The world’s safest battery system

EST-Floattech develops and manufactures state-of-the-art energy storage systems (ESS) for the maritime and land-based industry. The Green Orca® High Energy ESS is our flagship product.

The technical design choices for the Green Orca® ESS started with a high performance Li-ion battery cell and resulted in the world’s safest, DNV-GL certified Li-ion ESS.
Kokam Battery Cells

Our partnership with Kokam, one of the world’s leading cell manufacturers, is a strong foundation for our ESS design, in which our state-of-the-art technology is combined with Kokam’s patented and certified cell design.

Lithium Polymer NMC pouch cells

Our Green Orca Modules use Kokam’s Lithium Ion Polymer NMC (Nickel Manganese Cobalt Oxide) pouch cells. The NMC chemistry has a high energy density and overall strong performance while the pouch shape ensures better heat dissipation resulting in excellent efficiency.

Z-Folding

The unique ‘Z-folding’ cell construction technique significantly reduces internal cell resistance and thus delivers an exceptional cycle life, thermal performance and high discharge rate capability.

Life time & Cycle Life

Our cells have a Cycle Life of approx. 4,600 cycles, and DoD of 80% at an EoL of 80%. Based on your operations, we can predict the expected lifetime for your application with our simulation software.

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1) Cycle Life: the number of complete charge-discharge cycles a battery can perform by a certain DoD (see table)
2) At 1C charge and discharge
3) Depth of Discharge % (DoD): the percentage of total capacity that is discharged (see table)
4) End-of-Life % (EoL): indicates the time elapsed before a battery becomes unusable, as the capacity decreases with use and over time
**Green Orca® Modules**

By combining Kokam’s leading cell technology with our own mechanical design and battery management system (BMS), we created the Green Orca High® Energy Module. The module is safe by design due to multiple safety layers in mechanical design and software, meeting strict DNV-GL and NMA class requirements.

**Mechanical design**

Our mechanical design combined with a patented spring load construction keep the cells in position under the most demanding circumstances. Due to our cell arrangement, we achieve a permanent ultra-low impedance power path inside the battery module. The base of the module contains a thermal conductive material allowing extra heat dissipation and mechanical robustness. The aluminium enclosure prevents ingress of water and dust.

**Energy Modules (C-Ratings, Capacity)**

The Green Orca® High Energy Battery Module uses 14 x 200Ah / 3.7V cells, connected in series, resulting in a gross energy capacity of 10.5kWh and a nominal voltage of 52V. The Green Orca has a nominal C-rating of 2C discharge (400A), and a nominal charge rating of 1C (200A).

**Battery Management System (BMS)**

Our current generation battery management system (BMS) is the result of 10 years of continuous development and is essential for safe and optimal ESS performance. The key features of the BMS are:

- Continuous, active cell balancing to ensure maximum system up-time
- High resolution redundant individual cell voltage and temperature measurements
- Synchronised wide range current measurement
- Redundant hardware and software safety layers

Each string of battery modules has a battery control unit (BCU) which collects all BMS data and calculates accurate and real-time State of Charge (SoC), State of Health (SoH) & other ESS information for optimal system integration.
Green Orca® Energy Storage System

EST-Floattech’s 30+ years experience in marine system integration resulted in a state-of-the-art ESS design and unparalleled customer service in every step of the ship building process, from conceptual design to sea trials of the vessel. Our ESS uses a battery control unit (BCU) for integration with the ship’s system, is modular and adaptable to different needs and purposes and is DNV-GL approved for maximum safety.

Our system is developed for use in maritime applications, such as fully electric or hybrid propulsion (combined with diesel generators, hydrogen or LNG power systems). In diesel-hybrid applications peak shaving can reduce generator size and increase efficiency. Our ESS can also be used for hotel loads or auxiliary equipment power.

Battery Control Unit (BCU)

The Battery Control Unit (BCU) is responsible for communication between the battery modules and the application’s power management system. The BCU transforms the separate battery modules into a state-of-the-art Energy Storage System (ESS) and adds another layer of hardware and software safety.

The BCU collects and processes all battery module data and has redundant sensors & safety mechanisms built in. It contains the power electronics necessary for switching a battery string on or off. The BCU comes in two versions for ease of integration: Master & Slave BCU. The Master BCU connects to the ship’s communication and can control up to three Slave BCU’s. Interfacing is possible through Modbus TCP (preferred), CAN-bus (NMEA2000) or hardwired 24Vdc I/O. The BCU is powered by a redundant 24Vdc supply and has pre-charge functionality built in, making start-up from black-out possible.

Modular and adaptable design

Our modular and adaptable design can meet different mechanical and electrical requirements.

Three main configurations are commonly used in order to integrate the ESS into the ship’s power distribution system:

- Modular and adaptable design
- Our system is developed for use in maritime applications, such as fully electric or hybrid propulsion (combined with diesel generators, hydrogen or LNG power systems).
- In diesel-hybrid applications peak shaving can reduce generator size and increase efficiency. Our ESS can also be used for hotel loads or auxiliary equipment power.

The amount of modules in a string depends on AC or DC bus voltage requirements and strings can be connected in parallel to meet capacity or redundancy requirements.
Safety and Certification
Marine applications need to be reliable and safe and our ESS has been designed to assure safety in all circumstances. Li-Ion batteries have an inherent ‘Thermal Runaway’ risk due to the amount of chemical energy stored inside the battery cells. Our ESS includes multiple safety layers for prevention and our passive safety system offers protection in the rare occurrence of a thermal runaway.

Prevention with hardware & software
Li-Ion ESS, just like diesel tanks for example, have a high amount of chemical energy stored inside. When a Li-Ion battery (cell) reaches certain temperatures, a thermal runaway event can happen where this chemical energy is rapidly released in the form of hot gasses. A thermal runaway needs to be prevented and contained should it ever happen. The building blocks of our ESS, the BMS and BCU, contain intrinsic, redundant hardware and software safety systems and processes. They prevent the Li-Ion battery cells of reaching these critical limits.

Passive safety system
Our safe by design philosophy resulted in a passive safety system thanks to our integrated exhaust system which funnels thermal runaway-gasses to a safe location outside the battery room. Aluminium battery housing and fire retardant insulation between battery modules prevent the propagation of a thermal runaway-event to other modules.

DNV-GL type approval and NMA compliance
EST-Floattech’s Green Orca® High Energy storage system complies with the RSV12-2016 propagation test of the Norwegian Maritime Authority (NMA), and requirements of DNV-GL. Our DNV-GL type approval means less requirements for the battery room.
Technical specifications

**Green Orca® High Energy**

- **Capacity**: 10.5 kWh
- **Cycle Life at 80% D.O.D and 80% E.O.L.**
  - >4,600 cycles at 1C charge/discharge
  - >20,000 cycles at 1C charge/discharge
  - >75,000 cycles at 1C charge/discharge
- **Nominal Charge**: 200A/1C
- **Nominal Discharge**: 400A/2C
- **Maximum Discharge**: 600A/3C
- **Module Voltage Minimum**: 45V
- **Module Voltage Nominal**: 52V
- **Module Voltage Maximum**: 58V
- **Balancing Type (BMS)**: Continuously Active Balancing
- **Certification**: DNV-GL Type Approval, NMA Level 1 Propagation Approval
- **Dimensions (W x H x D)**: 335 x 541 x 542 mm
- **Communication**: ModBus, CANbus or Hardwired I/O
- **Allowed Current Ripple**: 5% peak to peak max
- **Weight**: 82 kg
- **Cooling**: Air Cooled
- **Gas Exhaust System**: Stainless steel
- **Racking**: Aluminum
- **Dedicated Battery Room**: Required by Class

**Battery Cell Tests**

- UN38.3 T-2 Thermal abuse
- UN38.3 T-5 External Short Circuit
- UN38.3 T-6 Impact
- UN38.3 T-8 Forced Discharge
- Overcharge (by the redundant safety system)

**Battery System Tests**

- Propagation Test
- Safety function test – Emergency stop function
- Capacity Validation
- Sensor Loss
- State of Charge Validation
- IEC 62619 Overcharge with Voltage
- IEC 62619 Overcharge with Current
- IEC 62619 Overheating Control
- IEC 61000-4 EMC

**Environmental Tests**

- DNV-GL CG0339 Vibration
- DNV-GL CG0339 Dry Heat
- DNV-GL CG0339 Damp Heat
- DNV-GL CG0339 EMC