



Marine & Offshore

Certificate number: 60987/A1 BV

File number: ACE8/923/1

Product code: 2899I

This certificate is not valid when presented without the full attached schedule composed of 7 sections

www.veristar.com

TYPE APPROVAL CERTIFICATE

This certificate is issued to

LECLANCHE

Yverdon les bains - SWITZERLAND

for the type of product

BATTERY SYSTEM AND COMPONENTS

G/NMC lithium-ion battery-based Energy Storage System.

Requirements:

Bureau Veritas Rules for the Classification of Steel Ships

This certificate is issued to attest that Bureau Veritas Marine & Offshore did undertake the relevant approval procedures for the product identified above which was found to comply with the relevant requirements mentioned above.

This certificate will expire on: 25 Aug 2025

For Bureau Veritas Marine & Offshore,

At BV HAMBURG, on 18 Mar 2021,

Dirk Hoepfner



This certificate remains valid until the date stated above, unless cancelled or revoked, provided the conditions indicated in the subsequent page(s) are complied with and the product remains satisfactory in service. This certificate will not be valid if the applicant makes any changes or modifications to the approved product, which have not been notified to, and agreed in writing with Bureau Veritas Marine & Offshore. Should the specified regulations or standards be amended during the validity of this certificate, the product(s) is/are to be re-approved prior to it/they being placed on board vessels to which the amended regulations or standards apply. This certificate is issued within the scope of the General Conditions of Bureau Veritas Marine & Offshore available on the internet site www.veristar.com. Any Person not a party to the contract pursuant to which this document is delivered may not assert a claim against Bureau Veritas Marine & Offshore for any liability arising out of errors or omissions which may be contained in said document, or for errors of judgement, fault or negligence committed by personnel of the Society or of its Agents in establishment or issuance of this document, and in connection with any activities for which it may provide.

The electronic version is available at: <http://www.veristarnb.com/veristarnb/jsp/viewPublicPdfTypepec.jsp?id=twdkr4gmk1>

BV Mod. Ad.E 530 June 2017

This certificate consists of 5 page(s)

THE SCHEDULE OF APPROVAL

1. PRODUCT DESCRIPTION :

G/NMC is a lithium-ion battery-based Energy Storage System for use in battery-powered or hybrid vessels and offshore units. The system consists of battery modules (up to 33 G/NMC cells per module) with included battery monitoring unit (BMU), battery control unit (BCU) for modules connected in series as string and a switch unit for each string.

1.1 - Cell.

| Cell type: 946A01 | |
|---|----------------------------------|
| Lithium Nickel Manganese Cobalt oxide (NMC) – graphite | |
| LecCell G/NMC | 43Ah/200Wh |
| Nominal Capacity | 43Ah (C/5 discharge rate) |
| Nominal Voltage | 3,65V |
| Weight | ~1000g |

| Cell type: LC-51LE 48Ah | |
|---|----------------------------------|
| Lithium Nickel Manganese Cobalt oxide (NMC) – graphite | |
| LecCell G/NMC | 48Ah/178Wh |
| Nominal Capacity | 48Ah (C/8 discharge rate) |
| Nominal Voltage | 3,7V |
| Weight | ~1120g |

| Cell type: 946A03 - GL55 55Ah | |
|---|-----------------------------------|
| Lithium Nickel Manganese Cobalt oxide (NMC) – graphite | |
| LecCell G/NMC | 55Ah/200Wh |
| Nominal Capacity | 55Ah (C/10 discharge rate) |
| Nominal Voltage | 3,7V |
| Weight | ~1140g |

| Cell type: 946A04 - GL60 60Ah | |
|---|-----------------------------------|
| Lithium Nickel Manganese Cobalt oxide (NMC) – graphite | |
| LecCell G/NMC | 60Ah/220Wh |
| Nominal Capacity | 60Ah (C/10 discharge rate) |
| Nominal Voltage | 3,7V |
| Weight | ~1120g |

| | |
|-------------------------------|---|
| Volume | 475ml |
| Housing | Foil packing |
| Expected lifetime | >4500 cycles (at 1C charge/discharge full DoD and RT) |
| Expected calendar life | 10 years (at RT) |

1.1.1 - Module Type: M2Marine Battery Module technology.

Module includes embedded BMU which monitors up to 24 individual cell voltages and up to 4 cell group temperatures and the passive cell balancing. Each module is equipped with an independent heat detection line (Excessive Temperature Detection) which disconnect the main switch and activates the fire suppression. Every module is inserted in IP 65 box with water cooling element, exhaust channel and for water mist or foam based fire suppression systems designed.

1.1.2 - Battery Management system - BMS G2 1.0.X.

The BCU monitored cell parameters and ensures the safe operating range. BCU controls the charging, discharging, cell balancing etc. with up to 60 modules connected in series as string.

| | |
|-----------------|---|
| Software | Battery Measurement Unit (BMU): ver. 1.8.X |
| | Battery Control Unit (BCU): ver. 1.X.X |
| Hardware | BMU 24 channels version: rev C12 (embedded in the module). |
| | BMU 12 channels version: rev C13 (embedded in the module). |
| | BCU: rev C10 |

1.1.3 - Excessive Temperature Detection.

Consists of heat sensing cable FyreLine (fixed temperature 68°C) and WAGO PLC.

| | |
|------------|---|
| Cable Type | Thermocable 68°C (Eurofyre Limited, Fyreline, FLD68). |
| PLC Type | Wago controller 750-8101. |

1.1.3 - Fire Suppression System Activation.

The activation of the external fire suppression system is based on the excessive temperature detection line on the battery modules and the smoke detection at the extremity of the duct channel.

1.1.4 - Battery Module Configurations.

| Module | Article No. | Cell Type | Config. | Cells | Nominal | | | Discharge | | Charge |
|------------------|-------------|-----------|---------|-------|----------|---------|---------|------------|--------|------------|
| | | | | | Capacity | Energy | Voltage | Continuous | Pulse | Continuous |
| M2.GNMC(43)16s2p | 034000819 | 43Ah | 16s2p | 32 | 86Ah | 5,1 kWh | 58,40V | 258 A | 453 A | 86 A |
| M2.GNMC(43)8s4p | 034000808 | 43Ah | 8s4p | 32 | 172Ah | 5,1 kWh | 29,20V | 516 A | 905 A | 172 A |
| M2.GNMC(43)4s8p | 034000796 | 43Ah | 4s8p | 32 | 344Ah | 5,1 kWh | 14,60V | 1032 A | 1811 A | 344 A |
| M2.GNMC(43)6s5p | 034000802 | 43Ah | 6s5p | 32 | 215Ah | 4,8 kWh | 21,90V | 645 A | 1132 A | 215 A |
| M2.GMNC(48)4s8p | 034001000 | 48Ah | 4s8p | 32 | 384Ah | 5,7 kWh | 14,8V | 680 A | 1920 A | 384 A |
| M2.GMNC(55)16s2p | 034001011 | 55Ah | 16s2p | 32 | 110Ah | 6,4 kWh | 59,2V | 330 A | 550 A | 110 A |
| M2.GNMC(55)8s4p | 034001012 | 55Ah | 8s4p | 32 | 220Ah | 6,4 kWh | 29,6V | 660 A | 1100 A | 220 A |
| M2.GMNC(55)4s8p | 034001002 | 55Ah | 4s8p | 32 | 440Ah | 6,4 kWh | 14,8V | 680 A | 2200 A | 440 A |
| M2.GMNC(55)6s5p | 034001025 | 55Ah | 6s5p | 32 | 275Ah | 6,4 kWh | 22,2V | 680 A | 1375 A | 275 A |
| M2.GMNC(60)4s8p | 034001054 | 60Ah | 4s8p | 32 | 480Ah | 7,0 kWh | 14,8V | 680 A | 1200 A | 480 A |
| M2.GMNC(60)8s4p | 034001039 | 60Ah | 8s4p | 32 | 240Ah | 7,0 kWh | 29,6V | 680 A | 1200 A | 240 A |
| M2.GMNC(60)16s2p | 034001055 | 60Ah | 16s2p | 32 | 120Ah | 7,0 kWh | 59,2V | 360 A | 600 A | 120 A |

2. DOCUMENTS AND DRAWINGS :**2.1. Technical Documentation and Drawings.**

- 2.1.1 - Doc. DOC-X-C-MAT-GEN-003 - Leclanché MRS Functional Description, Version 14.0, dated 29/07/2020.
- 2.1.2 - Doc. DOT-X-C-MAT-GEN-005 - Leclanché MRS Installation Instruction, Version 9.0, dated 11/09/2020.
- 2.1.3 - Doc. DOT-X-C-MAT-GEN-007 - Leclanché MRS Maintenance Manual Z163, Version 8.0, dated 22/09/2020.
- 2.1.4 - Doc. DOT-X-C-MAT-GEN-008 - Leclanché MRS Battery Safety Assessment, Version 5.0, dated 25/11/2020.
- 2.1.5 - Doc. DOT-X-C-MAT-GEN-009 - Leclanché MRS Battery Ventilation Specification, Version 4.0, dated 28/01/2020.
- 2.1.6 - Doc. DOT-X-C-MAT-GEN-011 - Leclanché BMS G2 CAN interface description modbus, Version 6.0, dated 29/07/2020.
- 2.1.7 - Doc. DOT-X-C-MAT-GEN-027 - Leclanché MRS Technical Specifications E120, Version 2.0, dated 15/11/2019.
- 2.1.8 - Doc. DOT-X-C-MAT-GEN-037 - Leclanche Test Plan Thermal Propagation+Test-Marioff-Hi-Fog, Ver.1, dated 8/04/2020.
- 2.1.9 - Doc. DOT-X-C-MAT-GEN-039 - Leclanché Multistring Controller Specification, Version 7.0, dated 29/09/2020.
- 2.1.10 - Doc. DOT-X-C-MAT-GEN-040 - Leclanche Software Quality Plan, Version 7.0, dated 10/06/2020.
- 2.1.11 - Draw. DRW-X-C-MAT-GENERIC-001-1 - Leclanché GENERIC-001-1, GENERIC Block Diagram One Battery Pack, Rev. 1, 18/07/2019.
- 2.1.11 - Leclanché G/NMC Technology, Article Number 936A03, GL55 Energy Cell 55 Ah - datasheet.
- 2.1.12 - Leclanché G/NMC Technology, Article Number 936A04, GL60 Energy Cell 60 Ah - datasheet.
- 2.1.13 - Leclanché G/NMC Technology, Article Number 936A04, Product Safety Data Sheet, Rev.1, 17/03/2020.
- 2.1.14 - Leclanché Battery Dimensioning philosophy.
- 2.1.15 - Leclanche, Drop Test Plan, IEC62619, dated 25/06/2020.
- 2.1.16 - Optical Smoke Detector Apollo ORBIS Data Sheet, Doc. E20.200.01.tcd, Rev.0, 02/03/2005.
- 2.1.17 - Optical Smoke Detector Apollo ORBIS Data Sheet, Doc. PP5021/2017/Issue 1.
- 2.1.18 - Optical Smoke Detector Apollo ORBIS, ABS MED Certificate, Nro. 11-LD792467-5EC3.

2.2 - Approval conditions:

2.2.1 - For each delivery the following documentation of the battery system is to be submitted for approval:

2.2.1.1 Switch unit:

- Electrical datasheet.
- Assembly schedules and technical data.
- Electrical schematic diagram.
- Layout of electrical assembly.

2.2.1.2 Battery system:

- Reference to this type approval certificate.
- Copy of the approved Safety description.
- Project-specific Battery System Block Diagram.
- Technical specification of the battery system that is subject for product certification.
- Electric schematic diagram of the battery system showing internal arrangement of battery modules, battery strings, switch unit, emergency stop and independent safety system
- Functional description, including;
 - Project-specific overall description of the battery management system.
 - Software and hardware versions of BCU and BMU.
 - Interface between the BCU and switching unit.
 - Capacity calculations for the gas extract ventilation fan other relevant information not covered by the safety description.
- Test program for product certification, including routine tests specified in applicable rules.

3. TEST REPORTS :**3.1 - Intertek Deutschland GmbH Niederlassung Kaufbeuren Lab.**

- Leclanché MRS Vibration Test, Doc. DOT-X-C-MAT-GEN-032, Version 3.0, dated 05/02/2020.

3.2 - Leclanché SA Lab.

- Leclanché MRS Battery BOX IP Test Report - IEC60529, Document 10-103, Version 1.0, dated 19/04/2017.
- Leclanché MRS Battery Cell Gas Analysis – 55Ah Cell, Doc. DOT-X-C-MAT-GEN-015, Version 1.0, dated 03/06/2019.
- Leclanché MRS Battery Cell - UN38 test report 936A03, Doc. DOT-L-936A03-004, Version 1.0, dated 23/10/2019.
- Leclanché UN38.3 regulation extension Article Number 936A04 Test report result, dated 13/03/2020.
- Leclanché MRS Dry Heat Test, Doc. DOT-X-C-MAT-GEN-033, Version 4.0, dated 05/02/2020.
- Leclanché MRS Damp Heat Test, Doc. DOT-X-C-MAT-GEN-034, Version 3.0, dated 05/02/2020.
- Leclanché MRS Flame retardant Test, Doc. DOT-X-C-MAT-GEN-035, Version 2.0, dated 05/02/2020.
- Leclanché MRS Discharge & Endurance Test - IEC62620, DOT-X-C-MAT-GEN-038, Version 1, dated 20/03/2020.
- Leclanche, Drop Test Report, IEC62619, Version 1, dated 09/07/2020; witnesses by BV Surveyor.
- Leclanche, Drop Test Report IEC62619, cell type: 946A04 60Ah, dated 04/02/2021; witnesses by BV Surveyor.

3.3 - EMITECH LYON Lab.

- Leclanché MRS EMC Test, Doc. DOT-X-C-MAT-GEN-036, Eferry-TR-MA-3-07, Version 2.0, dated 05/02/2020.

3.4 -Pelastusopisto - Emergency Services College, Kuopio Finland witnesses by BV Surveyor.

- Leclanche, 2-01 Thermal Propagation+Test-Marioff-Hi-Fog Test Report, Cell type: 946A01 43Ah, Ver.3, dated 04/01/2017.
- Leclanche, MRS2.0 Thermal Propagation+Test-Marioff-Hi-FogTest Report, Cell type: 946A03 55Ah, Ver.3, dated 01/03/2019.

3.5 -Pelastusopisto - Emergency Services Academy fire theatre, Kuopio Finland witnesses by BV Surveyor.

- Leclanche, MRS2.0 Thermal Propagation with FiFi4 Marine foam test, Cell type: 946A04 60Ah, Ver.1, dated 17/12/2020.
- Leclanche, MRS2.0 Thermal Propagation with Marioff-Hi-Fog test, Cell type: 946A04 60Ah, Ver.1, dated 22/12/2020.

4. APPLICATION / LIMITATION :

4.1 - BV Rules for the Classification of Steel Ships.

4.2 - Approval also valid for ships to be granted for the notations: AUT-UMS, AUT-CCS, AUT-PORT, AUT-IMS & BATTERY SYSTEM.

4.3 - BUREAU VERITAS Environmental Category, EC Code: 31.

4.4 - The equipment fulfils the EMC requirements for installation in General Power Distribution Zones.

4.5 - The installation shall comply with the Manufacturer's recommendation described in the above-referenced documentation.

4.6 - Leclanché Battery Pack Risk Analysis document should inform project-specific risk analysis.

4.7 - The capacity and speed of the smoke extraction and ventilation fans for the integrated exhaust duct as mention within the safety description are to be submitted for each product certification individually (referenced in 2.1.1 above).

4.8 - The switch unit with fuses and contactors are not included on this type approval, individual approval and acceptance test should be carried out as part of the product certification. (referenced in 2.2.1.1 above).

4.9 - Cooling liquid leakage hazards are to be considered individually for each installation.

4.10 - The battery system shall only be operated with a fire suppression system, either a water mist system or a foam based system. The installation and arrangement shall be performed in accordance with the setup during the propagation tests. The activation of the external fire suppression system is based on the excessive temperature detection line on the battery modules and the smoke detection at the extremity of the duct channel. Failures of the system are to be alerted at the machinery alarm system. Individual approval and acceptance test should be carried out as part of the product certification.

5. PRODUCTION SURVEY REQUIREMENTS :

5.1 - The above products are to be supplied by **Leclanché SA** in compliance with the type described in this certificate.

5.2 - This type of product is within the category IBV of Bureau Veritas Rule Note NR320.

5.3 - BV product certificate is required.

5.4 - For information, **Leclanché SA** has declared to Bureau Veritas the following production site(s):



Leclanché SA
Avenue des Sports 42
1400 Yverdons-Les-Bains, VD
Switzerland

6. MARKING OF PRODUCT :

6.1 - Maker's name or trade mark.

6.2 - Serial number of the units.

6.3 - Equipment type number or model identification under which it was type tested.

6.4 -  or  conformity marking, as relevant.

7. OTHERS :

7.1 - It is **Leclanché SA** responsibility to inform shipbuilders or their sub-contractors of the proper methods of fitting, use and general maintenance of the approved equipment and the conditions of this approval.

7.2 - This certificate supersedes the Type Approval Certificate N° 60987/A0 BV issued on 25 Aug 2020 by the Society.

*** END OF CERTIFICATE ***