Assignatura: Pràctiques en Vaixell
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INTRODUCTION

The M/V Pacific Dream was constructed in 1988 for Celebrity Cruises, who operated the vessel as the Horizon. The vessel's service with Celebrity ended in September 2005, when it was transferred to Island Cruises as Island Star and had a refit.

In October 2008 Royal Caribbean Cruises, the owner of the Island Star, sold their 50% interest in Island Cruises to First Choice Holidays. Due to this the charter of the Island Star to Island Cruises will end in April 2009 and was then reported to be transferred to the fleet of RCL's Spain-based subsidiary Pullmantur Cruises as Pacific Dream.

The Pacific Dream has 208 m length, 29 m breadth and her summer draft is 7.72 m. Her gross tonnage is 47427 tons and her total power is 27532 HP.

She is registered in Valletta (Malta), her call sign is 9HYZ9 and her IMO number is 8807088.

She has 12 decks and the total capacity is 2448 people (1875 passengers and 573 crew people).
1. PROPULSION SYSTEM. DESCRIPTION AND OPERATION

The propulsion system is compounded in different parts:

- Main Engines
- Coupling
- Reduction Gear
- Propeller
- Bow thrusters and Stern thrusters
1.1. Main Engine

The main engines and the auxiliaries engines of the “M/V Pacific Dream” are Man B & W, their type designation is: L40/54, wherein

\[ L = \text{in-line engine} \]

\[ 40 = \text{cylinder bore in cm} \]

\[ 54 = \text{stroke in cm} \]

The number of cylinders in the engine is placed before the type designation. Thus, the complete type designation of a 6-cylinder engine will be 6L40/54.

“Pacific Dream” has four main engines, their distribution are:

- Port side: Father port and son port
- Starboard side: Father starboard and son starboard

The fathers are 9L40/54 with 5994 kW and the sons are 6L40/54 with 3996 kW at 514 rpm all of them.
The sons have a generator set everyone in this case we can choose to use the sons for propulsion or for electric power, but it is not possible to use for both uses at the same time.

1.1.1. Brief Description

The engine is single-acting four stroke engine of trunk piston design with exhaust gas turbocharger and charge air cooler (intercooler).

The crankcase and cylinder block is a one-piece casting designed to provide extra rigidity. The crankshaft is underslung with the bearing covers fastened to the casing from below and laterally braced to the casing. Largely dimensioned lateral openings provide good access to the crankgear. The oil sump serves as a collector only from where the oil drains into a separate tank.

The bearing shells of the crankshaft bearings are made of steel and have a thin running layer. Two thrust rings fitted to the bearing pedestals before and after the timing gear drive serve, together with the drive gear on the crankshaft in between, as locating bearing.

The cylinder liners are of special cast iron and are inserted into the support rings on the casing from above. They are centered in the support rings and additionally guided in the crankcase and cylinder block. Cooling of the cylinder liners is only in the area of the actual combustion space. Cooling water flows from a line to the support rings, passes around the most upper part of the cylinder liners and the liner collars and further through passage bores in the support rings directly to the cooling spaces in the cylinder heads.
The individual cylinder heads of grey cast iron are secured to the crankcase and cylinder block by 8 bolts and nuts each. Mounted in the cylinder head are two each inlet and exhaust valves, one each starting valve and fuel injection valve. On certain engine versions, a safety valve and an indicator valve are fitted in addition outside on the cylinder head.

The crankshaft is forged and equipped with counterweights on the crankwebs for good mass equilibrium. The driving gearwheel for the timing gear is attached to the crankshaft between the first two bearing points on coupling end.

The torsional vibration damper designed as sleeve spring damper, is mounted to the crankshaft on the free end.

The connecting rod consists of conrod shank, conrod head and bearing cap. Con-rod head and conrod shank are connected by anti-fatigue bolts so that in case of piston removal there is no need of opening up the crank (big end) bearing. Same as the main bearings, the crank (big end) bearings consist of steel shells which bear a thin running layer. The bearing cap is secured to the conrod shank by means of 2 anti-fatigue bolts.
The two-part piston includes a nodular cast iron skirt and a steel type piston crown of high thermal and wear resistance. Both parts are connected by anti-fatigue bolts. For piston sealing, 3 compression rings and 1 oil control ring each are used. The piston pin is floating, axial fixation is taken care of by circlips. The piston is cooled by oil fed through the connecting rods.
The camshaft is arranged laterally in the crankcase and cylinder block. Same as the crankshaft, it is borne in thinly layered steel shells which are attached to the crankcase and cylinder block by the bearing caps. Camshaft drive is effected via gearwheels from the crankshaft. The camshaft again drives the fuel injection pumps and operates the inlet and exhaust valves in the cylinder heads via swinging arms, pushrods and rocker arms.

The inlet valves are equipped with rotators. The valve seat rings installed in the cylinder head are water-cooled.

The exhaust valves are equipped with blades so that the valves are being rotated by the stream of exhaust gases passing by. The cages of the exhaust valves, cooled as far as the valve seat, are permitting valve removal without the need of removing the cylinder head.

The injection pump, one for each cylinder, feeds the fuel through a short pressure line to the injection valve situated in the cylinder head.

All lubricating points of the engine are connected with the forced-feed oil circuit of the engine. For lubrication of the piston running surfaces, lubricating bores are provided in the liners. The oil pressed into the piston crowns serves for cooling the pistons.
Cylinder liners, cylinder heads, exhaust valve cages and exhaust turbocharger are water-cooled. The charge air cooler (intercooler) and the injection valves are provided with separate cooling water circuits.

The engine is equipped with a pneumatic starter. The starting valves in the cylinder heads are pneumatically operated by means of pilot valves.

The operator’s stand is mounted to the engine and allows connection with an automatic operating system. The load or speed as set is controlled by a Woodward governor.

The governor controls engine speed by regulating the amount of fuel supplied to the engine. Speed control can be isochronous (the governor maintains a constant steady-state speed within the capacity of the engine, regardless of load) or droop (the governor speed setting decreases in proportion to increases the load). The PG-EG is designed to control speed within +/- 0.25 percent under either mechanical or electrical control.

![Functional Governor Diagram](image)

PGA-EG governor/actuators have pneumatic speed-reference setting of the ballhead backup governor. This speed setting device can be forward or reverse acting with the backup governor tacking speeds proportional or inversely proportional to signal air pressures. These units are designed to provide speed tracking of the electronic speed setting with the ballhead providing automatic backup should the electronic signal fail.
1.1.2. Operation

The main engines operation depended on the miles and the time that the cruise should be in the next port.

The route started in Santo Domingo every Saturday and the departure was at 20:00 and we had to arrive to Santa Lucia on Monday at 09:00, the distance was 576.3 miles and the required speed was 16.46 knots, in this case we needed all the main engines running.

To go from Santa Lucia to Martinica was in the opposite way because the distance was only 60.6 miles and we only needed 6.21 knots, so, after manœuvring it was necessary one son.

To go from Martinica to Guadalupe, the distance was 117.8 miles and the required speed was 10 knots, so, one father was enough.

To go from Guadalupe to Saint Maarten, the distance was 180.8 miles and the required speed was 16.4 knots, so, it was running two sons and one father.

To go from Saint Maarten to Tortola, the distance was 89.8 miles and the required speed was 7.70 knots and one son was enough.

And finally to go from Tortola to Santo Domingo the distance was 325.3 miles and the required speed was 18.3 knots, so, all main engines were running.

In the manœuvres were necessary all the main engines and after that it was stopped some engine depend on the required speed to arrive to the next port.
1.2. **Flexible Coupling**

The highly flexible coupling is a rubber coupling, flexible in all directions. Its essential parts are the flexible part, the membrane part and the connecting parts. All connecting elements of the coupling are arranged without clearance, so no wear will occur during operation. For this reason the coupling is free of maintenance.

The coupling must be protected against permanent influence of oil and against the radiation of heat. Oil mist and oil splashes are not detrimental. The flexible part is fit for use with ambient temperatures comprised between -50 °C to +80 °C. The segmental construction form of the flexible part guarantees good heat dissipation properties. The free-of-play torque transmission in the coupling and the large sectional rubber area of the flexible part provide good noise attenuation.

Basically, the connection surfaces and the fitted as well as the finish bores of the coupling are protected by Tectyl. Prior to installation, these surfaces must be cleaned by conventional solvents. After the cleaned surfaces are completely dry, they must be greased lightly.

The couplings for the fathers are: VULKAN-RATO-S 4311, and for the sons are: VULKAN-RATO-S 3925.
1.3. **Reduction Gear**

The “Pacific Dream” has four main engines and are divided in two groups: father and son port side main engines that are connected to port side reduction gear and the other group is formed by father and son starboard side main engines and they are connected to starboard side reduction gear.

- **Technical data:**
  - Manufacturer: Lohmann + Stolterfoht
  - Gear type: GVE/L (Stbd. Getriebe) N° 1254
  - Gear size: 1780 mm
  - Ratio: 3,9655 : 1
  - Gear centre distance: 3560 mm
  - Version: C 02
  - Cooling water demand: 38 cbm/h
  - Lubrication group: UU63
  - Oil quantity appr. : 2200 litres
  - Gear weight, appr. : 37000 kg
1.4. Propeller

Technical data:

Manufacturer: Lips

- Propeller
  - Rotational frequency: 130 min⁻¹
  - Direction of rotation: outward
  - Diameter: 5200 mm
  - Mass: 16405 kg
  - Moment of inertia: 20937 J in air

- Blades
  - Number of blades: 4
  - Blade area ratio: 0,613
  - Design pitch ahead: 28,29°
  - Bollard pitch ahead: 18,03°
  - Bollard pitch astern: -14,75
  - Blade material: Cunial
  - Mass of one blade: 2280 kg

- Hub
  - Type: 4C13-3
  - Diameter: 1300 mm
  - Diameter ratio: 0,25
  - Maximum actuating force: 1545 kN
  - Cylinder diameter ahead: 530 mm
  - Cylinder diameter astern: 490
  - Pin excentricity on blade carrier: 260 mm
  - Material: Cunial
  - Mass: 7285 kg
The hub body is cast in one piece and has large blade bearing collars designed to withstand the pin-slot mechanism loading with moderate bearing surface pressure. The blades are connected with the blade carriers by means of bolts. Movement of blades and blade carriers is effectuated by the axially moving cylinder yoke through a slot-pin mechanism. The slots are located in the cylinder yoke whilst the pins are integral with the blade carriers and are provided with high tensile strength bronze sliding blocks.

The cylinder yoke moves axially over two pistons. The forward piston forms an integral part with the tail shaft, the aft piston is integral with the hub body cover. When high pressure oil is pumped to the aft side of the cylinder yoke, this yoke moves forward, resulting in blade rotation with increasing pitch ahead. This cylinder is sealed with an "Eriflon" piston seal, consisting of a NBR Co ring and a PTFE sealing ring.

Based on the characteristics of the pitch actuating torque, low- or medium pressure oil can be pumped to the forward side of the cylinder yoke, resulting in pitch to move astern. A mechanized piston ring acts as seal here.

It is pointed out that both pressure compartments of the cylinder yoke are entirely surrounded by low-pressure hydraulic oil in the hub cavity for hub lubrication. The blade foot seals are synthetic rubber endless cord O-rings which are mounted under the blade-feet. The 0-rings are sized such that with retention of the correct compression rate required for the sealing action, the tolerance in the blade bearing can be absorbed.

The hub oil system is connected to the oil distribution block via the hollow shaft bore. This channel is connected with the header tank via the oil distribution block.
1.5. **Bow thrusters and Stern thruster**

In this section it has been explaining the propulsion system, but I thing that bow thrusters and stern thruster are a part of propulsion system not for sail but they are very important for to go alongside and for the departure. In my opinion they are the propulsion system for the manoeuvres and without them the manoeuvres would be very difficult and dangerous at the same time.

The “Pacific Dream” has two bow thrusters and one stern thruster.

The equipment consists of the following components:

- Tunnel
- Propeller with controllable and reversible pitch blades
- Nacelle with hollow propeller shaft, right angle gear and pinion shaft
- Hydraulic power unit with system components
- Remote control unit with system components
- Prime mover drive through flexible couplings

The propeller hub contains a hydraulic cylinder yoke which actuates the blades by means of a pin-slot mechanism.

The hydraulic oil feeds the cylinder yoke through the pipe in the hollow propeller shaft. This pipe is connected to the cylinder yoke and is mechanically linked to the feedback and pitch transmitting box, which contains two potentiometers. One potentiometer is the feedback to the ECU controller and the other for the independent pitch indication. The set point of the ECU comes from the station-in-command potentiometer.

The hydraulic power unit generates the hydraulic energy necessary for the system.
Technical data (It shows the characteristics of stern and bow thruster respectively)

Manufacturer: Lips

<table>
<thead>
<tr>
<th></th>
<th>Stern Thruster</th>
<th>Bow Thrusters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>CT12H2</td>
<td>CT16H-2P</td>
</tr>
<tr>
<td>Propeller</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diameter (mm)</td>
<td>2200</td>
<td>2500</td>
</tr>
<tr>
<td>Revs (rpm)</td>
<td>251</td>
<td>270</td>
</tr>
<tr>
<td>Blades</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of blades</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Blade material</td>
<td>Ni- Al- Bronze</td>
<td>Ni- Al- Bronze</td>
</tr>
<tr>
<td>Mass of one blade (kg)</td>
<td>151</td>
<td>229</td>
</tr>
<tr>
<td>Hub</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>VBS 6,5</td>
<td>VBS 7,5</td>
</tr>
<tr>
<td>Diameter (mm)</td>
<td>650</td>
<td>750</td>
</tr>
<tr>
<td>Material</td>
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<td>Ni- Al- Bronze</td>
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<tr>
<td>Mass (kg)</td>
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<td>1130</td>
</tr>
<tr>
<td>Nacelle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right angle drive gear</td>
<td>Cast steel</td>
<td>Cast steel</td>
</tr>
<tr>
<td>box with cyclo-palloid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gears</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td>9: 42</td>
<td>9: 39</td>
</tr>
<tr>
<td>Hydraulic system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump, make and type</td>
<td>Sauer-gear pump</td>
<td>Sauer-gear pump</td>
</tr>
<tr>
<td></td>
<td>TPF 200017</td>
<td>TPF 200022</td>
</tr>
<tr>
<td>Pump speed (rpm)</td>
<td>1000</td>
<td>1200</td>
</tr>
<tr>
<td>Pump capacity (dm³/sec)</td>
<td>0,459</td>
<td>0,422</td>
</tr>
<tr>
<td>Operating pressure (bar)</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>Electric motor, make</td>
<td>AEG 112 M</td>
<td>AEG 132 S</td>
</tr>
<tr>
<td>and type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power (kW)</td>
<td>4,6</td>
<td>4,6</td>
</tr>
<tr>
<td>Supply voltage (V)</td>
<td>660</td>
<td>660</td>
</tr>
<tr>
<td>Prime mover</td>
<td></td>
<td></td>
</tr>
<tr>
<td>type</td>
<td>DKSL120H6</td>
<td>DKSL12016</td>
</tr>
<tr>
<td>Power (kW)</td>
<td>1000</td>
<td>1600</td>
</tr>
<tr>
<td>Supply voltage (V)</td>
<td>660</td>
<td>660</td>
</tr>
<tr>
<td>Frequency (Hz)</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Speed (rpm)</td>
<td>1200</td>
<td>1200</td>
</tr>
<tr>
<td>Tunnel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diameter inside (mm)</td>
<td>2245</td>
<td>2545</td>
</tr>
<tr>
<td>Length (mm)</td>
<td>2200</td>
<td>2250</td>
</tr>
<tr>
<td>Wall thickness (mm)</td>
<td>25</td>
<td>25</td>
</tr>
</tbody>
</table>
2. AUXILIARY SYSTEMS. DESCRIPTION AND OPERATION.

2.1. Power System

The power system is formed for the auxiliary engines, for the son port side main engine, son starboard side main engine and for the emergency generator.

2.1.1. Auxiliary Engines

The “Pacific Dream” has three auxiliary engines, Man B & W 6L40/54, 3300 kW at 514 rpm. They have the same characteristics of the main engines but the power is less because the turbochargers are smaller.

How I explained before, the two son main engines have a generator set, but they only can make one function: propulsion or power not both at the same time.

Starboard side Auxiliary Engine

The characteristics of the generator sets of the three auxiliary engines and the two son main engines are:

- Manufacturer: AVK
- Output: 3750 kVA, 3000 kW
- Amperage: 3280 A
- Voltage: 660 V
- Frequency: 60 Hz
2.1.2. Emergency Generator

Technical data:
- Manufacturer: Caterpillar-diesel engine
- Type: 3508 DI-TAU, 8 cylinders, V engine
- Output: 760 kVA, 686 kW at 1800 rpm
- Fuel: MDO class B
- Fuel consumption: approx. 218 gr/ kWh
- Generator manufacturer: Kaick generator
- Type: DKBN 100/M-880-4
- Output: 760 kVA
- Speed: 1800 rpm
- Frequency: 60 Hz

2.1.3. Power Distribution

After to produce the power it has to be distributed to the consumers and not all the consumers are the same.

The big consumers are:
- A. C. Compressors (there are four and they need 750 kW everyone)
- Stern Thruster (1000 kW)
- Bow Thrusters (1600 kW x 2)
- Main Galley (440 kW)
- Shore Connection (440 kW)
- Substations (there are nine substations, the power arrives to them at 660 V and they transform until 230 V to be send to the others consumers)
2.2. Fuel System

The “Pacific Dream” uses for the main engines and for the auxiliaries engines consumption IFO 380, for the emergency generator is diesel oil and for the lifeboats is gas oil.

Tank distribution and capacity:

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Tank</th>
<th>Volume($m^3$)</th>
<th>Ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel oil</td>
<td>DB 9</td>
<td>90,8</td>
<td>78,1</td>
</tr>
<tr>
<td></td>
<td>Day Tk 12 S</td>
<td>12,9</td>
<td>11,1</td>
</tr>
<tr>
<td></td>
<td>Subtotal</td>
<td>103,7</td>
<td>89,2</td>
</tr>
<tr>
<td>Gas Oil</td>
<td>Service Tk 12 S</td>
<td>18,0</td>
<td>15,3</td>
</tr>
<tr>
<td></td>
<td>Emergency daytank</td>
<td>7,5</td>
<td>6,4</td>
</tr>
<tr>
<td></td>
<td>Subtotal</td>
<td>25,5</td>
<td>21,7</td>
</tr>
<tr>
<td>IFO 380</td>
<td>DB 7 P</td>
<td>106,4</td>
<td>103,2</td>
</tr>
<tr>
<td></td>
<td>DB 7 S</td>
<td>106,4</td>
<td>103,2</td>
</tr>
<tr>
<td></td>
<td>DB 8 P</td>
<td>179,8</td>
<td>174,4</td>
</tr>
<tr>
<td></td>
<td>DB 8 S</td>
<td>179,8</td>
<td>174,4</td>
</tr>
<tr>
<td></td>
<td>DB 9 P</td>
<td>89,0</td>
<td>86,3</td>
</tr>
<tr>
<td></td>
<td>DB 9 S</td>
<td>89,0</td>
<td>86,3</td>
</tr>
<tr>
<td></td>
<td>Overflow DB 9</td>
<td>21,0</td>
<td>20,3</td>
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<tr>
<td></td>
<td>Tk 7 P</td>
<td>295,4</td>
<td>286,5</td>
</tr>
<tr>
<td></td>
<td>Tk 7 S</td>
<td>313,3</td>
<td>303,9</td>
</tr>
<tr>
<td></td>
<td>SETTL. Tk 8 P</td>
<td>155,9</td>
<td>151,2</td>
</tr>
<tr>
<td></td>
<td>SETTL. Tk 8 S</td>
<td>155,9</td>
<td>151,2</td>
</tr>
<tr>
<td></td>
<td>Day Tk 8</td>
<td>58,5</td>
<td>56,7</td>
</tr>
<tr>
<td></td>
<td>Subtotal</td>
<td>1750,3</td>
<td>1697,8</td>
</tr>
<tr>
<td>Sludge Tk</td>
<td>DB 8 from separators</td>
<td>19,1</td>
<td>19,1</td>
</tr>
</tbody>
</table>

DB: Double bottom
Tk: Tank.
S: Starboard side
P: Port side
STTL: Settling tank
To purify the IFO 380 and the diesel oil, there are three separators for IFO 380 and one for diesel oil.

Technical data:

- Manufacturer: Alfa Laval
- Type (IFO 380): FOPX 610 TFD-24/60
  - Capacity: 4200 L/h at 98°C
- Type (diesel): MOPX 205 TGT-24/60
  - Capacity: 3300 L/h at 40°C
2.3. **Fresh Water System**

The “Pacific Dream” is a cruise ship, in this case the most important thing on board are the passengers and one of the most important things that the passengers need to be happy is plenty water. Imagine how many liters of water do you need when 1000 or more passengers are going to have a shower.

The distribution of the potable water tanks is this:

<table>
<thead>
<tr>
<th>Tank</th>
<th>Volume(m³)</th>
<th>Ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 P</td>
<td>292,9</td>
<td>292,9</td>
</tr>
<tr>
<td>4 S</td>
<td>292,9</td>
<td>292,9</td>
</tr>
<tr>
<td>5 P</td>
<td>230,1</td>
<td>230,1</td>
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<tr>
<td>5 S</td>
<td>230,1</td>
<td>230,1</td>
</tr>
<tr>
<td>6 P</td>
<td>300,9</td>
<td>300,9</td>
</tr>
<tr>
<td>6 S</td>
<td>300,9</td>
<td>300,9</td>
</tr>
<tr>
<td>13 P</td>
<td>84,8</td>
<td>84,8</td>
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<tr>
<td>13 S</td>
<td>84,8</td>
<td>84,8</td>
</tr>
<tr>
<td>Subtotal</td>
<td>1809,2</td>
<td>1809,2</td>
</tr>
</tbody>
</table>

| Technical water Tk 15 | 134,4 | 134,4 |
| Distilled Tk 15       | 546,8 | 546,8 |

The “Pacific Dream” has two different types of production of water on board: Evaporators and Reverse Osmosis.

2.3.1. **Evaporators**

There are two evaporators that they are located on the compartment number 9, port side evaporator and starboard side evaporator.

These evaporators are a little old and their production is not the same like when they were new.

When they were new the production was 18,5 m³/h and nowadays the production is about 25-30 m³ per watch (every four hours).
The manufacturer is “Serck Como”, type MSF 380/6 plant, is a multi-stage flash type desalination plant with 6 evaporating stages.

Brief description of the evaporating process:

The sea water enters the plant at the stage 6 condenser where it absorbs the latent heat of the steam produced in stage 6 thus increasing its temperature. This procedure is continued through stages 4, 3 etc. to stage 1 whereby the temperature is increased in each stage corresponding to the amount of steam produced in the individual stages. After leaving stage 1 the sea water is led through the brine heater where it is further heated to the brine top temperature.

On entering the stage 1 evaporation chamber, a certain quantity of the sea water evaporates due to the difference in pressure between the inlet and the 1st stage (flush process). In the 2nd stage, a further drop in pressure is encountered and thus further flashing results. This process continues from stage to stage whereby the evaporation intensity depends on the inlet temperature and the saturation temperature in the stage concerned.
The remaining brine in the evaporating chambers flows from stage to stage until it reaches stage where it is drawn off by the brine pump and delivered back to the sea.

The vapor produced in each stage rises from the brine and passes through a demister where brine droplets contained in the vapor are separated and only dry steam is allowed to flow into the condenser where it is condensed on the outer walls of the condenser tubes.

The distillate produced in each condenser is collected at the bottom of the condenser and is led through a downpipe to the main distillate collecting pipe which is directly connected to the distillate pump.

Insert gases produced during the process are drawn off at the individual stage condensers by means of the air ejectors.

The production of the evaporators has two destinations: potable water or technical water.

2.3.2. Reverse Osmosis

The Reverse Osmosis system specified hereinafter, is designed as a single stage, single pass sea water system using the latest generation of Spiral wound thin film composite TFC Membranes.
The raw water is natural water, and has to pass a specific pretreatment system, which removes certain impurities from the raw water and corrects other values to make it suitable to be used as feed water for the Reverse Osmosis system.

The Reverse Osmosis process is divided in three parts:

- Pretreatment
- Reverse Osmosis System
- Posttreatment

2.3.2.1. Pretreatment

The complete pretreatment system can be subdivided in three basic sections:

- Disinfection of raw water
- Removal of suspended matter and colloidal matter
- PH control and scale control

Disinfection of raw water

Although the membrane material is resistant against bacteriological attack and although all biological matter is rejected for more than 99.8%, the raw matter must be disinfected in order to avoid bacterial growth in the membranes.

A continuous disinfection of the raw water by chlorine cannot be used, because the TFC membranes are not chlorine resistant.

Any exposure to chlorine or other strong oxidants will cause an irreversible damage of the membranes.

Therefor the disinfection is achieved by a shock treatment with a high rate of sodium metabisulfite, once every 48 hours for a period of 20 minutes.
Removal of suspended and colloidal matter

In order to remove suspended and colloidal matter from the raw water, the reverse osmosis plant is equipped with three different filters:

- The first step is a multimedia filter system, using a special set of filter media, developed over many years of practical experience with reverse osmosis plants. This filter system will remove any particles, larger than 5 micron. In the back-wash line of this filter system a bag filter is installed to remove any particles larger than 200 µm, which could otherwise clog the internal distribution system of the multimedia filters during a filter back-wash.

- The last step, which serves only as an additional security, is a cartridge filter, loaded with 10 micron wound filter cartridges. This filter will remove any particles, which may have passed through the previous filters, due to any maloperation.

- After passing through the multimedia filter and the cartridge filter, the raw feed water will have a SDI (Silt density index) of < 5 under all conditions and will be suitable as feed water for the reverse osmosis system.

PH control and scale control

The Reverse Osmosis process is a concentration process, similar to evaporation. The concentrated effluent has a concentration of 1,4 till 1,65 times the original feed water salinity. Without any scale control, sparingly soluble salts like calcium carbonate would therefore precipitate on the membrane and reduce the plant performance.
Scale control can be achieved by the injection of a scale inhibitor, or by pH control of the feed water. The injection of an acid into the RO feed stream reduces the feed alkalinity according to the following equation:

\[ \text{HCO}_3^- + \text{H}^+ \rightarrow \text{H}_2\text{O} + \text{CO}_2 \uparrow \]  \[1\]

The additional free carbon dioxide will change the CaO / CO₂ balance and positively avoid calcium carbonate precipitation.

A further advantage of the acid dosing is the fact, that the permeate contains an adjustable amount of free carbon dioxide. Passing the permeate through a remineralizing bed of “juraperle jw” will neutralize the carbon dioxide and increase the hardness of the final product water to any required value as outlined later in this specification.

Handling acids however can be dangerous. A suitable alternative is the use of a sodium metabisulfite solution. Dissolving commercial sodium metabisulfite in water produces a mild acid:

\[ \text{Na}_2\text{S}_2\text{O}_5 + \text{H}_2\text{O} \rightarrow 2 \text{NaHSO}_3 \]  \[2\]

The H⁺ ion of the acid reacts with the dissolved bicarbonates according to equation [1]. The addition of sodium metabisulfite positively avoids carbonate deposits in the reverse osmosis membranes, even when the plant is operated at a slightly positive Stiff & Davis Index.

Further the same chemical is used for the shock disinfection described before and for the long term storage of the TFC membranes, thus reducing the number of different chemicals required for the plant operation considerably.
2.3.2.2. Reverse Osmosis System
After passing through the pretreatment, the raw water is supplied under pressure to the high pressure feed pump P2 of the reverse osmosis system. This pump is designed to generate the required pressure for the operation of the R.O. system.

This pressure is depending upon three factors:

- The mean osmotic pressure of the solution in the membranes, (depending upon raw water temperature, salinity and recovery of the system)
- The net driving pressure, required to produce the design product flow rate.
- The pressure drop in the R.O. system.

The total number of membranes and the number of membranes installed in each pressure tube are determined by three factors:

- The design plant output
- The design recovery rate
- The raw water temperature and salinity

The number of pressure vessels operating in parallel and the number of membranes in each vessel are mainly determined by the design recovery and are slightly influenced by the raw water salinity and temperature.

Standard recovery for a single element is ± 10 %, i.e. a sea water system operating at 40 % recovery will require at least 4 elements operating in series and a number of these banks operating in parallel. The average product flow rate of a 8" TFC element is ± 12 till 15m³/24h.

The product water salinity was given special attention, in order not to exceed the limits for chlorides (< 250 mg/l) and salinity (< 500 mg/l) even under the worst operating conditions (e.g. Caribbean seawater). In order to meet this goal, this design utilizes the latest TFC high rejection membrane, having a minimum salt rejection of 99,7 %.
The RO feed is delivered to all pressure vessels operating in parallel.

The vessels are fabricated according to ASME X specification for a max. operating pressure of 1000 psi (69 bar) and a burst pressure of 6000 psi (413 bar).

After leaving the last element in line, the concentrate is collected in a common manifold. The pressure, which is only slightly lower that the feed pressure, is throttled down in a control valve to atmospheric pressure and the concentrate is discharged to the effluent system.

Product water is taken from all pressure tubes in parallel and collected in a common manifold. Product flow and conductivity are measured and depending upon the product water conductivity, the product is delivered to the product water posttreatment, or - if the conductivity exceeds the alarm set point - the product is diverted automatically to the effluent discharge. In the product water diverting line two non-return valves, with a vacuum breaker in between are provided in order to fulfill the USPH requirements.

For the flushing of the RO membrane system during a plant shutdown with untreated product water and for any chemical cleaning procedure of the membranes a complete cleaning/flushing system, comprising a cleaning solution mixing vessel (V1) together with all required automatic valves and interconnecting pipework is provided. For these procedures the sea water pump serves as cleaning pump.

During every plant shutdown the RO system is as a first step flushed with treated RO feed for several minutes in order to displace any concentrated brine from the membranes. As a second step the system is flushed with untreated permeate from the cleaning vessel V1.

This flushing serves two purposes:

- Displacing the concentrated seawater from the membrane system and
- Disinfecting the membrane system simply by flushing with permeate
The flushing with product water is a simple but very effective method of disinfection, as all bacteria in the membrane system is killed due to the reduced osmotic pressure of the solution and flushed out to the waste.

After the flushing with product water, the system can remain stopped without any further chemical treatment for a maximum of 5 days. For longer shutdown periods, a 0.5 to 1.0 % sodium metabisulfite solution has to be mixed in the mixing vessel for sterilization purposes.

2.3.2.3. Posttreatment

Depending upon the RO feed pH, the product water has a pH value of 5.0 till 6.0, at the outlet of the membrane system.

Even when using a non-acid scale inhibitor, the untreated RO product is aggressive (LSI < 0) and would result in corrosion of carbon steel tanks and piping. A posttreatment to increase the product water pH and langelier index is required.

The simple addition of hydrated lime will raise the pH but will still leave the product water with a LSI of <0, as long as the pH is within the limits for potable water.

A better and less costly method is the use of remineralizing filters. Again some of these filters commonly use a dolomite material. These filters produce a product water with a high pH after any shutdown and in normal operation at low flow rates or at high temperatures. Furthermore the dolomite tends to clog together after periods of shutdown.

For the reasons outlined above, a remineralizing filter using a pure calcium carbonate material (juraperle jw), is provided. This filter will always deliver a product water with a LSI of ±0 and a pH value within the limits for potable water.

With this type of filter it is possible to adjust the desired product water hardness by adjusting the RO feed pH. A value of 3.5 till 4.0 °dH is sufficient to positively avoid corrosion in bare carbon steel tanks and piping.
The filter has to be topped-up when about 10 to 15 % of the filling are consumed. At the same time the filter is back-washed briefly to remove any debris from the filter bed.

An additional post-chlorination is provided to have a chlorine content of 0.2 ... 0.3 mg/l in the product water in accordance with the WHO rules for potable water.

The reverse osmosis system when was new produced 10,4 m³/h, nowadays is producing 14 m³ per watch (every four hours).

The water production on board it wasn’t enough for the consumption of the ship, in this case it was necessary to buy fresh water every day in every different port.
2.4. **Lube Oil System**

The lube oil system is compounded for: lube oil tanks, lube oil coolers and lube oil purifiers.

Lube oil tanks:

<table>
<thead>
<tr>
<th>Tank</th>
<th>Volume(m³)</th>
<th>Ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>M. E. Fat. P. DB 10</td>
<td>12,7</td>
<td>11,4</td>
</tr>
<tr>
<td>M. E. Son P. DB 10</td>
<td>11,2</td>
<td>10,1</td>
</tr>
<tr>
<td>M. E. Fat. S. DB 10</td>
<td>12,7</td>
<td>11,4</td>
</tr>
<tr>
<td>M. E. Son S. DB 10</td>
<td>11,2</td>
<td>10,1</td>
</tr>
<tr>
<td>AUX. E. P. DB 11</td>
<td>10,3</td>
<td>9,3</td>
</tr>
<tr>
<td>AUX. E. CT. DB 11</td>
<td>11,1</td>
<td>10,0</td>
</tr>
<tr>
<td>AUX. E. S. DB 11</td>
<td>11,1</td>
<td>10,0</td>
</tr>
<tr>
<td>L. O. Store DB 11</td>
<td>35,6</td>
<td>32,0</td>
</tr>
<tr>
<td>L. O. Store DB 12</td>
<td>75,6</td>
<td>68,0</td>
</tr>
<tr>
<td>L. O. Overflow DB 10</td>
<td>8,9</td>
<td>8,0</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>200,4</strong></td>
<td><strong>180,4</strong></td>
</tr>
</tbody>
</table>

M. E. Fat. P.: Main engine father port side
M. E. Son P.: Main engine son port side
M. E. Fat. S.: Main engine father starboard side
M. E. Son S.: Main engine son starboard side

DB: Double Bottom

AUX. E. CT.: Auxiliary engine center

L. O.: Lube oil

The Lube oil coolers are beside of engines (main and auxiliaries) and cool down the oil by passing fresh water into the cooler.
And we can find seven lube oil purifiers:

- For the father main engines are: Alfa Laval, WHPX 410 TGD-24/60 and their capacity is 3500 L/h at 90 °C (2 units).
- For the son main engines and auxiliaries: Alfa Laval, WHPX 407 TGD-24/60 and their capacity is 2000 L/h at 90 °C (5 units).
2.5. **Sea Water System**

The functions of sea water on the ship are:

- For the ballast
- To cool down the fresh water into the intercoolers

**Ballast tanks distribution:**

<table>
<thead>
<tr>
<th>Tank</th>
<th>Volume (m³)</th>
<th>Ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fore peak</td>
<td>722,7</td>
<td>740,8</td>
</tr>
<tr>
<td>Deep Tk 2</td>
<td>101,3</td>
<td>103,8</td>
</tr>
<tr>
<td>Deep Tk 3 P</td>
<td>156,0</td>
<td>159,9</td>
</tr>
<tr>
<td>Deep Tk 3 S</td>
<td>156,0</td>
<td>159,9</td>
</tr>
<tr>
<td>DB 7 P</td>
<td>39,4</td>
<td>40,4</td>
</tr>
<tr>
<td>DB 7 S</td>
<td>39,4</td>
<td>40,4</td>
</tr>
<tr>
<td>DB 8 P</td>
<td>113,9</td>
<td>116,7</td>
</tr>
<tr>
<td>DB 8 S</td>
<td>113,9</td>
<td>116,7</td>
</tr>
<tr>
<td>DB 9 P</td>
<td>88,5</td>
<td>90,7</td>
</tr>
<tr>
<td>DB 9 S</td>
<td>88,5</td>
<td>90,7</td>
</tr>
<tr>
<td>DB 10 P</td>
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<td>83,7</td>
</tr>
<tr>
<td>DB 10 S</td>
<td>81,7</td>
<td>83,7</td>
</tr>
<tr>
<td>DB 12 P</td>
<td>28,5</td>
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</tr>
<tr>
<td>DB 12 S</td>
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<td>29,2</td>
</tr>
<tr>
<td>DB 13</td>
<td>122,7</td>
<td>125,8</td>
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<tr>
<td>DB 14</td>
<td>121,5</td>
<td>124,5</td>
</tr>
<tr>
<td>Aft peak P</td>
<td>395,7</td>
<td>405,6</td>
</tr>
<tr>
<td>Aft peak S</td>
<td>395,7</td>
<td>405,6</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>2875,3</strong></td>
<td><strong>2947,1</strong></td>
</tr>
</tbody>
</table>

The other function how I told before is to cool down the fresh water from the main engines and the auxiliary engines by the coolers.
Main Engine Cooler

Auxiliary Sea Water Pumps and Coolers
2.6. **Air Compressed System**

The air system is compounded by compressors and air bottles to store the compressed air.

The compressed air is divided in three groups:

- **Starting Air**
  - The starting air is used for start the main and auxiliary engines.
  - We have 2 compressors for the starting air (working at 860 rpm and they produce 126 m$^3$/h) and 2 bottles to store it (at 30 bar and the capacity is 2000 L every one).

- **Control Air**
  - The control air is used for the devices that work with compressed air.
  - We have 2 compressors for the control air (working at 860 rpm and they produce 135 m$^3$/h) and a bottle to store it (at 8 bar and her capacity is 3000 L).

- **Working Air**
  - The working air is the air that is going around the engine room by pipes and you can connect an air gun to clean or to work with some special tool.
  - We have a compressor for the working air (working at 860 rpm and they produce 138 m$^3$/h) and a bottle to store it (at 8 bar and her capacity is 2000 L).
Air Compressors

Air Compressed Store Bottles
2.7. **Steam System**

The steam system is a very important system because we can give a lot of uses:

- To heat the fuel
- In the main galley is the most important energy to cook
- In the main laundry is used for the drying machines and to iron
- To heat the water for the passenger and crew

We have two different ways to produce steam: by oil-fired water tube boiler and by exhaust gas boiler, but normally it is made in combination.
2.7.1. Oil-fired Water Tube Boiler

We have two oil-fired water tube boilers.

Technical Data:

- Manufacturer: Aalborg marine boilers & engineering a/s
- Type: AQ 21
- Steam production: 8000 kg/h
- Working pressure: 7 bar
- Design pressure: 9 bar

Mode of operation:

The oil burner is burning with a horizontal flame into the furnace room. The hot exhaust gases pass from the furnace room up through the central uptake and up into the convection section, and then leave the exhaust gas boiler.
In the furnace room the temperature is high about 1200 °C. This high temperature and radiation cause that heat is transferred to the furnace tubes, and as they are water filled, steam will be produced in them. This steam is passing upwards, into the steam/water space.

When the hot exhaust gas is passing the convection tubes, heat will be transferred to the same, resulting in a steam production. This steam is likewise rising up into the steam/water space.

Owing to the high temperature in the furnace room, it will be necessary to take care of a sufficient circulation of water through the furnace tubes in order to keep their temperature down. Therefore the AQ 21 boiler is provided with 8 outside downcomers. Through these downcomers water circulates from the water/steam space and to the ring header, where the water is spread out to the place by means of the force of gravity of the water in the downcomers, and the water steam mixture in the furnace tubes and the convection tubes.
2.7.2. Exhaust Gas Boiler

We have five exhaust gas boilers: the manufacturer is Aalborg marine boilers & engineering a/s and the type is AV 8N.

They are divided in this way:

- Father main engines:
  - Units: 2
  - Working pressure: 7 bar
  - Design pressure: 9 bar
  - Steam production: 1700 kg/h

- Son main engine (port side):
  - Units: 1
  - Working pressure: 7 bar
  - Design pressure: 9 bar
  - Steam production: 1100 kg/h

- Auxiliary engines (port side and center)
  - Units: 2
  - Working pressure: 7 bar
  - Design pressure: 9 bar
  - Steam production: 950 kg/h

The AV 8N boiler is a water tube exhaust gas boiler with forced water circulation. The design is based upon many years of experience from use as an exhaust gas economizer in ships. The boiler generates steam solely on the heat extracted from the main engine exhaust.

The boiler may be used in cooperation with an oil fired boiler which acts as steam/water space. Alternatively, a separate steam/water drum is supplied.

The feed water is supplied to either the oil fired boiler or the separate steam/water drum.
The forced circulation in the boiler is secured by a circulating pump between the oil fired boiler or the separate steam/water drum.

The heated steam/water mixture is returned to the steam/water space where the steam is separated.

The boiler heating surfaces are built up of vertical registers carried out of bare steel tubes.

The tube registers, including tube bends and tube supports, are placed in the exhaust gas flow. The tube supports are fixed to the supporting beam at the side, where the inlet and outlet headers are placed. The other supports are not fixed to the respective supporting beams, so thermal expansion is free. The registers are supported in the casing by a heavy steel frame, and connected to the inlet and outlet headers. Necessary inspection doors are provided for inspection between the tube banks. The boiler foundation consists of foot plates giving the necessary support. The casing plate with flat iron is forming the connection to the inlet and outlet exhaust gas boxes.

2.8. **Air Conditioned System**

The a/c system is a very important system when you have a lot of passengers on holidays and in the Caribbean Sea when the temperatures can arrive till 40 ºC.

In this case there are four ABB compressor groups that they are compound by:

- Compressor
- Evaporator
- Condenser
These groups don’t work like an installation on shore, because an installation on shore has an expansion valve and in these groups we don’t have.

Other different thing is: these groups have to cool down plenty liters of water to send that water to all the passengers and crew cabins.

The reason they don’t have an expansion valve is because the compressor is compressing the freon (R 134 a), after it'll evaporate in the evaporator where the evaporator is like a intercooler because it has a lot of small pipes like a collector where the water is passing to be cool down and to be sent to the different places of the ship and finally the freon is condensed in the condenser to be sent to the compressor and start again the cycle.
3. SAFETY SYSTEMS. DESCRIPTION AND OPERATION.

The safety systems are in accordance with the requirements of the SOLAS (International Convention for Safety of Life at Sea).

3.1. Safety Training Program

The safety training program is scheduled every month to program the training for the emergency situations on board.

Every crew member has an action to do in an emergency situation, and everyone has to know how to do their functions perfectly.

In the “Pacific Dream” there is a fire and abandon ship drill every week for all crew, normally is on Monday or Wednesday depends on the month. But there are different drills every day but these are for different groups for specific functions in case of emergency, in that case you have to check what your group is and when you have to do your specific drill.

<table>
<thead>
<tr>
<th>SAFETY TRAINING PROGRAM NOVEMBER 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MONTDAY</strong></td>
</tr>
<tr>
<td>02 St.Lucia</td>
</tr>
<tr>
<td>03 Martinica</td>
</tr>
<tr>
<td>04 Guadaloupe</td>
</tr>
<tr>
<td>05 St. Martinne</td>
</tr>
<tr>
<td>06 Tortola</td>
</tr>
<tr>
<td>07 St. Domingo</td>
</tr>
<tr>
<td>08 At Sea</td>
</tr>
<tr>
<td><strong>TUESDAY</strong></td>
</tr>
<tr>
<td>10 St. Lucia</td>
</tr>
<tr>
<td>11 Martinica</td>
</tr>
<tr>
<td>12 Guadaloupe</td>
</tr>
<tr>
<td>13 St. Martinne</td>
</tr>
<tr>
<td>14 Tortola</td>
</tr>
<tr>
<td>15 St. Domingo</td>
</tr>
<tr>
<td>16 At Sea</td>
</tr>
<tr>
<td><strong>WEDNESDAY</strong></td>
</tr>
<tr>
<td>17 St. Lucia</td>
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<tr>
<td>18 Martinica</td>
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<td>19 Guadaloupe</td>
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<td>20 St. Martinne</td>
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<tr>
<td>21 Tortola</td>
</tr>
<tr>
<td>22 St. Domingo</td>
</tr>
<tr>
<td>23 At Sea</td>
</tr>
<tr>
<td><strong>THURSDAY</strong></td>
</tr>
<tr>
<td>24 St. Lucia</td>
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<td>25 Martinica</td>
</tr>
<tr>
<td>26 Guadaloupe</td>
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<tr>
<td>27 St. Martinne</td>
</tr>
<tr>
<td>28 Tortola</td>
</tr>
<tr>
<td>29 St. Domingo</td>
</tr>
<tr>
<td>30 At Sea</td>
</tr>
</tbody>
</table>

Safety Training Program November 2009
3.2. Fire Extinguish Elements

There are two groups of fire extinguish elements:

- Permanent elements
- Portable elements

3.2.1. Permanent Elements

The permanent elements are the elements that are installed in the ship and we can operate but we can't bring from one place to other place.

We have three different types of permanent elements:

- Fire Hydrants
  - The extinguisher agent is sea water that comes by emergency sea water pump.
  - The fire hydrants with fire hoses and lances are located all over the ship in the fire stations.

- Hi-fog Sprinklers
  - The extinguisher agent is sea water that comes by emergency sea water pump.
  - They are located in all the places of the ship where they can’t cause problems (very big electrical problems) with their use.

- FM 200
  - The extinguisher agent is \( \text{CF}_3\text{CHFCF}_3 \)-heptafluoropropane.
  - Is a substitute of \( \text{CO}_2 \). Is a compound that consists of carbon, fluorine and hydrogen. It is colorless, odorless and electrically non-conductive.
  - This installation is to use in the engine room only.
3.2.2. Portable Extinguishers

The advantage of those elements is we can bring everywhere we want.

We have three different types of portable extinguishers:

- **ABC / Dry Powder**
  - Suitable for A, B and C class fires
  - They are red and small and they have labeled “powder” in blue

- **CO₂**
  - Suitable for C class fires and fires involving electricity
  - They are red and big

- **Foam**
  - Suitable for B class fires
  - They are cream color

3.3. Lifesaving Elements

We have four different elements:

- **Life Jackets**
  - There is one life jacket for each person on board plus a spare of 5% children life jackets and 10% adult life jackets.

- **Life Rings**
  - Located all over the open decks
  - There are 24 pieces
- **Lifeboats**
  - There are 14 motorboats with a total capacity of 1848 people.
  - They are located in deck 9, 7 motorboats at port side (even numbers) and 7 at starboard side (odd numbers). In case of abandonment they will be lowered to deck 8.

- **Liferafts**
  - There are 49 liferafts with 25 people capacity each, and a total capacity of 1225 people.
  - They are located on deck 9 forward (port side: 13 pieces and starboard side: 14 pieces) and deck 8 aft (11 pieces for port side and starboard side).
4. POLLUTION PREVENTION SYSTEMS.
DESCRIPTION AND OPERATION.

The actions and the systems are in accordance with the requirements of the MARPOL 73/78.

4.1. Garbage Treatment on Board.

In a cruise ship there are a lot of people, so, it generates a lot of garbage every day.

In the “Pacific Dream” the garbage was separated in seven groups:

- Paper
  - It was burned in the incinerator.

- Plastic
  - It was stored and discharged to shore to be recycled.

- Glass
  - It was stored and discharged to shore to be recycled.

- Tins
  - It was stored and discharged to shore to be recycled.

- Food
  - It was pulped and threw to the sea for the fish.

- Medical waste
  - It was stored and discharged to shore to special company of medical waste.

- Others
  - It was stored and discharged to shore.
4.2. Bilge Water Separator

Bilge water separator or “turbulo separator” technical data:

- Manufacturer: Blohm+Voss AG
- Type: TPC H
- Capacity: 3600 L
- Rate: 10 m³/h
- PPM Limit: 15 ppm

The turbulo separator is designed as a gravity separator in which oil is separated in two stages from the bilge and ballast water, utilizing the different specific gravities (except chemical and stable emulsions). The oil/water mixture is pumped into the first stage through the inlet socket (C), where a preliminary de-oiling takes place.

Following this initial de-oiling in the first stage the oil/water mixture passes through the second stage, which is filled with a special coalescing material (10), for final de-oiling. The separated oil which has risen in the first stage (coarse separating space) is discharged from the separator through the oil outlet (A).
A compressed-air actuated 2/2 way-valve (13) on the outlet (A), controlled by an automatic oil drain system via a solenoid valve (12) regulates the oil discharge. Viscous oil is heated by a steam or electric heating (5), provided in the upper part of the separator to improve its flow properties. Venting is accomplished by a separate vent valve (3) arranged on the dome.

The coalescing material is corrosion-resistant, is oelophilic and has a large free volume. This prevents clogging of the material.

In addition to the parts already mentioned, the separator is provided with a switch cabinet (8), an electrode (2) for control of the oil discharge, filling socket (E), sampling cock (4) gauge (6), safety valve (7) and sludge discharge socket (F). Further, the HDW eccentric helical rotor pump, the capacity of which is designed to suit the separator, constitutes an integral part of the system.

The sludge produced by the bilge water separator, fuel oil separators and lube oil purifiers was discharged every week by a special company to treat it.
4.3. **Grey Water System**

Grey water is the water that comes from the showers, basins from the bathrooms and galleys and from the washing machines.

All this grey water comes by gravity to 8 small tanks of 12 m$^3$ every one and when are full, by a floating switch and a pump is discharged to the main grey water tanks.

There are three main grey water tanks:

- 8 Port side: 114 m$^3$
- 8 Starboard side: 114 m$^3$
- 13: 123 m$^3$

During all the day when the ship is alongside, these tanks are filling but when the ship starts to sail and arrive to 12 miles far from shore, this grey water is pumped out to the sea.

4.4. **Black Water System**

The black water comes from the toilets and need a treatment before to pump out the ship. We need vacuum units to suck the black water from the toilets.

![Vacuum Unit](image-url)
There are three vacuum units, the same number of sewage treatment plants.

The vacuum units produce vacuum with the circulation of the black water and with an ejector.

When the vacuum unit has a high level, by a floating switch and a pump, the black water is pumped to the sewage treatment plant to be treated.

Technical Data:

- Manufacturer: Triton-Format
- Capacity: 300m³/day

The purpose of the treatment plant is to reduce the environmental pollution by untreated waste water.

The treatment unit consists of:

- Aeration section
- Settling section
- Disinfection section
Aeration section

In the aeration section mainly organic matters as connections from hydrogen, carbon and sulfur will be transformed by aerobe bacteria to carbon dioxide and water.

By reducing the organic matters the aerobe bacteria reproducing themselves.

They are only possible to stay alive in liquids with enough oxygen in it.

The necessary oxygen will be transferred to the waste water by membrane aerators fitted on the tank bottom and powered by means of a blower.

The amount of the air supply to the individual aeration units is regulated by means of the gate valves on the distribution pipe on top of the unit. The capillary distribution of the oxygen is carried out by means of membrane aerators. The membrane aerators are installed on the bottom of the tanks.
Settling section

Via the internal overflow made of PVC-piping, the oxygen-enriched sewage flows into the final settling section, which, advantageously, is funnel-shaped and a quiet section without any turbulence.

During this second phase of the treatment, the activated sludge settles on account of the weight differences while the process of biological degradation continues.

On the bottom of the chamber there are nine sludge lifters which use compressed air to convey the sedimented activated sludge (bacteria) back into the aeration chamber. This compressed-air feeding is carried out in synchronization over nine solenoid valves mounted on the top of the sewage treatment plant.

Sludge which is not conveyed to the aeration section stay on the bottom, become anaerobe and float up to the upper surface of the settling tank.

In the upper part there is an overflow to the disinfection chamber and two skimmers sludge lifters.

The sludge will be transferred by this skimmer sludge lifters which use compressed air to convey the sludge back into the aeration chamber. This compressed-air feeding is carried out with two solenoid valves mounted on the top of the sewage treatment plant.

Disinfection section

To destroy unhealthy bacteria, the supply of a certain amount of chlorine in the disinfection section is provided. The amount should be calculated such that the remaining chlorine-residual values are between 1-3 mg/l. One aerator of the same type as for the aeration section is installed on the bottom of the disinfection section, such that a good mixture is guaranteed of the chlorine with the purified sewage. The regulation is carried out by means of a manual valve on the top of the sewage treatment plant.

The emptying of the disinfection tank is carried out by pumps. Two pumps are provided for each plant. The operator selects one of these two service pumps as the service pump.
5. CONCLUSIONS

This memory shows how productive was my experience in the cruise ship “Pacific Dream”. In my opinion is one of the best experiences that I’ll ever have, not only for having been working in the Caribbean, to work in the field that I was studying and comparing the theory with the practical, to work with people from over the world and to improve my English.

In conclusion, I think that all the people have to embark and feel this sensations.
6. BIBLIOGRAPHY

- Man B & W handbook
- Vulkan handbook
- Lohmann + Stolterfoht handbook
- Lips handbook
- Caterpillar handbook
- Alfa Laval handbook
- Evaporator handbook
- Reverse Osmosis handbook
- Aalborg marine boilers & engineering a/s handbook
- Familiarization for crew manual
- Bilge water separator handbook
- Sewage Treatment Plant handbook