Power generating module Document ("PGMD")

This form is intended for the registration of a new Power Generating Module (PGM) with a capacity from 1 MW to 50 MW ("Type B") or from 50 MW to 60 MW ("Type C"). If you want to register more than one new power generating modules, please complete a separate form for each power generating module. A wind farm or solar park, consisting of several generating units (e.g. wind turbines), connected to one connection point, is considered as a single power generating module, so that one form will suffice. You can complete this form with the help of your installer and/or the supplier of the power generating module. Fill in all requested information on this form. Add attachments only if requested

If you wish to install an Electricity Storage Module, you must complete and submit the form for a storage unit ("ESMD"). If you want to install both an Power Generating Module and an Electricity Storage Module, you must complete and submit both forms (PGMD and ESMD).

General Data

Site of the connection point (As stated in connection agreement (ATO)

Street/house number	:	
Postal code	:	
City	:	
EAN-code of the connection	:	*(if already known)*

Commissioning date

The planned date of commissioning of the power generating module.

Date	:	

Power generating module data

The data below relates to the power generating module as a whole.
This concerns parameters/performance at the connection point of the system operator.

Structure of electrical installation

Attach a single-line diagram/plan of the structure of your electrical installation as an annex to this form. It must include the primary components from the point of connection to the generators or convertors. The location and settings of the protection must be Incorporated in the single line diagram. Cable data (type, length) and transformer data (power, primary and secondary voltage, short-circuit impedance, tap position) should also be provided.

Diagram in annex

Primary energy source

Choose from one or more of these standard categories.

☐ B01 - biomass
☐ B04 - natural gas
☐ B09 - geothermal
☐ B11 - hydropower
☐ B16 - sun
☐ B17 - waste
☐ B19 - wind

☐ B15 - other renewable (please specify) :

☐ B20 - other (please specify) :

If present storage

Capacity : MWh

Power : MW

Maximum capacity : [ ] MW

Maximum continuous active power that the generation module can produce at the connection point, less demand related solely to the self-consumption of that generation module itself. This is not the connection capacity in MVA, it may be higher.active power that the power generating module can produce and deliver to the grid at the connection point. This is not the same as the connection capacity in in MVA, which can be higher.

Installed peak power solar park : [ ] MW_p

In the case of a wind farm or solar park, the total sum of the installed power of solar panels.

Declared supply voltage Uc : [ ] kV

Supply voltage Uc agreed by the power system operator and the network user at the connection point. See the connection agreement (ATO) or the offer for the realization of connection to the grid.

Short-circuit current/nominal current ratio : [ ] (Isc/In) [ ] kA

The short-circuit contribution of the electricity generating unit at the connection point in relation to the rated current and as abolute value. If an electricity storage module is also installed, you must also refer to the corresponding ESMD form in which the short-circuit contribution of the ESM is stated.

Protection settings (RfG article 14(5) and Netcode elektriciteit, articles 2.13 and 2.37)

If applicable in the generating module/customer installation: the resulting behavior of protections in the electricity generating module at the connection point. If directional overcurrent protection devices or protective devices with time-dependent overcurrent functions (inverse characteristic) are used, please include them separately in an appendix.

			Breaking time	
Under voltage U<	: [ ]	p.u. (% of U_c)	[ ]	seconds
Over voltage U>	: [ ]	p.u. (% of U_c)	[ ]	seconds
Over current I>	: [ ]	kA	[ ]	seconds
Over current I>>	: [ ]	kA	[ ]	seconds
Under frequency f<	: [ ]	Hz	[ ]	seconds
Over frequency f>	: [ ]	Hz	[ ]	seconds

Be aware: protection settings must not conflict with the requirement to remain in operation in the event of a short circuit in the grid (fault-ride-through) or in the event of a deviating frequency and/or voltage. (Netcode articles 3.17 and 3.15 paragraph 10)

Data Power Generating Module

The data below relate to the individual generating units that are part of the power generating module. A distinction can be made between solar PV, wind energy and other. The data is hereby specified per PV-installation, wind turbine, synchronous generator or other type of unit. The data per PV-facility/wind turbine/synchronous generator and the number of these are given. It is possible to fill in up to 3 different types of PV-inverters or a single wind turbine or synchronous generator. If there are more than 3 types of generating units, please specify in an annex.
Furthermore, if applied, data of a park controller are required to fill in.

Solar PV facility

Number of inverters :

Nominal power per inverter :

Rated apparent power of the inverter, expressed in MVA.

Brand and type inverter

Brand/manufacturer :

Type :

Wind turbines

Number of wind turbines :

Nominal power of wind turbine : MVA

Rated apparent power of the wind turbine, expressed in MVA.

Wind turbine technology (generator technology used in the wind turbine)

Choose from one of these categories.

☐ double fed induction generator (DFIG)

☐ full inverter

Brand and type of wind turbine

Brand/manufacturer :

Type :

Synchronous

Number of synchronous generators :

Nominal power per generator : MVA

Rated apparent power of the synchronous generator, expressed in MVA.

Brand/manufacturer :

Type :

Nominal power factor (cos φ) :

Subtransiënt reactance (saturated) : *p.u. (“per unit”)*

Park controller (if applied)

Brand/manufacturer :

Type :

Other

Total nominal power :

Brand/manufacturer :

Type generating unit :

Data MV/LV and (if applied) HV/MV transformers

Usually, the generation units (wind turbine, PV inverters, synchronous generator) are connected to the internal MV network through a MV/LV transformer. Fill in the details of this MV/LV transformer(s) below. The form can be used to specify two types of MV/LV transformers. If more than two types of MV/LV transformers are installed, they shall be specified in an annex.
In some cases, there is a connection to a grid with a higher voltage (e.g. 50 or 66 kV) from the system operator. Then it is likely that a step-up transformer will be installed between this high-voltage grid and the medium-voltage grid to which the individual generation units with their MV/LV transformers are connected. In that case, enter the data of this step-up transformer at TR HV/MV.
Star point treatment: any star point present on the primary side of the HV/MV transformer (if present) or the MV/LV transformers should not be connected to earth (floating).

Nameplate data		**TR MV/LV type 1**		**TR MV/LV type 2**		**TR HV/MV**	
Nominal power	:		MVA		MVA		MVA
Nominal voltage primary (HV or MV)	:		kV		kV		kV
Nominal voltage secondary (MV or LV)	:		kV		kV		kV
Nominal short circuit voltage	:		%		%		%
Nominal copper or short-circuit losses	:		kW		kW		kW
Nominal iron or no-load losses	:		kW		kW		kW
Vector group windings (e.g. Dyn5)	:						

Tap changer							
Rated voltage highest tap	:		kV		kV		kV
Rated voltage lowest tap	:		kV		kV		kV
Tap size	:		kV		kV		kV
Online (change on-load) yes/no	:						
Offline (change only off-load), yes/no if yes, what is tap position at site	:						

Data for demonstrating compliance with technical requirements

Your power generating module must comply with the legal technical requirements for connection to the grid. These requirements are based on European Regulation 2016/631 ("Requirements for generators", RfG) and are included in the Dutch Netcode elektriciteit. For more explanations, see 'Handleiding Compliance Monitoring'.

Declaration of Conformity
By signing the bottom of this form, you declare that your power generating module meets all relevant technical requirements for connection to the grid, as stated in the RfG and the Netcode elektriciteit and the connection agreements.

Demonstration of compliance
You must demonstrate that your complete power generating module meets the RfG and Netcode elektriciteit requirements at the Connection Point. To this end, you must draw up an itemized declaration of compliance *in accordance with Annexes 1 and 2.*
The requirements you must meet, and the way in which you must demonstrate compliance, can be found in the document 'RfG compliance verification'. The requested substantiation by means of compliance tests and simulations must be submitted as an appendix to this PGMD.

Specified Declaration of Compliance
You must use a brand and type of inverter/wind turbine/generator and park controller that has previously been checked by the system operators for compliance with the requirements of RfG and the Netcode and is accepted. You can check with your system operator whether your intended inverter/wind turbine/generator/park controller has previously been tested and accepted. If this is not the case, you will need to provide documents (certified type-test reports, certificate of compliance) in accordance with Annex 1. The system operator will then check whether the requirements of the RfG and Netcode are met.
In addition, you will be required to perform PGM model simulation calculations and on-site testing with the fully operational PGM as listed in Annex 2. You must draw up reports and send them to the system operator for acceptance.
For Type B base parks (simple grid structure, 1 type of generation unit and 1 type of transformer), an Excel tool is made available for the simulation calculation of the reactive power exchange by the system operators (BLOS Excel load flow tool). This Excel tool contains an explanation of what a base park is. An Excel reporting tool is available for the reporting of the calculation results when using a separate specific load flow simulation program for the reactive power exchange (BLOR Excel rapport tool).
A standard test protocol is available for on-site testing at the operational PGM Type B (Type B test protocol).

Contact details and signature

Name	:	
Name Company	:	
Street / House number	:	
Post code	:	
City	:	
Telephone number	:	
Email address	:	
Signature *(fill in using Adobe Reader “Fill in and sign” function)*	:	

Annex 1

Compliance requirements for individual generation units and park controller PGM Types B and C

The individual generation units (PV inverter, wind turbine, synchronous generator) and park controllers in Type B and C power park modules must meet certain requirements in order to be used in PGM Type B and Type C parks. For some requirements, a certificate of compliance issued by a certified body and/or certified type test report for the individual generation unit in question is sufficient as evidence. The system operator assesses the evidence for compliance with the requirements of the RfG and the Netcode. If the result of the assessment is positive, the system operator will place the generation unit in question on a list of permitted generation units. If the PGM Type B or C park uses generation units and park controller that are already on this list, no evidence needs to be provided, and Annex 1 does not need to be completed.

If the generating unit and/or park controller is not mentioned on this list, the reference number of the type-test report and the certificate of conformity must be entered in the table below. In addition, the type test report and certificate of compliance must be sent along with the PGMD form for assessment by the system operator. For your information, the requirements in the EN50549-2 standard are almost identical to the requirements in the RfG and Netcode. A type test report and certificate of compliance based on EN50549-2 are strongly preferred.

Requirement RfG / Netcode elektriciteit Type B and Type C generating unit	Type test report reference	Compliance certificate reference
LFSM-O (Limited frequency sensitivity mode - over frequency)		
Frequency and voltage range (PPM)		
Reactive power capability		
Fault-Ride-Through, fast fault current injection and active power recovery after fault clearance		
Reconnection after tripping		
Rapid voltage changes, flicker, harmonics (power quality) For all generation units of the PPM (e.g. wind turbine, PV inverter): type test reports, as appendices, as specified in NEN-EN-IEC 61400-21		
Supplementary for Type C generating unit[1)]		
LFSM-U (Limited frequency sensitivity mode - under frequency)		
FSM (Frequency sensitivity mode)		
Controllability and control range active power		
Voltage, reactive power, power factor control		
Synthetic inertia (PPM, if applicable)		
Damping power oscillations (PPM, if applicable)		

Requirement RfG / Netcode elektriciteit Type B and Type C generating unit	**Type test report reference**	**Compliance certificate reference**
Park controller		
LFSM-O (Limited frequency sensitivity mode - over frequency)		
LFSM-U (Limited frequency sensitivity mode - under frequency)		
FSM (Frequency sensitivity mode)		
Controllability and control range active power		
Voltage, reactive power, power factor control		

[1] One or more functions can be included in a park controller. In this case, this function is not required in the generating unit.

Annex 2

Model simulations and on-site testing PGM Types B and C

This annex lists the model simulations and on-site tests for Type B and Type C PGMs. This assumes that the individual generating units and park controller are permitted and are listed on the list of system operators.
Type B PGM with a maximum power (Pmax) of less than 5 MW does not require on-site testing.

Requirement RfG / Netcode elektriciteit	Report simulation reference	Report on-site test for PGM $P_{max} \geq$ 5MW
Type B PGM		
LFSM-O (Limited frequency sensitivity mode - over frequency)		☐
Reactive power capability	☐	☐
Reconnection after disconnection		☐
Type C PGM		
LFSM-O (Limited frequency sensitivity mode - over frequency)	☐	☐
LFSM-U (Limited frequency sensitivity mode - under frequency)	☐	☐
FSM (Frequency sensitivity mode)	☐	☐
Frequency restoration		☐
Active power controllability		☐
Reactive power capability	☐	☐
Voltage, reactive power, power factor control		☐
Fault-Ride-Through, fast fault current injection and active power recovery after fault clearance	☐	
Reconnection after disconnection		☐
Island operation (if applicable)	☐	☐
Black-start capability (SPGM, if applicable)		☐
Tripping to house load (SPGM)		☐
Synthetic inertia (PPM, if applicable)	☐	☐
Damping power oscillations (PPM, if applicable)	☐	☐

Guide for filling in the PGMD form

This document is a guide on how to complete the PGMD form. For the completeness of information, all fields up to and including page 3 in the form must be completed. After page 3, only the fields that apply to your situation. Some fields are explained in more detail in this guide, in order to clarify a few things.

Preliminary remark:
The PGMD is intended for both synchronous electricity generating units (such as CHP) and asynchronous/inverter-coupled generating units (such as a wind or solar farm). The asynchronous generating units are also referred to as Power Park Modules (PPM) in the PGMD. The PPM category can then be subdivided into a ‘basic park’ and a ‘complex park’ with the following definitions:

- Basis park: park with short cabling, all inverters of the same type, all transformers of the same type, the same number of inverters per transformer, etc. A difference in distribution of up to 2 inverters per transformer is acceptable.
- Complex park: if a park does not meet the criteria of a base park, it is automatically a complex park. This concerns a park with different inverter types, different number of transformer types, different number of inverters per transformer, etc.

Lay-out electrical installation

A single-line diagram/diagram of the lay-out of your primary installation should be added here. There are no unambiguous requirements that the single-line diagram must meet, but for the quickest and most efficient assessment possible, it is desirable to have the following points clearly highlighted in the diagram:

- Location of the connection point with the system operator
- Protections for the entire power generation module (including the relevant settings))
- Type designation inverters/generating units
- Location step-up transformer

Short-circuit/rated current ratio

Here, the short-circuit current contribution of the electricity generating unit in relation to the nominal current (Isc/In) and absolute value (kA) at the transfer point with the system operator is requested. In the case of a base park, the factor Isc/In of the respective individual inverter/generating unit type can be entered.

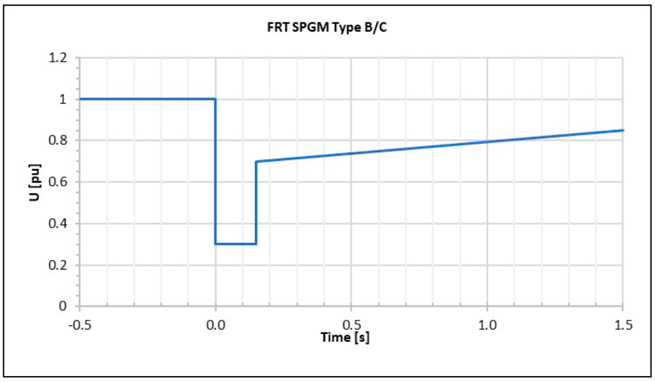
Protection settings in PGMD form

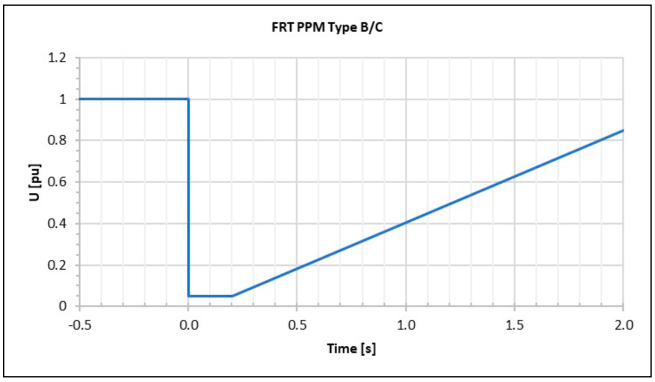
The protection settings requested in the PGMD form relate to the customer installation and not to the system operator’s protections. The behavior at the connection point is important, even if the protection is located deeper in the system, for example at the inverter. This refers to the **resulting behavior at the connection point** of all protective devices located in the customer system, whether they are located in the Low Voltage (LV) or Medium Voltage (MV) system or whether they are settings of the inverters/generating units. These settings shall not conflict with the requirements of the Netcode. This concerns in particular the requirements for the fault-ride-through capability specified in Article 3.17 and to the frequency and voltage range specified in Article 3.15(10).

In addition to the general requirements for the protection settings discussed here, individual system operators may also set specific requirements. These will then be communicated to you separately, for example as part of the quotation in the event of a new or reinforcement of your connection.

Under voltage protection U<

The setting of the under voltage protection must not conflict with the requirements for the fault-ride-through capability as specified in Article 3.17 of the Netcode. See the graphs below and also section 4.2.14 of the document 'RfG compliance verification' on the site of Netbeheer Nederland: Netbeheer Nederland.

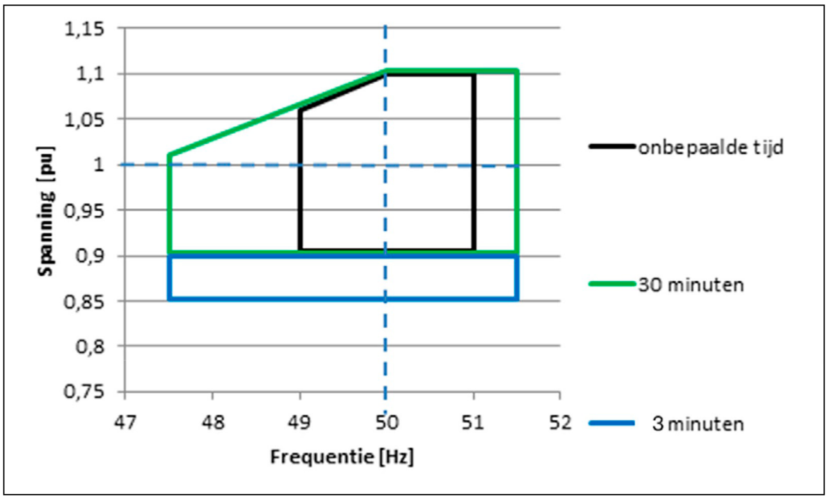




Spanning (p.u.)		Tijd (s)	
U_{ret}	0,3	t_{clear}	0,15
U_{clear}	0,7	t_{rec1}	0,15
U_{rec1}	0,7	t_{rec2}	0,15
U_{rec2}	0,85	t_{rec3}	1,5

Spanning (p.u.)		Tijd (s)	
U_{ret}	0,05	t_{clear}	0,2
U_{clear}	0,05	t_{rec1}	0,2
U_{rec1}	0,05	t_{rec2}	0,2
U_{rec2}	0,85	t_{rec3}	2

At the same time, the setting of the under voltage protection must be in line with the frequency and voltage range requirements as specified in Article 3.15(10) of the Netcode. See the graph below and section 4.2.7 of the document *'RfG compliance verification'*.



If the under voltage and/or over voltage protectors (U< and U>) are set at inverter level, they must be converted to the voltage level at the connection point in the PGMD form. This can be done by observing the winding ratio of the step-up transformer.

Over current protection I> en I>>

The over current protections I> and I>> are specifically requested in the form, as these settings shall not conflict with the fault-ride-through requirements. During a short circuit elsewhere in the grid, the PGM shall not switch off at I> due to the short-term short-circuit contribution of the PGM. This can be solved by choosing t> larger than 1.5 seconds (for synchronous) or larger than 2 seconds (for PPM), or I> greater than the short-circuit contribution of the PGM. At the same time, it is important that the over current protections are selective (faster) compared to the protection of the system operator, in the event of a fault in the customer installation itself.

The over current protections (I> and I>>) in the PGMD form are the protections that will be the first to respond in the event of a fault. It is important that the most critical protection is converted to the connection point with the lowest setting. Again, the conversion can be done by means of the winding ratio of the transformer.

Frequency protections (f< en f>)

The setting of frequency protection devices must be such that the PGM remains within the set frequency limits connected to the grid, in accordance with Article 3.13 of the Netcode:

Article 3.13

1 The power generating module shall be able to remain connected to the grid and in operation within the following frequency range and time periods, as referred to in Article 13(1)(a)(i) of Regulation (EU) 2016/631 (NC RfG):

1. in the frequency range from 47.5 Hz to 48.5 Hz for 30 minutes;
2. in the frequency range from 48.5 Hz to 49.0 Hz for 30 minutes;
3. in the frequency range from 49.0 Hz to 51.0 Hz for an unlimited period of time;
4. in the frequency range from 51.0 Hz to 51.5 Hz for 30 minutes.

Proof of compliance

As stated in the form, you must send proof that your power generating module as a whole (i.e. the assembly of all inverters, generating units, cabling, protections, transformers, installations, etc. that make up your generation installation) complies with the Netcode. More information about this can be found in the 'Guide Compliance Monitoring' on the website of Netbeheer Nederland: Netbeheer Nederland.

Proof of compliance is by means of a specified declaration of compliance which demonstrates that your installation as a whole meets the requirements of the Netcode.

Annexes 1 and 2 describe the evidence to be provided. It should be immediately clear from this evidence that these requirements are met. This evidence shall be supported by **test data** on individual components, in particular the inverters/generating units. Subsequently, tests and simulations must be carried out to demonstrate that your installation as a whole is compliant, see Appendix 2.

1. In the case of the use of a generating unit that is on the list of permitted units Type B of the system operators, the supporting documents of Annex 1 do not have to be provided.
2. In the case of the use of a generating unit that is not yet on the list of permitted units Type B of the system operators, the supporting documents in Annex 1 must be provided.

The simulation and test results according to Annex 2, which demonstrate compliance with the requirements at park level, must always be provided. In the case of a base park, the BLOS Excel tool provided by the system operators can be used to simulate the reactive power exchange (see https://www.netbeheernederland.nl/dossiers/regulering-20/documenten).

The document 'RfG compliance verification' of the joint Dutch system operators states which tests and simulations are required. This document can be found on the website of Netbeheer Nederland.
In this document, you can deduce (on page 9) which category your PGM falls into. Next, the table on p. 30, the technical requirements for which it must be demonstrated by tests/simulations that they are met. In the table on p. 27, for each type of PGM, reference is also made to the paragraphs in the document where these tests/simulations are described in terms of content, i.e. how they should be performed. Below is a screenshot of this table with reference to the subsection numbers.

Sub-paragraph	Requirement	SPGM				PPM				OPPM
		A	B	C	D	A	B	C	D	
1	LFSM-O	x	x	x	x	x	x	x	x	x
2	LFSM-U			x	x			x	x	x
3	FSM			x	x			x	x	x
4	Frequency restoration			x	x			x	x	x
5	Black start capability			x	x					
6	Tripping to houseload			x	x					
7	Frequency range and Voltage range	x	x	x	x	x	x	x	x	x
8	Reactive power capability		x	x	x		x	x	x	x
9	Active power controllability							x	x	x
10	Voltage control mode							x	x	x
11	Reactive power control mode							x	x	x
12	Power factor control mode							x	x	x
13	Island operation			x	x			x	x	x
14	FRT (profiles different B/C and D)		x	x	x		x	x	x	x
15	Reconnecting after disconnection		x	x	x		x	x	x	x
16	Post fault active power recovery		x	x	x		x	x	x	x
17	Power Oscillation Damping Control (POD)				x			x	x	x
18	Fast fault current injection						x	x	x	x
19	Synthetic inertia							x	x	x
20	Power quality: voltage fluctuations, harmonics								x	x
21	Insulation coordination								x	x

Contribution to short-circuit power

A simulation/calculation of the short-circuit contribution is not an RfG assessment point, but when assessing the PGMD form, it can be requested as a substantiation/further explanation. For the completeness of information and as an additional check on the ratio of short-circuit/nominal current at the connection point, it is therefore desirable to add an appendix in addition to the PGMD form, from which the ratio Isc/In and the absolute contribution (kA) can be deduced.

- In the case of a base park, the contribution to the short-circuit power can be demonstrated by attaching the technical information of the generating unit type used. This is information about the short-circuit currents of the respective type.
- In the case of a complex park, please demonstrate the contribution to the short-circuit power at the connection point with the grid operator. Reference can be made here to a calculation and/or simulation that is added as an appendix.