DNV·GL

Certificate No:
TAE000026N

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Battery (Accumulator)

with type designation(s)
ORCA Energy

Issued to
Corvus Energy Inc.
Richmond BC, Canada

is found to comply with
DNV GL 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 GL.

Issued at **Høvik** on **2017-08-14**
This Certificate is valid until **2022-08-13**.
DNV GL local station: **Vancouver**

for **DNV GL**

Approval Engineer: **Marta Alonso Pontes**

Andreas Kristoffersen
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.

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Name and place of manufacture

Corvus Energy
Richmond BC
Canada

Product description

Air cooled lithium-ion battery based energy storage system (EES) for use in battery-powered or hybrid vessels and off-shore units.
The system consists of battery 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 battery 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 battery pack. The MCM communicates with the pack modules, other packs, and external systems.
The battery modules, PDM, MCM and all other pack components are housed within a dedicated racking systems 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:	ME1(G)-(VVV)V-AR*
Chemistry:	Lithium ion NMC
Number of cells:	24
Cell configuration:	2P12S
Max Voltage:	50 V
Min Voltage:	36 V
Capacity:	128 Ah
Energy:	5,7 kWh
Cooling:	Forced air

MCM

Type:	MCM10(G)-(EE)*

PDM

Type:	PDM100-(AAA)A-(PS)-(F)-(RR)R-(BS)*

Pack

Type:	E(NN)(VVV)(C)-AR-(EE)-(PS)-ST-(Core)*
Max No. of modules:	24
Max Voltage:	1200V
Max Energy:	137 kWh

* The values in parenthesis may vary from one configuration to another. Refer to CORVUS document "Configurations for DNVGL TAC Rev2" dated 18 July 2017 for possible configurations.

Battery Management system
Functionality of BMS is distributed between MCB, MCM and PDM. Independent overtemperature protection according to DNV GL Pt.6 Ch.2 Sec.1 [4.1.5.2] is arranged as hardwired signal tripping high voltage interlock loop (HVIL).

The software is identified by the following versions:

Modules
SW: v1.3.2 Build# 359

MCM
SW: v.1.3.18 Build # 449

PDM
SW: v1.3.9 Build#338

Application/Limitation

1. When installed on a ship or offshore unit, the DNV GL class rules for battery installation must be followed (DNV GL 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 GL rules Pt.6 Ch.2 Sec.1 shall be fulfilled.
3. Communication interface between battery arrays / banks is not covered by this Type Approval and if installed it shall be approved and tested on case by case basis
4. The Type Approval covers hardware and software listed under Product description
5. The Type Approval is valid for systems made by production facilities listed under Place of Manufacture

Product certification:
A DNV GL product certificate according to DNV GL 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 (DNVGL-CG-0339)

Temperature	Class A
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 GL 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 DNVGL-CP-0418, DNVGL-CG-0339 and pack level safety function tests, DOC#: 1009814 rev.C

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