Certificate No:
TAE00004G7

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Li-Ion Battery System

with type designation(s)
Blue Marlin

Issued to
Corvus Energy
Richmond, BC, Canada

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.

Issued at **Høvik** on **2022-09-01**
This Certificate is valid until **2027-08-31**.
DNV local station: **Vancouver**

Approval Engineer: **Sverre Eriksen**

for **DNV**

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.

Name and place of manufacture

Corvus Energy	Richmond BC, Canada

Product description

Liquid cooled lithium-ion capacitor based energy storage system (ESS) for use in battery-powered or hybrid vessels and off-shore units.
The system consists of capacitor modules connected in series to form a pack and achieve the required system voltage. Packs are installed in parallel in order to provide the required energy capacity.
Each capacitor module contains a module control board (MCB) which monitors and communicates voltage, temperature and diagnostic information to the pack controller. The pack controller consists of pack disconnection module (PDM) and master control module (MCM). PDM is the electrical interface between the load and the pack. The MCM communicates with the pack modules, other packs, and external systems.
The capacitor modules, PDM, MCM and all other pack components are housed within a dedicated racking system which provides: all module and pack electrical interconnection, pack communication, module cooling, and an integrated thermal runaway exhaust duct.

Module including cells and MCB

Type:	MC33-130V-LQ
Chemistry:	Lithium-ion capacitor
Number of cells:	36
Cell configuration:	1P36S
Max Voltage:	136.8 V
Min Voltage:	79.2 V
Peak current:	557 A
Continuous current	200 A
Energy:	110 Wh
Cooling:	Liquid cooled

MCM

Type:	MCM10(G)-(EE)*

PDM

Type:	PDM100-315A-(CCN)-(PS)-(F)-(RR)R-(BS)-(Custom)*

Pack

Type:	C(NN)130(N)1-LQ-MB-VAC-(MT)-(Core)-(Custom)*
Max No. of modules:	8
Max Voltage:	1094V
Max Energy:	873 Wh

* The values in parenthesis may vary from one configuration to another, the following are availability:

Definition:	Variable:	Options:	Availability:
Rack Configuration	C	Single Column Triple Pack	S K
Current Sensor	CCN	351 = 1 x 350 Amp Sensor 352 = 2 x 350 Amp Sensor 501 = 1 x 500 Amp Sensor 502 = 2 x 500 Amp Sensor	351 352 501 502
Generation	G	First Generation for Rack	1
Energy/Power Management System protocol	EE	Modbus CANBus J1939	MB CN
Number of Batteries	NN	Single column between 3 – 8 Triple Pack between 3 – 5	03, 04, 05, 06, 07, 08 03, 04, 05

Capacitor Management system (BMS)
Functionality of BMS is distributed between MCB, MCM and PDM.

The software is identified by the following versions:

BMS controlled release version : 1.8.x

Software change management is described in Corvus Controlled Versioning Specification document No. 1011985.

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 piping system venting the exhaust gases from the rack to open air/safe location shall be verified onboard in each case. Requirements in DNV rules Pt.6 Ch.2 Sec.1 shall be fulfilled.
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.

Product certification:
A DNV product certificate according to DNV Pt.6 Ch.2 Sec.1 Table 2 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
- (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	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, DNV-CG-0339 and system functional type tests given in Corvus document 1019568.

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