



Certificate no.:
TAE00004VG

TYPE APPROVAL CERTIFICATE

This is to certify:

that the Li-Ion Battery System

with type designation(s)
SEAL

issued to

Hanwha Aerospace Co., Ltd.
Changwon-si, Gyeongsangnam-do, Korea, Republic of

is found to comply with

DNV rules for classification – Ships, offshore units, and high speed and light craft

Application:

Product approved by this certificate is accepted for installation on all vessels classed by DNV following DNV Rules of July 2023.

Issued at **Høvik** on **2024-04-12**

This Certificate is valid until **2029-04-11**.

DNV local unit: **AK Admin Support**

for **DNV**

Approval Engineer: **Georgy Abramenko**

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 AS, its parent companies and their subsidiaries as well as their officers, directors and employees ("DNV") 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.



Form code: TA 251

Revision: 2023-09

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Name and place of manufacture

Hanwha Aerospace Co., Ltd., 1204, Changwon-daero, Seongsan-gu, Changwon-si, Gyeongsangnam-do, Republic of Korea

Powerlogics Co., Ltd., 163, Gwahaksaneop 4-ro, Oksan-myeon, Heungdeok-gu, Cheongju-si, Chungcheongbuk-do, Republic of Korea

Product description

Air cooled lithium-ion modular battery based electrical energy storage system (EES) for use in battery-powered or hybrid vessels and offshore units.

The system refers to a parallel structure of a rack assembly including safety features. Battery system consists of one or several battery racks (up to 8), depending on required power and energy. Each battery rack contains battery packs, BPU (battery protection unit), bus bars.

The battery packs are filled with insulating oil for effective cooling performance during operation of battery system. Each battery pack consists of battery modules (4 pcs), power and communication interfaces, vent screw.

Cylindrical cells are fitted in a battery module with module BMS units, temperature and voltage sensors.

Battery racks are controlled by the System Protection Unit (SPU) which interfaces with the customers Energy or Power Management System (EMS/ PMS).

The battery racks have integrated off-gas duct and the battery pack meets the DNV Pt.6 Ch.2 Sec.1 Non-Propagation Design Option #1, no cell-to-cell propagation.

Battery pack

Type: HA-SEAL-PACK

Pack	
Configuration	4 modules (15S 28P)
Cooling	Air cooling outside, insulating oil inside pack
Energy	6.69kWh
Enclosure	IP56
Module	
Type of cells	LGES 21700 M50L
Chemistry	Lithium ion NCMA
Cells manufacturer	LG Energy Solution
Number and configuration of cells in module	15S 7P
Max voltage	61.8V
Min voltage	45V
Energy	1.67kWh
Cooling	Insulating oil

Battery rack with battery protection unit (BPU)

Battery protection unit, type: HA-SEAL-BPU

No. of packs per rack	1-17
Voltage per pack	45 – 1050.6V DC
Max energy	113.82kWh
Cooling	Air
Enclosure	IP44

System protection unit (SPU)

Type: HA-SEAL-SPU

No. of controllable racks	1 – 8 racks
Enclosure	IP44

Battery Management system (BMS)

Functionality of BMS is distributed between the battery modules BMS (MBMS), battery protection unit (BPU) or RBMS, system protection unit (SPU) or SBMS.

BMS firmware: V1.00

Application/Limitation

1. When installed on a ship or offshore unit, the DNV class rules for battery installation must be followed (DNV Pt.6 Ch.2 Sec.1).

2. The Type Approval covers hardware and software listed under Product description.
3. The Type Approval is valid for systems made by production facilities listed under Place of Manufacture.
4. Leakage detection is expected to be provided by system integrator for each delivery according to Hanwha battery system documentation (ref. Hanwha SEAL Lithium ion Battery System Technical Description Manual Rev.1.7).

Type Approval documentation

Product certification:

Battery systems rated equal or larger than 50kWh shall have a product certificate according to DNV Pt.6 Ch.2 Sec.1 Table 4 for each delivery to DNV classed vessels.

For product certification, at least the following documents should 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) Electrical schematic diagram showing the battery packs, strings, modules with switchgears and control gears, dimensions of bus bars as relevant;
- (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 (DNV-CG-0339)

Temperature Class B
Humidity Class B
Vibration Class A
EMC Class A
Enclosure class B (IP44)

Software update notification

When the type approved software is revised (affecting all future deliveries) DNV 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 DNV-CP-0418, Rules for Ships Pt.6 Ch.2 Sec.1 (ed. July 2023), DNV-CG-0339

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