DNV·GL

Certificate No:
TAE0000474

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Li-Ion Battery System

with type designation(s)
COBRA Battery System

Issued to
Becker Marine Systems GmbH
Hamburg, Germany

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 **Hamburg** on **2021-02-03**
This Certificate is valid until **2026-02-02**.
DNV GL local station: **Hamburg – CMC North/East**

for **DNV GL**

Approval Engineer: **Andreas Andrecht**

Arne Schaarmann
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 GL AS, its parent companies and subsidiaries as well as their officers, directors and employees ("DNV GL") 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.

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Product description

The COBRA battery system consists of water- or air- cooled battery racks that contain up to eight battery modules utilizing LFP battery cells and the switch unit. The system is scalable up to ten compact battery racks per control cabinet. The system is not limited to the following example configurations.

COBRA battery system configurations

Number of Racks connected (with 8 Modules)	1	2	3	4	5	6	7	8	9	10	Unit
Capacity @ > 1C	100	200	300	400	500	600	700	800	900	1000	Ah
Capacity @ < 1C	105	210	315	420	525	630	735	840	945	1050	Ah
Energy@ > 1C	89,6	179	269	358	448	538	627	716	806	896	kWh
Energy@ < 1C	94	188	282	376	470	564	658	752	846	940	kWh

Battery Rack - BR 0D xx xxxxx

Number of Modules per Rack	1	2	3	4	5	6	7	8	Unit
Protection class	IP54								
Nominal DC-Voltage	112	224	336	448	560	672	784	896	V
Min DC-Voltage	88	176	264	352	440	528	616	704	V
Max DC-Voltage	125	250	375	500	625	750	875	1000	V
Max Current	250								A

Battery Module BM 0D xx xxxxx

Protection class	IP44
Energy @ > 1C	11,2 kWh
Energy @ < 1C	11,7 kWh
Capacity @ > 1C	100 Ah
Capacity @< 1C	105 Ah
Nominal voltage	112 V
Min voltage	88 V
Max voltage	125 V
Configuration	35S1P
Cooling	Water with 30-50% Glycol or air

Switch Unit SU 0D xx xxxxx

Protection class	IP44
Max. Switching Current	250 A
Fuse	Max. 250A

Control Cabinet CC 0D xx xxxxx

Connected Racks	1	2	3	4	5	6	7	8	9	10	Unit
Supply voltage	24										VDC
Max Power consumption (System)	88	121	165	210	250	294	338	380	424	466	W
Protection class	IP55										

Cell

Nominal voltage	3,2 V
Discharge cut-off voltage	2,5 V
Charge cut-off voltage	3,65 V
Capacity @ > 1C	100 Ah
Capacity @ < 1C	105 Ah
Chemicals	LFP

Battery Management System (BMS) and system overview
The BMS and independent safety system consists of BMS Slave (Cell Monitoring Unit CMU), BMS Master (Master Control Unit MCU), CobraSense42 Slave and CobraSense42 Master.

BMS Cell Monitoring Unit (CMU)
The slave-BMS consists of three single boards. They are located in the battery modules. Their purpose is to measure the status of the LFP cells and transmit the data to the master BMS. Each slave board can measure the voltage of up to twelve cells and sense four temperatures. Each board has twelve balancing resistors that can be individually activated by the master to achieve SOC balance on cell level. For temperature control, the boards are equipped with two internal temperature sensors to avoid overheating while balancing

COBRASense42 Slave (CS42S)
The COBRASense42 Slave is part of the battery module and is designed for independent safety functionality of the battery module. The purpose of the board is to detect cell venting, redundant temperature monitoring and the module cooling liquid leakage detection. A safety line trips the main breaker in case of fault detection.

Switch Unit (SU)
The switch unit comprises the master BMS, the COBRASense42 master, two power fuses and two circuit breakers.

BMS Master Control Unit (MCU)
The MCU is a device to incorporate and extend the functions of the slave BMS. It creates the interface between the BMS and the PLC.

COBRASense42 Master (CS42M)
The COBRAsense42 master is installed in the switch-unit. It communicates with the COBRASense42 slaves and monitors the pilot line.

Control Cabinet (CC)
Every battery system (consisting of 1 to 10 battery racks) is connected to one control cabinet which manages the basic functions of the system. The CC represents the interface to the ship's system.

Software Versions

COBRASense42-Master	
Application software version	V01
COBRASense42-Slave	
Application software version	V07
BMS	
Software Version	CRC: 0x19743093 /ID: 0
Control Cabinet	
Software Version	CB000104-01/2.00.00

Location classes

Temperature Class B
Humidity Class A
Vibration Class A
EMC Class A
Enclosure IP4x

Application/Limitation

Ventilation Fans
The capacity and speed of the smoke extraction and ventilation fans for the integrated exhaust shall be submitted for each product certification individually.

Battery room ventilation
The battery room ventilation shall comply with the requirements as given for design option 1 with integrated ventilation duct.

Approval conditions

For each delivery to DNV GL class the following documentation of the battery system is to be submitted for approval:

Battery system

- Reference to this type approval certificate
- Copy of the safety description
- I130 Project-specific Battery System Block Diagram
- E120 Technical specification of the battery system that is subject for product certification
- E170 Electric schematic diagram of the battery system showing internal arrangement of battery modules, battery strings, switch unit, emergency stop and independent safety system
- Z060 Functional description, including a project-specific overall description of the battery management system
    - software and hardware versions of components
    - capacity calculations for the gas extract ventilation fan
    - other relevant information not covered by the safety description
- Z252 Test program for product certification, including routine tests specified in applicable rules
- Z265 Calculation report, documentation of the SOC and SOH calculation

The Type Approval covers hardware and software listed under product description.

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.

Product certificate
Each delivery of the application system is to be certified according to Pt.6, Ch.2, Sec. 1. The certification test is to be performed at the manufacturer of the application system before the system is shipped to the yard. After certification, the clause for application software control will be put into force. The independent cell voltage disconnection is integrated in the system and is not required to be tested during certification. See DNVGL-RU-SHIP Pt.6 Ch.2 Sec.1, Table 7 Tests of battery systems, item 10.

Application software control
All changes in software are to be recorded as long as the system is in use on board. Documentation of major changes are to be forwarded to DNV GL for evaluation and approval before implemented on board.

Type Approval documentation

Tests carried out

Type tests for the battery system according to applicable DNV GL rules and standards as listed below have been carried out. DNVGL-RU-SHIP Pt.6 Ch.2 Sec.1 (Edition 2020-07), DNVGL-RU-SHIP Pt.4 Ch.8, DNVGL-RU-SHIP Pt.4 Ch.9, DNVGL-CG-0339 (Edition: 2019-12), DNVGL-CP-0418 (Edition: 2020-07).

Tests not requiered by DNVGL-CP-0418 but part of IEC 62619 as well as IEC 62620 have been carried out additionally.

Propagation test passed in accordance to DNVGL-RU-SHIP Pt.6 Ch.2 Sec.1 [4.2.2] edition January 2019 (with design option 1: No propagation between cells)

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