APPENDIX N

6.3 Water Systems

Illustrations

6.3 WATER SYSTEMS

6.3.1 Fresh Water Evaporator Plant

Evaporator

Maker:	Serck Como
Model:	MSF 740-7
Type:	7 stage flash evaporator
No. of sets:	3
Capacity:	740 tonnes/day

Evaporator Sea Water Pump

Maker:	Pompe Garbarino S.p.A
Type:	MU 200/315
Capacity:	530m³/h at 4.4kg/cm²
Motor rating:	440V, 110kW, 1,750 rpm

Evaporator Brine Pump

Maker:	Serck Como
Type:	NT 200-400
Capacity:	500m³/h at 2.5kg/cm²
Motor rating:	440V, 42.2kW, 1,750 rpm

Evaporator Ejector Pump

Maker:	Pompe Garbarino S.p.A
Type:	MU 80-400L
Capacity:	105m³/h at 6.5kg/cm²
Motor rating:	440V, 37kW, 1,750 rpm

Distillate Pump

Maker:	Allweiler
Type:	CLT50-315
Capacity:	33m³/h at 5kg/cm²
Motor rating:	440V, 8.7kW, 1,750 rpm

Condensate Pump

Maker:	Serck Como
Type:	NB 25 - 200/1
Capacity:	9m³/h at 4.0kg/cm²
Motor rating:	440V, 3.4kW, 3,500 rpm

Recirculation Pump (Unit No.3 only)

Maker:	Pompe Garbarino S.p.A
Type:	MU 150-250
Capacity:	340m³/h at 2.5kg/cm²
Motor rating:	440V, 37kW, 1,750 rpm

Introduction

Three fresh water generators are provided. These are of the flash evaporation type where heating of the sea water feed takes place outside the evaporator unit. All evaporators are identical, but two of the evaporators, No.1 and No.2 are supplied with sea water feed which has been heated by means of the waste heat in the diesel engine cooling water. The other unit, No.3, employs heating from the steam system. Heat from the diesel engine jacket cooling systems is supplemented by steam heating as necessary. Sea water feed to the evaporators is heated externally in a sea water heater and the heated sea water is then passed into the evaporator chamber by way of a motor controlled valve. The chamber is maintained at a low pressure and so when the sea water enters the chamber it rapidly evaporates as its temperature is above the evaporation temperature corresponding to the pressure in the chamber. This is the principle of flash evaporation.

During evaporation, gases dissolved in the sea water are liberated and these can destroy the vacuum. The low pressure evaporator is fitted with an air ejector system to keep the pressure in the evaporator chamber low enough to allow for evaporation. There are no heat transfer surfaces on which salt scale can form during evaporation because of the external heating, so it is possible to evaporate more of the sea water without risk of scale causing deterioration in performance. After initial evaporation, the temperature of the sea water cools but this sea water is then passed into a chamber maintained at a lower pressure and so further evaporation takes place. The flash evaporators have seven evaporation chambers, each maintained at a successively lower pressure and evaporation can take place in each stage without further heating of the sea water. Brine from the seventh stage is removed by means of a brine pump. This brine can be pumped overboard or some can be mixed with the incoming sea water feed in order to maintain the desired sea water feed temperature.

Sea water feed is supplied to the evaporator by the sea water pump and this sea water, after mixing with the outgoing brine if necessary, passes through the condensing coils in each stage thereby extracting heat from the vapour as it is condensed. The heated sea water then passes through the sea water heater before entering the evaporator chamber.

The vapour produced by evaporation in each stage passes through a demister screen which removes any salt water particles. It is then condensed in a chamber above the evaporation chamber. The condensate, or distilled water, produced in each stage flows through to the final stage due to the reduction in stage pressure and is removed by the evaporator distillate pump and cooled in the distillate cooler before passing to the distilled water storage tanks.

The sea water feed is heated to the brine top temperature (BTT) of 78°C. The use of remix brine enables the temperature of the sea water at the inlet to the evaporator to be maintained at 32°C. A maximum recirculation of 80% brine is allowed. In order to maintain the required brine top temperature, the sea water is heated in the sea water heater by the diesel engine HT cooling water for the No.1 and No.2 units or by circulated hot water for the No.3 unit. If the associated diesel engine is operating at a reduced load, the booster heater uses steam to increase the HT cooling water temperature in order to achieve the desired BTT. In the case of the No.3 unit, steam is supplied to the booster heater to ensure the correct circulating water temperature in order to obtain the correct BTT in the sea water.

There are two air ejectors fitted to each evaporator and these are of the venturi type with sea water used as the driving fluid to eject the gases from the evaporator chamber. Most of the dissolved gases are liberated from the brine in the first stage and this has an ejector of its own. Vacuum is maintained in the subsequent stages by the second ejector which has its suction located at the final stage. There is a separate ejector pump and water leaving this pump first flows through the distillate cooler before it reaches the air ejectors. Discharge from the ejectors is overboard.

Distilled water production depends upon the BTT and this depends upon diesel generator load and the heating available from the steam supply to the booster heater. The control system adjusts the supply of heated sea water to the evaporator first stage chamber depending upon the BTT, if the value of 78°C is not reached. The control system automatically adjusts the flow rate of heated sea water to the evaporator first stage chamber to compensate for any reduced sea water temperature. The distilled water pump removes the condensate from the evaporator and pumps it to storage via a cooler. If the salinity of the distilled water is too high, the control system temporarily operates the distilled water three-way valve and dumps the distilled water overboard. When the salinity returns to an acceptable level the distilled water is diverted to the storage system. Once set up and working, the evaporators will operate automatically and produce distilled water at the maximum rate allowed by the heating system. Very low sea water inlet temperatures may restrict water production as the flow rate of the sea water to the evaporator will be reduced in order to compensate for a reduced inlet temperature below the maximum of 78°C.

Chemical dosing of the sea water feed is used to prevent deposits inside the heat exchanger. Dosing chemicals, diluted with distilled water from the evaporator outlet, are introduced into the sea water pump suction line. The chemicals prevent the formation of salt scale inside the heat exchanger and the interstage condensers through which the sea water flows. The dosing rate recommended by the chemical supplier must not be exceeded. The dosing rate is obtained by adjusting the stroke of the dosing pump.

(**Note:** The recommendations of the chemical manufacturer must be studied carefully with respect to the setting of the dosing pump stroke and the dilution of the chemical with distilled water in the dosing tank.)

CAUTION

The evaporator plant must not be used for producing distilled water for domestic consumption when operating in restricted waters near coasts or estuaries.

The evaporators may be operated from the local control panel or via the IMACS workstations. Remote manual starting and stopping of the evaporators is possible through the IMACS. The distilled water production and transfer system is controlled and monitored via IMACS mimic 4B-101 Evaporator Overview. Each evaporator has its own mimic display through which it may be operated and monitored:

- No.1 evaporator - mimic 4B-201
- No.2 evaporator - mimic 4B-202
- No.3 evaporator - mimic 4B-203

The local operator panel should be thoroughly understood by any personnel involved in operating the evaporators or changing their configuration. The operating program set for the evaporator should not be changed unless there is a justifiable reason. Under normal circumstances, operating an evaporator from its local panel is simply a case of activating the switches and buttons after a check has been made that the valves are set correctly. To start an evaporator locally, the main switch must be turned to the ON position, the key switch set to the LOCAL position and the START pushbutton pressed. To stop an evaporator, the SHUT DOWN pushbutton must be pressed. To start an evaporator from the IMACS mimic screen, the main control panel mains switch must be in the ON position, the key switch set to the REMOTE position and the START soft key must be pressed at the mimic. To stop an evaporator, the STOP soft key must be pressed.

Procedure for Operating the No.1 Evaporator

This procedure assumes that the plant is in a cold condition.

a) Check that no restrictions apply to the operation of the evaporator.

b) Ensure that electrical power is available at the evaporator control panel and that the valves to all instruments and gauges are open.

c) Select REMOTE operation at the evaporator control panel. Ensure all pump selector switches are in AUTO.

d) Ensure that water is circulating in the HT CFW system and that it is at the correct temperature. Supply steam to the booster heater and ensure that the steam supply valve is under the control of the evaporator control system. Ensure that the circulation pump is available. Check that the steam supply valve is under the control of the evaporator control system.

e) Fill the chemical dosing tank with distilled water or fresh water from the potable water system and add the quantity of chemical indicated by the chemical supplier. Agitate the tank to ensure correct mixing.

f) Set the evaporator sea water system as in section 2.4.6.

g) Set the evaporator manual valves as shown in the following table. Many evaporator valves are motor operated and under the control of the evaporator control system:

Position	Description	Valve
Operational	HT inlet valve	M01VPG
Operational	HT bypass valve	M02VPG
Open	HT outlet valve	107VPG
Open	HT inlet vent valve to expansion tank	196VPG
Closed	HT vent to atmosphere valve	197VPG
Open	Booster heater vent valve to expansion tank	
Open	Recirculating pump outlet valve	B15
Operational	Steam inlet valve	MV13
Operational	Steam inlet control valve	RV3
Operational	Condensate outlet valve	RV4
Closed	Chemical cleaning outlet valve	V51
Closed	Chemical cleaning inlet valve	V52
Open	Chemical cleaning isolating valve	B3
Closed	Chemical dosing tank filling valve	V48
Closed	Chemical dosing tank drain valve	V49
Open	Booster heater vacuum valve	V46
Operational	Evaporator vacuum breaking valve	MV12
Open	Evaporator vacuum breaking valve	V45
Open	Distillate cooler distillate inlet valve	B10
Open	Distillate cooler distillate outlet valve	B11
Closed	Distillate cooler distillate bypass valve	B12
Closed	Stage fresh water drains (x7)	
Closed	Stage sea water drains (x7)	
Open	No.1 evaporator distillate outlet valve	671VPG
Open	Control air isolating valves (x2)	

For No.3 Evaporator Only

Position	Description	Valve
Open	Recirculating pump inlet valve	173VPG
Open	Recirculating pump outlet valve	174VPG
Closed	Heating water drain valve	179VPG
Open	Heating water return valve	178VPG
Open	Heating water tank suction valve	175VPG
Closed	No.3 evaporator expansion tank sampling valve	176VPG
Closed	No.3 evaporator expansion tank drain valve	177VPG

h) At the evaporator IMACS mimic 4B-201, start the evaporator by pressing the START soft key.

i) Check that the evaporator starts and ensure that the evaporator ejector pump, evaporator sea water pump, dosing unit pump, evaporator brine pump and evaporator distillate pump all start. In the case of evaporator No.3, ensure that the booster heating system is operating correctly.

j) Check that the evaporator ejector pump has reduced the evaporator chamber pressure to the required level. Check that the ejectors can maintain that pressure.

k) The control system will regulate the flow of heated sea water to the evaporator depending upon the temperature of the sea water at the evaporator inlet. It will adjust the steam supply to the booster heater as necessary and also the amount of brine remix.

l) The control system will control the rate of discharge of distilled water depending upon the level of production. It will divert the distilled water overboard until the salinometer confirms that the salinity is below the minimum acceptable level.

m) When the salinity reaches an acceptable level, the three-way control valve will discharge the distilled water into the potable water system.

CAUTION

The level of dosing chemical added must be monitored carefully and details recorded. Under certain sea water conditions, foaming in the evaporator may occur and this requires the addition of anti-foaming chemicals to the dosing tank. The instructions provided by the chemical supplier must be studied carefully before chemicals are used.

6.3.2 Distilled Water Transfer System

Feed Water Transfer Pump

Maker:	Pompe Garbarino S.p.A
Type:	Centrifugal self-priming
Model:	MU 32/200LP
No. of sets:	2
Capacity:	10m³/h at 2.0kg/cm²
Rating:	440V, 3.6kW, 1,750 rpm

Distilled and Potable Water Tank Capacities

Tank	Capacity
Port distilled water double bottom tank	34.3m³
Starboard distilled water double bottom tank	34.3m³
Boiler distilled water double bottom reserve tank	79.1m³

Introduction

Distilled water made in the three evaporators is transferred to distilled water storage tanks on the ship and also to the potable water tanks. Distilled water may also be supplied to the tanks from shore or barge facilities via connections at the port and starboard bunker stations.

As the distilled water is produced at low temperature, all bacteria may not have been destroyed and so an ultraviolet steriliser is used to sterilise the distilled water. This unit is used on all evaporator manufactured water. The distilled water is then passed through a mineralising filter before being discharged to either the distilled water filling line or the potable water storage tanks. A water softener is located in the distribution line to the distilled water tanks.

Distilled water is used in the machinery spaces as technical water and is supplied to the technical distilled water system by means of a hydrophore unit. This unit is supplied by the two distilled water transfer pumps which draw water from either the port or starboard double bottom distilled water tanks. The unit is automatic and works on a pressure switch arrangement. This system is described in section 6.3.5. Distilled Water Service System.

Distilled water which is to be used as boiler feed water is supplied to the respective hot wells also using an independent hydrophore system. This system is fed by the feed water transfer pumps which can draw water from all three distilled water storage tanks, although they are usually fed from the distilled water double bottom reserve tank. The unit is automatic and works on a pressure switch arrangement. From the hydrophore unit, the water is supplied to the respective hot wells as required through automatic motorised valves which are operated by a level controller in the respective hotwell. A bypass valve is provided for use should the motorised valve fail.

Both feed water transfer pumps can also be used to transfer the contents of the three distilled water reserve tanks to each other and also ashore if required.

The IMACS Evaporator Overview mimic 4B-101 and the Distilled Water System mimic 5A-104 provide monitoring of the distilled water transfer system and control facilities for the remotely operated valves.

Procedure for Supplying Distilled Water to the Distilled Water and Boiler Reserve Tanks from the Evaporators

a) Ensure that the evaporator(s) are functioning correctly.

b) Check the quantity of water in the tanks and estimate the time needed to transfer the quantity required.

c) Check that the valves to all instruments and gauges are open.

d) Set the valves as shown in the following table:

Position	Description	Valve
Open	Distilled water outlet valve from No.1 evaporator	671VPG
Open	Distilled water outlet valve from No.2 evaporator	672VPG
Open	Distilled water outlet valve from No.3 evaporator	673VPG
Open	UV steriliser inlet valve	FB161
Open	UV steriliser outlet valve	FB160
Closed	UV steriliser bypass valve	FB162
Open	No.1 mineralisation unit inlet valve	FB159
Open	No.1 mineralisation unit outlet valve	FB150
Open	No.2 mineralisation unit inlet valve	FB156
Open	No.2 mineralisation unit outlet valve	FB149
Open	No.3 mineralisation unit inlet valve	FB153
Open	No.3 mineralisation unit outlet valve	FB148
Closed	Mineralisation unit bypass valve	FB163
Closed	Mineralisation unit outlet to the potable water system valve	FB143
Open	Mineralisation unit outlet to the distilled water system valve	FB144
Open	No.1 water softener unit inlet valve	FB167
Open	No.1 water softener outlet valve	FB166
Open	No.2 water softener unit inlet valve	FB169
Open	No.2 water softener outlet valve	FB168
Closed	Water softener unit bypass valve	FB170
Closed	Distilled water bunker system line valve	684VPG

e) Bring the evaporator plant on line as described in section 6.3.1 and check that they are supplying distilled water to the distilled water distribution system.

f) The above arrangement supplies distilled water from the evaporators to the distilled water tanks via the UV steriliser and treatment plant.

g) From the IMACS Distilled Water System mimic 5A-104, open the remotely operated filling valves for the distilled water tanks (as shown in the following table) as required. When the tank is filled to the required capacity, the filling valve is closed.

Description	Valve
Port distilled water double bottom tank remote filling valve	681VPJ
Starboard distilled water double bottom tank remote filling valve	683VPJ
Boiler feed water double bottom reserve tank remote filling valve	682VPJ

6.3.3 Water Treatment Systems

Potable Water Treatment System

Maker: Culligan Italiana S.p.A

Mineralising Filters

Model: Hi Flo 6 Cullneu UU 72 Special
Type: pH neutralisation and remineralisation by calcium and magnesium salts
No. of sets: 3
Capacity: 35m³/h from each unit

Water Softening Plant

Model: Ultraline HB200
Type: Ion exchanger resin
No. of sets: 2
Capacity: 12m³/h

Chlorination Unit (Bunkering)

Type: Sodium hypochlorite injection
No. of sets: 1
Capacity: 95m³/h

Chlorination Unit (Distilled Water Production)

Type: Sodium hypochlorite injection
No. of sets: 1
Capacity: 320m³/h

pH Control Unit (Bunkering)

Type: Hydrochloric acid injection
No. of sets: 1
Capacity: 320m³/h

pH Control Unit (Distilled Water Production)

Type: Hydrochloric acid injection
No. of sets: 1
Capacity: 95m³/h

Post Treatment Chlorine Control System

Type: Sodium hypochlorite injection
No. of sets: 1 (with two dosing pumps)
Capacity: 250m³/h potable water

Post Treatment Chlorine Removal System

Type: Sodium bisulphite injection
No. of sets: 1 (with two dosing pumps)
Capacity: 250m³/h potable water

Ultraviolet Steriliser

Type: Ultraviolet light
Model: UV24L
No. of sets: 1
Capacity: 100m³/h

Introduction

The water production and bunkering systems require treatment in order to destroy harmful bacteria, neutralise acidity, restore necessary salts and hardness to distilled water to make it palatable, to prevent the formation of sediments and to inhibit corrosion.

CAUTION

Extreme care must always be exercised in the storage and handling of chemicals as they can be harmful to the skin, eyes and internal organs. Contamination should be prevented and chemicals should never be mixed except where this is part of a treatment.

Potable Fresh Water System

Distilled and bunkered water is treated in order to make it suitable for consumption on board the vessel. Distilled water from the evaporators and bunkered water from shore facilities or barges, is treated before storage. For the distilled water, this treatment involves initial neutralisation and sterilisation by passage through an ultraviolet filter. If the distilled water is to be used as distilled water in the ship's system, it is passed through a softener unit before flowing to the distilled water storage tanks. If the water is to be used as domestic water throughout the ship, it is passed through a mineralising unit, before passing through chlorination and pH control units prior to transfer to the potable water storage tanks.

The ultraviolet light steriliser destroys bacteria by subjecting it to strong ultraviolet light. Water flows through the steriliser chamber which is illuminated by an ultraviolet discharge lamp. The unit must not be operated without water flow otherwise overheating will occur. The ultraviolet intensity is monitored by the control system and an alarm raised if the intensity falls below a predetermined level. Overheating, indicating inadequate water flow, will also produce an alarm.

The neutralisation and mineralisation filter is automatic and acts to mineralise and neutralise acid water by means of calcium carbonate and magnesium oxide. The rate at which these chemicals dissolve depends upon the acidity of the water and a check must be maintained on the chemical levels so that they may be replenished as necessary (generally when one third of the chemical has been used). Backwash lasts approximately six minutes and is controlled by a programmable timer, which is shared by the softening system. The potable water used in the backflush is collected in a small mounted tank of 4m³, before being passed to the grey water system. The pH is increased to about 8.0/8.5.

The water softening unit is used for softening the treated water before it is discharged to the distilled water tanks. It operates automatically by replacing calcium and magnesium hardness ions with sodium ions in an ion exchange unit. Sodium chloride is used for ion exchange and a brine tank is provided for the regeneration of the ion exchange unit. A softener bypass is available for use when the softener is being regenerated, if water flow to the distilled water tanks should still be needed during regeneration. The softener is only used for distilled water.

The ultraviolet light steriliser, softener, water production pH control, chlorine dosing units and the mineralisation and neutralisation filters are monitored by the IMACS Evaporator overview mimic 4B-101. The potable cold water system chlorine and PH booster/adjustment units are monitored from mimic 4B-103 Cold Potable Water Distribution.

Potable water flowing to the potable water storage tanks from either evaporator production or bunkering passes through a chlorination and pH control unit combination.

Chlorine (sodium hypochlorite) is used to destroy bacteria in water received from the shore or from the evaporator plant. Water flowing to the storage tanks is analysed automatically and the level of chlorine introduced is adjusted to give the required residual chlorine level. Sufficient chlorine is added so that there is an ample reserve in the water stored in the tanks. Tanks must be used in an organised way so that water does not remain in a tank for a prolonged period. Chlorine gradually leaches from the water and protection from bacteria is removed if the level of reserve chlorine in the water falls too low. Potable fresh water stored in tanks should be tested periodically to ensure that there is adequate chlorine reserve. The results of such tests must be recorded.

Procedure for the Operation of the Feed Water Transfer System

The feed water transfer system normally operates on the boiler distilled water double bottom reserve tank. However, in an emergency it can operate on either of the two distilled water double bottoms through cross-connection valve 606VPG. The below procedure assumes normal operation.

a) Ensure that all gauges and instrument valves are open and that the gauges and instruments are functioning.

b) Check that there is water in the boiler feed reserve double bottom tank.

c) Set the system valves as shown in the following table:

Position	Description	Valve
Open	Boiler feed reserve double bottom tank suction valve	656VPG
Closed	Feed water transfer/distilled water transfer cross-connection valve	606VPG
Open	No.1 feed water transfer pump suction valve	651VPG
Open	No.1 feed water transfer pump discharge valve	653VPG
Open	No.1 feed water transfer pump air ejector inlet valve	687VPG
Operational	No.1 feed water transfer pump air ejector solenoid valves (x2)	687VPG, no number
Open	No.1 feed water transfer pump discharge line valve	658VPG
Closed	No.1 feed water transfer pump recirculation valve	657VPG
Open	No.2 feed water transfer pump suction valve	652VPG
Open	No.2 feed water transfer pump discharge valve	654VPG
Open	No.2 feed water transfer pump air ejector inlet valve	668VPG
Operational	No.2 feed water transfer pump air ejector solenoid valves (x2)	688VPG, no number
Closed	Make-up water hydrophore vessel inlet valve	655VPG
Open	Port hotwell level control inlet valve	661VPG
Operational	Port hotwell level control valve	662VPG
Closed	Port hotwell level control bypass valve	663VPG
Open	Starboard hotwell level control inlet valve	664VPG
Operational	Starboard hotwell level control valve	665VPG
Closed	Starboard hotwell level control bypass valve	666VPG

d) Switch one of the transfer pumps to LOCAL control.

e) Open the hydrophore inlet valve 655VPG. Start the pump using the local START pushbutton and fill the hydrophore unit until it is approximately three quarters full. Stop the pump.

f) Connect up the local air supply valve to the hydrophore needle valve and pressurise the unit to its normal working pressure.

(Note: If the level in the hydrophore unit falls too low before the correct working pressure is reached, shut off the air supply and restart the transfer pump to restore the water level. The pressure should be constantly monitored when the air supply is open or the transfer pump is running.)

g) Once the hydrophore unit is at the correct working pressure with the level approximately half-way in the hydrophore, shut off the air supply and stop the pumps.

h) Switch both pumps to REMOTE.

i) At the IMACS Distilled Water System mimic 5A-104, select the duty unit by pressing either the 1-2/2-1 lead/lag softkey. The pumps will now operate on a pressure switch to maintain the level in the hydrophore unit.

The system is now operational. The boiler feed water reserve double bottom tank will need to be topped-up occasionally as previously described.

Procedure for Supplying Distilled Water from the Bunker Station

CAUTION

Before any water is taken from a barge or shore station, it should be sampled and analysed to ensure that it does not contain harmful chemicals or bacteria.

a) Check the quantity of water in the tank(s) to be filled and estimate the time needed to transfer the quantity required.

b) Establish a system of communication with the bunker station and the shore supply station/supply barge.

c) Connect the distilled water supply pipe to the bunker pipe.

d) Set the valves as shown in the following table. The arrangement assumes that the port bunker station is to be used for supply:

Position	Description	Valve
Open	Port bunker station water filling valve	689VPG
Closed	Starboard bunker station water filling valve	690VPG
Open	Bunker filling line valve	684VPG
Closed	No.1 water softener outlet valve	FB166
Closed	No.2 water softener outlet valve	FB168
Closed	Water softener unit bypass valve	FB170

e) Open one (or more) remotely operated tank filling valves as required.

Description	Valve
Port distilled water double bottom tank remote filling valve	681VPJ
Starboard distilled water double bottom tank remote filling valve	683VPJ
Boiler feed water double bottom reserve tank remote filling valve	682VPJ

f) Signal for the distilled water supply pump from the shore station/barge to be started.

g) Signal for the distilled water supply pump from the shore station/barge to be stopped when the required quantity of distilled water has been taken.

(Note: The above provides direct access for distilled water from ashore/barge to the distilled water tank.)

The potable water analysis and treatment units also monitor the pH of the evaporator produced and bunkered water, introducing hydrochloric acid to adjust the acidity as necessary to give a value of 7.2 to 7.4.

Post Storage Treatment Systems

When potable water is taken from the tanks for consumption, it is analysed and treated before being pumped to the cold potable water main. Water is analysed by the residual chlorine and pH meters. Chlorine is added and removed, if required, by means of chemical injection pumps.

Post tank chlorination/chlorine removal is carried out in order to produce a residual chlorine level in the potable water (to destroy any remaining bacteria) of between 0.6ppm and 1.0ppm. The dosing pump introduces the correct amount of sodium hypochlorite to give the required chlorine level.

If the chlorine level is in excess of that required, the chlorine removal system operates. The chlorine removal dosing pump injects the required amount of sodium bisulphite chemical to give the required sodium hypochlorite concentration.

A pH removal system is incorporated in the post treatment system and this makes use of the same analyser as the chlorine treatment system. The injection of hydrochloric acid produces the recommend pH value of 7.0 to 7.5.

The pH and residual free chlorine levels are monitored continuously at the maximum distance from the injection source (the navigating bridge - far point). A circular chart with 24 hour paper is used for monitoring the far point levels. A similar unit is available in the control room. The pH and chlorine values in the wheelhouse are also continuously displayed on IMACS mimic 4B-103 Cold Potable Water Distribution. Charts in the recorders are changed daily and records are kept as per fleet regulations.

The IMACS also provides operational monitoring of the potable water treatment systems.

Used sample water from sampling instruments is collected in a small mounted tank before being discharged by a dedicated pump to the grey water collection system.

Distilled water contains no salts or hardness and this makes it unpleasant to consume and potentially a problem, as distilled water can remove salts from the human body. Distilled water for domestic consumption is passed through mineralising filters at the production stage in order to produce hardness.

Swimming Pools and Whirlpool Spa Water Treatment (See Section 8.7)

Swimming pools can be supplied with fresh water or sea water, the fresh water coming from the potable water system. There are three passenger swimming pools, ten spa pools, one children's pool, one baby pool and one crew swimming pool; all swimming pools are heated.

Each pool has its own filtration and chemical treatment system. Swimming pool water is continuously circulated and passage through the filter units forms part of the circulation system. Swimming pool water for analysis is drawn directly from the pool through a dedicated sampling line. The samples then pass either directly to a deck scupper or, as in the case of the larger pools, to a sampling water collection tank before being transferred by means of a dedicated pump to the grey water collection system.

The free chlorine level of the swimming pool water should be maintained at between 0.3ppm and 0.6ppm and chemicals are introduced before the filter in order to maintain the water between these limits. The pH of the swimming pool water is also monitored and chemicals added after the filter and heater in order to maintain the water at the correct pH. Chemical treatments are added from dosing units for pH and chlorine.

Water condition is constantly monitored, recorded and the necessary chemicals added to maintain the pH and chlorine levels. There are pH, chlorine content and common alarms for each swimming pool via the IMACS.

There are ten spa pools and one paddling pool. Each of these has its own water treatment plant and, like the swimming pool systems, they operate automatically for bromine addition (for chlorine content) and acid addition (for pH). Like the swimming pools, the spa pool and paddling pool systems are monitored, recorded and alarmed.

It is essential that records are kept of the sampling and testing of swimming pool and spa water together with details of the chemical treatment consumption.

Boiler Feed Water Treatment (See Section 6.2.3)

Distilled water from the evaporators is passed directly to the boiler feed reserve water tanks through the mineralising filter and water softener. The distilled water is stored in the boiler feed reserve tanks until required for use and although it is free from scale forming salts, there is the potential for boiler corrosion.

In order to reduce the likelihood of corrosion in the boilers and exhaust gas economisers, the boiler feed water is treated chemically. Testing of the boiler water is carried out on a regular and frequent basis, samples being drawn directly from the boilers via sample coolers. The results of these tests indicate the amount of water treatment required.

Water treatment is added to the boiler by three dosing units, one for each boiler and one for the steam separator. A measured quantity of the treatment chemical is pumped into the feed water supply line at two points. One directs the chemical into the feed line after the feed pumps with the other injecting chemical into the feed pipe just before the feed water enters the boiler. This ensures that the chemical is dispersed quickly throughout the boiler system.

Fresh Water Cooling Systems (See Sections 2.5.1, 2.5.2 and 2.5.3)

Distilled water is used in the HT and LT cooling fresh water circulation systems to prevent any scale formation in the systems. The problem with the cooling fresh water systems is one of corrosion and a number of different types of electrochemical corrosion cells are possible. The most common of these is due to dissimilar metals but it is possible to have corrosion cells formed due to differential aeration and even due to temperature gradients. The use of corrosion inhibiting chemicals in the cooling fresh water is essential if corrosion in all parts of the systems is to be prevented.

Water samples are taken from all systems for analysis and chemical treatment is added to the systems as required via dosing units.

Evaporator Sea Water (See section 6.3.1)

Sea water supplied to the evaporator must be treated in order to prevent the formation of scale in the interstage condensers and the heater. Any scale formation will inhibit heat transfer and impair the performance of the evaporator. As water is being produced for domestic purposes from the treated sea water, it is essential that dosing chemical concentrations recommended by the manufacturer are strictly adhered to at all times. Chemical use must be recorded and the distillate tested for any residue.

6.3.4 Hot and Cold Potable Water System in Machinery Spaces

Potable Hot Fresh Water Circulation Pump

Maker:	Pompe Garbarino S.p.A
Model:	MU65/400L
Type:	Vertical in line, centrifugal
No. of sets:	2
Capacity:	40m³/h at 6kg/cm²
Motor rating:	440V, 18kW, 1,750 rpm

Laundry Hot Fresh Water Circulation Pump

Maker:	Pompe Garbarino S.p.A
Model:	BT 201
Type:	Side channel, horizontal, centrifugal
No. of sets:	1
Capacity:	2m³/h at 1kg/cm²
Motor rating:	440V, 1.3kW, 1,750 rpm

Potable Water Pumps

Maker:	Pompe Garbarino S.p.A
Model:	MU 100 - 400 LE
Type:	Centrifugal self-priming
No of sets:	3
Capacity:	125m³/h at 8.0kg/cm²
Rating:	440V, 66kW, 1,750 rpm

Main Potable Water Heater

Type:	Steam heated, shell and tube
No. of sets:	4
Capacity:	9,418,500kJ/h

Galley Potable Water Booster Heater

Type:	Steam heated, shell and tube
No. of sets:	1
Capacity:	3,683,703kJ/h

Laundry Potable Water Heater

Type:	Steam heated, shell and tube
No. of sets:	1
Capacity:	6,446,481kJ/h

Tank	Capacity
No.1 port potable water tank	222.1m³
No.1 starboard potable water tank	222.1m³
No.2 port potable water tank	193.5m³
No.2 starboard potable water tank	193.5m³
No.3 port potable water tank	327.1m³
No.3 starboard potable water tank	327.1m³
No.4 port potable water tank	336.2m³
No.4 starboard potable water tank	336.2m³
No.5 port potable water tank	274.3m³
No.5 starboard potable water tank	274.3m³
No.6 port potable water tank	386.7m³
No.6 starboard potable water tank	379.1m³

Cold Water System-Introduction

Distilled water manufactured in the three evaporators is transferred to potable water storage tanks on the ship for storage prior to use in the ship's potable water system. Potable water may also be supplied to the tanks from shore or barge facilities via connections at the port and starboard bunker stations and at the port and starboard potable water bunkering stations, all on deck 4. Monitoring of the potable water system is achieved on IMACS mimics 4B-101 to 4B-104.

As the distilled water produced by the evaporators contains no natural salts, it can be harmful when consumed and so treatment is needed to restore some of the salts which would otherwise be leached from the human body by the distilled water. As the distilled water is produced at low temperature, all bacteria may not have been destroyed and so an ultraviolet steriliser is used to sterilise the distilled water. This unit is used on all evaporator manufactured water. The distilled water is then passed through a mineralising filter before being discharged to the potable water storage tanks.

Distilled water which is destined for potable use is treated in a pH unit and a prechlorination unit before discharge to the potable water storage tanks. Potable water loaded at the bunker stations also undergoes the pH and chlorination procedure. The quantity of chlorine and pH chemicals are carefully metered to ensure that the correct dose is added (see section 6.3.3).

Potable water storage tanks are filled and used in pairs. This eliminates any heeling moments that would be generated by filling individual tanks. The potable cold water system throughout the ship operates on a constant flow basis with water circulated by the potable water pumps which are set up in a cascade arrangement so that pumps will start operating and shut down in accordance with demand. All three pumps are identical. These pumps draw water from one pair of the potable water storage tanks. The suction valves from these tanks are remotely operated and the tanks are fitted with remote reading quantity gauges. The tanks also have high and low level alarms so that a warning is given when a tank is nearly empty and the supply needs to be taken from elsewhere. The high level alarm provides warning when filling the tanks from the evaporator system or bunkering.

Pumps may be selected for LOCAL mode operation via the local selector switch and operated from local START and STOP pushbuttons. Normally the pumps are operated in the REMOTE mode from the IMACS workstations via the Gold Potable Water Distribution 4B-103 as described above.

The transfer pump can be operated in order to transfer potable water between storage tanks without affecting the overall operation of the cold potable system. The duty and standby pumps are operated on cascade contol, with the lead pump being selected on IMACS mimic 4B-103. The standby pump starts by means of a signal from the flow transmitter.

The IMACS mimic 4B-103 also has facilities for the operation of the remotely operated valves for the cold potable water supply system and the suction valves from the potable water storage tanks. After leaving the pumps, the cold potable water firstly passes through a flow meter before reaching the chlorine monitoring/treatment equipment. This equipment constantly monitors the chlorine content of the circulating cold water and adds chemical to adjust the level to the desired set point, usually around 1.0ppm. This equipment can add chemical to both adjust the chlorine content level up and down.

The flow is then split to supply make-up water to the hot water circulating system. The cold potable water feed then supplies the ship's distribution lines.

Water in the potable water circulating system returns to the pump suction after circulating around the distribution lines. As with the hot potable water system, the recirculation arrangement ensures that a fresh supply of cold potable water is always available at every part of the ship. Circulating cold water ensures that cold water is immediately available at each location. Discharge into the ship system lines is via a distribution valve arrangement which includes a strainer, relief valve, drain valve and pressure gauge as well as isolating valves. The return lines pass through a similar arrangement which includes a pressure gauge, twin strainers arranged in parallel, a flow meter and a hand operated regulating valve. The regulating valves ensure that the correct pressure is maintained at all locations. All loop lines can be drained to the bilge through the drain valve on the inlet valve arrangement. A back-up loop (O) can be used to supply cold water to any of the distribution loops through a cross-connection valve.

The return water passes through another flow meter before drawing make-up water from the potable water storage tanks and then passing back to the pump suction.

The laundry has its own supply which passes through a flow meter before being split to supply make-up to the laundry hot water system (see later in this section). The laundry can also be supplied via the back up cold water loop O.

A further supply (loop N) to the exhaust gas boiler washing lines does not recirculate and would normally be left isolated and drained when not in use.

Procedure for Supplying Distilled Water from the Evaporators to the Potable Water Storage Tanks

a) Check the quantity of water in the potable water tanks.

b) Check that the valves to all instruments and gauges are open.

c) Check that the evaporator(s) are ready for operation.

d) Set the valves as shown in the following table:

(Note: Potable water tank filling valves are indicated as open but they will only be open for filling a particular tank.)

Position	Description	Valve
Open	Distilled water outlet valve from No.1 evaporator	671VPG
Open	Distilled water outlet valve from No.2 evaporator	672VPG
Open	Distilled water outlet valve from No.3 evaporator	673VPG
Open	UV steriliser inlet valve	FB161
Open	UV steriliser outlet valve	FB160
Closed	UV steriliser bypass valve	FB162
Open	No.1 mineralisation unit inlet valve	FB159
Open	No.1 mineralisation unit outlet valve	FB150
Open	No.2 mineralisation unit inlet valve	FB156
Open	No.2 mineralisation unit outlet valve	FB149
Open	No.3 mineralisation unit inlet valve	FB153
Open	No.3 mineralisation unit outlet valve	FB148
Closed	Mineralisation unit bypass valve	FB163
Open	Mineralisation unit outlet to the potable water system valve	FB143
Open	Vacuum breaker isolator valve	FB123
Closed	Mineralisation unit outlet to the distilled water system valve	FB144
Active	Evaporator discharge chlorination system	
Active	Evaporator discharge pH control system	
Open	No.1 port potable water tank	FB002
Open	No.1 starboard potable water tank	FB001
Open	No.2 port potable water tank	FB022
Open	No.2 starboard potable water tank	FB021
Open	No.3 port potable water tank	FB016
Open	No.3 starboard potable water tank	FB015
Open	No.4 port potable water tank	FB074
Open	No.4 starboard potable water tank	FB073
Open	No.5 port potable water tank	FB048
Open	No.5 starboard potable water tank	FB047
Open	No.6 port potable water tank	FB076
Open	No.6 starboard potable water tank	FB075

(Note: The potable water tank filling valves are operated remotely from the IMACS via Potable Water Storage mimic 4B-102.)

Potable water from the evaporators or from a shore supply is chlorinated before storage and it is essential that the chlorination unit is started and operational before transfer to the potable water tanks commences. The chlorination system must be checked for the correct operation and dosing of the water (see section 6.3.3, Water Treatment Systems).

e) Ensure that the water treatment plant is operating correctly.

f) Bring the evaporator(s) on line and when the salinity of the condensate produced is below the minimum acceptable level, ensure that the condensate is pumped to the storage system.

g) Fill the potable water tanks as required.

h) When the evaporators are out of service, the valves to the analysing and dosing unit must be shut.

Procedure for Filling the Potable Water Tanks from the Bunker Connections

CAUTION

Before any water is taken from a barge or shore station, it should be sampled and analysed to ensure that it does not contain harmful chemicals or bacteria.

a) Establish an effective communication system with the bunker station and the barge/shore station.

b) Connect the water supply pipe to the ship's connection at the bunker station.

c) Check that valves to all gauges and instruments are open and the gauges and instruments are operating correctly.

d) Check the potable water tanks and determine the quantity to be loaded. Ensure that the correct tanks are set to receive the water. Take a reading from the bunkering flow meter.

e) Set the valves as shown in the following table. The assumption is made that one port potable water filling station hosepipe connection is being used to supply potable water:

Position	Description	Valve
Open	Port potable water filling station No.1 filling valve	FB141
Closed	Port potable water filling station No.2 filling valve	FB140
Closed	Port potable water filling station No.3 filling valve	FB139
Closed	Port potable water filling station No.4 filling valve	FB138
Open	Port potable water filling station vacuum breaker isolating valve	FB142
Closed	Port potable water filling station discharge valve	FB135
Closed	Starboard potable water filling station discharge valve	FB127
Closed	Port bunker station discharge valve	FB596
Closed	Starboard bunker station discharge valve	FB588
Open	Bunkering flow meter inlet valve	FB126
Open	Bunkering flow meter outlet valve	FB125
Closed	Bunkering flow meter bypass valve	FB025
Open	Vacuum breaker isolator valve	FB124
Open	Vacuum breaker isolator valve	FB121
Active	Bunkering chlorination system	

Position	Description	Valve
Active	Bunkering pH control system	
Open	No.1 port potable water tank	FB002
Open	No.1 starboard potable water tank	FB001
Open	No.2 port potable water tank	FB022
Open	No.2 starboard potable water tank	FB021
Open	No.3 port potable water tank	FB016
Open	No.3 starboard potable water tank	FB015
Open	No.4 port potable water tank	FB074
Open	No.4 starboard potable water tank	FB073
Open	No.5 port potable water tank	FB048
Open	No.5 starboard potable water tank	FB047
Open	No.6 port potable water tank	FB076
Open	No.6 starboard potable water tank	FB075

(**Note:** Tank filling valves are shown as opened, but only valves for those tanks being filled would be open. Valves are actuated from the IMACS Potable Water Storage mimic 4B-102.)

f) Signal the shore station/barge to commence pumping water.

g) When the tanks have reached their filling capacities, signal the shore station/barge to stop the pumps.

h) Shut the bunker station valve and disconnect the pipe.

i) Shut the system valves and shut down the water analysing and dosing unit. Take a reading from the bunkering flow meter. Determine the exact amount of bunkered water and make an entry in the log book.

Procedure for Supplying Cold Potable Water to the Ship's System

The procedure assumes that the system is already fully primed, with all loop isolating valves open and drain valves shut. All cross-connection valves from the back up loop O are also assumed to be closed. Pumps No.1 and 2 are in use drawing from No.1 port and starboard potable water tanks.

a) Ensure that all gauges and instrument valves are open and that the gauges and instruments are functioning.

b) Check that there is water in the tank to be used.

c) Set the system valves as shown in the following table:

Position	Description	Valve
Open	No.1 port potable water tank suction valve	FB011
Open	No.1 starboard potable water tank suction valve	FB010
Closed	No.1 port potable water tank transfer suction valve	FB014
Closed	No.1 starboard potable water tank transfer suction valve	FB013
Closed	No.2 port potable water tank suction valve	FB033
Closed	No.2 starboard potable water tank suction valve	FB032
Closed	No.3 port potable water tank suction valve	FB043
Closed	No.3 starboard potable water tank suction valve	FB042
Closed	No.4 port potable water tank suction valve	FB069
Closed	No.4 starboard potable water tank suction valve	FB068
Closed	No.5 port potable water tank suction valve	FB057
Closed	No.5 starboard potable water tank suction valve	FB056
Closed	No.6 port potable water tank suction valve	FB085
Closed	No.6 starboard potable water tank suction valve	FB084
Closed	System drain valve	FB089
Open	No.1 potable water pump suction valve (manual)	FB097
Open	No.2 potable water pump suction valve (manual)	FB101
Open	No.3 potable water pump suction valve (manual)	FB105
Closed	No.1 potable water pump transfer suction valve (manual)	FB096
Closed	No.2 potable water pump transfer suction valve (manual)	FB100
Closed	Hot water system bleed valve	FB108
Closed	No.3 potable water pump transfer suction valve (manual)	FB104
Open	No.1 potable water pump discharge valve	FB098
Open	No.2 potable water pump discharge valve	FB102
Open	No.3 potable water pump discharge valve	FB106
Closed	No.1 potable water pump transfer discharge valve	FB099
Closed	No.2 potable water pump transfer discharge valve	FB103
Closed	No.3 potable water pump transfer discharge valve	FB107
Closed	System drain valve	FB090
Open	Pump discharge flow meter inlet valve	FB091
Open	Pump discharge flow meter outlet valve	FB092
Closed	Pump discharge flow meter bypass inlet valve	FB093
Closed	Pump discharge flow meter bypass outlet valve	FB094
Closed	Pump discharge flow meter drain valve	FB095
Open	Vacuum breaker isolating valve	FB119
Closed	Exhaust gas boiler washing line isolating valve	FB253
Open	Hot water circulating system make-up valve	FB383
Open	Laundry flow meter inlet valve	FB356
Open	Laundry flow meter outlet valve	FB357
Open	Laundry flow meter bypass valve	FB355
Open	Laundry hot water system makeup valve	FB370
Open	Laundry cold water isolating valve	FB369
Open	System return flow meter inlet valve	FB027
Open	System return flow meter outlet valve	FB026
Closed	System return flow meter bypass valve	FB028

d) Select the potable water pumps for REMOTE mode at their selector switches. At the IMACS mimic 4B-103, select the desired cascade control mode and the IMACS will start pumps as required when necessary to maintain system pressure.

e) Allow the system to operate for some time and check that water is available at all locations.

Potable water may be taken from the other potable water storage tanks as required by opening the relevant tank suction valve at the IMACS mimic 4B-103.

Procedure for Transferring the Contents of One Potable Water Tank to Another

On rare occasions, it may be necessary to transfer the contents of the potable water tanks internally, i.e. from one tank to another. This procedure must be approved by the bridge prior to any transfer.

To achieve the transfer, it would be necessary to use one of the cold potable water pumps as a dedicated transfer pump. It would therefore not be necessary to shut down the cold potable water system in any way.

To transfer between tanks, the following procedure must be adopted:

a) Establish which tanks are to be transferred and the quantities. Ensure that there is sufficient room/water in the tanks to complete the transfer.

b) Obtain permission from the bridge prior to commencing the transfer.

c) Check that the valves to all instruments and gauges are open.

d) Set the valves as in the following table. This assumes that the proposed transfer is from No.4 port to No.4 starboard and that No.3 cold potable water pump is to be used for the transfer:

Position	Description	Valve
Closed	No.1 port potable water tank direct suction valve	FB014
Closed	No.1 starboard potable water tank direct suction valve	FB013
Closed	No.2 port potable water tank direct suction valve	FB036
Closed	No.2 starboard potable water tank direct suction valve	FB035
Closed	No.3 port potable water tank direct suction valve	FB046
Closed	No.3 starboard potable water tank direct suction valve	FB045
Open	No.4 port potable water tank direct suction valve	FB072
Closed	No.4 starboard potable water tank direct suction valve	FB071
Closed	No.5 port potable water tank direct suction valve	FB060
Closed	No.5 starboard potable water tank direct suction valve	FB059
Closed	No.6 port potable water tank direct suction valve	FB088
Closed	No.6 starboard potable water tank direct suction valve	FB087
Closed	No.3 cold potable water pump system suction valve (manual)	FB105
Closed	No.3 cold potable water pump system discharge valve	FB106
Open	No.3 cold potable water pump tank suction valve (manual)	FB104
Open	No.3 cold potable water pump tank discharge valve	FB107
Closed	Cold potable water pump shore discharge valve	FB117
Open	Cold potable water pump tank discharge valve	FB115
Closed	No.1 port potable water tank filling valve	FB002
Closed	No.1 starboard potable water tank filling valve	FB001
Closed	No.2 port potable water tank filling valve	FB022
Closed	No.2 starboard potable water tank filling valve	FB021
Closed	No.3 port potable water tank filling valve	FB016
Closed	No.3 starboard potable water tank filling valve	FB015
Closed	No.4 port potable water tank filling valve	FB074
Open	No.4 starboard potable water tank filling valve	FB073
Closed	No.5 port potable water tank filling valve	FB048
Closed	No.5 starboard potable water tank filling valve	FB047
Closed	No.6 port potable water tank filling valve	FB076
Closed	No.6 starboard potable water tank filling valve	FB075

e) Start No.3 cold potable water pump either locally or via the IMACS. Ensure that the pump is operating normally and that water is being transferred correctly.

f) When the transfer is complete, stop the pump and return the valves to their normal operating position.

g) Record the transfer in the log book.

Procedure for Discharging Potable Water Ashore

On rare occasions, such as during superchlorination procedures, it may be necessary to discharge the contents of the potable water tanks ashore. Permission must be obtained from the bridge prior to commencing the discharge.

To achieve the transfer, it would be necessary to use one of the cold potable water pumps as a dedicated transfer pump. It would not be necessary to shut down the cold potable water system in any way.

To discharge ashore, the following procedure must be adopted:

a) Establish an effective communication system with the bunker station and the barge/shore station.

b) Connect the water discharge pipe to the ship's discharge connection at the bunker station.

c) Check that valves to all gauges and instruments are open and the gauges and instruments are operating correctly.

d) Check the potable water tanks and determine the quantity to be discharged. Ensure that the correct tanks are set to be emptied.

e) Set the valves as in the following table. This assumes that the proposed transfer is from No.4 port and starboard to the shore facility and that No.3 cold potable water pump is to be used for the transfer. Discharge will be from the port fresh water bunkering station:

Position	Description	Valve
Closed	No.1 port potable water tank direct suction valve	FB014
Closed	No.1 starboard potable water tank direct suction valve	FB013
Closed	No.2 port potable water tank direct suction valve	FB036
Closed	No.2 starboard potable water tank direct suction valve	FB035
Closed	No.3 port potable water tank direct suction valve	FB046
Closed	No.3 starboard potable water tank direct suction valve	FB045
Open	No.4 port potable water tank direct suction valve	FB072
Open	No.4 starboard potable water tank direct suction valve	FB071
Closed	No.5 port potable water tank direct suction valve	FB060
Closed	No.5 starboard potable water tank direct suction valve	FB059
Closed	No.6 port potable water tank direct suction valve	FB088
Closed	No.6 starboard potable water tank direct suction valve	FB087

Position	Description	Valve
Closed	No.3 cold potable water pump system suction valve (manual)	FB105
Closed	No.3 cold potable water pump system discharge valve	FB106
Open	No.3 cold potable water pump tank suction valve (manual)	FB104
Open	No.3 cold potable water pump tank discharge valve	FB107
Open	Cold potable water pump shore discharge valve	FB117
Closed	Cold potable water pump tank discharge valve	FB115
Open	Port fresh water bunker station discharge valve	FB135
Closed	Starboard fresh water bunker station discharge valve	FB127
Closed	Port bunker station discharge valve	FB596
Closed	Starboard bunker station discharge valve	FB588

f) Signal the shore station/barge that pumping is about to commence. Start No.3 cold potable water pump either locally or via IMACS.

g) When the tank is empty, stop the pump and inform the shore facility that the transfer is complete.

h) Shut the bunker station valve and disconnect the pipe.

i) Shut the system valves. Determine the exact amount of water discharged and make an entry in the log book.

Hot Water System-Introduction

Hot potable water is circulated around the ship by two hot potable water circulation pumps, one normally selected as the duty pump and the other as the standby pump. Pumps may be operated locally by setting the selector switch to the LOCAL position and operating the pumps by means of the local START and STOP pushbuttons. Selecting the REMOTE mode allows the pumps to be operated from the IMACS workstations via the Hot Potable Water Distribution mimic 4B-104. The IMACS has control facilities for the manual starting and stopping of the pumps. Pumps are started in a lead/lag standby arrangement by soft keys on the IMACS display, either 1-2 or 2-1.

Four steam heaters are used to raise the temperature of the water, the heaters being located at the pump outlet. Suction for the pumps is taken from the hot water return system. The hot water system is linked to the pressurised cold potable water system and therefore operates under pressure with make-up from the cold potable water system. The heater control system maintains a constant temperature of approximately 60°C in the hot water system. Control of the heaters is in a cascade arrangement so that heaters will start operating and shut down in accordance with demand. Temperature is monitored and controlled by IMACS utilising motorised control valves. A further set of air operated control valves act as fail-safe steam isolating valves, shutting in the event of pump failure etc. These valves close in their fail-safe position and so will isolate the steam supply in a blackout situation.

As with the cold potable water system, the recirculation arrangement ensures that a fresh supply of hot potable water is always available at every part of the ship. Circulating hot water ensures that hot water is immediately available at each location. Discharge into the ship system lines is via a distribution valve arrangement which includes a strainer, relief valve, drain valve and pressure gauge as well as isolating valves. The return lines pass through a similar arrangement which includes a pressure gauge, twin strainers arranged in parallel, a flow meter and a hand operated regulating valve. The regulating valves ensure that the correct pressure is maintained at all locations. All loop lines can be drained to the bilge through the drain valve on the inlet valve arrangement. A back-up loop (O) can be used to supply hot water to any of the distribution loops through a cross-connection valve.

The galley supply has its own water heater, which boosts the heat supply to this high consumer. Temperature control is achieved in a similar fashion to the main hot water heaters, i.e. motorised control valves actuated via the IMACS. This heater supplies water to both of the galley hot water loops and has a bypass valve for use in an emergency.

The laundry water supply is essentially a separate system within the hot water system. This sub-system has its own circulating pump and heater as well as its own make up from the cold potable water system and operates in an identical fashion to the main hot water system. The hot water is delivered to the laundry hot water loop and returns directly to the laundry hot water pump suction. make-up water to the laundry system passes through its own flow meter allowing the laundry consumption to be monitored separately. The laundry system will therefore run as a separate system unless a fault should develop. If the laundry pump/heater should malfunction, a cross-connection is available from the main hot water system back-up supply on loop O. Care should be taken if the cross-connection is used as the water will be supplied at a much higher pressure (6 bar as opposed to 2 bar).

Illustration 6.3.1a Fresh Water Generator Plant

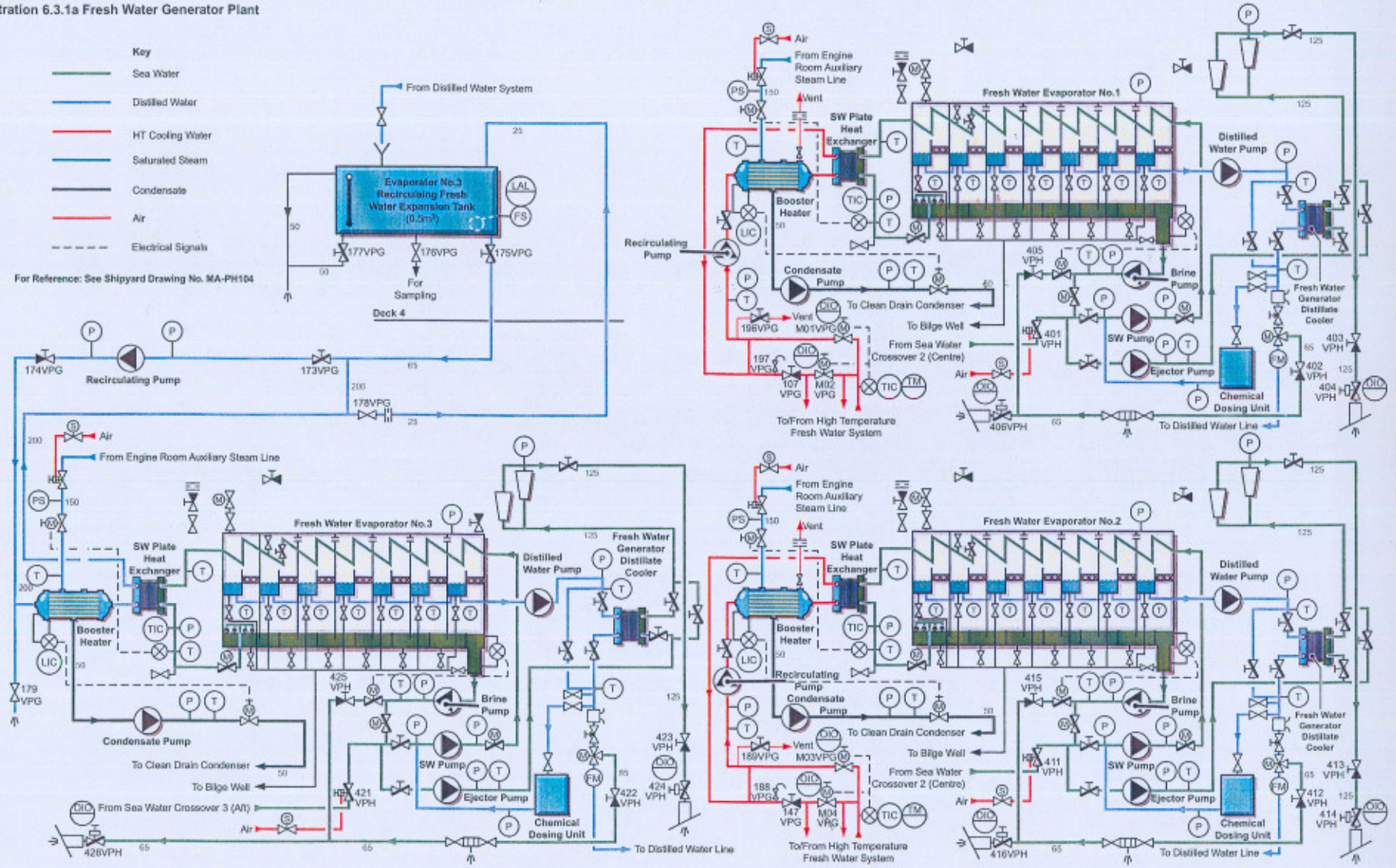
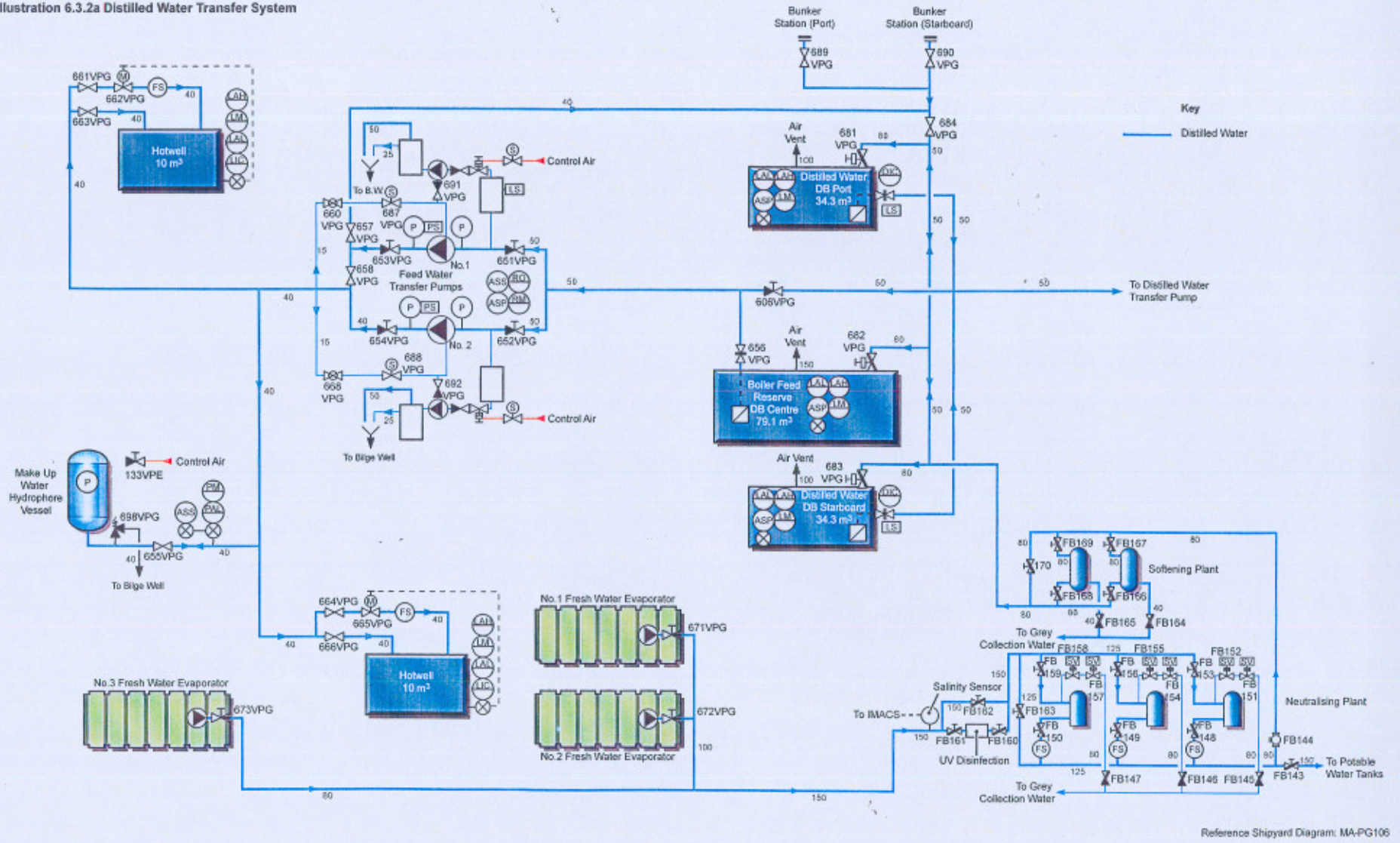


Illustration 6.3.2a Distilled Water Transfer System



Reference Shipyard Diagram: MA-PG106

Illustration 6.3.3a Potable Water Treatment System

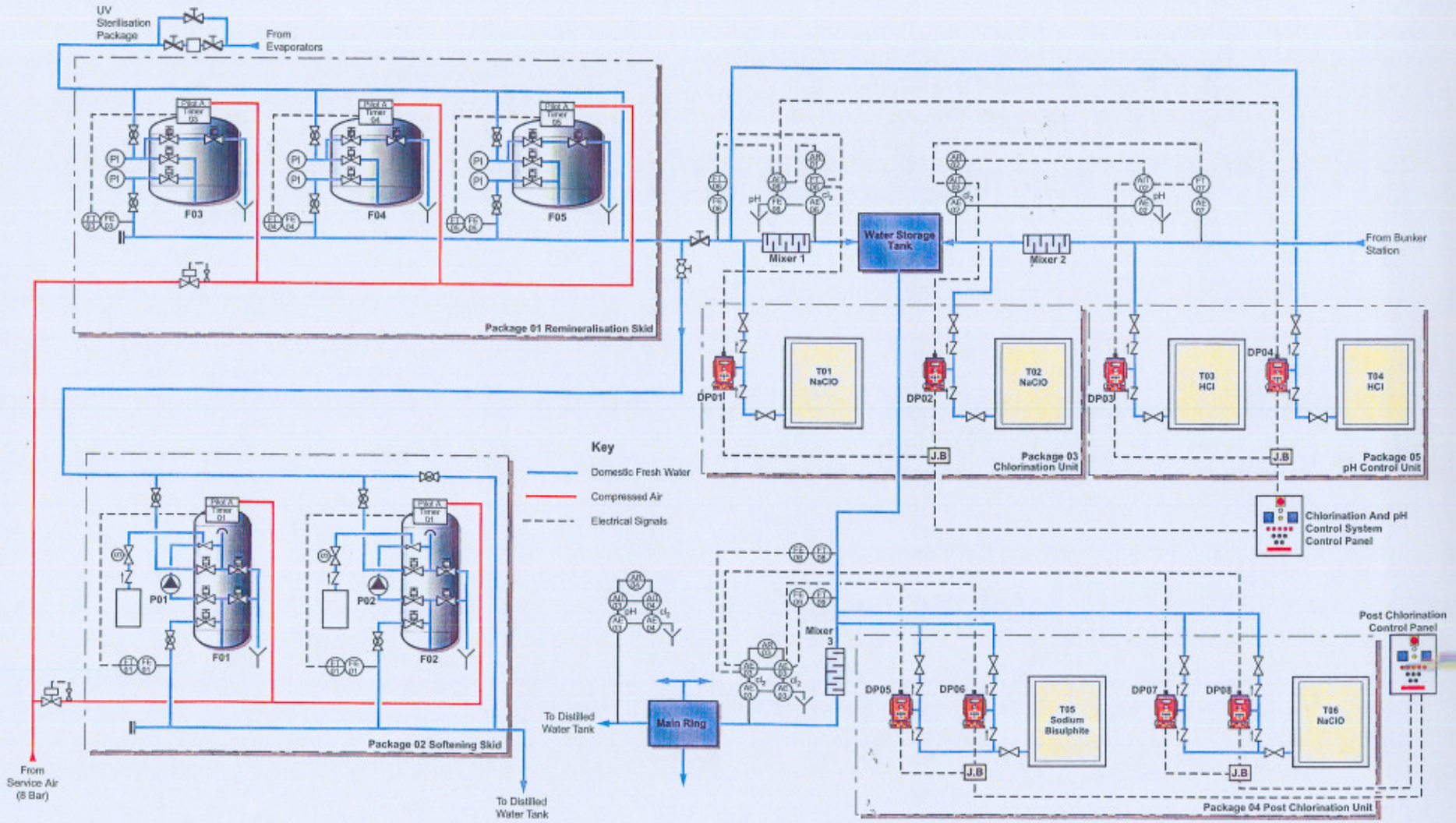


Illustration 6.3.4a Hot and Cold Potable Fresh Water System

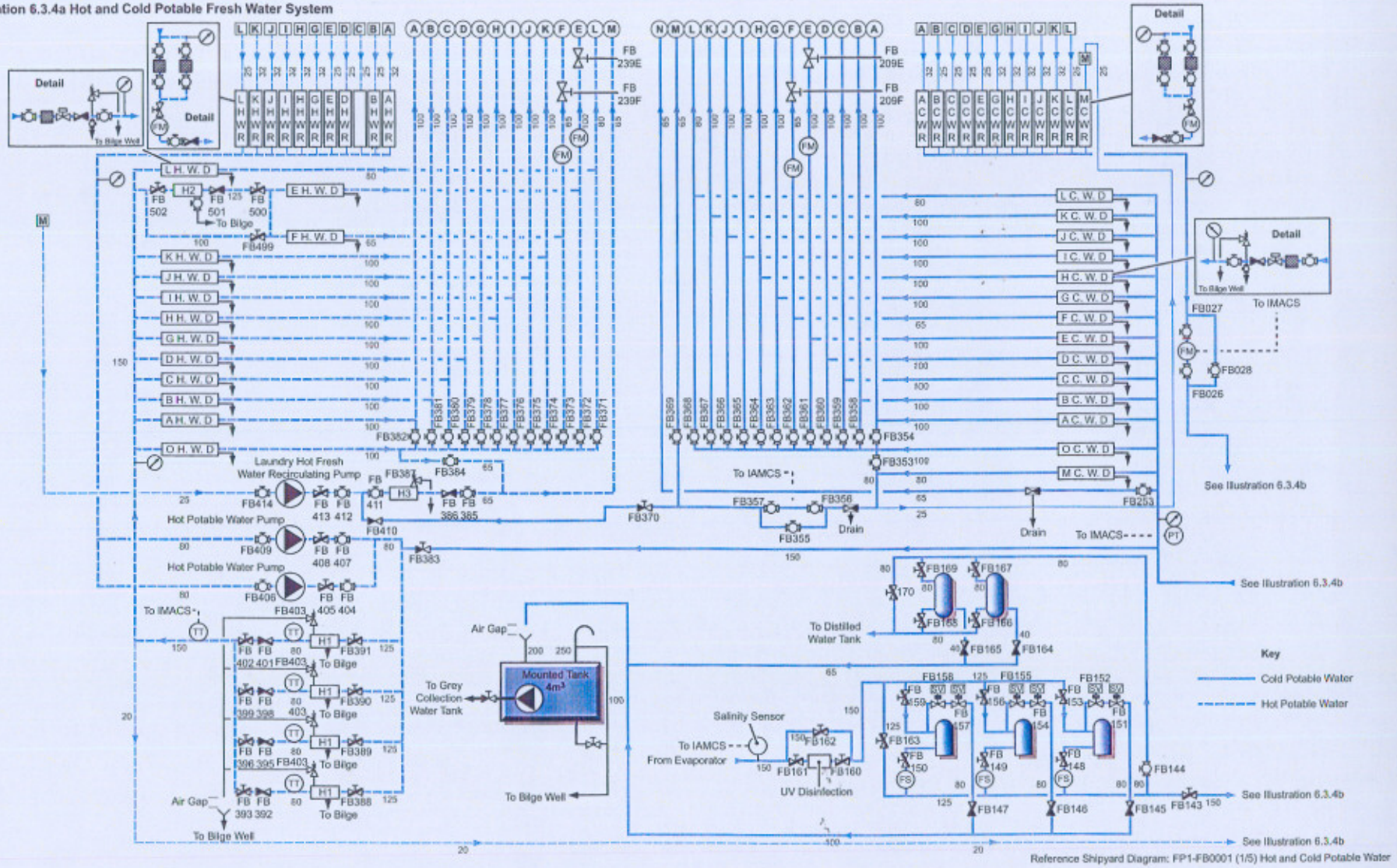
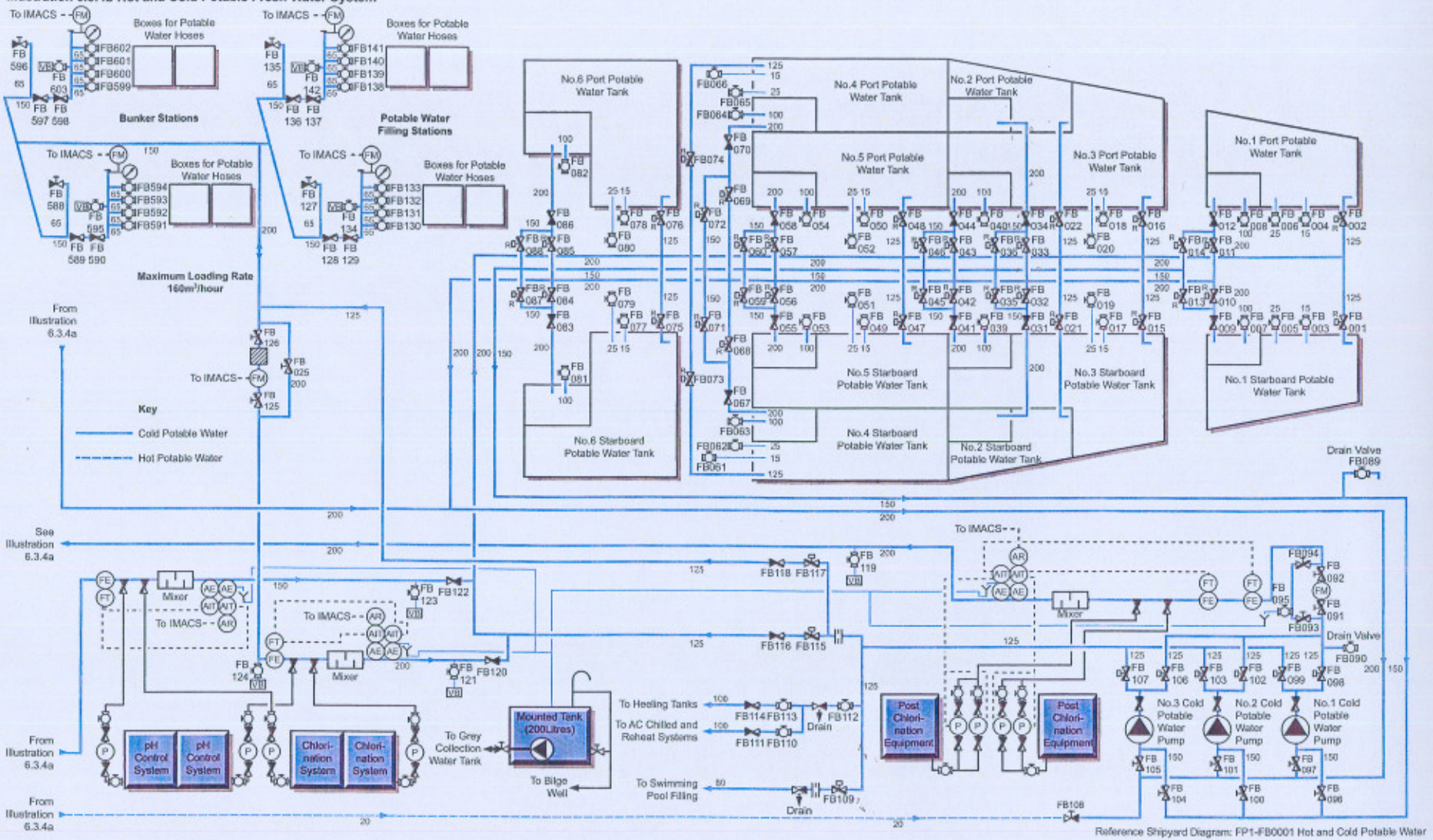


Illustration 6.3.4b Hot and Cold Potable Fresh Water System



Reference Shipyard Diagram: FP1-FB0001 Hot and Cold Potable Water