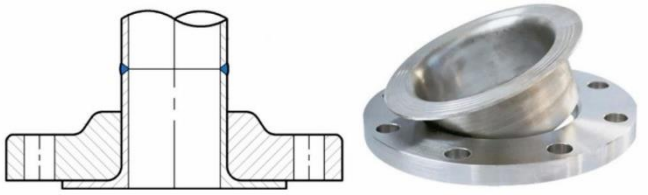
Socket Flanges (Flange tipe soket)



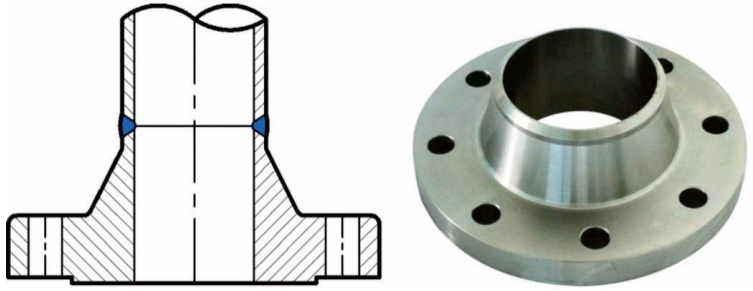
Slip On Flanges (Flange tipe slip on)



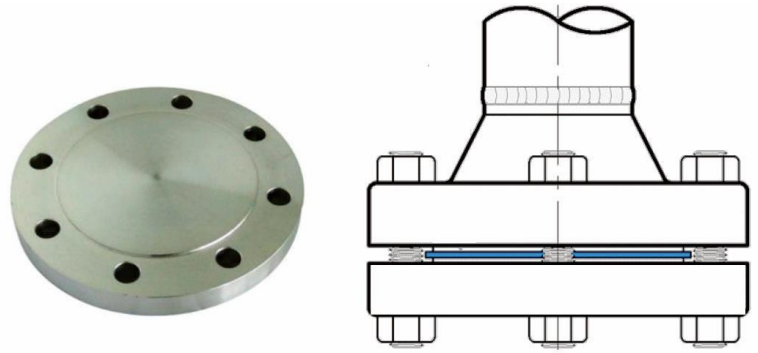
Threaded Flanges (Flange tipe Ulir



Lap Joint Flanges



Weldneck Flanges (Flange tipe weldneck)



Blind Flanges

CONTENTS

- Bilge System
- Ballast system
- Fuel Oil System
- Lube Oil and Dirty Oil System
- Compressed Air System
  - : Service / Control Air
  - : Starting Air
- Potable Water System
- Fire Fighting System
  - : Fire Main System
  - : CO2 System
  - : Sprinkler
- Sanitary System
- Refrigerant System
- Deck Drainage System
- Engine Cooling System
  - : Sea Water Cooling
  - : Fresh Water Cooling
- Engine Exhaust System

Bilge System

Bilga digunakan untuk menampung air buangan dari ruang muat atau kebocoran pipa dari sistem pendingin dan digunakan untuk memompa bilga dari limpahan atau buangan air yang telah bercampur minyak pelumas atau bahan bakar di kamar mesin. Hal ini dikarenakan untuk menjaga lingkungan dengan tidak membuang limbah kelaut sesuai aturan yang ada. Pempuangan limbah hanya dilakukan ketika dalam pelayaran di daerah tertentu (sejauh mungkin dari Pelabuhan >12 mil) dengan syarat kapasitas 60 liter/mil, kandungan minyak 100 ppm atau kurang. Untuk mengurangi pencemaran maka sebelum dibuang limbah dari bilga melewati separator dengan alarm, bila telah memenuhi syarat kandungan minyak yang harus dibuang maka limbah dibuang bila belum memenuhi maka aliran kembali ke separator.

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Bilge System contd.

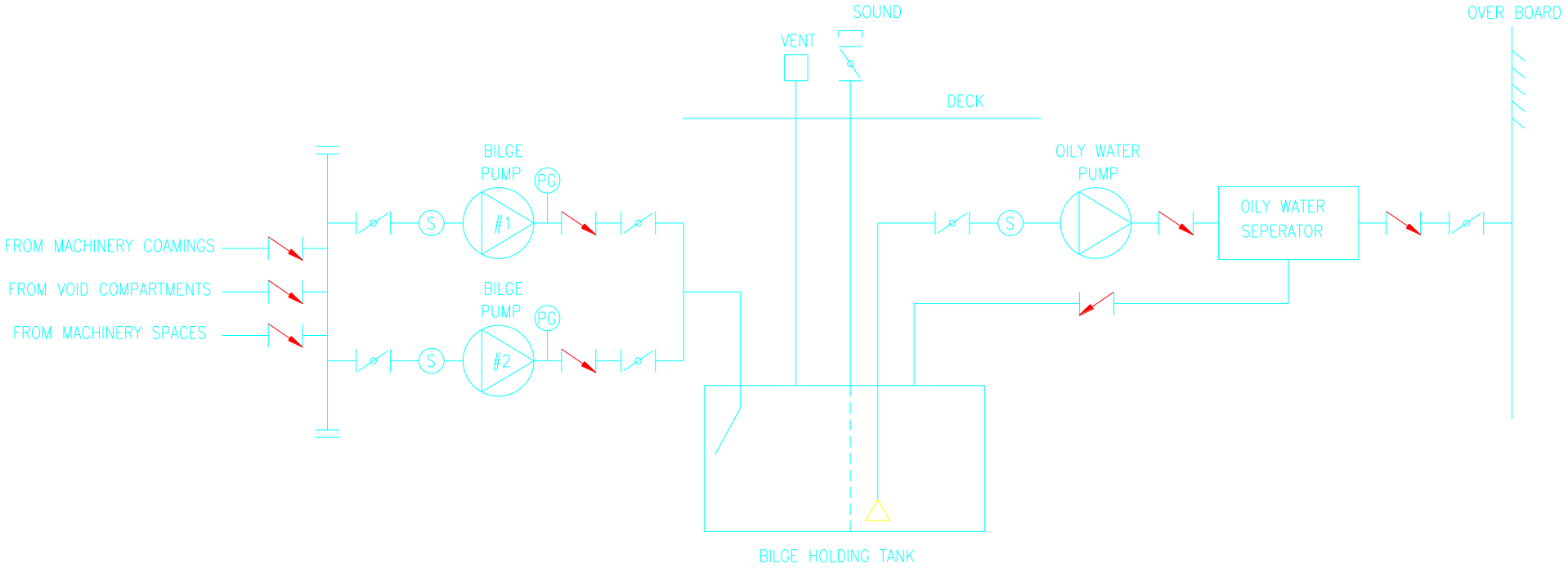
- Piping: consists of suction lines from various compartments, leading to the pumps and discharge line to overboard or to the bilge holding tank.

. The Water from the compartments are led through the scuppers / drains to the Header pipe, which should be generally located at the lowest position.

. Mud boxes are generally installed in the pipe line for sedimentation of dirts.

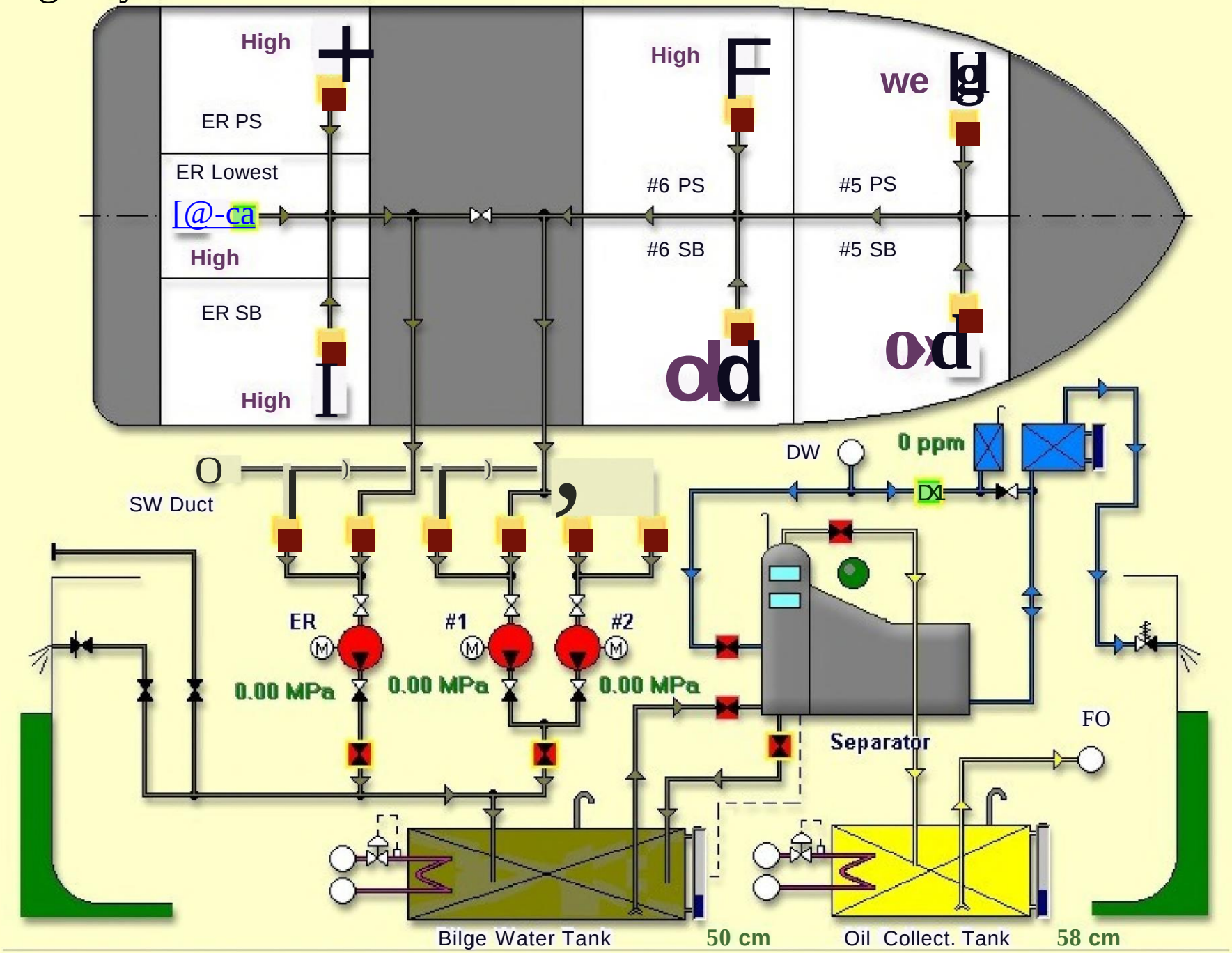
- Oily Water Separator: They are generally used in this system to separate oil and water, so that the water which is discharged overboard meets the MARPOL requirement.

Bilge System contd.



BILGE SYSTEM

Bilge System



Oily-water Separator

Ballast System

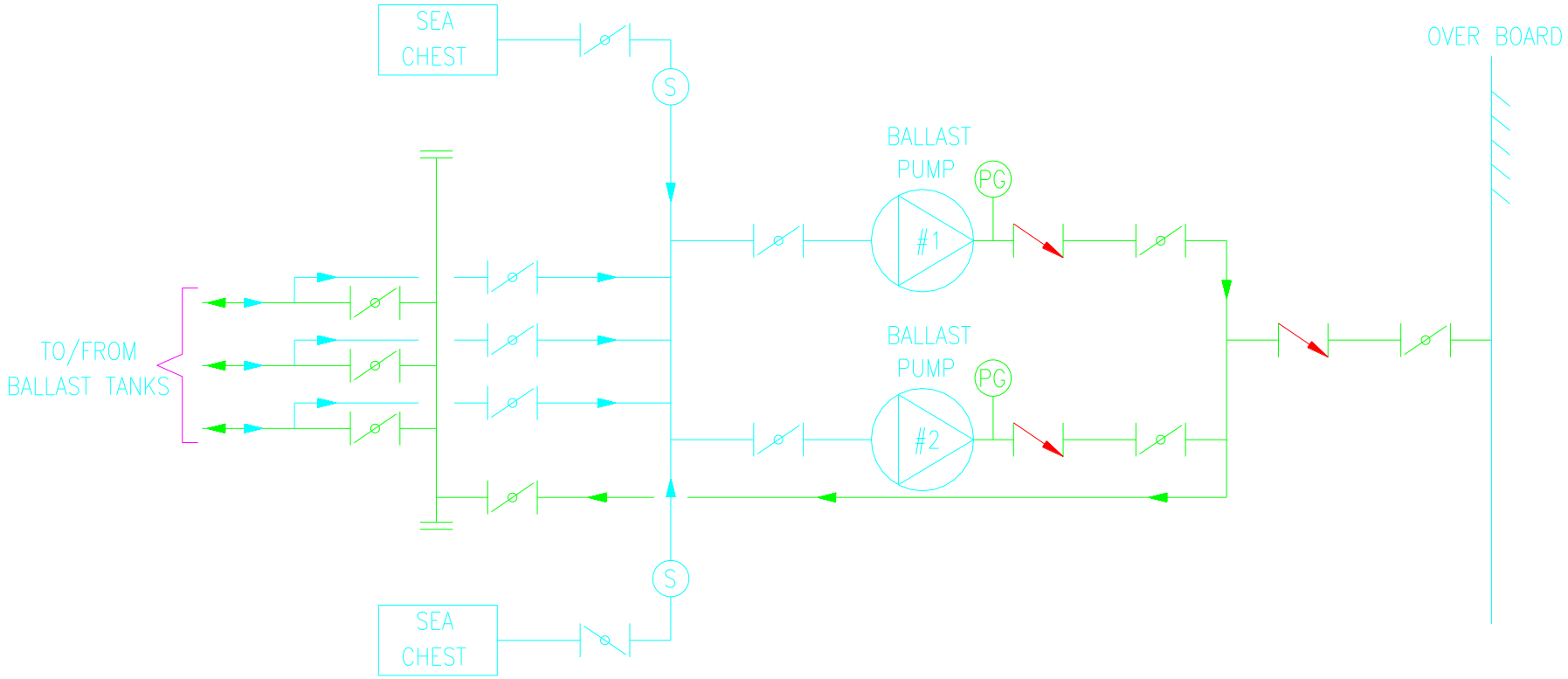
- Ballast digunakan untuk menyesuaikan sarat kapal dalam kondisi ballast atau menyesuaikan keseimbangan kapal karena muatan dengan cara memindahkan air ballast dari tangki ke tangki pada tangki ballast dasar ganda, tangki depan dan belakang untuk menjaga keselamatan kapal. Pompa ballast selain untuk memindahkan dan mengisi air di tangki ballast juga digunakan untuk pompa bilga dan dihubungkan dengan generator service pump (PDU).
- A chamber in the bottom of the hull called as Ballast tanks are filled with sea water to provide this ballast.

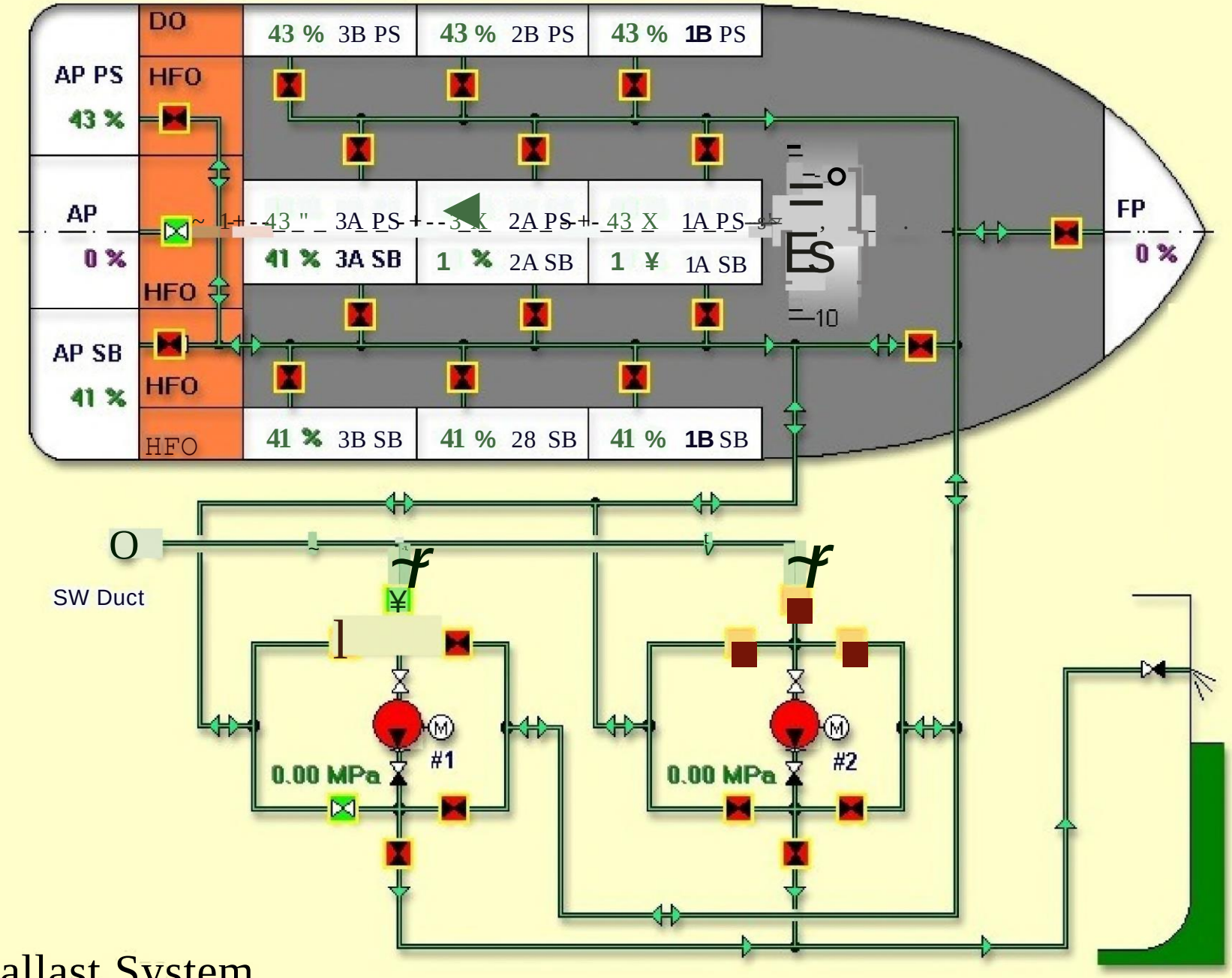
- The System consists of :-

  Ballast Pump: They take suction from the Sea Chest and discharge to ballast Tanks at the time of ballasting operation, they can also take suction from ballast tanks and discharge water into the Sea at the time of de ballasting operation.
- Piping: Connects all the Ballast Tanks. There are Suction Manifolds at the end of each pipe line.

  These manifolds are arranged in such a way that pumps can take suction either from the sea chest or from the Ballast Tanks. Flow in these lines are bidirectional, so Non return Valves are not to be installed in the Ballast line.

Ballast System contd.





Ballast System

Fuel Oil System

Untuk keperluan melayani keperluan operasional semua sistem permesinan (utamanya mesin bantu dan mesin induk) yang ada di kamar mesin terdiri dari :

a. Sistem bahan bakar (*Fuel oil sistem*).
b. Sistem minyak pelumas (*lubrication oil sistem*).
c. Sistem pendinginan mesin (*Cooling sistem*).
d. Sistem udara start (*Air starting system*).
e. Sistem gas buang (*exhaust gas system*).

Fuel Oil System

- Instalasi pipa Bahan Bakar/Fuel Oil digunakan untuk mengalirkan kebutuhan bahan bakar dari tanki bahan bakar ke sistim di permesinan dan dari luar ke dalam kapal pada saat pengisian bahan bakar. Pengaliran bahan bakar menggunakan sarana pompa, pompa ini disebut Pompa bahan bakar/Fuel Oil pump and Fuel Oil Transfer pump. Selanjutnya dari pompa pengaturan aliran bahan bakar juga dikontrol dengan menggunakan sistim katub/valve.
- Fuel Oil are sometimes mixed with the Drilling mud for Drilling purpose.
- The System consists of :-

Fuel Oil Transfer Pump: Diesel fuel is taken onboard through the loading / Bunkering stations located at the Main deck Port / Stbd and delivered to Fuel oil storage tanks.

Fuel oil is then transferred from the Storage tank to the Settling tank through the Flow meter.

Fuel Oil purifier: Fuel oil from the Settling tank is purified and stored in the day tank.

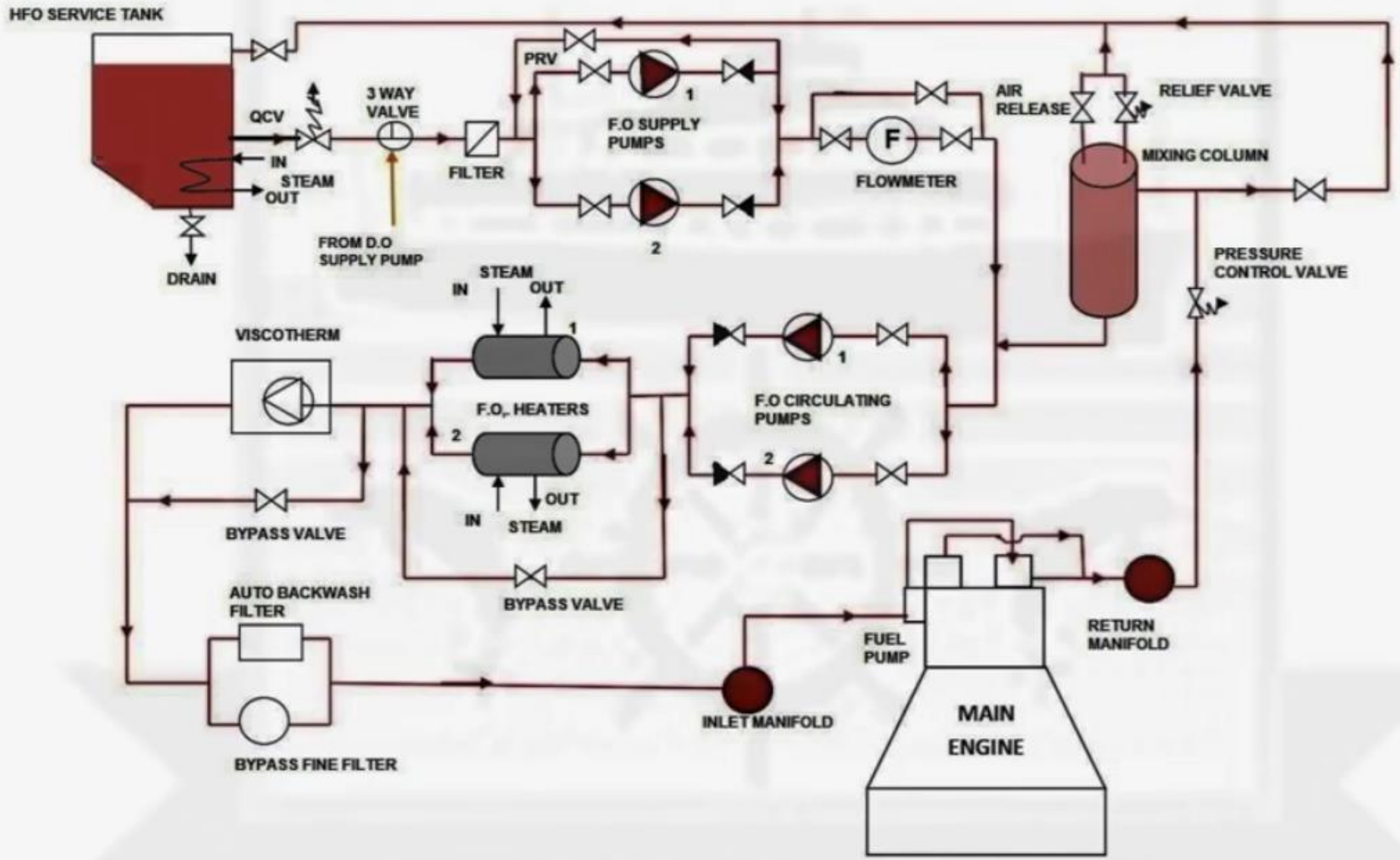
Fuel oil System contd.

Fuel Oil Service Pump: They deliver Fuel Oil from the day tanks to Service Outlets at various locations.

- **Piping**: Pipes are routed from Bunkering / Loading station to storage tanks.

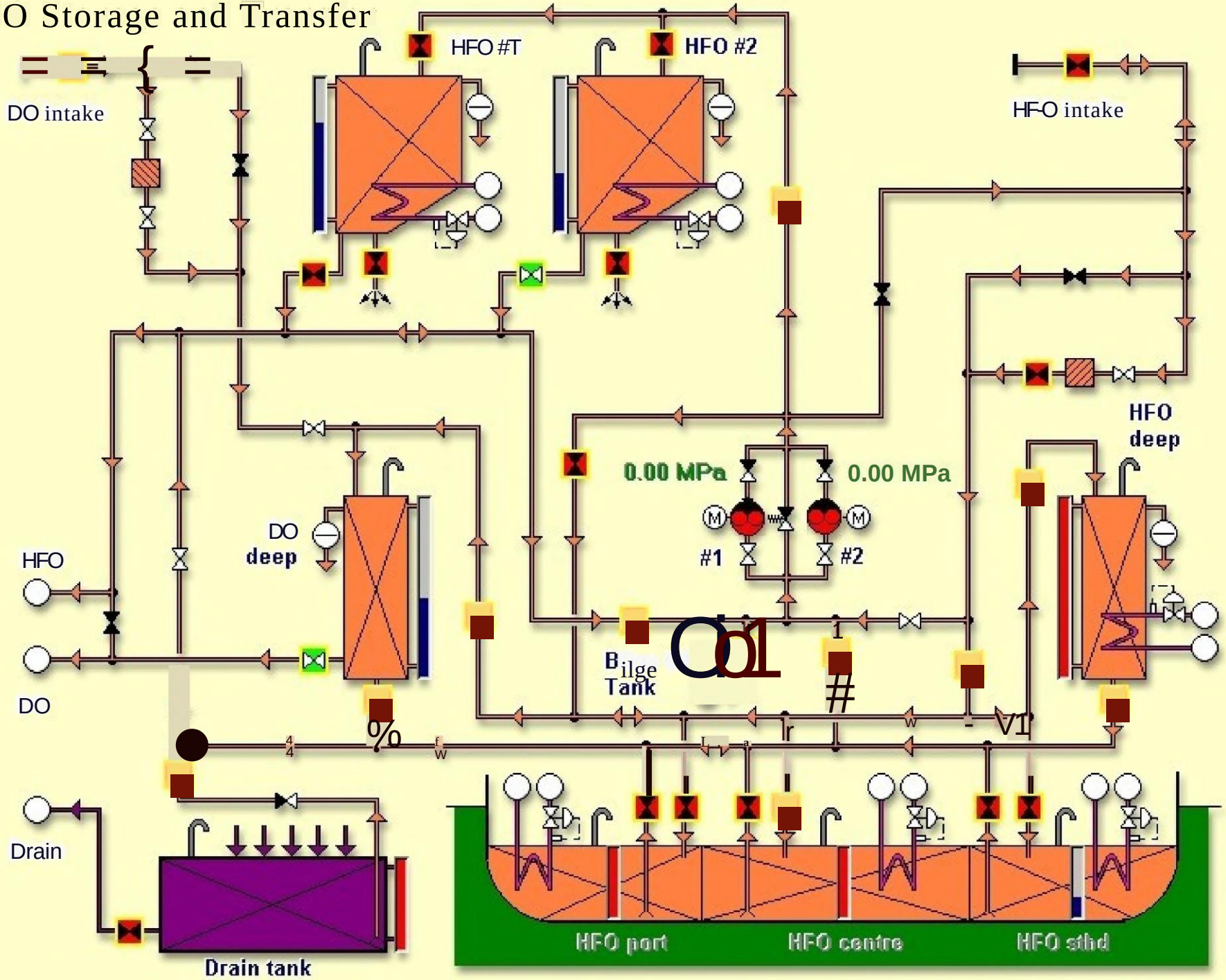
Fuel oil can be transferred from storage tanks to settling tanks, from settling tanks to day tanks, from day tanks to Main Engines and to service outlets throughout the rig via service pumps.

MAIN ENGINE FUEL OIL SYSTEM



LINING UP OF THE SYSTEM HAS TO BE DONE BEFORE STARTING THE PUMPS. LINING UP MEANS OPERATING THE REQUIRED VALVES FOR SAFE OPERATION. HERE WE ARE GOING TO USE NO:1 PUMPS AND NO.2 WILL BE IN STANDBY MODE. SO ACCORDINGLY WE HAVE TO SET THE VALVES.

FO Storage and Transfer



FO Storage and Transfer

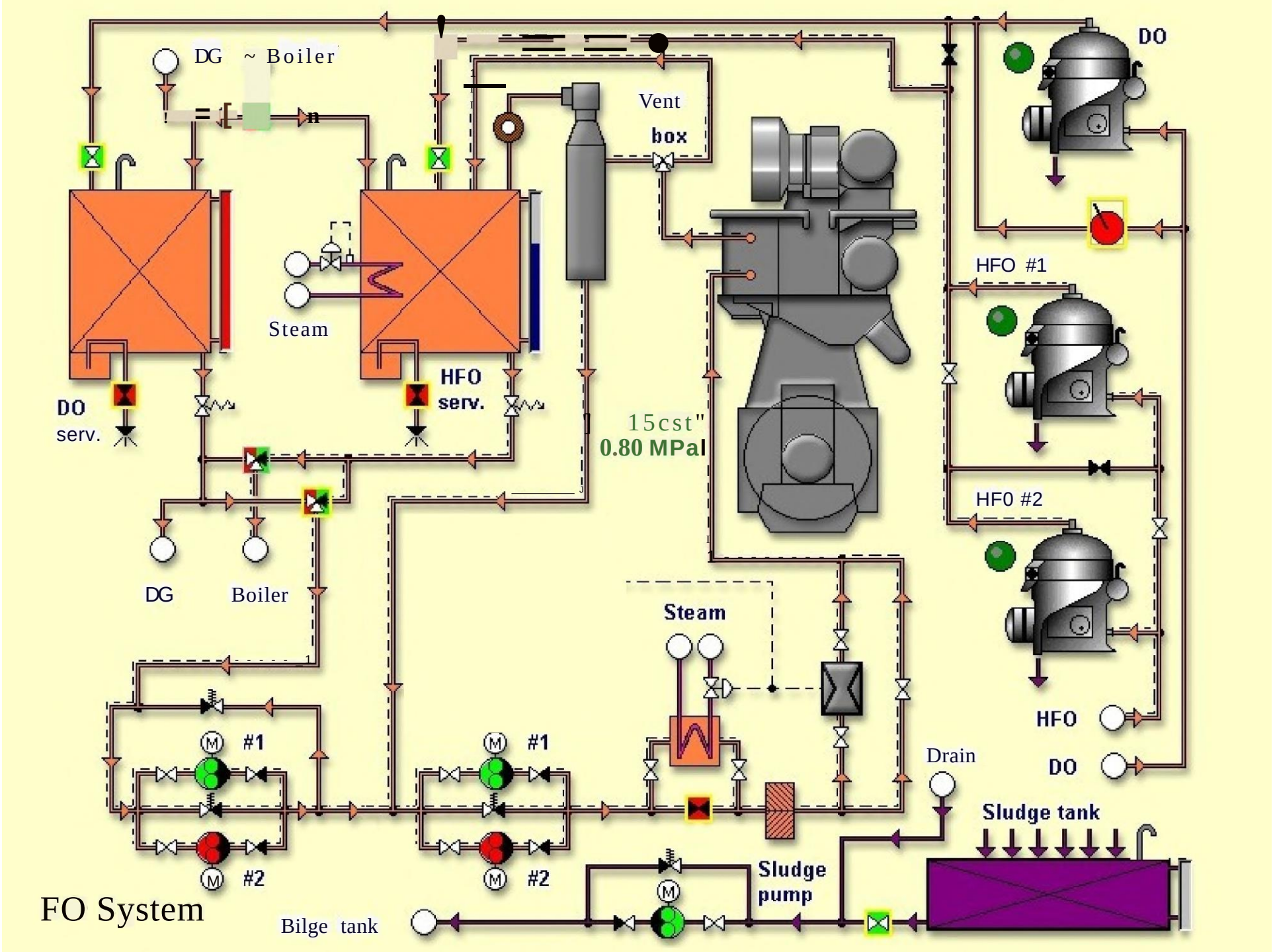
Important concerns

- Overflow pipes
- Quick-closing valves
- Drain to waste oil tanks (spill trays)
- Level gauge with heat-resistant glass for sounding
- Remote control of fuel oil valves
- Insulation of hot surfaces where fuel oil leaks (possibly in a spray form) is possible

HFO Settling Tank

HFO Service **Tank**

Quick-closing Valves


DG ~ Boiler
Vent
box
DO
HFO #1
HFO #2
Steam
HFO
serv.
DO
serv.
15cst"
0.80 MPal
DG
Boiler
Steam
#1
#2
#1
#2
Drain
HFO
DO
Sludge tank
Sludge
pump
Bilge tank

FO System

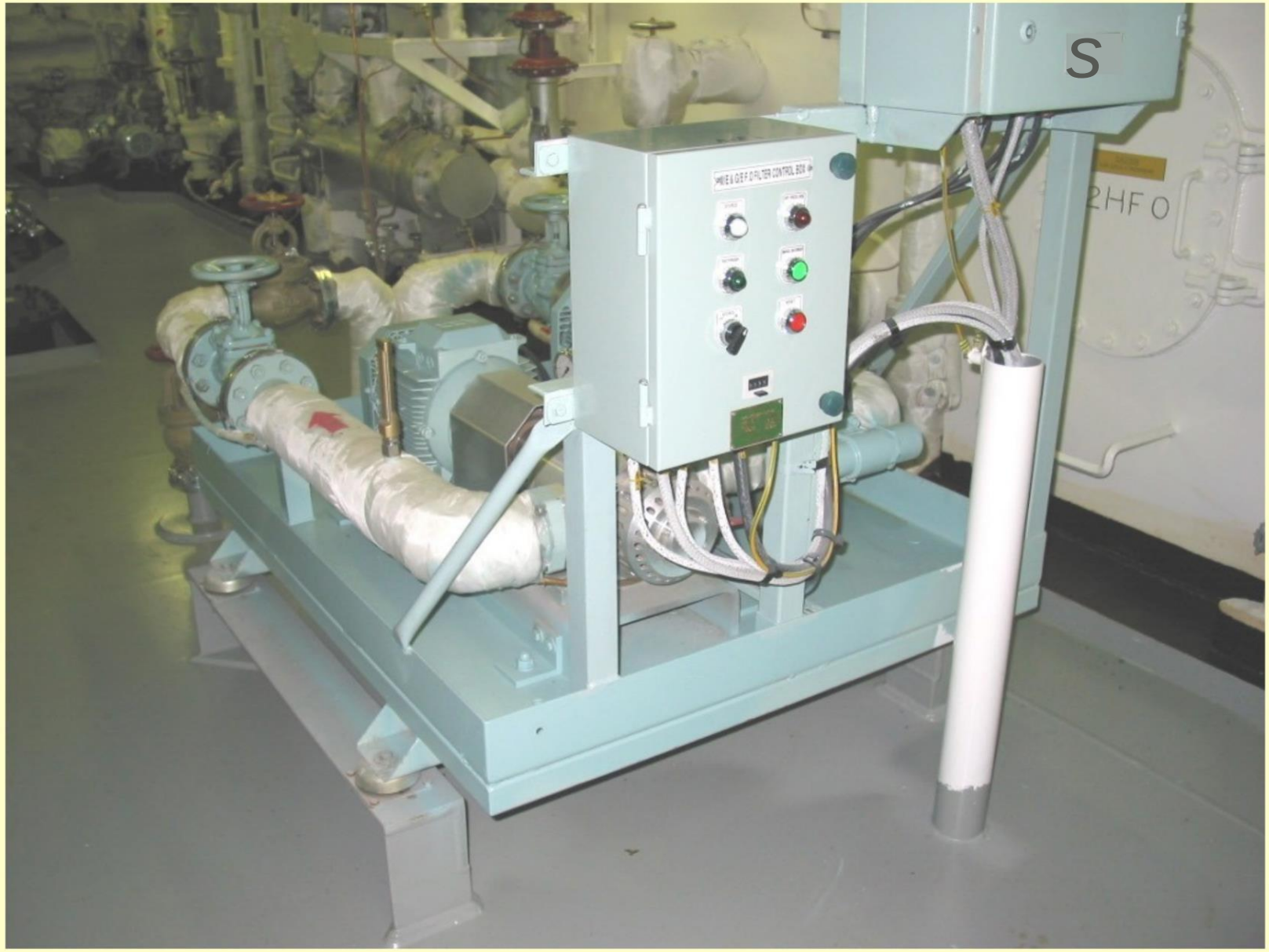
FO Supply to Engine

Main components

- Storage (bunkers)
- Transfer pump
- Settling tank
- Heater
- Purifier
- Service tank
- Filter
- Viscosity controller
- Return Tank (10 to 15 minutes engine operation)

HFO Duplex Filter

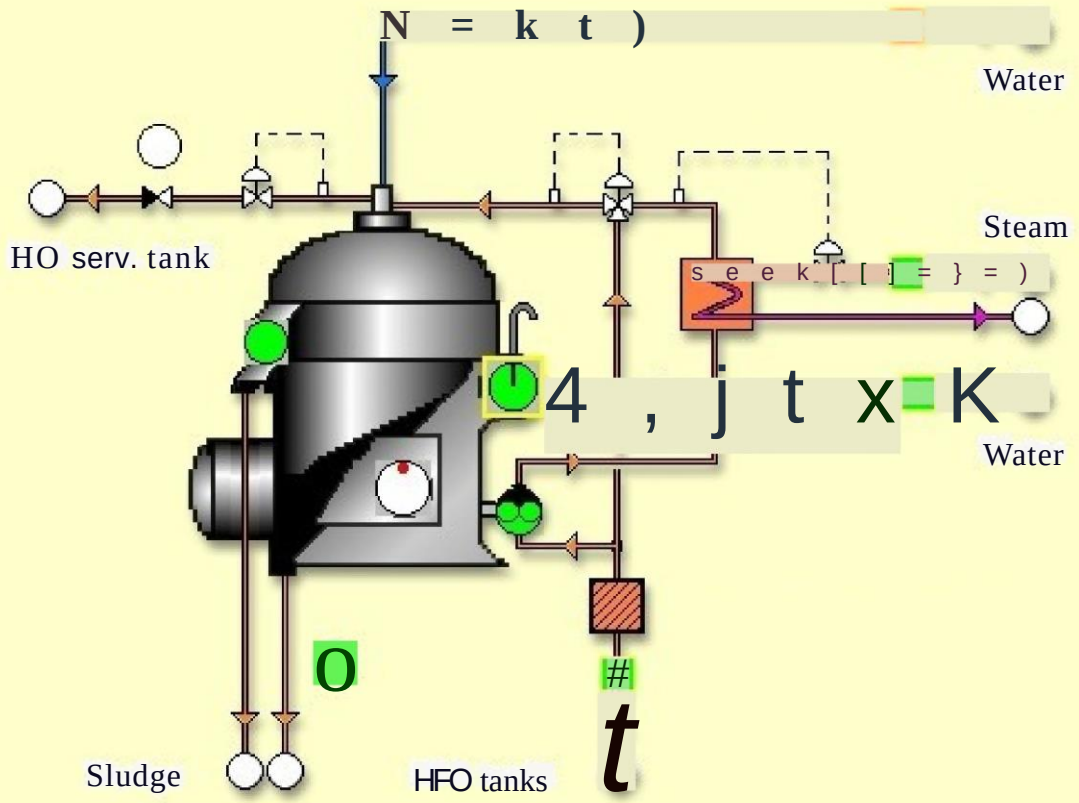
HFO Transfer **Pump**



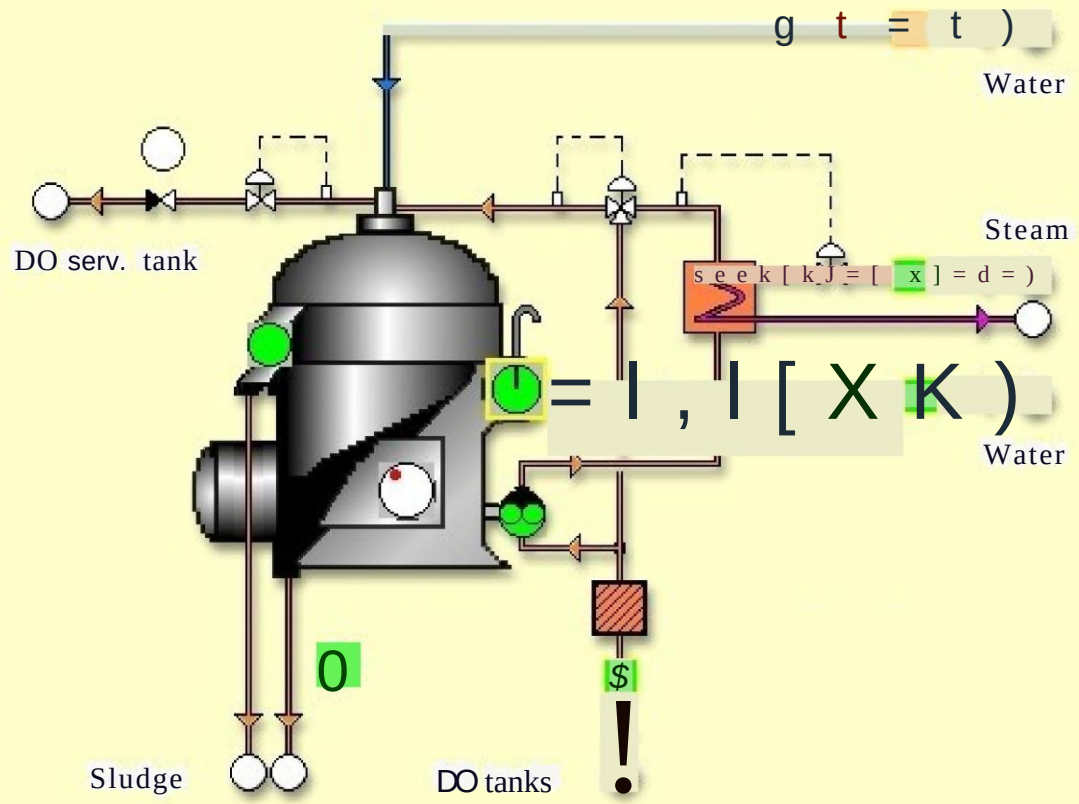
HFO Heater

HFO Separator

HFO Separation System



Diesel Fuel Separation System



Diesel Fuel Separation System

Lube Oil and Dirty Oil System

- Lube oil system is used to supply lube oil to the Main engines and Mud pumps.

- Dirty Oil system is used to remove contaminated lube oil and fuel oil from the equipment to a waste oil tank. The dirty oil is then transferred to loading vessel through a MARPOL discharge connection at Port and Stbd.

- The System consists of :-

Lube Oil Transfer Pump: Lube oil from the tank inside the Engine Room and Mud Pump Room are fed to the equipment by Lube oil transfer pumps.

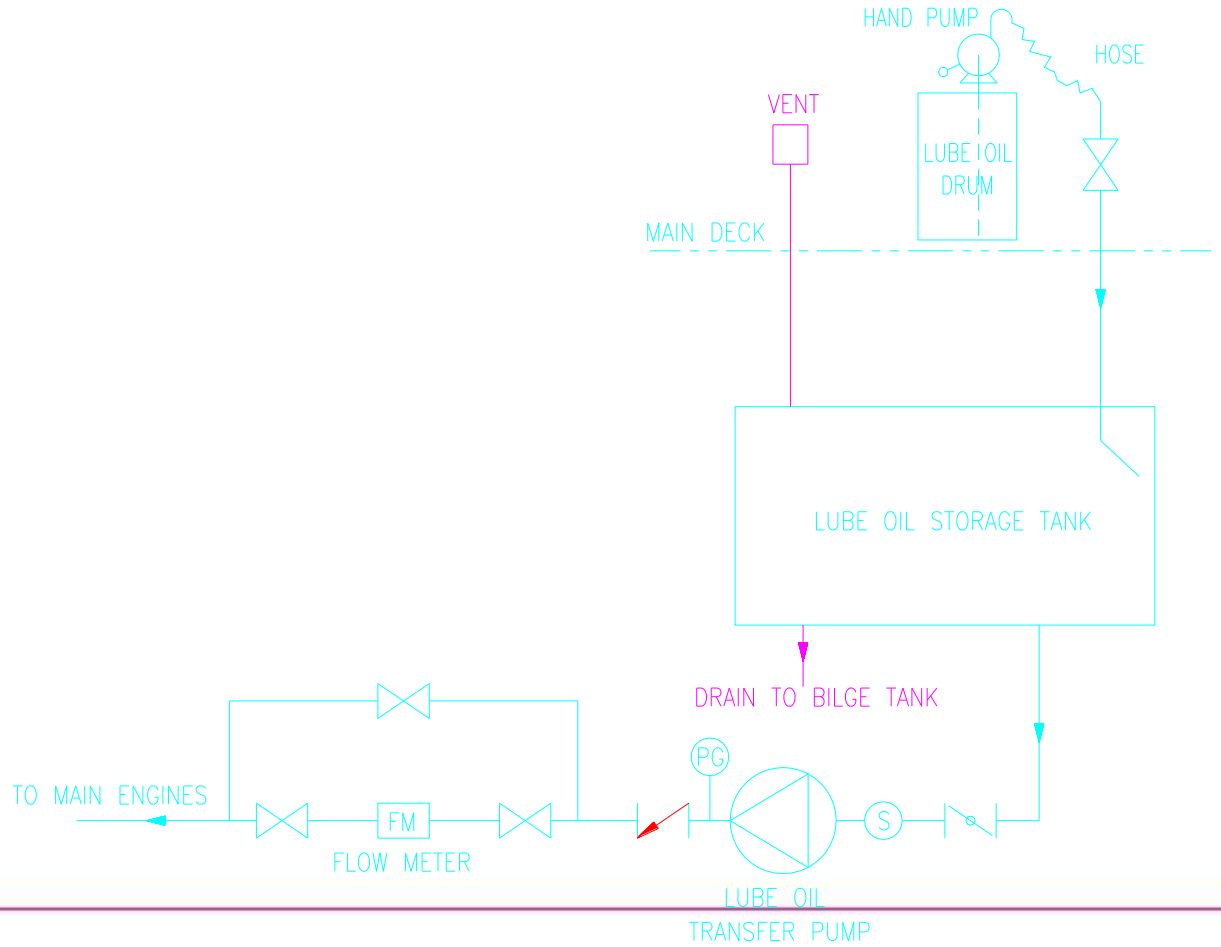
Hand Pump: They are used to transfer Lube oil from Portable drums to the Lube oil tanks.

Lube Oil and Dirty Oil System contd.

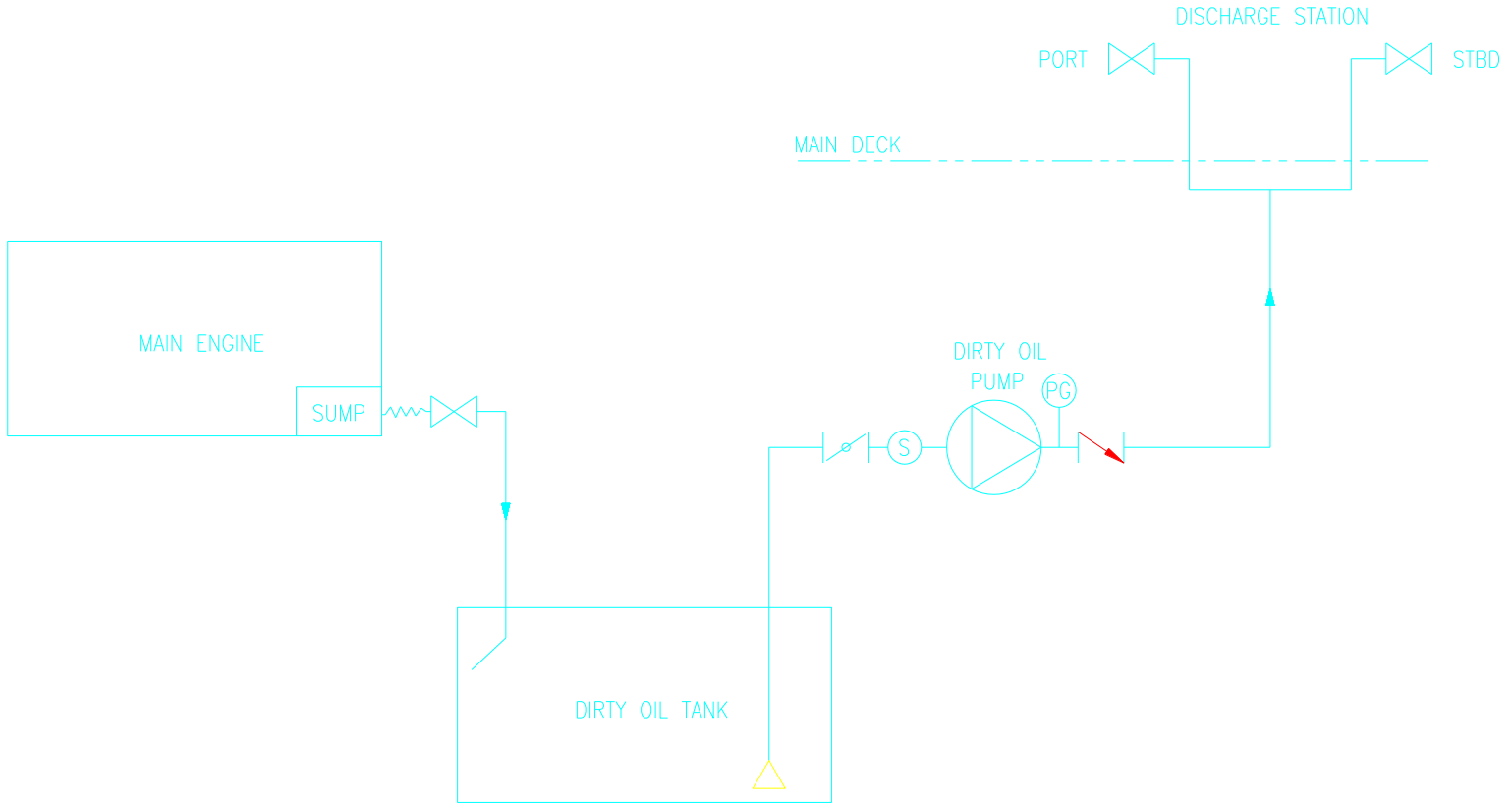
- **Piping**: Pipes are used for transferring the lube oil from the respective LO service tanks, to the main generators and to mud pumps. All the waste oil is collected in waste oil tank generally located in column.

  The waste oil pump takes suction from the waste oil tank and discharge back to waste oil tank or to Main Deck Marpol discharge connections at Port/Stbd.

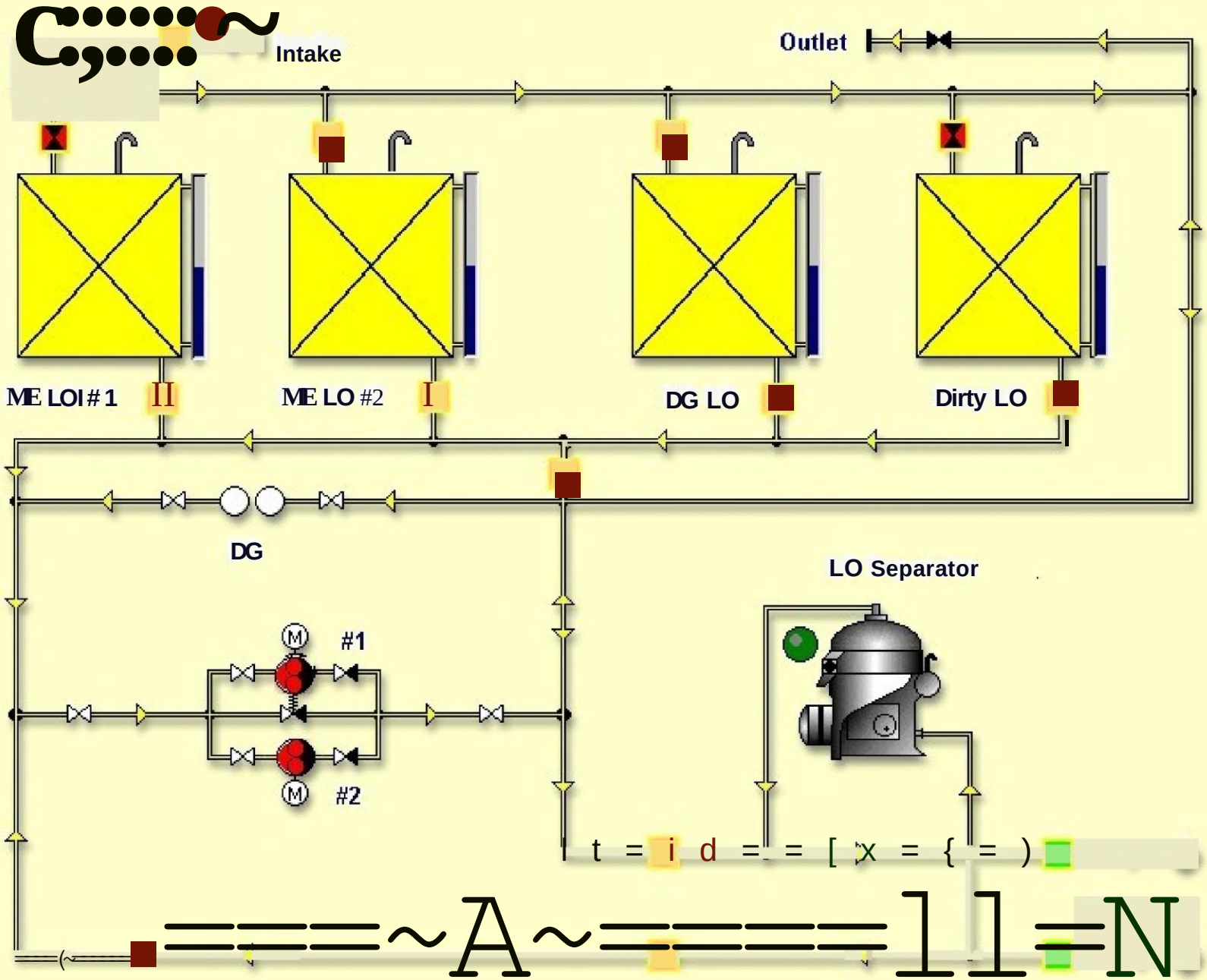
Lube Oil and Dirty Oil System contd.



Lube Oil and Dirty Oil System contd.



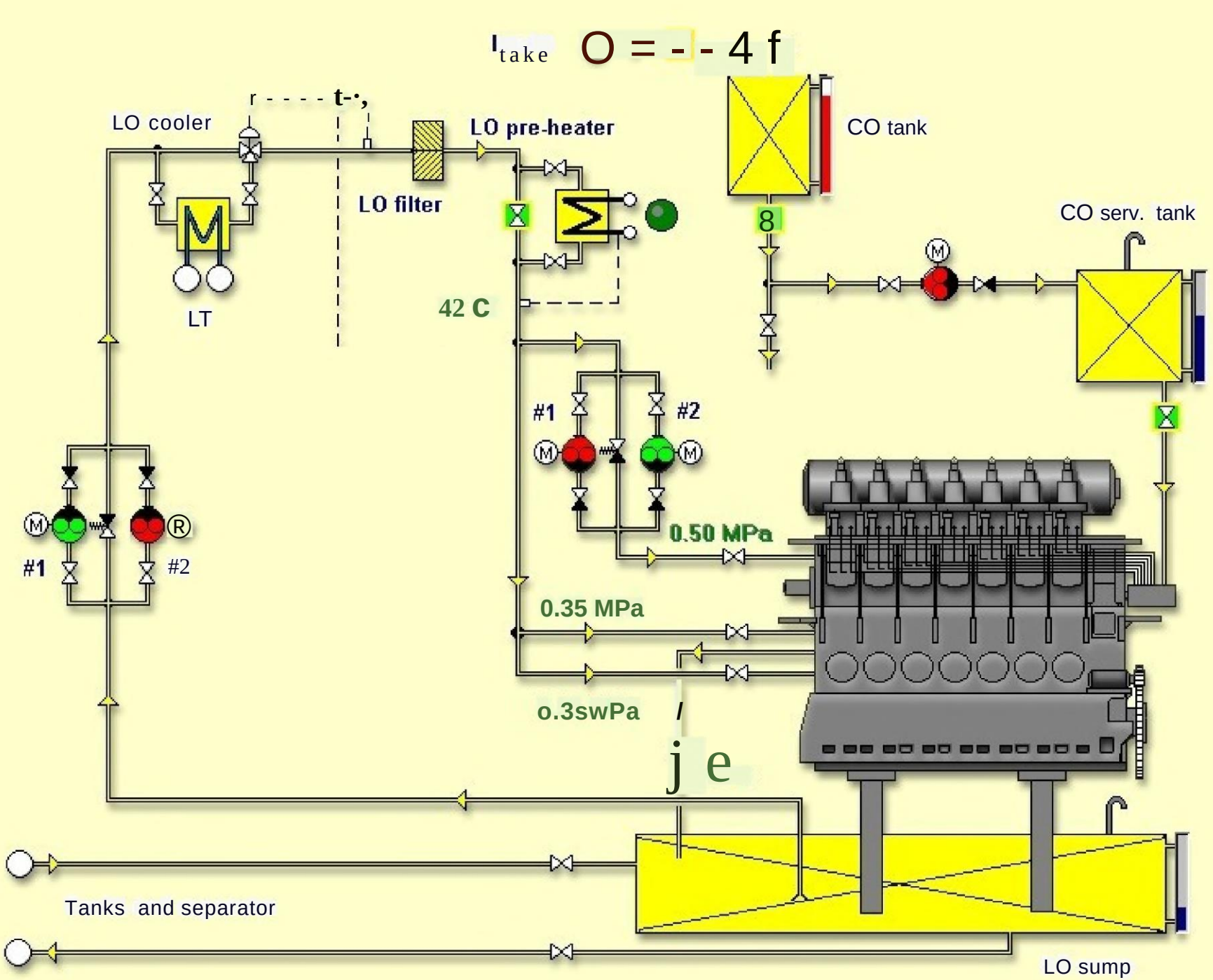
DIRTY OIL SYSTEM


Intake
Outlet
ME LOI # 1
II
ME LO #2
I
DG LO
Dirty LO
DG
LO Separator
#1
#2

Lubricating Oil Storage and Transfer

Main components

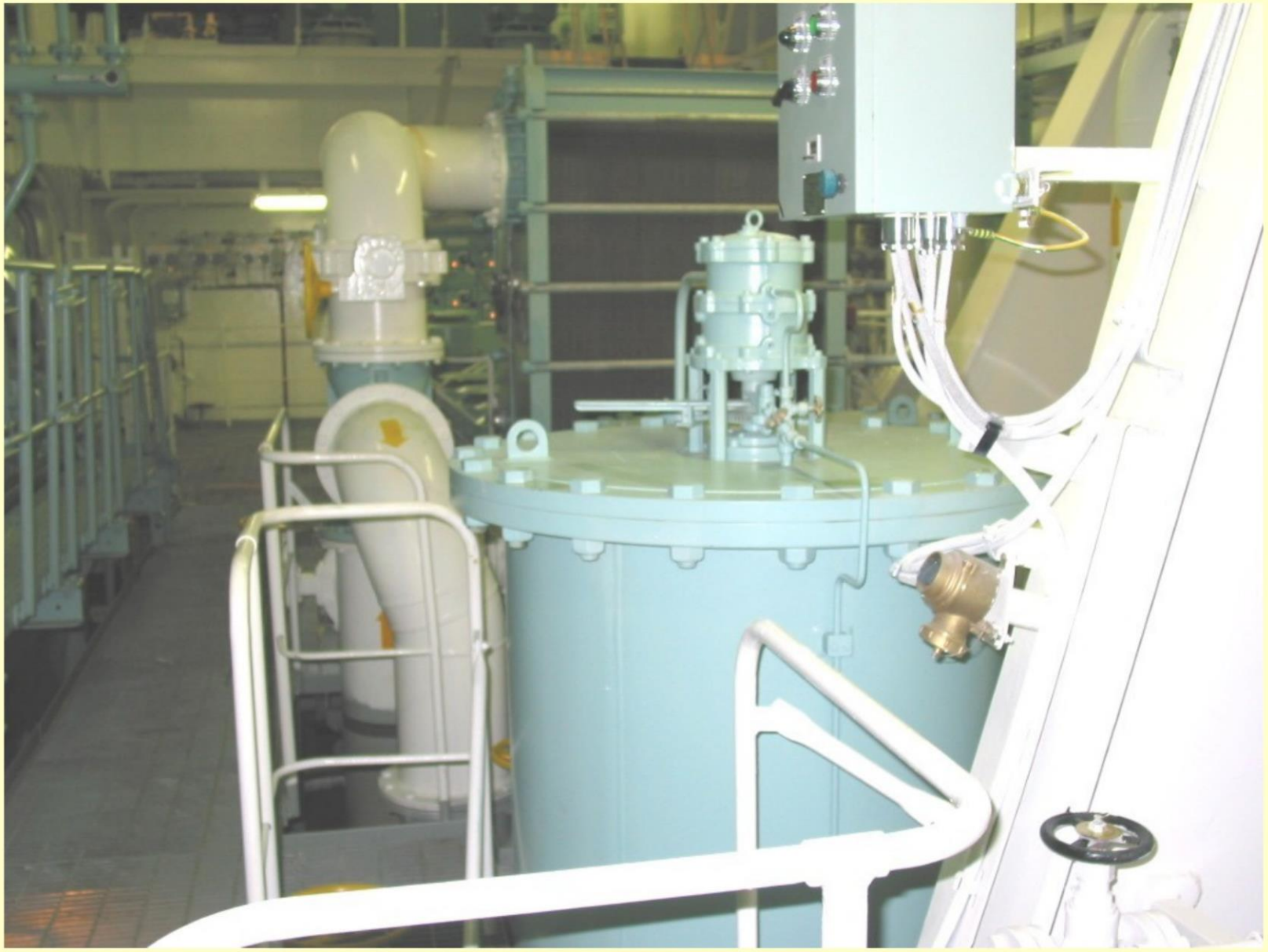
- Filling from deck to tanks
- Main LO storage tank to deliver to ME sump tank
- Quick-closing valves operable from outside ER where valves are below top of tanks (not applicable for small tanks below 0.5 m)
- Air pipes may terminate inside ER provided their openings do not constitute a fire hazard
- Duplex filters (or self-cleaning) are used without interrupting operations


LO cooler
LO filter
LO pre-heater
CO tank
CO serv. tank
LT
42 C
#1
#2
0.50 MPa
0.35 MPa
#1
#2
Tanks and separator
LO sump

Lubricating Oil Service Tank

_{ b ricating **oil Pump**

Lubricating Oil Filter - Self-cleaning

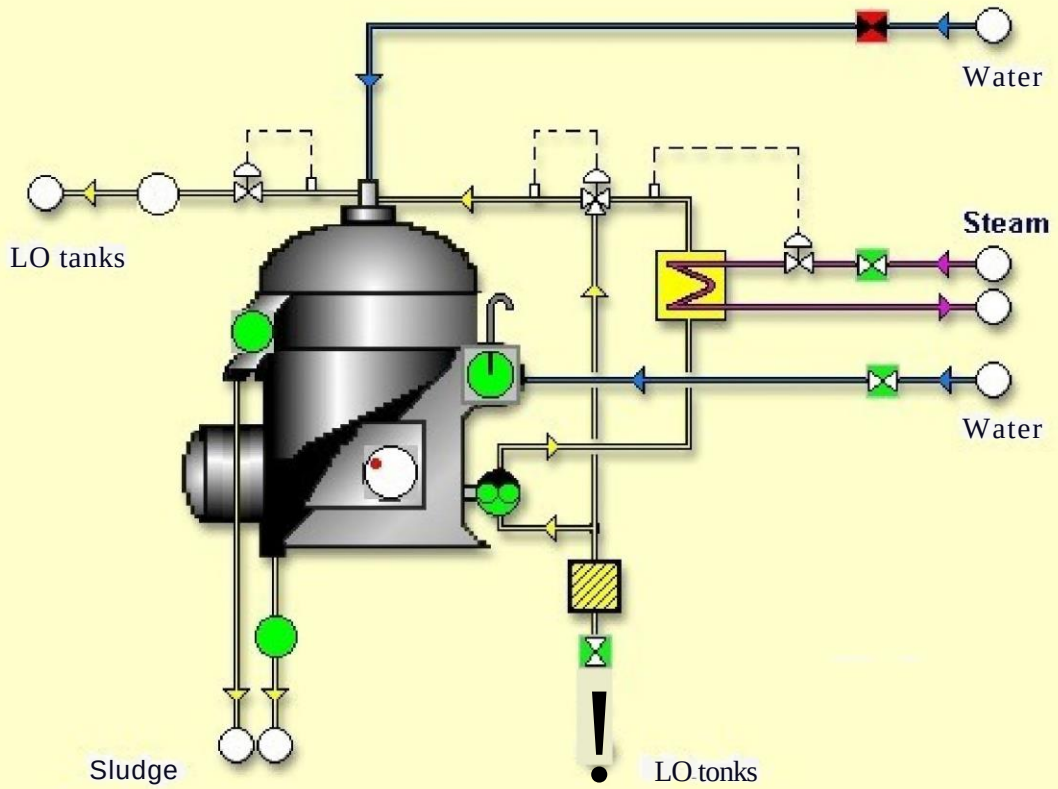


Lubricating Oil Filter - Self-cleaning

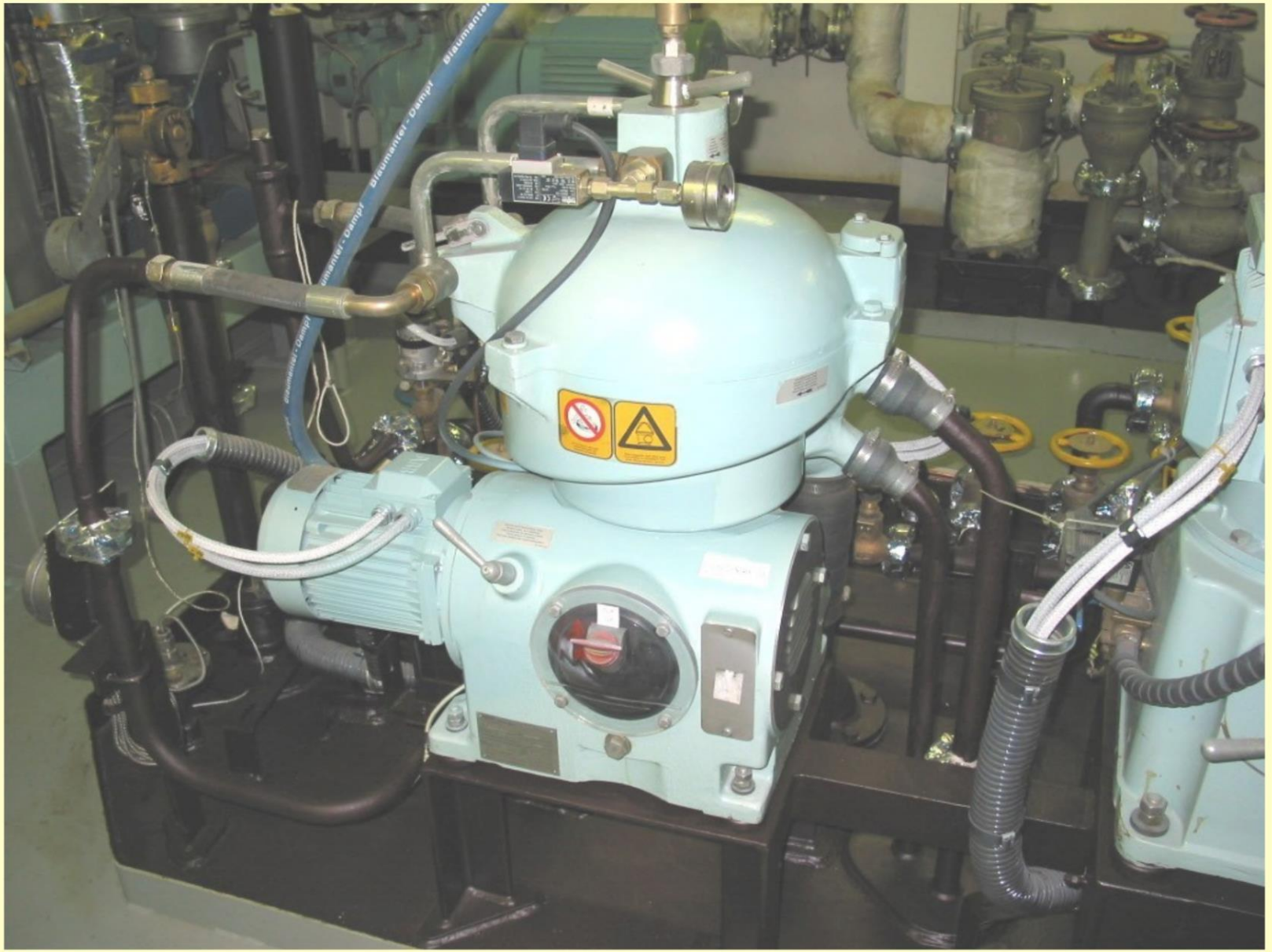
Lubricating Oil System - Thermostatic Valve

Shell-and-Tube LO Cooler

Lubricating Oil Purifier



Lubricating Oil Purifier



Compressed Air System

Service air System

- The purpose of the service air system is to provide high quality compressed air to rig equipment, service outlets ,bulk air reducing station and equipment operation.
- The purpose of the control air system is to provide high quality compressed air to fire dampers, tank gauging system and instrument control.
- The System consists of :-

Service Air Compressor: They increase the pressure of Gas or vapor by compressing it and producing compressed air for Pneumatic application.

Service Air Dryers: The Compressed air passes through the Dryer to eliminate the Moisture content in it.

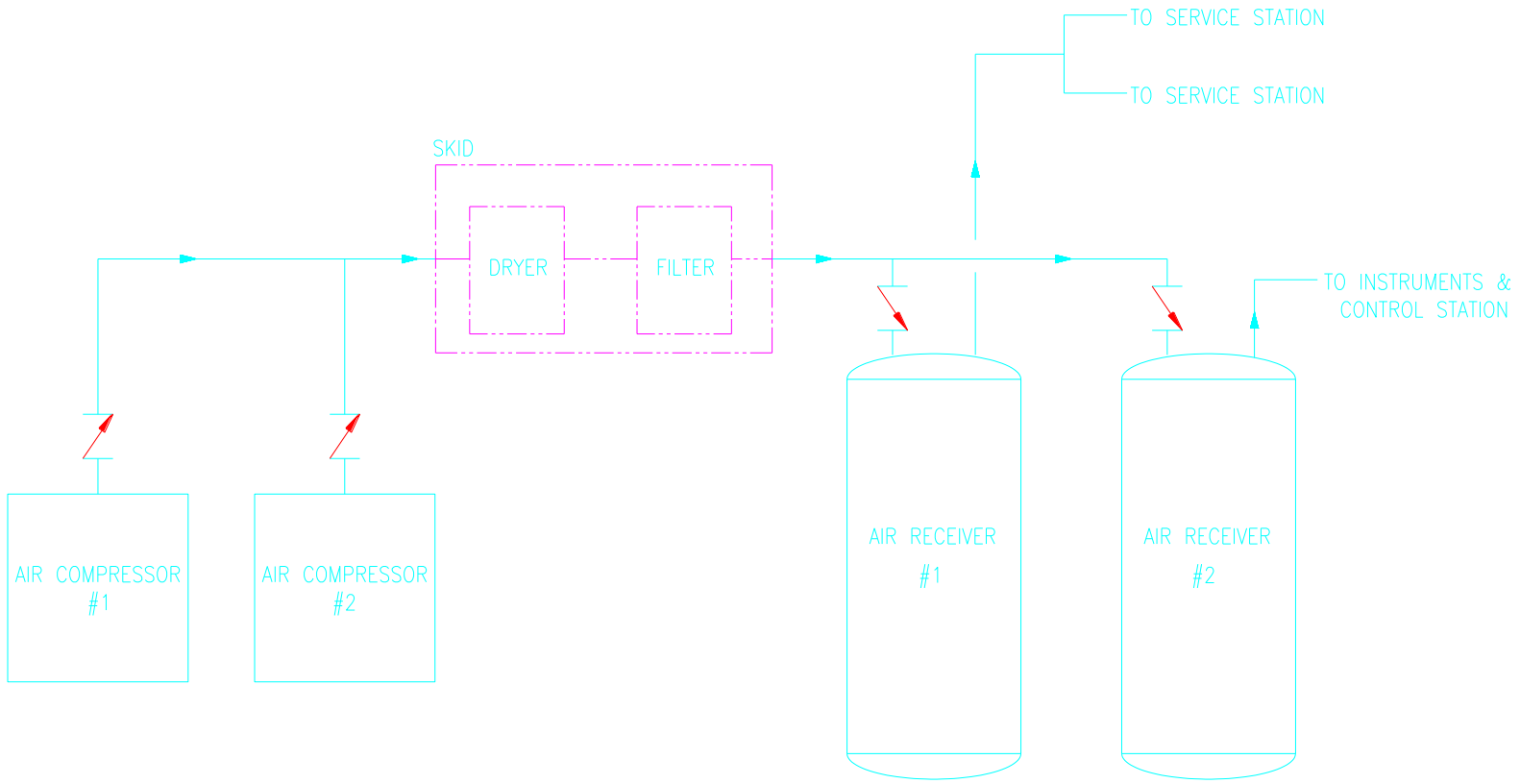
Service Air receiver: They are used to store the compressed air.

Compressed Air System contd.

Service air System

- **Piping**: Piping runs from the Service Air compressors to the air receivers, then to the air dryers. Air is piped into the ring header from the air receivers. Relief valves from the system are vented to the main deck. Sea water piping supplies cooling water to the air compressors.

Compressed Air System contd.

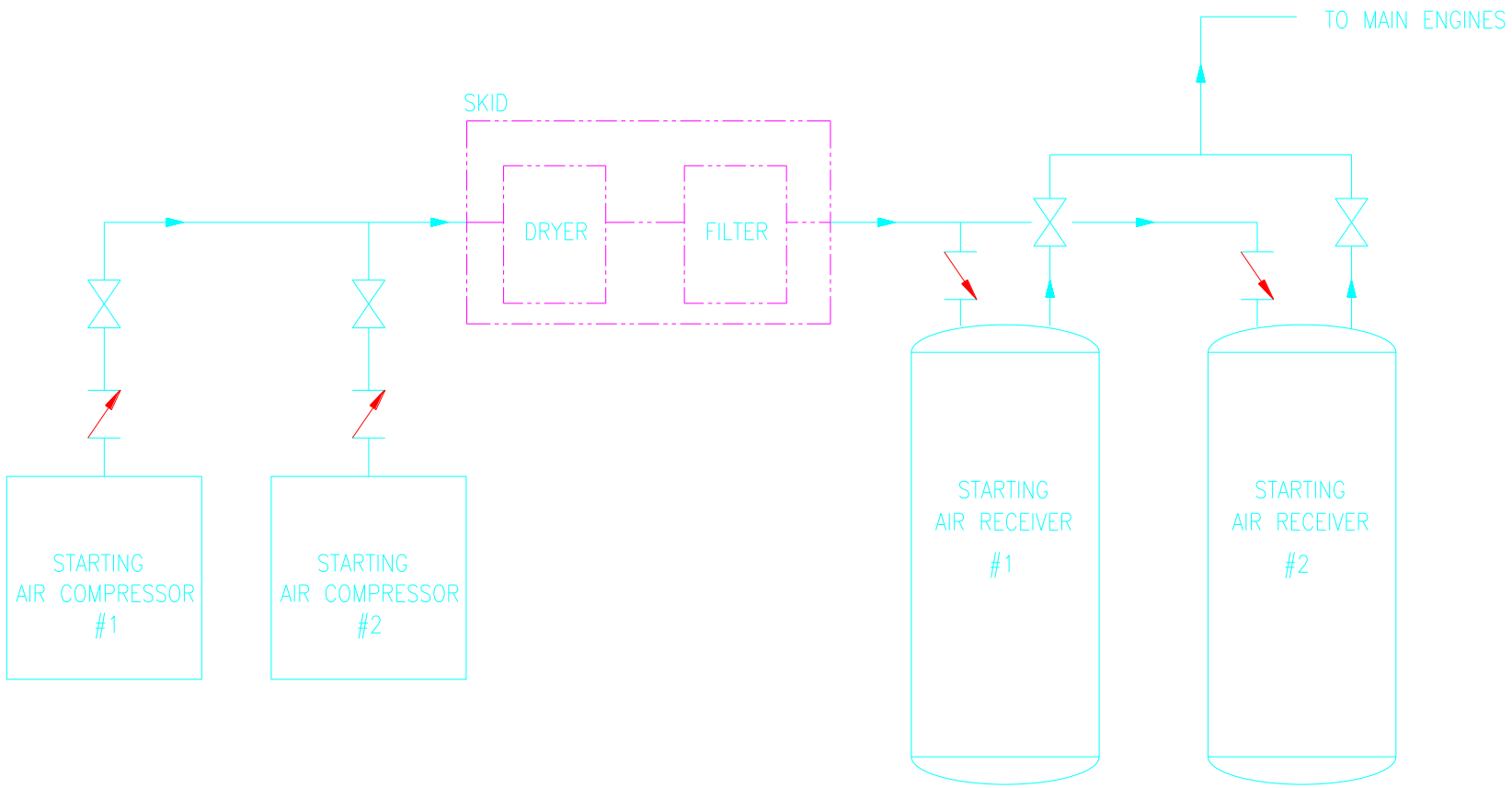


Compressed Air System contd.

Starting air System

- **Piping**: Piping runs from the Starting Air compressors to the Starting air receivers. Air is piped into the header from the air receivers. Relief valves from the system are vented to the main deck. They are used to provide air supply for generator to start.

Compressed Air System contd.



Air Compressors

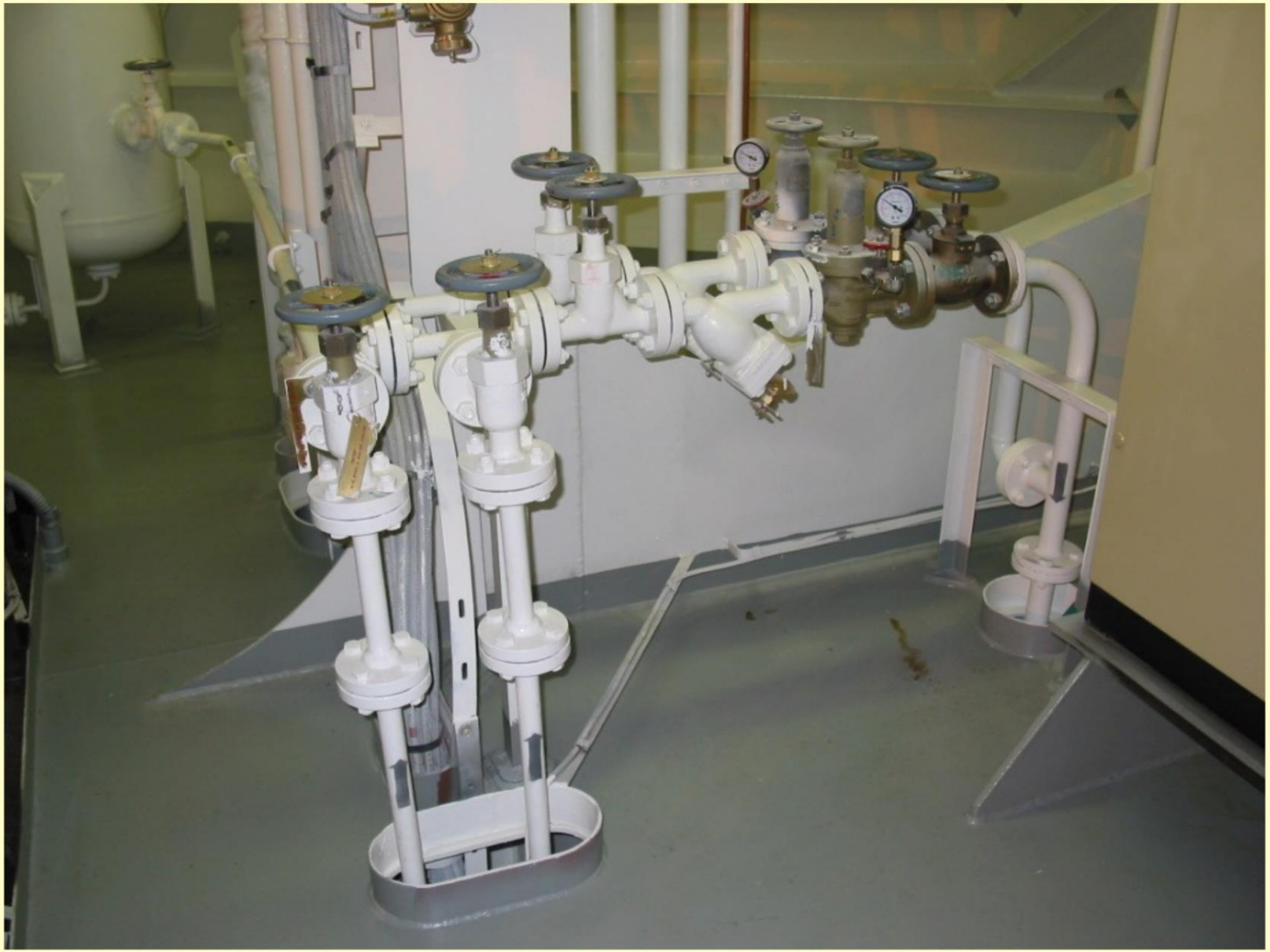
Air Receivers

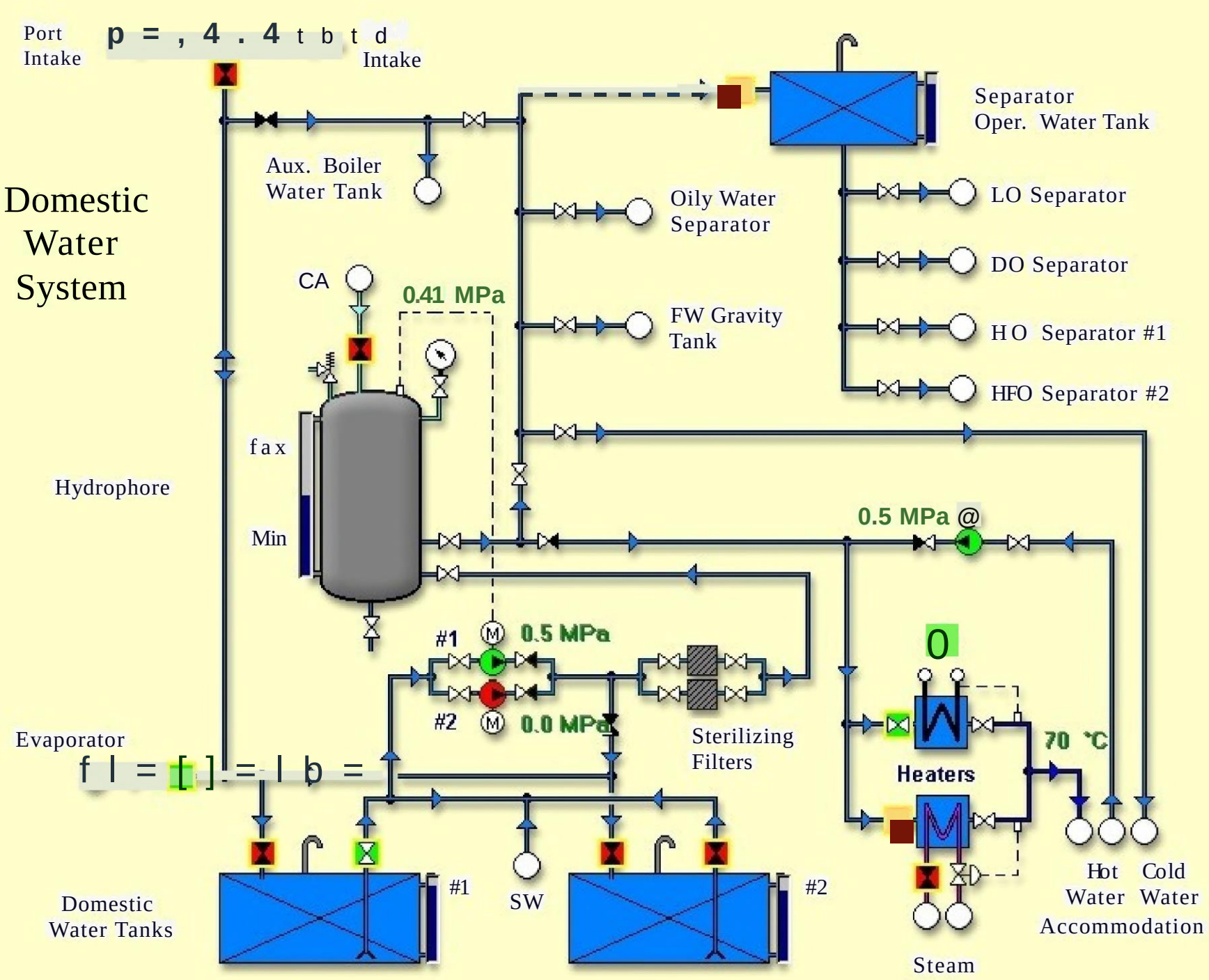
Auxiliary Air Receiver

Emergency Air Receiver

Control Air Dryer (Refrigerant-type)

Pressure-reducing Station




Port Intake
Intake
Separator Oper. Water Tank
Aux. Boiler Water Tank
Oily Water Separator
LO Separator
DO Separator
CA
0.41 MPa
FW Gravity Tank
HO Separator #1
HFO Separator #2
Domestic Water System
fax
Hydrophore
Min
0.5 MPa @
#1
0.5 MPa
#2
0.0 MPa
0
Sterilizing Filters
Evaporator
70 °C
Heaters
Hot Water
Cold Water
Accommodation
Domestic Water Tanks
#1
SW
#2
Steam

Potable Water System

- The purpose of the potable water system is to supply clean and treated water for drinking, cooking, washing and machinery services.

  Potable water is stored in the storage tank and pumped to a pressure set tank. From pressure tank, water is distributed through a U.V sterilizer.
  This treated water is then delivered to Living quarters for basic utilities.

  Fresh water can be generated on board by means of Water Maker or it can also be supplied externally from the filling stations.

- The System consists of :-

  Potable water Pump: Water from the storage tank which is generally located at the bottom hull is fed to the Pressure Tank by means of Potable water pumps.

  Hydrophore tank: It is a pressure tank, which is under pressure by means of compressed air, the level of water inside the tank is maintained by virtue of pressure of compressed air inside the tank.

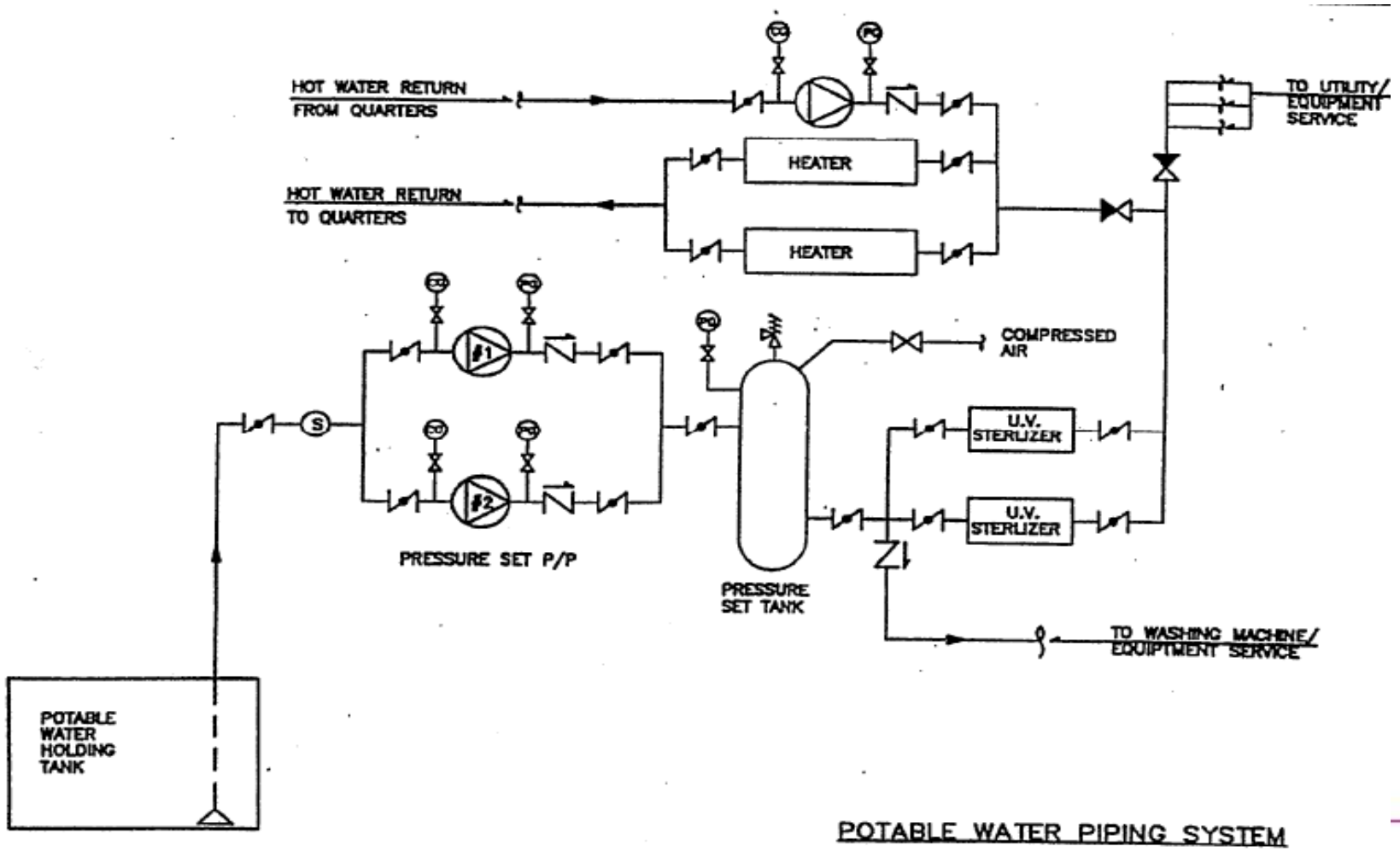
Potable Water System contd.

Activated Carbon filter: They are used to eliminate the impurities and bad odour.

UV Sterilizer: They are used to eliminate the impurities and disinfect the water to make it fit for drinking.

- **Piping**: Pipe line runs from Bunkering stations to the storage tanks, Potable water is fed into the Hydrophore tank by means of Potable water pump and there after it passes through the Activated carbon filter, through the UV Sterilizer it is conveyed to the Living Quarters for basic utilities.

Potable Water System contd.



POTABLE WATER PIPING SYSTEM

Fire fighting System

Fire Main System

- The purpose of the fire main system is to extinguish fire.
- Normally the medium used is sea water. This System is provided with two (2) Fire pumps one working and one stand-By located at different compartments, so that a fire or flooding in one compartment will not put both the pumps to stall.

  The distribution header is arranged in a Ring Main manner, Sea water at a required pressure by means of a jockey pump is distributed to the various fire stations on board the vessel.

  An international shore connection is provided at Port and Stbd so that water can be supplied to the ring header from an external source.
- The System consists of :-

  Fire water Pump: Sea Water from the Sea chest is fed to the Pressure Tank by means of Fire water pumps.

  Hydrophore tank: It is a pressure tank, which is under pressure by means of compressed air, the level of water inside the tank is maintained by virtue of pressure of compressed air inside the tank.

  Fire Stations: They are located at different locations on board a vessel, It consists of hose, hose reels and jet nozzles to discharge water for fire fighting purpose.

Fire fighting System contd.

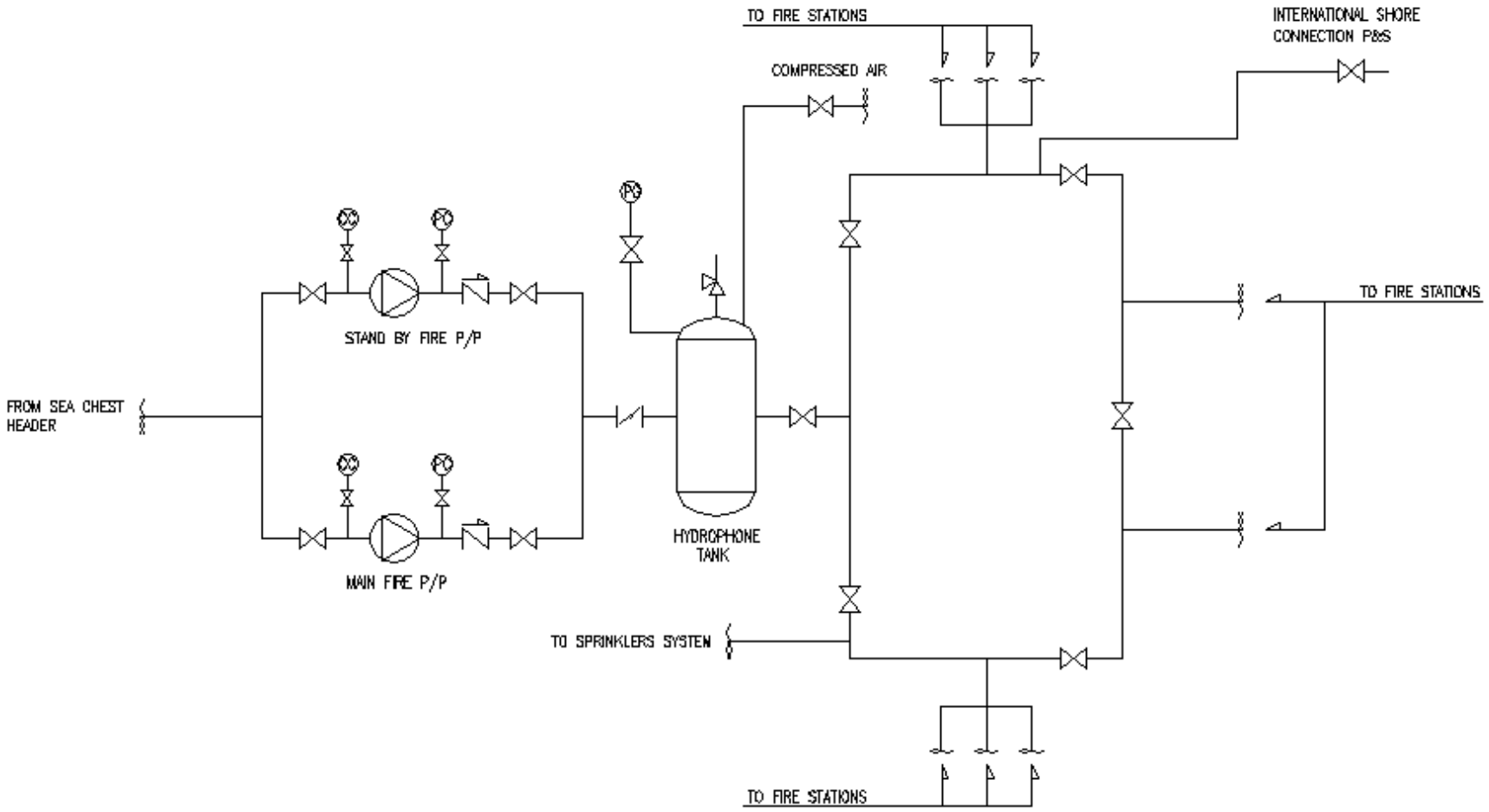
Fire Main System

- **Piping**: Sea water is taken in through the Sea chest and is fed into the Hydrophore tank by means of Fire water pump and there after it passed to the Ring main header.

  An international shore connection is provided at Port and Stbd so that water can also be supplied to the ring header from an external source.

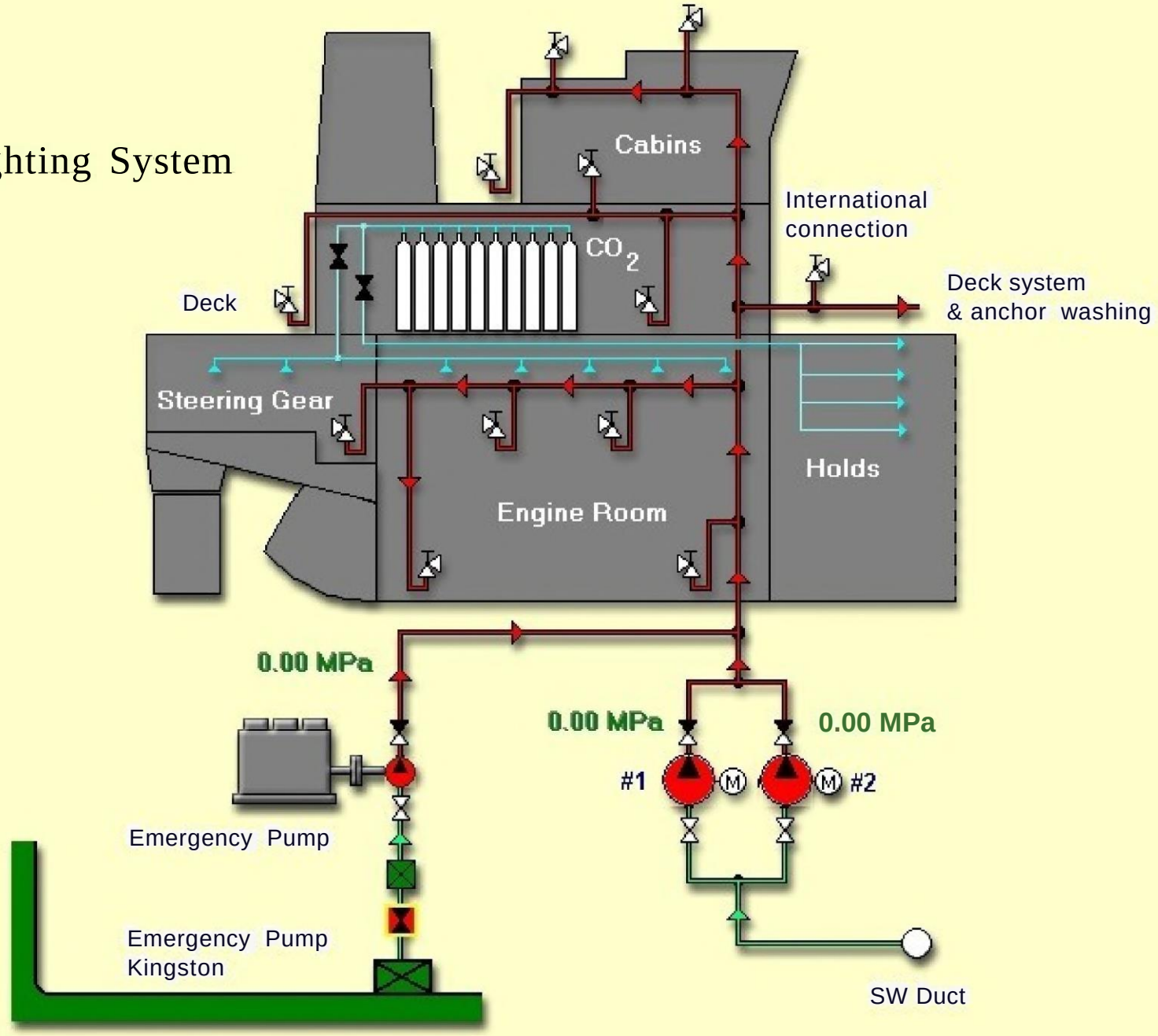
  Branch piping from the Ring main are connected to the Fire stations at different locations.

Fire fighting System contd.



FIRE MAIN SYSTEM

Fire-fighting System

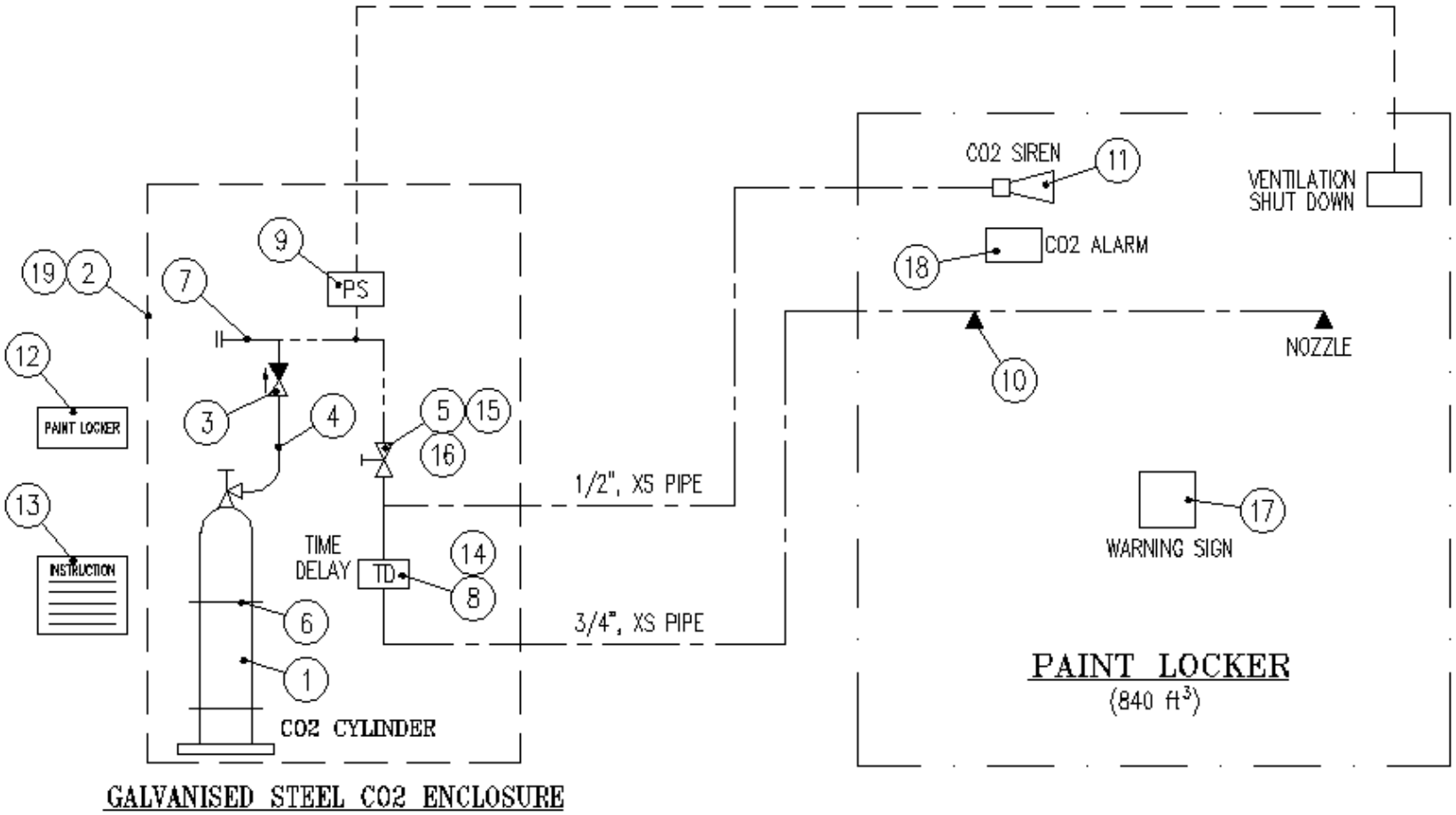


Fire fighting System contd.

CO_2 System

- This a dry fire protection system, generally provided for compartments like Engine room, Emergency generator room, paint locker room, galley hood etc which has the potential to cause fire
- The system is equipped with Audio and visual alarms in the protected spaces to alert personals to evacuate from alarmed spaces. Prior to release of CO2 the room ventilation fans and fire dampers will be shut down.

Fire fighting System contd.



Fire fighting System contd.

Sprinkler System

- This a Wet fire protection system, generally provided for accommodation area.

  Normally, the system is filled with fresh water and pressurized by the compressed air for initial operation. Subsequently water is supplied from the Fire main header.

- Each sprinkler header is fitted with a flow switch and any flow of water through this header is detected by the flow switch, which activates an alarm in the control panel.
- When the pressure in the Sprinkler system drops below the fire main pressure, the fire pumps starts and supplies water to the sprinkler system.

Sanitary System

- The purpose of the sanitary system is to flush off WCs and urinals.

  The flushing water is stored in a holding tank. The pump takes suction from the holding tank and discharge the water to the pressure set tank, which is charged up by compressed air. The water in the system is then pressurized to preset valve.

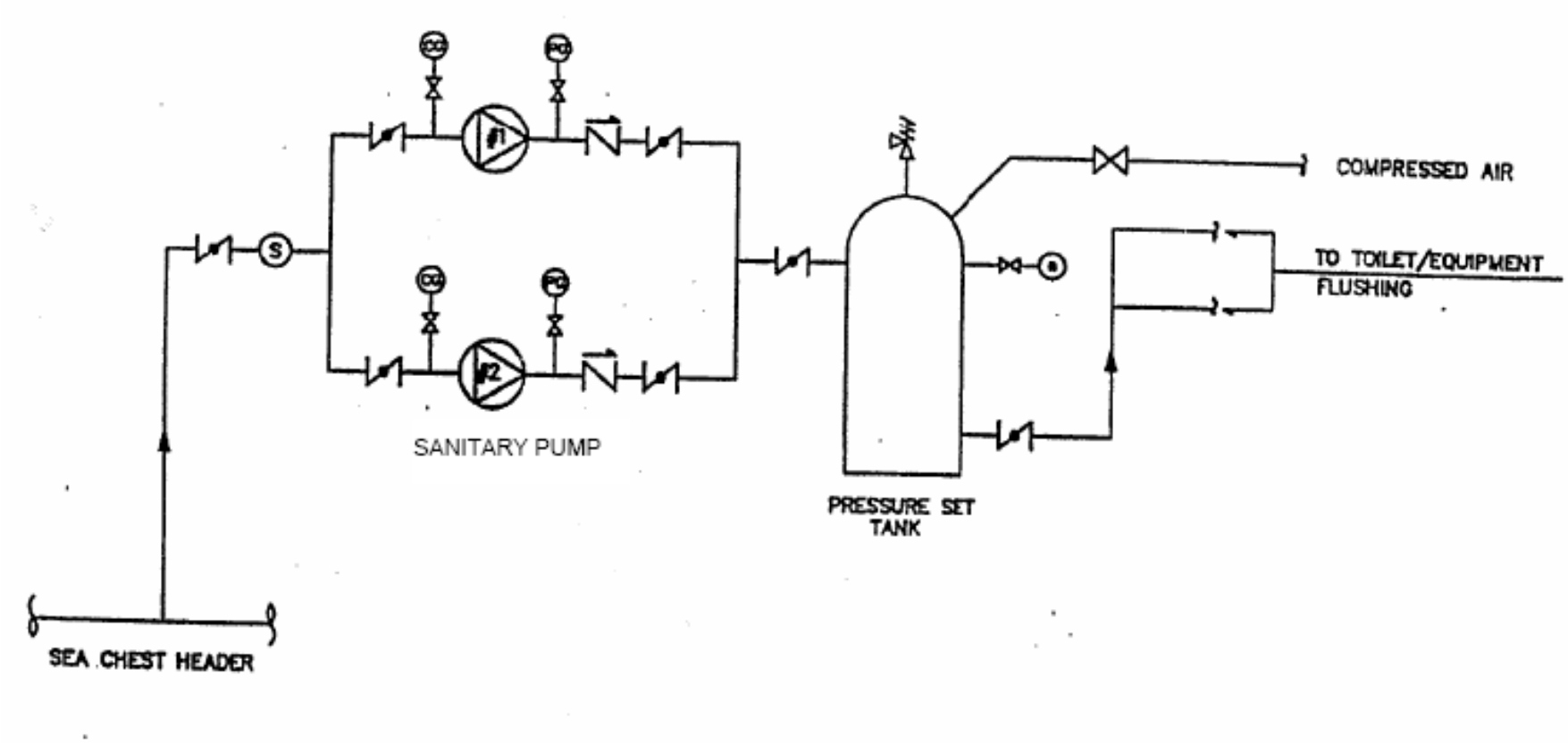
  A flushing control valve is installed at each unit for open / close control.

- The System consists of :-

  Sanitary water Pump: Sea Water from the Sea chest is fed to the Pressure Tank by means of Sanitary water pumps.

  Pressure set tank: It is a pressure tank, which is under pressure by means of compressed air, the level of water inside the tank is maintained by virtue of pressure of compressed air inside the tank.

Sanitary System contd.



Sanitary System contd.

Sanitary Drainage system

- The purpose of the Sewage Treatment System is to treat Black drain water from toilets, in order to comply with MARPOL requirements for the quality of discharged effluent. Grey water from sinks and showers go directly overboard during normal operations.

  The waste from the water closet, urinal and hospital drain is drained to Sewage holding tank to prevent contamination. The clean drain from basins, washing machines and drinking fountains are discharged overboard.

  A Sewage treatment unit is installed to process the waste and then discharge overboard. Untreated wastes can also be discharged to another vessel through the MARPOL discharge station.

- The System consists of :-

  Sewage treatment plant: The Sewage Treatment Unit operates on the extended aeration principle and are used to process the waste and then discharge sewage overboard.

  Sewage transfer pump: They are used to Transfer the Sewage from Holding tank to STP.

  Centrifugal Blower / Rotary air compressor: They are used to produce air for promoting digestion by bacteria.

Sanitary System contd.

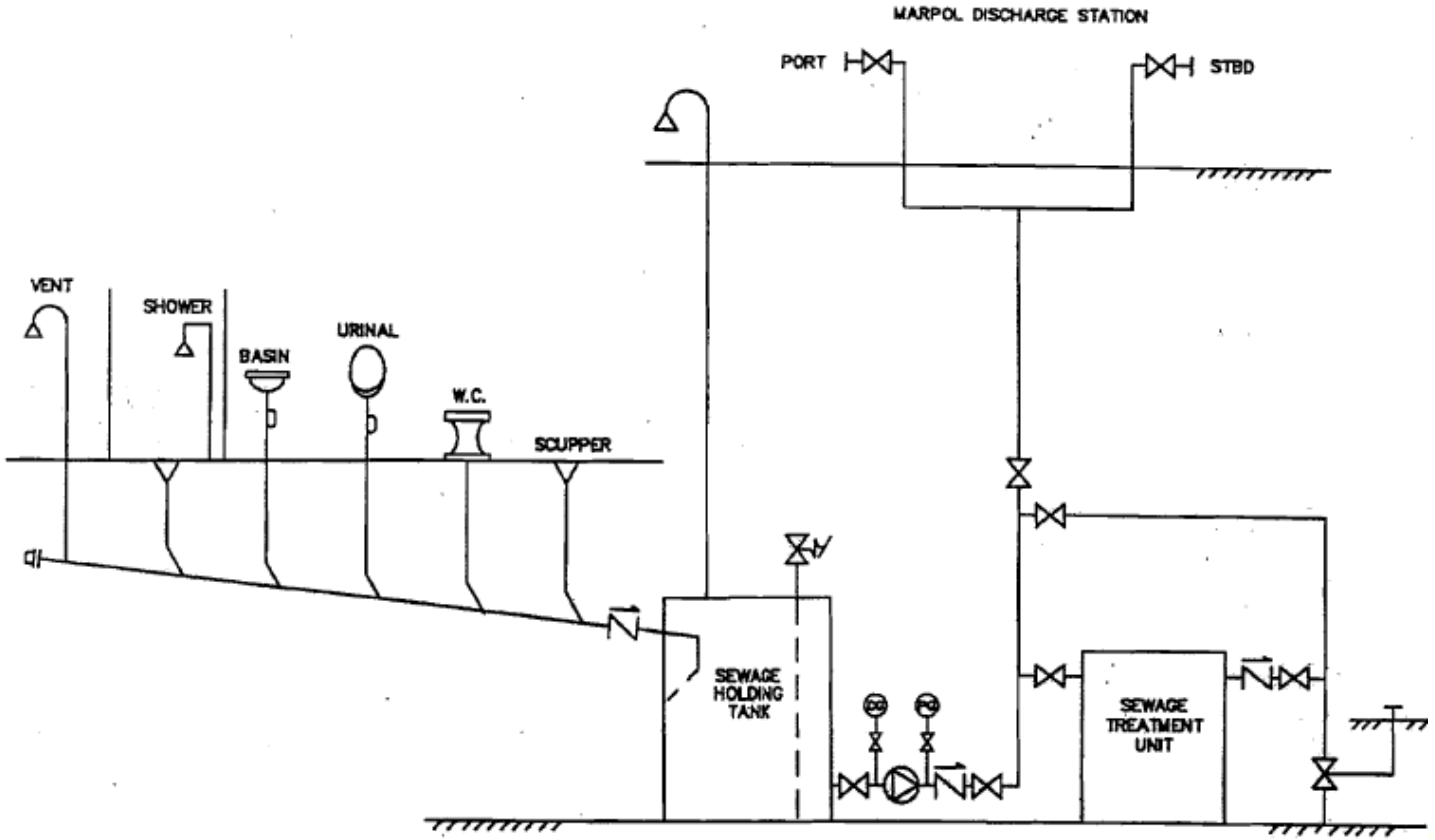
Sanitary Drainage system

Grease trap: They separate the greasy oily lumps formed at the galley before the waste sewage is collected in the Holding tank.

OBD pump: They are used to dump the treated Sewage out of the vessel.

Sanitary System contd.

Sanitary Drainage system



SANITARY DRAINAGE PIPING SYSTEM

Refrigerant System

- The purpose of the refrigeration system is to cool down and maintain a reduced room temperature in the Chiller Room (4 °C) and Freezer Room (-25 °C) for preservation of foodstuffs.
- R-404A grade refrigerant is generally used in this system
- The System consists of :-

Compressor: They increase the pressure of Refrigerant Gas by compressing it.

Condenser: It cools the compressed refrigerant gas and changes its state into liquid form.

Refrigerant System contd.

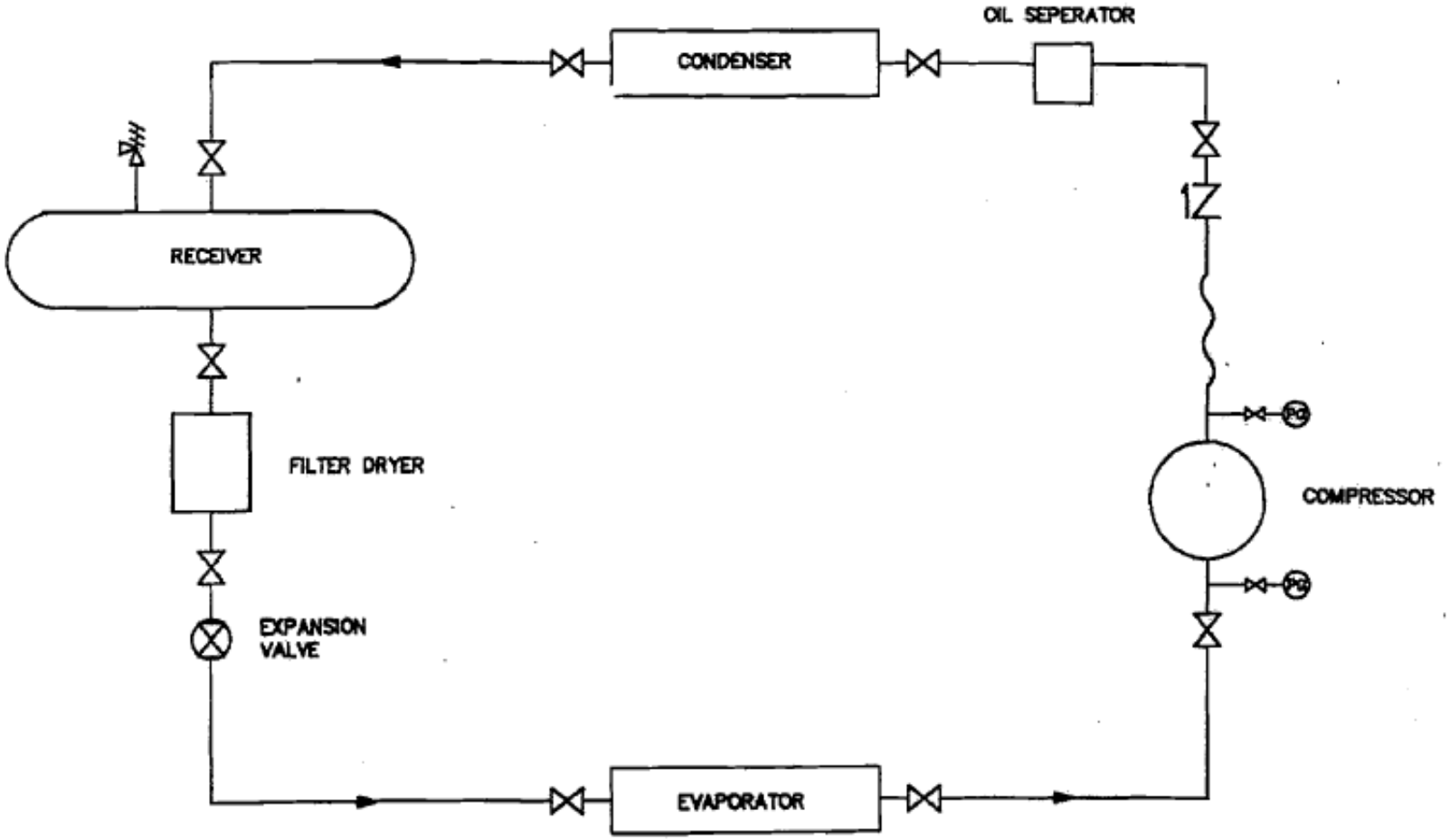
Receiver: It is a vessel in which any gas in the refrigerant is separated.

Only liquid refrigerant is allowed to pass beyond this stage.

Expansion Valve: It is used to lower the pressure and hence increasing the volume of the refrigerant.

Evaporator: The chamber in which the exchange of heat takes place.

Refrigerant System contd.

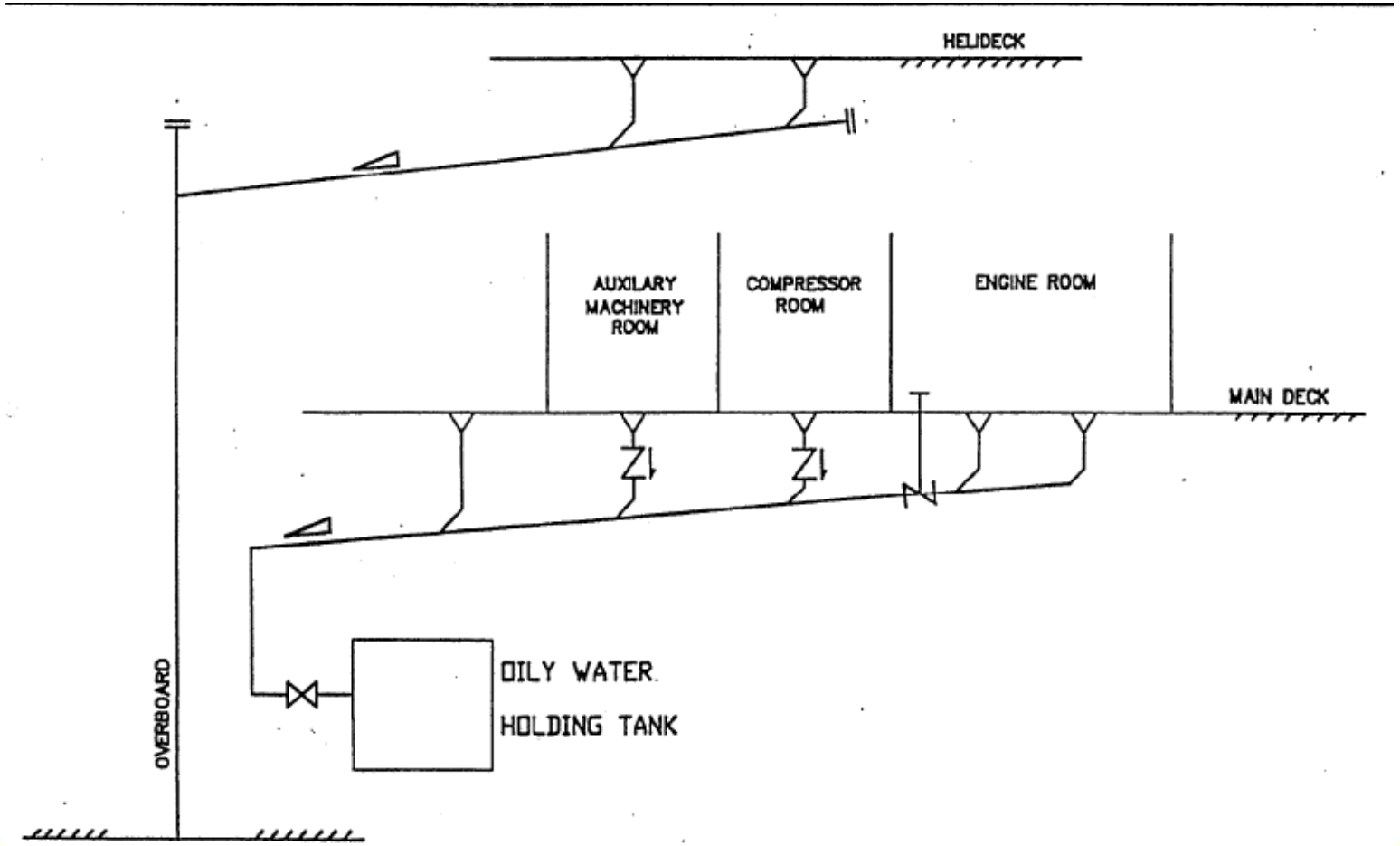


Deck drainage System

- The purpose of this system is provided for gravity draining of waste water from deck to either a bilge holding tank or overboard.
- Clean water is let out directly by over board discharge line, as per MARPOL requirement oily water has to be collected in a bilge holding tank, Oil has to be separated

  by passing it into the OWS before sending it over board.

Deck drainage System contd.



Engine cooling System

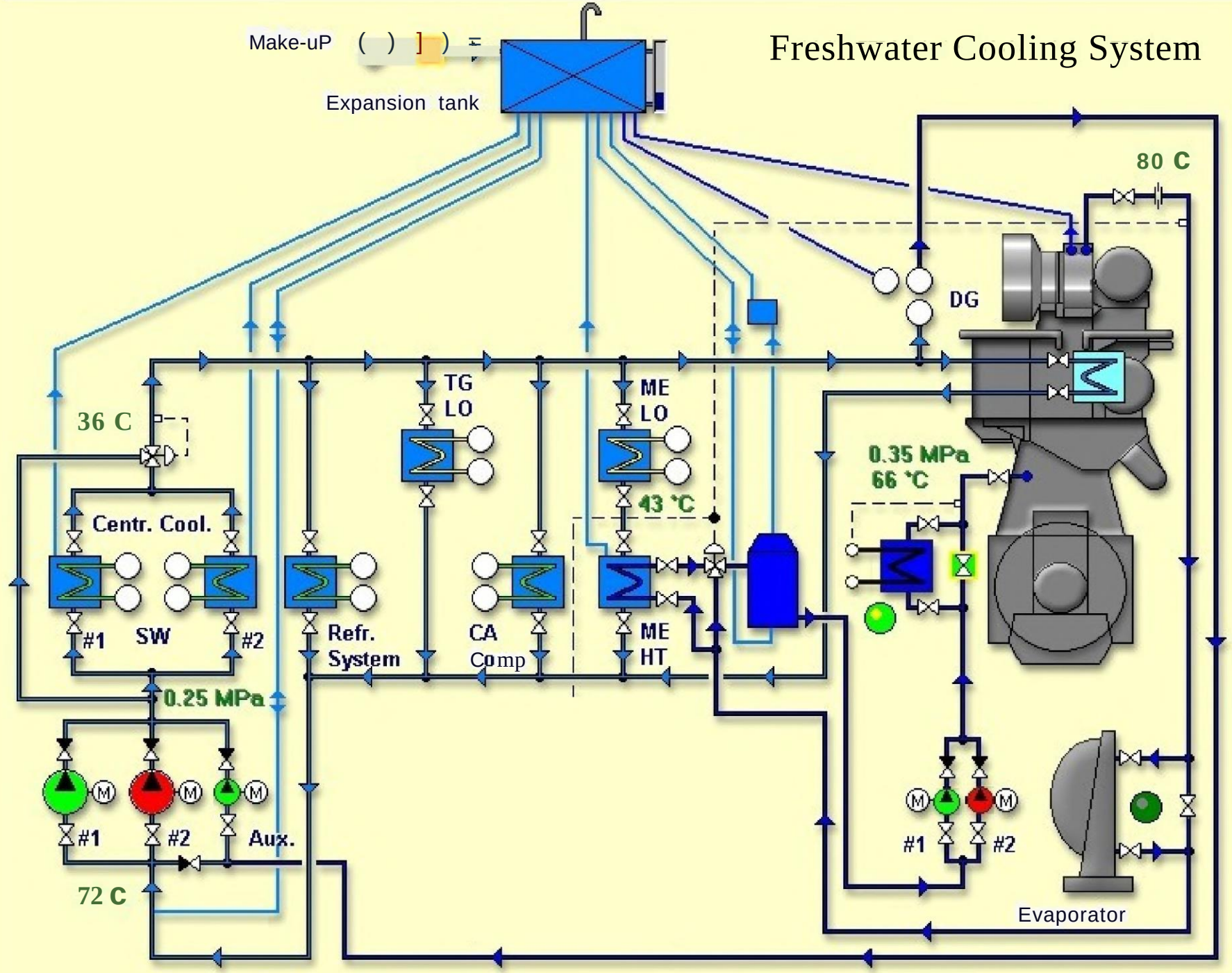
Sea water cooling

- The purpose of the Engine cooling system is to dissipate heat produced by the engine during operation.
- This part of engine cooling is low temperature and of open loop type. The sea water cooling pump takes suction from sea chest header and discharges to the engine heat exchanger. The low temperature sea water then exchanges heat with high temperature fresh water, the heated water is discharged overboard.
- Fresh water is circulated to Lube Oil cooler and charge air cooler.

Seawater Cooling System

Overboard Discharge

Freshwater Cooling System



Engine cooling System contd.

Fresh water cooling

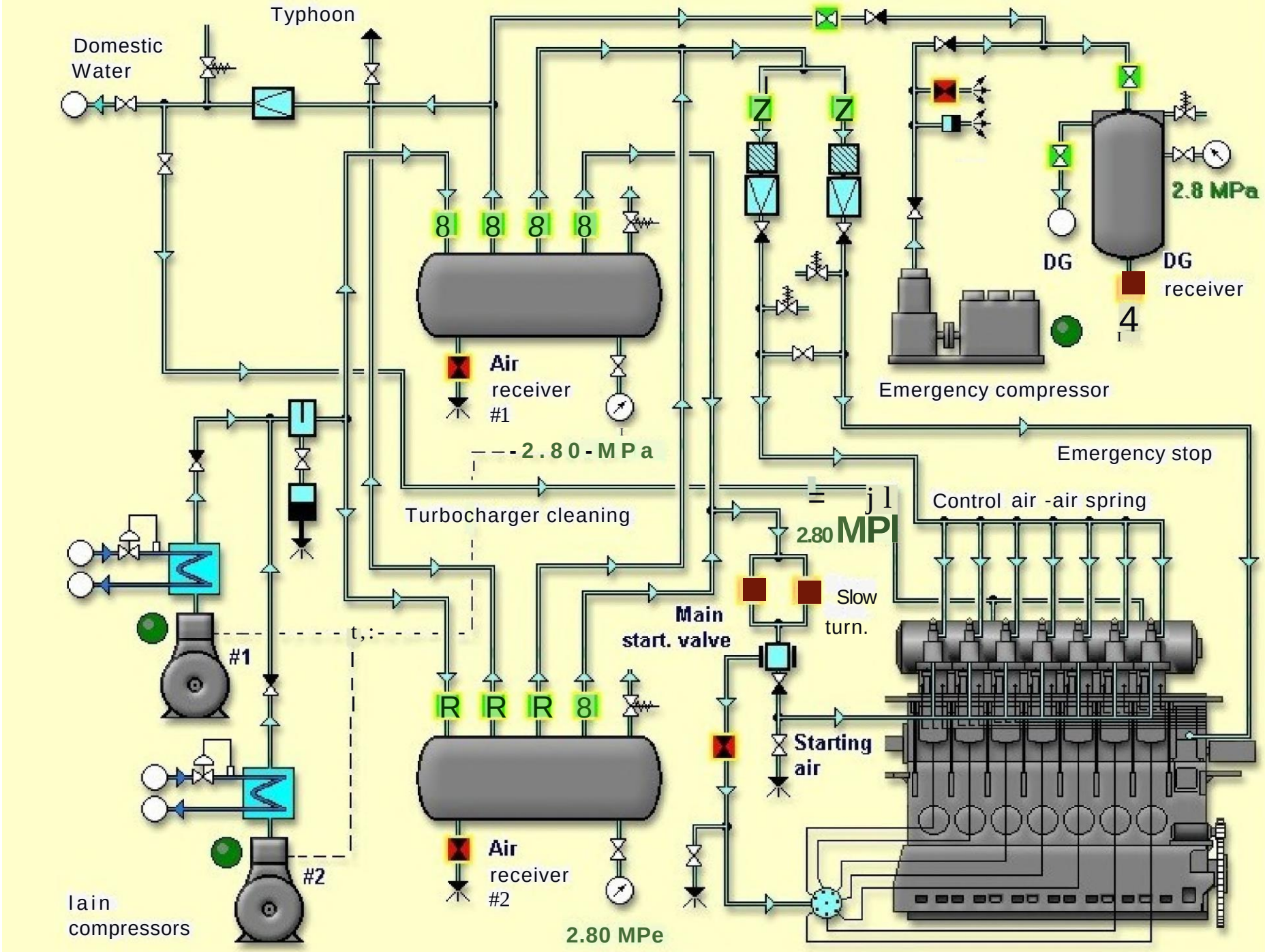
- This part of engine cooling is high temperature and of closed loop type. The built in engine fresh water cooling pump takes suction from the expansion tank.
- Fresh water is circulated to an Oil cooler, after cooler, cylinder block and cylinder head.
- The high temperature fresh water is cooled down by the low temperature sea water through a heat exchanger .

Freshwater Generator (Evaporator)

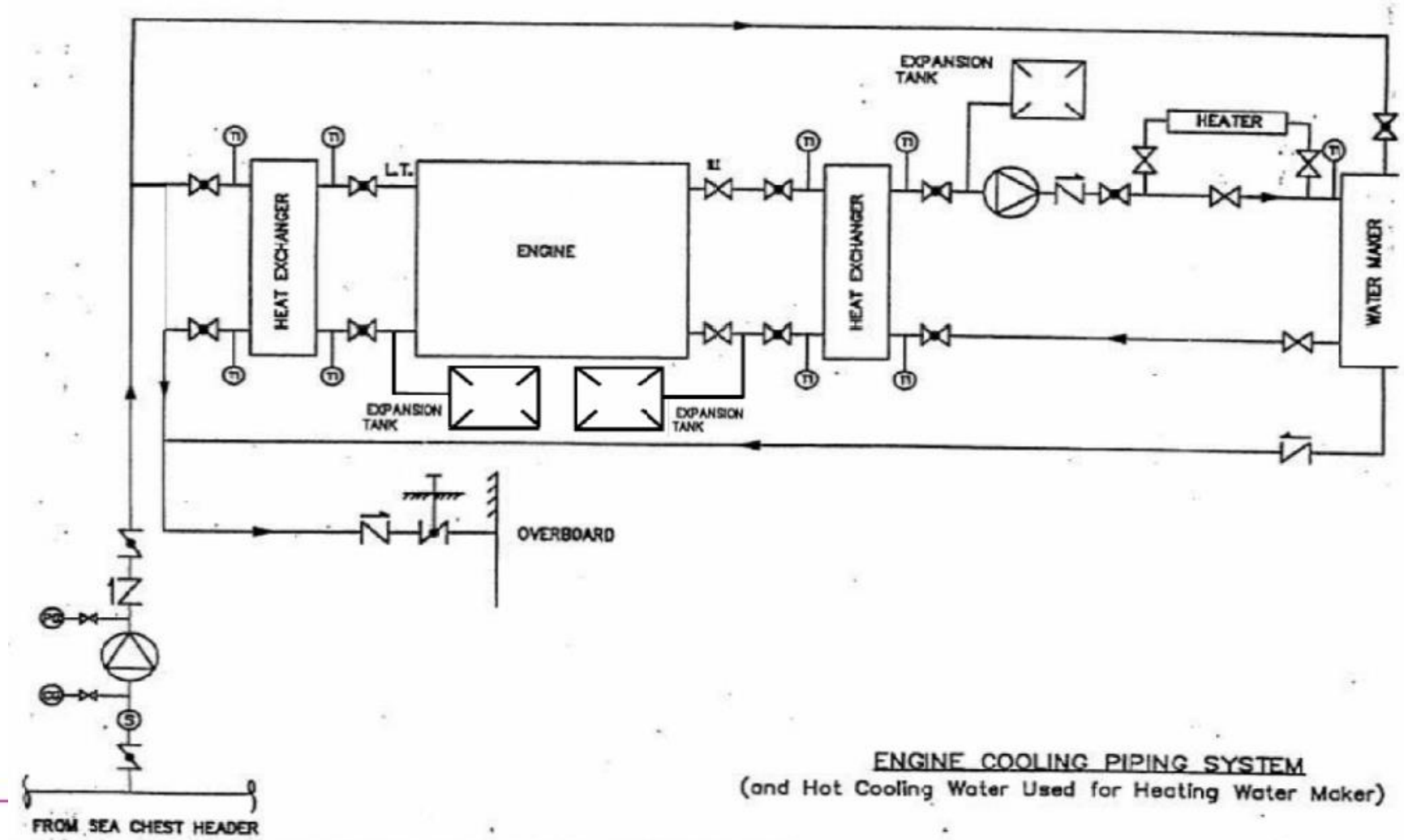
Freshwater Cooler (Plate-type)

Jacket Water **Pump**

Freshwater Header Tank


Typhoon
Domestic
Water
Air
receiver
#1
2.8 MPa
DG
DG
receiver
Emergency compressor
Emergency stop
Turbocharger cleaning
Control air -air spring
2.80 MPa
Slow
turn.
Main
start. valve
Starting
air
#1
#2
lain
compressors
Air
receiver
#2
2.80 MPe

Engine cooling System contd.



ENGINE COOLING PIPING SYSTEM
(and Hot Cooling Water Used for Heating Water Maker)

Engine Exhaust System

- The purpose of this system is to vent out the exhaust gasses to atmosphere from an internal combustion engine.
- The exhaust gases should be kept away from the ventilation intake ducts and walk way area.
- These pipes are to be supported in such a way that the pipes should be free to expand and contract due to temperature change.

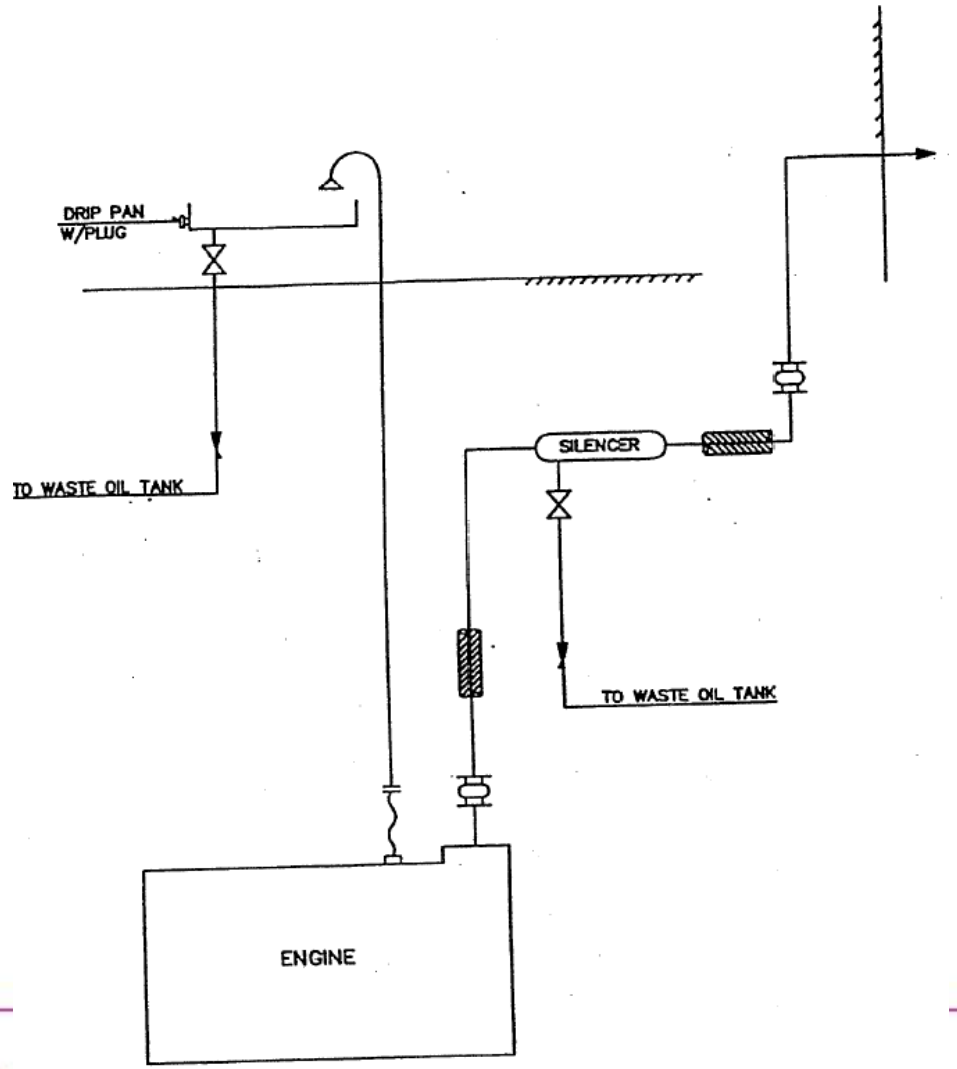
Engine Exhaust System contd.

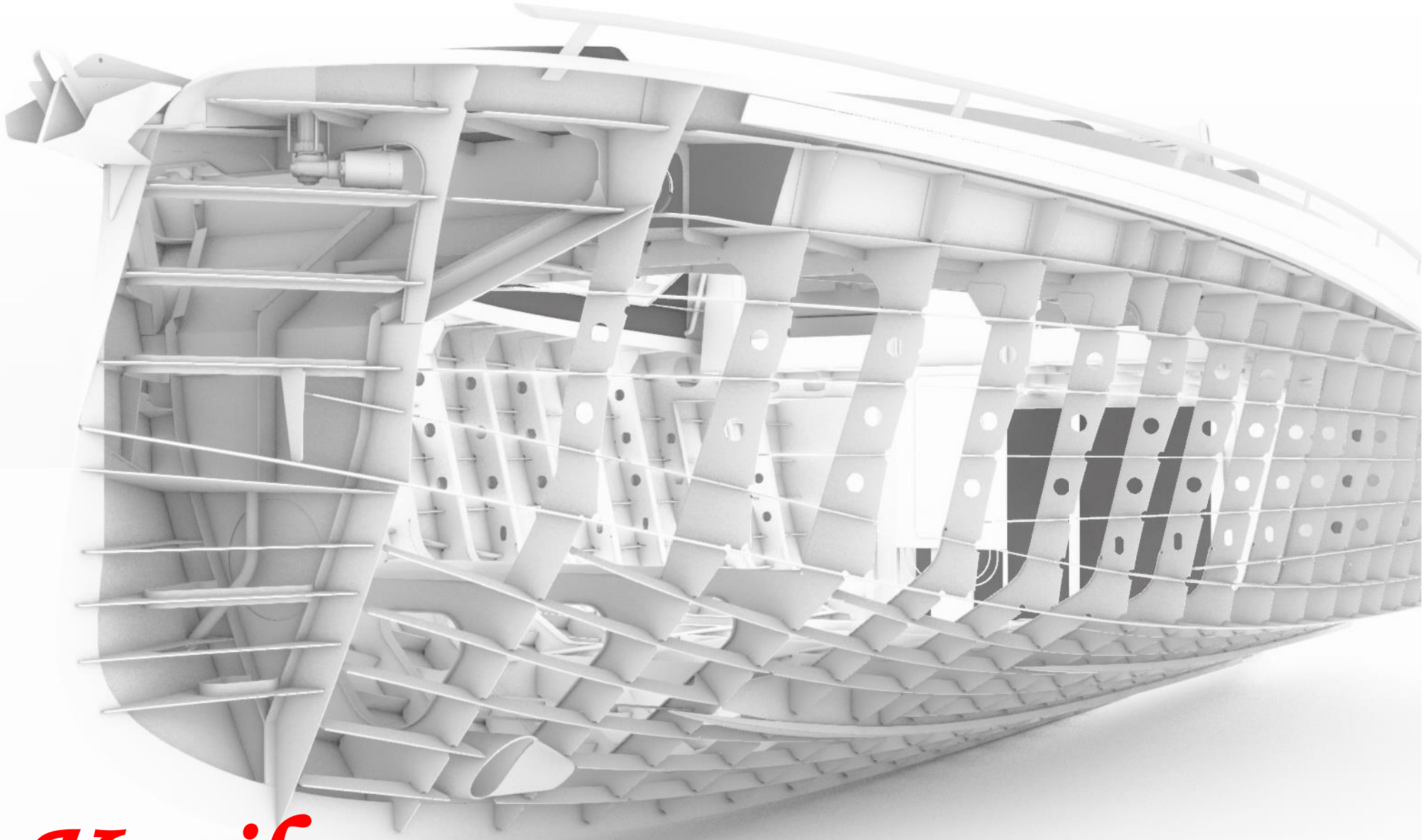
- The System consists of :-

  Spark arresting silencer: It is used to arrest sparks or small flames of fire, which travels along with the exhaust gases produced by the IC engine.

  Expansion bellow: It is used to accommodate the expansion and contraction in Exhaust pipes due to temperature change.

Engine Exhaust System contd.



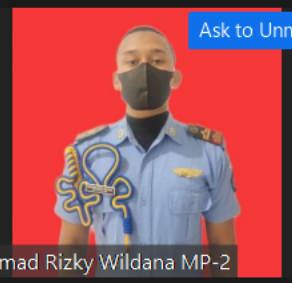


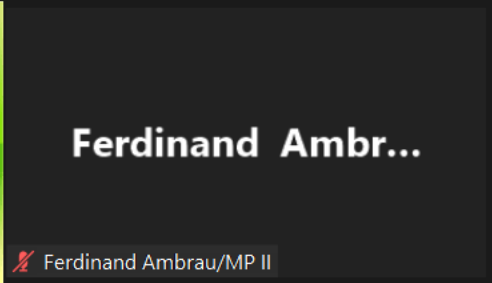
Terima Kasih

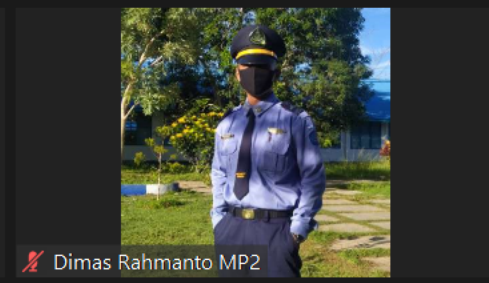
SEMOGA BERMANFAAT

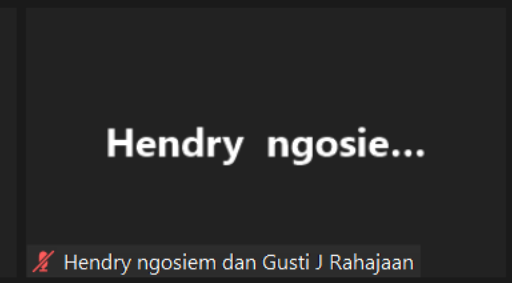
Zoom Meeting

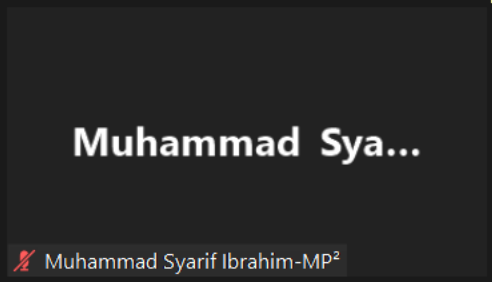
View

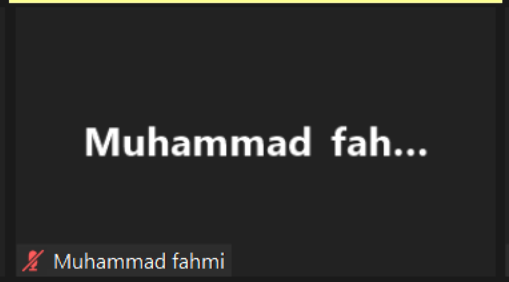


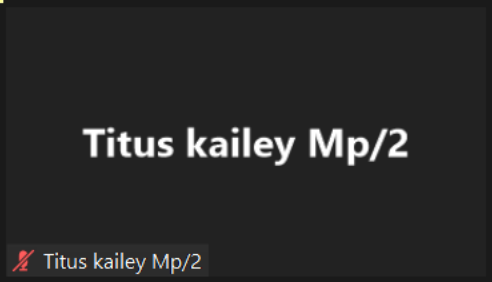


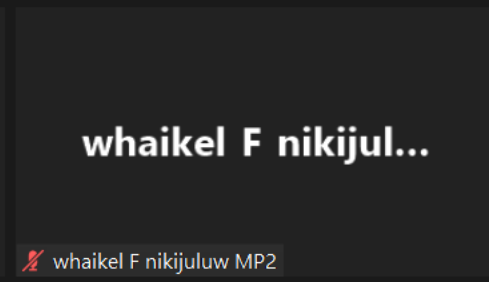


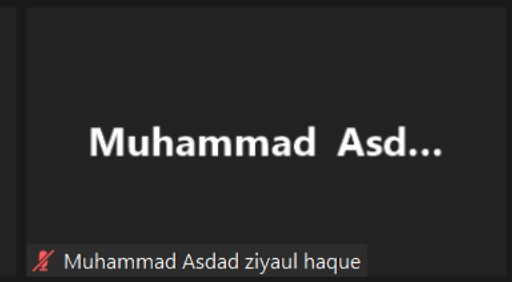


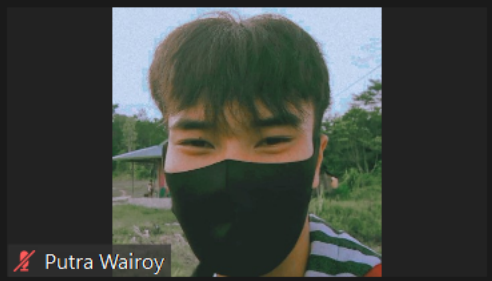


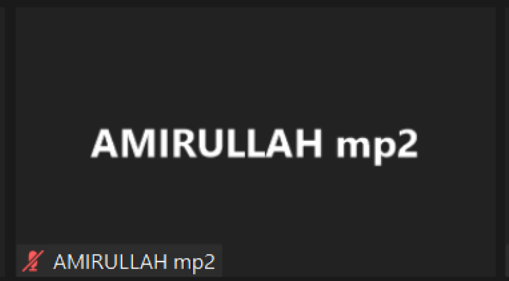


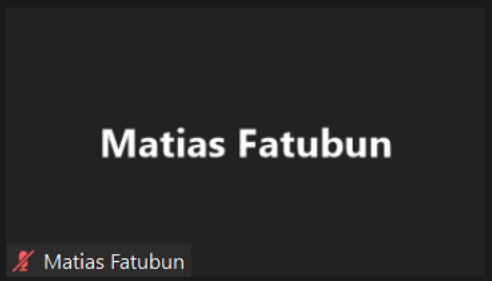


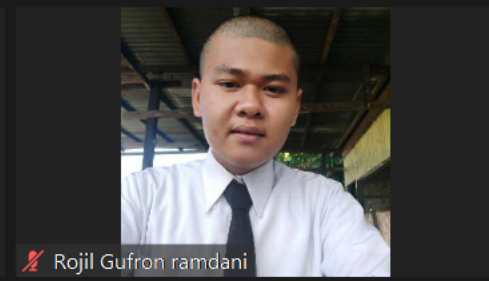












Mute | Start Video | Security | Participants 17 | Chat | Share Screen | Record | Reactions | Apps | End

28°C 15:16 15/09/2021

Zoom Meeting

View

Muhamad Rizky Wildana MP-2

David A Kafiar (MP) II

Dimas Rahmanto MP2

Hendry ngosie...

Hendry ngosiem dan Gusti J Rahaj...

Muhammad Sya...

Muhammad Syarif Ibrahim-MP²

Muhammad fah...

Muhammad fahmi

whaikel F nikijul...

whaikel F nikijuluw MP2

Muhammad As...

Muhammad Asdad ziyaul haque

Putra Wairoy

AMIRULLAH mp2

AMIRULLAH mp2

Matias Fatubun

Matias Fatubun

Rojil Gufron ramdani

JENRY RIFALDO TARPONO (MP 2)

zoom

Zulkarnaen. Yanis

Anthonius Rum...

Anthonius Rumbino (MP).2

Titus kailey Mp/2

Titus kailey Mp/2

Mute | Start Video | Security | Participants 17 | Chat | Share Screen | Record | Reactions | Apps | End

Participants (17)

Find a participant

zoom (Host, me)

AMIRULLAH mp2

Anthonius Rumbino (MP).2

David A Kafiar (MP) II

Dimas Rahmanto MP2

Hendry ngosiem dan Gusti J Rah...

JENRY RIFALDO TARPONO (MP 2)

Matias Fatubun

Muhamad Rizky Wildana MP-2

Muhammad Asdad ziyaul haque

Muhammad fahmi

Muhammad Syarif Ibrahim-MP²

Putra Wairoy

Rojil Gufron ramdani

Titus kailey Mp/2

whaikel F nikijuluw MP2

Invite | Mute All | ...

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