

Understanding Load Shedding and Blackout Recovery

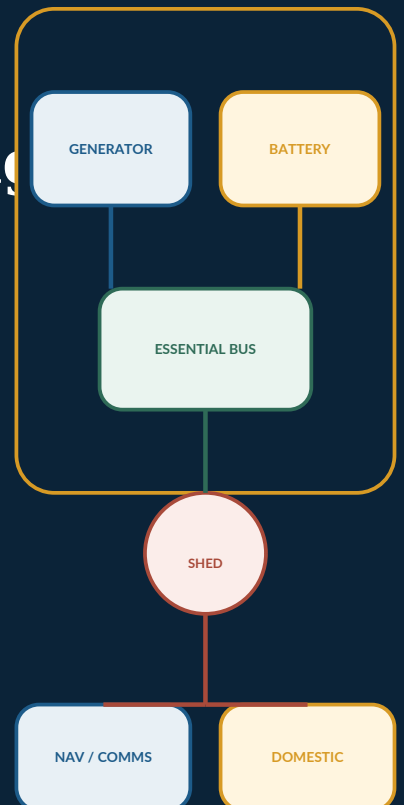
An owner's guide to overload protection,
essential power and controlled restoration

A blackout is rarely solved by starting
a generator and reconnecting everything.

Recovery depends on protecting the source,
restoring essentials and controlling demand.

Absolute Marine

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SHED | START | RESTORE

GUIDE OVERVIEW

What load shedding and blackout recovery are designed to do

Load shedding protects an electrical source before overload becomes a total loss. Blackout recovery restores power in a controlled order while preserving starting energy, essential services and a stable generator or inverter supply.

SCOPE	This guide covers common yacht arrangements using generators, shore supplies, inverters, battery-backed essential circuits and automatic or manual load shedding. Actual control logic and recovery sequences are vessel-specific and should be verified from current drawings and tested procedures.
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By the end of this guide, you should be able to:

- Distinguish overload prevention, load shedding, standby-generator start and full blackout recovery.
- Identify essential and non-essential loads, control power, generator-start circuits, bus transfer and emergency supplies.
- Recognise poor load priority, failed automatic start, control-power loss and uncontrolled reloading.
- Understand why recovery must restore services in stages rather than reconnecting every circuit immediately.
- Ask better questions during purchase, survey, refit, sea trial and offshore preparation.

CORE PRINCIPLE	The objective is not to keep every appliance running. It is to keep the source stable, preserve essential functions and restore capability without causing another trip.
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Safety

A blackout may stop lighting, ventilation, fuel transfer, steering auxiliaries, bilge pumps and communications while generators or automatic transfer equipment can start without warning. Follow the vessel procedure and keep clear of live switchboards and rotating machinery.

SYSTEM ARCHITECTURE

How overload prevention and recovery fit together

A useful diagram should show each source, normal and essential bus, load-shedding stage, generator-start circuit, emergency battery, transfer device, control supply and the circuits restored automatically after voltage returns.



The main functions

- Overload detection: Recognises falling frequency, high current, low voltage or a source approaching its safe limit.
- Load shedding: Removes preselected loads quickly enough to prevent source collapse.
- Standby generation: Starts another generator when capacity or redundancy is insufficient.
- Blackout detection: Confirms loss of the main bus and initiates emergency or recovery logic.
- Essential supply: Keeps selected DC or AC circuits alive while normal generation is unavailable.
- Sequential restoration: Reconnects auxiliaries and domestic loads only after the source is stable.

CONTROL POWER IS A DEPENDENCY	The controller, generator starter, fuel solenoid, breaker motor and transfer switch may all depend on one battery, fuse or DC bus. A healthy generator cannot start if its control path is dead.
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LOAD HIERARCHY

Deciding what must remain and what can be shed

Load priority should reflect consequence. A yacht may comfortably lose air-conditioning or a water heater while retaining navigation, communications, bilge pumping, control systems and the equipment needed to restore generation.



Priority should be vessel-specific: a pump or fan may be essential because another critical system depends on it.

Load group	Why it matters	Owner focus
Navigation and communications	Supports safe manoeuvring, distress communication and situational awareness.	Independent DC endurance, converter dependencies and restart behaviour.
Bilge, flooding and fire support	Maintains detection, pumping, alarms and selected emergency equipment.	Which pumps are battery backed, generator dependent or manually startable.
Machinery controls and ventilation	Engines, generators and switchboards may require DC control and cooling air.	Hidden fans, fuel pumps, PLCs and seawater pumps needed before load can return.
Refrigeration and hotel services	Can affect food, medicines and crew endurance but may tolerate temporary loss.	Delay or cycle to reduce inrush and preserve source margin.
Heating, cooking and water heating	High power and usually deferrable during degraded operation.	Automatic shedding, manual isolation and no unexpected restart after recovery.
Thrusters, cranes and windlass	Short-duration high demand may coincide with manoeuvring or anchoring.	Interlocks, generator configuration and operational restrictions.

ESSENTIAL IS NOT THE SAME AS ALWAYS ON

Some critical loads should be restored only when required. Keeping every pump, charger and fan energised can consume the margin needed for propulsion support or recovery.

OVERLOAD DETECTION

Recognising when a power source is losing stability

Load shedding must respond before voltage or frequency collapse causes contactors, motors and electronic equipment to drop out together. Current alone may not reveal every overload condition.

CURRENT

Shows real or apparent source loading

FREQUENCY

Falls if engine cannot maintain speed

VOLTAGE

May sag with overload, fault or poor regulation

POWER / RESERVE

Shows how much real margin remains

The useful trigger and delay depend on source type, generator dynamics, motor starts and protection settings.

Observation	Possible interpretation	Owner focus
High current with stable frequency	Source is heavily loaded but engine and regulator still holding.	Preserve reserve and avoid starting another major load.
Frequency falls during motor start	Generator engine or governor cannot accept the sudden real-power demand.	Start sequencing, preloading, motor condition and generator size.
Voltage falls while frequency holds	Reactive load, excitation limit, cable drop or voltage-regulator issue.	Phase current, power factor, AVR alarms and feeder condition.
One phase overloaded	Single-phase loads are distributed unevenly on a three-phase source.	Phase balance and neutral current rather than total kW alone.
Repeated short cycling	Shed loads reconnect too quickly or trigger thresholds are too close.	Hysteresis, restart delay and stable source margin before restoration.
Source trips before shedding	Controller delay, failed signal, wrong settings or protective device operates first.	Event sequence and coordination between control and protection.

NAMEPLATE CAPACITY IS NOT CONTINUOUS MARGIN

Ambient heat, generator condition, power factor and existing motor loads can reduce the practical capacity available for another large demand.

AUTOMATIC LOAD SHEDDING

Stages, priorities, delays and reclosure

Automatic systems may open contactors, trip feeder breakers or inhibit selected equipment. Good logic removes enough demand quickly, but does not shed the very auxiliaries needed to keep the source running.



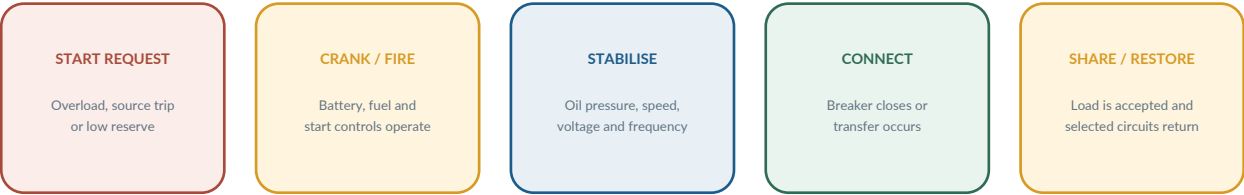
Function	Potential weakness	Owner focus
Load grouping	Later refits move an essential load onto a shed feeder or leave a high-demand load unshed.	Physical circuit verification and current load schedule.
Trigger input	Failed current transformer, frequency signal or network data prevents action.	Independent indication, alarm and test method.
Stage timing	Too slow allows collapse; too fast sheds loads during normal motor starts.	Settings supported by realistic loaded tests.
Contactor or breaker action	Command is sent but device sticks, auxiliary contact lies or control power is lost.	Actual feeder status and local/manual operation.
Reconnection logic	All loads return together, source cycles or machinery restarts unexpectedly.	Minimum stable time, staggered start and manual inhibit.
Manual override	Bypass remains active or crew cannot identify which loads were shed.	Clear indication, controlled use and positive return to automatic.

A SHED COMMAND NEEDS FEEDBACK	The display may show that a load was removed while a welded contactor or incorrect auxiliary contact leaves it connected. Loaded functional testing should confirm the real current reduction.
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STANDBY GENERATION

Automatic start, synchronising and bus connection

A standby generator may start because the running source is overloaded, failed or no longer provides enough redundancy. Starting is only the first part: the machine must reach stable voltage and frequency before taking load.



Area	Common failure	Owner focus
Start battery and charger	Battery is weak, isolator open, charger failed or control fuse lost.	Independent endurance, terminal condition and tested cranking performance.
Fuel and air	Closed valve, empty day tank, air in system or shutdown not reset.	Ready-state checklist and no hidden dependence on electrically powered transfer.
Pre-lubrication / auxiliaries	Required pump, heater or ventilation is unavailable after blackout.	Which auxiliaries are battery backed or must be started manually.
Voltage and frequency build-up	AVR, governor, excitation or sensing fault prevents stable output.	Time limit, alarm and manual recovery option.
Breaker close / transfer	Interlock, synchroniser, undervoltage relay or breaker motor fails.	Local indication, manual close conditions and no unsafe bypass.
Load acceptance	Generator starts but immediately trips when too many loads reconnect.	First-load size, staged restoration and available reserve.

AUTO-START MUST BE TESTED AS A SYSTEM

A successful no-load start does not prove the generator will connect, accept the first essential loads and remain stable during recovery.

THE BLACKOUT EVENT

What changes when the main electrical bus is lost

A blackout can remove propulsion auxiliaries, steering pumps, lighting, navigation displays, fuel transfer, ventilation and communications at the same time. Battery-backed equipment may hide the extent of the loss for several minutes.

IMMEDIATE LOSS

AC motors, pumps and hotel services stop

BATTERY-BACKED LOADS

Navigation and controls may continue temporarily

MACHINERY CONSEQUENCE

Cooling, fuel, steering or ventilation may degrade

CREW RESPONSE

Stabilise vessel and start recovery sequence

The first priority is the yacht's safe condition, not the fastest possible return of domestic power.

Immediate concern	Possible consequence	Owner response
Loss of steering auxiliaries	Hydraulic or electric pumps stop; manual or alternate mode may be required.	Maintain control, reduce speed and select the designed backup promptly.
Loss of engine-room ventilation	Heat rises and generators or propulsion machinery may derate or trip.	Reduce machinery load and restore ventilation early in the sequence.
Loss of fuel or cooling pumps	Running engines or generators may stop after stored pressure/flow disappears.	Know which auxiliaries need emergency power or manual intervention.
Loss of navigation displays	Some equipment reboots slowly or loses sensor/network data.	Preserve independent instruments and avoid manoeuvring assumptions.
Dark accommodation and machinery spaces	Crew movement and fault response become slower and more hazardous.	Emergency lighting, torches and clear role allocation.
Automatic restarts	Pumps, compressors and fans may restart unexpectedly when power returns.	Keep people clear and control high-demand loads before re-energising.

A PARTIAL BLACKOUT CAN BE HARDER TO RECOGNISE	One bus section, phase or control supply may fail while other lights remain on. Confirm which source and buses are actually live before operating ties or breakers.
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ESSENTIAL AND EMERGENCY POWER

Bridging the gap before normal generation returns

Emergency batteries, UPS units, DC-DC converters and emergency generators provide time and selected services. Their value depends on actual endurance and whether the loads connected still match the original design.

EMERGENCY BATTERY

Immediate DC power to designated circuits

UPS

No-break supply for selected electronics

EMERGENCY GENERATOR

Independent source after main bus loss

ESSENTIAL BUS

Prioritised circuits with controlled demand

Area	What can undermine it	Owner focus
Emergency battery capacity	Ageing, added loads, failed charger or untested runtime.	Demonstrated endurance at realistic load and temperature.
UPS units	Internal batteries fail silently, bypass remains selected or output shuts down on overload.	Alarm history, battery replacement, bypass state and downstream load list.
Emergency generator	Shares fuel, cooling, exhaust, start battery or ventilation with the failed system.	True independence, automatic start and load acceptance.
DC converters	One converter supplies several apparently independent 12 V or 24 V circuits.	Alternate feed and failure indication.
Emergency lighting	Fittings work briefly or only in selected spaces.	Runtime test, charging status and practical coverage of escape/operating routes.
Essential load growth	New electronics and communications exceed original emergency capacity.	Updated load survey and reserve calculation.

EMERGENCY POWER BUYS DECISION TIME	It should support safe control and recovery, not encourage continued normal operation while the main fault remains unresolved.
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CONTROLLED RESTORATION

Why loads should return in stages

After a source is available, the bus may still be unstable and many motors or chargers will demand high starting current. Recovery should restore the equipment needed to sustain the source before comfort loads return.



Recovery stage	Checks before continuing	Common mistake
Source stable	Correct breaker position, voltage, frequency, oil pressure, cooling and no active trip.	Closing the bus as soon as the engine fires.
Source-support auxiliaries	Ventilation, seawater, fuel, lubrication and control supplies operating.	Loading a generator while its room or alternator remains hot.
Essential circuits	Steering, navigation, communications, bilge and alarms respond normally.	Assuming equipment recovered because its display lights up.
Motor and compressor loads	Allow starting current and stabilisation before the next load.	Starting several pumps, chillers or refrigeration compressors together.
Chargers and inverter-chargers	Charge-current limits and battery state do not consume all generator reserve.	Allowing every charger to start at maximum output after a blackout.
Domestic services	Source reserve remains adequate and automatic shed logic has reset correctly.	Restoring cooking, water heating and air-conditioning before operational loads.

WATCH FOR THE SECOND BLACKOUT

The most common recovery failure is reconnecting more load than the new source can accept. Pause after each stage and confirm stable values.

MANUAL RECOVERY

Crew roles, communication and reduced-power operation

Automatic recovery can fail or be intentionally disabled. A manual procedure should be short enough to use under pressure and clear about who controls the vessel, who manages machinery and who communicates status.



Closed-loop communication reduces duplicate actions, unsafe breaker operation and uncertainty about which loads are live.

Manual action	Good practice	Risk to control
Confirm blackout extent	Check source, main bus, essential bus and control-power indications.	Operating a tie or breaker into a faulted section.
Reduce demand	Open or inhibit high-demand non-essential circuits before connecting a source.	Automatic restart creating immediate overload.
Start alternate source	Use the normal ready-state and start procedure; confirm auxiliaries and alarms.	Repeated cranking that exhausts the start battery or masks a fuel/control fault.
Connect or transfer	Use the intended interlocked path and confirm breaker position physically/indirectly.	Unsafe paralleling or energising a dead bus with a short circuit.
Restore essentials	Use a written order and verify each service actually functions.	Assuming a breaker-on indication proves the equipment is working.
Operate reduced mode	Record prohibited loads and generator reserve until the original fault is repaired.	Gradual return to normal demand without reassessing margin.

PROCEDURES SHOULD BE AT THE CONTROLS	A blackout checklist stored only on a powered computer or buried in a manual may be unavailable when needed. Keep a concise printed or independently powered version.
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HIDDEN DEPENDENCIES

Control power, data networks and shared auxiliaries

Load shedding and blackout recovery are control systems layered over generators, switchboards, batteries and machinery. A single shared dependency can defeat both the primary and backup path.



Dependency	How it can defeat recovery	Questions to resolve
One control battery or fuse	Both generator start circuits, breaker motors or PLCs become unavailable.	What independent manual or alternate control remains?
Shared day tank or transfer pump	Standby generator starts briefly but loses fuel with the same fault as the running set.	Is there gravity supply, manual transfer or independent reserve?
Common seawater inlet	Both generators overheat or cannot accept sustained load.	Can each source cool independently in degraded operation?
One ventilation fan/control	Backup generator trips on high temperature after taking load.	Which fan is powered before the main bus returns?
Shared network or PLC	All source status, load shedding and breaker commands disappear together.	Local control, hard-wired protection and manual status indication.
Single operator knowledge	Crew cannot perform manual recovery if the usual operator is unavailable.	Familiarisation, simple diagrams and periodic drills.

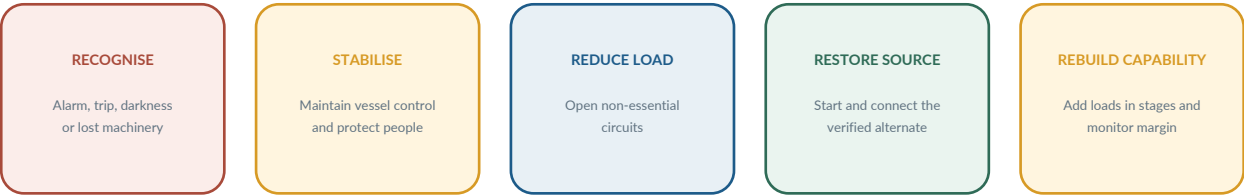
TEST ONE FAILURE AT A TIME

A backup is credible only when the primary path is genuinely unavailable during the test. Normal operation can hide shared dependencies.

FAILURE AWARENESS

Common weaknesses and immediate response

Most blackout problems begin with an unresolved overload, weak start battery, recurring breaker trip, failed control signal or incomplete recovery test.



Failure or evidence	Possible cause	Immediate thinking
Loads do not shed	Controller, signal, contactor, breaker or control-power fault.	Manually reduce demand before the source trips and preserve event evidence.
Standby generator does not start	Battery, fuel, shutdown, ECU, charger or start-logic fault.	Use the documented manual start path and protect remaining start attempts.
Generator starts but will not connect	Voltage/frequency not stable, interlock, breaker or synchronising fault.	Do not bypass protection blindly; consider another source or reduced DC operation.
Source connects then trips again	Too much load, unresolved short/earth fault or failed auxiliaries.	Open feeders and rebuild the bus progressively.
Essential bus also dead	Emergency battery, converter, fuse, transfer or common negative/control fault.	Preserve portable communications/lighting and identify the common failure.
Equipment behaves unpredictably after restoration	Brownout, network reboot, phase loss or incomplete control reset.	Verify each critical function and keep the yacht in a conservative operating state.

DO NOT NORMALISE IT	A generator that sometimes fails to auto-start, a breaker that needs repeated reset or a load-shedding alarm that clears itself is an unresolved reliability defect.
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TESTING AND MAINTENANCE

Proving the sequence rather than individual components

A start test, breaker test or alarm test alone does not prove blackout recovery. The system should be assessed as a timed sequence from source loss through essential restoration and controlled reloading.



Area	Good evidence	Why it matters
Load schedule and priorities	Current list of circuit demand, shed stage and essential classification.	Confirms refits have not undermined the original logic.
Generator auto-start	Test from the actual trigger through stable load acceptance.	Finds battery, fuel, control and breaker dependencies.
Load-shedding stages	Measured current reduction, device feedback and correct reconnection delay.	Proves the controller changes real demand.
Emergency batteries and UPS	Runtime, charger condition, alarm and transfer tests.	Confirms no-break and bridge-time capability.
Blackout drill	Controlled event with roles, timings, communications and safety observer.	Reveals procedure, labelling and human-factor weaknesses.
Event logs and alarms	Accurate time sequence, source values, trips and operator actions retained.	Allows root-cause analysis instead of repeated part replacement.

Useful spares and records

- Generator-start batteries, charger records, selected control fuses, relays and contactor/actuator parts where realistic.
- Current single-line diagram, load-priority table and manual recovery checklist.
- Event logs showing source voltage, frequency, current, alarms and breaker sequence.
- Portable lighting, communications and safe access to manual generator controls.
- Specialist contacts for generator, switchboard, automation and marine electrical support.

WORK TO REFER	Protection settings, breaker coordination, PLC programming, automatic transfer logic, live switchboard work and controlled blackout testing require competent marine electrical specialists.
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OFFSHORE READINESS

Buyer questions and readiness checklist

An offshore-ready system has clear load priorities, reliable standby generation, genuine emergency endurance, tested recovery logic and crew who can restore essential services manually if automation fails.

Area	Questions for purchase or survey
Architecture	Do current drawings show normal, essential and emergency buses, source transfer, shed stages and control-power supplies?
Load priorities	Are essential and non-essential circuits defined from the yacht's present equipment and cruising programme?
Standby generation	Will the standby set start, connect and accept load after loss of the running source without shared dependencies?
Emergency power	Are battery, UPS and emergency-generator endurance supported by loaded testing and recent records?
Recovery sequence	Does the yacht restore ventilation, fuel, cooling, steering, navigation, communications and bilge capability in a controlled order?
History and support	Are blackouts, nuisance trips, failed auto-starts, software changes and obsolete controls fully documented?
Crew readiness	Can more than one person operate the manual recovery procedure in darkness and under time pressure?

Quick readiness check

	Readiness statement
☐	I can identify every normal, essential and emergency power source and bus.
☐	Current load priorities and automatic shed stages match the actual installation.
☐	Standby generators can auto-start, connect and accept representative load.
☐	Emergency batteries, UPS units and essential circuits have demonstrated endurance.
☐	Blackout recovery restores source-support auxiliaries before high-demand loads.
☐	There are no unresolved nuisance trips, failed starts or unexplained control alarms.
☐	A concise manual recovery procedure is available at the operating positions.
☐	More than one person has practised reduced-power and blackout recovery roles.

KEY TAKEAWAY

Dependable load shedding and blackout recovery combines realistic priorities, early overload protection, reliable generator starting, genuine emergency power, staged restoration, clear documentation and practised crew response.

Guidance to consult

Use current vessel single-line drawings and the installed generator, switchboard, automation, battery, inverter and protective-device manufacturers' instructions, together with applicable flag-state, coding, class, insurance and yard requirements.

Understanding Yacht Systems

Practical guides for owners, buyers
and offshore cruising crews.

AMTG-025

Understanding Load Shedding and Blackout Recovery

RELATED GUIDES

AMTG-003 Understanding Marine Electrical Systems

AMTG-004 Understanding Electrical Redundancy

AMTG-005 Understanding Generators and Load Management

AMTG-021 Understanding Battery Banks and Charging Systems

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