1. Installations: description and operation

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1.1. Equipment locations

The following schematic illustrations depict the disposition of critical equipment around the vessel.

1.1.1. Safety equipment

Manual fire-extinguishers in the saloon and lower-deck cupboard and a fire-blanket in the galley. Automatic fire extinguisher systems are installed in the engine room and fore locker. A first aid kit is located in the day-head.

Figure 1.1. Safety equipment (above deck)

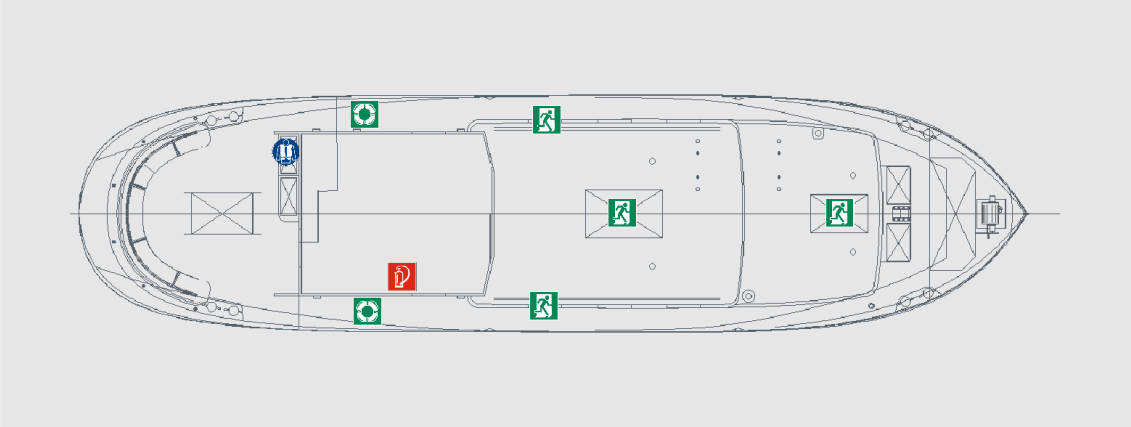
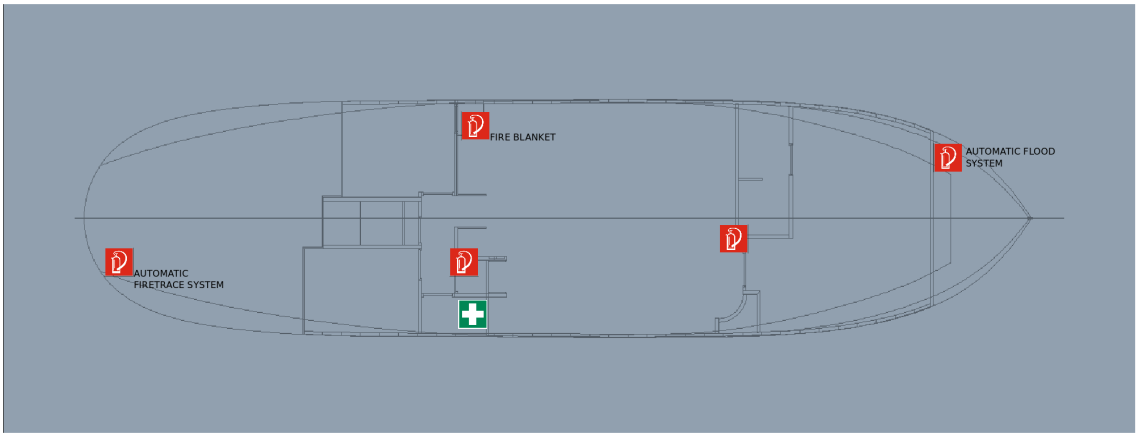


Figure 1.2. Safety equipment (below deck)



1.1.2. Electrical distribution

Figure 1.3. Electrical distribution (below deck)

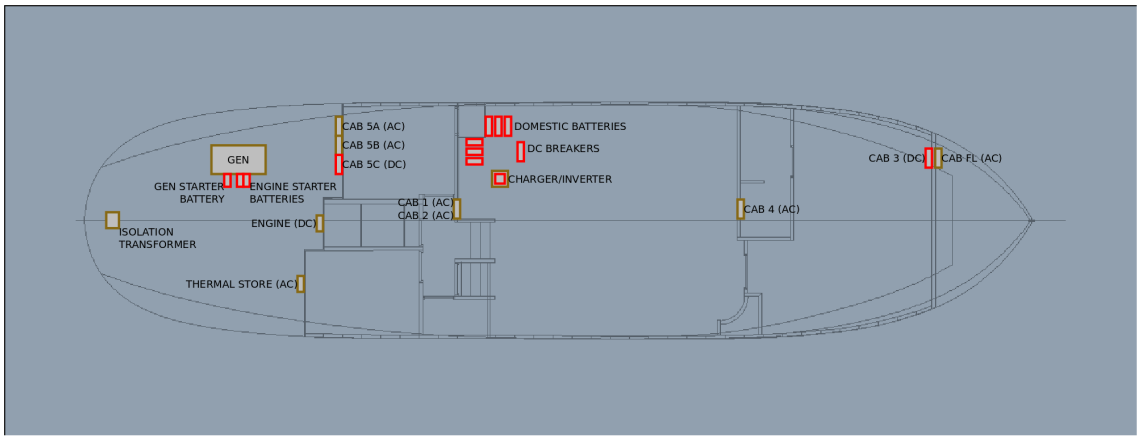
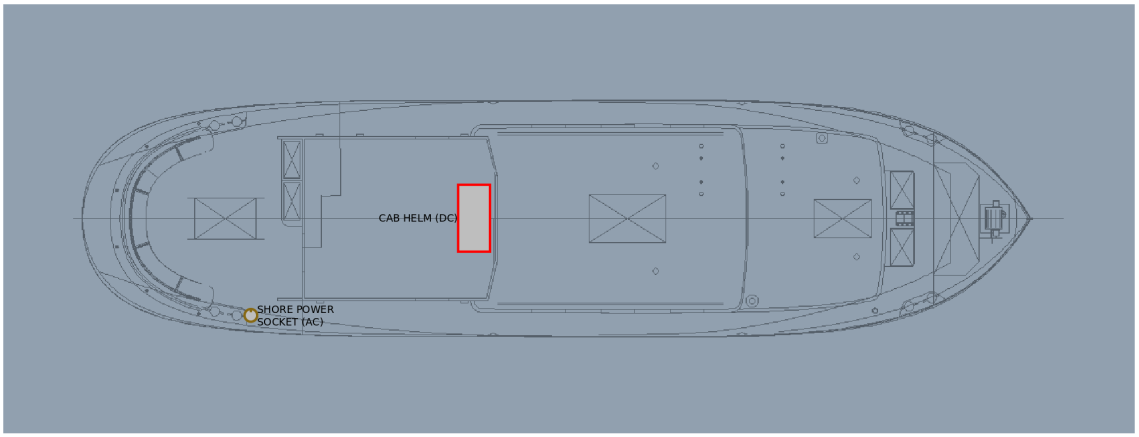


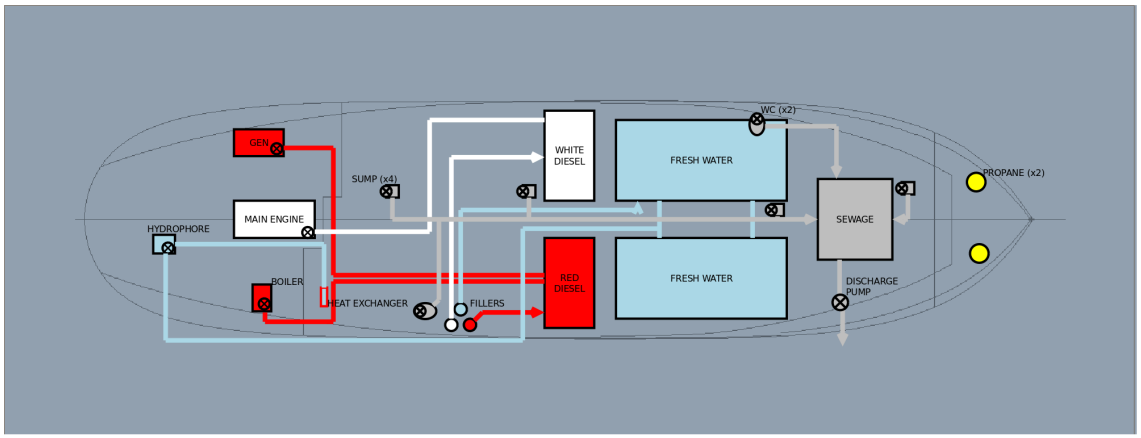
Figure 1.4. Electrical distribution (above deck)



1.1.3. Fluid storage and handling

The vessel provides storage for red diesel (1100 litres), white diesel (1100 litres), fresh water (4000 litres), sewage (1400 litres) and propane gas (2 x 11kg bottles). Diesel oil consumers pump their own fuel. Hot and cold water is provided as a ship wide resource by a hydrophore and heat-exchange calorifier. Sewage is pumped to the holding tank by WCs and sumps and the tank can be emptied either by pump-out or by an overboard discharge pump.

Figure 1.5. Fluid storage and handling



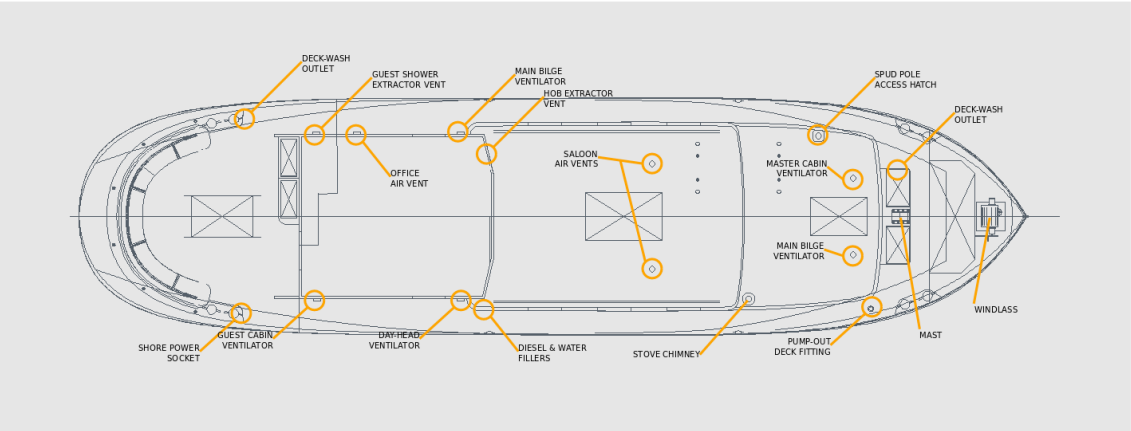
1.1.4. Hydraulics

The ship's hydraulic system is driven by a transmission mounted pump feeding a hydraulic reservoir and control unit. The control unit directly feeds an 'orbitrol' steering system and provides a high-pressure feed to the bow thruster motor and low pressure feeds to the windlass and mast cylinder.

1.1.5. Deck equipment

The following schematic shows the position of the most important above-deck installations.

Figure 1.6. Deck equipment



1.2. Control panels

Operation of the vessel is supported by two physical control panels:

- the domestic panel provides instrumentation and control of all house functions and enables/disables...
- the helm panel which provides instrumentation and control of the ship's navigation and technical installations.

In addition, a number of virtual interfaces and controls are implemented by the ship's Signal K server are made available on the vessel's LAN.

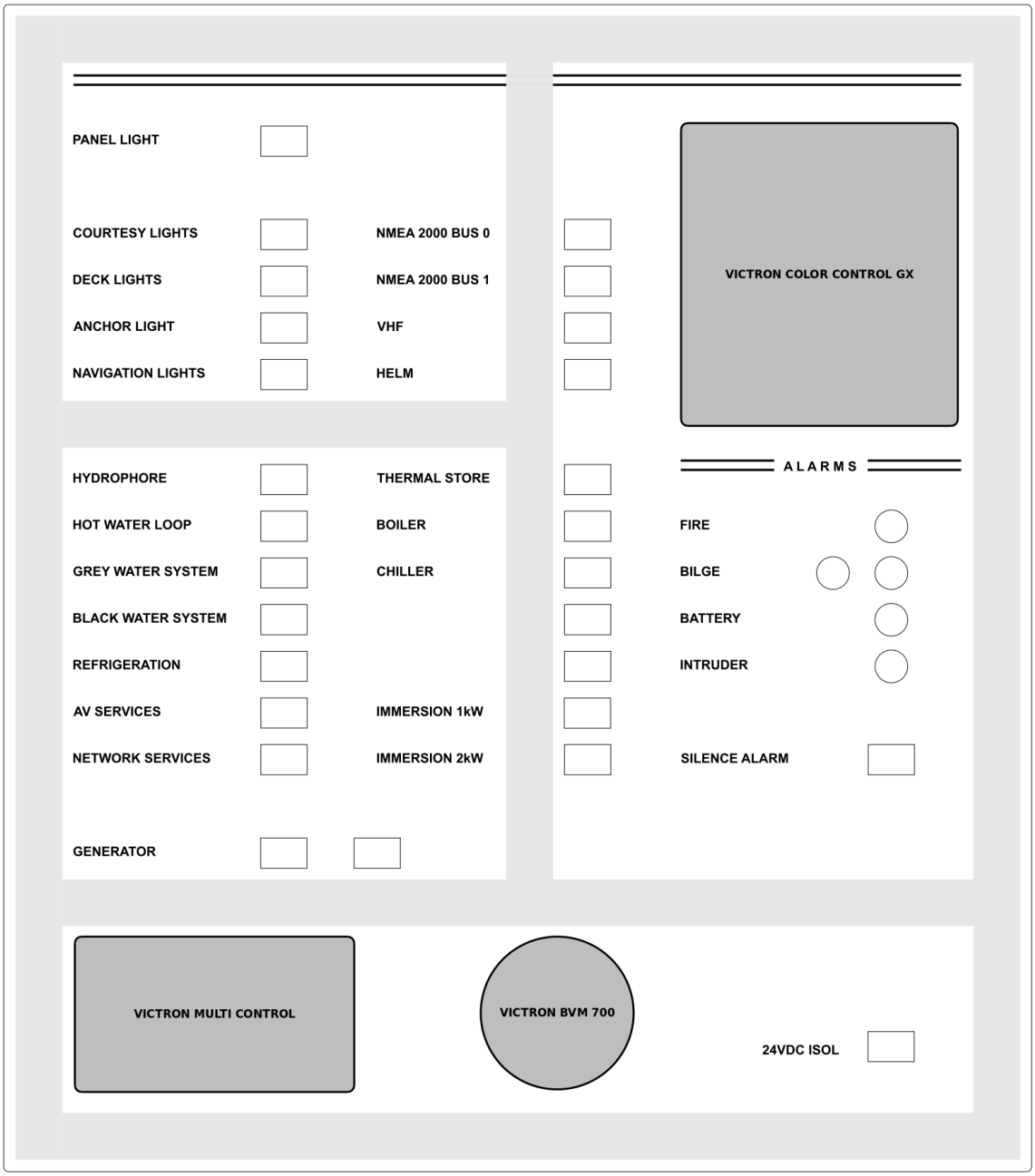
1.2.1. Physical control panels

1.2.1.1. Domestic panel

See ??? for an electrical schematic.

The domestic panel, located in the lower companionway, is the ship's primary control panel bringigng together all of the ship's 'house management' functions and providing controls for enabling and disabling most of vessel's systems. For most controls to actually do anything NMEA BUS 0 must be enabled.

Figure 1.7. Domestic panel layout



1.2.1.1.1. Instruments and control panels

The domestic panel incorporates three sub-panels concerned primarily with the ship's electrical power systems.[1]

Refer to the manufacturer's user manuals for information on the operation of these devices.

1.2.1.1.2. Indicator and switch controls

1.2.1.1.2.1. Indicators

All indicators on the domestic panel reflect the state of helm alarm system channels.

[1]The Color Control GX is also able to display tank level information.

FIRE

Illuminates to indicate that a fire alarm signal is active. Consult the fire alarm panel to determine the source of the alarm.

BILGE

The left-hand indicator Illuminates when the engine room bilge pump is running. The right-hand indicator illuminates when the main compartment bilge pump is running.

BATTERY

Illuminates when the battery management system reports low voltage on the domestic battery bank.

INTRUDER

Illuminates when the intruder alarm is triggered. Consult the intruder alarm panel to determine the source of the alarm.

1.2.1.1.2.2. Switch controls

PANEL LIGHT (OFF-ON)

Operates the domestic panel backlighting. The backlighting can be dimmed at the helm.

COURTESY LIGHTS (OFF-ON)

Operates the side-deck courtesy lights.

DECK LIGHTS (OFF-ON)

Operates the fore-deck work lights.

ANCHOR LIGHT (OFF-ON)

Operates the anchor light.

NAVIGATION LIGHTS (OFF-ON)

Operates the port-side, starboard-side, stern and steaming lights.

HYDROPHORE (OFF-ON)

Operates the pressurised water system.

HOT WATER LOOP (OFF-ON)

Enables the hot-water loop. The hot-water loop is operated by an intelligent pump and once enabled will take some time to learn the domestic hot-water usage pattern.

GREY WATER SYSTEM (OFF-ON)

(unused)

BLACK WATER SYSTEM (OFF-ON)

(unused)

REFRIGERATION (OFF-ON)

Operates the refrigerator and freezer.

AV SERVICES (OFF-ON)

Operates the satellite receiver and DLNA file server.

NETWORK SERVICES (OFF-ON)

Operates the network switch, file server and mapping system.

GENERATOR (2 SWITCHES (OFF-ON))

These controls are only active if the generator control panel is in AUTO mode. In which case:

The left-hand switch starts the generator. The right-hand switch transfers generator control to the Victron Color Control GX battery management system so that a low-voltage alarm will automatically start the generator.

NMEA 2000 BUS 0 (OFF-ON)

Operates the NMEA 2000 BUS 0 power supply. BUS 0 is the ship's 'domestic bus' and must be on for the operation of most domestic controls, instrumentation and services.

NMEA 2000 BUS 1 (OFF-ON)

Operates the NMEA 2000 BUS 1 power supply. BUS 1 is the ship's 'navigation bus' and must be on for the operation of most navigation controls, instrumentation and services.

VHF (OFF-ON)

Enables the ship's VHF services which include the main VHF and AIS transceivers.

HELM (OFF-ON)

Enables the ship's helm panel. Most helm controls will only operate if this switch is ON.

THERMAL STORE (OFF-ON)

Enables the ship's domestic hot water system.

BOILER (OFF-ON)

Enables the ship's diesel boiler. Note that the boiler will only operate if channel 1 (space heating) or channel 2 (hot water) of the galley timer control are ON.

CHILLER (OFF-ON)

Enables the ship's chiller system. Note that the chiller will only operate if the galley chiller control panel is set appropriately.

IMMERSION 1KW (OFF-ON)

Operates the thermal stores upper immersion heater.

IMMERSION 2KW (OFF-ON)

Operates the thermal stores lower immersion heater.

SILENCE ALARM (OFF-(CANCEL))

Cancels the audible component of the helm alarm system annunciator. The visual component of the alarm annunciator will continue to operate until the alarm condition is cleared.

24VDC ISOL (OFF-(OPERATE))

Operates the change-over solenoid on the DC system non-essential services master switch.

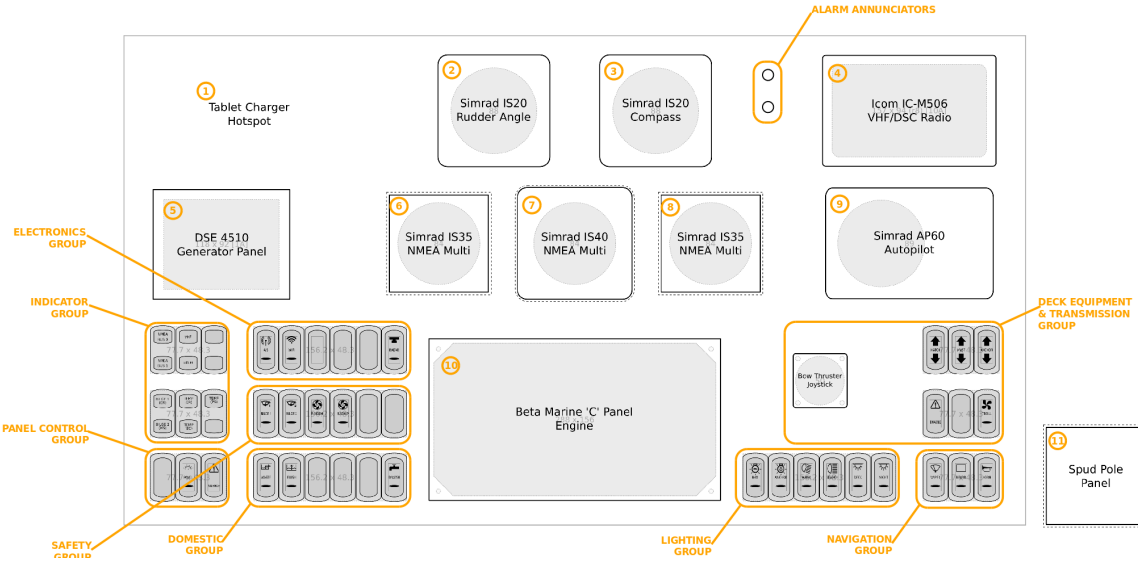
1.2.1.2. Helm panel

The helm panel (see Figure 1.8, “Helm panel”) brings together important controls and instrumentation mainly concerned with navigation of the vessel.

The helm panel is incrementally enabled by four domestic panel controls **HELM**, **NMEA BUS 0**[2], **NMEA BUS 1** and **VHF**[3]which must all be switched ON for the helm panel to be fully functional.

Non-navigation and safety features (including a multi-channel alarm system which alerts a range of critical operating conditions) of the helm panel are available at all times irrespective of the state of domestic panel controls.

Figure 1.8. Helm panel



1.2.1.2.1. Helm alarm system

The alarm system has ten input channels. A signal on any channel will trigger an audible and visual signals at the alarm annunciator; the audible component of an alarm can be cancelled by operating the SILENCE control (the visual alarm component will remain active until the fault or safety condition which triggered the alarm is removed).

Channel	Name	Meaning
1	Engine compartment bilge emergency level	Either the bilge pump is switched off or inundation is beyond the capacity of the bilge pump.
2	Main compartment bilge emergency level	Either the bilge pump is switched off or inundation is beyond the capacity of the bilge pump.
3	Engine compartment bilge pump operating	The bilge pump has been started either by the float switch or by manual operation of the helm control.
4	Main compartment bilge pump failure	The bilge pump has been started either by the float switch or by manual operation of the helm control.
5	Waste discharge pump operating	The waste discharge pump has been started either automatically or by manual operation of the helm control.
6	Domestic battery bank low	The battery controller at the domestic panel has signalled a low-voltage alarm for the domestic battery bank. This alarm signal may be accompanied by an automatic generator start.

[2]Only required for access to tank level data
[3]Required for operation of the main VHF radio

Channel	Name	Meaning
7	Fire alarm active	The fire alarm system has been triggered.
8	Intruder alarm active	The intruder alarm system has been triggered.
9	(unused)	
10	(unused)	

1.2.1.2.2. Instruments and control panels

The ship's helm panel is the primary location for navigation instrumentation and control and incorporates switches, indicators (both described below) and the following discrete instruments and control panels.

Ref	Instrument	Type	Domestic panel control dependency	Data connections	Default configuration
1	Tablet induction charger		None		
2	Multi display	Simrad IS40	HELM, NMEA BUS 1, NMEA BUS 0 (optional)	NMEA 2000	Depth/log/ temperature
3	Multi display	Simrad IS40	HELM, NMEA BUS 1, NMEA BUS 0 (optional)	NMEA 2000	Compass
4	VHF transceiver	Icom M506	When VHF enabled	NMEA 2000	
5	Generator control	DSE 4510	Always	Ethernet	
6	Multi display	Simrad IS35	HELM, NMEA BUS 1, NMEA BUS 0 (optional)	NMEA 2000	Tank levels
7	Multi display	Simrad IS40	HELM, NMEA BUS 1, NMEA BUS 0 (optional)	NMEA 2000	Rudder
8	Multi display	Simrad IS35	HELM, NMEA BUS 1, NMEA BUS 0 (optional)	NMEA 2000	Autopilot auxiliary
9	Autopilot control	Simrad AP60	HELM, NMEA BUS 1, NMEA BUS 0 (optional)	NMEA 2000	
10	Engine control	Beta Marine 'C'	Always	(none)	
11	Spud control		Always	(none)	

Refer to the manufacturer's user manuals for information on the operation of these devices.

1.2.1.2.3. Indicator and switch controls

The helm panel indicators and switches are water resistant, mult-function, industrial devices rated for 24VDC operation at up to 30A. Background and function illumination is by LED.

Some of the panel switches handle operating currents (for example the windscreen-wiper switch), but the majority switch a signal in the mA range sufficient to operate an NMEA 2000 switch bank interface or, occasionally, a remote relay.

1.2.1.2.3.1. Indicators

Carling VP series, two-segment, LED indicators are used throughout.

NMEA0 / NMEA1

The upper indicator segment illuminates when NMEA BUS 0 is powered.

The lower indicator segment illuminates when NMEA BUS 1 is powered.

The ship's NMEA busses are switched at the domestic panel and for navigational use of the helm use both indicator segments should be lit.

VHF / HELM

The upper indicator segment illuminates when VHF systems are enabled (this includes the ship's primary maritime VHF transceiver and the vessel's AIS transponder).

The lower indicator segment illuminates when the helm panel is enabled.

The ship's VHF sytems and the helm panel are switched at the domestic panel and for navigational use of the helm both indicator segments should be lit.

BILGE 1 (ER) / BILGE 2 (MS)

The upper indicator segment illuminates when either the engine compartment bilge system is disabled or the engine room bilge pump is running.

The lower indicator segment illuminates when either the main compartment bilge system is disabled or the main compartment bilge pump is running.

TEMP (ER) / TEMP (BC)

The upper indicator segment illuminates when the engine compartment temperature exceeds 30C.

The lower indicator segment illuminates when the battery compartment temperature exceeds 30C.

WASTE PUMP / (not used)

The upper indicator segment illuminates when the waste discharge pump is running.

1.2.1.2.3.2. Switches

Carling L series switches are used throughout.

The switches used in the helm panel are either two-state (single-throw) or three-state (double throw). Two state switches adopt the European convention that the 'up' position is the 'off' state and the other position signals some type of 'on'-ness. Three position switches adopt the 'up is off' convention where possible, but there are a number of situations where this principle cannot apply.

The notation used in this section to describe a two position switch is (*upState-downState*) and a three position switch (*upState-midState-downState*). If a switch position is momentary (i.e. the switch must be held in position by finger pressure), then this position is indicated in parentheses: for example (*upState*-(*downState*)).

1.2.1.2.3.2.1. Deck equipment & transmission group

These controls are concerned with heavy equipment under hydraulic operation and with change of transmission mode of operation.

For safety reasons, the **ENABLE** control must be switched on before other controls in this group will operate.

All of the controls in this group with the exception of the bow-thruster joystick are avaialable on a hand-held deck remote control.

ANCHOR ((UP)-STOP-(DOWN))

Raises and lowers the anchor. The anchor must be released and the winch engaged before operating this control.

ENABLE (OFF-ENABLE)

In the ON position the other controls in this group together with the bow-thruster joystick are enabled.

HATCH ((OPEN)-STOP-(CLOSE))

Opens and closes the fore-deck hatch. The hatch must be unlocked before operating this control.

MAST ((UP)-STOP-(DOWN))

Raises and lowers the mast. The mast guys must be released before operating this control.

TROLL (OFF-ON)

In the ON position the transmission is switched to trolling mode, restricting the propellor revolutions for slow speed manoevering.

1.2.1.2.3.2.2. Domestic group

These controls are concerned with operation of some domestic systems.

D.WASH (OFF-ON)

In the ON position the aft deck-wash raw-water pump is enabled.

FLUSH (OFF-ON)

In the ON position the sewage holding tank will be automatically flushed with raw water when waste discharge completes.

WASTE (OFF-AUTO-ON)

In the AUTO position the sewage holding tank will be automatically discharged when it reaches the alert capacity set in the ship's Signal K system. If this mode is selected then the holding tank discharge valve and sea-cock must be left open.

In the ON position the sewage discharge pump will operate. Before selecting this mode, the holding tank discharge valve and sea-cock must be open.

1.2.1.2.3.2.3. Electronics group

These controls operate auxilliary electronic equipment supporting navigation.

AIS (OFF-RECV-TRANSMIT)

In the RECV position the ship's AIS transceiver will receive data from other stations, but will not broadcast this ship's position.

In the TRANSMIT position the transceiver will both receive and transmit AIS data.

RADAR (OFF-ON)

In the ON position the ship's radar is powered up.

WIFI (OFF-ON)

In the ON position the ship's external WiFi gateway is powered up. The gateway provides a high-gain antenna for accessing external WiFi hotspots and a local wireless hub which supports, amongst other things, VoIP communication for deck crew.

1.2.1.2.3.2.4. Lighting group

These controls are concerned with operation of lights associated with navigation.

NAV (OFF-ON)

In the ON position the ship's navigation lights (steaming light, stern light, port and starboard lights) are illuminated.

ANCHOR (OFF-ON)

In the ON position the ship's anchor light is illuminated.

WORK (OFF-ON)

In the ON position the ship's work lights (covering the foredeck) are illuminated.

SEARCH (OFF-ON)

In the ON position the ship's searchlight connection socket is powered.

DECK (OFF-ON)

In the ON position the ship's courtesy lights are illuminated.

NIGHT (OFF-ON)

In the ON position the ship's red wheelhouse night lighting is illuminated.

1.2.1.2.3.2.5. Navigation group

WIPER (OFF-ON-(MODE))

In the ON position the windscreen wiper(s) operate. The operating speed and the screen wash are selected by the MODE position. Refer to the windscreen wiper controller manual for more information.

BOARD (OFF-ON)

In the ON position the ship's blue board is displayed (moved to its vertical position); in the OFF psoition the board is restored to its horizontal parking position.

HORN (OFF-(ON))

In the ON position the ship's horn sounds for the duration the switch is operated.

1.2.1.2.3.2.6. Panel control group

These controls are concerned with modifying the operation of the helm panel itself.

PANEL ((UP)-OFF-(DOWN)

In the UP position panel background illumination is increased; in the DOWN position panel illumination is decreased.

SILENCE (OFF-(SILENCE))

The SILENCE position cancels the audible component of any active alarm conditions. Note that the alarm indicator lamp will remain illuminated until the cause of the alarm condition is cleared and that any new alarm conditions will cause the audible alarm to sound again).

1.2.1.2.3.2.7. Safety group

These controls are concerned with operation of environmental safety systems.

BILGE 1 (OFF-AUTO-ON)

This control operates the engine compartment bilge system and should normally be left in the AUTO position. The bilge system is integrated into the ship's helm alarm system and operation of this control may trigger an alert.

In the AUTO position the engine compartment bilge pump will be operated by the system float switch.

In the ON position the engine compartment bilge pump will run continuously.

BILGE 2 (OFF-AUTO-ON)

This control operates the main compartment bilge system and should normally be left in the AUTO position. The bilge system is integrated into the ship's helm alarm system and operation of this control may trigger an alert.

In the AUTO position the main compartment bilge pump will be operated by the system float switch.

In the ON position the main compartment bilge pump will run continuously.

E.ROOM (OFF-AUTO-ON)

This control operates the engine room ventilation system and should normally be left in the AUTO position.

In the AUTO position the engine room ventilation system will operate when the engine room temperature exceeds the set point on the engine room thermostat.

In the ON position the engine room ventilation system will run continuously.

B.COMP (OFF-AUTO-ON)

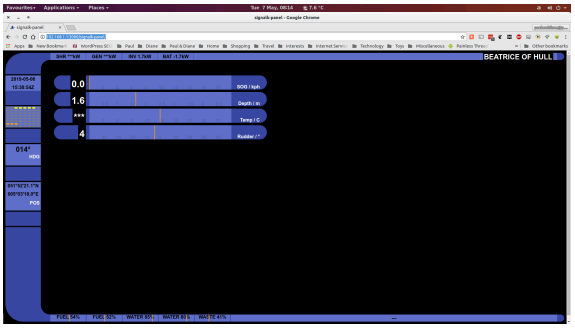
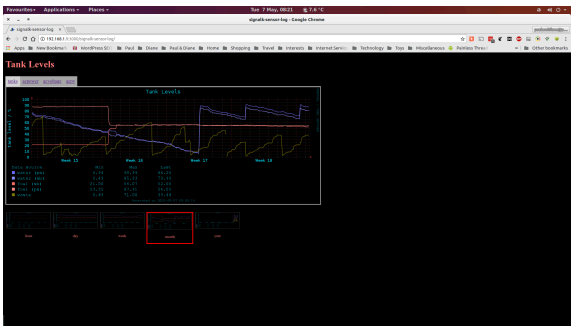
This control operates the battery compartment ventilation system and should normally be left in the AUTO position.

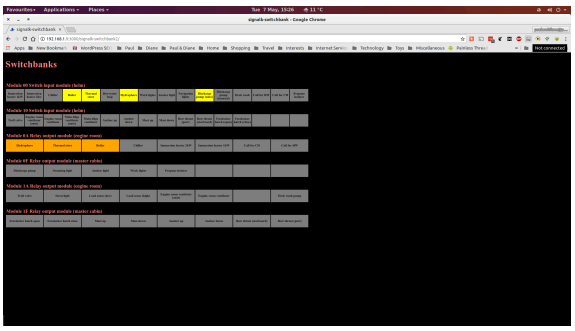
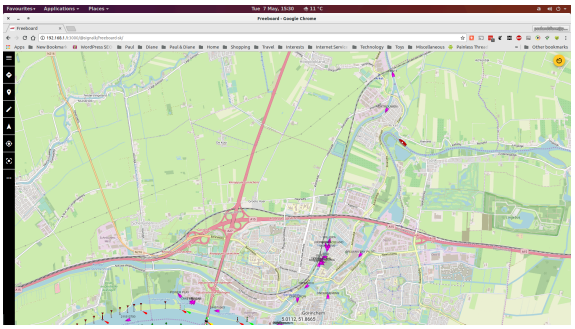
In the AUTO position the battery compartment ventilation system will operate when the battery compartment temperature exceeds the set point on the battery compartment thermostat.

In the ON position the battery compartment ventilation system will run continuously.

1.2.2. Logical control panels

A number of logical control panels are implemented as Signal K server webapp plugins.

Signalk Panel (http://192.168.1.1:3000/signalk-panel/) is a simple integrated instrument panel displaying house and navigation data.	
Signalk Log Viewer (http://192.168.1.1:3000/signalk-log-viewer/) is a viewer for data logged by the `signalk-log-viewer` plugin.	

Signalk Switchbank (http://192.168.1.1:3000/signalk-switchbank/) visualises the state of NMEA 2000 switchbank input and output channels defined by the `signalk-switchbank` plugin.	
Freeboard-sk (http://192.168.1.1:3000/freebaord-sk/) chartplotter.	

1.3. Propulsion and steering

The vessel is powered by a marine diesel engine driving a fixed propellor through a reversing marine gearbox. The entire propulsion drive-train is flexibly mounted and well isolated.

1.3.1. Main engine

The vessel is equipped with a four cylinder, water-cooled, diesel engine fitted with a dry exhaust system. Waste heat from the main engine is used to charge the ship's thermal buffer.

Make	Deutz	
Type	BF4M 1013MC	
Engine number		
Power rating (kW (hp))		
Cooling	Water (indirect)	
Engine controls	Cable	

 Take care to perform the necessary routine maintenance.

 Remove the key from the helm engine panel before working on the engine.

 The engine becomes hot during operation and remains hot afterwards.

 [deut1]

1.3.1.1. Main engine controls

The main engine instrument and control panel is located at the helm.

To start the engine:

1. Ensure that the helm lever control is in neutral and the throttle at the tick-over position.
2. Insert the key in the ignition switch and rotate clockwise to position I (ignition on). The green 'panel ready' and red 'low oil pressure' and 'charge failure' warning indicators will illuminate and the associated audible alarm will sound.
3. Turn the ignition key clockwise against its spring to position II (start) and hold to crank the engine. Release the key as soon as the engine starts or, if the engine fails to start, after five seconds.
4. If the engine failed to start repeat step (3). If the engine repeatedly fails to start there is a fault: consult the engine user manual.
5. When the engine starts the charge failure and low oil pressure warning lights should extinguish and the alarm should silence. If either of these fail to happen, consult the engine user manual.
6. Allow the engine to warm up for a few minutes before operating under load.

To stop the engine:

1. Ensure that the helm lever control is in neutral and the throttle at the tick-over position.
2. If the engine has been under heavy load, allow it to run at tick-over for a few minutes to cool.
3. Press the engine panel STOP button.

4. Wait for the engine to stop, the charge failure light and low oil pressure lights to illuminate and the associated alarm to sound.

5. Turn the ignition key to position 0.

⚠To avoid damage to the engine alternator never stop the engine by simply turning the ignition key to position 0.

Engine speed is controlled by the combined throttle/gear lever which operates through control cables: if the engine speed or gears cannot be changed then in the first instance check for a broken cable.

1.3.1.2. Main engine electrics

The main engine operates at 24VDC. Twin 120Ah 12VDC cranking batteries are installed on the port side of the engine room with an adjacent battery isolator switch, split-charge module and dedicated 24VDC battery charger which is energised only when the ship is connected to shore or generator supply.

The main engine alternator provides up to 140A of charging current to both the engine starter batteries and the domestic battery bank through the split charge system.

1.3.1.3. Main engine exhaust

The vessel has a dry exhaust system routed through a silencer and discharging through the transom.

⚠ The exhaust system is thoroughly insulated against heat loss, but caution must be exercised when moving around the engine room during or shortly after operation of the main engine.

1.3.1.4. Main engine cooling

The main engine is indirectly cooled through an immersed heat exchanger located in a protected cavity at the port side of the hull.

The heat exchanger can be serviced from the engine room without the need for lift-out or dry-docking. A subsidiary primary cooling circuit is used to heat the ship's thermal buffer through a heat transfer coil.

The primary cooling circuit is pumped by a mechanically driven engine mounted impeller.

⚠ The exposed cooling circuit pipework becomes hot during engine operation.

[blok2]

1.3.2. Transmission

The vessel is equipped with a conventional marine reduction gearbox mounted directly to the rear of the main engine. Gearbox lubrication is separate from the main engine, but uses the same type of lubricating oil.

The gearbox supports an electrically selectable trolling mode and provides a permanent power take off (PTO) for the ship's hydraulic system.

Make	PRM	
Type	500	
Reduction ration	2:1	
Gearbox number		
Gearbox controls	Cable (fwd/rev/troll) and electrical (troll enable)	

⚠ Take care to perform the necessary routine maintenance.

Remove the key from the helm engine panel before working on the engine.

[prm1][prm2]

1.3.3. Shafting and propellor

The output of the vessel's gearbox is coupled to the propellor shaft by a flexible coupling which reduces vibration and eliminates the need for precise engine alignment. The propellor shaft exits the vessel through a conventional stuffing-box with continuous automatic shaft lubrication.

1.3.3.1. Anti-vibration coupling

Make	Python-drive	
Type	P200-T	

[pyth1]

1.3.3.2. Shaft seal

The shaft seal is a standard marine stuffing box with double sealing.

Make		
Type		

The stuffing material requires periodic replacement.

[blok1]

1.3.3.3. Shaft lubrication

The primary shaft lubrication system is electrically driven and operates continuously whilst the main engine is running. If the automatic lubrication system fails, a conventional manual lubrication cup can be used to ensure that the shaft can be operated safely.

Make		
Type		
Grease		

Regularly check grease levels and top-up as necessary.

MANUAL NOT SUPPLIED

1.3.3.4. Propellor

Make	Michigan	
Type	GL469	
Size (in)	32 x 27	

1.3.4. Steering

The steering system is hydraulically operated. Turning the ship's wheel operates a helm pump which pumps fluid through pipework to twin steering cylinders connected to a quadrant on the rudder.

When the ship's main engine is running, power from the ship's hydraulic system is used to augment the manual steering system, making steering lighter and more comfortable in use.

1.3.4.1. Steering assistance

Steering assistance is implemented through an 'orbitrol' valve which opens when the wheel is turned, allowing the hydraulic system to effect rudder cylinder action. Assisted steering is only available when the main engine is running.

1.3.4.2. Emergency steering

In the unlikely event of the hydraulic steering system failing the rudder can be operated manually through use of an emergency tiller. To use the emergency tiller:

1. Open the hatch over the aft centre deck locker to gain access to the tiller and rudder shaft.

2. Fit the tiller to the top of the rudder shaft

3. Open the bypass valve connecting the two hydraulic steering cylinder

4. Move the tiller to position the rudder

⚠ Steering using the tiller is only possible at low speeds - one person should operate the tiller and another the engine controls.

⚠ Keep the locker housing the tiller and rudder shaft clear of obstructions so that in an emergency the tiller can be installed easily.

1.4. Fuel system

Refer to Figure 1.1, “Safety equipment (above deck)” for a system overview.

Twin steel storage tanks are integrated into the vessel's hull midships. Fuel from the 1800 litre port-side tank is used exclusively for main-engine propulsion whilst fuel from the 1800 litre starboard tank is used exclusively for domestic heating and electricity generation. The two storage tanks are not interconnected, but barbs and valves are provided which would allow tank interconnection in an emergency.

Fuel filling, distribution, return and tank venting is through metallic pipes and non-metallic hoses of sturdy construction. All connections to (moving) machinery is made with flexible hoses.

Water separators and filters are placed in front of each fuel consumer. The generator fuel supply line is assisted by a lift pump mounted inside the generator cabinet.

1.4.1. Filling the tanks

Two filling points clearly marked "DIESEL" are located in a recess on the starboard side of the vessel just forwards of the wheelhouse. The left-hand filler connects to the domestic fuel tank; the right-hand filler connects to the propulsion fuel tank.

In some regulatory authorities it is permissible to use reduced tax fuel ('red diesel' in Europe) for domestic purposes. DO NOT fill the vessel's propulsion tank with red-diesel. The procedure for filling a tank is:

1. Determine the type of fuel to be taken on (red or white diesel) and so identify the associated tank and filler location.
2. Check the appropriate tank level using one of the vessel's display gauges and so determine how much fuel can be taken on.
3. Open the correct filler cap.
4. Start filling the tank: begin with a steady to moderate flow.
5. Check the tank level by monitoring a display gauge.
6. Do not fill the tank to its maximum: gauges are not exactly accurate and room should be left for expansion of the fuel and contraction of the tank. Filling to 90% capacity is sensible.
7. Replace and close the filler cap.
8. Clean up any spills
9. Make an entry in the ship's log.

⚠ Diesel oil must be treated as chemical waste and an absorbant cloth should be to hand when filling the ship's tanks.

1.4.2. Water separators and filters

Water separators and filters are located in the engine compartment.

The main engine is served by two water separators: the separator in use is selected by a valve which allows a changeover should one separator become clogged or require service. The generator and boiler each have single water separators. Any water collected by the separators should be regularly drained.

Fuel filters are located adjacent to or mounted on the main engine, generator and boiler.

⚠ Water separator and fuel filter elements must be regularly changed.

FILL ME IN

1.4.3. Tank level monitoring

Each tank is equipped with an electronic tank level monitoring system consisting of a hydrostatic tank level sender which broadcasts messages onto the ship's domestic NMEA 2000 bus. Tank level data can be displayed on screens located at the helm, domestic panel and elsewhere.

Variations in tank level readings are possible due to conditions of trim, list, seaway and callibration.

Tank level readings require NMEA BUS 0 to be enabled on the ship's domestic panel.

[mare1]

1.5. Fresh water system

The fresh water system consists of two 1680 litre stainless-steel fixed storage tanks, a hydrophore with a 230VAC electrical pump and an on-demand, plate heat-exchanger based, hot water generator.

Refer to Figure 1.1, “Safety equipment (above deck)” for a system overview.

The twin tanks are normally commoned through valves located under the saloon floor: it is possible to operate the system from just one tank by closing the appropriate valves between tanks and on the commoning manifold.

1.5.1. Filling the tanks

Ensure that the hose you use for topping up your potable water tanks is appropriate for potable water and that your chosen water water source is in fact dispensing drinking water.

1. Locate the deck filler marked "WATER".
2. Clean the area around the filler and ensure that any adjacent filler caps are firmly closed.
3. Clean the end of the hose which will be inserted into the ship's filler port and run water through the hose for a sufficient time to eliminate any retained or static water from the supply.
4. Open the deckfitting, insert the hose and commence filling.
5. Fill the tank. Do not overfill - a 90% reading on the tank gauge is a sensible target.
6. Remove the hose and replace the filler cap.
7. Make an entry in the ship's log.

1.5.2. Tank level monitoring

Each tank is equipped with an electronic tank level monitoring system consisting of a hydrostatic tank level sender which broadcasts messages onto the ship's domestic NMEA 2000 bus. Tank level data can be displayed on screens located at the helm, domestic panel and elsewhere.

⚠ Variations in tank level readings are possible due to conditions of trim, list, seaway and callibration.

⚠ Tank level sensing requires NMEA BUS 0 to be enabled on the ship's domestic panel.

[mare1]

1.5.3. Pressure system

The ship's hydrophore is installed in the engine room and consists of a 230VAC electrically driven pump and pressure vessel. The system is set to a default pressure of 3bar and will automatically maintain this, starting the pump as necessary to cater for demand.

The system is entirely automatic in operation and it is recommended that the hydrophore remain powered at all times.

To enable and disable the pressure system use the switch labelled HYDROPHORE on the ship's domestic panel.

⚠ The pressure system can only be enable and disabled if NMEA BUS 0 is enabled.

⚠ The motor and pump have an exposed mechanism and may begin operation unexpectedly.

Danger of electrical shock 230VAC

[spec1]

1.5.4. Hot water

Hot water is generated by a heat exchanger system located in the engine-room. When a hot-water tap is opened fluid from the ship's thermal buffer is pumped through the heat exchanger primary circuit and used to heat cold water, delivered by the hydrophore, in the heat exchanger secondary circuit.

An independent pumped hot-water loop attempts to predict demand for hot water and ensure that, under most circumstances, pre-heated water is available at an outlet in anticipation of its likely use.

When the thermal buffer is fully charged it can supply enough hot water for at least a day's normal domestic usage without the input of any additional energy.

If the thermal buffer is cold, then it can be recharged for the purpose of hot water generation almost instantaneously from the ship's boiler or less rapidly by use of the immersion heaters (waste heat from operation of the main engine and generator is also used to recharge the buffer). Refer to Section 1.10.1, “Thermal buffer” for detailed information on managing the thermal buffer.

To enable and disable the hot-water system use the switch marked THERMAL STORE on the ship's domestic panel.

To enable and disable the hot-water loop use the switch marked HOT WATER LOOP on the ship's domestic panel.

The hot water system can only be enabled and disabled if NMEA BUS 0 is enabled.

FILL ME IN

1.5.5. Heads

WCs on the vessel are operated electrically and flush from the ship's fresh water system, discharging directly into the ship's black water holding tank. The WC units are operated by a simple flush button and consume either 3 litres of 5 litres of water per operation depending on the selected flush mode.

WC units operate at 230VAC, unplug from mains before servicing.

[sani1]

1.6. Waste water system

The waste water system consists of a 1100 litre holding tank, which accumulates grey water waste from sinks, basins and showers and black water waste from WCs. The holding tank is vented through the hull via a charcoal filter.

WCs pump waste directly to the holding tank. All other waste water flows by gravity to sumps positioned around the vessel which automatically pump collected waste to the holding tank.

The holding tank can be emptied through a deck pump-out connection or by use of the ship's own discharge pump.

Refer to Figure 1.1, “Safety equipment (above deck)” for a system overview.

⚠ Never let the holding tank become too full: overfilling can cause a system malfunction with overflow of sewage water into the bilge and backflow into the rerst of the system.

1.6.1. Heads

WCs pump macerated waste directly to the holding tank each time the 'flush' function is activated.

The WCs operate at 230VAC and are supplied via circuit-breakers in distribution cabinets C1 and C4. The WCs should normally remain powered whenever the vessel is in use.

⚠ WC units operate at 230VAC, unplug from mains before servicing.

sani2

1.6.2. Sumps

Four sealed waste water sumps are located in the bilge at various locations around the vessel. Each sump contains a float switch which detects when the sump is full and energises a pump to dischargethe contents of the sump to the holding tank.

SUMP1

Collects waste water from the guest cabin shower and from the lower-deck fancoil unit condensate drain. The unit is accessed through a hatch in the office floor.

SUMP2

Collects waste water from washing machine, dishwasher, galley sink, day head basin, saloon fancoil unit condensate drain and the lower-deck porthole condensation drains. The unit is accessed through the crawlspace beyond the lower companionway.

SUMP3

Collects waste water from the master cabin en-suite basin and shower. The unit is accessed through the crawlspace beyond the lower companionway.

SUMP4

Collects waste water from the master cabin fancoil unit condensate drain. The unit is accessed through the hatch under the master cabin bed.

The sumps operate at 230VAC and are supplied via circuit-breakers in distribution cabinets C1 and C4. The sumps should normally remain powered whenever the vessel is in use.

⚠ Sump units operate at 230VAC, unplug from mains before servicing.

sani1

1.6.3. Tank level monitoring

The holding tank is equipped with an electronic tank level monitoring system consisting of a hydrostatic tank level sender which broadcasts messages onto the ship's domestic NMEA 2000 bus. Tank level data can be displayed on screens located at the helm, domestic panel and elsewhere.

Variations in tank level readings are possible due to conditions of trim, list, seaway and callibration.

Tank level readings require NMEA BUS 0 to be enabled on the ship's domestic panel.

[mare1]

1.6.4. Empting the holding tank

The holding tank can be emptied at a suitable shore-side pump-out facility or by pumping out using the ship's own discharge pump.

1.6.4.1. Emptying the holding tank at a pump-out station

1. Splash the area around the pump-out DECK FITTING with water to prevent any possible spillage adhering to the deck.
2. Close the tank DISCHARGE VALVE.
3. Open the tank SUCTION VALVE
4. Open the DECK FITTING and connect the suction hose from the shore pump-out facility. Make the sure the connection between the inner surface of the DECK FITTING and the suction hose is secure and leak free.
5. Start the shore-side suction and allow to complete.
6. Disconnect suction hose.
7. Close DECK FITTING.
8. Wash down deck if necessary and wash hands.
9. Close SUCTION VALVE
10. Make entry in ship's log.

1.6.4.2. Emptying the holding tank by pumping it out

1. Make sure that the vessel is in a body of water where pumping out is permitted and that discharge will not inconvenience anyone.
2. Open DISCHARGE VALVE and SEA COCK.
3. Operate the WASTE switch at the helm panel to start the discharge pump. The helm alarm will signal an alert whilst the pump is running: the audible component of the alert can be silenced, but the visual alert will continue until the discharge pump is switched off.
4. Listen for a change in pump resonance which indicates the tank is empty or monitor progress of the discharge on a tank level display. Discharging a full holding tank will take over 30 minutes. Do not let the discharge pump run dry unnecessarily.
5. Switch off the waste pump.

6. Close DISCHARGE VALVE and SEA COCK.

7. Make an entry in the ship's log.

1.6.4.3. Emptying the holding tank by pumping it out automatically

The vessel has an automatic discharge system integrated into the ship's NMEA 2000 controller. The automatic mode is selected from the **WASTE** switch at the helm panel and causes the controller to continuously monitor the waste level in the holding tank: at 90% capacity the controller will start the wast discharge pump, stopping it again when the tank reaches 10% capacity. Whilst the pump is in operation the helm alarm will signal an alert.

⚠ Ensure that the DISCHARGE VALVE and SEA COCK remain open whilst the discharge system is set to automatic.

1.7. Bilge pumping system

The vessel is equipped with two electrically operated bilge pumps, one in the engine compartment and another in the main compartment. Each pump is connected to a float switch which operates the bilge pump automatically when water is detected in the bilge. Each float switch is backed-up by an independent water level sensor connected to the ship's alarm system.

1.7.1. Bilge system controls

Each bilge system is operated by a three-position switch located at the helm (labelled **E.ROOM** and **M.COMP**):

UP POSITION

The bilge pump and float switch are switched off. In normal use the switch should never be left in this position unless the vessel is out of the water or the bilge system is being serviced. When the switch is in this position the associated bilge pump alarm indicator will illuminate.

MID POSITION

The bilge pump and float switch are enabled in automatic mode. If the float switch detects water in the bilge the pump will start automatically and the helm alarm annunciator and indicator will signal an alert and the associated bilge pump alarm indicator will illuminate.

DOWN POSITION

The bilge pump will run, the helm alarm annunciator and indicator will signal an alert and the associated bilge pump alarm indicator will illuminate.

1.7.2. Bilge system alarms

Each bilge system has an indicator light at the helm which illuminates when the assocated bilge system is switched off and/or when the bilge pump is running. The indicator will flash when the bilge backup sensor detects water: typically this means that the float switch has failed to activate the bilge pump or the compartment is being inundated at a rate beyond the capacity of the bilge pump.

The helm alarm system will activate when a bilge pump is running for whatever reason and also when a backup sensor detects water. The audible component of the alarm can be cancelled, but the visual component will remain active until the condition causing the alert is corrected.

1.8. Data networks

NMEA 2000 and Ethernet data networks are installed on the ship together with some small-scale proprietary networks concerned with operation of the Victron power system.

1.8.1. NMEA 2000

The vessel is equipped with two NMEA 2000 buses, bridged at the helm but powered separately via switches on the domestic panel.

NMEA BUS 0 ('domestic bus')

> NMEA bus 0 supports all on-board control functions and instrumentation of the ship's domestic or 'house' systems.
>
> If this bus is not permanently enabled then very few of the ship's systems can be monitored or operated.

NMEA BUS 1 ('navigation bus')

> NMEA bus 1 supports instrumentation and controls related to navigation of the vessel.
>
> This bus must be enabled when navigating the vessel, but should be powered down when the ship is moored.

The following schematic indicates the general arrangement of the NMEA 2000 network.

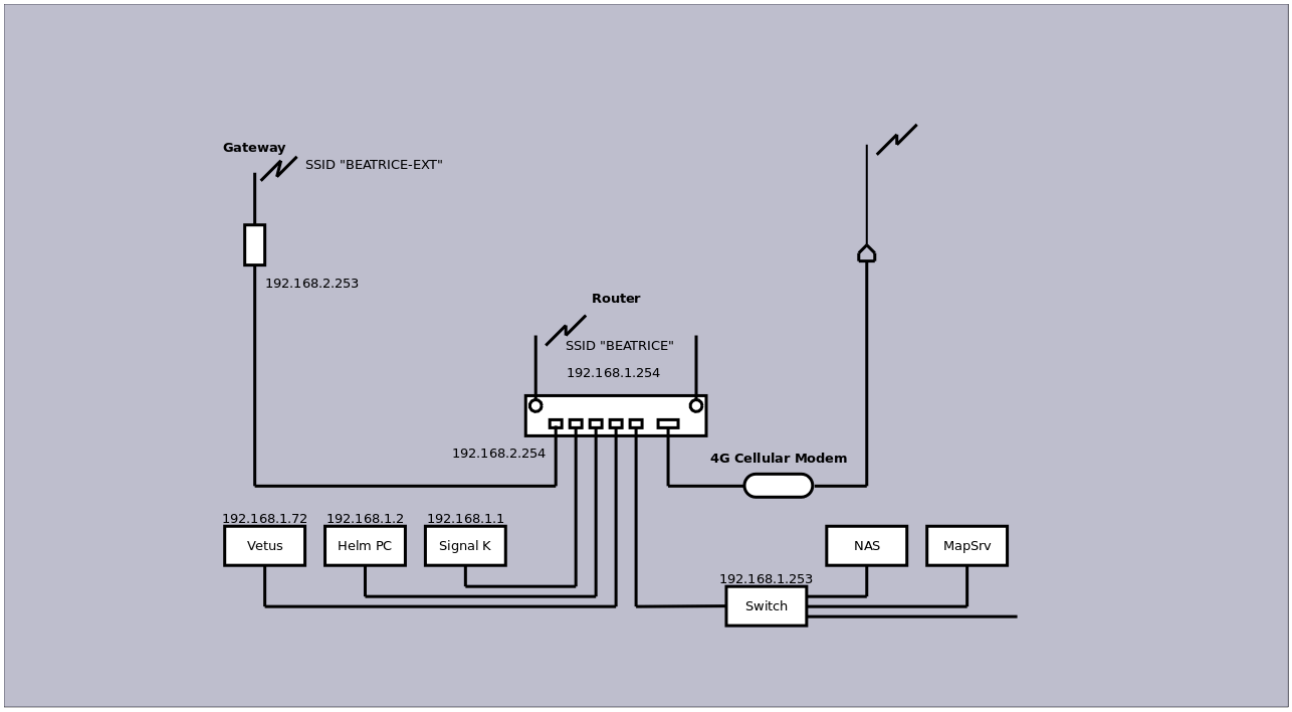
1.8.1.1. Equipment

The following table lists NMEA 2000 infrastructure components.

Device	Serial #	Instance	Bus	Location
Actisense NGT-1-ISO NMEA 2000 gateway		n/a	0	Helm
Actisense QNB1 network block		n/a	1	Helm panel
Oceanic Systems 3478 relay output module		0x0A	0	Engine room
Oceanic Systems 3478 relay output module		0x1A	1	Engine room
Oceanic Systems 3478 relay output module		0x0F	0	Master cabin
Oceanic Systems 3478 relay output module		0x1F	1	Master cabin
Oceanic Systems 4410 switch input module		0x01	0	Helm
Oceanic Systems 4410 switch input module		0x11	0	Helm
Maretron NBE100 network bus extender		n/a	0 & 1	Helm

1.8.2. Ethernet LAN

Figure 1.9. Ethernet LAN infrastructure components



Ethernet is used to support general access to ship services including information displays, virtual control panels, VoIP deck communication, map and NIS services and audio and video entrtainment.

1.8.2.1. Equipment

The following table lists Ethernet infrastructure components.

Item	Location	IP addresses (hostname)
NetGear N600 wireless router	Helm	192.168.1.254 (gateway), 192.168.2.254 (WAN), 192.168.3.254 (USB 4G)
Ubiquiti Networks Bullet gateway	On deck below blue-board	192.168.2.253 (bullet)
Cisco managed switch	Lower companionway server rack	192.168.1.253 (switch)
Signal K / NMEA controller	Helm	192.168.1.1 (controller)
Navigation PC	Helm	192.168.1.101 (helm)
NAS/DLNA server	Lower companionway server rack	192.168.1.2 (nas)
OpenSeaMap server	Lower companionway server rack	192.168.1.3 (maps)

1.8.2.2. Wired networks

CAT6 UTP cabling from around the ship terminates at a network switch located in the ship's data cabinet which is accessible behind a panel on the port side of the lower companionway. The switch WAN port is connected by a single cable to the main router located at the helm. Helm equipment which benefits from an Ethernet connection is cabled directly to the main router's built in LAN switch.

A second wired network consisting of a single cable connects the main router's WAN port to the ship's external gateway.

1.8.2.3. Wireless networks

The ship implements two WiFi networks: an internal network (SSID="BEATRICE") simply extends the vessels 192.168.1.0 network whilst an external network (SSID="BEATRICE-EXT") supports VoIP intercom use for deck crew and allows restricted access to on-board services for guests.

1.8.3. WAN

Connection to external networks is provided in three ways:

1. By WiFi. The ship's wireless gateway operates in station mode to allow connection to an available WiFi hotspot. The administration interface allows identification of and connection to available networks and is accessible at https://192.168.2.254/ with default credentials "ubnt:ubnt". For this service to be available, the **WiFi** switch at the helm must be on.

2. By 4G. The ship's router is equipped with a 4G USB dongle connected to a remote external antenna. The arrangement give a broadband quality data link to the Internet at a maximum speed of 150Mbs. The administration interface at https://192.168.1.254/ allows management of the connection.

3. By SMS. The USB dongle used for 4G connection also supports sending and receiving SMS messages which are used by some Signal K applications for notification of alerts and for remote control.

1.9. Electrical system

The vessel has a comprehensive electrical system with multiple sites of control and layered safety features. In summary.

System	Rating	Battery	Charging	Master switch
Generator start	12VDC	1 x 12VDC 120Ah	Alternator (on generator)	Engine room (aft switch)
			12 VDC battery charger	
Main engine start	24VDC	2 x 12VDC 120Ah	Alternator (split charge with domestic system)	Engine room (forward switch)
			24VDC battery charger	
Domestic	24VDC	12 x 2VDC 1100Ah	Main engine alternator (split charge)	Battery compartment
			Victron Quattro	
Generator	230VAC 12kVA	n/a		
Shore power	230VAC 7kVA	n/a	n/a	n/a
Inverter	230VAC 8kVA	n/a	n/a	n/a

1.9.1. 12VDC generator starting system

The generator starting system operates at 12VDC and is entirely self-contained with no consumers other than the generator system (including the generator control panel located at the helm).

1.9.1.1. Battery and master switch

A single 12VDC 120Ah battery and associated master switch are located below the generator housing on the port side of the engine room.

1.9.1.2. Charging system

The generator battery is charged from the generator alternator and from a separate 230VAC battery charger located next to the battery. The battery charger is only energised when the ship is on shore or generator power.

1.9.2. 24VDC main engine starting system

The main engine starting system operates at 24VDC and supports the main engine sytem (including the main engine control panel located at the helm), the shaft lubrication system and the navigation stern light.

1.9.2.1. Battery and master switch

Two 12VDC 120Ah series-connected batteries and associated master switch are located below the generator housing on the port side of the engine room.

1.9.2.2. Charging system

The main engine batteries are charged via a split-charge controller from the main engine alternator (the residual charging current is used to charge the ship's domestic battery bank) and from a separate 230VAC battery charger located next to the battery. The battery charger is only energised when the ship is on shore or generator power.

1.9.3. 24VDC domestic system

The domestic system operates at 24VDC and supports all ship's systems other than generator and main engine starting.

230VAC is distributed across the ship.

1.9.3.1. Batteries and master switch

Twelve 2VDC 1100Ah series-connected batteries provide power through the main isolator switch to the DC main distribution board all of which are located in the battery compartment below the galley floor.

1.9.3.2. Main distribution board

The main distribution board is supplied from the main isolator switch and is configured in three circuit groups each with differing isolation possibilities. See

Fuse (circuit)	Fuse rating/A	Group	Remark
F1 Inverter/charger	250		
F2 Inverter/charger	250		
F3 Spud pole	150		
F4 Alternator	150		
F5 Helm B	150	Helm non-essential services (all helm panel functions with the exception of bilge and alarm systems).	Group can be isolated locally at distribution board and remotely by the **DC ISOL** control on the domestic panel.
F6 Cabinet C3	100	""	
F7 (spare)		""	
F8 (spare)		""	
F9 Helm A	100	Helm essential services (bilge and alarm systems only).	Group can be isolated locally at distribution board.

1.9.3.3.

1.9.4. Domestic 230VAC system

The ship's 230VAC system supports most domestic consumer functions including hydrophore, heating, cooling, ventilation, galley refrigeration, interior lighting, WC and waste sumps. The supply-side of the system is controlled by an integrated charger-inverter monitored and operated from the domestic panel.

All outgoing circuits are routed through the main distribution cabinet C1 to a collection (C2, C4, C5a and C5b) of sub-cabinets which feed individual consumer circuits. All circuits are fused by circuit breaker and single-pole residual current protection.

Residual current safety features are only functional if the shore-power connection is properly polarised.

1.9.4.1. Energy sources

The following table lists available energy sources. The ship's systems are configured to automatically select the energy source with the lowest priority number when it is available. The charger/inverter is able to concurrently top-up any shortfall in generator or shore supply by inversion.

Source	Rating/kVA	Device	Priority	Control principle	Isolation
Generator	12	Diesel generator set	1	The generator is started manually by operation of the helm control panel or the **GENERATOR** control on the domestic panel. Automatic generator start is possible (see ? and the	Disconnect isolator switch in engine room.
Shore power	7	Isolating transformer	2	Shore power is automatically enabled when the shore power connection is plugged in.	Disconnect isolator switch in engine room.
Domestic battery set	8	Charger-inverter	3	The charge function is permanently enabled and can only be defeated by isolating the domestic battery bank. The inverter function can be disabled by the charger-inverter control panel on the domestic panel.	Main battery isolator.

1.9.4.2. 230VAC distribution

1.9.4.2.1. Distribution cabinet C1

Distribution cabinet C1 is the upper of the two cabinets installed in the forward bulkhead of the lower deck lobby and is the ship's main AC distribution cabinet.

The cabinet receives two 230VAC supplies directly from the ship's inverter/charger. A no-break supply (via isolator (1)) feeds all of the cabinet devices, deriving power from the currently selected source. A second supply (via isolator (6)) derives power from shore and generator only and routes this directly to cabinet C5a since the only consumers of this supply are located in the ship's engine room.

All circuits in the cabinet are overload and leakage protected. Four RCBO devices at the top-right of the cabinet supply individual circuits making these consumers insensitive to failures in other circuits and to nuisance tripping. Four outgoing circuits (protected by (2)) supply downstream distribution cabinets with circuits protected by (3), (4) and (5) supplying consumers in the galley and lower-deck.

Figure 1.10. Distribution cabinet C1

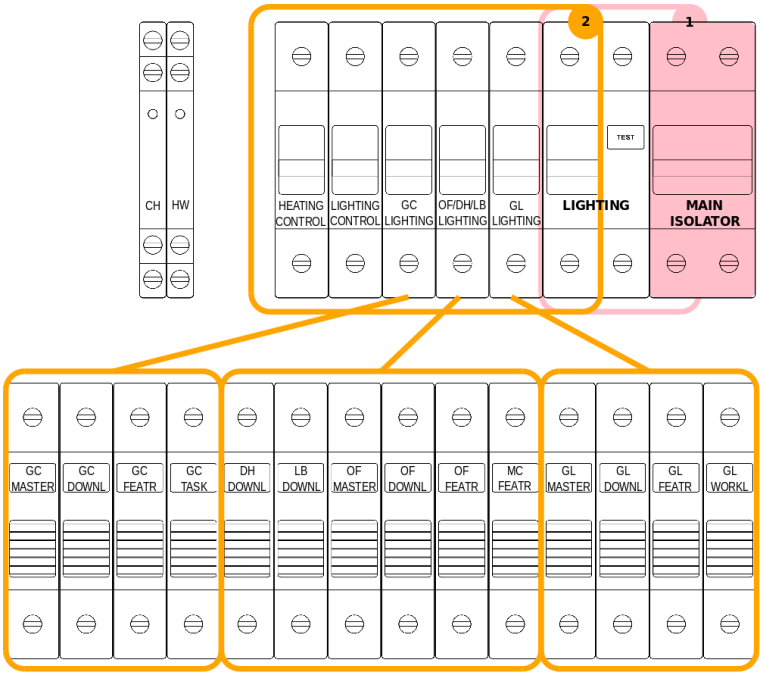
1.9.4.2.2. Distribution cabinet C2

Distribution cabinet C2 is the lower of the two cabinets installed in the forward bulkhead of the lower deck lobby.

The cabinet receives a 230VAC supply from cabinet C1 via isolator (1).

All circuits in the cabinet are overload and leakage protected and are concerened with lighting control for the aft of the ship, operation of the ship's PIR sensors, and heating control. The distribution cabinet houses a 12VDC power supply for the ship's PIR sensors and a 24VDC power supply for light switch circuits on the lower deck. The ship's intruder alarm system is installed in the lower half of the cabinet.

Figure 1.11. Distribution cabinet C2



1.10. Space heating, cooling and hot water

The vessel is equipped with an integrated hydronic space heating and cooling system (SHCS) (see ???).

SHCS is bi-modal: at any one time the system can be in either heating mode or cooling mode and it is not possible to heat one space on the ship whilst simultaneously cooling another.

The operating mode of SHCS is selected by the **CHILLER** switch at the domestic panel: when the switch is OFF, the system is in heating mode; when it is ON, the system is in cooling mode.[4]Domestic hot water is available irrespective of the operating mode of SHCS.

The vessel has a mix of fancoil and radiator heat exchangers: radiators only operate in heating mode whilst fancoil units will operate in both heating mode and cooling mode.

The primary heat source on the vessel is a large thermal buffer, consisting of a well-insulated mass of heated water, and in order for the ship to be heated and hot-water to be available, the buffer must be maintained at an appropriate operating temperature.

The primary heat sink on the vessel is a refrigeration unit capable of chilling the circulating hydronic fluid and so allowing fancoil units to blow cold air.

1.10.1. Thermal buffer

The thermal buffer holds 250 litres of hydronic fluid which acts as the heat source for space heating and domestic hot water.[5]Hydronic fluid in the thermal buffer stratifies by temperature: the hottest fluid at the top of the buffer and the coldest at the bottom. Hydronic fluid for domestic water heating is taken from the top of the buffer and fluid used for space heating is taken from the middle of the buffer. Cooled fluid is returned to the bottom of the store in order to preserve stratification.

1.10.1.1. Operating characteristics

The buffer is designed to operate at a maximum temperature of 85C and it can be heated (recharged) from the sources shown in the following table.

Heat source	Time for full recharge	Time for HW availability
1kW immersion heater	Several hours	~ 30 minutes
2kW immersion heater	~ 1 hour	~ 20 minutes
Diesel boiler	10 minutes	Instantaneous
Waste heat from generator	20 minutes	< 5 minutes
Waste heat from engine	20 minutes	< 5 minutes

Typically the hydronic fluid in the thermal buffer rapidly assumes a temperature gradient and it will be capable of driving the hot-water system and, to a lesser extent, SHCS in less time than would be required for a full recharge.

Exactly what constitutes a recharge using the boiler is determined by three thermostats mounted on the thermal store and one mounted on the boiler.

Thermostat	Set point/C (initial configuration)	Remark
Boiler	80	Determines the absolute maximum temperature of the thermal buffer.

[4]In fact, the ship's central chiller can operate in reverse cycle, so it is possible to operate the HVAC system in cooling mode in a way which generates space heating.

[5]One benefit of using a buffer is that its high heat capacity ensures that the diesel boiler runs more efficiently with less cycling than would occur if the boiler were directly driving the heating or hot water systems; a further benefit is that once heated the buffer can produce many times its own volume of domestic hot water.

Thermostat	Set point/C (initial configuration)	Remark
T1 (top thermostat)	50	Used to switch on the boiler when the recharge is intended to support hot water production.
T2 (middle thermostat)	60	Used to switch on the boiler when the recharge is intended to support space heating.
T3 (lower thermostat)	60	Used to switch off the boiler.

T3 determines the 'depth' of buffer recharge: the higher the set point the more heat is absorbed in the store in any given mode. Tweaking the thermostat settings for a particular domestic pattern of usage is an interesting exercise.

1.10.1.2. Operating the thermal buffer

The user can choose how and when to recharge the thermal buffer and typically this choice will be based upon the demand for heat and the economy of an available heat source. For example, if the demand is solely for hot water, then a fully charged buffer may continue to satisfy this demand for up to 48h with no intervention and indefinitely with occasional, low-level, energy input. Equally, if there is a demand for space heating throughout the boat, then the diesel boiler might be the obvious recharge source although availability of shore power and a low or zero space heating demand might make immersion heating a suitable alternative. For a vessel navigating norther Europe in the summer it is unlikely that any additional heat input to the buffer will be necessary over and above that supplied by the main engine.

The domestic panel controls which operate the buffer are:

IMMERSION 1kW

Operates the 1kW immersion heater which is the located towards the top of the thermal buffer and can effectively prepare the system for hot water generation only.

IMMERSION 2kW

Operates the 2kW immersion heater which is located further down the the thermal buffer and can quickly prepare the system for hot water generation only.

IMMERSION 1kW and **IMMERSION 2kW**

Running both immersion heaters simultaneously will rapidly prepare the buffer for hot water generation and can also support low demand space heating.

BOILER

Recharging the buffer using the boiler supports immediate hot water generation (even when the store is at ambient temperature) and continuous high-load heating demands.

1.10.2. Domestic hot water

Domestic hot water is available any time the thermal buffer is charged.

A fully charged buffer can support up to 48 hours of solely domestic hot water demand before requiring a recharge. If the domestic panel **BOILER** switch is ON, then channel 2 of the four-channel time controller located in the galley can be used to schedule or initiate an immediate recharge of the thermal buffer.

Hot water is generated by a plate heat exchanger with its primary circuit fed from the thermal buffer and its secondary circuit fed directly from the hydrophore. The output of the plate heat exchanger passes through a blending valve to give a comfortable domestic hot-water temperature. An independent, intelligent, hot-water loop can be used to make hot water available instantaneously at each outlet.

1.10.2.1. Operating the hot water system

The domestic panel controls which operate the domestic hot water system are:

THERMAL STORE

Operates the plate heat exchanger system. This ensures that the pump driving the primary heat exchange circuit is enabled: a flow switch will start the pump when a hot water outlet is opened or when the hot-water loop is enabled. This control should be left in the ON position when the ship is occupied.

HOT WATER LOOP

Enables the hot water loop. The hot water loop is driven by an intelligent pump which learns periods of hot-water demand and only runs to anticipate these.

1.10.2.2. Using the boiler for hot-water generation

If the boiler is the preferred recharge source for the buffer, then channel 2 of the four-channel time controller located in the galley can be used to schedule recharge events or initiate an ad-hoc recharge.

1.10.3. Space heating

Space heating is available any time the thermal buffer is charged, but the demands of heating the entire ship will rapidly deplete the buffer if one or more means of continuous recharge is not available.

1.10.3.1. Operating the heating system

The heating system will only be available if the domestic panel **CHILLER** control is OFF.

The heating system circulation pump is operated by channel 1 of the four-channel time controller located in the galley. If the heating demand is high and neither the generator or main engine are running, then the thermal store should be configured for recharge from the diesel boiler by setting the domestic panel **BOILER** switch to ON. If the heating demand is low and shore or generator power is available, then using both immersion heaters to recharge the store is feasible.

1.10.4. Space cooling

The cooling system will only be available if the domestic panel **CHILLER** control is set to ON.

The chiller system control panel is located in the galley. Refer to the chiller system documentation for details of operation.

1.11. Hydraulics

The ship's hydraulic system is powered by a permanently engaged pump connected to the main engine gearbox power take-off port.

Pressurised oil is pumped to the adjacent reservoir and distribution unit. The distribution unit valve block includes an 'orbitrol' system for assisted steering and two electrically operated load-sense valves, one high-pressure, one low-pressure, which feed fluid to a subsidiary valve block located in the fore-locker which in turn operates the anchor windlass motor, mast hydraulic cylinder and bow-thruster motor.

 Do not alter any of the system settings

 Do ensure that the oil level in the reservoir remains topped up

1.12. Fire prevention and fire fighting systems

1.12.1. Fire detection and alarm system

The vessel is equipped with a central fire detection and alarm system which covers all compartments of the vessel and all living spaces in the main compartment. Operation of the alarm system is fully documented in the manufacturer's manual.

A separate propane gas detector is located in the bilge immediately below the galley.

⚠ Detectors are tailored to the space in which they are installed and in the event of failure must be replaced with a detector with a similar scope of application.

📖 Operation of the alarm system is fully documented in the manufacturer's manual.

1.12.2. Manual fire-fighting equipment

Manual fire extinguishers are installed in clearly visible locations in the wheelhouse, saloon and lower deck lobby. A fire blanket is installed in the galley.

⚠ Have extinguishers checked at the calendar intervals indicated on the equipment.

⚠ Replace expired or discharged extinguishers with devices of identical or greater fire fighting capacity.

1.12.3. Automatic fire-fighting equipment

Automatic fire extinguishing systems are installed in the engine room and fore-locker. Both systems use Firetrace® tubing as the distribution, detection and discharge medium and deploy Novec 1230 as the fire suppressant.

The engine-room system is configured to givel local coverage of flash-points including the interior of the generator casing. In the event of a discharge in the engine room, an automatic switch disables the engine room ventilation system to prevent fire suppressant being evacuated by the engine room extractor fans.

The fore-locker system is designed to flood the entire locker space.

⚠ Novec 1230 is an environmentally neutral, non-toxic, halon replacement, but it can still cause asphyxiation - do not enter the protected space after a system discharge without allowing the suppressant to disperse.

📖 FILL ME IN

1.12.4. Fire prevention responsibilities

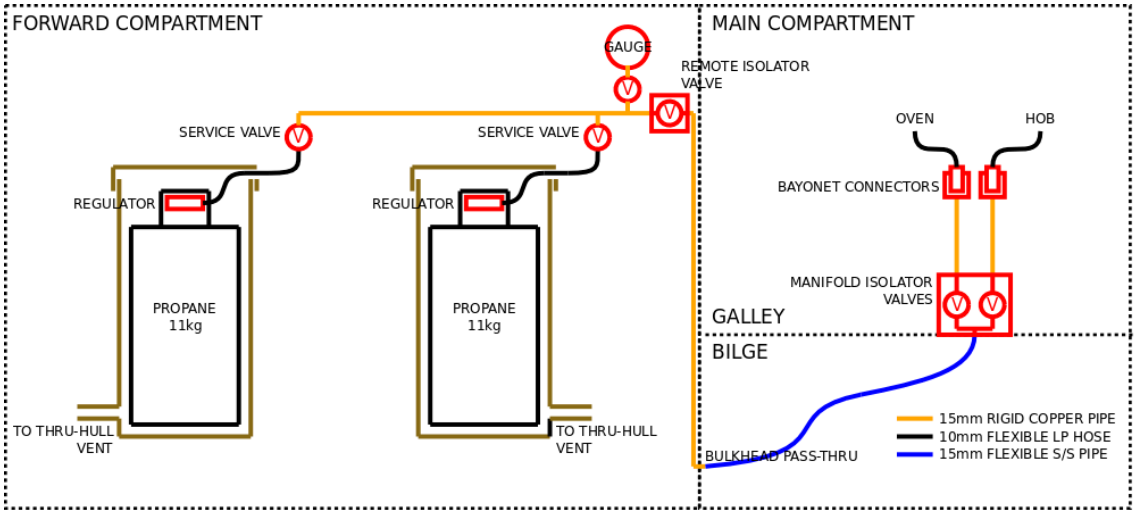
It is the responsibility of the skipper of the ship to:

- have fire-fighting equipment checked at the intervals indicated on the equipment;
- replace fire fighting equipment, if expired or discharged, by devices of identical or greater fire fighting capacity;
- inform members of the crew about:
  - the location and operation of fire fighting equipment;
  - the operation of the automatic extinguisher system and the hazards it presents;
  - the location of escape hatches.

- ensure that fire fighting equipment is readily accessible when the vessel is occupied.

1.13. Security

1.14. LPG system



The LPG system consists of a storage facility in the ship's fore-locker connected by rigid, low-pressure, pipework to consumers (oven and hob) located in the galley. A remote isolator valve located close the cylinders in the fore-locker is operated by a switch in the galley.

An LPG gas sensor is located in the galley bilge with an alarm annunciator in the galley itself.

1.14.1. Cylinders and cylinder locker

A maximum of two 11kg LPG gas cylinders may be installed in twin gas lockers located in the ship's fore-locker. The gas lockers are vented to the outside of the vessel at the bow.

1.14.2. Pressure regulator

37mBar gas regulators are fitted directly to each gas bottle with low-pressure flexible connections to service valves located outside the gas locker.

1.14.3. Oven and hob

The oven and hob are connected by flexible hoses to bayonet-connectors mounted on the bulkhead behind the oven. The oven and hob are disconnected by a single isolator valve located at floor level in the galley.

1.14.4. Advice for LPG systems on-board

It is recommended that the LPG system is shut down when not in use.

1.15. Deck wash

The ship's deck wash system serves auto-stop bayonet-style hose connector outlets located on the aft-deck and fore-deck.

1.15.1. Forward deck wash outlet

The forward deck wash outlet is supplied with fresh water from the ship's pressurised domestic water system.

The outlet and it's associated above-deck pipework can be isolated and drained via a combined stop/drain cock located behind an access panel at the back of the master cabin hanging locker.

1.15.2. Aft deck wash outlet

The aft deck wash outlet can be configured to supply either fresh water from the ship's pressurised domestic water system or raw water from the environment.

The outlet and it's associated above-deck pipework can be isolated and drained via a combined stop/drain cock located on the engine room deck head just aft of the engine room hatch.

⚠Operate the **D.WASH** switch at the helm to disable the raw water deck wash pump when its service is not required.

1.15.2.1. Changing the supplied water type

The source of water for the aft deck wash outlet is changed by opening and closing two valves in the engine room: The fresh water shut-off valve is located on the deck head just aft of the engine room hatch; the raw water pump isolating valve is located on the chiller unit raw-water intake manifold.

To select fresh water supply:

1. Connect a hosepipe to the desk wash outlet and allow water to flow freely away.
2. Operate the **D.WASH** switch at the helm to disable the raw water deck wash pump.
3. Close the raw water pump isolating valve.
4. Open the fresh water shut-off valve.
5. Disconnect the hosepipe from the desk wash outlet as soon as a fresh water flow has been established.

To select raw water supply:

1. Connect a hosepipe to the desk wash outlet and allow water to flow freely away.
2. Close the fresh water shut-off valve.
3. Open the raw water pump isolating valve.
4. Ensure that the raw water through-hull sea cock supplying the chiller unit raw water intake is open.
5. Operate the **D.WASH** switch at the helm to enable the raw water deck wash pump.
6. Disconnect the hosepipe from the desk wash outlet as soon as a raw water flow has been established. The deck wash pump will stop automatically.
7. Operate the **D.WASH** switch at the helm to disable the raw water deck wash pump.

⚠Ensure that fresh water shut-off valve is kept closed when the raw water pump is in use. An automatic double-check valve provides passive protection against cross-contamination of the fresh water system with raw water, but it is best not to rely on this as the sole means of system isolation.

1.15.3. Regular maintenance

WEEKLY

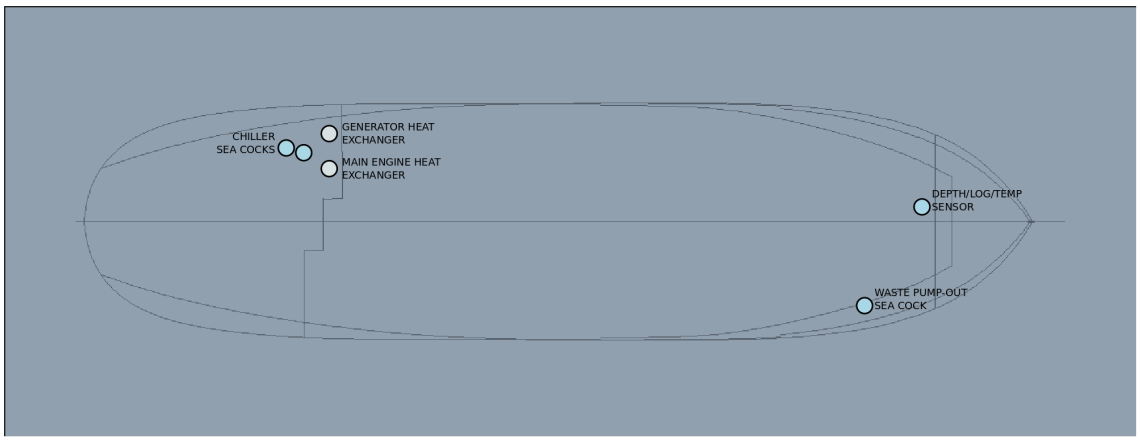
1. Check the security of all raw water deck wash pump hose connections.
2. Check the condition of the raw water deck wash pump flexible hoses, replacing any which show signs of wear or failure.

IN FREEZING CONDITIONS

1. Isolate and drain down the fresh water supply to the forward deck wash outlet.
2. Isolate both the fresh water and raw water supplies to the aft deck wash outlet and drain down the outlet.

1.16. Through-hull fittings and valves

Figure 1.12. Through-hull penetrations



There are four below-waterline hull penetrations and two penetrations for heat exchanger coils which are just above the waterline at normal trim.

Penetration	Access
Sea cock (waste discharge)	Floor hatch in master cabin (starboard side).
Sea cock (chiller cooling water intake)	Engine room (port side)
Sea cock (chiller cooling water outlet)	Engine room (port side)
Heat-exchanger (generator)	Engine room (port side)
Heat-exchanger (main engine)	Engine room (port side)
Sensor (depth/log sensor)	Floor hatch in master cabin (below bed)

1.16.1. Hull penetrating sensors

The hull is penetrated by a single combined depth/log/temperature sensor installed in the main compartment hull.

1.16.2. Hull ports and sea-cocks

1.17. Deck equipment