November 2022

Annex 2 to the guide for connection of power generating plants to the low-voltage grid (≤1 kV)

Type B

Version 1.3

Version log

|  |  |  |
| --- | --- | --- |
| **Version** | **Change** | **Date** |
| 1.0 | A translated version of the Danish Guide for Power generating plants LV. | 27-04-2018 |
| 1.1 | Annex B1.2 and B2.1 are updated, so is clear what is covered by the EN50549-1 | 20-12-2019 |
| 1.2 | Update of annex | 29-10-2021 |
| 1.3 | Layout update. Updated according to positive list. | 18-11-2022 |

Table of contents

[Version log 2](#_Toc131167184)

[Table of contents 3](#_Toc131167185)

[Annex 2. DOCUMENTATION FOR TYPE B POWER-GENERATING PLANTS 4](#_Toc131167186)

[B2.1. Documentation for type B power-generating plants (part 1) 4](#_Toc131167189)

[B2.2. Documentation for type B power-generating plants (part 2) 15](#_Toc131167190)

DOCUMENTATION FOR TYPE B POWER-GENERATING PLANTS

2. 1. Documentation for type B power-generating plants (part 1)

Please complete the documentation with power-generating plant data before commissioning and send it to the DSO.

* + 1. Identification

|  |  |
| --- | --- |
| Power-generating plant name: |  |
| Global Service Relation Number (GSRN-number): |  |
| Plant owner name and address: |  |
| Plant owner telephone number: |  |
| Plant owner e-mail address: |  |

* + 1. Description of the power-generating plant

|  |  |
| --- | --- |
| Type: | Synchronous power-generating plant  Power park module |
| Primary energy source:  \*Describe type: | Wind  Solar  Fuel  Other\* |
| Energy conversion technology: | Steam turbine  Gas turbine  Combined cycle plant  Internal combustion engine  Inverter-based |
| Fuel type, if applicable: |  |
| Manufacturer/model: |  |
| Voltage at the POC (Uc): |  |
| Nominal power (Pn): |  |
| Minimum power (Pmin): |  |
| Rated mechanical shaft power for drive system (Pmech)  (only synchronous plants): |  |
| Is a process diagram available for the plant?  Document reference: | Yes  No |
| Is a single-line diagram available showing settlement metering, online metering, ownership boundaries and operation manager boundaries?  Document reference: | Yes  No |

* + - 1. Generator data

Please only complete this section for **synchronous** power-generating plants.

|  |  |  |  |
| --- | --- | --- | --- |
| **Description** | **Symbol** | **Unit** | **Value** |
| Rated apparent power : | Sn | MVA |  |
| Rated voltage: | Un | kV |  |
| Rated frequency: | fn | Hz |  |
| Rated Power Factor(cosφ): | cosφn | - |  |
| Rated minimum reactive power generation from PQ diagram: | Qmin,n | Mvar |  |
| Rated maximum reactive power generation from PQ diagram: | Qmax,n | Mvar |  |
| Synchronous speed: | nn | Rpm |  |
| Total moment of inertia for rotating mass (generator, drive system, etc.): | Jtot | kg⋅m2 |  |
| Total moment of inertia for generator: | JG | kg⋅m2 |  |
| Total moment of inertia for drive system: | JD | kg⋅m2 |  |
| Rotor type: | - | - | Salient poles  Distinct poles |
| Stator resistance per phase: | Ra | p.u. |  |
| Temperature for resistance: | TR | ºC |  |
| Stator dispersion reactance per phase: | Xad | p.u. |  |
| Positive-sequence reactance, d axis: | Xd | p.u. |  |
| Transient reactance, d axis: | X’d | p.u. |  |
| Subtransient reactance, d axis: | X’’d | p.u. |  |
| Saturated positive-sequence reactance, d axis: | Xd,sat | p.u. |  |
| Saturated subtransient positive-sequence reactance, d axis: | X”d,sat | p.u. |  |
| Positive-sequence reactance, q axis: | Xq | p.u. |  |
| Transient reactance, q axis: | X’q | p.u. |  |
| Subtransient reactance, q axis: | X’’q | p.u. |  |
| Transient open circuit time constant, d axis: | T’d0 | s |  |
| Subtransient open circuit time constant, d axis: | T’d0 | s |  |
| Transient open circuit time constant, q axis: | T’q0 | s |  |
| Subtransient open circuit time constant, q axis: | T’’q0 | s |  |
| Potier reactance: | Xp | p.u. |  |
| Saturation point at 1.0 p.u. voltage: | SG1.0 | p.u. |  |
| Saturation point at 1.2 p.u. voltage: | SG1.2 | p.u. |  |
| Reactance, inverse-component: | X2 | p.u. |  |
| Resistance, inverse-component: | R2 | p.u. |  |
| Reactance, zero-component: | X0 | p.u. |  |
| Resistance, zero-component: | R0 | p.u. |  |
| Is the generator star point earthed? | - | - | Yes  No |
| If yes, ground reactance: | Xe | Ohm |  |
| If yes, ground resistance: | Re | Ohm |  |
| Generator's short-circuit ratio  (Rated): | Kc | p.u. |  |

* + - 1. Generator information

This section can be **omitted** for power park modules.

|  |  |
| --- | --- |
| Manufacturer: |  |
| Type/Model: |  |
| Does the generator comply with relevant sections of the following European standards?   * DS/EN 60034-1, ‘Rotating electrical machines – Part 1: Rating and performance’, 2004 * DS/EN 60034-3 ‘Rotating electrical machines – Part 3: Specific requirements for turbine-type synchronous machines’, 1995 | Yes  No |
| Is detailed generator documentation enclosed? | Yes  No |
| If yes, please provide reference to documentation: |  |

* + - 1. Excitation system

This section can be **omitted** for power park modules.

|  |  |
| --- | --- |
| Manufacturer: |  |
| Type/Model: |  |
| Does the excitation system comply with relevant parts of the following European standards:   * DS/EN 60034-16-1:2011 ‘Rotating electrical machines – Part 16: Excitation systems for synchronous machines – Chapter 1: Definitions’ * DS/CLC/TR 60034-16-3:2004 ‘Rotating electrical machines – Part 16: Excitation systems for synchronous machines – Section 3: Dynamic performance’. | Yes  No |
| Is the power-generating plant equipped with excitation system as specified in section 5.4.5? | Yes  No |
| Is detailed excitation system documentation enclosed? | Yes  No | |
| If yes, please provide reference to documentation: |  | |

* + - 1. Generator or plant transformer

This section can be **omitted** for power park modules.

|  |  |
| --- | --- |
| Manufacturer: |  |
| Type/Model: |  |
| Is detailed transformer documentation enclosed?  If yes, please provide reference to documentation: | Yes  No |

* + 1. EN50549-1

|  |  |
| --- | --- |
| Is the power-generating plant in accordance with the requirements in EN50549-1?  If yes, please provide reference to documentation:  Demands in *italic* must be answered.  Demands in questions with normal letters are included in EN50549-1 | Yes  No |

* + 1. Tolerance of frequency and voltage deviations
       1. Phase jump

|  |  |
| --- | --- |
| *Does the power-generating plant remain connected during voltage phase jumps of 20 degrees at the POC as specified in section 5.1.1?*  *If yes, please provide reference to documentation:* | Yes  No |

* + - 1. Operating area for voltage and frequency

|  |  |
| --- | --- |
| Is the power-generating plant capable of remain connected to the public electricity supply grid within the voltage and frequency range specified in section 5.1.1 and 5.1.2 and on figure 5.1 and generating continuously within the normal operating range.  If yes, please provide reference to documentation: | Yes  No |

* + - 1. Frequency change

|  |  |
| --- | --- |
| Will the power-generating plant remain connected in case of frequency changes of 2.0 Hz/s at the POC?  If yes, please provide reference to documentation:  *- - To be completed for synchronous power generating plant* | Yes  No |

* + - 1. Permitted reduction of active power during underfrequency

|  |  |
| --- | --- |
| *Is the active power reduction at underfrequency less than the limit specified in section 5.1.2.2?*  *If yes, please provide reference to documentation:* | Yes  No |

* + 1. Tolerance of voltage deviations

|  |  |
| --- | --- |
| *Does the power-generating plant stay connected to the public electricity supply grid during voltage dips as specified in section 5.1.3.3?*  *If yes, please provide reference to documentation:* | Yes  No |
| Does the power-generating plant stay connected to the public electricity supply grid during voltage swells as specified in section 5.1.3.2?  If yes, please provide reference to documentation: | Yes  No |

* + - 1. Fast fault current

Please only complete this section for **power park modules**.

|  |  |
| --- | --- |
| *Does the power park module supply fast fault current as specified in section 5.1.3.3 (b)?*  *If yes, please provide reference to documentation:* | Yes  No |

* + 1. Start-up and reconnection of a power-generating plant

|  |  |
| --- | --- |
| Is connection and synchronisation performed as specified in section 5.2?  If yes, please provide reference to documentation: | Yes  No |
| Is it possible to bypass automatic synchronisation?  If no, please provide reference to documentation: | Yes  No |

* + 1. Active power control
       1. Frequency response – overfrequency

|  |  |
| --- | --- |
| *Is the power-generating plant equipped with a frequency response function for overfrequency as specified in section 5.3.1?*  *If yes, please provide reference to documentation:* | Yes  No |

* + - 1. Absolute power limit function

|  |  |
| --- | --- |
| *Is the power-generating plant equipped with an absolute power limit function as specified in section 5.3.2.1?*  *If yes, please provide reference to documentation:* | Yes  No |

* + - 1. Ramp rate limit

|  |  |
| --- | --- |
| Is the power-generating plant equipped with ramp rate limit as specified in section 5.3.2.2?  If yes, please provide reference to documentation: | Yes  No |

* + 1. Reactive power control
       1. Operating range

|  |  |
| --- | --- |
| Is the power-generating plant capable of supplying reactive power at Pn and varying operating voltages as specified in section 5.4?  If yes, please provide reference to documentation: | Yes  No |
| Is the power-generating plant capable of supplying reactive power when active power varies as specified in section 5.4?  If yes, please provide reference to documentation: | Yes  No |

* + - 1. Power Factor control

|  |  |
| --- | --- |
| *Is the power-generating plant equipped with a Power Factor control function as specified in section 5.4.2?*  *If yes, please provide reference to documentation:* | Yes  No |

* + - 1. Automatic Power Factor control

|  |  |
| --- | --- |
| *Is the power-generating plant equipped with an Automatic Power Factor control function as specified in section 5.4.3?*  *If yes, please provide reference to documentation:* | Yes  No |

* + - 1. Q control

|  |  |
| --- | --- |
| *Is the power-generating plant equipped with Q control function as specified in section 5.4.4?*  *If yes, please provide reference to documentation:* | Yes  No |

* + 1. Power quality

|  |  |
| --- | --- |
| *Are the values in the provided documentation computed values?* | Yes  No |
| *Are the values in the provided documentation measured values?* | Yes  No |
| *Is a report documenting that the calculations or measurements comply with the emission requirements included?*  *If yes, please provide reference to documentation:* | Yes  No |

* + - 1. Rapid voltage changes

|  |  |
| --- | --- |
| *Does the plant comply with the limit value for rapid voltage changes specified in section 5.6.1.3?*  *If yes, please provide reference to documentation:* | Yes  No |

* + - 1. DC content

Please only complete this section for **power park modules**.

|  |  |
| --- | --- |
| *Does the DC content during normal operation exceed 0.5% of nominal current as specified in section 5.6.1.1?*  *If yes, please provide reference to documentation:* | Yes  No |

* + - 1. Voltage unbalance

Please only complete this section for **power park modules**.

|  |  |
| --- | --- |
| *Does the plant have balanced three-phase load, as specified in section 5.6.1.2?*  *If yes, please provide reference to documentation:* | Yes  No |

* + - 1. Flicker

Please only complete this section for **power park modules**.

|  |  |
| --- | --- |
| *Is the flicker contribution for the entire plant below the limit value specified in section 5.6.1.4?*  *If yes, please provide reference to documentation:* | Yes  No |

* + - 1. Harmonic overtones

Please only complete this section for **power park modules**.

|  |  |
| --- | --- |
| *Are all the harmonic overtones for the entire plant below the limit values specified in 5.6.1.5?*  *If yes, please provide reference to documentation:* | Yes  No |

* + - 1. Interharmonic overtones

Please only complete this section for **power park modules**.

|  |  |
| --- | --- |
| *Are all the interharmonic overtones for the entire plant below the limit values specified in section 5.6.1.6?*  *If yes, please provide reference to documentation:* | Yes  No |

* + - 1. Distortions in the 2-9 kHz frequency range

Please only complete this section for **power park modules**.

|  |  |
| --- | --- |
| *Are emissions of distortions in the 2-9 kHz frequency range less than 0.2% of In as required in section 5.6.1.7?*  *If yes, please provide reference to documentation:* | Yes  No |

* + 1. Protection

|  |  |
| --- | --- |
| *Is the plant equipped with the protection functions required in section 5.5.3?*  *If yes, please provide reference to documentation:* | Yes  No |

* + - 1. Islanding detection

|  |  |
| --- | --- |
| *Is the plant equipped with the protection functions required in section 5.5.4?*  *If yes, please provide reference to documentation:* | Yes  No |

* + - 1. Additional requirements for grid protection of synchronous power-generating plants

This section can be **omitted** for power park modules.

|  |  |
| --- | --- |
| *Is a synchronous undervoltage relay used?* | Yes  No |
| *Is an overcurrent relay used?* | Yes  No |
| *If yes, please provide reference to documentation:* |  |

* + 1. Requirements for information exchange

|  |  |
| --- | --- |
| *Is the power-generating plant capable of exchanging information as required in section 5.7*  *If yes, please provide reference to documentation:* | Yes  No |

* + 1. Signature

|  |  |
| --- | --- |
| Date: |  |
| Company: |  |
| Responsible: |  |
| Signature (Responsible): |  |

* 1. Documentation for type B power-generating plants (part 2)

Please complete the documentation with power-generating plant data after commissioning and send it to the DSO.

* + 1. Identification

|  |  |
| --- | --- |
| Power-generating plant name: |  |
| Global Service Relation Number (GSRN number): |  |
| Plant owner name and address: |  |
| Plant owner telephone number: |  |
| Plant owner e-mail address: |  |

* + 1. Active power control
       1. Active power control at overfrequency

|  |  |
| --- | --- |
| Is the frequency response function for overfrequency enabled?  If yes, what are the setting values?  Frequency threshold (fRO):  Droop:  Time for islanding detection (minimum response time): | Yes  No  \_\_\_\_\_\_\_\_Hz  \_\_\_\_\_\_\_\_%  \_\_\_\_\_\_\_\_ms |

* + - 1. Absolute power limit function

|  |  |
| --- | --- |
| Is the absolute power limit function enabled?  If yes, which set point value is used? | Yes  No  Controlled online  \_\_\_\_\_\_\_\_kW |

* + - 1. Ramp rate limit

|  |  |
| --- | --- |
| Is the power-generating plant ramp rate limit enabled?  If yes, which set point value is used? | Yes  No  Controlled online  \_\_\_\_\_% Pn/min |

* + 1. Reactive power control
       1. Q control

|  |  |
| --- | --- |
| Is the Q control function enabled?  If yes, which set point is used?  (Values different from 0 kVAr must be agreed with the DSO) | Yes  No  Controlled online  \_\_\_\_\_\_\_\_kVAr |

* + - 1. Power Factor control

|  |  |
| --- | --- |
| Is the Power Factor control function enabled?  If yes, which set point is used?  (Values different from cosφ 1.0 must be agreed with the DSO) | Yes  No  Controlled online  \_\_\_\_\_\_\_\_ cosφ  Inductive  Capacitive |

* + - 1. Automatic Power Factor control

|  |  |
| --- | --- |
| Is the automatic Power Factor control function enabled?  (Must only be enabled subject to prior agreement with the DSO)  If yes, which set points are used?  Set point 1 – P/Pn  Set point 1 – Power Factor (inductive)  Set point 2 – P/Pn  Set point 2 – Power Factor (inductive)  Set point 3 – P/Pn  Set point 3 – Power Factor (inductive) | Yes  No  \_\_\_\_\_\_\_\_%  \_\_\_\_\_\_ cosφ  \_\_\_\_\_\_\_\_%  \_\_\_\_\_\_ cosφ  \_\_\_\_\_\_\_\_%  \_\_\_\_\_\_ cosφ |

* + 1. Protection
       1. Relay settings

Please state the actual values at the time of commissioning in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Protection function** | **Symbol** | **Setting** | | **Trip time** | |
| Overvoltage (step 2) | U>> |  | V |  | ms |
| Overvoltage (step 1) | U> |  | V |  | s |
| Undervoltage (step 1) | U< |  | V |  | s |
| Overfrequency | f> |  | Hz |  | ms |
| Underfrequency | f< |  | Hz |  | ms |
| Frequency change | df/dt |  | Hz/s |  | ms |

* + - 1. Islanding detection

|  |  |
| --- | --- |
| Are vector jump relays or active islanding detection used? | Yes  No |

* + - 1. Additional relay settings for synchronous power-generating plants

This section can be **omitted** for power park modules.

Please state the actual relay setting values at the time of commissioning in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Protection function** | **Symbol** | **Setting** | | **Trip time** | |
| Overcurrent | I> |  | A |  | ms |
| Synchronous undervoltage\* |  |  | V |  | ms |

\*If synchronous undervoltage relay is used.

* + 1. Conformance testing

|  |  |
| --- | --- |
| Is a plan for conformance testing available as specified in sections 5.8.2?  If yes, please provide reference to documentation: | Yes  No |

* + 1. Signature

|  |  |
| --- | --- |
| Date: |  |
| Installation contractor: |  |
| Commissioning manager: |  |
| Signature (commissioning manager): |  |
| Plant owner: |  |
| Signature (plant owner): |  |