D.1 Terms of Technical Requirements for Power- Generating Modules[1]

1. Introduction

1.1 These Terms are set based on paragraph 6 of Article 9 of the Electricity Act, No. 65/2003, as subsequently amended (referred to hereafter as the Electricity Act) and Article 6 of Regulation No. 513/2003, on system management in the electricity system.

1.2 These Terms are based on EU Regulation 2016/631 (17.05.2016) "Establishing a Network Code on Requirements for Grid Connection of Generators (RfG)" which is based on the proposals put forward by ENTSO-E.

1.3 The Minister has confirmed these Terms pursuant to paragraph 6 of Article 9 of the Electricity Act.

2. Definitions

The following definitions apply in these Terms:

2.1 Power Factor: The ratio of the absolute value of active power to apparent power.

2.2 House load operation: Ensures that power-generating facilities can continue to supply their in-house loads in the event of network failures, resulting in power-generating modules being disconnected from the network.

2.3 Island operation: The temporary operating mode of two or more transmission grid sections which have been (electrically) separated from each other and therefore become asynchronous.

2.4 Maximum Capacity ($P_{max)}$: The maximum continuous active power that a power-generating module can feed into the transmission system, as specified in the connection agreement or agreed between Landsnet and the power-generating facility owner.

2.5 Symmetrical fault: a fault affecting all phases equally. An example is a three-phase short circuit.

2.6 Reactive Power: The imaginary component of the apparent power at fundamental frequency, usually expressed in kilovar (1000 VAr) or megavar (1,000,000 VAr).

2.7 Power Park Module (PPM): A unit or ensemble of units generating electricity, which is either non-synchronously connected to the network or connected through power electronics, and that also has a single connection point to a transmission system.

[1] This is a translation from the Icelandic version of the grid code. In case of discrepancy the Icelandic version shall apply.

2.8 Asymmetric fault: A fault that does not affect all phases. An example is a two-phase short-circuit.

2.9 Setpoint: The target value for any parameter typically used in control schemes

2.10 P-Q-Capability Diagram: A diagram describing the reactive power capability of a power generating module in the context of varying active power at the connection point.

2.11 Active Power: The real component of the apparent power at fundamental frequency, expressed in watts or multiples thereof, such as kilowatts (1000 W) or megawatts (1,000,000 W).

2.12 Power System Stabilator (PSS): An additional functionality of the AVR of a synchronous power generating module whose purpose is to damp power oscillations.

2.13 Synchronous Power Generating Module: An indivisible set of installations that can generate electrical energy such that the frequency of the generated voltage, the generator speed, and the frequency of network voltage are in a constant ratio and thus in synchronism.

2.14 Automatic Voltage Regulator (AVR): The continuously acting automatic equipment that controls the terminal voltage of a synchronous power generating module.

2.15 Voltage: The difference in electrical potential between two points measured as the root-mean-square value of the positive sequence phase-to-phase voltages at nominal frequency.

2.16 Fault-ride through: The capability of electrical equipment to remain connected to the power system despite a disturbance occurring in the system.

2.17 Current: The rate at which electric charge flows, measured by the root-mean-square value of the positive sequence of the phase current at nominal frequency.

2.18 Fast Fault Current: A current supplied by a power generating module during a disturbance, which the system protection equipment can detect.

2.19 Apparent Power: The product of current and voltage, measured in volt-amperes (VA). Standard units include kilovolt-amperes (kVA, 1,000 VA) or megavolt-amperes (MVA, 1,000,000 VA).

2.20 Synthetic Inertia: The facility provided by a power park module to replace the effect of inertia of a synchronous power-generating module to a prescribed level of performance.

2.21 Connection Point: The location point where a power-generating module, energy-intensive user or distributor connects to Landsnet's transmission system.

2.22 Connection Agreement: A contract between Landsnet and the power-generating module's owner describing the connection and the necessary technical requirements.

2.23 Frequency: The electric frequency of the system expressed in hertz, which can be measured in all parts of the synchronous area under the assumption of a consistent value for the system in the time frame of seconds. Its nominal value is 50Hz.

2.24 Frequency Sensitive Mode (FSM): The operating mode of a power generating module in which the active power output changes in response to a change in system frequency, in such a way that it assists with the recovery to target frequency.

2.25 Limited Frequency Sensitive Mode - Underfrequency (LFSM-U): An operating mode of a power generating module that increases active power output in response to a change in system frequency below a certain value.

2.26 Limited Frequency Sensitive Mode - Overfrequency (LFSM-O): An operating mode of a power generating module that decreases active power output in response to a change in system frequency above a certain value.

2.27 Frequency Control: The capability of a power generating module to adjust its active power output in response to a measured deviation of system frequency from a setpoint, to maintain stable system frequency.

2.28 Inertia: The property of a rotating rigid body, such as the rotor of an alternator, that maintains its state of uniform rotational motion and angular momentum unless an external torque is applied.

2.29 U-Q/Pmax: A profile representing the reactive power capability of a power generating module in the context of varying voltage at the connection point.

2.30 A Power Generating Module is either:

- A Synchronous Power Generating Module
- A Power Park Module

2.31 A type B power generating module has an installed capacity of 1.5 MW to 10 MW and a connection point of 66 kV or less.

2.32 A type D power generating module is a power generating module with an installed capacity from and including 10 MW with a connection point of 66 kV or higher.

2.33 A step change in voltage or frequency: A sudden, single change between two steady-state voltage or frequency values, of unknown duration.

3. General

3.1 Landsnet is legally obligated to ensure the secure operation and stability of Iceland's transmission system, including technical requirements regarding power-generating modules.

3.2 These terms and conditions apply to all power-generating modules with an installed capacity of 1.5 MW or more directly connected to the transmission system. The terms solely apply to power-generating modules taken into operation after introducing these Terms. However, these terms apply if a power-generating module has been updated/refurbished, and a new and extensively amended connection agreement is therefore required. If the owner of a power generating module has entered into a binding contract to purchase equipment for the power generating modules within two years of implementing these Terms, then the previous Terms apply.

(i) Any refurbishment of power-generating modules, which could affect its technical ability, shall be reported to Landsnet well in advance

3.3 Power-generating modules must have an accurate, stable and highly controllable (real-time) rapid response to provide basic system operation to ensure the security of supply. These requirements apply irrespective of the operating conditions of the transmission system and are in accordance with detailed requirements for power-generating modules. The requirements should ensure the system's real-time response to events that may arise in the transmission system. The efficiency of power-generating modules must be sufficient to deal with disruptions, and the need for information and steering/control should be adequate to utilise the processing units under different conditions in the transmission system.

4. General requirements for power-generating modules

4.1 Power Generating Modules shall fulfil the following requirements relating to Frequency:

a) Frequency:

(i) A Power Generating Module shall be capable of staying connected to the Network and operating within the Frequency ranges and time periods specified:

47.0-47.5 Hz	period of 20 s
47.5-52.0 Hz	unlimited period
52.0 – 53.0 Hz	period of 20 s

(ii) Taking into account item 4.1 a) i), the power generating module shall be capable of automatic disconnection at a specified frequency if required by Landsnet. Landsnet and the owner of the power-generating module shall agree on the conditions and settings for automatic disconnection.

b) The power generating module shall be capable of remaining connected to the transmission system during any frequency changes up to a maximum of 0.5 Hz per second.

4.2 Regarding the limited frequency sensitive mode—over frequency (LFSM-O), the following shall apply:

a) The Power Generating Module shall be capable of activating the provision of Active Power Frequency Response according to Figure 1

b) The control shall start within the range of 50.2 Hz to 50.5 Hz.

c) The droop range shall be adjustable and between 2-12% according to the s_2 index shown in Figure 1. The final value shall be determined in consultation with Landsnet.

d) The Power Generating Module shall be capable of activating frequency-dependent active power control with the shortest time delay possible, and at most within 2 seconds. If the delay is longer, the owner of the power generating module shall specifically justify the delay with appropriate documentation.

e) Landsnet can require that a power generating module at the minimum regulating level be capable of the following:

i) Continuing operation at that level

ii) Further decreasing active power output

f) The Power Generating Module shall be capable of stable operation during LFSM-O operation. When LFSM-O is active, the LFSM-O Setpoint will prevail over any other Active Power Setpoints

4.3 The following shall apply regarding Limited Frequency Sensitive Mode–Underfrequency (LFSM-U) for Type D power generating modules:

a) The Power Generating Module shall be capable of activating the provision of Active Power Frequency Response according to Figure 2 and in accordance with the following:

(i) The power generating module shall be capable of activating frequency-dependent active power control, which shall start within the range from 49.8 Hz to 48.0 Hz.

ii) The droop range shall be adjustable and between 2-12% according to the s_2 index shown in Figure 2. The final value shall be determined in consultation with Landsnet.

b) The actual delivery of active power frequency response in LFSM-U mode shall consider:

i. Ambient conditions such as meteorological conditions and water flow

ii. The operational condition of the power generating modules, in particular limitations on operation near maximum capacity and at low frequency. This includes the relevant environmental factors in accordance with Articles 4.5 and 4.6

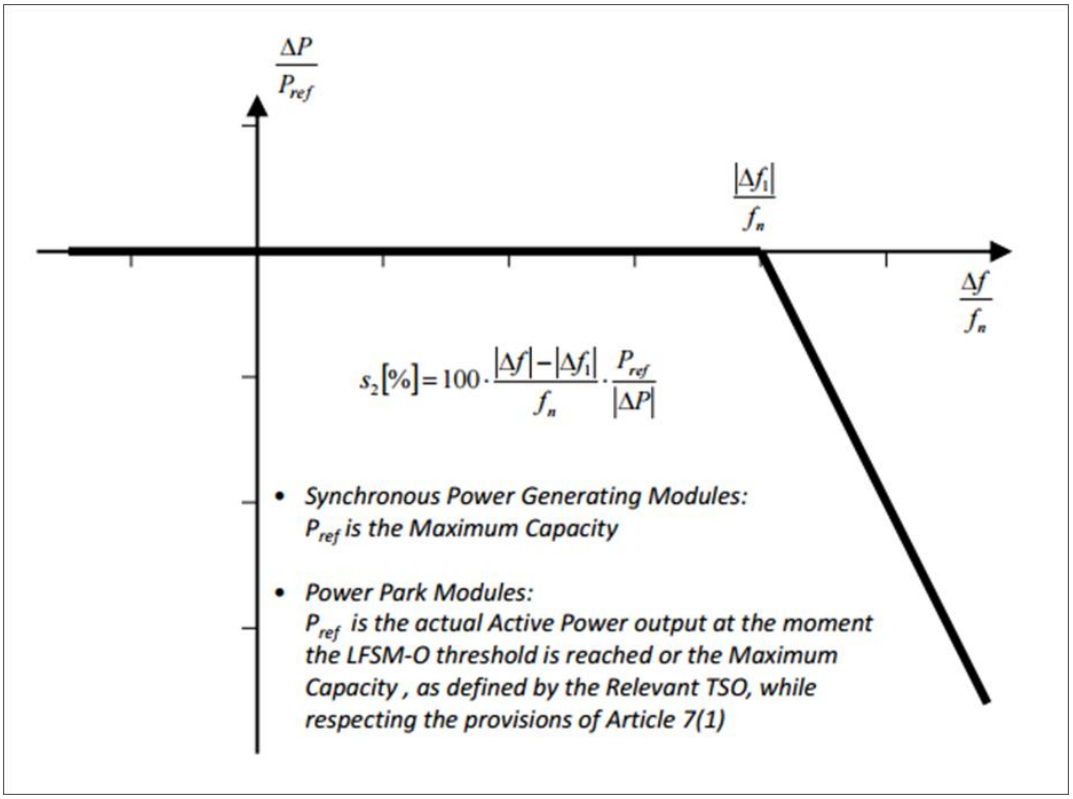

Figure 1: Frequency-dependent active power control of power generating modules under over frequency (figure from European Commission: "Network code on requirements for grid connection of generators").

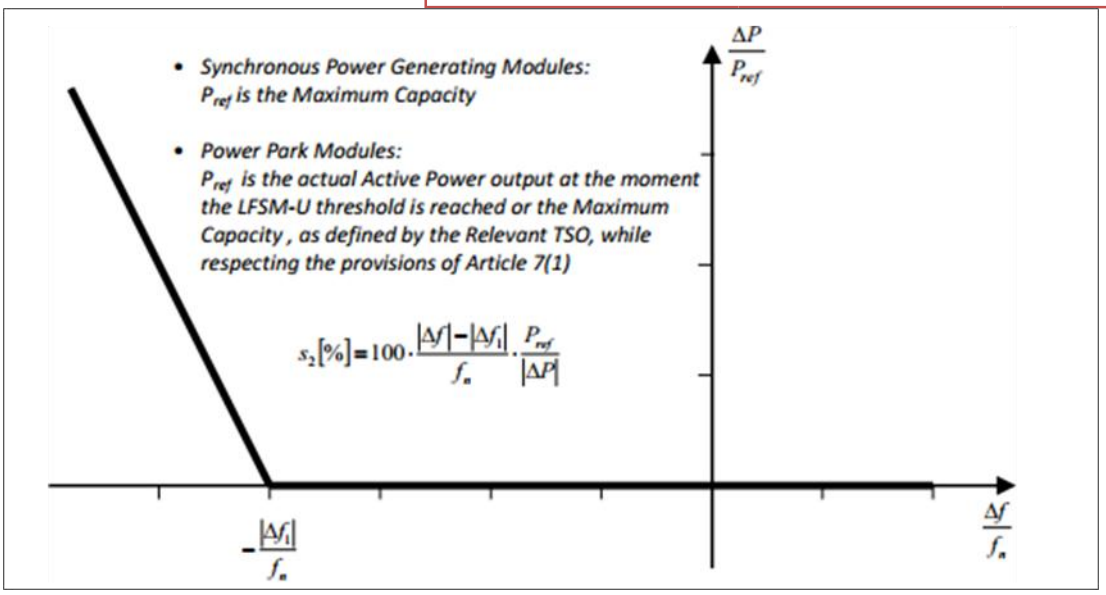

Figure 2: Frequency-dependent active power control of power generating modules under underfrequency (figure from European Commission: "Network code on requirements for grid connection of generators").

c) The activation of frequency-dependent active power control by the power generating module under underfrequency shall not be unduly delayed. If such a delay exceeds 2 seconds, the owner of the power-generating module shall provide explanations to Landsnet justifying the delay.

d) Under frequency-dependent active power control during underfrequency, the power generating module shall be capable of increasing active power output up to maximum capacity.

e) Stable operation of the power-generating system shall be ensured.

4.4 The power generating module shall be capable of maintaining constant output at its target active power values regardless of changes in frequency except where output follows the changes specified in the context of Articles 4.2, 4.5 or Articles 4.3 and 4.7 c).

4.5 Landsnet may permit active power output to reduce with frequency from maximum output, within the limits shown in Figure 3. This applies to power generating modules that, for technical reasons, cannot deliver full output under underfrequency conditions.

a) 49 Hz: Falling by a reduction rate of 2 % of the maximum capacity per 1 Hz frequency drop

b) 49.5 Hz: Falling by a reduction rate of 10 % of the maximum capacity per 1 Hz frequency drop

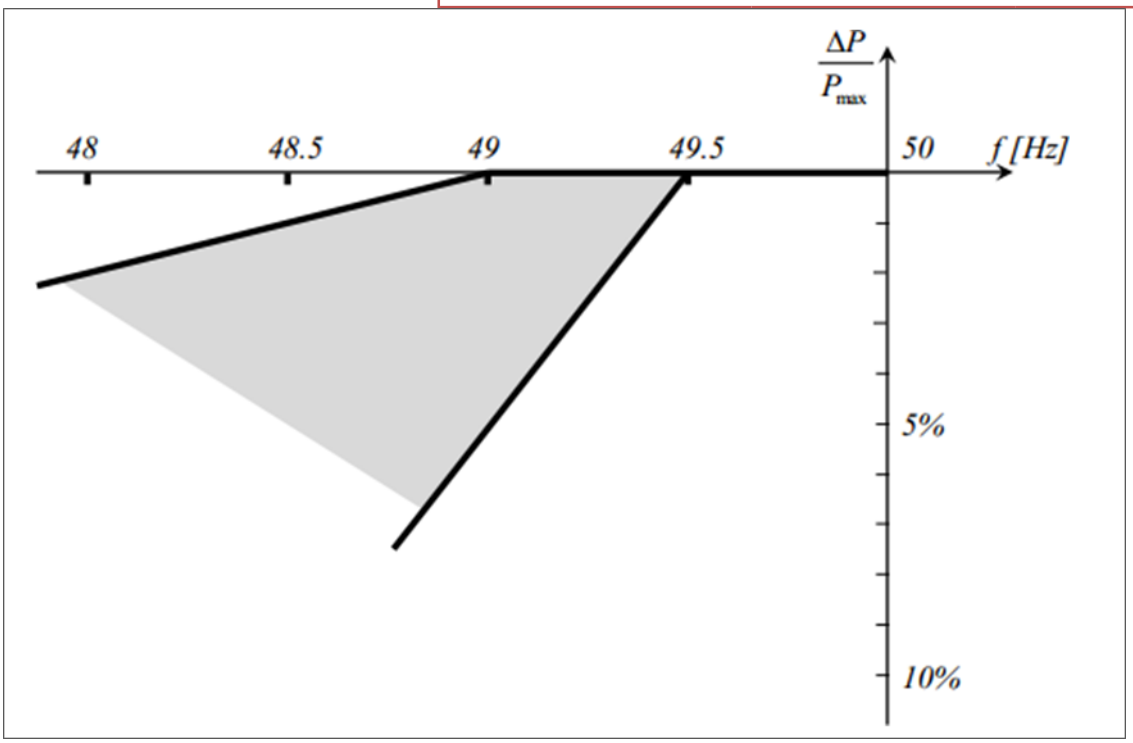

Figure 3. Reduction of maximum power capability with decreasing frequency (figure from European Commission: "Network code on requirements for grid connection of generators").

4.6 The admissible active power reduction from maximum output shall:

a) Specify the ambient conditions applicable

b) Consider the technical capabilities of the power-generating module

4.7 A type D power generating module shall fulfil the following requirements regarding frequency stability:

a) The power generating module's control system shall be capable of receiving an active power setpoint from the power plant control system, the plant area control system, or another control centre. The control system's response to changes in an external active power setpoint shall be without time delay. The setpoint tolerance shall be less than 0.5%.

b) Manual local control shall be allowed in cases where the automatic remote-control devices are out of service

c) When frequency sensitive mode (FSM) is active, the following shall apply cumulatively in addition to what is stated in Article 4.3:

(i) The power-generating module shall be capable of providing active power frequency response in accordance with the parameters specified in Table 1 and after consulting with Landsnet.

(ii) The frequency response deadband and droop shall be adjustable.

(iii) In the event of a frequency step-change, the power-generating module shall be capable of activating full active-power frequency response, at or above the line

shown in Figure 4, in accordance with the parameters specified in Table 2 in cooperation with Landsnet.

Table 1 Parameters for active power frequency response.

Parameters		Ranges
Active power range related to maximum capacity	$\frac{\lvert\Delta P_1\rvert}{P_{max}}$	1.5-10%
Frequency response insensitivity	$\lvert\Delta f_i\rvert$	10-30 mHz
	$\frac{\lvert\Delta f_i\rvert}{f_n}$	0.02-0,06%
Frequency response deadband		0-500m Hz
Droops		2-12%

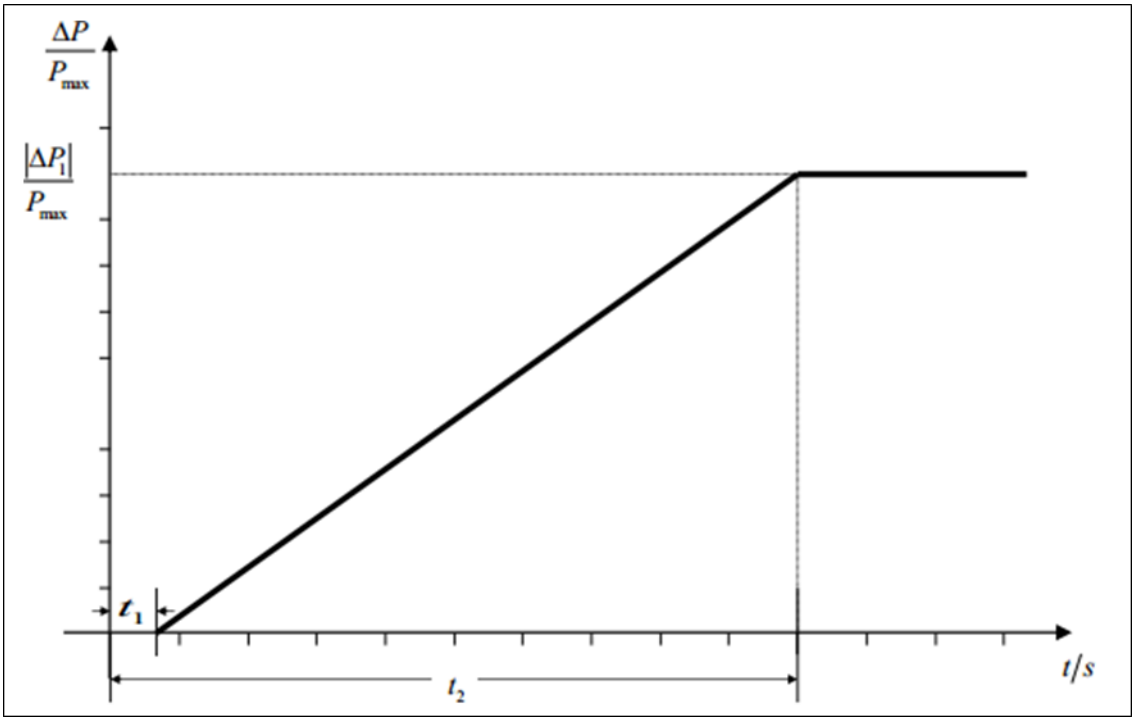

Figure 4 Limits on capability for active power frequency response (figure from European Commission: "Network code on requirements for grid connection of generators").

(iv) The initial activation of the active-power frequency response shall be rapid. If the delay in initial activation of active-power frequency response is greater than one second, the power-generating facility owner shall provide technical evidence demonstrating why a longer time is needed. Landsnet may specify a shorter time than one second for power-generating modules without inertia.

If the power-generating facility owner cannot meet this requirement, they shall provide technical evidence demonstrating why a longer time is needed.

(v) The power-generating module shall be capable of providing full active-power frequency response for 30 minutes

(vi) Within the time limits laid down in Article 4.7 c) (v), active power control must not have any adverse impact on the active-power frequency response of the power-generating module.

d) Regarding real-time monitoring of frequency-sensitive mode (FSM), the following shall apply:

(i) The communication interface shall be capable of, at least, transmitting following signals to Landsnet's control centre:

- Status signal of FSM (on/off)
- Scheduled active power output
- Actual value of the active power output
- Actual parameter settings for active-power frequency response
- Droop and deadband

(ii) Landsnet may define additional signals that the power generating operator shall provide to enable monitoring of the operation of power generating modules and verification of the performance of active power frequency response.

Table 2 Parameters for full activation of active power frequency response resulting from frequency step change

Parameters		Ranges or values
Active power range related to maximum capacity (frequency response range)	$\frac{\lvert\Delta P_1\rvert}{P_{max}}$	1.5-10%
For power-generating modules with inertia, the maximum admissible initial delay t 1, unless justified otherwise		1 second
For power-generating modules without inertia, the maximum admissible initial delay t 1, unless justified otherwise in line with Article 4.7 c) (iv)		LN can specify parameters less than 1 sec
Maximum admissible choice of full activation time t 2		30 seconds

4.8 Type D power-generating modules shall fulfil the following requirements relating to voltage stability:

a) Voltage ranges:

(i) In accordance with Article 4.9, the power generating module shall be capable of staying connected to the network and operating within the ranges of the network

voltage (pu voltage) at the connection point, and for the period specified below:

- 0.90 pu-1.05 pu for an unlimited period
- 1.05 pu-1.10 pu for a period of 60 minutes

(ii) If there is simultaneous overvoltage and underfrequency, or undervoltage and overfrequency, Landsnet may determine a shorter period during which the power generating module must remain connected to the transmission system.

b) Landsnet and the owner of the power generating module may agree on a wider voltage range or a longer period. If such an arrangement is considered beneficial and technically feasible, the owner of the power-generating module shall not oppose such an agreement.

c) In accordance with item a), Landsnet has the right to define the voltage at the connection point at which the power generating module shall be capable of automatic disconnection from the transmission system. Landsnet and the owner of the power-generating module shall agree on the conditions and criteria for automatic disconnection.

4.9 The power generating module shall be reliable and fulfil the following:

a) Withstand faults in the power system in accordance with the following:

(i) In the event of a fault, the power generating module shall remain connected to the power system and operate stably if the voltage at the connection point, as a function of time, is above the limits shown in Figure 5.

(ii) The voltage curve shows the lower voltage limits between phases at the connection point during and after a symmetrical fault in the transmission system.

(iii) The power generating module shall be capable of remaining connected to the transmission system and continuing operation during a symmetrical fault if the phase-to-phase voltage at the connection point is above the limits shown in Figure 5, unless the module's internal protection equipment requires disconnection from the system due to an internal fault. However, the protection equipment shall not prevent the module from withstanding the abovementioned faults.

(iv) Without prejudice to Article 4.9 (iii), undervoltage protection shall be set to the broadest possible technical capability of the power-generating module, unless Landsnet requires narrower settings in accordance with Article 4.10. The power-generating facility owner shall justify the settings in accordance with this condition.

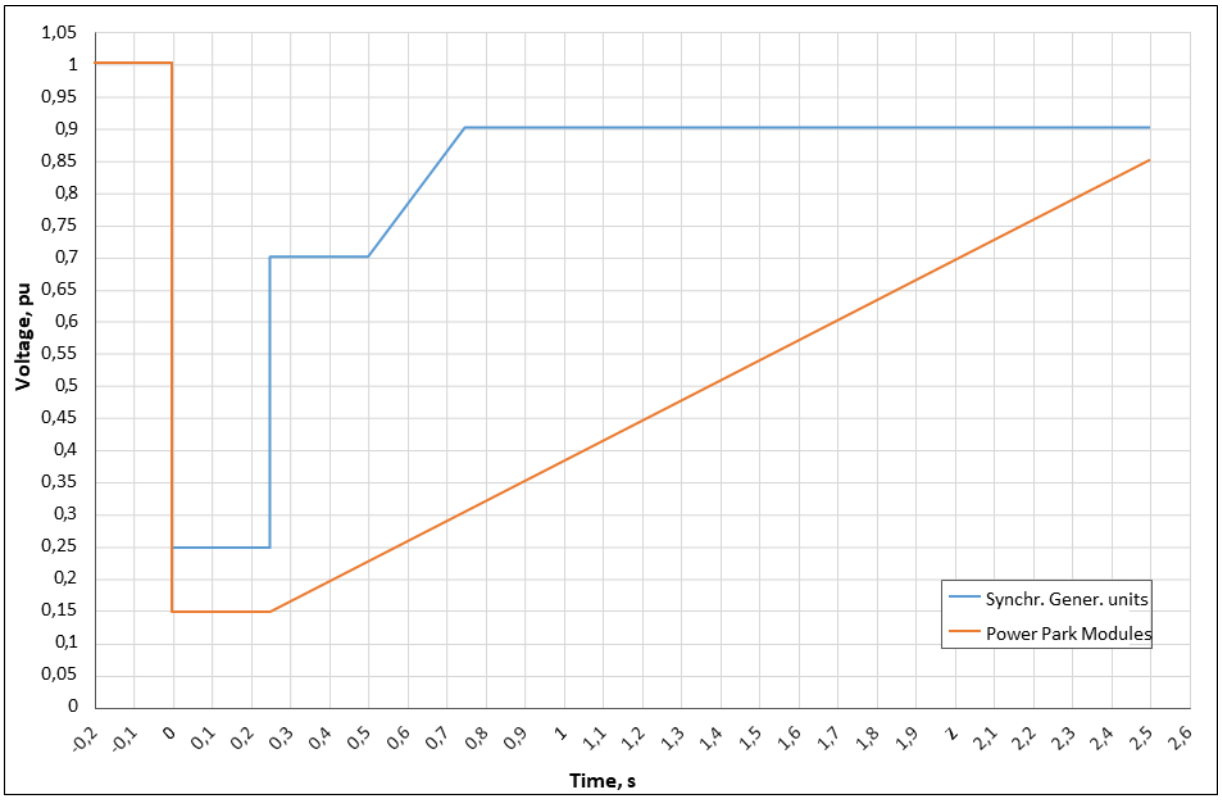

Figure 5. Fault-ride-through profile of a power-generating module. Landsnet's requirements.

Type D power generating modules shall be capable of the following:

b) In the event of power oscillations, power-generating modules shall retain steady-state stability when operating at any operating point of the P-Q-capability diagram

c) Without prejudice to Articles 4.5 and 4.6, power-generating modules shall be capable of remaining connected to the network and operating without power reduction, as long as voltage and frequency remain within the specified limits pursuant to this Grid Code.

d) Power-generating modules shall be capable of remaining connected to the network during single-phase or three-phase auto-reclosures on meshed network lines. The details of that capability shall be subject to coordination and agreements on protection schemes and settings as referred to in Article 4.10 b)

4.10 Power-generating modules shall fulfil the following general system management requirements:

a) Control of power-generating modules and parameter values:

(i) The schemes and settings of the different control devices of the power-generating modules necessary for transmission system stability and for taking emergency action shall be coordinated and agreed between Landsnet and the power-generating facility owner

(ii) Any changes to the schemes and settings mentioned in point 4.10 a (i) shall be agreed upon with Landsnet

b) Protection equipment:

(i) Landsnet's transmission system is directly grounded, and its protection system is designed on that basis. Therefore, all customer equipment connected to the transmission system must have a grounded neutral point on the side interfacing with Landsnet's system.

(ii) Landsnet shall specify the schemes and settings necessary to protect the network, considering the characteristics of the power-generating module. The protection schemes needed for the power-generating module and the network, as well as the settings relevant to the power-generating module, shall be coordinated and agreed between Landsnet and the power-generating facility owner

(iii) The protection equipment of the power-generating module shall take precedence over operational controls, considering the security of the system and health and safety requirements, as well as mitigating any damage to the power-generating module

(iv) Any changes to the protection schemes and settings mentioned in point (ii) shall be approved by Landsnet

c) Protection systems- power generating modules:

(i) The generating module shall disconnect the relevant unit from the transmission system in the event of a fault to limit any effect on the transmission system

(ii) The unit shall be disconnected from the transmission system within 100 msec in the event of a short circuit in the power generating module

(iii) The power generating module's contribution to the short-circuit current shall be disconnected as fast as possible, within 400 ms

d) The power-generating facility owner shall organise its protection and control devices in accordance with the following priority ranking (from highest to lowest):

(i) Network and power-generating module protection

(ii) Synthetic inertia, if applicable

(iii) Frequency control

(iv) Power restriction

(v) Power gradient constraint

e) Information:

(i) Power-generating facilities shall be capable of exchanging information with Landsnet in real time and as specified by the standards used by Landsnet at any given time

(ii) Landsnet shall specify the content of information exchanges (Landsnet's signal list)

4.11 Power generating modules shall fulfil the following requirements relating to

system restoration:

a) Black start capability:

(i) A power-generating module shall be capable of starting from shutdown without any external electrical energy supply within a time frame specified by Landsnet

(ii) A power-generating module with black start capability shall be able to synchronise within the frequency limits laid down in Article 4.1 (a) and, where applicable, voltage limits specified in Article 5.2

(iii) A power-generating module with black start capability shall be capable of automatically regulating dips in voltage caused by connection of demand

(iv) A power-generating module with black start capability shall:

- Be capable of regulating load connections in block load
- Control frequency in case of over frequency and under frequency within the whole active power output range between the minimum regulating level and the maximum capacity, as well as at the house load level
- Be capable of parallel operation of a few power-generating modules within one island
- Control voltage automatically during the system restoration phase

b) Capability to take part in island operation:

(i) The power-generating module shall be capable of participating in island operation upon request from Landsnet.

- The frequency limits for island operation shall be in accordance with Article 4.1 a)
- The voltage limits for island operation shall be in accordance with Article 4.9 and 5.2, where applicable

(ii) Power-generating modules shall be able to operate in FSM during island operation, as specified in Article 4.7 c)

In the event of a power surplus, power-generating modules shall be capable of reducing the active power output to any new operating point within the P-Q-capability diagram. The power-generating module shall be capable of reducing active power output as much as inherently technically feasible, but to at least 55 % of its maximum capacity

(iii) The method for detecting a change from interconnected system operation to island operation shall be agreed upon between the power-generating facility owner and Landsnet. The agreed method of detection must not rely solely on the system operator's switchgear position signals

c) Synchronisation capability:

(i) When a power generating module is started, it shall not be synchronised with the transmission system unless Landsnet has granted prior authorisation.

(ii) The power-generating module shall be equipped with the necessary synchronisation facilities

(iii) Synchronisation of power-generating modules shall be possible at frequencies within the ranges set out in Article 4.1

(iv) Landsnet and the owner of the power generating module shall agree on the settings of the synchronisation equipment before the module is commissioned. The agreement shall cover:
- Voltage
- Frequency
- Phase angle range
- Phase sequence
- Deviation of voltage and frequency

(v) If the power-generating module is disconnected from the transmission system, it can be resynchronised quickly with the grid in accordance with the system protection strategy agreed upon between Landsnet and the operator in the event of a disturbance.

(vi) A power-generating module with a minimum re-synchronisation time greater than 15 minutes after disconnection from any external power supply must be designed to trip to the house load from any operating point in its P-Q-capability diagram. In this case, the identification of house load operation must not be based solely on Landsnet's switchgear position signals

(vii) Power-generating modules shall be capable of continuing operation following tripping to the house load, irrespective of any auxiliary connection to the external network. Landsnet shall specify the minimum operation time, taking into consideration the specific characteristics of prime mover technology.

4.12 Type D power-generating modules shall fulfil the following general system management requirements:

a) If the power generating module falls out of synchronism with the power system or becomes uncontrollable, it shall be capable of automatically disconnecting from the transmission system. The module shall disconnect from the transmission system within 200 ms.

b) Instrumentation:

(i) Power-generating facilities shall be equipped with a facility to provide fault recording and monitoring of dynamic system behaviour. This facility shall record the following parameters:

- Voltage
- Active power
- Reactive power
- Frequency

Landsnet has the right to specify quality parameters to be complied with.

(ii) The settings of the fault recording equipment, including triggering criteria and the sampling rates shall be agreed between the power-generating facility owner and Landsnet.

(iv) The facilities for quality of supply and dynamic system behaviour monitoring shall include arrangements for the power-generating facility owner and Landsnet to access the information. The communications protocols for recorded data shall be

agreed upon between the power-generating facility owner and Landsnet

c) Simulation models:

(i) At the request of Landsnet, the power-generating facility owner shall provide simulation models which adequately reflect the behaviour of the power-generating module in both steady-state and dynamic simulations (50 Hz component) or in electromagnetic transient simulations.
The power-generating facility owner shall ensure that the models provided have been verified against the results of compliance tests and shall notify Landsnet of the results.

(ii) The models provided by the power-generating facility owner shall contain the following sub-models, depending on the existence of the individual components:

- Alternator and prime mover
- Speed and power control
- Voltage control, including, if applicable, power system stabiliser ('PSS') function and excitation control system
- Power-generating module protection models, as agreed between Landsnet and the power-generating facility owner
- Converter models for power park modules

(iii) The request by Landsnet referred to in point (i) shall include the following:

- The format in which models are to be provided
- The provision of documentation on a model's structure and block diagrams
- An estimate of the minimum and maximum short circuit capacity at the connection point, expressed in MVA, as an equivalent of the network

d) At the request of Landsnet, the owner of the generating unit shall provide records from the generating unit to enable a comparison between the simulation results and actual operation.

e) If Landsnet considers it necessary to install equipment for the system's operation and security, it will review this with the owner of the generating unit to reach a joint conclusion.

f) Landsnet shall specify minimum and maximum limits on rates of change of active power output (ramping limits), taking into consideration the specific characteristics of prime mover technology

g) Earthing arrangement of the neutral-point at the network side of step-up transformers shall comply with the specifications set out by Landsnet

5. Requirements for synchronous power generating modules

5.1 Synchronous power generating modules shall fulfil the requirements set out in Chapter 4

5.2 Synchronous power-generating modules shall fulfil the following additional requirements relating to voltage stability:

a) Reactive power capability: Landsnet shall have the right to specify the capability of a synchronous power-generating module to provide reactive power.

b) Voltage control system: A synchronous power-generating module shall be equipped with a permanent automatic excitation control system that can provide constant alternator terminal voltage at a selectable setpoint without instability over the entire operating range of the synchronous power-generating module

Type D synchronous power generating module shall fulfil the following additional requirements concerning voltage stability:

c) Landsnet may specify supplementary reactive power to be provided if the connection point of a synchronous power-generating module is neither located at the high-voltage terminals of the step-up transformer to the voltage level of the connection point nor at the alternator terminals, if no step-up transformer exists.

d) The power generating module shall be capable of providing reactive power at its maximum capacity within the boundaries described in Figure 6.

(i) The synchronous power-generating module shall be capable of moving to any operating point within its U-Q/P_{max} profile in appropriate timescales to target values requested by Landsnet

e) If a generating unit is operating at a production level lower than maximum output, it shall be capable of operating at all points on the generator's P-Q diagram, at least down to the minimum level required for stable operation. Despite limited active power production, the reactive power production at the connection point shall fully comply with the generator's P-Q capability curve, considering losses in the transformer.

f) The power-generating facility owner and Landsnet shall agree on the parameters and settings of the voltage control system components.

g) The generating unit shall be equipped with automatic voltage regulation (AVR). The agreement referred to in subparagraph (a) shall cover the specifications and performance of an automatic voltage regulator (AVR') regarding steady-state voltage and transient voltage control and the specifications and performance of the excitation control system. The latter shall include:

(i) Bandwidth limitation of the output signal to ensure that the highest frequency of response cannot excite torsional oscillations on other power-generating modules connected to the network

(ii) An underexcitation limiter to prevent the AVR from reducing the alternator excitation to a level which would endanger synchronous stability

(iii) An overexcitation limiter to ensure that the alternator excitation is not limited to less than the maximum value that can be achieved, whilst ensuring that the synchronous power-generating module is operating within its design limits

(iv) A stator current limiter

(v) A PSS function to attenuate power oscillations, if the synchronous power-generating module size is above a value of maximum capacity specified by the relevant TSO

5.3 Landsnet and the power-generating facility owner shall enter into an agreement regarding the power-generating module's technical capabilities to aid angular stability under fault conditions.

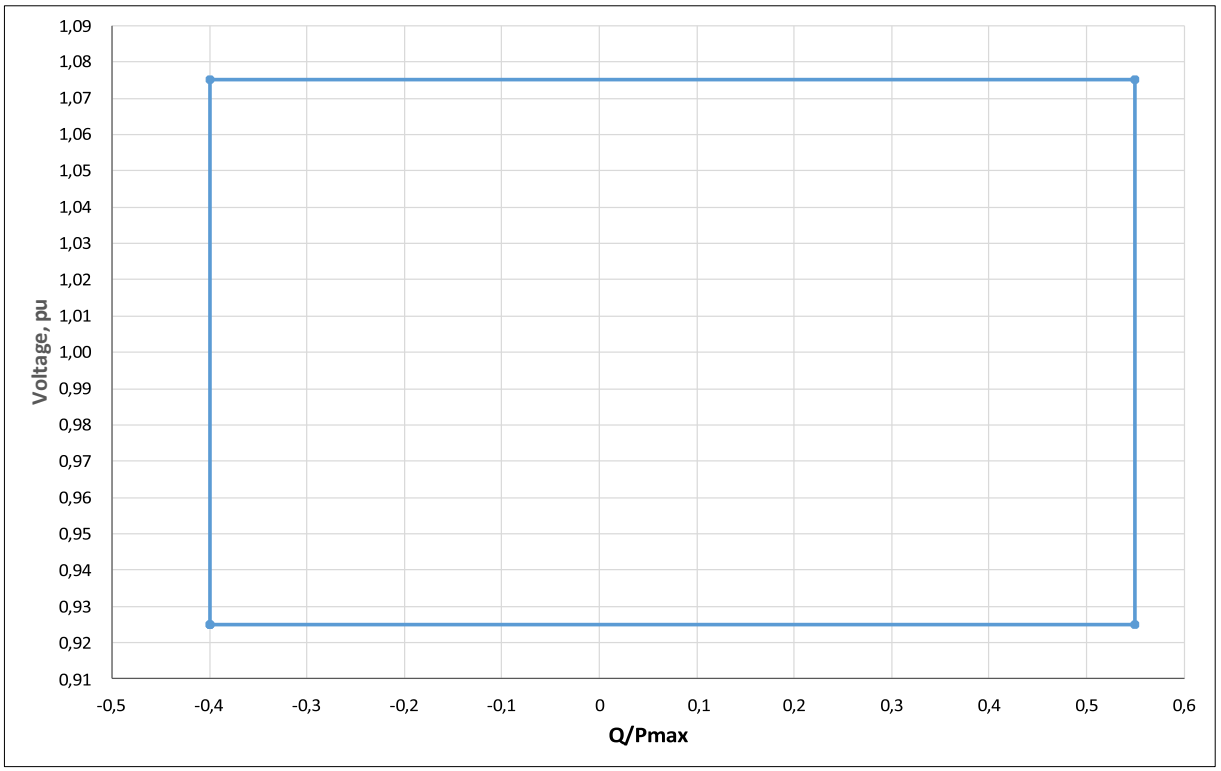

Figure 6. U-Q/Pmax-profile of a synchronous power-generating module. Power-generating modules shall be capable of operating within the envelope.

6. Requirements for power park modules

6.1 Power park modules shall fulfil the requirements laid down in Chapter 4.

6.2 Power park modules shall fulfil the following additional requirements in relation to voltage stability:

a) Landsnet shall have the right to specify that power park modules be capable of providing synthetic inertia during very fast frequency deviations

b) Landsnet specifies the operating principle of control systems installed to provide synthetic inertia and the associated performance parameters

6.3 Power park modules shall fulfil the following additional requirements in relation to voltage stability:

a) Landsnet shall have the right to specify that a power park module be capable of providing fast fault current at the connection point in case of symmetrical (3-phase) faults, under the following conditions:

(i) The power park module shall be capable of activating the supply of fast fault current either by:

- Ensuring the supply of the fast fault current at the connection point, or
- Measuring voltage deviations at the terminals of the individual units of the power park module and providing a fast fault current at the terminals of these units

(ii) Landsnet shall specify the following:

- How and when a voltage deviation is to be determined, as well as the end of the voltage deviation
- The characteristics of the fast fault current, including the time domain for measuring the voltage deviation and fast fault current

b) Regarding the supply of fast fault current in case of asymmetrical (1-phase or 2-phase) faults, Landsnet shall have the right to specify a requirement for asymmetrical current injection.

Type D power park modules shall also fulfil the following requirements:

c) Landsnet may specify supplementary reactive power to be provided if the connection point of a synchronous power-generating module is neither located at the high-voltage terminals of the step-up transformer to the voltage level of the connection point nor at the alternator terminals, if no step-up transformer exists.

d) Regarding reactive power capability:

(i) The power park module shall be capable of providing reactive power at its maximum capacity within the boundaries described in Figure 7. If a power park module connects to the transmission system in a substation where a hydro power station is also connected, and the hydro power station is at least twice as large as the power park module, then Landsnet can reject this requirement. This will only be allowed if there are no foreseen long-term voltage problems in the area. A power park module shall be capable of providing reactive power with a power coefficient between 0.9 and 1.0, lagging or leading, at rated power, at all times.

(ii) The power park module shall be capable of operating within the defined boundaries, according to Figure 7, with all power park module units available. If some units are unavailable due to maintenance or faults, the reactive power capability can be less, accordingly.

(iii) The power park module shall be capable of moving to any operating point within its P-Q/Pmax profile in appropriate timescales to target values requested by Landsnet.

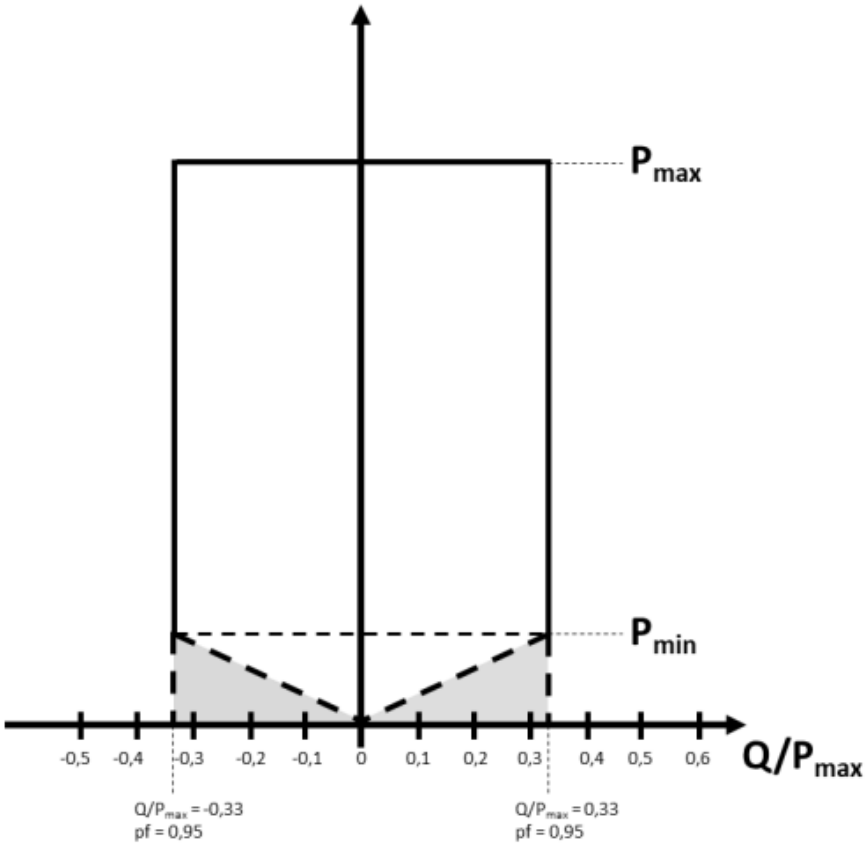

Figure 7. P-Q/Pmax-profile of a power park module. Power park modules shall be capable of operating within the rectangle shown in the figure.

e) Regarding reactive power control modes:

(i) The power park module shall be capable of automatically providing reactive power through either voltage control mode, reactive power control mode, or power factor control mode in cooperation with Landsnet.

(ii) For the purposes of voltage control mode, the power park module shall be capable of contributing to voltage control at the connection point by provision of reactive power exchange with the network with a setpoint voltage covering 0,95 to 1,05 pu in steps no greater than 0,01 pu, with a slope having a range of at least 2 to 7 % in steps no greater than 0.5 %. The reactive power output shall be zero when the grid voltage value at the connection point equals the voltage setpoint

(iii) The setpoint may be operated with or without a deadband, selectable in a range from zero to ± 5% of the nominal voltage in steps no greater than 0.5 %.

(iv) Following a step change in voltage, the power park module shall be capable of achieving 90 % of the change in reactive power output. It must settle at the value specified by the slope within a time limit of 1 sec with a steady-state reactive tolerance no greater than 5 % of the maximum reactive power.

(v) In reactive power control mode, the power park module shall be capable of operating at any point within the operating range specified in Articles 6.3 c) and d), in steps no larger than 5 MVAr or 5% of full reactive power output (whichever value is lower). The control accuracy for reactive power shall be within ±5 MVAr or ±5% of full reactive power output.

(vi) In power factor control mode, the power park module shall be capable of controlling the power factor at the connection point within the reactive power range referred to in Articles 6.3 c) and d), in steps no larger than 0.01. Landsnet shall define the target power factor and the permissible deviation, expressed in % or MVA, within specified time limits in the event of a sudden change in power production.

(vii) Landsnet, in coordination with the power park module owner, shall specify which reactive power control mode options and associated setpoints apply, and what further equipment is needed to make the adjustment of the relevant setpoint operable remotely.

f) Landsnet shall specify whether active power contribution or reactive power contribution has priority during faults for which fault-ride-through capability is required. If priority is given to active power contribution, this provision must be established no later than 150 ms from the inception of the fault.

g) A power park module shall be capable of contributing to damping power oscillations at Landsnet‘s request. The voltage and reactive power control characteristics of power park modules must not adversely affect the damping of power oscillations.

6.4 Type D power park modules shall fulfil the following additional requirements in relation to robustness:

a) Landsnet shall specify the post-fault active power recovery that the power park module can provide and shall specify:

(i) When the post-fault active power recovery begins, based on a voltage criterion

(ii) A maximum allowed time for active power recovery

(iii) A magnitude and accuracy for active power recovery

b) The specifications shall be in accordance with the following principles:

(i) Priority between the requirements for transient fault current pursuant to Articles 6.3 a) and b), and active power restoration.

(ii) Dependence between active power recovery times and duration of voltage deviations

(iii) A specified limit of the maximum allowed time for active power recovery

(iv) Adequacy between the level of voltage recovery and the minimum magnitude for active power recovery

(v) Adequate damping of active power oscillations

7. Confirming power plant specifications

7.1 The preparation and design of a power plant shall consider its impact on the electricity system, both during normal operation and disturbance events. In this context, the dynamic behaviour of the electricity system during operational disturbances shall, among other things, be simulated to assess the power plant's impact. The generation company shall provide Landsnet with an accurate model of the relevant power plant and its connection to the transmission system, in accordance with further specifications from Landsnet.

7.2 Landsnet is authorised to monitor the testing of the generating unit and may also conduct tests at a later stage or request additional data to verify that the requirements of these conditions regarding the characteristics of the generating unit are being met.

8. Liability

8.1 The liability stipulations in the General Terms on Electricity Transmission and System Management (A1) also apply to the technical requirements for production units.

9. Force Majeure

9.1 The stipulations on force majeure in the General Terms on Electricity Transmission and System Management (A1) also apply to the technical requirements for production units.

10. Breach of terms

10.1 A request may be made for the National Energy Authority to take action based on Chapter VII of the Electricity Act in the event of a breach of these conditions.

11. Regulation and remedies

11.1 The National Energy Authority shall regulate companies' operations pursuant to the Electricity Act, No. 65/2003, and their compliance with the conditions applying to these operations according to laws, regulations, and these Terms.

11.2 In the event of a dispute regarding the implementation or interpretation of these conditions, where the National Energy Authority has decision-making authority pursuant to Chapter VII of the Electricity Act, the matter shall be referred to the Authority and, where applicable, to the Electricity Appeals Committee for resolution. If the dispute does not fall within the jurisdiction of the National Energy Authority, the matter may be referred to the District Court of Reykjavik for resolution.

12. References

12.1 A.1 General Terms on Electricity Transmission and System Management.

12.2 Overview of requirements for various power-generating module types.

Reference 12.2

Overview of requirements for various power-generating module types

	Landsnet (Definitions 2.31 & 2.32)		B	D
4.	**General requirements: power-generating modules**			
	4.1		x	x
	4.2		x	x
	4.3			x
	4.4		x	x
	4.5		x	x
	4.6		x	x
	4.7			x
	4.8			x
	4.9	a)	x	x
		b) - d)		x
	4.10		x	x
	4.11		x	x
	4.12			x
5.	**Requirements for synchronous power generating modules**			
	5.1		x	x
	5.2	a) - b)	x	x
		c) - g)		x
	5.3			x
6.	**Requirements for power park modules**			
	6.1		x	x
	6.2		x	x
	6.3	a) - c)	x	x
		d) - h)		x
	6.4			x

Chapters not referred to in the table above cover all power generating modules.