



Certificate no.:
TAE00004TV

TYPE APPROVAL CERTIFICATE

This is to certify:

that the Li-Ion Battery System

with type designation(s)

Navius MRS-3 Battery Sytem

issued to

Leclanché E-Mobility SA
Yverdon-les-Bains, Switzerland

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.

Issued at **Høvik** on **2025-02-27**

This Certificate is valid until **2030-02-26**.

for **DNV**

DNV local unit: **Augsburg**

Approval Engineer: **Andreas Andrecht**

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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Product description

The Navius MRS-3 battery system is a scalable energy storage solution consisting of lithium-ion battery modules housed in a steel rack with a disconnect system and controlled by a functionally safe BMS. It stores electrical energy and releases it on demand to the vessel's electrical distribution system. The system is designed for marine environments and is designed as a fully enclosed system with the battery system acting as its own battery space with attached exhaust ventilation system for the extraction of smoke and gases in the event of a thermal runaway. The battery is built up from Battery modules housed within IP Battery modules which are steel enclosures with a liquid cooled heatsink as the floor of the IP Battery module. The modules are connected in series electrically and installed in a vertical rack. When installed in the rack and mated to the safety manifold at the back of the rack, the IP Battery module provides a gas tight enclosure. Several racks are connected to house the requisite number of modules required to achieve battery system voltage. A control unit connects electrically to both ends of the serially connected Battery modules. The IP Battery modules are installed in racks together with the safety manifold and a control unit which includes switching, fusing and the BMS master.

Cell Data:

Cell chemistry	G/NMC (622)
Nominal Capacity (typical)	65 Ah (measured at C/10 discharge rate, RT)
Nominal Energy	242 Wh (measured at C/10 discharge rate, RT)
Nominal Voltage	3,72 V
Voltage range	3,0 V to 4,35 V
Housing	Foil packaging

IP Battery Module M3-9s4p

Cell	G/NMC 65Ah 936A06
Dimensions (w x h x d)	425 x 203.5 x 674 [mm]
Module	9S4P configuration
Weight	72 [kg]
Volume	58.3 [l]
Cooling	Liquid cooling via external cooling plate
IP Class	IP 4x with terminals covered and IP2x with terminals exposed
Electrical	
Nominal voltage (OCV)	33.48 [VDC]
Minimum voltage (OCV)	27 [VDC]
Maximum voltage (OCV)	39.15 [VDC]
Capacity	260 [Ah] (discharge current C/10 = 26 [A])
Nominal Energy (BoL)	8.7 [kWh]
Type designation	MRS-3.0 9S4P 65Ah MARINE MODULE ASSEMBLY
Hardware Version	P00000065
Software Version	FSS: 2.x.x (x= minor changes, e.g bug fixes)

IP Battery Module M3-12s3p

Cell	G/NMC 65Ah 936A06
Dimensions (w x h x d)	425 x 203.5 x 674 [mm]
Module	12S3P configuration
Weight	72 [kg]
Volume	58.3 [l]
Cooling	Liquid cooling via external cooling plate
IP Class	IP 4x with terminals covered and IP2x with terminals exposed
Electrical	
Nominal voltage (OCV)	44.64 [VDC]
Minimum voltage (OCV)	36 [VDC]
Maximum voltage (OCV)	52.2 [VDC]
Capacity	195 [Ah] (discharge current C/10 = 19.5 [A])
Nominal Energy (BoL)	8.7 [kWh]
Type designation	MRS-3.0 12S3P 65Ah MARINE MODULE ASSEMBLY
	LOW CURRENT / HIGH CURRENT
Hardware Version	P00000371 / P00000398
Software Version	FSS: 2.x.x (x= minor changes, e.g bug fixes)

IP Battery Module M3-18s2p

Cell	G/NMC 65Ah 936A06
Dimensions (w x h x d)	425 x 203.5 x 674 [mm]
Module	18S2P configuration
Weight	72 [kg]
Volume	58.3 [l]
Cooling	Liquid cooling via external cooling plate
IP Class	IP 4x with terminals covered and IP2x with terminals exposed
Electrical	
Nominal voltage (OCV)	66.96 [VDC]
Minimum voltage (OCV)	54 [VDC]
Maximum voltage (OCV)	78.3 [VDC]
Capacity	130 [Ah] (discharge current C/10 = 13 [A])
Nominal Energy (BoL)	8.7 [kWh]
Type designation	MRS-3.0 18S2P 65Ah MARINE MODULE ASSEMBLY
Hardware Version	P00000397
Software Version	FSS: 2.x.x (x= minor changes, e.g bug fixes)

Mid-Pack Contactor

Dimensions (w x h x d)	190 x 129 x 277 [mm]
IP Class	IP 44
Type designation	MRS-3 800A MID-PACK CONTACTOR ASSEMBLY
Hardware Version	P00000170

Control Unit & Interface Unit

Dimensions (w x h x d)	425 [mm] x 416.5 [mm] x 669 [mm]
CU Weight	56.4 [kg]
IU Weight	13.5 [kg]
Cooling plate	1 x cooling plate
Cooling plate coolant volume:	0.34 [l]
IP Class	IP 44 with rear vent covered and IP4x with no cover in place
Hardware Version	FSM_LV: 2.x.x
Software Version	FSM_HV: 2.x.x (x= minor changes, e.g bug fixes)

Versions:

P00000181	CONTROL UNIT_400A_WO-GUI_WO-IOT_WO-MSC
P00000182	CONTROL UNIT_400A_GUI_WO-IOT_WO-MSC
P00000183	CONTROL UNIT_400A_WO-GUI_IOT_WO-MSC
P00000184	CONTROL UNIT_400A_WO-GUI_WO-IOT_MSC
P00000185	CONTROL UNIT_400A_GUI_IOT_WO-MSC
P00000186	CONTROL UNIT_400A_GUI_WO-IOT_MSC
P00000187	CONTROL UNIT_400A_WO-GUI_IOT_MSC
P00000188	CONTROL UNIT_400A_GUI_IOT_MSC
P00000189	CONTROL UNIT_800A_WO-GUI_WO-IOT_WO-MSC
P00000190	CONTROL UNIT_800A_GUI_WO-IOT_WO-MSC
P00000191	CONTROL UNIT_800A_WO-GUI_IOT_WO-MSC
P00000192	CONTROL UNIT_800A_WO-GUI_WO-IOT_MSC
P00000193	CONTROL UNIT_800A_GUI_IOT_WO-MSC
P00000194	CONTROL UNIT_800A_GUI_WO-IOT_MSC
P00000195	CONTROL UNIT_800A_WO-GUI_IOT_MSC
P00000196	CONTROL UNIT_800A_GUI_IOT_MSC
P00000299	CONTROL UNIT_24VDC_400A_WO-GUI_WO-IOT_WO-MSC
P00000300	CONTROL UNIT_24VDC_400A_GUI_WO-IOT_WO-MSC
P00000301	CONTROL UNIT_24VDC_400A_WO-GUI_IOT_WO-MSC
P00000302	CONTROL UNIT_24VDC_400A_WO-GUI_WO-IOT_MSC
P00000303	CONTROL UNIT_24VDC_400A_GUI_IOT_WO-MSC
P00000304	CONTROL UNIT_24VDC_400A_GUI_WO-IOT_MSC
P00000305	CONTROL UNIT_24VDC_400A_WO-GUI_IOT_MSC
P00000306	CONTROL UNIT_24VDC_400A_GUI_IOT_MSC
P00000307	CONTROL UNIT_24VDC_800A_WO-GUI_WO-IOT_WO-MSC
P00000308	CONTROL UNIT_24VDC_800A_GUI_WO-IOT_WO-MSC
P00000309	CONTROL UNIT_24VDC_800A_WO-GUI_IOT_WO-MSC
P00000310	CONTROL UNIT_24VDC_800A_WO-GUI_WO-IOT_MSC
P00000311	CONTROL UNIT_24VDC_800A_GUI_IOT_WO-MSC
P00000312	CONTROL UNIT_24VDC_800A_GUI_WO-IOT_MSC
P00000313	CONTROL UNIT_24VDC_800A_WO-GUI_IOT_MSC
P00000314	CONTROL UNIT_24VDC_800A_GUI_IOT_MSC

GUI graphical user interface, IOT edge device and MSC multistring controller options of the control unit and part of the project case by case approval.

M3-9s4p Battery String Configuration (up to 32 Modules, 1200V)

Cooling	Liquid cooling
IP Class	IP44
Rated full Capacity	260 [Ah] (discharge current C/10 = 26 [A])
Maximum Charging C Rate (EOL) 5	Project specific based on the operational profile of the vessel
Maximum Discharging C Rate (EOL) 5	Project specific based on the operational profile of the vessel
Maximum Nominal Energy (BoL)	279 [kWh]

M3-12s3p Battery String Configuration (up to 24 Modules, 1200V)

Cooling	Liquid cooling
IP Class	IP44
Rated full Capacity	195 [Ah] (discharge current C/10 = 19.5 [A])
Maximum Charging C Rate (EOL) 10	Project-specific based on the operational profile of the vessel
Maximum Discharging C Rate (EOL) 10	Project specific based on the operational profile of the vessel
Maximum Nominal Energy (BoL)	209 [kWh]

M3-18s2p Battery String Configuration (up to 16 Modules, 1200V)

Cooling	Liquid cooling
IP Class	IP44
Rated full Capacity	130 [Ah] (discharge current C/10 = 13 [A])
Maximum Charging C Rate (EOL) 15	Project specific based on the operational profile of the vessel
Maximum Discharging C Rate (EOL) 15	Project specific based on the operational profile of the vessel
Maximum Nominal Energy (BoL)	139.5 [kWh]

Battery Cooling Mechanical Specification

Material	Cooling plate standing below each battery module.
Cooling liquid composition	De-ionized/Demineralized water 60 [%] and Ethylene Glycol 40 [%]. Note: Glycol must include a corrosion inhibitor.
Cooling liquid temperature	18 ± 2 [°C]3 – Cooling circuit temperature is preferred to be equal to, or higher, with battery room temperature to avoid condensation
Cooling flow rate	2 [l/min] /cooling plate

Mid-Pack Contactor

The system is equipped with minimum one, up to 3 Mid-pack contactor per string which is intended to reduce the maximum voltage presence in the battery sting in the following states:

- Battery string powered off
- Critical error occurred:
 - Insulation fault of the battery string
 - Emergency stop of the battery string activated
 - Battery active safety system activated in the zone where the certain battery string located.

Battery Management System

The MRS-3 marine battery system is based on a proprietary functional safe BMS, which consist of following HW parts:

- FSM Functional Safe Master unit
- FSS Functional Safe Slave Unit
- Intermediate PCB

FSM is a separate unit integrated in the control unit of the MRS-3 battery system. FSS and intermediate PCB (IB) are integrated inside of the each M3 battery module inside MRS-3 IP battery.

The BMS communicates with host system via the CAN bus in case when the multi string controller (MSC) option is not used. In case of the MSC option, the communication between the MSC and host system is implemented based on the Modbus TCP interface. Host system on the vessel side is typically PMS or EMS of the vessel.

Integrated Insulation Monitoring

The MRS- 3 control unit includes an integrated insulation monitoring device (IMD), which monitors the insulation level of the battery string when the battery string is disconnected from the load circuit. If IMD detects too low insulation resistance, the BMS activates the insulation fault and prevents connection of the battery string. In case of the detected insulation fault the mid-pack contactor is controlled open by BMS to mitigate the risk for two ground fault situation.

Excessive Temperature Detection System

In addition to the safety functions implemented in the BMS the system is equipped with an independent system preventing excessive temperatures that will trip the main contactors in case of high temperature detection.

Battery Active Safety System

The MRS-3 battery system has an integrated battery active safety system (BASS), which can be connected into sprinkler system of the vessel, which is used for protecting other spaces of the vessel also or the separate standalone BASS SKID can be used.

Location Classes

Temperature Class	A
Humidity Class	A
Vibration Class	A
EMC Class	A
Enclosure Class	IP44

Application/Limitation

Multi String Controller

The multi string controller is part of the case by case approval and excluded from the type approval.

Battery room ventilation

The battery room ventilation shall comply with the requirements as given for design option 2 without integrated ventilation duct.

The Battery Active Safety System used as module propagation extinguishing shall be supplied from two independent sources of power (for e.g. main and emergency source of power).

Place of production

Leclanché E-Mobility SA
Avenue des Découverts 14C
1400 Yverdon-les-Bains – Switzerland

Approval conditions

For each delivery to DNV 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

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

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.

Product certificate

When installed on a DNV classed ship or offshore unit 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 overcharge protection is CID based on cell level and is not required to be tested during product certification. For non DNV classed installations the product certification will be not mandatory.

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 for evaluation and approval before implemented on board.

Type Approval documentation

Tests carried out

Type tests for the battery system according to applicable DNV rules and standards as listed below have been carried out. DNV-RU-SHIP Pt.6 Ch.2 Sec.1 (Edition 2022-07), DNV-RU-SHIP Pt.4 Ch.8, DNV-RU-SHIP Pt.4 Ch.9, DNV-CG-0339 (Edition: 2019-12), DNV-CP-0418 (Edition: 2020-07).

The Propagation test has been passed in accordance to DNV-RU-SHIP Pt.6 Ch.2 Sec.1 design option 2 no propagation between modules.

Marking of product

The products to be marked with:

- manufacturer name
- model name
- serial number
- power supply ratings

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



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- 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