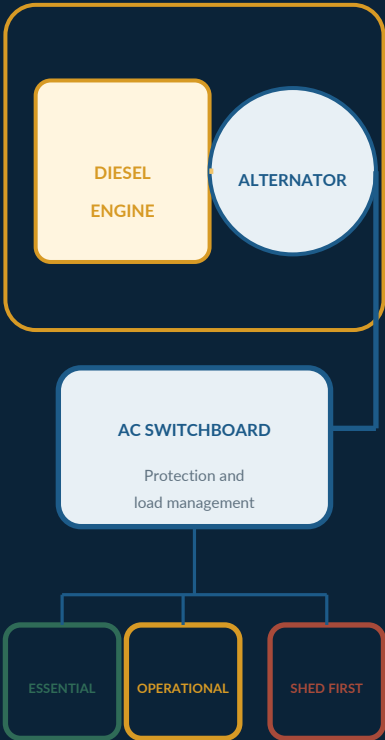


Understanding Generators and Load Management

An owner's guide to onboard AC power, stable loading and blackout resilience

A generator creates electrical capacity.

Load management decides whether that capacity remains stable and useful.



GENERATE | PROTECT | PRIORITISE

Stable power depends on the generator and the way the yacht manages demand.

GUIDE OVERVIEW

What generators and load management are designed to do

A marine generator converts fuel into stable AC electrical power. Load management keeps the connected demand within the available capacity, protects the source and preserves essential services when power is limited.

SCOPE

This guide provides a practical whole-system overview. Actual installations may use one or more fixed-speed generators, variable-speed sets, parallel operation, inverter support, automatic start/stop, shore power and sophisticated power-management systems.

By the end of this guide, you should be able to:

- Explain the generator's main support systems and the route from fuel to AC power.
- Distinguish continuous electrical demand from short-duration starting or surge loads.
- Understand why overload, persistent light loading and poor load sequencing can reduce reliability.
- Recognise the purpose of source transfer, load shedding and automatic power management.
- Ask better questions during purchase, survey, maintenance and offshore preparation.

CORE PRINCIPLE

Generator reliability is not determined by the engine alone. Fuel, cooling, exhaust, starting power, alternator condition, controls, switchgear and the connected loads all influence whether useful power remains available.

Safety

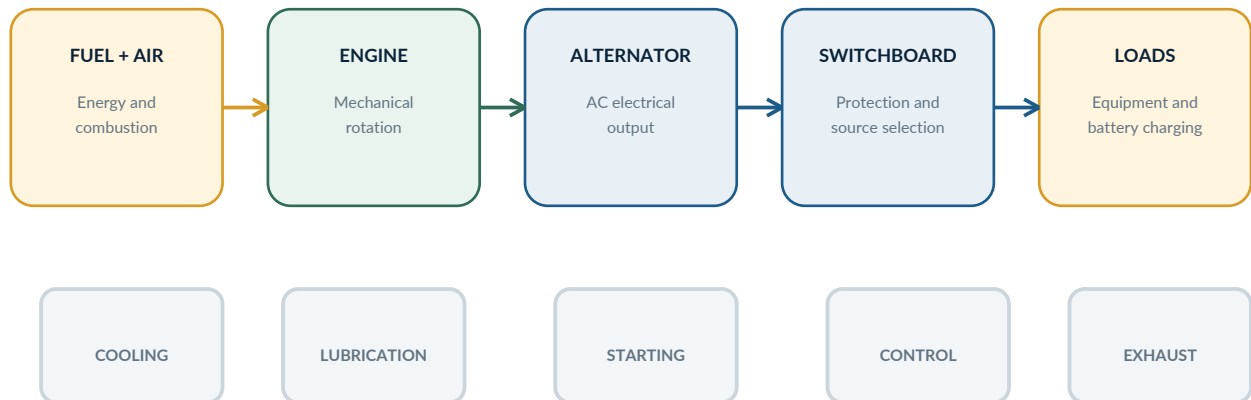
Generators combine fuel, exhaust gases, hot surfaces, moving parts, cooling water and potentially lethal AC voltage. Do not remove electrical covers, bypass shutdowns, parallel sources or work on a running set unless the correct procedure is understood and the work is within your competence.

SYSTEM OVERVIEW

From diesel fuel to usable AC power

The generator set is only one part of the power chain. Stable operation depends on every support system and on the way the switchboard accepts and distributes the output.

A generator is an integrated engine, alternator and control system supported by fuel, cooling, starting, exhaust and distribution.



The basic sequence

- Combustion: The diesel engine converts fuel energy into mechanical rotation.
- Generation: The alternator converts rotation into AC electrical output.
- Regulation: Engine governing maintains frequency while voltage regulation maintains the electrical output.
- Protection: Sensors and protective devices trip the set or breaker when unsafe conditions are detected.
- Distribution: The switchboard connects the healthy source to selected loads through suitable protection.
- Load management: Demand is sequenced, limited or shed so that the source remains stable.

OWNER INSIGHT

The most useful habit is to learn the normal voltage, frequency, current, coolant temperature, oil pressure and load at familiar operating conditions. Change is easier to recognise when a baseline exists.

Fixed-speed and variable-speed sets

Many conventional marine generators run at a fixed engine speed to maintain the required AC frequency. Some newer systems vary speed and use power electronics to produce stable output. The operating principles, service requirements and acceptable loading may differ, so the manufacturer's guidance remains essential.

MAIN COMPONENTS

What owners should be able to identify

A generator is a compact machinery system. Good access, clear labels and complete records make inspection and fault finding much easier.

Component	What it does	Owner focus
Diesel engine	Provides mechanical power to drive the alternator.	Service hours, oil, belts, mounts, leaks, smoke, sound and vibration.
Alternator and voltage regulator	Produces and controls AC voltage.	Cleanliness, ventilation, insulation condition, stable output and specialist test history.
Governor / speed control	Maintains engine speed and therefore electrical frequency.	Stable frequency during load changes and no persistent hunting.
Fuel system	Supplies clean diesel to the engine.	Filters, valves, return route, tank selection, air leaks and contamination history.
Cooling system	Removes heat through coolant and raw-water circuits.	Seacock, strainer, impeller, heat exchanger, coolant and exhaust-water flow.
Starting system	Cranks the engine and powers controls before generation is established.	Starting battery, charger, isolator, cabling and alternative starting arrangements.
Control and protection	Starts, stops, monitors and protects the set.	Alarm history, emergency stop, shutdown sensors, remote controls and manual fallback.
Exhaust and ventilation	Removes gases, heat and combustion products.	Leaks, water injection, hose condition, compartment airflow and carbon-monoxide risk.

PRACTICAL POINT

The generator may be unable to start or remain online even when the engine itself is healthy. A weak starting bank, blocked strainer, contaminated fuel, failed sensor or downstream electrical fault can remove the complete source.

MULTIPLE SOURCES

Redundancy, load sharing and generator strategy

Two generators can improve resilience and operational flexibility, but only when each set is maintained, usable and not defeated by a shared dependency.

Arrangement	Potential advantage	Important limitation
Two similar sets	Either may support a large proportion of normal demand; spares and procedures may be common.	Both may share fuel, cooling, starting, switchgear or the same design weakness.
Large and small set	Allows the smaller generator to match light domestic demand and the larger set to support high loads.	Different parts, procedures and capacities; the small set may not support every critical operating condition.
Parallel operation	Combines capacity and can share high demand between sets.	Requires reliable synchronising, load sharing, protection and control; one fault may affect the common bus.
Generator plus inverter support	Batteries and inverter can cover short peaks or quiet periods.	Energy must later be replaced; battery condition and inverter limits become part of generator resilience.
Single generator with strong DC reserve	Simpler machinery installation with limited essential operation possible after generator loss.	High-demand AC services may be unavailable and charging endurance must be understood.

Shared dependencies to identify

- Fuel tank, transfer system, filters or shut-off manifold.
- Seawater intake, strainer, cooling circuit or machinery-space ventilation.
- Starting bank, charger, control power or emergency stop circuit.
- AC switchboard, bus tie, transfer control or power-management network.
- Exhaust route, fire risk or flooding exposure within the same machinery space.

READINESS TEST

If one generator is unavailable, identify exactly which loads the remaining set can support, which must be shed and whether the yacht can continue the intended voyage with an acceptable margin.

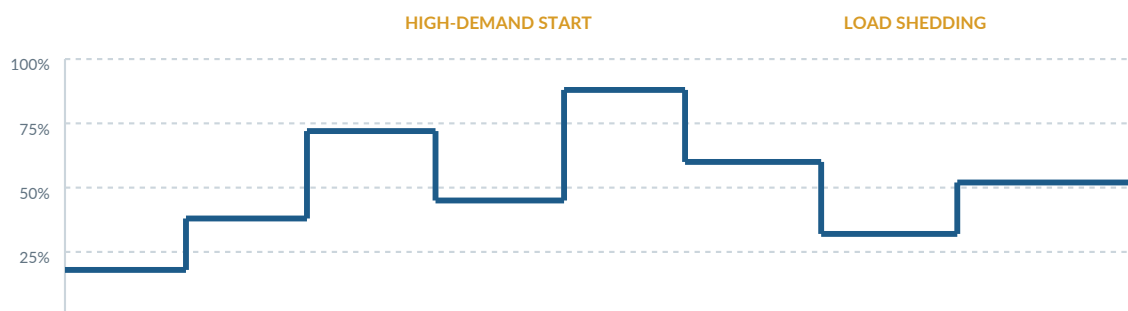
Redundancy is consumed

Once one generator has failed, the remaining source may still support normal operation. However, the yacht no longer has the same reserve against a second fault. The passage and operating plan should be reassessed.

CAPACITY AND DEMAND

Understanding generator load

A generator must support both the steady electrical demand and the short-duration demands created when motors, compressors, pumps and heating loads start or switch.



Illustrative only: the important issue is how starting loads, continuous demand and available capacity interact.

Useful terms

Term	Practical meaning
kW	Real power doing useful work or producing heat. This is commonly the clearest measure of generator engine loading.
kVA	Apparent power: voltage multiplied by current. Generator and switchgear ratings may be stated in kVA.
Power factor	The relationship between real and apparent power. Motors and electronic loads can make current demand higher than the kW figure alone suggests.
Continuous load	Demand expected to remain connected for a sustained period.
Starting / surge load	A short higher demand when a motor, compressor, transformer or other equipment starts.
Available reserve	Capacity remaining to accept the next load without excessive voltage or frequency disturbance.

Why headline size is not the whole answer

- Ambient temperature, ventilation and installation conditions may affect available output.
- Motor-starting demand may cause voltage and frequency dips even when the normal running load appears acceptable.
- Electronic loads can create harmonic or power-quality concerns that are not visible from kW alone.
- A generator sized for every load at once may spend much of its life at inefficiently low demand.
- Two unequal generator sizes can match different operating profiles more effectively, but add switching and maintenance complexity.

SIZING QUESTION

The useful question is not only 'How many kilowatts is the generator?' It is 'Can it accept the yacht's real load profile, including the largest starting events, while maintaining stable voltage and frequency?'

LOAD MANAGEMENT

Keeping demand within the available supply

Load management may be manual, automatic or integrated into a wider power-management system. Its purpose is to prevent overload while preserving the functions that matter most.



Load management protects the source by controlling which demands operate together.

Common load-management functions

- Load sequencing: Starts large motors and compressors in a controlled order rather than simultaneously.
- Load inhibition: Prevents selected equipment operating when insufficient capacity is available.
- Load shedding: Disconnects lower-priority demand before the source trips.
- Generator auto-start: Starts another set when demand rises or the online source is lost.
- Generator auto-stop: Removes an unnecessary set when demand falls, subject to minimum run and cooldown requirements.
- Source transfer: Moves the switchboard between shore, generator, inverter or another healthy source.

Manual operation still matters

Automation can reduce crew workload and react quickly, but the owner should understand the manual fallback. A failed load-management controller, network or sensor should not make it impossible to restore basic power safely.

OPERATIONAL DISCIPLINE	When capacity is limited, switch off or inhibit high-demand non-essential equipment before adding another major load. Protecting the source is more important than keeping every domestic service available.
------------------------	--

Parallel operation

Some yachts operate generators in parallel so that sets share demand. This requires compatible equipment, synchronising, correct load sharing and reliable control. Owners should not attempt manual paralleling unless the system is specifically designed for it and the approved procedure is understood.

OPERATING PRACTICE

Starting, loading and stopping a generator

A consistent operating routine helps reveal faults early and avoids unnecessary thermal, mechanical and electrical stress.

Stage	Owner focus
Before start	Check fluid levels where safe, seacock and strainer condition, fuel supply, leaks, starting battery and that large loads are not already connected unexpectedly.
Start and stabilise	Confirm oil pressure, cooling-water flow, voltage and frequency. Allow the set to stabilise in accordance with the manufacturer's guidance.
Apply load	Connect demand progressively, watching for unstable voltage, frequency, smoke, hunting, abnormal noise or alarms.
Operate	Monitor load, temperatures, pressures, exhaust and machinery-space condition. Keep demand within the permitted rating.
Unload	Remove major loads in a controlled way rather than opening the generator breaker under an uncontrolled heavy demand.
Cooldown and stop	Follow the manufacturer's unloaded or reduced-load cooldown and shutdown procedure, then check for leaks or unusual heat.

Persistent light loading

Conventional diesel generators operated for long periods at very low load may not reach the temperature and combustion conditions intended by the manufacturer. Depending on engine design and duty, this can contribute to carbon deposits, oil dilution, exhaust fouling or 'wet stacking'.

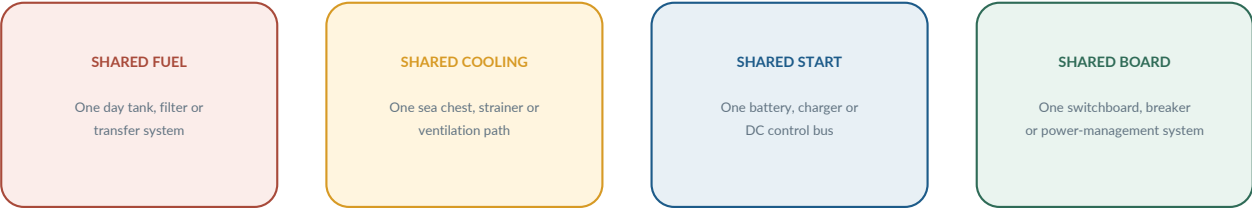
- Do not apply a universal minimum-load rule without checking the specific generator manufacturer.
- Review whether the generator size matches the yacht's normal demand.
- Use meaningful load periodically if required by the manufacturer or service provider.
- Investigate persistent smoke, exhaust deposits, oil consumption or poor running.
- Load-bank testing should be planned and carried out by competent personnel where appropriate.

BALANCED OPERATION	The objective is neither to overload the set nor to run it lightly without purpose. A good operating profile keeps the generator within the manufacturer's intended duty while meeting the yacht's real power needs.
---------------------------	--

DEPENDENCIES AND RESILIENCE

What can remove generation or several sources together

A generator is not independent if it shares the fuel, cooling intake, starting supply, ventilation, control network or switchboard fault that removed the primary set.



Assess independence against blackout, fire, flooding and fuel contamination.

Common dependency	Failure effect	Owner focus
Fuel supply	Contamination, shut-off or an empty day tank can stop several sets.	Confirm alternate tank, filtration and transfer options.
Seawater cooling	One sea chest, blocked strainer or flooded compartment may remove all sets.	Trace intakes, pumps and isolation by generator.
Starting and control power	One battery, charger or DC bus can prevent every source starting.	Test independent starting after normal control-power loss.
Exhaust and ventilation	Shared air path, fire damper or exhaust fault can affect several sets.	Inspect separation and shutdown interaction.
Switchboard and power management	One breaker, bus or controller can reject healthy generation.	Retain local manual operation and configuration backups.
Crew and maintenance	Incorrect transfer or neglect can remove the standby source.	Use clear procedures, rotation and loaded testing.

GENERATOR COUNT IS NOT RESILIENCE

Two generators in one space with shared fuel, cooling, starting and switchboard control may be vulnerable to one casualty.

MONITORING AND NORMAL VALUES

Knowing whether the generator is stable and usefully loaded

Useful monitoring includes electrical output, engine condition, supporting services and the connected load. Values are most useful when trended at known operating conditions.

ELECTRICAL
Voltage, frequency, current, kW, kVA and power factor

ENGINE
Oil pressure, coolant temperature and speed

SUPPORT
Fuel, cooling, exhaust, ventilation and starting

LOAD
Continuous demand, peaks and available reserve

Learn the normal response when the largest motors and chargers start.

Observation	What it may indicate	Owner response
Frequency drops during load change	Overload, governor response, fuel restriction or engine power problem.	Shed load and compare with normal response.
Voltage sags or fluctuates	Starting surge, AVR, alternator, cable or downstream fault.	Protect sensitive equipment and investigate before adding load.
Coolant temperature rises	Low seawater flow, fouled exchanger, pump or ventilation problem.	Reduce load and restore cooling before shutdown.
Persistent smoke or hunting	Fuel, air, injection, overload or governor fault.	Avoid normalising change and arrange diagnosis.
Load appears low but current is high	Poor power factor, phase imbalance or harmonic load.	Review kW, kVA and phase current, not one headline value.
Frequent automatic shedding	Insufficient reserve, unstable source or poor sequencing.	Identify the initiating load and review the plan.

RECORD COMPARABLE CONDITIONS

Temperature, frequency and current are most useful when the active loads, ambient conditions and generator configuration are known.

FAILURE AWARENESS

Common weaknesses and warning signs

Generator problems often begin with a change in sound, smoke, temperature, voltage, frequency or the way the set responds when loads are connected.

Finding or symptom	Possible cause	Why it matters
Voltage falls as load increases	Overload, alternator or regulator fault, engine power loss, loose connection or poor power factor.	Motors and electronics may trip, overheat or behave unpredictably.
Frequency low or unstable	Engine overload, fuel restriction, governor fault or unstable engine speed.	Indicates the engine is not maintaining the required speed and may precede a trip.
Breaker trips after a load starts	Starting surge, overload, short circuit, earth fault or unsuitable protection.	Repeated resetting can conceal a downstream fault and destabilise the whole bus.
Coolant or exhaust-temperature alarm	Blocked strainer, failed impeller, low coolant, fouled heat exchanger or exhaust restriction.	Continuing to run may damage the engine, exhaust system or surrounding equipment.
Black or white smoke	Overload, poor combustion, fuel issue, low temperature or engine fault.	Shows that combustion or loading has changed and requires investigation.
Set will not start	Starting battery, control power, fuel, shutdown circuit, emergency stop or interlock problem.	A nominal backup source is unavailable when needed.
Hunting or repeated load cycling	Governor instability, rapidly changing loads, poor load sharing or control fault.	Can cause unstable power, nuisance trips and mechanical stress.

DO NOT NORMALISE IT

A generator that regularly alarms, smokes, hunts, overheats or trips under a familiar load deserves explanation. Repeatedly restarting or resetting it may turn a manageable fault into a blackout or machinery failure.

Downstream faults

A healthy generator can trip because the problem is elsewhere: damaged cabling, a failed appliance, water in a panel, a short circuit or excessive combined demand. Before blaming the generator, establish whether the source, switchboard or connected load caused the event.

MAINTENANCE AND TESTING

Building dependable generator performance

Routine maintenance protects the diesel engine, alternator and supporting services. Testing under meaningful load proves that the complete source remains usable.

Area	Owner and maintenance focus
Engine service	Oil and filters, fuel filters, belts, valve clearances where specified, mounts and manufacturer service intervals.
Cooling	Seacock, strainer, impeller, coolant quality, hoses, heat exchanger and exhaust-water flow.
Fuel	Clean supply, tank selection, shut-offs, filters, water separation, return route and evidence of air leakage.
Alternator	Clean dry ventilation, bearings, insulation condition, voltage regulation and specialist electrical inspection.
Starting	Battery capacity, charger, terminals, isolation, emergency stop and remote-start circuits.
Exhaust / ventilation	Hoses, clamps, water-injection components, leaks, compartment temperature and carbon-monoxide precautions.
Switchgear and controls	Breakers, contactors, transfer switches, alarms, sensors, wiring, software and event history.

Meaningful testing

- Run each set long enough to reach normal operating temperature.
- Apply realistic loads and observe voltage, frequency, temperature, smoke and load acceptance.
- Test remote starts, source transfer, alarms and shutdowns using approved procedures.
- Confirm the starting battery is charging and the generator can restart after a normal stop.
- Record defects, alarms and readings rather than only noting that the set 'ran'.

GOOD RECORDS	Record engine hours, date, service work, load, voltage, frequency, temperatures, alarms and any unusual behaviour. Trends can reveal cooling, fuel or regulation problems before a shutdown occurs.
--------------	---

Work to refer

Internal alternator work, insulation testing, live switchboard work, synchronising or parallel controls, load-bank connection, major engine repair and persistent protection trips should be referred to appropriately qualified professionals.

RECORDS, SPARES AND SUPPORTABILITY

Keeping generation understandable and recoverable

Useful documentation identifies the exact engine, alternator, AVR, governor, controller, breaker, fuel and cooling arrangements, normal readings and the parts needed for realistic recovery.

DIAGRAMS

Fuel, cooling, control and output paths

BASELINE

Load, voltage, frequency and temperatures

SPARES

Filters, impellers, fuses and selected controls

SUPPORT

Software, manuals and specialist contacts

Spares should match the exact set and be usable by the crew or available technician.

Area	Useful evidence or provision	Why it matters
System and wiring diagrams	Fuel, cooling, exhaust, start, control, output and switchboard routes.	Speeds fault isolation and exposes shared dependencies.
Operating baseline	Voltage, frequency, current, kW or kVA, temperatures and pressures by load.	Makes gradual deterioration visible.
Service and event history	Hours, loaded runs, alarms, trips, repairs and repeated symptoms.	Shows whether faults were resolved or merely reset.
Selected engine spares	Filters, impeller, belts, seals, hoses and approved sensors.	Supports common machinery recovery.
Electrical and control spares	Fuses, relays, contactors, AVR or controller parts where realistic.	Avoids unsafe substitutions and long delays.
Configuration and support	Controller files, passwords, software, manuals and specialist contacts.	Protects against obsolete or replaced control hardware.

SUPPORTABILITY INCLUDES THE ALTERNATOR AND CONTROLLER

An engine with abundant spares may still be unusable if the AVR, governor module, breaker or proprietary display is obsolete.

BUYER AND SURVEY-REPORT PERSPECTIVE

Assessing generator condition, capacity and source resilience

A buyer should see every generator start from cold, accept meaningful load, support large starting events and transfer correctly while reviewing maintenance, supportability and shared dependencies.



A warm unloaded marina run is not a complete generator assessment.

Area	Questions and evidence to request
Generator set	What are the engine, alternator, controller, age, hours and service history?
Cold start	Does each set start promptly without abnormal smoke, noise, leakage or repeated attempts?
Loaded performance	Are voltage, frequency, temperature, oil pressure and current stable under representative demand?
Largest loads	Can the set accept motors, chargers, watermakers and air-conditioning without excessive dip or trip?
Cooling and exhaust	Are intake, strainer, pump, heat exchanger, exhaust hose and ventilation sound?
Transfer and shedding	Do source changeover, automatic priorities and manual fallback work as intended?
Redundancy	Which fuel, cooling, starting, control or switchboard fault removes multiple sources?
Supportability	Are alternator, AVR, governor, controller and switchgear parts still available?

REVIEW INSIGHT

Generator risk is often a pattern: light-load service, incomplete records, shared day tanks, weak start batteries, obsolete controls and no evidence of loaded testing.

OFFSHORE READINESS

Blackout response and owner-familiarisation checklist

A blackout should trigger a controlled response: protect navigation, identify the fault, reduce demand, restore a healthy source and reconnect loads deliberately.



Questions before departure

- Which loads are essential for safe navigation, communications, alarms and machinery control?
- What is the largest motor or compressor starting load on each generator?
- Can non-essential loads be shed quickly from the main operating position?
- Can each generator start, connect and accept load independently?
- How long can essential services operate if no generator is available?

Quick readiness check

	Readiness statement
☐	Normal voltage, frequency and useful load range are known.
☐	Fuel, cooling, starting and exhaust arrangements are understood.
☐	Large starting loads and automatic sequencing are identified.
☐	Essential and non-essential load groups are clearly defined.
☐	Source transfer, load shedding and blackout recovery have been demonstrated.
☐	Standby sets are serviced and exercised under meaningful load.

KEY TAKEAWAY

A dependable generator system is demonstrated by stable operation, sensible loading, reliable supporting services, clear priorities and a crew able to recover from source loss without creating a second fault.

Standards and guidance to consult

Where applicable, consult the current edition of ISO 13297 Small craft - Electrical systems - Alternating and direct current installations, the generator and switchgear manufacturers' instructions, and relevant flag-state, coding, class, insurance and local requirements.

Understanding Yacht Systems

Practical guides for owners, buyers
and offshore cruising crews.

AMTG-005

Understanding Generators and Load Management

RELATED GUIDES

AMTG-003 Understanding Marine Electrical Systems

AMTG-004 Understanding Electrical Redundancy

AMTG-021 Understanding Battery Banks and Charging Systems

AMTG-025 Understanding Load Shedding and Blackout Recovery

AMTG-034 Understanding Emergency Power Systems

ABOUT ABSOLUTE MARINE

Independent technical advice for explorer yacht owners,
buyers and offshore cruising yacht owners.

Survey Report Reviews | Offshore Readiness Reviews
Reliability | Risk | Readiness

absolute-marine.co.uk

info@absolute-marine.co.uk