1. Electrical system

The vessel has a number of DC and AC electrical systems as summarised below.

System	Rating	Battery	Charged by	Master switch
Generator engine	12VDC	1 x 12VDC 120Ah	Generator alternator	Engine room (aft switch)
			12VDC battery charger	
Main engine	24VDC	2 x 12VDC 120Ah	Main engine alternator	Engine room (forward switch)
			24VDC battery charger	
Domestic (DC)	24VDC	12 x 2VDC 1100Ah	Main engine alternator	Battery compartment
			24VDC battery charger	
			Solar charge controller	
Domestic (AC)	230VAC	n/a	n/a	n/a

1.1. Generator engine system

The generator engine system is entirely self-contained with no consumers other than the generator starter system.

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

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.

1.2. Main engine system

The main engine system operates at 24VDC and supports the main engine starter system, propeller shaft lubrication pump, raw-water deck-wash pump and the stern navigation light.

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

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 batteries. The battery charger is only energised when the ship is on shore or generator power.

1.3. Domestic system

The domestic system consists of a 24VDC house battery bank connected to a 230VAC inverter-charger. This integrated system supports all domestic and navigation electrical systems: there is no bias towards the use of DC or AC for particular purposes and individual equipment is specified for AC or DC connection based on technical, performance and efficiency considerations.

1.3.1. Domestic (DC) system

The domestic DC system operates at 24VDC and supports all ship's systems which require a direct current supply (other than those supported by the generator and main engine systems discussed above).

Twelve 2VDC 1100Ah series connected batteries and associated master switch are located in the battery compartment below the galley floor.

The house batteries are charged by an integrated 8kW inverter-charger and 5kW solar charge controller.

The inverter-charger automatically blends inverting and charging depending upon the availability of an external 230VAC power source, but can be switched to charger-only mode using the control mounted in the domestic panel. Two 230VAC energy inputs are available: a shore-power connection on the aft deck allows connection to a utility outlet and supplies energy to the inverter-charger through a 7kW isolating transformer; the ship's generator can provide up to 12kW of energy when off-grid.

The solar charge controller connects to a 1kW solar panel array mounted over the aft deck.

The main DC connection box integrates all suppliers and consumers

are of can be switched between charge only and inverter-charge only energised when the the ship is connected to a 230VAC shore power supply or when the ship's generator is running.

A direct connection from the battery isolator switch powers Busbar 1 which supports connection of services which should be permanently available even when the boat is out of service. This includes connections to charging sources (charger/inverter, main engine alternator and solar charge controller) and some safety critical consumers (helm-panel essential services like bilge pumps and alarms and spudpole). Individual isolators can be operated to disconnect these consumers if required.

A second connection from the battery isolator switch goes via an isolator to Busbar 2 which supports connection of all non-essential consumers. This isolator can be operated remotely from the domestic panel `MAIN ISOLATOR` control.

1.3.2. Batteries and master switch

Twelve 2VDC 1100Ah series-connected batteries and associated master switch are located in the battery compartment below the galley floor.

1.3.3. 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.

1.3.4.

1.4. 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.

1.4.1. 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.

1.4.2. 230VAC distribution

1.4.2.1. 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. Distribution cabinet C1

1.4.2.2. 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 2. Distribution cabinet C2