



Certificate no.:
TAE00004VJ

TYPE APPROVAL CERTIFICATE

This is to certify:

that the Li-Ion Battery System

with type designation(s)
Moray

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 approved by this certificate is accepted for installation on all vessels classed by DNV, following DNV Rules of July 2022 edition

Issued at **Høvik** on **2024-06-03**

This Certificate is valid until **2029-06-02**.

for **DNV**

DNV local unit: **East & South Norway CMC**

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

Corvus Energy Nesttun, Norway

Product description

Subsea modular battery system designed exclusively for use in subsea applications. It is further designed to be used in a pressure compensated container with an inner diameter to 360mm at atmospheric pressure and under a nitrogen atmosphere.

The system consists of one or several battery strings connected in parallel, depending on required power and energy.

Each battery string contains a string controller, and several series connected modules.

Battery management system (BMS) is a distributed system and must be configured and calibrated for each application.

Each battery module consists of 4 subsea battery cells, control circuits for monitoring of the cells, busbars, module fuse.

The battery module meets the DNV Pt.6 Ch.2 Sec.1 Non-Propagation Design Option #1, no cell-to-cell propagation.

Module including cells

Type of cells	Cylindrical 18650 Li-ion cells
Chemistry	Lithium ion NMC
Cells manufacturer	LG
Number and configuration of cells	74p8s (4 cell-modules 74p2s)
Max voltage	32 V
Min voltage	24 V
Capacity	259 Ah
Energy	8,2 kWh
Cooling	Air cooled, modules are submerged to nitrogen environment

Battery module with control circuits

Type: Moray battery module

String controller

Type: Moray EE-Top

Max no. of strings: 21

Max Voltage: VDC 672 VDC

Battery Management system

Functionality of BMS is distributed between the battery modules, battery string controller.

The software is identified by the following versions:

Battery string controller: CU v2.2xx.x / CS v1.9.x

Battery module: CGM v1.9.x / DCM v1.0x

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. Battery system is designed for subsea applications, with modules to be arranged in nitrogen filled container. Battery containers/ canisters serve a 'battery room', and battery modules shall not be taken out for charging or testing on open deck.

5. The container and arrangement of gas relief in case of thermal runaway event are not covered by this type approval certificate.

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	no humidity class (to be permanently installed in nitrogen filled containers/ canisters)
Vibration	Class A
EMC	Class A
Enclosure	IPxx ¹

¹ battery system shall be provided in container (ref. Application / Limitation note 4)

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