November 2022

Annex 3 to guide for

connection of power-generating plants to the medium and high-voltage grid (>1 kV)

Type C and D

Version 1.2

Version log

|  |  |  |
| --- | --- | --- |
| **Version** | **Change** | **Date** |
| 1.0 | A translated version of the Danish Guide for Power generating plants MV and HV | 30-04-2018 |
| 1.1 | Update of annex | 29-10-2021 |
| 1.2 | Layout update. | 18-11-2022 |

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DOCUMENTATION FOR TYPE C AND D SYNCHRONOUS POWER-GENERATING PLANTS

3. 1. Documentation for type C and D synchronous power-generating plant (part 1)

Please complete the documentation with synchronous power-generating plant data to obtain **energisation operational notification (EON),** that allows to energise the plant’s internal network and auxiliaries.

* + 1. Identification

|  |  |
| --- | --- |
| Power-generating plant name: |  |
| Power-generating plant owner name and address: |  |
| Power-generating plant owner telephone number: |  |
| Power-generating plant owner email address: |  |

* + 1. Description of the power-generating plant

|  |  |
| --- | --- |
| Primary energy source:  \*Describe type: | Fuel  Other\* |
| Energy conversion technology | Steam turbine  Gas turbine  Combined cycle plant  Internal combustion engine |
| Fuel type, if applicable: |  |
| Manufacturer/model: |  |
| Voltage at the POC (Uc): |  |
| Nominal power (Pn): |  |
| Minimum power (*Pmin*): |  |

* + - 1. Generator transformer

|  |  |
| --- | --- |
| Is the plant connected through a generator transformer?  If yes, fill in the remaining fields: | Yes  No |
| Manufacturer: |  |
| Type/Model: |  |
| Is detailed transformer documentation enclosed?  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 power-generating plant comply with the limit value for rapid voltage changes specified in sections 5.6.1.3 and 6.6.1.3 for type C and D plants, respectively?  If yes, please provide reference to documentation: | Yes  No |

* + 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 3) | U>>> |  | V |  | ms |
| 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 |

|  |
| --- |
| please provide reference to documentation of the protection functions: |

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

|  |  |
| --- | --- |
| Is a synchronous undervoltage relay used? | Yes  No |
| Is an overcurrent relay used? | Yes  No |
| Is a study of the type and parameter values of protection functions available?  If yes, please provide reference to the study: | Yes  No |

* + 1. Simulation model requirements

|  |  |
| --- | --- |
| Is a simulation model as specified in sections 5.8 and 6.8 for type C and D plants, respectively, sent to Energinet? | Yes  No |

* + 1. Signature

|  |  |
| --- | --- |
| Date: |  |
| Contractor: |  |
| Manager: |  |
| Signature (manager): |  |
| Plant owner: |  |
| Signature (plant owner): |  |

* 1. Documentation for type C and D synchronous power-generating plant (part 2)

Please complete the documentation with synchronous power-generating plant data to obtain **interim operational notification (ION)** and send it to the DSO*.*

* + 1. Identification

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

* + 1. Description of the power-generating plant

|  |  |
| --- | --- |
| Primary energy source:  \*Describe type: | Fuel  Other\* |
| Energy conversion technology | Steam turbine  Gas turbine  Combined cycle plant  Internal combustion engine |
| 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*): |  |
| Is a process diagram available for the plant?  Document reference: | Yes  No |
| Is a single-line diagram available showing settlement metering, online metering, voltage reference point, ownership boundaries and operation manager boundaries?  If yes, please provide reference to document: | Yes  No |

* + 1. Generator

|  |  |
| --- | --- |
| 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. 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. Excitation system

|  |  |
| --- | --- |
| 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 plant equipped with an excitation system as specified in sections 5.4.5 and 6.4.5.3 for type C and D plants, respectively? | Yes  No |
| Is detailed excitation system documentation enclosed?  If yes, please provide reference to documentation: | Yes  No | |

* + 1. PSS function

|  |  |
| --- | --- |
| Is the plant equipped with a PSS function as specified in section 6.4.5.3?  If yes, please provide reference to documentation: | 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?  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 or 6.1.1 and 6.1.2 and on figure 5.1 or 6.1 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: | Yes  No |

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

|  |  |
| --- | --- |
| Is the active power reduction at underfrequency less than the limit specified in section 4.1.2.2 and 6.1.2.2?  If yes, please provide reference to documentation: | Yes  No |

* + 1. Tolerance of voltage deviations

|  |  |
| --- | --- |
| Will the power-generating plant remain connected to the public electricity supply grid in case of voltage dips as specified in sections 5.1.3.3 and 6.1.3.3 for type C and D plants, respectively?  If yes, please provide reference to documentation: | Yes  No |
| Will the power-generating plant remain connected to the public electricity supply grid in case of voltage swells as specified in sections 5.1.3.2 and 6.1.3.2 for type C and D plants, respectively?  If yes, please provide reference to documentation: | Yes  No |

* + 1. Connection and synchronisation

|  |  |
| --- | --- |
| Is connection and synchronisation performed as specified in sections 5.2 and 6.2 for type C and D plants, respectively?  If yes, please provide reference to documentation: | Yes  No |
| It is possible to bypass automatic synchronisation?  Reference to documentation: | Yes  No |

* + 1. Active power control
       1. Power response to overfrequency

|  |  |
| --- | --- |
| Is the power-generating plant equipped with a frequency response function for overfrequency as specified in sections 5.3.1 and 6.3.1 for type C and D plants, respectively?  If yes, please provide reference to documentation: | Yes  No |

* + - 1. Power response to underfrequency

|  |  |
| --- | --- |
| Is the power-generating plant equipped with a frequency response function for underfrequency as specified in sections 5.3.2 and 6.3.2 for type C and D plants, respectively?  If yes, please provide reference to documentation: | Yes  No |

* + - 1. Frequency control

|  |  |
| --- | --- |
| Is the power-generating plant equipped with a frequency control function as specified in sections 5.3.3 and 6.3.3 for type C and D plants, respectively?  If yes, please provide reference to documentation: | Yes  No |

* + - 1. System protection scheme

|  |  |
| --- | --- |
| Is the power-generating plant equipped with a system protection scheme function as specified in section 5.3.4.3 and 6.3.4.3 for type C and D, respectively?  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 sections 5.3.4.1 and 6.3.4.1 for type C and D plants, respectively?  If yes, please provide reference to documentation: | Yes  No |

* + - 1. Ramp rate limit function

|  |  |
| --- | --- |
| Is the power-generating plant equipped with a ramp rate limit function as specified in sections 5.3.4.2 and 6.3.4.2 for type C and D plants, respectively?  If yes, please provide reference to documentation: | Yes  No |

* + 1. Reactive power control functions

|  |  |
| --- | --- |
| Is it possible to use the resolution specified in sections 5.4 and 6.4 for type C and D plants, respectively, for the set point values?  If yes, please provide reference to documentation: | Yes  No |

* + - 1. Requirements for reactive power control range

|  |  |
| --- | --- |
| Is the power-generating plant capable of supplying reactive power at Pn and varying operating voltages as specified in sections 5.4.1 and 6.4.1 for type C and D plants, respectively?  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 sections 5.4.1 and 6.4.1 for type C and D plants, respectively?  If yes, please provide reference to documentation: | Yes  No |

* + - 1. Q control

|  |  |
| --- | --- |
| Is the power-generating plant equipped with a Q control function as specified in sections 5.4.4 and 6.4.4 for type C and D plants, respectively?  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 sections 5.4.2 and 6.4.2 for type C and D plants, respectively?  If yes, please provide reference to documentation: | Yes  No |

* + - 1. Voltage control

|  |  |
| --- | --- |
| Is the power-generating plant equipped with a voltage control function as specified in sections 5.4.3 and 6.4.3 for type C and D plants, respectively?  If yes, please provide reference to documentation: | Yes  No |
| Where is the voltage reference point located? |  |

* + 1. Power quality

|  |  |
| --- | --- |
| Have changes been made to the system that have an impact on the power quality since the EON?  If yes, please provide reference to documentation: | Yes  No |

* + 1. Information exchange
       1. Data communication

|  |  |
| --- | --- |
| Have data communication protocols and data security requirements been established and configured as specified in section 5.7 and 6.7 for type C and D plants, respectively? | Yes  No |
| Are the signals specified in section 5.7 and 6.7 available in the PCOM interface? | Yes  No |

* + - 1. Fault recording

|  |  |
| --- | --- |
| Is logging equipment installed at the POC as specified in sections 5.7.3 and 6.7.3 for type C and D plants, respectively? | Yes  No |
| Has an agreement been made with the DSO and the transmission system operator defining which incidents to log?  If yes, which incidents are to be logged? | Yes  No |

* + 1. Simulation model requirements

|  |  |
| --- | --- |
| Is the simulation model approved by Energinet?  If yes, please provide reference to documentation: | Yes  No |

* + 1. Conformance testing

|  |  |
| --- | --- |
| Is a plan for conformance testing available as specified in sections 5.9 and 6.9 for type C and D plants, respectively?  If yes, please provide reference to documentation: | Yes  No |

* + 1. Conformance simulation

|  |  |
| --- | --- |
| Is a plan for conformance simulation available as specified in sections 5.9.3 and 6.9.3 for type C and D plants, respectively?  If yes, please provide reference to documentation: | Yes  No |

* + 1. Signature

|  |  |
| --- | --- |
| Date: |  |
| Contractor: |  |
| Manager: |  |
| Signature (manager): |  |
| Plant owner: |  |
| Signature (plant owner): |  |

* 1. Documentation for type C and D synchronous power-generating plant (part 3)

Please complete the documentation with synchronous power-generating plantdata to obtain **final operational notification** **(FON)** and send it to the DSO*.*

* + 1. Identification

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

* + 1. Active power control
       1. Power response to overfrequency

|  |  |
| --- | --- |
| Is the frequency response function for overfrequency as specified in sections 5.3.1 and 6.3.1 for type C and D plants, respectively, enabled?  If yes, what are the set point values?  Frequency threshold:  Droop:  Time for islanding detection (minimum response time): | Yes  No  \_\_\_\_\_\_\_\_Hz  \_\_\_\_\_\_\_\_%  \_\_\_\_\_\_\_\_ms |

* + - 1. Power response to underfrequency

|  |  |
| --- | --- |
| Is the frequency response function for underfrequency as specified in sections 5.3.2 and 6.3.2 for type C and D plants, respectively, enabled?  If yes, what are the set point values?  Frequency threshold:  Droop:  Intentional delay for islanding detection (minimum response time): | Yes  No  \_\_\_\_\_\_\_\_Hz  \_\_\_\_\_\_\_\_%  \_\_\_\_\_\_\_\_ms |

* + - 1. Frequency control

|  |  |
| --- | --- |
| Is the frequency control function as specified in sections 5.3.3 and 6.3.3 for type C and D plants, respectively, enabled?  If yes, what are the set point values?  Frequency threshold – Low (fRU):  Frequency threshold – High (fRO):  Droop:  Desired frequency:  ΔP: | Yes  No  Controlled online  \_\_\_\_\_\_\_\_Hz  \_\_\_\_\_\_\_\_Hz  \_\_\_\_\_\_\_\_%  \_\_\_\_\_\_\_\_Hz  \_\_\_\_\_\_\_\_kW |

* + - 1. Absolute power limit function

|  |  |
| --- | --- |
| Is the absolute power limit function as specified in sections 5.3.4.1 and 6.3.4.1 for type C and D plants, respectively, enabled?  If yes, which set point value is used? | Yes  No  Controlled online  \_\_\_\_\_\_\_\_kW |

* + - 1. Ramp rate limit function

|  |  |
| --- | --- |
| Is the power-generating plant ramp rate limit function as specified in sections 5.3.4.2 and 6.3.4.2 for type C and D plants, respectively, 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 as specified in sections 5.4.4 and 6.4.4 for type C and D plants, respectively, 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 as specified in sections 5.4.2 and 6.4.2 for type C and D plants, respectively, 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. Voltage control

|  |  |
| --- | --- |
| Is the voltage control function as specified in sections 5.4.3 and 6.4.3 for type C and D plants, respectively, enabled?  (Must only be enabled subject to prior agreement with the DSO)  If yes, which set point is used? | Yes  No  Controlled online  \_\_\_\_\_\_\_\_kV |

* + 1. PSS-function

|  |  |
| --- | --- |
| Er the PSS-function activated? | Yes  No  Controlled online |

* + 1. Conformance testing

|  |  |
| --- | --- |
| Is documentation of conformance testing enclosed?  If yes, please provide reference to documentation: | Yes  No |

* + 1. Conformance simulation

|  |  |
| --- | --- |
| Is documentation of conformance simulation enclosed?  If yes, please provide reference to documentation: | Yes  No |

* + 1. Verification of simulation model

|  |  |
| --- | --- |
| Is a simulation model verified with the conformance test with Energinet?  If yes, please provide reference to documentation: | Yes  No |

* + 1. Signature

|  |  |
| --- | --- |
| Date: |  |
| Contractor: |  |
| Manager: |  |
| Signature (manager): |  |
| Plant owner: |  |
| Signature (plant owner): |  |