



Certificate No:
TAE000048X

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Li-Ion Battery System

with type designation(s)
Forsee Power Pulse 2.5 Marine battery system

Issued to
ZHONGSHAN FORSEE POWER INDUSTRY CO., LTD
Zhongshan, Guangdong, China

is found to comply with
DNV GL 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.

Issued at **Høvik** on **2021-06-09**

This Certificate is valid until **2026-06-08**.

DNV local station: **China South NB**

for **DNV**

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 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: 2021-03

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Name and place of manufacture

Zhongshan Forsee Power Power Industry co. LTD
 Zhongshan, Guangdong,
 China

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 to be no thermal runaway propagation between modules.

The battery system is designed to ventilate possible off-gas directly to the EES space.

The ESS system consists of three variants battery module with different battery cell capacity and one variant of master Battery management system (MBMS). A MBMS can manage up to 12 strings in parallel connection. A battery string consists of one battery management controller (BMC) which is connected to a maximum of 15 battery modules.

Module including cells and control circuits

Type:	Pulse 2.5 (Li-ion prismatic cells)
Chemistry:	Lithium Titanate Oxide (LTO)
Number of cells:	48
Cell configuration:	2P24S
Max Voltage (nominal):	825 V
Min Voltage (nominal):	55 V
Capacity:	20, 40 and 46 Ah
Energy:	2.5, 2.2 and 1.1 kWh
Cooling:	Liquid cooling

Battery Management System (BMS)

Type:	System level:	Master Battery Management System (MBMS)
	String level:	Battery Management Controller (BMC) consisting of PDU (Power Distribution Unit) and BMS (Battery Management System)
		Modulator unit (LHD controller) for independent overcharge protection function
	Module level:	Carte MODULE (CMOD)
Max No. of modules:	1x MBMS is connected to maximum 12 strings in parallel and 1x BMC is connected to maximum 15 battery modules.	
Max load voltage:	32 Vdc	
Max load current:	5 A	

Application/Limitation

- When installed on a DNV classed ship or offshore unit, the DNV class rules for battery installation must be followed (DNV GL Pt.6 Ch.2 Sec.1)
- The Type Approval covers hardware and software listed under Product description
- The Type Approval is valid for systems made by production facilities listed under Place of Manufacture
- The battery system is type approved in accordance to DNV GL Pt.6 Ch.2 Sec.1 (July 2019)
- Salt mist test is done in accordance to DNVGL-CG-0339 Sec.3 [10] (December 2019), for all units except the "Modulator" unit.
- Presence of alarms (audible and visual) and monitoring on "top level" system HMI is responsibility of system integrator and subject for verification case-by-case. This applies to all relevant parameters and alarms handled by BMS, as well as the independent overcharge protection system, the latter consisting of the "Modulator" units and the LHD line.

Product certification:

Battery systems rated equal or larger than 50kWh shall have a product certificate according to DNV GL 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, Ref. to DNV GL Pt.6 Ch.2 Sec.1 Table 8:

- 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)



Job Id:
Certificate No: **TAE000048X**

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

Type Approval documentation

Tests carried out

Tests according to DNVGL-CP-0418 (July 2019) 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