

TYPE APPROVAL CERTIFICATE

This is to certify:**That the Li-Ion Battery System**with type designation(s)
MG RS Battery system

Issued to

MG Energy Systems B.V.
Leeuwarden, Friesland, Netherlands

is found to comply with

DNV GL rules for classification – Ships, offshore units, and high speed and light craft**Application :****Products approved by this certificate are accepted for installation on all vessels classed by DNV GL.**Issued at **Høvik** on **2020-07-10**for **DNV GL**This Certificate is valid until **2025-07-09**.DNV GL local station: **Netherlands CMC**Approval Engineer: **Hanwee Low**

Marta Alonso Pontes
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.

LEGAL DISCLAIMER: Unless otherwise stated in the applicable contract with the holder of this document, or following from mandatory law, the liability of DNV GL AS, its parent companies and subsidiaries as well as their officers, directors and employees ("DNV GL") arising from or in connection with the services rendered for the purpose of the issuance of this document or reliance thereon, whether in contract or in tort (including negligence), shall be limited to direct losses and under any circumstance be limited to 300,000 USD.



Name and place of manufacture

MG Energy Systems B.V.
Foeke Sjoerdswei 3
8914 BH Leeuwarden, Friesland, Netherlands

Product description

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

The battery system is designed according to design option 1, (no thermal runaway propagation between cells within a module) with extinguishing system, propagation protection system (PPS).

The battery system is ready for installation with integrated off-gas duct.

The system consists of four variants of MG RS battery modules and two variants of MG master HV battery management system (master BMS). A battery pack consists of one master BMS and can be connected to up to 48 battery modules where each module consists of a slave and redundant BMS. These battery modules can be connected in series or in parallel to meet the required system voltage and capacity.

Module including cells and control circuits

Type: MG RS series Battery Module
MGRS12S4P176/14S3P132/16S3P132/24S2P088
Chemistry: Lithium ion NMC
Number of cells: 42 - 48
Cell configuration: 12S4P, 14S3P, 16S3P, 24S2P
Max Voltage: 88 V
Min Voltage: 44 V
Capacity: 88 - 192 Ah
Energy: 6.7 - 8.4 kWh
Cooling: Liquid

Battery Management System (BMS)

Type: MG Master HV (MGMHV800300/500)
Max No. of modules: 48
Max load voltage: 900 V
Max load current: 300 - 500 A

Application/Limitation

1. When installed on a DNVGL classed 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.
3. The Type Approval covers hardware and software listed under Product description
4. The Type Approval is valid for systems made by production facilities listed under Place of Manufacture
5. Loss of propagation protection system (PPS) and cell swelling limit (based on state of health) shall raise warning to alert operator

Product certification:

A DNV GL product certificate according to DNV GL Pt.6 Ch.2 Sec.1 Table 4 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
- (E170) Project specific electric schematic drawing showing ratings of busbars and breakers.
- (I030) Project-specific Battery System Block Diagram
- (I020) Project-specific functional description
- Information on software versions for BMC, BPC and BSC applicable for the project

Job Id: **262.1-031394-1**
Certificate No: **TAE0000401**

- (Z252) Test procedure at manufacturer

Location classes (DNVGL-CG-0339)

Temperature	Class A
Humidity	Class B
Vibration	Class A
EMC	Class A
Enclosure	IP65

Type Approval documentation

Tests carried out

Tests according to DNVGL-CP-0418 and DNVGL-CG-0339 (December 2019).

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 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