Certificate no.:
TAE00004UB

TYPE APPROVAL CERTIFICATE

This is to certify:

that the Li-Ion Battery System

with type designation(s)
Dolphin NG

issued to
Corvus Energy AS
Nesttun, **Norway**

is found to comply with
DNV rules for classification – Ships, offshore units, and high speed and light craft

Application:

Product(s) approved by this certificate is/are accepted for installation on all vessels classed by DNV following DNV rules of July 2022

Issued at **Høvik** on **2023-12-12**

This Certificate is valid until **2028-12-11**.

for **DNV**

DNV local unit: **Mid-North Norway CMC**

Approval Engineer: **Sverre Eriksen**

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.

Name and place of manufacture
Corvus Energy Nesttun, Norway

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 consists of one or several battery strings connected in parallel, depending on required power and energy. Each battery string contains a string disconnection unit and 4 to 24 series-connected modules. A battery string can be operated as an independent unit or in a system comprising several strings, controlled by the Pack Controller (PC) which interfaces with the customers Energy Management System (EMS).

The battery modules contain cells and control circuits which monitor and control the cell blocks and communicate with the string controller. Each battery module is individual cooled and ventilated by two fans, circulating air from battery space through the battery module.

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

Battery module with control circuits
Type: DE0120-50V-AR

Type of cells	Cylindrical 21700 Li-ion cells
Chemistry	Lithium ion NMC
Cells manufacturer	CBAK
Number and configuration of cells	38p12s
Max voltage	50,4 V
Min voltage	30.0 V
Energy	8,21 kWh
Cooling	Forced air
Enclosure	IP55

Battery string with string disconnect module and stack interface base.
String disconnection module: SDM2000-160A-X-E
Stack interface base: SIB200A
Stack cap: SC200A-AR

No. of modules per string	4-24
Max Voltage	1200V DC
Max strings	16
Enclosure	IP55

Pack controller
Type: Pack Controller PC0200-R
Enclosure: IP66

Battery Management system (BMS)
Functionality of BMS is distributed between the battery modules, stack interface base, string disconnect module and the pack controller.
BMS firmware: Rev 4.x.x.

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.

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 A
Humidity Class B
Vibration Class A
EMC Class A

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, 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