Electricity Storage Module Document (ESMD)

This form is intended for the registration of a new Electricity Storage Module (ESM) with a capacity from 1 MW to 60 MW.
An electricity storage module always is connected to one connection point.

An electricity storage module consists of either one synchronously connected unit (e.g. a motor/generator set) or one or more non-synchronously connected units (e.g. battery plus inverter). A separate form should be filled in for each synchronous electricity storage module. However, all non-synchronously connected units connected to one connection point shall be considered as one non-synchronous electricity storage module, the capacity of which is equal to the sum of the capacities of the individual units of the electricity storage module. One form shall be filled in for this non-synchronous electricity storage module.

If you want to register more than one new electricity storage module, please fill in a separate form for each module.
An electricity storage module installed at a wind or solar farm (PPM) is not part of that wind or solar farm and should be registered separately.

You can complete this form with the help of your installer and/or the supplier of the electricity storage module. Fill in all requested information on this form. Add attachments only if requested.

General data

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

Street/house number :

Post code :

City :

EAN code of the connection : *(if already known)*

Commissioning date

The planned date of commissioning of the electricity storage module.

Date :

Electricity Storage Module data

The data below relates to the electricity storage 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.

Diagram in annex.

Technology used

*Choose from one of these standard categories *)*

- ☐ Chemical (including: ammonia, hydrogen, synthetic)
- ☐ Electrochemical (batteries)
- ☐ Mechanical (including: underground compressed air pump storage)
- ☐ Thermal (including: heat storage, thermochemical)
- ☐ Other (please specify) :

**) Electrical equipment such as synchronous compensators, capacitors and regenerative braking systems are not included in the definition of an electricity storage module.*

Maximum capacity : [MW]
Maximum active power that the electricity storage module can produce and deliver to the grid at the connection point.

Maximum consumption capacity : [MW]
Maximum active power that the electricity storage module can draw from the grid at the connection point.

Maximum ramp-up speed of the active power : [%/second]
Maximum amount of active power the electricity storage module can increase per second, expressed as a percentage of the maximum capacity per second.

Maximum ramp-down speed of the active power : [%/second]
Maximum amount of active power the electricity storage module can decrease per second, expressed as a percentage of the maximum capacity per second.

Maximum storage capacity : [MWh]
Maximum amount of electrical energy the electricity storage unit can store.

Declared supply voltage U_c : [kV]
Supply voltage U_c agreed by the power system operator and the network user. See the connection agreement (ATO) or the offer for the realisation of connection to the grid.

Short-circuit current/nominal current ratio : [Isc/In]
The short-circuit contribution of the electricity storage module relative to the nominal current.

Protection settings (NC RfG article 14(5) and Netcode elektriciteit, articles 2.13 and 2.37)
If present in the electricity storage module, the resulting behaviour at the connection point.

			Breaking time	
Undervoltage U<	:	p.u. (% of U_c)		ms
Overvoltage U>	:	p.u. (% of U_c)		ms
Overcurrent I>	:	kA		ms
Overcurrent I>>	:	kA		ms
Undervoltage f<	:	Hz		ms
Overfrequency f>	:	Hz		ms

Protection settings shall not conflict with the requirement to remain in operation in the event of a short-circuit in the grid (fault-ride-through Netcode 3.17) or with a deviating voltage or frequency (Netcode 3.15:10).

Power Quality, in case of a non-synchronously connected electricity storage module (Netcode elektriciteit, article 2.15)
For all units in the electricity storage module, provide type test reports as specified in NEN-EN-IEC 61400-21 (en) Wind turbines - Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines:
Annex A.2: Voltage fluctuations (continuous operation, flicker), Switching operations
Annex A.3: Current harmonics, interharmonics and higher frequency components

Proof

Name of supporting document attached as an annex.

Data for the electricity storage modules

The data below relate to the individual units that are part of the electricity storage module. The data is hereby specified per unit type.

Non-synchronously connected electricity storage module:

It is possible to fill in up to 3 different types of inverters. If there are more than 3 inverter types, please specify in an annex.

Number of inverters	:			
Nominal power per inverter	:			

Rated apparent power of the inverter, expressed in MVA.

Brand and type of inverter

Brand/manufacturer	:			
Type :				

Synchronously connected electricity storage module:

Nominal power per generator : [MVA]

The rated apparent power the synchronous generator, expressed in MVA.

Brand and type of synchronous machine

Brand/Manufacturer :

Type :

Nominal power factor (cos φ) :

Sub transient reactance (saturated) : [p.u.] (“per unit”)

Data for step-up transformer (if present)

The step-up transformer connects the electricity storage module to the DSO/TSO grid.
This form can be used to specify three step-up transformer types. If more than three step-up transformer types are installed, they must be specified in an annex.

Name plate data		**TR type 1**		**TR type 2**		**TR type 3**	
Nominal power	:		MVA		MVA		MVA
Nominal voltage primary (HV)	:		kV		kV		kV
Nominal voltage secondary (LV)	:		kV		kV		kV
Nominal relative 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)	:						

Star point treatment

Choose from one of these categories.

- ☐ isolated
- ☐ star grounded
- ☐ impedance grounded

Tap changer

Rated voltage highest tap position	:		kV		kV		kV
Rated voltage lowest tap position	:		kV		kV		kV
Tap size	:		kV		kV		kV

Tap changer control

Choose from one of these categories.

- ☐ online (continuously on-load adjustable)
- ☐ offline (only off-load adjustable)

Data for the provision of demand response

The electricity storage module may provide demand response for active power control, reactive power control or for managing transmission constraints. Electricity storage modules not connected to the transmission network (110 kV or higher) shall collectively fulfil the requirements of Articles 28 and 29 of the NC DCC as part of demand aggregation through a third party.

☐ yes, the electricity storage module provides demand response
☐ no, the electricity storage module does not provide demand response

If the answer is "no", you can skip the next two questions.

If yes

Choose from one of these categories.

☐ individually
☐ collectively as part of demand aggregation through a third party

Please, specify :

If yes

Choose from one of these categories.

☐ provision of active power control
☐ provision of reactive power control
☐ provision of transmission constraint management
☐ provision of demand response system frequency control

Data concerning the switching of electricity storage modules from demand to production

The electricity storage module in storage mode shall be able to adjust the active power in the event of a frequency disturbance in order to maintain the stability of the grid. If the electrical storage module is unable to adjust the operating power in the event of a frequency drop below 49.8 Hz, the electrical storage module, when acting as load, shall automatically disconnect.

The automatic transition from storage mode (the electricity storage module draws electrical energy from the grid) to generation mode (the electricity storage module supplies electrical energy to the grid) takes place according to the scheme:

- The frequency drops to a value below 49.8 Hz
- The active power consumed in storage mode is adjusted at a frequency below 49.8 Hz with a droop of 1%
- After switching to generation mode, the supplied active power is adjusted continuously with droop of 1%
- The reverse process is followed when returning to nominal frequency

☐ yes, the electricity storage module is capable of switching automatically from storage mode to generation mode according to the scheme above

☐ no, the electrical storage module, when acting as load, shall shut down automatically at a frequency lower than 49.7 Hz

Data for demonstrating compliance with technical requirements

Your electricity storage module must comply with the legal technical requirements for connection to the grid. These requirements are based on the Dutch Netcode elektriciteit.

Declaration of Conformity
By signing the bottom of this form, you declare that your electricity storage module meets all relevant technical requirements for connection to the grid, as stated in the Netcode elektriciteit and the connection agreement (ATO).

Demonstration of compliance
You must demonstrate that your equipment meets the requirements of the Netcode elektriciteit. You can do this by means of a conformity certificate that covers all requirements. However, you can also choose to draw up a specified declaration of conformity yourself. The requirements you must meet and the way in which you must demonstrate conformity can be found in the document 'ESM compliance verification'. The requested substantiation by means of compliance tests and simulations should be provided as an annex to this ESMD.

Equipment Certificate
You must provide evidence that your entire electricity storage module at the connection point meets the requirements of the Electricity Grid Code. A recognized certifying body can provide an equipment certificate for this that can serve as proof. You should send a copy of this equipment certificate as an annex to this form. A certificate of a single component (such as a generator or inverter) can be part of the evidence but is not sufficient evidence for the entire electricity storage module.
If you do not have an equipment certificate that demonstrates full conformity, you must draw up a specified declaration of conformity (see below).

Do you have a certificate of conformity for the entire electricity storage module?
☐ yes, see Annex
☐ no

Specified declaration of conformity
Instead of or in the absence of a certificate of conformity, you can choose option 1 or 2:
1. Draw up a specified declaration of conformity yourself. This shall be supported by reports of conformity tests and simulations and, where appropriate, component certificates. For this option, please fill in annex I (from 1 to 60 MW) and also Annex II (from 50 to 60 MW).

Do you draw up a specified declaration of conformity? Choose.
☐ yes, see specified declaration of conformity in Annexes I and II
☐ no

2. Only for electricity storage modules up to 50 MW and on a temporary basis: use a make and type of inverter that has been previously tested and approved by the grid operators for compliance with the requirements of the Netcode elektriciteit. You can have your grid operator check whether the inverter you intend to use has been previously tested and accepted. You must also submit a simulation calculation of the reactive power exchange at the connection point with which you demonstrate that the electricity storage module at the connection point meets the reactive power requirements. For basic configurations, a simple model calculation using an Excel tool made available by the grid operators will suffice. This Excel tool contains an explanation of when a Basic Configuration can be said to exist.

Choose an answer.
☐ yes, see manufacture/type in the "Data for the electricity storage modules" section and see also the completed Excel tool as an annex
☐ no

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 I Requirements for Electricity Storage Modules with maximum capacity from 1 MW to 60 MW

This annex describes the requirements that must be met for Electricity Storage Modules with a maximum capacity from 1 MW to 60 MW. For each requirement, it is indicated whether tests and/or simulations are required as evidence. Instead of a test and/or simulation, a certificate or certified test/simulation reports can also be used as evidence for the relevant component.

NC RfG, article 13(2): LFSM-O: limited frequency sensitive mode – overfrequency
The technical capability of the electricity storage module to continuously modulate the active power to contribute to the frequency control in the event of a large frequency increase in the system is demonstrated. The steady-state parameters of controls (such as droop and power-frequency control threshold value) and the dynamic parameters, including frequency step change response shall be verified.
In case of an electricity storage module with a maximum capacity less than 50 MW and if for this requirement certificates or certified test reports are available for all units, controllers and other dynamically active equipment in the electricity storage module, simulations to prove compliance with this requirement will not be required by the system operator. The control settings shall be specified to the system operator.

Proof

Test and simulation :

Name of supporting document attached as an annex. *See "RfG Compliance verification" section 4.2.1*

NC RfG 13(1): Frequency range and voltage range (in the case of a non-synchronously connected ESM)
To prove that the electricity storage module is able to remain connected to the grid and operate within the range of the frequency and voltage at the connection point. The frequency range and voltage range tests may be executed as type test on a unit.

Proof

Test :

Name of supporting document attached as an annex. *See "RfG Compliance verification" section 4.2.7*

NC RfG 18(2) and 21(3): Reactive power capability
Performance at connection point.
The technical capability of the electricity storage module to deliver inductive and capacitive reactive power at the connection point according to NC RfG and Netcode elektriciteit is demonstrated. The capability of the electricity storage module to change the operating point to any desired value of the reactive power within the agreed reactive power range is demonstrated.
In case of an ESM with a maximum capacity less than 50 MW and if for this requirement certificates or certified test reports are available for all units and other active components in the ESM, these may be used together with load flow based network calculations to prove the ESM reactive power capability at the connection point. In that case an on-site test will not be required by the system operator.

Proof

Test and simulation :

Name of supporting document attached as an annex. *See "RfG Compliance verification" paragraph 4.2.8*

NC RfG 14(3): Fault-Ride-Through

Performance at connection point.

The fault-ride-through capability of the electricity storage module in accordance with the conditions described in NC RfG Article 14 (3) (a), under which the electricity storage module is able to remain connected to the grid and remain in stable operation after the electrical system has been disrupted by faults in the electricity system that have been switched off according to company policy is demonstrated by a type test or a simulation.

In case of an ESM with a maximum capacity less than 50 MW and if for this requirement unit certificates or certified test reports are available for all units in the ESM, simulations to prove compliance with these requirements will not be required by the system operator.

Proof

Test or Simulation :

Name of supporting document attached as an annex. *See "RfG Compliance verification" section 4.2.14*

NC RfG 14(4): Reconnecting after the electricity storage module has been disconnected caused by a network disturbance

After being disconnected from the grid due to a network disturbance, it is demonstrated that the electricity storage module is capable of reconnecting with the grid and supplying stable minimum power to the grid.

Proof

Test :

Name of supporting document attached as an annex. *See "RfG Compliance verification" section 4.2.15*

NC RfG 17(3) and 20(3): Post fault active power recovery

Performance at connection point.

The capability of the electricity storage module to restore the amount of active power prior to the failure as soon as possible after a fault.

In case of an ESM with a maximum capacity less than 50 MW and if for this requirement unit certificates or certified test reports are available for all units in the ESM, simulations to prove compliance with this requirement will not be required by the system operator.

Proof

Test or Simulation :

Name of supporting document attached as an annex. *See "RfG Compliance verification" section 4.2.16*

NC RfG 20(2): Fast current injection in the event of a fault (in the case of a non-synchronously connected ESM)

Performance at terminals of the individual units of the ESM.

The capability of the electricity storage module to ensure the injection of fast fault current, due to rapid voltage deviations at the terminals of the individual units of the ESM (for example the inverters), is demonstrated.

In case of an ESM with a maximum capacity less than 50 MW, if for this requirement unit certificates or certified test reports are available for all units in the ESM, simulations to prove compliance with this requirement will not be required by the system operator.

Proof

Test or Simulation :

Name of supporting document attached as an annex. *See "RfG Compliance verification" section 4.2.18*

NC DCC, Article 28(2): Demand response (if applicable)

The test shall demonstrate that the electricity storage unit is able to provide demand response for active power control, reactive power control or transmission constraint management within the ranges, time frame and duration specified in the connection agreement (ATO).

Proof

Test :

Name of supporting document attached as an annex. *See "DCC Compliance verification" paragraph 4.2.11*

NC ER, Article 15(3): Switching of electrical storage units operating as load

The test shall demonstrate that the electricity storage module acting as load (in storage mode):

a) is capable of automatically switching to generation mode within the specified time period and up to a set point for the generated active power defined by the transmission system operator in the system protection plan; or
b) when the electricity storage module is not able to switch within the time period set by the transmission system operator in the system protection plan, is able to automatically disconnect the electricity storage unit functioning as load.

Proof

Test and simulation :

Name of supporting document attached as an annex. *See "ESM Compliance verification" section 4.2.1*

Annex II Additional requirements for Electricity Storage Modules with maximum capacity from 50 MW to 60 MW

This annex describes the requirements that must be met for Electricity Storage Modules with maximum capacity from 50 MW to 60 MW. For each requirement, it is indicated whether tests and/or simulations are required as evidence. Instead of a test and/or simulation, a certificate can also be used as evidence for the relevant requirement.

NC RfG 15(2)(c): LFSM-U: limited frequency sensitive mode - underfrequency
The test shows that the electricity storage module is technically capable of continuously modulating the active power in operating points below the maximum capacity in order to contribute to the frequency control in the event of a large frequency decrease in the power system. The steady-state parameter settings of the controls, (such as droop and power-frequency control threshold value) and the dynamic parameters, including frequency step change response shall be verified.

Proof

Test and simulation :

Name of supporting document attached as an annex. *See "RfG Compliance verification" section 4.2.2*

NC RfG 15(2)(d): FSM: Frequency sensitive mode
The test shows that the electricity storage module is technically capable of continuously modulating the active power over the full operating range between maximum capacity and minimum regulating level to contribute to the frequency control. The steady-state parameters of regulations, such as droop and deadband and dynamic parameters, including robustness through frequency step change response and large, fast frequency deviations shall be verified.

Proof

Test and simulation :

Name of supporting document attached as an annex. *See "RfG Compliance verification" section 4.2.3*

NC RfG 15(2)(e): Frequency restoration
The technical capability of the electricity storage module to participate in frequency restoration control is demonstrated and the cooperation of FSM and the scheme for the restoration of the frequency is verified.

Proof

Test :

Name of supporting document attached as an annex. *See "RfG Compliance verification" section 4.2.4*

NC RfG 15(2)(a): Active power controllability (in the case of a non-synchronously connected ESM)
The technical capability of the electricity storage module to be in operation at a load level that is lower than the reference value established by the relevant system administrator or relevant TSO is demonstrated.

Proof

Test :

Name of supporting document attached as an annex. *See "RfG Compliance verification" section 4.2.9*

NC RfG 21(3)(d): voltage control mode/reactive power control mode/power factor control mode in the case of a non-synchronously connected ESM
The capability of the electricity storage module to remain in operation in voltage control mode/reactive power control mode/ power factor control mode is demonstrated. The settings, accuracy, insensitivity and duration for activating the reactive power are verified. The system operator selects one of the three control options (voltage/reactive power/power factor) for testing.

Proof

Test :

Name of supporting document attached as an annex. *See "RfG Compliance verification" section 4.2.10/11/12*

NC RfG 15(5)(a): Black-start capability (in case of a synchronously connected ESM and if applicable)
It is demonstrated that an electricity storage module with black-start capability is able to start up from standstill without any external electrical supply within a time specified by the relevant system administrator, in consultation with the relevant TSO.

Proof

Test :

Name of supporting document attached as an annex. *Zie "RfG Compliance verification" paragraaf 4.2.5*

NC RfG, artikel 15(5)(c)(iii): overschakeling naar eigenbedrijfsbelasting (in geval van een Synchroon gekoppelde elektriciteitsopslageenheid)
De technische capaciteit van de elektriciteitsopslageenheid om na afschakeling van het systeem over te gaan naar stabiel eigenbedrijf wordt aangetoond.

Proof

Test :

Name of supporting document attached as an annex. *Zie "RfG Compliance verification" paragraaf 4.2.6*

NC RfG, artikel 15(5)(b): eilandbedrijf (indien van toepassing)
Aangetoond wordt dat de elektriciteitsopslageenheid in staat is om deel te nemen aan eilandbedrijf.

Proof

Simulatie :

Name of supporting document attached as an annex. *Zie "RfG Compliance verification" paragraaf 4.2.13*

NC RfG 21(2)(a): Synthetic inertia (only for a non-synchronously connected ESM and if applicable)
The electricity storage module is shown to be able to provide synthetic inertia to a low frequency event with very fast frequency deviation.

Proof

Simulation :

Name of supporting document attached as an annex. *See "RfG Compliance verification" section 4.2.19*

NC RfG 21(3)(f): Power Oscillations Damping Control (only for a non-synchronously connected ESM and if applicable)
It is demonstrated that the electricity storage module is capable of damping active power oscillations. It is also shown that the control features for voltage and reactive power of an electricity storage module do not have a negative effect on damping power oscillations.

Proof

Simulation :

Name of supporting document attached as an annex. *See "RfG Compliance verification" section 4.2.17*