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# **Technical Requirements for the Client's Electrical Installation**

Valid from 31. 07.2025

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# 1 General requirements

- 1.1 This guide sets out the requirements of the transmission system operator for the construction of the client's electrical installation. The guide shall be applied together with the standard terms and conditions for connecting to the electricity transmission system of Elering AS (hereinafter the Connection Conditions).
- 1.2 The requirements provided in this guide are mandatory for equipment located from the connection point up to and including the client's first circuit breaker. The requirements for equipment located on the client's side beyond the circuit breaker are of a recommendatory nature, except for Chapters 3, 4 and 5 of this guide;
- 1.3 The client shall be responsible for ensuring that their electrical installations comply with applicable legislation (including construction standards for electrical installations) and with the standards and requirements established by the transmission system operator in the version in force at the time of submission of the connection application.
- 1.4 When designing, constructing, and operating the electrical installation, the client shall follow the requirements and suggestions set out in this guide, applicable standards and regulations, as well as the provisions in the standard terms and conditions of the network contract concluded with the transmission system operator. When preparing and submitting the electrical installation's design documentation, the client shall follow the guideline "Requirements for the Preparation and Modelling of the Electrical Design Documentation for the Client".
- 1.5 The client is responsible for ensuring that they are familiar with all relevant requirements prior to commencing design and construction.
- 1.6 For a single 330 kV connection point where the supply continuity under the N-1 condition guaranteed by the transmission system operator and the client is not ensured, the maximum generation or consumption capacity of the client's installation to be connected may be up to 400 MW.
- 1.7 When transferring power from the client's installation to and/or from the TSO's 330 kV network exceeding 400 MW, the client's installation must ensure the N-1 condition, so that any single fault does not result in the disconnection of more than 400 MW of production and/or consumption capacity. In particular, the client's connection must be implemented with lines up to the TSO connection points that mutually reserve capacity, fully routed on separate towers—including the line end towers—and capable of maintaining transmission continuity even if one line is taken out of service. In addition, the control systems of a power plant with a maximum generation and/or consumption capacity exceeding 400 MW must be designed so that the failure or outage of a single control system does not result in the disconnection of more than 400 MW of generating capacity.

- 1.8 The total capacity connected to a single 330 kV connection point may exceed 400 MW if the client's generation module is connected in the TSO substation via mutually reserving connection points and the client's installation ensures the N-1 condition. In particular, the connection to the connection points must be implemented with mutually reserving lines fully routed on separate towers, including the line end towers, and the failure or outage of a single control system must not result in the disconnection of more than 400 MW of generating capacity.

## **2 Requirements for the selection of the client's electrical equipment**

### **2.1 Primary equipment**

- 2.1.1 The client must ensure that:

- 2.1.1.1 their electrical installations are suitable for the prospective short-circuit currents, the values of which at the connection point are provided by the transmission system operator in the connection contract offer;
- 2.1.1.2 their electrical installations are equipped with relay protection and automation, as well as load-shedding and/or disconnection automation systems in accordance with the requirements of the transmission system operator, which are specified in the Grid Code, the connection contract, and during the coordination of the electrical design documentation;
- 2.1.1.3 the earthing system of any electrical equipment or set of equipment located within the dissipation area of the transmission system operator's earthing installation is connected to the transmission system operator's earthing installation via two separate conductors, and the thermal short-circuit current withstand of the client's earthing conductor is equal to that of the transmission system operator's earthing conductor;
- 2.1.1.4 at least one winding of its 110 kV or 330 kV power transformer is connected in a delta configuration. Other types of power transformers must be agreed in advance with the transmission system operator, who will provide the relevant conditions and requirements. The transmission system operator has the right to refuse the connection of power transformers of a different type. The neutral point of the power transformer must be capable of being earthed via a neutral switch and must be equipped with a surge arrester and a provision for installing a short-circuit current limiting reactor. The need for and parameters of the reactor shall be determined by the transmission system operator based on the level of short-circuit currents in the transmission grid;
- 2.1.1.5 the tap connections and winding insulation levels of the client's power transformers must be at least as follows:

Object	Um	AC (50 Hz)	SI	LI
	kV	kV	kV	kV
		Internal Insulation	Line terminal	
A-B-C (HV)	362	510	950	1,175
N	245	360	-	850
2a-2b-2c (MV)	123	230	-	550
2n	123	230	-	550

- 2.1.1.6 their electrical installations are protected against overvoltages.
- 2.1.2 The recommended rated primary voltages for the client's power transformers are 347 kV for a 330 kV transformer and 115 kV for a 110 kV transformer. When selecting a transformer, the client must ensure that the power transformer is capable of operating within the voltage ranges required by the Grid Code.
- 2.1.3 The on-load tap changer of the power transformer is preferably located on the primary winding side and must be adjustable under voltage.
- 2.1.4 The recommended tap changer steps are: for 330 kV power transformers:  $\pm 6 \times 1.33\%$ ; for 110 kV power transformers:  $\pm 9 \times 1.67\%$ .
- 2.1.5 It is recommended to install current transformers with built-in cores in the primary bushings of the power transformer—class 5P20 for protection relays and class 0.2S for metering.

## 2.2 Principles for selecting rated voltage levels of the client's equipment

Network rated voltage	330 kV	110 kV
Maximum allowable continuous voltage of	362	123
Maximum voltage temporarily allowed for equipment (20 min)	379.5	126.5
Rated voltages of power transformers	347/(117.5)/...	115/(...)/

## 2.3 Short-circuit current withstand

2.3.1 In the design of insulation, overvoltage protection, and relay protection and automation, the client must consider the following: autotransformers must operate with a solidly earthed neutral; the 330 kV and 110 kV windings of conventional transformers may operate with either a solidly earthed neutral (also via a neutral switch), a reactor-earthed neutral, or an isolated neutral. In doing so, the client must take into account that: the earth short-circuit current voltage factor in the 330 kV transmission grid must not exceed 1.2; the earth short-circuit current voltage factor in the 110 kV transmission grid must not exceed 1.4; (The earth short-circuit current voltage factor indicates the ratio between voltages occurring in healthy phases during an earth fault and the normal phase-to-ground voltage.) Additionally, the client must be aware that in transmission substations, surge arresters are only installed near power transformers, cable sealing ends, and in gas-insulated switchgear (GIS), for the protection of transmission system operator's equipment.

2.3.2 In the design of electrical installations, it must be ensured that all materials and equipment can withstand the maximum mechanical stresses that may occur under fault conditions during operation.

2.3.3 All current-carrying conductors must have a short-circuit current withstand capability of at least one second, unless agreed otherwise.

## **2.4 Safety distances**

2.4.1 In substation design, the minimum permissible insulation clearances defined in standard EVS-EN 61936-1 must not be reduced for safety reasons.

2.4.2 When determining safety distances, the effects of wind, environmental conditions, and other relevant factors must also be considered, and larger clearances must be used accordingly.

## **2.5 Creepage distances**

2.5.1 When selecting equipment, insulation requirements must take into account the environmental conditions prevailing at the substation site. As a general rule, the minimum creepage distance of equipment insulation shall be at least 20 mm/kV. If the transmission system operator deems a greater creepage distance necessary, this will be specified in the connection contract offer.

## **2.6 Radio interference and acoustic noise**

2.6.1 The selection and design of equipment must ensure that corona-induced radio interference remains below the values specified in the standards adopted by the transmission system operator.

- 2.6.2 Acceptable technical solutions include those where radio interference, measured in accordance with IEC-CISPR 18 at a frequency of 0.5 MHz and at a distance of 20 metres from the furthest switchyard component, does not exceed:
- 2.6.3 30 dB in rainy weather,
- 2.6.4 15 dB in dry weather.
- 2.6.5 Acoustic noise caused by the client's electrical installation must not cause the noise level at the boundary of the transmission system operator's substation to exceed the limit value set out in legislation and/or the relevant plan.

### **3 Automation and relay protection**

- 3.1 The protection and automation systems from the client's connection point to the client's first power transformer(s) and the TSO's protection must be compatible and operate selectively to ensure the reliability of the electrical system. Both parties are responsible for ensuring that the protective devices they own are operational.
- 3.2 The owner of the primary equipment is responsible for the protection of their equipment. The protection systems in the transmission system operator grid are intended to protect the equipment of the transmission system operator. The client must take into account that the transmission system operator's protection does not guarantee the disconnection or protection of the client's equipment (such as power transformers, switchyard, overhead lines, or cable lines) in the event of faults or short circuits.
- 3.3 The transmission system operator shall provide the client with the position signals (auxiliary contacts) of the TSO bay switchgear connected to the client's installation. As a rule, control interlocks are not used between the primary equipment of the transmission system operator and the client (excluding distribution system operators).
- 3.4 At a 110 kV or 330 kV connection point, the client's primary protection of their electrical installation's relay protection must operate selectively in the event of a fault in the client's equipment, and must activate within at least 0.1 seconds of the fault occurrence. For voltages of 110 kV and 330 kV, the client's primary protections are considered to be differential protection, distance protection with communication, or another solution that meets the same requirements.
- 3.5 Switching devices shall be operated by the owner of the respective equipment.
- 3.6 As a rule, all power transformers are first energised without load and only then put into service. The client generally energises their own power transformer. If there is no client's circuit breaker on the high-voltage side of the client's power transformer, the TSO may, upon the client's request, energise the client's power transformer using a circuit breaker located in the TSO's installation.

- 3.7 If more than one client power transformer is connected to a 110 kV or 330 kV connection point, each power transformer must have a separate circuit breaker on its high-voltage side within the client's installation.
- 3.8 For power transformers with a capacity exceeding 100 MVA, the high-voltage side circuit breaker must be equipped with synchronous switching automation, and the client is responsible for the synchronous switching of their power transformer(s). If there is no client-owned circuit breaker on the high-voltage side of the client's power transformer, the synchronous switching automation shall be provided in the TSO's installation.
- 3.9 The TSO shall install a separate terminal cabinet in its substation bay for each client, into which the client can connect circuits and the necessary device(s) to implement the main protection of their installation, in accordance with the principles set out in the *"Technical Principles and Solutions for Transmission System Operator's Electrical Installations."*
- 3.10 The client must take into account that the TSO does not provide auxiliary or own-use power (DC or AC) for the equipment in the client's installation at its substation. Therefore, the client must either install or procure an own-use solution from the distribution system operator.
- 3.11 The exact number and capacity of circuits between the transmission system operator's equipment and the client's equipment will be determined during the coordination of the electrical design documentation.

## **4 Electricity quality requirements**

- 4.1 The values presented here are used by the transmission system operator as planning values.
- 4.2 The permissible limit values for clients are lower and are specified individually for each client in the connection contract.
- 4.3 Voltage variations caused by the client must not exceed 3% at the connection point.

### **4.4 Flicker:**

- 4.4.1 Flicker in the 110 kV power network:

$$E_{P_{st}i} = 1,0$$

$$E_{P_{ti}i} = 0,8$$

- 4.4.2 Flicker in the 330 kV power network:

$$E_{P_{st}i} = 0,8$$

$$E_{P_{ii}} = 0,6$$

#### 4.5 Voltage asymmetry

4.5.1 During normal operation, the 10-minute average of the negative-sequence component must not exceed: 1.4% of the positive-sequence component in the 110 kV network; 1.0% of the positive-sequence component in the 330 kV network (in 95% of weekly measurements).

#### 4.6 Harmonics

4.6.1 Voltage harmonics

4.6.1.1 Planning values for higher-order voltage harmonics (up to 50th order) in the 110 kV transmission grid of the transmission system operator are as follows:

Odd harmonics				Even harmonics	
Indivisible by 3		Divisible by 3			
Order $h$	Relative voltage $u_h$ , %	Order $h$	Relative voltage $u_h$ , %	Order $h$	Relative voltage $u_h$ , %
5	3	3	2.7	2	1.5
7	2.7	9	1.1	4	0.8
11	2	15	0.3	6	0.4
13	1.8	21	0.2	8	0.4
17	1.4	27	0.2	10	0.3
19	1.2	33	0.2	12	0.3
23	1	39	0.2	14	0.3
25	0.9	45	0.2	16	0.3
29	0.8			18	0.3
31	0.7			20	0.3
35	0.6			22	0.3
37	0.6			24	0.25
41	0.5			>24	0.25
43	0.5				
47	0.45				
49	0.4				

4.6.1.2 Planning values for higher-order voltage harmonics (up to 50th order) in the 330 kV transmission grid of the transmission system operator are as follows:

Odd harmonics				Even harmonics	
Indivisible by 3		Divisible by 3			
Order $h$	Relative voltage $u_h$ , %	Order $h$	Relative voltage $u_h$ , %	Order $h$	Relative voltage $u_h$ , %
5	2	3	2	2	1.4
7	2	9	1	4	0.8
11	1.5	15	0.3	6	0.4
13	1.5	21	0.2	8	0.4
17	1.2	>21	0.2	10	0.35
19	1			12	0.3
23	0.9			14	0.3
25	0.8			16	0.25
29	0.7			18	0.25
31	0.65			20	0.25
35	0.6			22	0.25
37	0.55			24	0.2
41	0.5			>24	0.2
43	0.45				
47	0.4				
49	0.4				

4.6.1.3 The voltage total harmonic distortion (THD) up to the 50th order must not exceed 3% in the TSO's transmission network.

#### 4.6.2 Current harmonics

4.6.2.1 Maximum permissible current emission values for clients at the connection point.

% of the client's maximum current	
Maximum current distortion (TDD)	5%
Psyphometric phase current value	5 A
Negative-sequence current component	20%

#### 4.6.2.2 Permissible emission limits for odd current harmonics

Harmonic order	Current harmonic emissions limit in relation to current strength %
$h < 11$	4.0
$11 \leq h < 17$	2.0
$17 \leq h < 23$	1.5
$23 \leq h < 35$	0.6
$35 \leq h < 50$	0.5
Total harmonics distortion factor (TDD)	5.0

#### 4.6.3 High-frequency communication disturbances

4.6.3.1 The client must ensure that the electromagnetic interference generated by their electrical installation does not exceed 35 dB (0 dB = 0.775 V) within the frequency range 40–500 kHz, measured at the input of a standard remote switching device at the connection point. This requirement exists because the transmission system operator uses high-frequency communication in its network.

### 5 Requirements for generating units and storage devices connected to the transmission grid

#### 5.1 Operation of generating units under frequency and voltage deviations and grid disturbances

5.1.1 Generating units must be capable of operating in parallel with the power network and remaining connected within the frequency and voltage ranges established by legislation.

#### 5.2 Protection function of the generating unit

5.2.1 Generating units must be equipped with protection functions compliant with legal requirements, to prevent damage of the generating units in the event of malfunctions or power system disturbances where operational parameters deviate beyond the designed and minimum required thresholds of the generating unit.

5.2.2 Except in wind and solar parks, protection devices installed on the generating unit must ensure disconnection to internal load in the cases and under the conditions specified by law and must be able to reconnect to the network after the grid disturbance has cleared.

5.2.3 Following protection activation, reconnection of the generating unit to the network must take place in accordance with the conditions laid down in legislation.

### **5.3 Requirements applicable to the voltage regulators of synchronous power-generating modules**

5.3.1 For static exciters, the ceiling voltage must be at least twice the nominal excitation voltage; for brushless exciters, at least 1.6 times the nominal excitation voltage of the generator. In determining ceiling voltage, all applicable voltage regulation requirements must be considered.

5.3.2 The excitation system must allow the ceiling voltage to be maintained for 10 seconds. When designing the excitation system, it is taken into account that the requirements for ceiling voltage must also be met during nearby network short circuits.

5.3.3 Voltage regulation must operate automatically during normal conditions.

5.3.4 Steady-state dynamic characteristics must be determined by measurement. This involves changing the setting of the voltage regulator while the generator is running idle and disconnected from the network, to produce a 10% change in generator terminal voltage.

5.3.5 Voltage must be raised and lowered in steps, causing the generator output voltage to change from 95% to 105% and from 105% to 95% of the rated voltage. In both directions, the change in generator output voltage must comply with the following requirements:

5.3.5.1 the generator output voltage must not oscillate;

5.3.5.2 if voltage is increased to 90% within the aforementioned range of change, the voltage rise time must be 0.2–0.3 seconds for a static exciter and 0.2–0.5 seconds for a brushless exciter;

5.3.5.3 The upper limit of overshoot must not exceed 15% of the adjustment range.

5.3.6 If voltage is reduced within the range of 90% to 0%, the voltage reduction time for a brushless exciter must be 0.2–0.8 seconds.

5.3.7 A power system stabiliser (PSS) must be installed on the synchronous power-generating module. It shall suppress low-frequency (0.2–1.0 Hz) oscillations between the generator and the power system and must be switchable. The stabiliser's output signal must be limitable, and the limiting parameters must be adjustable.

### **5.4 Active, reactive power and voltage control**

- 5.4.1 The active and reactive power output of the generating unit must be remotely controllable from the energy system control centre.
- 5.4.2 Active power control ( $P = \text{constant}$ ) must be implemented at the connection point. In active power control, the client is free to allocate power between the different power-generating facilities of generating units connected behind a single connection point, provided that the maximum and minimum output capabilities of the generating units in operation are achievable.
- 5.4.3 When using the  $P = \text{constant}$  control mode, the active power setpoint must be adjustable in increments of 1 MW across the entire active power regulation range.
- 5.4.4 The accuracy of active power setpoint control must be at least  $\pm 5\%$  of the rated active power, but not more than  $\pm 5$  MW, whichever is smaller.
- 5.4.5 In case of rapid curtailment, the active power output of the power park module must be reducible from rated power to 20% within two seconds after receipt of the control signal in the electric wind turbine, wind farm, or solar plant control system. To quickly limit the active power of wind farms, a single wind turbine or group of wind turbines can be switched off.
- 5.4.6 The generating unit must be capable of providing automatic frequency restoration reserve (aFRR) of at least 5% of the generating unit's rated power. Solar and wind power plants must at least provide downward regulation capability.
  - 5.4.6.1 The entire reserve must be activated within 5 minutes of the control signal, with an activation delay no longer than 30 seconds.
  - 5.4.6.2 The generating unit must be able to receive a new setpoint every 4–10 seconds when providing aFRR.
  - 5.4.6.3 The accuracy of maintaining the aFRR setpoint must be at least  $\pm 10\%$  of the offered reserve or 0.1 MW, whichever is greater.
  - 5.4.6.4 More detailed requirements for aFRR are described in the document [„The Prequalification Process and Technical Requirements of Automatic Frequency Restoration Reserves \(aFRR\) Service“](#).
- 5.4.7 Reactive power control ( $Q = \text{constant}$ ) must also be implemented at the connection point and may be activated by the transmission system operator as needed and compensated based on a mutual agreement. The allocation of reactive power generation or consumption between power-generating facilities is free, provided that the reactive power as per the P/Q curve of the operating power-generating facilities is achievable.
- 5.4.8 When using the  $Q = \text{constant}$  control mode, the reactive power setpoint must be adjustable in 1 Mvar increments within the scope of the declared P-Q diagram, but not less than the minimum capability required by the Grid Code.

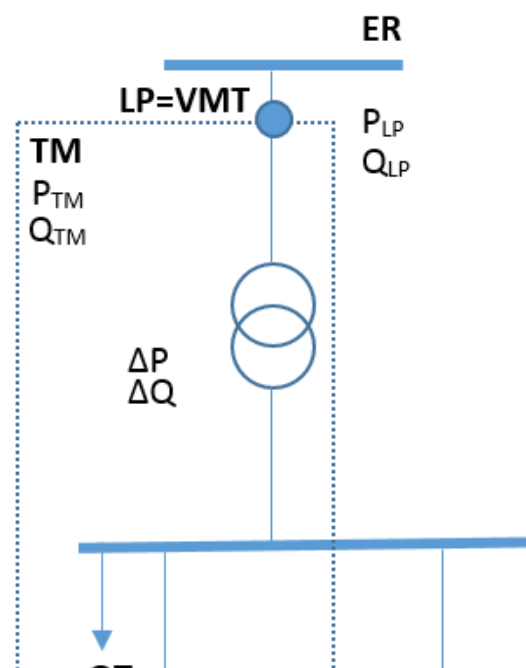
- 5.4.9 The regulation accuracy of the reactive power setpoint must be at least  $\pm 5\%$  of the full reactive power range (from the maximum inductive to the maximum capacitive reactive power of the generation module), but not more than  $\pm 5$  Mvar, whichever is smaller.
- 5.4.10 Voltage-based reactive power control, or voltage control functionality ( $U=\text{const}$ ), which, according to the setpoint and grid voltage, is able to change the reactive power output of the generating unit within the P-Q diagram declared by the client, but not less than the minimum capacity specified in the Grid Code. Activation of this voltage control function shall be initiated by the transmission system operator as needed and compensated accordingly. During the voltage control functionality, the distribution of reactive power between the power-generating facilities of generating units connected to a single connection point is free, provided that the reactive power according to the P/Q curve of the operating power-generating facilities is achievable.
- 5.4.11 The reference location for all adjustable output power values (voltage, active power, reactive power, etc.) is the connection point of the generating unit to the transmission system operator grid.

## **5.5 Additional requirements for the connection of mixed installations**

- 5.5.1 The control system reference point for the generating unit shall be the connection point defined in the connection contract between the transmission system operator and the client, regardless of where the electricity generating equipment is connected within the client's electrical installation.
- 5.5.2 When connecting a hybrid installation, the full electrical part of the project must be submitted in accordance with the guideline "Requirements for the Preparation and Modelling of the Client's Electrical Design Documentation". However, all attachments already submitted by the client during a previous connection process may be omitted, provided that no changes have been made to the previously submitted data and the client refers to the application or letter through which the data were previously sent to the TSO. The requirement for submitting models shall be reviewed on a case-by-case basis. For generating units connected to the grid before 2003 and where additional electricity consumption is added as part of the new connection process, the electrical design documentation must only cover the parts of the client's equipment and installations that are being constructed, modified or renovated in relation to the new connection.

- 5.5.3 For the purpose of data exchange on mixed installations, the client must ensure additional measurements to the transmission system operator's energy system control centre, reflecting the generating unit's performance without the effect of consumption, measured at the connection point of the generating unit (hereinafter the virtual metering point of the generating unit). The compliance of the generating unit shall be assessed based on measurements at this virtual metering point of the generating unit.
- 5.5.4 The addition of supplementary signals shall be carried out in accordance with the guideline "Data Exchange Requirements for the Client's Electrical Installation."
- 5.5.5 The generating unit's control system must be designed to enable the transmission system operator to control the generating unit from the virtual metering point as illustrated in explanatory Figure 5.6.8 of the document.
- 5.5.6 The  $Q = \text{constant}$  control signal must operate at the virtual metering point of the generating unit, and reactive power of the generating unit must be controllable within the declared P/Q diagram range, excluding the effect of consumption.
- 5.5.7 The  $Q = 0$  control signal must apply to the connection point of the mixed installation. When this signal is active, the generating unit must maintain 0 MVar at the connection point of the mixed installation.
- 5.5.8 The  $U = \text{constant}$  control signal must apply at the connection point of the mixed installation. The generating unit must maintain the specified voltage setpoint within the reactive power capability range at this point.
- 5.5.9 The  $P = \text{constant}$  control signal must apply at the virtual metering point of the generating unit. The active power must be controllable within the range of  $P_{\text{MAX}}$  to  $P_{\text{MIN}}$ , regardless of the effect of consumption.
- 5.5.10 Diagram explaining data exchange and control in a mixed installation:

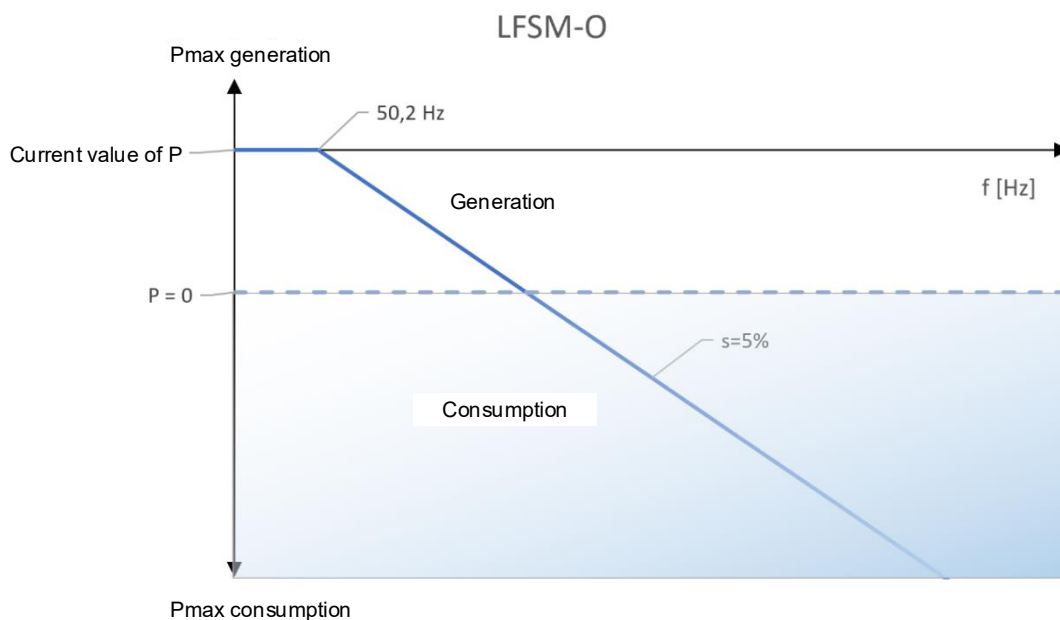
*LP, VMT – connection point (virtual metering point) 110 kV*  
*OT – self-consumption*  
*OL – direct line (mixed installation consumption)*  
*GEN – generator*  
*TM – generating unit (without consumption impact)*  
 *$\Delta$  – loss*  
 *$P$  – active energy*  
 *$Q$  – reactive energy*





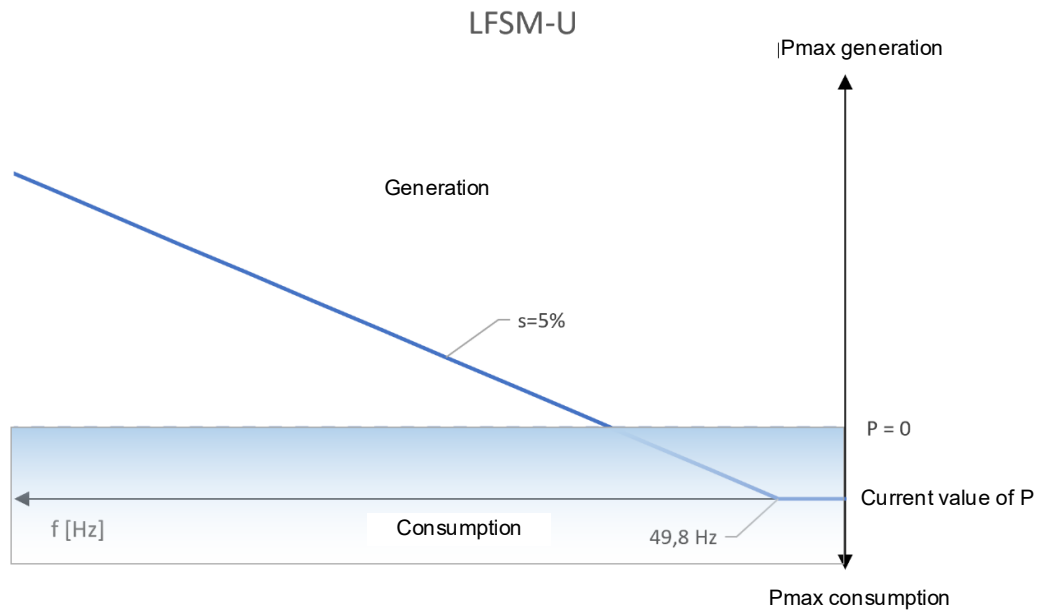
## 5.6 Additional requirements for storage devices

- 5.6.1 Storage devices are subject to the same technical requirements as generating units. The key distinction lies in the ability of storage devices to switch between generation and consumption modes.
- 5.6.2 The maximum capacity  $P_{\max}$  of a generation-oriented storage device is the maximum continuous active power that the storage module can generate, minus the module's self-consumption.
- 5.6.3 The maximum capacity  $P_{\max}$  of a consumption-oriented storage device is the maximum continuous active power that the storage module can consume.
- 5.6.4 Transition of the storage device between generation and consumption modes must occur smoothly.
- 5.6.5 When the storage device approaches its capacity limits (either discharging or fully charging), its power must be reducible at a configurable rate, typically set to 10% of  $P_{\max}/\text{min}$  per minute by default, within its technical capability.
- 5.6.6 The required control capability (range and speed) for adjusting the setpoint of the storage device depends on the maximum generation-oriented capacity  $P_{\max}$  in generation-oriented operation and on the maximum consumption-oriented capacity  $P_{\max}$  in consumption-oriented operation.
- 5.6.7 Limited frequency sensitive mode – overfrequency (LFSM-O)



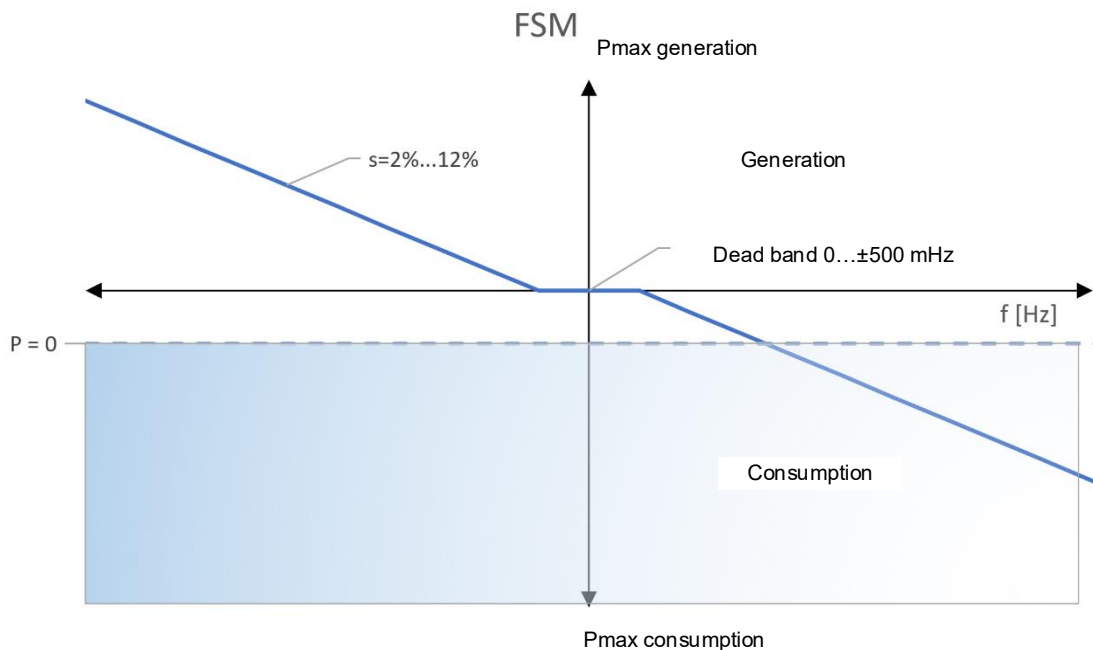
$P_{\max}$  (generation or consumption) serves as the base active power value against which changes in the output active power of the storage module are determined. In case of overfrequency (frequency deviation  $> 0.2$  Hz), the storage device must ensure an active power reduction (in generation mode) or increase (in consumption mode) according to a droop of  $S = 5\%$ .

5.6.8 Limited frequency sensitive mode – underfrequency (LFSM-U)



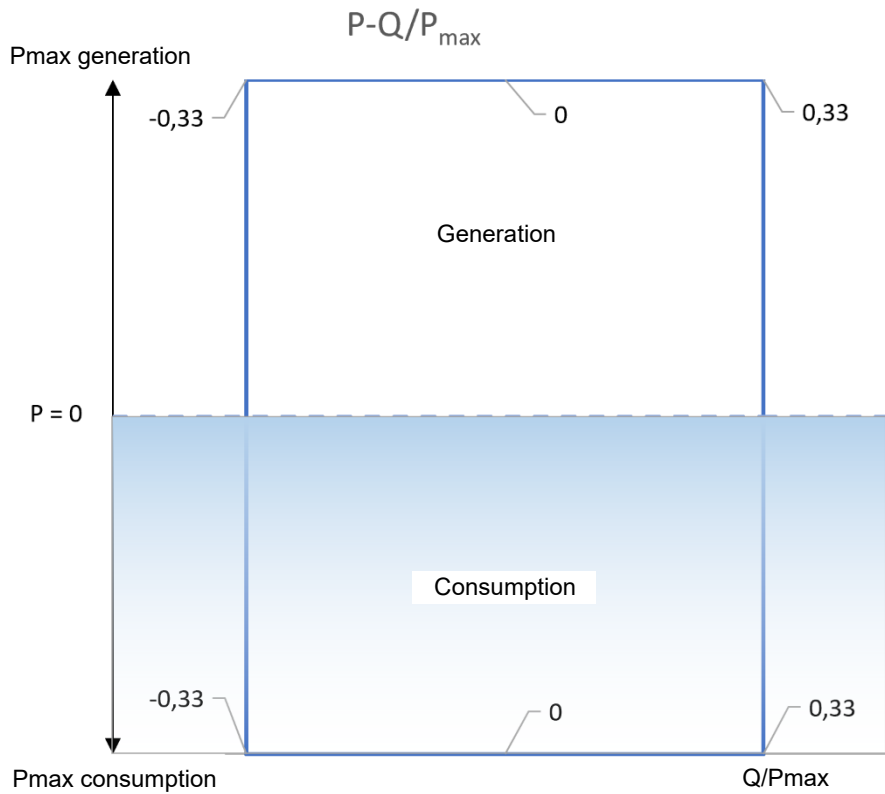
$P_{\max}$  (generation or consumption) serves as the base active power value against which changes in the output active power of the storage device are determined. In case of underfrequency (frequency deviation  $> 0.2$  Hz), the storage device must ensure an active power increase (in generation mode) or reduction (in consumption mode) according to a droop of  $S = 5\%$ .

5.6.9 Frequency sensitive mode (FSM) of the storage device



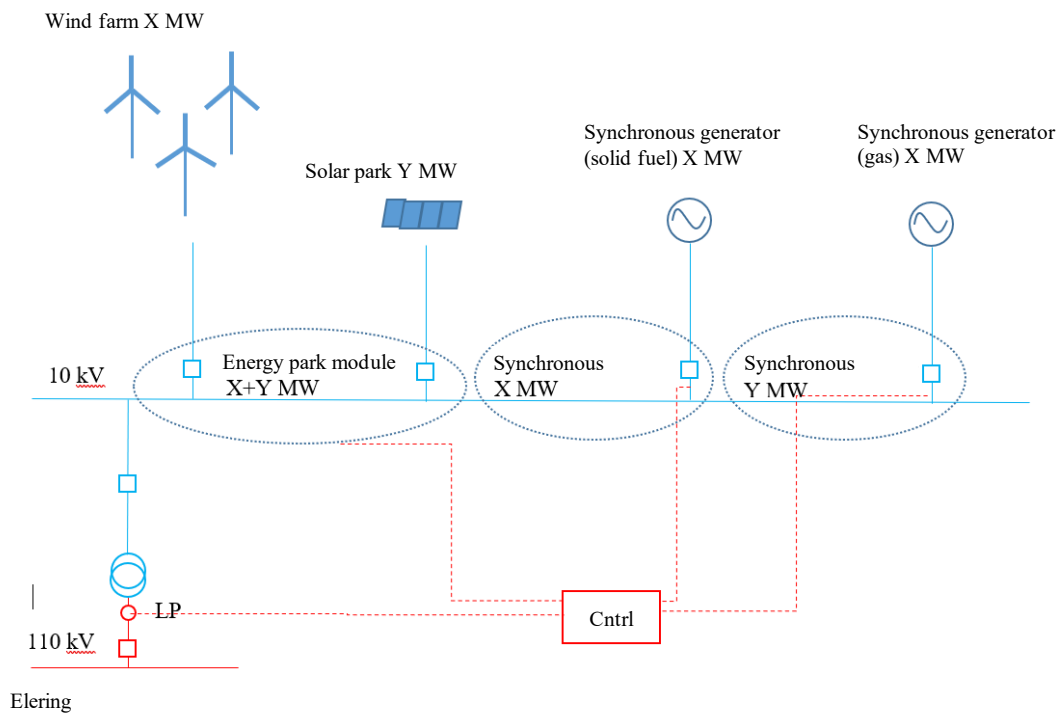
$P_{\max}$  (generation or consumption) serves as the base active power value against which changes in the output active power of the storage device are determined.

5.6.10 Storage module PQ/ $P_{\max}$  diagram



$P_{\max}$  (generation or consumption) is the base value of active power, against which the reactive power Q capability of the storage device must be ensured.

### 5.7 Additional requirements for connecting different types of generating units to a single connection point (hybrid module)



- 5.7.1 The reference point for a group of generating units of different types shall be the connection point agreed in the connection contract between the transmission system operator and the client.
- 5.7.2 If the generating units connected to the connection point are subject to different capability requirements, separate reference points (e.g. in the client's medium-voltage switchyard) must be agreed for each generating unit.
- 5.7.3 Each generating unit must have its own dedicated control system. Active power setpoint control shall be implemented relative to the agreed reference point.
- 5.7.4 In addition, a common control system must be established for the of generating units of different types, which ensures that the reactive power of the hybrid power plant can be controlled relative to the connection point (LP) by the transmission system operator.
  - 5.7.4.1 The  $Q=\text{const}$  control signal must operate at the common connection point of hybrid generating units, and the distribution of reactive power between the generating units is not important.
  - 5.7.4.2 The  $U=\text{const}$  control signal must operate at the common connection point of hybrid generating units, and the distribution of reactive power between the generating units is not important.
- 5.7.5 When assessing the compliance of hybrid generating units, tests are performed on both the generating units to demonstrate compliance with the RfG requirements at the connection point, as well as on the entire installation as a whole.
- 5.7.6 For hybrid generating units, a certificate of conformity is issued per generating unit. If a common control system exists, the common control system must meet the specified requirements and conditions for the compliance of hybrid generating units to be valid.
- 5.7.7 If one or more of the generating units connected to the connection point are found to be non-compliant, the compliance of the corresponding generating units will be suspended. If a failure occurs in the common control system of generating units of different types, or a significant change is made, the compliance of all generating units is suspended.
- 5.7.8 Compliance will be restored after the faults have been eliminated and the necessary tests have been performed.