DNV·GL

Certificate No:
TAE000048S

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Li-Ion Battery System

with type designation(s)
AYK A-176A BATTERY SYSTEM

Issued to
Anyikong Energy Ltd.
Naxxar, Malta

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 **2021-02-26**
This Certificate is valid until **2026-02-25**.
DNV GL local station: **Italy/Malta CMC**

Approval Engineer: **Andreas Andrecht**

for **DNV GL**

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 air cooled AYK Battery is designed to be modular and can be scaled up to 1000VDC. The smallest entity of the battery is the battery module. Battery modules can be connected in series to form a string. The maximum number of modules connected in series is twenty-four (24). The voltage of the string depends on the number of modules connected in series. Strings are isolated from a common DC buss by a breaker. Strings connected in parallel form a battery bank controlled by a multi string manager unit.

Each string has a single string controller unit where the BMS control layer resides. The BMS control layer performs the safety and control functions for the string. A 2nd hardware overcharge protection performs independent form the BMS but part of the printed boards.

LFP prismatic Cell

Rated Capacity	230 Ah
Limited Charge Voltage	3.65 V
Nominal Charge Current	115A
Max. Charge Current	230A
Nominal Discharge Current	115A
Max. Discharge Current	230 A
Discharge Cut-off Voltage	2.5 V

Module

The module consists of three 4s2P cell stacks with a result in a 12s2p configuration.

Rated Capacity	430 Ah
Limited Charge Voltage	43.8 V
Nominal Charge Current	230A
Max. Charge Current	460A
Nominal Discharge Current	230A
Max. Discharge Current	460 A
Discharge Cut-off Voltage	30V

String

Voltage	Modules in Series	Energy 12S2P (A-176A)
400V	9	158.4kWh
500V	12	211.2kWh
600V	14	246.4kWh
700V	16	281.6kWh
800V	18	316.8kWh
900V	21	369.6kWh
1000V	24	422.4kWh

Battery Bank (Multi Strings)

Strings	400V	500V	600V	700V	800V	900V	1000V	
1	158	211	246	282	317	370	422	kWh
2	317	422	493	563	634	739	845	kWh
3	475	634	739	845	950	1109	1267	kWh
4	634	845	986	1126	1267	1478	1690	kWh
5	792	1056	1232	1408	1584	1848	2112	kWh
6	950	1267	1478	1690	1901	2218	2534	kWh
7	1109	1478	1725	1971	2218	2587	2957	kWh
8	1267	1690	1971	2253	2534	2957	3379	kWh
9	1426	1901	2218	2534	2851	3326	3802	kWh
10	1584	2112	2464	2816	3168	3696	4224	kWh

Identification Battery Module A-176A

A0005-02	Assembly A0005	Rev. 02
Module level BMS board		P0030 Rev. 02
Module level BMS software		0.1.214.1104
Smoke detector board		P0035 Rev. 02
Smoke detector board software		0.1.214.1104
Valve driver board		P0036 Rev. 02
Valve driver board software		0.1.214.1104

Identification Single String Controller

A0006-02	Assembly A0006	Rev. 02
String Controller BMS Board		P0032 Rev. 02
String Controller BMS Software		0.1.214.1104
Current measurement Software		0.1.214.1104
HVI Board		P0033 Rev. 02
Buss Voltage Measurement Software		0.1.214.1104
String Voltage Measurement Software		0.1.214.1104
ABB_Breaker_SACE_TMAX_T5		

Identification Multi String Manager

A0003-03	Assembly A0003	Rev. 02

Location Classes

Temperature Class A
Humidity Class B
Vibration Class A
EMC Class A
Enclosure Class x7

Application/Limitation

Multi String Manager
The String Manager has been passed the environmental test in accordance to CG-0339. The software of multi string manager has to be tested individually as part of the product certificate for each project.

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 and IEC 62620 have been carried out additionally.

The Propagation test has been passed in accordance to DNVGL-RU-SHIP Pt.6 Ch.2 Sec.1 design option 1 no propagation between cells with modules equipped with internal water mist system activated by a module gas detector.

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
- 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