

TYPE APPROVAL CERTIFICATE

This is to certify:**That the Li-Ion Battery System**with type designation(s)
Green Orca ALU 1050

Issued to

EST-Floattech B.V.
Medemblik, Netherlandsis found to comply with
DNV GL rules for classification – Ships**Application :****Product approved by this certificate is accepted for installation on all vessels classed by DNV GL.**Issued at **Høvik** on **2018-03-09**This Certificate is valid until **2023-03-08**.DNV GL local station: **Rotterdam, Product Certification /Verification**for **DNV GL**Approval Engineer: **Marta Alonso Pontes**

Andreas Kristoffersen
Head of Section

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid. The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.



Name and place of manufacture

EST-Floattech B.V.
Medemblik, Netherlands

Product description

Air cooled lithium-ion battery based energy storage system (ESS) for use in battery-powered or hybrid vessels and off-shore units.

The system consists of battery modules(packs) connected in series to form a string and achieve the required system voltage. Strings are installed in parallel in order to provide the required energy capacity. The batteries are equipped overpressure relief valves and the battery racks have an integrated thermal runaway exhaust duct. In between each pack there is thermal isolation.

Each module contains own battery management system (BMS) that is interfaced with top level battery control unit (BCU). BCU monitoring unit provides multifunction user interface and communication with other BCUs and external systems.

Module/Pack EST50-1050 EST

Chemistry: Lithium ion NMC
Number of cells: 14
Cell configuration: 1P14S
Max Voltage: 58.1V
Min Voltage: 44.8 V
Capacity: 200 Ah
Energy: 10,5 kWh

String

Max No. Of modules in series: 18
Max. Voltage: 1045V
Max Energy: 209 kWh

BMS

The status of each module is monitored by the BMS, which will perform the following functions:

- Monitor individual Cell Voltages
- Monitor Battery current
- Monitor individual Cell Temperatures
- Calculate and monitor SOC, SOH
- Perform active balancing between the individual Cells
- Perform active balancing between the individuals packs
- Perform Safe Guard functions (e.g. over- under voltage levels, over- under- temperature levels, overcurrent levels)

BCU

The Battery control unit connects the string of battery modules to the the system DC-bus. The BCU can switch ON/OFF the battery string by (dis)connecting it to the DC-Bus.

The BCU measures string current, string voltage and DC bus voltage.

BCU monitor

- User interface display
- Communication with other BCUs
- Communication with external systems
- Interface to peripheral devices and sensors

Independent overtemperature protection according to DNV GL Pt.6 Ch.2 Sec.1 [4.1.5.2] is arranged as hardwired loop tripping string contactor.

The software is identified by the following versions:

Component	Release date	Version
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BMS	31-01-2018	V1.3.xxx
BCU	31-01-2018	V1.3.xxx
BCU monitor	31-01-2018	V4.0.xxx

Information on software versions valid for this approval and software change management can be found in EST Floattech Software Quality Document R0.1

Application/Limitation

1. When installed on a ship or offshore unit, the DNV GL class rules for battery installation must be followed (DNV GL Pt.6 Ch.2 Sec.1).
2. The piping system venting the exhaust gases from the rack to open air/safe location shall be verified onboard in each case. Requirements in DNV GL rules Pt.6 Ch.2 Sec.1 shall be fulfilled and manufacturer instructions shall be followed.
3. It is required to gas free the pipe by mechanical ventilation. The ventilation shall either be continuously running or automatically starting upon detection of thermal event. Capacity of the fan according to manufacturer's recommendations.
4. The room shall have overpressure.
5. To withstand vibration, kit according to manufacturer's specification to be in place.
6. The Type Approval covers hardware and software listed under Product description.
7. The Type Approval is valid for systems made by production facilities listed under Place of Manufacture.

Product certification:

A DNV GL product certificate according to DNV GL Pt.6 Ch.2 Sec.1 Table 2 is required for each delivery. The following documents shall be submitted for approval:

- Reference to this type approval certificate
- Copy of the approved Safety description
- (E120) Technical specification of the battery system that is subject for product certification
- (I030) Project-specific Battery System Block Diagram
- (I020) Project-specific functional description
- Information on software versions applicable for the particular delivery
- (Z252) Test procedure at manufacturer

Location classes (DNVGL-CG-0339)

Temperature Class A
Humidity Class B
Vibration Class A
EMC Class A
Enclosure IP67

Software update notification

When the type approved software is revised (affecting all future deliveries) DNV GL is to be informed by forwarding updated software version documentation. If the changes are judged to affect functionality for which rule requirements apply a new functional type test may be required and the certificate may have to be renewed to identify the new software version

Type Approval documentation

Tests carried out

Tests according to DNVGL-CP-0418

Marking of product

Manufacturer name, and battery system type designation.

Periodical assessment

The scope of the periodical assessment is to verify that the conditions stipulated for the Type approval



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are complied with and that no alterations are made to the product design or choice of materials.

The main elements of the assessment are:

- Inspection on factory samples, selected at random from the production line (where practicable)
- Results from Routine Tests (RT) checked (if not available tests according to RT to be carried out)
- Review of type approval documentation
- Review of possible change in design, materials and performance
- Ensuring traceability between manufacturer's product type marking and Type Approval Certificate.

Periodical assessment is to be performed after 2 years and after 3.5 years. A renewal assessment will be performed at renewal of the certificate.

END OF CERTIFICATE