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 50 MW ("Type B") or 50 to 60 MW ("Type C"). An electricity storage module always is connected to one connection point.
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 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.

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.

If you wish to install an electricity generating module, you must complete and submit the form for a generating module ("PGMD"). If you want to install both an electricity 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 :

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 storage units/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.

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 continuous active power that the electricity storage module can produce at the connection point, less demand related solely to the self-consumption of that storage unit itself. This is not the connection capacity in MVA, it may be higher

Maximum consumption capacity : [MW]

Maximum active power that the electricity storage module can draw at the connection point, including demand related solely to the self-consumption of that storage unit itself. This is not the connection capacity in MVA, it may be higher.

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]

See the connection agreement (ATO) or the offer for the realisation of connection to the grid.

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

The short-circuit contribution of the electricity storage module at the Connection Point. The short-circuit contribution of the electricity storage module at the connection point in relation to the rated current and in absolute value. If an electricity generation unit is/will also be installed, you must also refer to the corresponding PGMD form in which the short-circuit contribution of the PGM is stated.

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

If applicable in the storage module/customer installation: the resulting behavior of protections in the electricity storage 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	
Undervoltage U<	:		p.u. (% van U_c)		seconds
Over voltage U>	:		p.u. (% van 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 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).

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. Furthermore, if applied, data of a park controller are required to fill in.

Non-synchronously connected electricity storage module:

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

Number of converters	:			
Nominal power per unit	:			

Rated apparent power of the unit, expressed in MVA.

Brand and type of inverter

Brand/manufacturer	:			
Type	:			

Synchronously connected electricity storage module:

Nominal power synchronous machine : [MVA]

The rated apparent power of the synchronous machine, 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”)

Park controller (if applied)

Brand/manufacturer :

Type :

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

Usually, the storage units 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 storage 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).

Name plate 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 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

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 complete electricity storage 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 'ESM compliance verification'. The requested substantiation by means of compliance tests and simulations must be submitted as an annex to this ESM.

Gespecificeerde conformiteitsverklaring
You must use a brand and type of storage unit and park controller that has previously been checked by the system operators for compliance with the requirements of the Netcode and is accepted. You can check with your system operator whether your intended unit and 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 Netcode are met.
In addition, you will be required to perform ESM model simulation calculations and on-site testing with the fully operational ESM 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 storage 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 ESM 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 storage units and park controller ESM Types B and C

The individual storage units (converters) and park controllers in Type B and C electricity storage modules must meet certain requirements in order to be used in ESM 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 storage unit in question is sufficient as evidence. The system operator assesses the evidence for compliance with the requirements of the Netcode. If the result of the assessment is positive, the system operator will place the storage unit in question on a list of permitted storage units. If the ESM Type B or C park uses storage 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 storage 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 ESMD 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 Netcode. A type test report and certificate of compliance based on EN50549-2 are strongly preferred

Requirement Netcode elektriciteit Type B and Type C storage unit	**Type test report reference**	**Compliance certificate reference**
LFSM-O (Limited frequency sensitivity mode - over frequency)		
LFSM-U (Limited frequency sensitivity mode - under frequency) Including switching from demand to generation		
Frequency and voltage range (N-ESM)		
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 storage 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 storage unit[1)]		
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)		

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 storage unit.**

Annex 2

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

This annex lists the model simulations and on-site tests for Type B and Type C ESMs. For Type C, the simulation models must be provided at the request of the grid operator. This assumes that the individual storage units and park controller are permitted and are listed on the list of system operators.
Type B ESM 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 voor ESM P_{max} ≥ 5MW**
Type B ESM		
LFSM-O (Limited frequency sensitivity mode - over frequency)		
LFSM-U (Limited frequency sensitivity mode - under frequency)		
Reactive power capability		
Reconnection after disconnection		
Type C ESM		
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 (S-ESM, if applicable)		
Synthetic inertia (N-ESM, if applicable)		
Damping power oscillations (PPM, if applicable)		
Demand modification (demand response, if applicable)		
Very fast active power control (demand response, if applicable)		