

EQUIPMENT CERTIFICATE

| | | | |
|------------------------------|------------|--------------|-----------------|
| Certificate No.: | Issued: | Valid until: | GCC class |
| TC-GCC-DNVGL-SE-0124-07602-0 | 2021-07-02 | Unlimited | TC _i |

Issued for:

PV Inverters SG3-20RT (PPM Type A)

With specifications and software version as listed in Annex 2

Issued to:

Sungrow Power Supply Co., Ltd.

No.1699 Xiyou Rd. New & High Technology Industrial Development Zone
Hefei, P. R. China., 230088

According to:

DNVGL-SE-0124, 2016-03: Certification of Grid Code Compliance

PTPIREE, 2021-4: 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-DNVGL-SE-0124-07602_A072-0 Network Code Requirements for a PGM of Type A - Poland, Certification Report, dated 2020-07-01

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, 2021-07-02

For DNV Renewables Certification



Bente Vestergaard
Director and Service Line Leader Type
and Component 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, 2021-07-02

For DNV Renewables Certification



Liselotte Ulvgaard
Project Manager

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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 full 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 section 4.2 and sections 5.1-5.4 of the certification report CR-GCC-DNVGL-SE-0124-07602_A072-0.

2 Assessment criteria and normative references for this certificate:

- /A/ Service Specification DNVGL-SE-0124: Certification of Grid Code Compliance, DNV GL, March 2016
- /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)

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 |
| 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 section 1

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Schematic description and technical data of the generating units

1 Schematic description of the generating unit

The Sungrow solar inverter family SG3-20RT, consisting of: SG3.0RT, SG4.0RT, SG5.0RT, SG6.0RT, SG7.0RT, SG8.0RT, SG10RT, SG12RT, SG15RT, SG17RT, SG20RT 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 20 kW. The different output power variants are achieved through derating via software. Due to different power levels, SG3.0RT, SG4.0RT, SG5.0RT, SG6.0RT use 2-way PV inputs (1 PV (12.5A) in MPPT1, 1 PV(12.5A) in MPPT2), SG7.0RT, SG8.0RT, SG10RT, SG12RT use 3-way PV inputs (2 PV (12.5A+12.5A) in MPPT1 , 1 PV(12.5A) in MPPT2) while SG15RT, SG17RT, SG20RT use 4-way PV inputs (2 PV(12.5A+12.5A) in MPPT1, 2 PV(12.5A+12.5A) in MPPT2). There is no further difference 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 | SG3.0RT | SG4.0RT | SG5.0RT | SG6.0RT |
|---------------------------------------|-----------|-----------|-----------|-----------|
| No. of phases | 3 | 3 | 3 | 3 |
| Rated 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 |
| Contribution to short circuit current | 2 x 16A | 2 x 16A | 2 x 16A | 2 x 16A |
| Generating Unit | SG7.0RT | SG8.0RT | SG10RT | SG12RT |
| No. of phases | 3 | 3 | 3 | 3 |
| Rated apparent power | 7,7 kVA | 8,8 kVA | 11 kVA | 13,2 kVA |
| Rated active power | 7 kW | 8 kW | 10 kW | 12 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 |
| Contribution to short circuit current | 32A + 16A | 32A + 16A | 32A + 16A | 32A + 16A |
| Generating Unit | SG15RT | SG17RT | SG20RT | |
| No. of phases | 3 | 3 | 3 | |
| Rated apparent power | 16,5 kVA | 18,7 kVA | 22 kVA | |
| Rated active power | 15 kW | 17 kW | 20 kW | |
| Rated AC-voltage (phase to phase) | 400 Vac | 400 Vac | 400 Vac | |
| Rated frequency | 50 Hz | 50 Hz | 50 Hz | |
| Contribution to short circuit current | 2 x 32A | 2 x 32A | 2 x 32A | |

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2.2 DC Input

| Generating Unit | SG3.0RT, SG4.0RT, SG5.0RT, SG6.0RT | SG7.0RT, SG8.0RT, SG10RT, SG12RT | SG15RT, SG17RT, SG20RT |
|-----------------------|---------------------------------------|-------------------------------------|---------------------------|
| Min. MPPT voltage | 160 V | 160 V | 160 V |
| Max. MPPT voltage | 1000 V | 1000 V | 1000 V |
| Max. DC input voltage | 1100 V | 1100 V | 1100 V |
| Max. DC input current | 2 x 12,5 A | 25A + 12,5A | 2 x 25 A |

2.3 Software Version

| | |
|------------------|---|
| Software version | LCD_BERYL-S_V11_V01_A * MDSP_BERYL-S_V11_V01_A * |
|------------------|---|

(*) The software naming differs from what is stated in the test report. As explained and confirmed by the manufacturer, the only difference is the name of the software, not the software itself.

2.4 Unit transformer

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

2.6 Grid Protection

The protection is not part of certification scope

2.7 Control settings

The control interface allows for the selection of different parameter sets via the “Country/Region” field, which provide default settings based on specific grid codes and national requirements. For this certification report the parameter set called “Poland” in the 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.

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Type tests

1 Type tests

Tests were performed between 2021-03-05 and 2021-03-10 in the Germanischer Lloyd Industrial Services (Shanghai) Co., Ltd. in P.R. China. All tests were performed under ISO-17025 accreditation and they were performed on the SG20RT unit.

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

| Scope | Reference |
|---|------------------------|
| Frequency range | 3.1.1 and 3.1.2 of /1/ |
| Rate of Change of Frequency (RoCoF) withstand capability, df/dt | 3.2 of /1/ |
| Remote cessation of active power | 3.3 of /1/ |
| Limited Frequency Sensitive Mode – over frequency (LFSM-O) | 3.4 of /1/ |

| Test report(s) | Document number | Content |
|----------------|-----------------|--|
| /1/ | 10285372-A-4-A | Measurement of power control characteristics of a PV inverter of the type SG20RT according to FGW TG3 Rev. 25 and Polish Grid Code |

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-DNVGL-SE-0124-07602-A072-0.