



# EQUIPMENT CERTIFICATE

Certificate No.:	Issued:	Valid until:	GCC class
TC-GCC-DNV-SE-0124-09652-1	2023-07-17	Unlimited	TC <sub>i</sub>

Issued for:

## PV Inverters AF[3-30]K-[TH/THP] (PPM Type A)

With specifications and software version as listed in Annex 2

Issued to:

### Afore New Energy Technology (Shanghai) Co., Ltd.

Building 7, No.333 Wanfang Rd, Minhang District, Shanghai, China. 201112

According to:

**DNV-SE-0124, 2021-10: Certification of Grid Code Compliance**

**PTPIREE, 2021-04: Conditions and procedures for using certificates in the process of connecting power generating modules to power networks**

**32016R0631, 2016-04: Requirements for Generators (NC RfG)**

**PSE, 2018-12: Requirements of general application resulting from Commission Regulation (EU) 2016/631 of 14 April 2016**

detailed in Annex 1

Based on the document:

CR-GCC-DNV-SE-0124-09652-A072-1

Network Code Requirements for a PGU of Type A - Poland, Certification Report, dated 2023-07-17

Further assessment information, including scope and conditions, is found in Annex 1. Description of the PV inverters and type tests performed is found in Annex 2 and Annex 3 respectively.

Hamburg, 2023-07-17

For DNV Renewables Certification

**Bente Vestergaard**

Service Line Leader for Type Certification



By DAKKS according DIN EN IEC/ISO 17065 accredited Certification Body for products. The accreditation is valid for the fields of certification listed in the certificate.

Hamburg, 2023-07-17

For DNV Renewables Certification

**Rui Cai**

Project Manager

# EQUIPMENT CERTIFICATE – ANNEX 1

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## Conditions, assessment criteria and scope of assessment

Provided that the conditions listed in section 1 are considered at project level, the PV inverters as further specified in Annex 2 comply with the requirements within scope of this certification, as specified in section 3.

### 1 Conditions

- Changes of the system design, hardware or the software of the certified PV inverters are to be approved by DNV.
- Inverter settings must finally be agreed and checked at project level to ensure grid code compliance, based on the requirements of relevant System Operator (SO). For the functionalities within scope of this certification, more information about the settings assessed is found in Control Settings in section 4.2 as well as the corresponding assessment sections 5.1 - 5.4 of the certification report CR-GCC-DNV-SE-0124-09652-A072-1.
- The capability of remote control has been shown on unit level but must finally be ensured at project level, considering any further requirements of relevant System Operator (SO) and the full communication network. For the functionalities within scope of this certification, this concerns:
  - Remote cessation of active power (see section 5.3)
  - Remote blocking and control of LFSM-O (see section 5.4).of the certification report CR-GCC-DNV-SE-0124-09652-A072-1.

### 2 Assessment criteria and normative references for this certificate:

- /A/ Service Specification DNV-SE-0124: Certification of Grid Code Compliance, DNV, March 2016 amended October 2021
- /B/ Conditions and procedures for using certificates in the process of connecting power generating modules to power networks, Warunki i procedury wykorzystania certyfikatów w procesie przyłączenia modułów wytwarzania energii do sieci elektroenergetycznych, version 1.2, PTPIREE, dated 2021-04-28, (in the following: PTPIREE 2021-04)
- /C/ Requirements of general application resulting from Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators (NC RfG) – as approved by the decision of the President of the Energy Regulatory Office DRE.WOSE.7128.550.2.2018.ZJ dated January 2nd 2019, Wymogi ogólnego stosowania wynikające z Rozporządzenia Komisji (UE) 2016/631 z dnia 14 kwietnia 2016 r. ustanawiającego kodeks sieci dotyczący wymogów w zakresie przyłączenia jednostek wytwórczych do sieci (NC RfG), PSE S.A., dated 2018-12-18 zatwierdzone Decyzją Prezesa Urzędu Regulacji Energetyki DRE.WOSE.7128.550.2.2018.ZJ z dnia 2 stycznia 2019 r, (in the following: PSE 2018-12)
- /D/ Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators, published in the Official Journal of the European Union L112/1, The European Commission, 27/04/2016. Document 32016R0631, (in the following: NC RfG)

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### 3 Scope of assessment and results

The following functionalities have been assessed based on the rules for the use of equipment certificates for Power Park Modules (PPMs), as specified in chapter 7 and 9 of the PTPIREE 2021-04 /B/. The functions denoted “Not Applicable” in the table of chapter 7 has not been included.

Capability	NC RfG /D/	PSE 2018-12 /C/	Type A	Assessment result (*)
Frequency range	13.1(a)	13.1(a)(i)	x	Compliant
Rate of Change of Frequency (RoCoF) withstand capability, df/dt	13.1(b)	13.1(b)	x	Compliant
Remote cessation of active power	13.6	13.6	x	Compliant
Remote control of active power	14.2	14.2(b)		Compliant
Limited Frequency Sensitive Mode – over frequency (LFSM-O)	13.2	13.2(a), (b), (f)	x	Compliant

(\*) Please note also the corresponding conditions for compliance, as stated in section 1.

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## Schematic description and technical data of the generating units

### 1 Schematic description of the generating unit

The AFORE solar inverter family AF[3-30]K-[TH/THP], consisting of: AF3K-TH, AF4K-TH, AF5K-TH, AF6K-TH, AF8K-TH, AF10K-TH, AF12K-TH, AF15K-TH, AF17K-TH, AF20K-TH, AF25K-TH, AF30K-TH, AF3K-THP, AF4K-THP, AF5K-THP, AF6K-THP, AF8K-THP, AF10K-THP, AF12K-THP, convert electrical energy generated by photovoltaic modules (DC) to three-phase alternating current (AC).

They run at 400 V rated output voltage with a rated active power output of 3 kW to 30 kW. The different output power variants are achieved through derating via software. Models AF3K-TH, AF4K-TH, AF5K-TH, AF6K-TH, AF8K-TH, AF10K-TH, AF12K-TH, AF3K-THP, AF4K-THP, AF5K-THP, AF6K-THP, AF8K-THP, AF10K-THP, AF12K-THP have 2 MPPT trackers with 2 input strings, model AF15K-TH has 2MPPT trackers with 3 input strings, models AF17K-TH, AF20K-TH, AF25K-TH, AF30K-TH have 2MPPT trackers with 4 input strings. In addition, AF10K-TH, AF12K-TH, AF10K-THP, AF12K-THP, AF15K-TH, AF17K-TH, AF20K-TH, AF25K-TH, AF30K-TH have 2 external fans and 1 internal fan, while the others have no external fan. Finally, the current limit of BAT port of AF[3-12]K-TH on DC side is 30A, AF[3-12]K-THP increase to 50A. There are no further differences in the hardware or firmware used, as stated by the manufacturer.

The electrical data of the generating unit is summarized in the following section.

### 2 Technical data of main components

According to the documents provided by the manufacturer, the following components are used.

#### 2.1 General Specifications

Generating Unit	AF3K-TH	AF4K-TH	AF5K-TH	AF6K-TH
No. of phases	3	3	3	3
Maximum apparent power	3.3 kVA	4.4 kVA	5.5 kVA	6.6 kVA
Rated active power	3 kW	4 kW	5 kW	6 kW
Rated AC-voltage (phase to phase)	400 Vac	400 Vac	400 Vac	400 Vac
Rated frequency	50 Hz	50 Hz	50 Hz	50 Hz
Generating Unit	AF8K-TH	AF10K-TH	AF12K-TH	AF15K-TH
No. of phases	3	3	3	3
Maximum apparent power	8.8 kVA	11 kVA	13.2 kVA	16.5 kVA
Rated active power	8 kW	10 kW	12 kW	15 kW
Rated AC-voltage (phase to phase)	400 Vac	400 Vac	400 Vac	400 Vac
Rated frequency	50 Hz	50 Hz	50 Hz	50 Hz
Generating Unit	AF17K-TH	AF20K-TH	AF25K-TH	AF30K-TH
No. of phases	3	3	3	3
Maximum apparent power	18.7 kVA	22 kVA	27.5 kVA	33 kVA
Rated active power	17 kW	20 kW	25 kW	30 kW
Rated AC-voltage (phase to phase)	400 Vac	400 Vac	400 Vac	400 Vac
Rated frequency	50 Hz	50 Hz	50 Hz	50 Hz

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<b>Generating Unit</b>	<b>AF3K-THP</b>	<b>AF4K-THP</b>	<b>AF5K-THP</b>	<b>AF6K-THP</b>
No. of phases	3	3	3	3
Maximum apparent power	3.3 kVA	4.4 kVA	5.5 kVA	6.6 kVA
Rated active power	3 kW	4 kW	5 kW	6 kW
Rated AC-voltage (phase to phase)	400 Vac	400 Vac	400 Vac	400 Vac
Rated frequency	50 Hz	50 Hz	50 Hz	50 Hz

  

<b>Generating Unit</b>	<b>AF8K-THP</b>	<b>AF10K-THP</b>	<b>AF12K-THP</b>
No. of phases	3	3	3
Maximum apparent power	8.8 kVA	11 kVA	13.2 kVA
Rated active power	8 kW	10 kW	12 kW
Rated AC-voltage (phase to phase)	400 Vac	400 Vac	400 Vac
Rated frequency	50 Hz	50 Hz	50 Hz

## 2.2 DC Input

<b>Generating Unit</b>	<b>AF3K-TH, AF4K-TH, AF5K-TH, AF6K-TH, AF8K-TH, AF10K-TH, AF12K-TH, AF3K-THP, AF4K-THP, AF5K-THP, AF6K-THP, AF8K-THP, AF10K-THP, AF12K-THP</b>	<b>AF15K-TH</b>	<b>AF17K-TH, AF20K-TH</b>	<b>AF25K-TH, AF30K-TH</b>
Min. MPPT voltage	150 V	150 V	150 V	150 V
Max. MPPT voltage	850 V	850 V	850 V	850 V
Max. DC input voltage	1000 V	1000 V	1000 V	1000 V
Max. DC input current	2 x 20 A	20 A + 32 A	2 x 32 A	2 x 40 A

## 2.3 Software Version

<b>Generating Unit</b>	<b>AF3K-TH, AF4K-TH, AF5K-TH, AF6K-TH, AF8K-TH, AF10K-TH, AF12K-TH, AF15K-TH, AF17K-TH, AF20K-TH, AF25K-TH, AF30K-TH, AF3K-THP, AF4K-THP, AF5K-THP, AF6K-THP, AF8K-THP, AF10K-THP, AF12K-THP</b>
Firmware version	1.01
Software version	1.20

## 2.4 Unit transformer

The transformer is not part of the generating unit and consequently has not been part of the assessment.

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## **2.5 Grid Protection**

The protection is not part of certification scope

## **2.6 Control settings**

The control interface allows for the selection of different parameter sets via the “Safty” field, which provide default settings based on specific grid codes and national requirements. For this certification report the parameter set called “Poland” in the display interface, was assessed for the functionalities within scope of this certification.

It should be noted that compliance can be achieved also with other parameter sets and control settings, but that changes to control settings will affect the inverter control behaviour which can thus affect compliance. It should be noted the final settings must be agreed on project level in agreement with relevant system operator.

Protection settings has not been part of the assessment. Since these could intervene with and affect the compliance of the assessed functionalities, this must be further assessed at project level.

# EQUIPMENT CERTIFICATE – ANNEX 3

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## Type tests

### 1 Type tests

Tests were performed between 2022-12-14 and 2023-01-09 in the Afore lab, Shanghai in P.R. China. All tests were performed under ISO-17025 accreditation and they were performed on the AFORE AF30K-TH unit and some tests on the AFORE AF4K-TH unit.

The results used for assessment are documented in the measurement report(s) as specified below:

Scope	Reference
Frequency range	Section 3.1 of /1/
Rate of Change of Frequency (RoCoF) withstand capability, df/dt	Section 3.2 of /1/
Remote cessation of active power	Section 3.3 of /1/
Limited Frequency Sensitive Mode – over frequency (LFSM-O)	Section 3.4 of /1/

Test report(s)	Document number	Content
/1/	10420319-SHA-TR-01-A	Measurement of power control characteristics of a Hybrid inverter of the type AF30K-TH according to FGW TG3 Rev. 25

The tests results have been assessed against the requirements of PSE 2018-12 /C/ and NC RfG /D/. Further details are described in the corresponding certification report CR-GCC-DNV-SE-0124-09652-A072-1.