MEMORANDUM

TO Participants Expert Meeting

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FROM Saskia Jaarsma

SUBJECT Abstract RfG for offshore PPM

TER BESLUITVORMING ☐
TER INFORMATIE ■

As discussed during the Expert Meeting of 18 March 2015, this document is provided by TenneT to stakeholders for the sole purpose of information.

It concerns an informal abstract of the provisions from the draft European Network Code Requirements for Generators which are intended to be applicable for offshore power park modules.

ABSTRACT OF NETWORK CODE *REQUIREMENTS FOR GENERATORS*
(Updated draft NC RfG 21.01.2015)
REQUIREMENTS FOR OFFSHORE POWER PARK MODULES

Article 1 (Subject matter)

This Regulation establishes a network code which lays down the requirements for grid connection of power generating facilities, including synchronous power generating modules, power park modules and offshore power park modules, to the interconnected electricity system. It, therefore, helps to ensure fair conditions of competition in the internal electricity market, to ensure system security and the integration of renewable electricity sources, and to facilitate Union-wide trade in electricity.
It also lays down the obligations for ensuring that network operators make appropriate use of the power generating facilities' capabilities in a transparent and non-discriminatory manner to provide a level playing field throughout the Union.

Article 2 (Definitions)

For the purposes of this Regulation, the definitions in Article 2 of Regulation (EC) No 714/2009, Article 2 of Commission Regulation No [000/2014 – CACM], Article 2 of Commission Regulation (EU) No 543/2013 and Article 2 of Directive 2009/72/EC shall apply.
In addition, the following definitions shall apply:

(1) 'synchronous area' means an area covered by interconnected TSOs with a synchronously connected and, therefore, common system frequency in a steady state, such as the synchronous areas of Continental Europe ('CE'), Great Britain ('GB'), Ireland ('IRE') and Northern Europe ('NE') and the power systems of Lithuania, Latvia and Estonia, together referred to as 'Baltic' which are part of a wider synchronous area;

(2) 'voltage' means the difference in electrical potential between two points measured as the root-mean-square value of the positive sequence phase-to-phase voltages at fundamental frequency;

(3) 'apparent power' means the product of voltage and current at fundamental frequency, and the square root of three in the case of three-phase systems, usually expressed in kilovolt-amperes ('kVA') or megavolt-amperes ('MVA');

(4) 'power generating module' means either a synchronous power generating module or a power park module;

(5) 'power generating facility' means a facility that converts primary energy into electrical energy and which consists of one or more power generating modules connected to a network at one or more connection points;

(6) 'power generating facility owner' means a natural or legal entity owning a power generating facility;

(7) 'synchronous power generating module' means an indivisible set of installations which can generate electrical energy such that the frequency of the generated voltage, the generator speed and the network voltage are in a constant ratio and thus in synchronism;

(8) 'significant power generating module' means a power generating module which is deemed significant on the basis of its impact on cross-border system performance via influence on the control area's security of supply;

(9) (...)

(10) 'relevant TSO' means the TSO in whose control area a power generating module, a demand facility, a demand unit, a distribution network or a HVDC system is or will be connected to the network at any voltage level (= ***Transmissiesysteembeheerder op zee***);

(11) 'network' means a plant and apparatus connected together in order to transmit or distribute electricity (= ***Transmissiesysteem op zee***);

(12) 'network operator' means the natural or legal person that operates a network and can be either a transmission system operator, a distribution system operator or closed distribution system operator (= ***Transmissiesysteembeheerder op zee***);

(13) 'connection agreement' means a contract between the relevant network operator and either the power generating facility owner, demand facility owner, distribution system operator or HVDC system owner, which includes the relevant site and specific technical requirements for the power generating facility, demand facility, distribution network, distribution network connection or HVDC system;

(14) 'connection point' means the interface at which the power generating module, demand facility, distribution network or HVDC system is connected to a transmission network, offshore network, distribution network or HVDC system, as identified in the connection agreement;

(15) 'maximum capacity' or 'Pmax' means the maximum continuous active power which a power generating module can feed into the network as defined in the connection agreement or as agreed between the relevant network operator and the power generating facility owner;

(16) 'power park module' or 'PPM' means 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 network, distribution network, closed distribution system or HVDC system;

(17) 'offshore power park module' means a power park module located offshore with an offshore connection point;

(18) (...)

(19) 'active power' means the real component of the apparent power at fundamental frequency, expressed in watts or multiples thereof such as kilowatts ('kW') or megawatts ('MW');

(20) 'pump-storage' means a hydro unit in which water can be raised by means of pumps and stored to be used for the generation of electrical energy;

(21) 'frequency' means the electric frequency of the system expressed in hertz that 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, with only minor differences between different measurement locations. It's nominal value is 50Hz;

(22) 'droop' means the ratio of the steady-state change of frequency, referred to as nominal frequency, to the steady-state change in active power output, referred to as maximum capacity, expressed in percentage terms;

(23) 'minimum regulating level' means the minimum active power, as defined in the connection agreement or as agreed between the relevant network operator and the power generating facility owner, down to which the power generating module can regulate;

(24) 'setpoint' means the target value for any parameter typically used in control schemes;

(25) 'instruction' means any command, within its authority, given by a network operator to a power generating facility owner, demand facility owner, distribution system operator or HVDC system owner in order to perform an action;

(26) ‘active power’ means the real component of the apparent power at fundamental frequency, expressed in watts or multiples thereof such as kilowatts ('kW') or megawatts ('MW');

(27) ‘secured fault’ means a fault which is successfully cleared according to the network operator’s planning criteria;

(28) ‘reactive power’ means the imaginary component of the apparent power at fundamental frequency, usually expressed in kilovar ('kVAr') or megavar ('MVAr');

(29) 'fault-ride-through' means the capability of electrical devices to be able to remain connected to the network and operate through periods of low voltage at the connection point caused by secured faults;

(30) ‘alternator’ means a device that converts mechanical energy into electrical energy by means of a rotating magnetic field;

(31) ‘current’ means the rate at which electric charge flows which is measured by the root-mean-square value of the positive sequence of the phase current at fundamental frequency;

(32) 'stator' means the portion of a rotating machine which includes the stationary magnetic parts with their associated windings;

(33) ‘inertia’ means the property of a rotating rigid body, such as an alternator, such that it maintains its state of uniform rotational motion and angular momentum unless an external torque is applied;

(34) ‘synthetic inertia’ means the facility provided by a power park module or HVDC system to replace the effect of inertia of a synchronous power generating module to a prescribed level of performance;

(35) ‘frequency control’ means the capability of a power generating module or HVDC system to adjust its active power output in response to a measured deviation of system frequency from a setpoint, in order to maintain stable system frequency;

(36) ‘frequency sensitive mode’ or ‘FSM’ means the operating mode of a power generating module or HVDC system 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;

(37) ‘limited frequency sensitive mode – overfrequency’ or ‘LFSM-O’ means a power generating module or HVDC system operating mode which will result in active power output reduction in response to a change in system frequency above a certain value;

(38) ‘limited frequency sensitive mode – underfrequency’ ‘LFSM-U’ means a power generating module or HVDC system operating mode which will result in active power output increase in response to a change in system frequency below a certain value;

(39) ‘frequency response deadband’ means an interval used intentionally to make the frequency control unresponsive;

(40) ‘frequency response insensitivity’ means the inherent feature of the control system defined as the minimum magnitude of the frequency or input signal which results in a change of output power or output signal;

(41) ‘P-Q-capability diagram’ means a diagram describing the reactive power capability of a power generating module in the context of varying active power at the connection point;

(42) ‘steady-state stability’ means the state to which a network or a synchronous power generating module reverts, following a sufficiently minor disturbance;

(43) ‘island operation’ means the independent operation of a whole network or part of a network that is isolated after being disconnected from the interconnected system, having at least one power generating module or HVDC system supplying power to this network and controlling the frequency and voltage;

(44) 'houseload operation' means the operation which ensures that power generating facilities are able to continue to supply their in-house loads in the event of network failures resulting in power generating modules being disconnected from the network and tripped onto their auxiliary supplies;

(45) 'black start capability' means the capability of recovery of a power generating module from a total shutdown through a dedicated auxiliary power source without any electrical energy supply external to the power generating facility;

(46) 'authorised certifier' means an entity that issues equipment certificates and whose accreditation is given by the national affiliate of the European cooperation for Accreditation ('EA'), established in accordance with Regulation (EC) No 765/2008;

(47) 'excitation control system' means a feedback control system that includes the synchronous machine operating in the power system and its excitation system;

(48) 'closed distribution system' means a system which distributes electricity within geographically confined industrial, commercial or shared services and does not, with the possible exception of a small number of households located within the area served by the system and with employment or similar associations with the owner of the system, supply households customers;

(49) 'closed distribution system operator' or 'CDSO' means a natural or legal person operating, ensuring the maintenance of and, if necessary, developing a closed distribution system;

(50) 'U-Q/Pmax-profile' means a profile representing the reactive power capability of a power generating module or HVDC converter station in the context of varying voltage at the connection point;

(51) (...)

(52) (...)

(53) (...)

(54) (...)

(55) 'power system stabiliser' or 'PSS' means an additional functionality of the AVR of a synchronous power generating module whose purpose is to damp power oscillations;

(56) 'fast fault current' means a current injected by a power park module or HVDC system during and after a voltage deviation caused by an electrical fault with the aim of identifying a fault by network protection systems at the initial stage of the fault, supporting system voltage retention at a later stage of the fault and system voltage restoration after fault clearance;

(57) 'power factor' means the ratio of the absolute value of active power to apparent power under periodic conditions;

(58) 'slope' means the ratio of the change in voltage, based on nominal voltage, to a change in reactive power in-feed from zero to maximum reactive power, based on maximum reactive power;

(59) 'offshore grid connection system' means the complete interconnection between an offshore connection point and the onshore system at the onshore grid interconnection point;

(60) 'onshore grid interconnection point' means the point at which the offshore grid connection system is connected to the onshore network of the relevant network operator;

(61) (...)

(62) (...)

(63) (...)

(64) (...)

(65) (...)

(66) (...)

Article 3 (Right to refuse grid connection for new power generating modules)

1. The connection requirements set out in this Regulation shall apply to new power generating modules which are considered significant in accordance with Article 5, unless otherwise provided.

2. The relevant network operator shall refuse to allow the connection of a power generating module which does not comply with the requirements set out in this Regulation and which is not covered by a derogation granted by the national regulatory authority pursuant to Article 56. The relevant network operator shall communicate such refusal, by means of a reasoned statement in writing, to the power generating facility owner and to the national regulatory authority.

Article 4 (Application to existing power generating modules)

1. Existing power generating facilities are not subject to the requirements of this Regulation, except where:

   (a) the power generating facility has been modified to such an extent that its connection agreement must be substantially revised in accordance with the following procedure:

      (i) power generating facility owners who intend to undertake substantial modernisation shall notify their plans to the relevant network operator in advance;

      (ii) if the relevant network operator considers that the extent of the renovation is such that a new connection agreement is required, the network operator shall notify the relevant national regulatory authority or, where applicable, the Member State; and

      (iii) the relevant national regulatory authority or, where applicable, the Member State shall decide if a new connection agreement is required and which elements of this Regulation shall apply, in accordance with paragraph 2 of Article 7; or

   (b) a national regulatory authority or, where applicable, the Member State decides to make an existing power generating module subject to all or some of the requirements of this Regulation, following a proposal from the relevant TSO in accordance with the criteria set out in paragraph 3.

2. For the purposes of this Regulation, a power generating module shall be considered existing if:

   (a) it is already connected to the network on the date of entry into force of this Regulation; or

   (b) the power generating facility owner has concluded a final and binding contract for the purchase of the main plant by [*two year after the entry into force of the Regulation*] and submits a notification to the relevant network operator confirming this circumstance by [*30 months after the entry into force of the Regulation*].

   The confirmation submitted by the power generating facility owner to the relevant network operator shall at least indicate the contract title, its date of signature and date of entry into force, and the specifications of the main plant to be constructed, assembled or purchased.

   The Member State may provide that in specified circumstances the national regulatory authority may determine whether the power generating module is to be considered an existing power generating module or a new power generating module.

3. Following a public consultation and in order to address significant factual changes in circumstances, such as the evolution of system requirements including penetration of renewable energy sources, smart grids, distributed generation or demand response, the relevant TSO may propose to the national regulatory authority concerned, or where applicable, the Member State to extend the applicability of this Regulation to existing power generating modules.

For that purpose a sound and transparent quantitative cost-benefit analysis shall be carried out, in accordance with paragraphs 1 to 5 of Article 35, which shall indicate:

(i) the costs, in regard to existing power generating modules, of requiring compliance with this Regulation;

(ii) the socio-economic benefit resulting from applying the requirements set out in this Regulation; and

(iii) the potential of alternative measures to achieve the required performance.

4. Before undertaking the quantitative cost-benefit analysis referred to in paragraph 3, the relevant TSO shall:

(a) carry out a preliminary qualitative comparison of costs and benefits; and

(b) obtain approval from the national regulatory authority concerned or, where applicable, the Member State.

5. The relevant TSO may assess the application of some or all of the provisions of this Regulation to existing power generating modules every three years.

The relevant TSO shall inform stakeholders before undertaking such assessment. The relevant TSO shall take account of the legitimate expectations of power generating facility owners before assessing the application of this Regulation to existing power generating modules.

Article 5 (Determination of significance)

1. The power generating modules shall comply with the requirements on the basis of the voltage level of their connection point and their maximum capacity according to the categories set out in paragraph 2.

2. Power generating modules within the following categories shall be considered as significant:

(a) connection point below 110 kV and maximum capacity of 0.8 kW or more (type A);

(b) connection point below 110 kV and maximum capacity at or above a threshold proposed by each relevant TSO in accordance with the procedure laid out in paragraph 3 of Article 5 (type B). This threshold shall not be above the limits for type B power generating modules contained in Table 1;

(c) connection point below 110 kV and maximum capacity at or above a threshold defined by each relevant TSO in accordance with Article 5(3) (type C). This threshold shall not be above the limits for type C power generating modules contained in Table 1; or

(d) connection point at 110 kV or above (type D). A power generating module is also of type D if its connection point is below 110 kV and its maximum capacity is at or above a threshold defined in accordance with Article 5(3). This threshold shall not be above the limit for type D power generating modules contained in Table 1.

Synchronous area	**Limit for maximum capacity threshold from which a power generating module is of type B**	**Limit for maximum capacity threshold from which a power generating module is of type C**	**Limit for maximum capacity threshold from which a power generating module is of type D**
Continental Europe	1 MW	50 MW	75 MW

Table 1: Limits for thresholds for type B, C and D power generating modules

3. Proposals for maximum capacity thresholds for types B, C and D generating modules shall be subject to approval in accordance with paragraph 1 of Article 7. In forming proposals the relevant TSO shall coordinate with adjacent TSOs and DSOs and conduct a public consultation. A proposal by the relevant TSO to change the thresholds shall not be made sooner than three years after the previous proposal.

4. Power generation facility owners shall assist this process and provide data as requested by the relevant TSO.

5. If, as a result of modification of the thresholds, a power generating module qualifies under a different type, the procedure laid down in Article 4(3) concerning existing power generating modules shall apply before compliance with the requirements for the new type is required.

[Article 6]

Article 7 (Regulatory aspects)

1. Where in this Regulation reference is made to this paragraph, the specific terms and conditions governing connection and access to networks or their methodologies shall be approved by the responsible national regulatory authorities in accordance with paragraphs (1), (6) and (10) of Article 37 of Directive 2009/72/EC and Article 14 of Regulation (EC) No 714/2009, or, where applicable, established as technical rules by national regulatory authorities or Member States in accordance with Article 5 of Directive 2009/72/EC.

2. When applying the provisions of this Regulation, Member States, national regulatory authorities and network operators shall:

   (a) apply the principles of proportionality and non-discrimination;

   (b) ensure transparency;

   (c) apply the principle of optimisation between the highest overall efficiency and lowest total costs for all parties involved;

   (d) respect the responsibility assigned to the relevant TSO to ensure system security, including as required by national legislation;

   (e) consult with relevant DSOs and take account of potential impacts on their system;

   (f) take into consideration agreed European standards and technical specifications.

[Article 8]

Article 9 Confidentiality obligations

1. Any confidential information received, exchanged or transmitted pursuant to this Regulation shall be subject to the conditions of professional secrecy laid down in paragraphs 2, 3 and 4.

2. The obligation of professional secrecy shall apply to any person subject to the provisions of this Regulation.

3. Confidential information received by the persons referred to in paragraph 2 in the course of their duties may not be divulged to any other person or authority, without prejudice to cases covered by national law, the other provisions of this Regulation or other relevant Union law.

4. Without prejudice to cases covered by national or Union law, regulatory authorities, bodies or persons who receive confidential information pursuant to this Regulation may use it only for the purpose of carrying out their duties under this Regulation.

Article 10 (General requirements for type A power generating modules)

1. Type A power generating modules [Offshore PPMs] shall fulfil the following requirements relating to frequency stability:

   (a) With regard to frequency ranges:

      (i) a power generating module shall be capable of remaining connected to the network and operate within the frequency ranges and time periods specified in Table 2;

      (ii) in compliance with the provisions of paragraph 2 of Article 7, wider frequency ranges or longer minimum times for operation may be agreed between the relevant network operator, in coordination with the relevant TSO, and the power generating facility owner to ensure the best use of the technical capabilities of a power generating module, if it required to preserve or to restore system security;

      (iii) the power generating facility owner shall not unreasonably withhold consent to apply wider frequency ranges or longer minimum times for operation, taking account of their economic and technical feasibility.

   (b) With regard to the rate of change of frequency withstand capability, a power generating module shall be capable of staying connected to the network and operate at rates of change of frequency up to a value defined by the relevant TSO, according to the provisions of paragraph 2 of Article 7 unless disconnection was triggered by rate-of-change-of-frequency-type loss of mains protection. This rate-of-change-of-frequency-type loss of mains protection will be defined by the relevant network operator in coordination with the relevant TSO and subject to notification to the national regulatory authority. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework.

Synchronous area	**Frequency range**	**Time period for operation**
Continental Europe	47.5 Hz – 48.5 Hz	To be defined by each TSO in accordance with Article 7(1), but not less than 30 minutes
	48.5 Hz – 49.0 Hz	To be defined by each TSO with due regard to the provisions of Article 7(1), but not less than the period for 47.5 Hz – 48.5 Hz
	49.0 Hz – 51.0 Hz	Unlimited
	51.0 Hz – 51.5 Hz	30 minutes

Table 2: Minimum time periods for which a power generating module has to be capable of operating on different frequencies, deviating from a nominal value, without disconnecting from the network.

2. With regard to the limited frequency sensitive mode — overfrequency (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 at a frequency threshold and droop settings determined by the relevant TSO, in consultation with the TSOs of the same synchronous area, and taking into account the potential for compliance on an aggregate level. Where compliance is to be met on an aggregate level, those requirements should be submitted for approval in accordance with paragraph 1 of Article 7.. The modalities of that approval shall be determined in accordance with the applicable national regulatory framework;

(b) the frequency threshold shall be between 50.2 Hz and 50.5 Hz inclusive;

(c) the droop settings shall be between 2 % and 12 %;

(d) the power generating module shall be capable of activating a power frequency response with an initial delay that is as short as possible. If that delay is greater than two seconds, the power generating facility owner shall justify the delay, providing technical evidence to the relevant TSO;

(e) in compliance with the provisions of paragraph 1 of Article 7, the relevant TSO may require that upon reaching minimum regulating level, the power generating module be capable of either:

(i) continuing operation; or

(ii) further decreasing active power output;

(f) the power generating module shall be capable of operating stably during LFSM-O operation. When LFSM-O is active, the LFSM-O setpoint will prevail over any other active power setpoints.

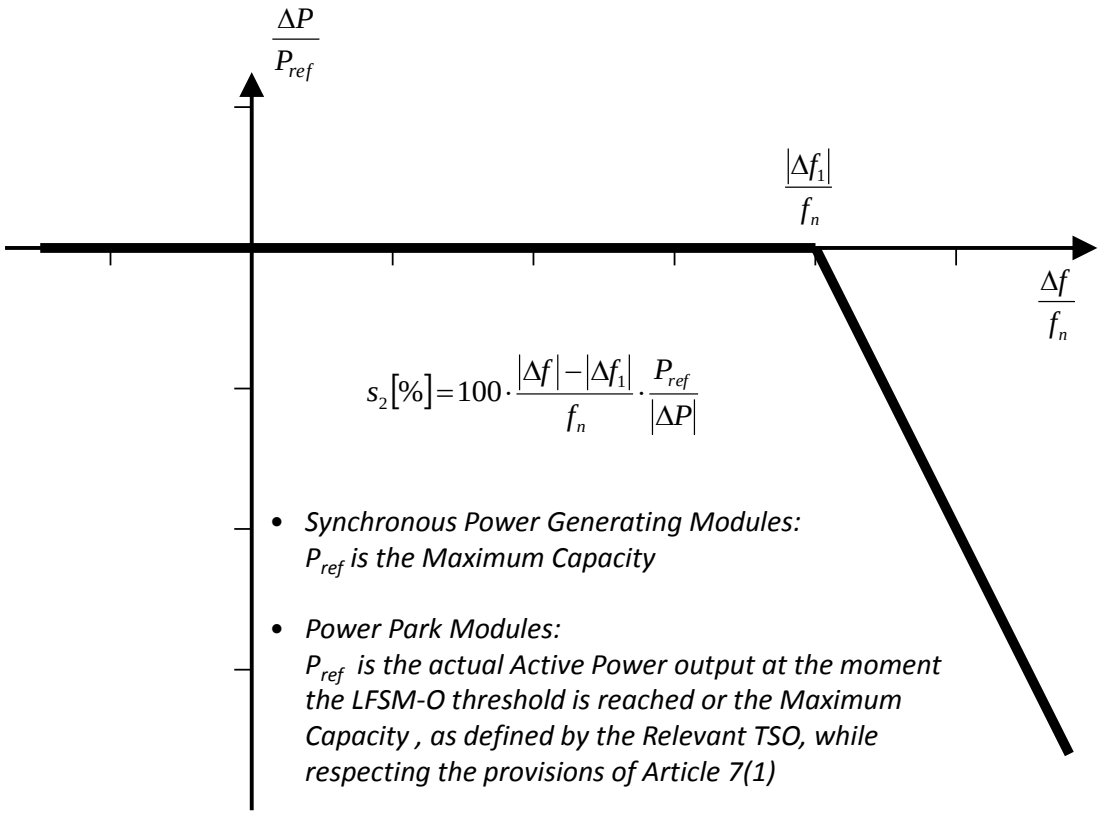

Figure 1: active power frequency response capability of power generating modules in LFSM-O. P_{ref} is the reference active power to which ΔP is related and may be defined differently for synchronous power generating modules and power park modules. ΔP is the change in active power output from the power generating module. f_n is the nominal frequency (50 Hz) in the network and Δf is the frequency change in the network. At overfrequencies where Δf is above Δf_1, the power generating module has to provide a negative active power output change according to the droop S_2.

3. The power generating module shall be capable of maintaining constant output at its target active power value regardless of changes in frequency, except where output follows the changes defined in the context of paragraphs 2 and 4 of Article 10 or points (c) and (d) of Article 12(2) as applicable.

4. The relevant TSO shall define admissible active power reduction from maximum output with falling frequency in their control area as a rate of reduction falling within the boundaries, illustrated by the full lines in Figure 2:

   (a) below 49 Hz falling by a reduction rate of 2% of the maximum capacity at 50 Hz per 1 Hz frequency drop;

   (b) below 49.5 Hz falling by a reduction rate of 10% of the maximum capacity at 50 Hz per 1 Hz frequency drop.

5. The admissible active power reduction from maximum output shall:

   (a) clearly define the ambient conditions applicable;

   (b) take account of the technical capabilities of power generating modules; and

   (c) comply with Article paragraph 1 of Article 7.

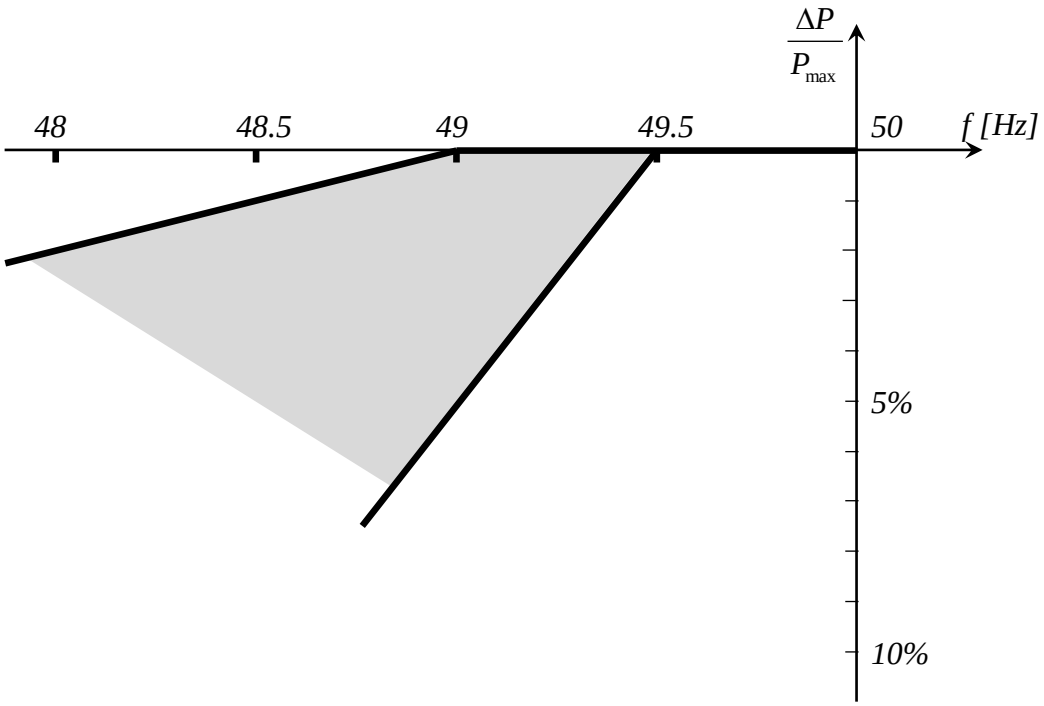

Figure 2: Maximum power capability reduction with falling frequency. The diagram represents the boundaries defined by the relevant TSO while complying with the provisions of paragraph 1 of Article 7.

Article 11 (General requirements for type B power generating modules)

1. (...)

2. (...)

3. Type B power generating modules [Offshore PPMs] shall fulfil the following requirements in relation to robustness:

   (a) with regard to fault-ride-through capability of power generating modules:

(i) in accordance with paragraph 1 of Article 7, each TSO shall define a voltage-against-time-profile in line with Figure 3 at the connection point for fault conditions, which describes the conditions in which the power generating module is capable of staying connected to the network and continuing to operate stably after the power system has been disturbed by secured faults on the transmission network;

(ii) the voltage-against-time-profile shall express a lower limit of the actual course of the phase-to-phase voltages on the network voltage level at the connection point during a symmetrical fault, as a function of time before, during and after the fault;

(iii) the lower limit referred to in point (ii) shall be defined by the relevant TSO in accordance with paragraph 1 of Article 7 using the parameters set out in Figure 3, and within the ranges set out in Tables 3.1 and 3.2;

(iv) each TSO, in accordance with paragraph 1 of Article 7 shall define and make publicly available the pre-fault and post-fault conditions for the fault-ride-through capability in terms of:

- the calculation of the pre-fault minimum short circuit capacity at the connection point;
- pre-fault active and reactive power operating point of the power generating module at the connection point and voltage at the connection point; and
- calculation of the post-fault minimum short circuit capacity at the connection point.

(v) at the request of a power generating facility owner, the relevant network operator shall provide the pre-fault and post-fault conditions to be considered for fault-ride-through capability as an outcome of the calculations at the connection point as defined in point (iv) regarding:

- pre-fault minimum short circuit capacity at each connection point expressed in MVA;
- pre-fault operating point of the power generating module expressed in active power output and reactive power output at the connection point and voltage at the connection point; and
- post-fault minimum short circuit capacity at each connection point expressed in MVA.

Alternatively, the relevant network operator may provide generic values derived from typical cases;

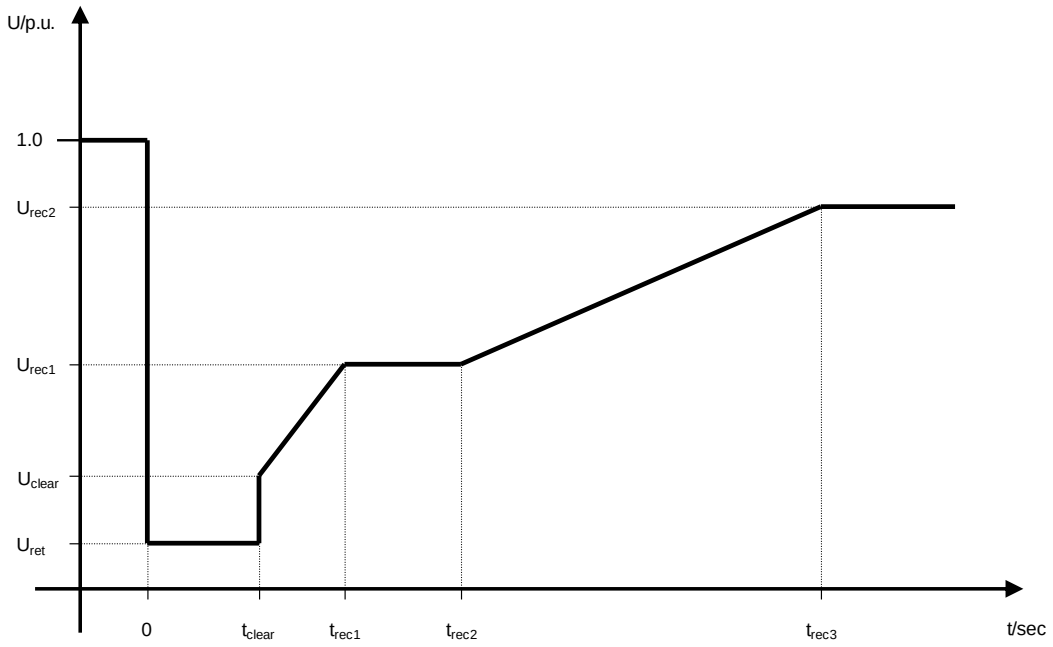

Figure 3: Fault-ride-through profile of a power generating module. The diagram represents the lower limit of a voltage-against-time profile of the voltage at the connection point, expressed as the ratio of its actual value and its nominal value per unit before, during and after a fault. U_{ret} is the retained voltage at the connection point during a fault, t_{clear} is the instant when the fault has been cleared. U_{rec1}, U_{rec2}, t_{rec1}, t_{rec2} and t_{rec3} specify certain points of lower limits of voltage recovery after fault clearance.

Voltage parameters [pu]		**Time parameters [seconds]**	
U_{ret}:	0.05 – 0.3	t_{clear}:	0.14 – 0.15 (or 0.14 - 0.25 if system protection and secure operation so require)
U_{clear}:	0.7 – 0.9	t_{rec1}:	t_{clear}
U_{rec1}:	U_{clear}	t_{rec2}:	t_{rec1} – 0.7
U_{rec2}:	0.85 – 0.9 and ≥ U_{clear}	t_{rec3}:	t_{rec2} – 1.5

Table 3.1: Parameters for Figure 3 for fault-ride-through capability of synchronous power generating modules.

Voltage parameters [pu]		Time parameters [seconds]	
U_{ret}:	0.05 – 0.15	t_{clear}:	0.14 – 0.15 (or 0.14 - 0.25 if system protection and secure operation so require)
U_{clear}:	U_{ret} – 0.15	t_{rec1}:	t_{clear}
U_{rec1}:	U_{clear}	t_{rec2}:	t_{rec1}
U_{rec2}:	0.85	t_{rec3}:	1.5 – 3.0

Table 3.2: Parameters for Figure 3 for fault-ride-through capability of power park modules.

(vi) the power generating module shall be capable of remaining connected to the network and continuing to operate stably when the actual course of the phase-to-phase voltages on the network voltage level at the connection point during a symmetrical fault, given the pre-fault and post-fault conditions in points (iv) and (v) of Article 11(3)(a), remain above the lower limit defined in point (ii) of Article 11(3)(a), unless the protection scheme for internal electrical faults requires the disconnection of the power generating module from the network. The protection schemes and settings for internal electrical faults must not jeopardise fault-ride-through performance;

(vii) without prejudice to point (vi) of Article 11(3)(a), undervoltage protection (either fault-ride-through capability or minimum voltage defined at the connection point voltage) shall be set by the power generating facility owner according to the widest possible technical capability of the power generating module, unless the relevant network operator requires narrower settings in accordance with point (b) of Article 11(5). The settings shall be justified by the power generating facility owner in accordance with this principle;

4. Type B power generating modules [Offshore PPMs] shall fulfil the following requirements relating to system restoration:

(a) the relevant TSO shall define in accordance with paragraph 1 of Article 7 the conditions under which a power generating module is capable of reconnecting to the network after an incidental disconnection caused by a network disturbance; and

(b) installation of automatic reconnection systems shall be subject both to prior authorisation by the relevant network operator and to the reconnection conditions specified by the relevant TSO.

5. Type B power generating modules [Offshore PPMs] shall fulfil the following general system management requirements:

(a) with regard to control schemes and settings:

(i) the schemes and settings of the different control devices of the power generating module that are necessary for transmission system stability and for taking emergency action shall be coordinated and agreed between the relevant TSO, the relevant network operator and the power generating facility owner in accordance with paragraph 2 of Article 7;

(ii) any changes to the schemes and settings, mentioned in point (i), of the different control devices of the power generating module shall be coordinated and agreed

between the relevant TSO, the relevant network operator and the power generating facility owner in accordance with paragraph 2 of Article 7, in particular if they apply in the circumstances referred to in point (i) of Article 11(5) (a);

(b) with regard to electrical protection schemes and settings:

(i) the relevant network operator shall define the schemes and settings necessary to protect the network, taking into account 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 the relevant network operator and the power generating facility owner, in accordance with paragraph 1 of Article 7. The protection schemes and settings for internal electrical faults must not jeopardise the performance of a power generating module, in line with the requirements set out in this Regulation;

(ii) electrical protection of the power generating module shall take precedence over operational controls, taking into account the security of the system and the health and safety of staff and of the public, as well as mitigating any damage to the power generating module;

(iii) protection schemes may cover the following aspects:

– external and internal short circuit;
– asymmetric load (negative phase sequence);
– stator and rotor overload;
– over-/underexcitation;
– over-/undervoltage at the connection point;
– over-/undervoltage at the alternator terminals;
– inter-area oscillations;
– inrush current;
– asynchronous operation (pole slip);
– protection against inadmissible shaft torsions (for example, subsynchronous resonance);
– power generating module line protection;
– unit transformer protection;
– backup against protection and switchgear malfunction;
– overfluxing (U/f);
– inverse power;
– rate of change of frequency; and
– neutral voltage displacement.

(iv) notwithstanding the provisions of paragraph 1 of Article 7, changes to the protection schemes needed for the power generating module and the network and to the settings relevant to the power generating module shall be agreed between the network operator and the power generating facility owner, and be concluded before any changes are made;

(c) 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 (active power adjustment);

(iv) power restriction; and

(v) power gradient constraint.

(d) with regard to information exchange:

(i) power generating facilities shall be capable of exchanging information between the power generating facility owner and the relevant network operator or the relevant TSO in real time or periodically with time stamping, as required by the relevant network operator or the relevant TSO, in accordance with paragraph 1 of Article 7;

(ii) the relevant network operator, in coordination with the relevant TSO, shall define the content of information exchanges and the precise list and time of data to be facilitated, in accordance with paragraph 1 of Article 7.

Article 12 (General requirements for type C power generating modules)

1. (...)

2. Type C power generating modules [Offshore PPMs] shall fulfil the following requirements relating to frequency stability:

(a) with regard to active power controllability and control range, the power generating module control system shall be capable of adjusting an active power setpoint in line with instructions given to the power generating facility owner by the relevant network operator or the relevant TSO.

The relevant network operator or the relevant TSO shall establish the period within which the adjusted active power setpoint must be reached. The relevant TSO shall define a tolerance (subject to the availability of the prime mover resource) applying to the new setpoint and the time within which it must be reached;

(b) manual, local measures shall be allowed in cases where the automatic remote control devices are out of service.

The relevant network operator or the relevant TSO shall notify the national regulatory authority of the time required to reach the setpoint together with the tolerance for the active power. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework;

(c) In addition to paragraph 2 of Article 10, the following requirements shall apply to type C power generating modules with regard to limited frequency sensitive mode – underfrequency (LFSM-U):

(i) the power generating module shall be capable of activating the provision of active power frequency response at a frequency threshold and with a droop determined by the relevant TSO in accordance with paragraph 1 of Article 7 as follows:

– the frequency threshold determined by the TSO shall be between 49.8 Hz and 49.5 Hz inclusive;

– the droop settings determined by the TSO shall be in the range 2 – 12 %.

– This is represented graphically in Figure 4;

(ii) the actual delivery of active power frequency response in LFSM-U mode should take into account:

– ambient conditions when the response is to be triggered;

– the operating conditions of the power generating module, in particular limitations on operation near maximum capacity at low frequencies and the respective impact of ambient conditions according to paragraphs 4 and 5 of Article 10; and

– the availability of the primary energy sources.

(iii) the frequency threshold and droop determined by the TSO shall be notified to the national regulatory authority. The precise modalities of that notification shall be determined in accordance with the applicable national regulatory framework;

(iv) the activation of active power frequency response by the power generating module shall not be unduly delayed. In the event of any delay greater than two seconds, the power generating facility owner shall justify it to the relevant TSO;

(v) in LFSM-U mode the power generating module shall be capable of providing a power increase up to its maximum capacity;

(vi) stable operation of the power generating module during LFSM-U operation shall be ensured;

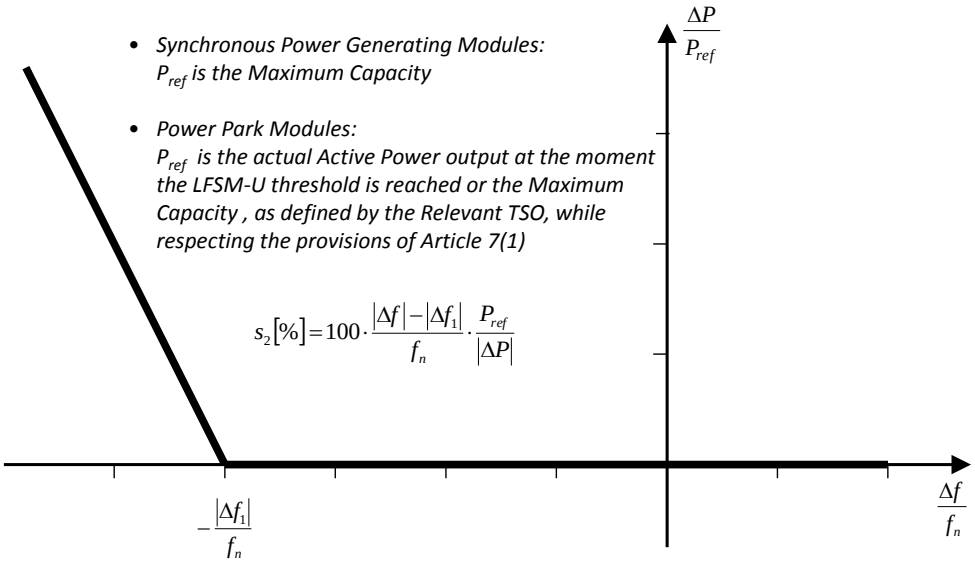

Figure 4: active power frequency response capability of power generating modules in LFSM-U. P_{ref} is the reference active power to which ΔP is related and may be defined differently for synchronous power generating modules and power park modules. ΔP is the change in active power output from the power generating module. f_n is the nominal frequency (50 Hz) in the network and Δf is the frequency change in the network. At underfrequencies where Δf is below Δf_1 the power generating module has to provide a positive active power output change according to the droop S_2.

(d) in addition to point (c) of Article 12(2), the following shall apply cumulatively when frequency sensitive mode ('FSM') is operating:

(i) the power generating module shall be capable of providing active power frequency response in accordance with the parameters specified by each TSO within the ranges shown in Table 4. In specifying those parameters, the TSO shall take account of the following facts:

– in case of overfrequency, the active power frequency response is limited by the minimum regulating level;

– in case of underfrequency, the active power frequency response is limited by maximum capacity;

– the actual delivery of active power frequency response depends on the operating and ambient conditions of the power generating module when this response is triggered, in particular limitations on operation near maximum capacity at low frequencies according to paragraphs 4 and 5 of Article 10 and available primary energy sources;

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 – 500 mHz
Droop s_1		2 – 12 %

Table 4: Parameters for active power frequency response in FSM (explanation for Figure 5)

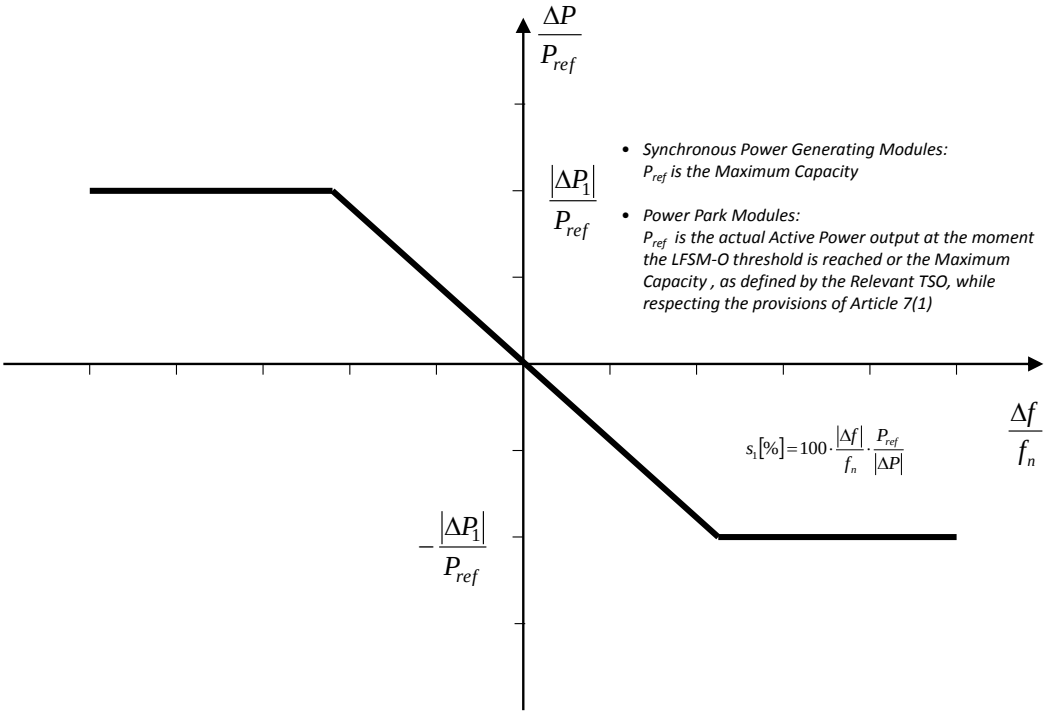

Figure 5: Active power frequency response capability of power generating modules in FSM illustrating the case of zero deadband and insensitivity. P_{ref} is the reference active power to which ΔP is related. ΔP is the change in active power output from the power generating module. f_n is the nominal frequency (50 Hz) in the network and Δf is the frequency deviation in the network.

(ii) the frequency response deadband of frequency deviation and droop must be able to be reselected subsequently;

(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 full line shown in Figure 6 in accordance with the parameters specified by each TSO (which shall aim at avoiding active power oscillations for the power generating module) within the ranges given in Table 5. The combination of choice of the parameters specified by the TSO shall take possible technology-dependent limitations into account;

(iv) The initial activation of active power frequency response required in accordance with this point shall not be unduly delayed.

If the delay in initial activation of active power frequency response is greater than two seconds, the power generating facility owner shall provide technical evidence demonstrating why a longer time is needed.

For power generating modules without inertia, the relevant TSO, in accordance with paragraph 1 of Article 7, may specify a shorter time than two seconds. If the power generating facility owner cannot meet this requirement they shall provide technical evidence demonstrating why a longer time is needed for the initial activation of active power frequency response;

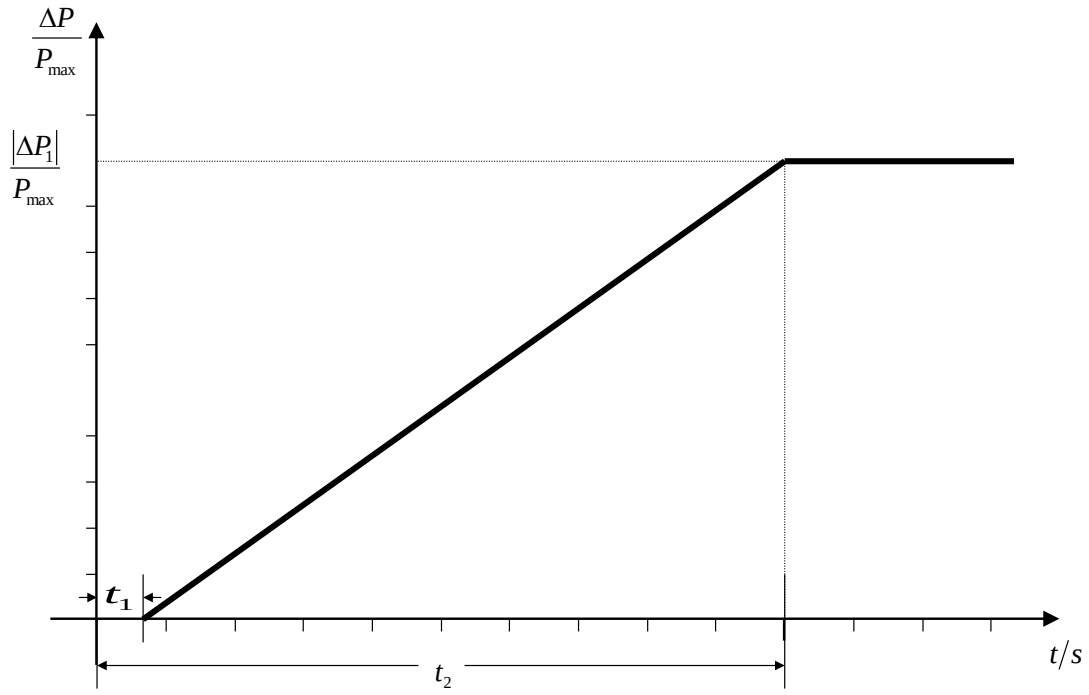

Figure 6: Active power frequency response capability. P_{max} is the maximum capacity to which ΔP relates. ΔP is the change in active power output from the power generating module. The power generating module has to provide active power output ΔP up to the point ΔP_1 in accordance with

the times t_1 and t_2 with the values of ΔP_1, $t_1$and t_2 being specified by the relevant TSO according to Table 5. t_1 is the initial delay. t_2 is the time for full activation.

(v) the power generating module shall be capable of providing full active power frequency response for a period of between 15 and 30 minutes as specified by the relevant TSO. In specifying the period, the TSO shall have regard to active power headroom and primary energy source of the power generating module;

(vi) within the time limits laid down in point (v) of Article 12(2) (d), active power control must not have any adverse impact on the frequency response of power generating modules;

(vii) the parameters specified by the relevant TSO in accordance with paragraphs 1, 2, 3 and 5 shall be notified to the relevant national regulatory authority. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework;

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 in line with Article 12 (2) (d) (iv)	2 seconds
For power generating modules without inertia, the maximum admissible initial delay t_1 unless justified otherwise in line with Article 12 (2) (d) (iv)	as specified by the relevant TSO while respecting the provisions of paragraph 1 of Article 7.
Maximum admissible choice of full activation time t_2 , unless longer activation times are allowed by the relevant TSO for reasons of system stability	30 seconds

Table 5: Parameters for full activation of active power frequency response resulting from frequency step change (explanation for Figure 6).

(e) with regard to frequency restoration control, the power generating module shall provide functionalities complying with specifications defined by the relevant TSO, in accordance with paragraph 1 of Article 7, aiming at restoring frequency to its nominal value or maintaining power exchange flows between control areas at their scheduled values;

(f) with regard to disconnection due to underfrequency, power generating facilities capable of acting as a load, including hydro pump-storage power generating facilities, shall be capable of disconnecting their load in case of underfrequency. The requirement referred to in this point does not extend to auxiliary supply;

(g) with regard to real-time monitoring of FSM:

(i) to monitor the operation of active power frequency response, the communication interface shall be equipped to transfer on-line from the power generating facility to the

network control centre of the relevant network operator and the relevant TSO, at the request of the relevant network operator and the relevant TSO, at least the following signals:

– 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) the relevant network operator and the relevant TSO shall specify in accordance with paragraph 1 of Article 7 additional signals to be provided by the power generating facility for monitoring and recording devices in order to verify the performance of the active power frequency response provision of participating power generating modules.

3. (...)

4. Type C power generating modules [Offshore PPMs] shall fulfil the following requirements relating to robustness:

(a) 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;

(b) without prejudice to paragraph 4 and 5 of Article 10, 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 Regulation;

(c) power generating modules shall be capable of remaining connected to the network during single-phase or three-phase auto-reclosures on meshed network lines, if applicable to the network to which they are connected. The details of that capability shall be subject to coordination and agreements on protection schemes and settings as referred to in point (b) of Article 11(5).

5. Type C power generating modules [Offshore PPMs] shall fulfil the following requirements relating to system restoration:

(a) with regard to black start capability:

(i) black start capability is not mandatory;

(ii) power generating facility owners shall, at the request of the relevant TSO, provide a quotation for providing black start capability. The relevant TSO may make such a request if it considers system security to be at risk due to a lack of black start capability in its control area;

(iii) a power generating module with black start capability shall be capable of starting from shutdown without any external electrical energy supply within a timeframe determined by the relevant network operator in coordination with the relevant TSO, in accordance with paragraph 1 of Article 7;

(iv) a power generating module with black start capability shall be able to synchronise within the frequency limits laid down in Article point (a) of Article 10(1) and voltage limits specified by the relevant network operator or in paragraph 2 of Article 13, where applicable;

(v) a power generating module with black start capability shall be capable of automatically regulating dips in voltage caused by load connections;

(vi) a power generating module with black start capability shall:

– be capable of regulating load connections in block load;

– control frequency in case of overfrequency and underfrequency within the whole active power output range between minimum regulating level and maximum capacity as well as at houseload level;

– be capable of parallel operation of a few power generating modules within one island; and

– control voltage automatically during the system restoration phase;

(b) with regard to the capability to take part in island operation:

(i) power generating modules shall be capable of taking part in island operation if required by the relevant network operator in coordination with the relevant TSO, in accordance with paragraph 1 of Article 7 and:

– the frequency limits for island operation shall be those established in accordance with point (a) of Article 10(1);

– the voltage limits for island operation shall be those established in accordance with paragraph 3 of Article 12 or paragraph 2 of Article 13, where applicable;

(ii) power generating modules shall be able to operate in FSM during island operation, as specified in point (d) of Article 12(2).

In the event of a power surplus, power generating modules shall be capable of reducing the active power output from a previous operating point to any new operating point within the P-Q-capability diagram. In that regard, 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 between the power generating facility owner and the relevant network operator in coordination with the relevant TSO, in accordance with paragraph 1 of Article 7. The agreed method of detection must not rely solely on the network operator's switchgear position signals;

(c) with regard to quick re-synchronisation capability:

(i) in case of disconnection of the power generating module from the network, the power generating module shall be capable of quick re-synchronisation in line with the protection strategy agreed between the relevant network operator in coordination with the relevant TSO and the power generation facility owner in the event of disturbances to the system;

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

(iii) power generating modules shall be capable of continuing operation following tripping to houseload, irrespective of any auxiliary connection to the external network. The minimum operation time shall be specified by the relevant network operator in coordination with the relevant TSO, taking into consideration the specific characteristics of the prime mover technology.

6. Type C power generating modules [Offshore PPMs] shall fulfil the following general system management requirements**:**

(a) with regard to loss of angular stability or loss of control, a power generating module shall be capable of disconnecting automatically from the network in order to help preserve system security or to prevent damage from the power generating module. The power generating facility owner and the relevant network operator in coordination with the relevant TSO shall agree on the criteria for detecting loss of angular stability or loss of control;

(b) with regard to instrumentation:

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

– voltage;

– active power;

– reactive power; and

– frequency.

The relevant network operator shall have the right to define, in accordance with paragraph 1 of Article 7, quality of supply parameters to be complied with on condition that reasonable prior notice is given;

(ii) in accordance with paragraph 1 of Article 7, the settings of the fault recording equipment, including triggering criteria and the sampling rates shall be agreed between the power generating facility owner and the relevant network operator in coordination with the relevant TSO;

(iii) the dynamic system behaviour monitoring shall include an oscillation trigger detecting poorly damped power oscillations, specified by the relevant network operator in coordination with the relevant TSO;

(iv) the facilities for quality of supply and dynamic system behaviour monitoring shall include arrangements for the power generating facility owner, and the relevant network operator and the relevant TSO to access the information. In accordance with paragraph 1 of Article 7, the communications protocols for recorded data shall be agreed between the power generating facility owner, the relevant network operator and the relevant TSO;

(c) with regard to the simulation models:

(i) at the request of the relevant network operator, the power generating facility owner shall provide simulation models which properly 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 referred to in Chapters 2, 3 and 4 of Title 4, and shall notify the results of the verification to the relevant network operator or relevant TSO. Member States may require that such verification be carried out by an authorised certifier;(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 the relevant network operator and the power generating facility owner, in accordance with paragraph 1 of Article 7; and

– converter models for power park modules;

(iii) the request by the relevant network operator referred to in point (i) shall be coordinated with the relevant TSO and comply with paragraph 1 of Article 7. It shall include:

– the format in which models are to be provided;

– the provision of documentation on a model's structure and block diagrams; and

– an estimate of the minimum and maximum short circuit capacity at the connection point, expressed in MVA, as an equivalent of the network;

(iv) the power generating facility owner shall provide power generating module recordings to the relevant network operator or relevant TSO if requested, having regard to the provisions of paragraph 1 of Article 7. The relevant network operator or relevant TSO may make such a request, in accordance with paragraph 1 of Article 7, in order to compare the response of the models with those recordings;

(d) with regard to the installation of devices for system operation and devices for system security, if the relevant network operator or the relevant TSO considers that it is necessary to install additional devices in a power generating facility in order to preserve or restore system operation or security, the relevant network operator or relevant TSO and the power generating facility owner shall investigate that matter and agree on an appropriate solution, in accordance with paragraph 1 of Article 7;

(e) the relevant network operator shall set, in coordination with the relevant TSO and in accordance with paragraph 1 of Article 7, minimum and maximum limits on rates of change of active power output (ramping limits) in both an up and down direction for a power generating module, taking into consideration the specific characteristics of the prime mover technology;

(f) earthing arrangement of the neutral-point at the network side of step-up transformers shall comply with the specifications of the relevant network operator.

Article 13 (General requirements for type D power generating modules)

1. (...)

2. (...)

3. Type D power generating modules [Offshore PPMs] shall fulfil the following requirements in relation to robustness:

(a) with regard to fault-ride-through capability:

(i) power generating modules shall be capable of staying connected to the network and continuing to operate stably after the power system has been disturbed by secured faults. That capability shall be in accordance with a voltage-against-time profile at the connection point for fault conditions defined by the relevant TSO in accordance with paragraph 1 of Article 7.

The voltage-against-time-profile shall express a lower limit of the actual course of the phase-to-phase voltages on the network voltage level at the connection point during a symmetrical fault, as a function of time before, during and after the fault.

That lower limit shall be defined by the relevant TSO in accordance with paragraph 1 of Article 7, using the parameters set out in Figure 3 and within the ranges set out in Tables 7.1 and 7.2 for type D power generating modules connected to the transmission network.

That lower limit shall also be defined by the relevant TSO in accordance with paragraph 1 of Article 7, using parameters set out in Figure 3 and within the ranges set out in Tables 3.1 and 3.2 for type D power generating modules connected to the distribution network or closed distribution system;

(ii) each TSO shall define, in accordance with paragraph 1 of Article 7, the pre-fault and post-fault conditions for the fault-ride-through capability referred to in point (iv) of Article 11(3)(a). The defined pre-fault and post-fault conditions for the fault-ride-through capability shall be made publicly available;

Voltage parameters [pu]		**Time parameters [seconds]**	
U_{ret}:	0	t_{clear}:	0.14 – 0.15 (or 0.14 - 0.25 if system protection and secure operation security require)
U_{clear}:	0.25	t_{rec1}:	t_{clear} – 0.45
U_{rec1}:	0.5 – 0.7	t_{rec2}:	t_{rec1} – 0.7
U_{rec2}:	0.85 – 0.9	t_{rec3}:	t_{rec2} – 1.5

Table 7.1: Parameters for Figure 3 for fault-ride-through capability of synchronous power generating modules.

Voltage parameters [pu]		**Time parameters [seconds]**	
U_{ret}:	0	t_{clear}:	0.14 – 0.15 (or 0.14 - 0.25 if system protection and secure operation so require)
U_{clear}:	U_{ret}	t_{rec1}:	t_{clear}
U_{rec1}:	U_{clear}	t_{rec2}:	t_{rec1}
U_{rec2}:	0.85	t_{rec3}:	1.5 – 3.0

Table 7.2: Parameters for Figure 3 for fault-ride-through capability of power park modules.

4. Type D power generating modules [Offshore PPMs] shall fulfil the following general system management requirements:

(a) with regard to synchronisation, when starting a power generating module, synchronisation shall be performed by the power generating facility owner only after authorisation by the relevant network operator;

(b) the power generating module shall be equipped with the necessary synchronisation facilities;

(c) synchronisation of power generating modules shall be possible at frequencies within the ranges set out in Table 2;

(d) in accordance with paragraph 1 of Article 7, the relevant network operator and the power generating facility owner shall agree on the settings of synchronisation devices to be concluded prior to operation of the power generating module. This agreement shall cover:

(i) voltage;

(ii) frequency;

(iii) phase angle range;

(iv) phase sequence;

(v) deviation of voltage and frequency.

[Article 14 – 16]

Article 17 (Requirements for type B power park modules)

1. (...)

2. Type B power park modules [Offshore PPMs] shall fulfil the following additional requirements in relation to voltage stability:

(a) (...);

(b) the relevant network operator in coordination with the relevant TSO shall have the right to require, in accordance with paragraph 1 of Article 7, 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) in accordance with paragraph 1 of Article 7), the relevant network operator in coordination with the relevant TSO shall specify:

– how and when a voltage deviation is to be determined as well as the end of the voltage deviation; and

– the characteristics of the fast fault current, including the time domain for measuring the voltage deviation and fast fault current, for which current and voltage may be measured differently from the method defined in Article 2.

(c) with regard to the supply of fast fault current in case of asymmetrical (1-phase or 2-phase) faults, the relevant network operator in coordination with the relevant TSO shall have the right to introduce a requirement for asymmetrical current injection, in accordance with paragraph 1 of Article.

3. Type B power park modules [Offshore PPMs] shall fulfil the following additional requirements in relation to robustness:

   (a) the relevant TSO shall specify, in accordance with paragraph 1 of Article 7, the post-fault active power recovery that the power park module is capable of providing 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; and

      (iii) a magnitude and accuracy for active power recovery;

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

      (i) priority between fast fault current requirements according to points (b) and (c) of paragraph (2) and active power recovery;

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

      (iii) a defined 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; and

      (v) adequate damping of active power oscillations.

Article 18 (Requirements for type C power park modules)

1. (...)

2. Type C power park modules [Offshore PPMs] shall fulfil the following additional requirements in relation to frequency stability:

   (a) in accordance with paragraph 1 of Article 7, the relevant TSO shall have the right to require that power park modules be capable of providing synthetic inertia during very fast frequency deviations;

   (b) the operating principle of control systems installed to provide synthetic inertia and the associated performance parameters shall be defined by the relevant TSO, in accordance with paragraph 1 of Article 7(2).

3. Type C power park modules [Offshore PPMs] shall fulfil the following additional requirements in relation to voltage stability:

   (a) with regard to reactive power capability, for a power park module whose connection point is not located at the high-voltage terminals of its step-up transformer nor at the terminals of the high-voltage line or cable to the connection point at the power park module, if no step-up transformer exists, supplementary reactive power may be required by the relevant network operator in accordance with paragraph 1 of Article 7 to compensate for the reactive power demand of the high-voltage line or cable between these two points from the responsible owner of this line or cable;

   (b) with regard to reactive power capability at maximum capacity:

      (i) the relevant network operator in coordination with the relevant TSO shall define, in accordance with paragraph 1 of Article 7, the reactive power provision capability requirements in the context of varying voltage. To that end, it shall define a U-Q/P_{max}-profile that may take any shape within the boundaries of which the power park module is capable of providing reactive power at its maximum capacity;

(ii) in accordance with paragraph 1 of Article 7(1), the U-Q/P_{max}-profile shall be defined by each relevant network operator in coordination with the relevant TSO in conformity with the following principles:

- the U-Q/P_{max}-profile shall not exceed the U-Q/P_{max}-profile envelope, represented by the inner envelope in Figure 8;
- the dimensions of the U-Q/P_{max}-profile envelope (Q/P_{max} range and voltage range) shall be within the values defined for each synchronous area in Table 9;
- the position of the U-Q/P_{max}-profile envelope shall be within the limits of the fixed outer envelope set out in Figure 8; and
- the defined U-Q/P_{max} profile may take any shape, having regard to the potential costs of delivering the capability to provide reactive power production at high voltages and reactive power consumption at low voltages;

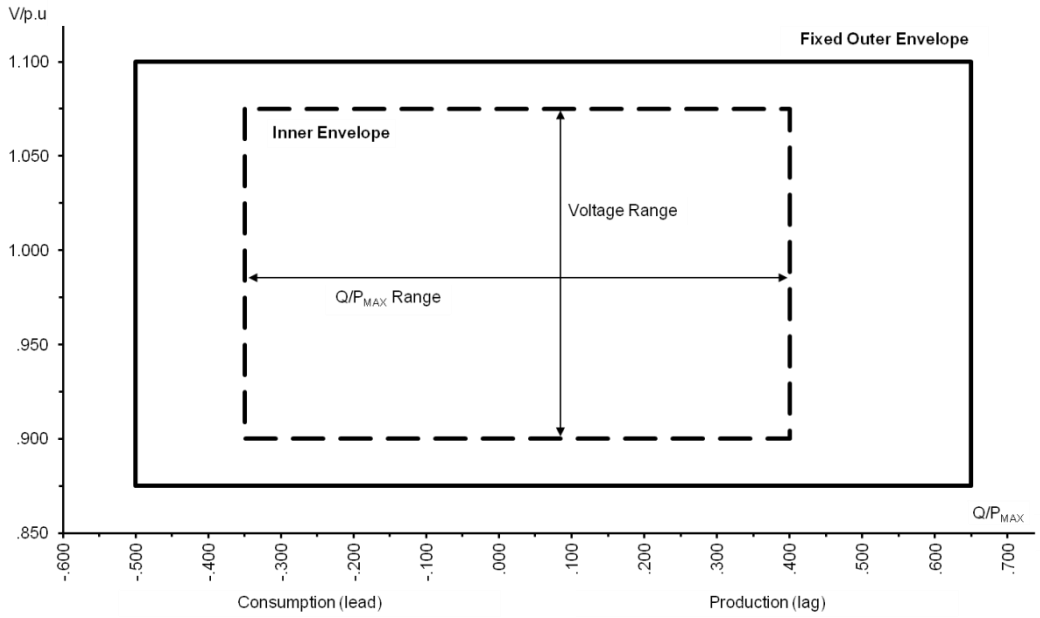

Figure 8: U-Q/P_{max}-profile of a power park module. The diagram represents boundaries of a U-Q/P_{max}-profile by the voltage at the connection point, expressed by the ratio of its actual value and its nominal value per unit, against the ratio of the reactive power (Q) and the maximum capacity (P_{max}). The position, size and shape of the inner envelope are indicative.

Synchronous area	Maximum range of Q/P_{max}	Maximum range of steady-state voltage level in PU
Continental Europe	0.75	0.225

Table 9: Parameters for the inner envelope in Figure 8

(iii) the reactive power provision capability requirement applies at the connection point. For profile shapes other than rectangular, the voltage range represents the highest and lowest values. The full reactive power range is therefore not expected to be available across the range of steady-state voltages;

(c) With regard to reactive power capability below maximum capacity:

(i) the relevant network operator in coordination with the relevant TSO shall define the reactive power provision capability requirements, in accordance with paragraph 1 of Article 7 and shall define a P-Q/P_{max}-profile that may take any shape within the boundaries of which the power park module is capable of providing reactive power below maximum capacity;

(ii) in accordance with paragraph 1 of Article 7, the P-Q/P_{max}-profile shall be defined by each relevant network operator in coordination with the relevant TSO, in conformity with the following principles:

– the P-Q/P_{max}-profile shall not exceed the P-Q/P_{max}-profile envelope, represented by the inner envelope in Figure 9;

– the Q/P_{max} range of the P-Q/P_{max}-profile envelope is defined for each synchronous area in Table 9;

– the active power range of the P-Q/P_{max}-profile envelope at zero reactive power shall be 1 pu;

– the P-Q/P_{max}-profile can be of any shape and shall include conditions for reactive power capability at zero active power; and

– the position of the P-Q/P_{max}-profile envelope shall be within the limits of the fixed outer envelope set out in Figure 9;

(iii) when operating at an active power output below maximum capacity ($P<P_{max}$), the power park module shall be capable of providing reactive power at any operating point inside its P-Q/P_{max}-profile, if all units of that power park module which generate power are technically available that is to say they are not out of service due to maintenance or failure, otherwise there may be less reactive power capability, taking into consideration the technical availabilities;

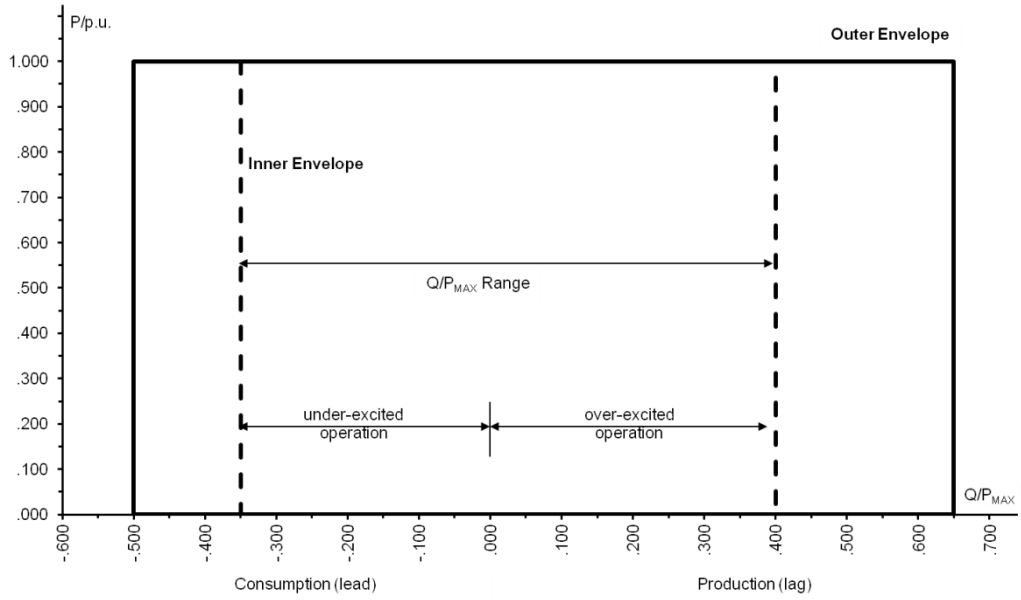

Figure 9: P-Q/P_{max}-profile of a power park module. The diagram represents boundaries of a P-Q/P_{max}-profile at the connection point by the active power, expressed by the ratio of its actual value

and the maximum capacity per unit, against the ratio of the reactive power (Q) and the maximum capacity (P_{max}). The position, size and shape of the inner envelope are indicative.

(iv) the power park module shall be capable of moving to any operating point within its P-Q/P_{max} profile in appropriate timescales to target values requested by the relevant network operator;

(d) with regard to reactive power control modes:

(i) the power park module shall be capable of providing reactive power automatically by either voltage control mode, reactive power control mode or power factor control mode;

(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 at least 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 nominal network 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 within a time t_1 to be specified by the relevant network operator in the range of 1 to 5 seconds, and must settle at the value defined by the operating slope within a time t_2 to be specified by the relevant network operator in the range of 5 to 60 seconds, with a steady-state reactive tolerance no greater than 5 % of the maximum reactive power. The relevant network operator shall set out the time specifications in accordance with paragraph 1 of Article 7;

(v) for the purpose of reactive power control mode, the power park module shall be capable of setting the reactive power setpoint anywhere in the reactive power range, defined by point (a) of Article 17(2) and by points (a) and (b) of Article 18(3), with setting steps no greater than 5 MVAr or 5 % (whichever is smaller) of full reactive power, controlling the reactive power at the connection point to an accuracy within plus or minus 5 MVAr or plus or minus5 % (whichever is smaller) of the full reactive power;

(vi) for the purpose of power factor control mode, the power park module shall be capable of controlling the power factor at the connection point within the required reactive power range, defined by the relevant network operator according to point (a) of Article 17(2) or defined by points (a) and (b) of Article 18(3), with a target power factor in steps no greater than 0.01. The relevant network operator shall define, in accordance with paragraph 1 of Article 7, the target power factor value and the tolerance expressed in Mvar or % on the reactive power value issued from conversion of power factor value, within a period of time, following a sudden change of active power output;

(vii) the relevant network operator, in coordination with the relevant TSO and with the power generating module owner, shall determine, in accordance with paragraph 1 of Article 7, which of the above three reactive power control mode options and associated setpoints is to apply, and what further equipment is needed to make the adjustment of the relevant setpoint operable remotely;

(e) with regard to prioritising active or reactive power contribution, the relevant TSO shall determine, in accordance with paragraph 1 of Article 7, 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, its provision shall be established no later than 150 ms from the fault inception;

(f) with regard to power oscillations damping control, if required by the relevant TSO in accordance with paragraph 1 of Article 7, a power park module shall be capable of contributing to damping power oscillations. The voltage and reactive power control characteristics of power park modules must not adversely affect the damping of power oscillations.

[Article 19]

Article 20 (General provisions for offshore power park modules)

1. The requirements set out in this Chapter apply to the connection to the network of AC-connected power park modules located offshore. DC-connected power park modules shall be exempted from the requirements of this Regulation. An AC-connected power park module located offshore which does not have an offshore connection point shall be considered as an onshore power park module and thus shall comply with the requirements governing power park modules situated onshore.

2. In accordance with paragraph 1 of Article 7, the offshore connection point of an AC-connected offshore power park module shall be defined by the relevant network operator.

3. AC-connected offshore power park modules within the scope of this Regulation shall be categorised in accordance with the following offshore grid connection system configurations:

(a) configuration 1: AC connection to a single onshore grid interconnection point whereby one or more offshore power park modules that are interconnected offshore to form an offshore AC system are connected to the onshore system ;

(b) configuration 2: Meshed AC connections whereby a number of offshore power park modules are interconnected offshore to form an offshore AC system and the offshore AC system is connected to the onshore system at two or more onshore grid interconnection points.

Article 21 (Frequency stability requirements applicable to AC-connected offshore power park modules)

The frequency stability requirements laid down respectively in Article 10(1) to (5), Article 12(2) and Article 18(2) shall apply to any AC-connected offshore power park module.

Article 22 (Voltage stability requirements applicable to AC-connected offshore power park modules)

1. Without prejudice to point (a) of Article 11(3) and point (a) of Article 13(3), an AC-connected offshore power park module shall be capable of staying connected to the network and operating within the ranges of the network voltage at the connection point, expressed by the voltage at the connection point related to nominal voltage (per unit), and within the time periods specified in Table 10.

2. (...)

Synchronous area	Voltage range	Time period for operation
Continental Europe	0.85 pu – 0.90 pu	60 minutes
	0.9 pu – 1.118 pu*	Unlimited
	1.118 pu – 1.15 pu*	To be decided by each TSO in accordance with Article 7(1)
	0.90 pu – 1.05 pu**	Unlimited
	1. 05 pu – 1.10 pu**	60 minutes

* The voltage base for pu values is below 300 kV.

** The voltage base for pu values is from 300 kV to 400 kV.

Table 10: The table shows the minimum period during which an AC-connected offshore power park module must be capable of operating over different voltage ranges deviating from a nominal value without disconnecting.

3. The voltage stability requirements defined respectively in points (b) and (c) of Article 17(2) as well as in paragraph 3 of Article 18 shall apply to any AC-connected offshore power park module.

4. The reactive power capability at maximum capacity defined in point (b) of Article 18(3) shall apply to AC-connected offshore power park modules, except for Table 9. Instead, the requirements of Table 11 shall apply.

Synchronous area	Maximum range of Q/P_{max}	Maximum range of steady-state voltage level in PU
Continental Europe	0.75	0.225

Table 11: Parameters for Figure 8

Article 23 (Robustness requirements applicable to AC-connected offshore power park modules)

1. The robustness requirements of power generating modules laid down in paragraph 4 of Article 12 and paragraph 3 of Article 17 shall apply to AC-connected offshore power park modules.

2. The fault-ride-through capability requirements laid down in point (a) of Article 11(3) and point (a) of Article 13(3) shall apply to AC-connected offshore power park modules.

Article 24 (System restoration requirements applicable to AC-connected offshore power park modules)

The system restoration requirements laid down respectively in paragraph 4 of Article 11 and paragraph 5 of Article 12 shall apply to AC-connected offshore power park modules.

Article 25 (General system management requirements applicable to AC-connected offshore power park modules)

The general system management requirements laid down in paragraph 5 of Article 11, paragraph 6 of Article 12 and paragraph 4 of Article 13 shall apply to AC-connected offshore power park modules.

[Article 26 – 35]

Article 36 (Responsibility of the power generating facility owner regarding compliance monitoring)

1. The power generating facility owner shall ensure that each power generating module complies with the requirements applicable under this Regulation throughout the lifetime of the facility. For type A power generating modules, the power generating facility owner may rely upon equipment certificates.

2. The power generating facility owner shall notify to the relevant network operator any planned modification of the technical capabilities of a power generating module which may affect its compliance with the requirements applicable under this Regulation, before initiating that modification.

3. The power generating facility owner shall notify the relevant network operator of any operational incidents or failures of a power generating module that affect its compliance with the requirements of this Regulation, without undue delay, after the occurrence of those incidents.

4. The power generating facility owner shall notify the relevant network operator of the planned test schedules and procedures to be followed for verifying the compliance of a power generating module with the requirements of this Regulation, in due time and prior to their launch. The relevant network operator shall approve in advance the planned test schedules and procedures.

5. The relevant network operator may participate in such tests and record the performance of the power generating modules.

Article 37 (Tasks of the relevant network operator)

1. The relevant network operator shall assess the compliance of a power generating module with the requirements applicable under this Regulation, throughout the lifetime of the power generating facility. The power generating facility owner shall be informed of the outcome of this assessment.

   For type A power generating modules, the relevant network operator may rely upon equipment certificates for this assessment.

2. The relevant network operator shall have the right to request that the power generating facility owner carry out compliance tests and simulations according to a repeat plan or general scheme, in accordance with paragraph 1 of Article 7.

   The relevant network operator shall have the right to request that the power generating facility owner carry out compliance tests after any failure, modification or replacement of any equipment that may have an impact on the power generating module's compliance with the requirements of this Regulation.

   The power generating facility owner shall be informed of the outcome of those compliance tests and simulations.

3. The relevant network operator shall make publicly available a list of information and documents to be provided as well as the requirements to be fulfilled by the power generating facility owner within the framework of the compliance process. The list shall cover at least the following:

   (a) all the documentation and certificates to be provided by the power generating facility owner;

   (b) details of the technical data on the power generating module of relevance to the grid connection;

   (c) requirements for models for steady-state and dynamic system studies;

   (d) timely provision of system data required to perform the studies;

(e) studies by the power generating facility owner to demonstrate the expected steady-state and dynamic performance in accordance with the requirements set out in Chapters 4 and 5 of Title IV;

(f) conditions and procedures, including the scope, for registering equipment certificates; and

(g) conditions and procedures for the use of relevant equipment certificates by the power generating facility owner.

4. The relevant network operator shall make public the allocation of responsibilities between the power generating facility owner and the network operator for compliance testing, simulation and monitoring.

5. The relevant network operator may totally or partially delegate the performance of its compliance monitoring to third parties. In such cases, the relevant network operator shall continue ensuring compliance with Article 9, including entering into confidentiality commitments with the assignee.

6. If compliance tests or simulations cannot be carried out as agreed between the relevant network operator and the power generating facility owner due to reasons attributable to the relevant network operator, then the relevant network operator shall not unreasonably withhold the operational notification referred to in Title 3.

Article 38 (Common provisions for compliance testing)

1. Testing of the performance of individual power generating modules within a power generating facility shall aim at demonstrating that the requirements of this Regulation have been complied with.

2. Notwithstanding the minimum requirements for compliance testing set out in this Regulation, the relevant network operator is, in accordance with paragraph 1 of Article 7, entitled to:

(a) allow the power generating facility owner to carry out an alternative set of tests, provided that those tests are efficient and suffice to demonstrate that a power generating module complies with the requirements of this Regulation;

(b) require the power generating facility owner to carry out additional or alternative sets of tests in those cases where the information supplied to the relevant network operator in relation to compliance testing under the provisions of Chapter 2, 3 or 4 of Title IV, is not sufficient to demonstrate compliance with the requirements of this Regulation; and

(c) require the power generating facility owner to carry out appropriate tests in order to demonstrate a power generating module's performance when operating on alternative fuels or fuel mixes. The relevant network operator and the power generating facility owner shall agree on which types of fuel are to be tested.

3. The power generating facility owner is responsible for carrying out the tests in accordance with the conditions laid down in Chapters 2, 3 and 4 of Title IV,. The relevant network operator shall cooperate and not unduly delay the performance of the tests.

4. The relevant network operator may participate in the compliance testing either on site or remotely from the network operator's control centre. For that purpose, the power generating facility owner shall provide suitable monitoring equipment to record all relevant test signals and measurements as well as ensure that the necessary representatives of the power generating facility owner are available on site for the entire testing period. Signals specified by the relevant network operator shall be provided if, for selected tests, the network operator wishes to use its own equipment to record performance. The relevant network operator has sole discretion to decide about its participation.

Article 39 (Common provisions on compliance simulation)

1. Simulation of the performance of individual power generating modules within a power generating facility shall aim at demonstrating that the requirements of this Regulation have been fulfilled.

2. Notwithstanding the minimum requirements set out in this Regulation for compliance simulation, the relevant network operator may, in accordance with paragraph 1 of Article 7:

   (a) allow the power generating facility owner to carry out an alternative set of simulations, provided that those simulations are efficient and suffice to demonstrate that a power generating module complies with the requirements of this Regulation or with national legislation; and

   (b) require the power generating facility owner to carry out additional or alternative sets of simulations in those cases where the information supplied to the relevant network operator in relation to compliance simulation under the provisions of Chapter 5, 6 or 7 of Title IV, is not sufficient to demonstrate compliance with the requirements of this Regulation.

3. To demonstrate compliance with the requirements of this Regulation, the power generating facility owner shall provide a report with the simulation results for each individual power generating module within the power generating facility. The power generating facility owner shall produce and provide a validated simulation model for a given power generating module. The scope of the simulation models is set out in point (c) of Article 12(6).

4. The relevant network operator shall have the right to check that a power generating module complies with the requirements of this Regulation by carrying out its own compliance simulations based on the provided simulation reports, simulation models and compliance test measurements.

5. The relevant network operator shall provide the power generating facility owner with technical data and a simulation model of the network, to the extent necessary to carry out the requested simulations in accordance with Chapter 5, 6 or 7 of Title IV.

[Article 40 – 42]

Article 43 (Compliance tests for type B power park modules)

1. (...)

2. With regard to type B power park modules, the LFSM-O response tests shall reflect the choice of control scheme selected by the relevant network operator.

3. (...)

Article 44 (Compliance tests for type C power park modules)

1. (...)

2. With regard to the active power controllability and control range test the following requirements shall apply:

   (a) the power park module's technical capability to operate at a load level below the setpoint set by the relevant network operator or the relevant TSO shall be demonstrated.

   (b) the test shall be deemed successful if the following conditions are fulfilled:

      (i) the load level of the power park module is kept below the setpoint;

      (ii) the setpoint is implemented according to the requirements laid down in Article 12(2)(a); and

(iii) the accuracy of the regulation complies with the value specified in point (a) of Article 12(2).

3. With regard to the LFSM-U response test the following requirements shall apply:

(a) the power park module's technical capability to continuously modulate active power to contribute to frequency control in case of a large frequency drop in the system shall be demonstrated;

(b) the test shall be carried out by simulating the frequency steps and ramps big enough to trigger at least 10 % of maximum capacity active power change with a starting point of no more than 80 % of maximum capacity, taking into account the droop settings and the deadband. If applicable, simulated frequency deviation signals shall be injected into the power park module controller scheme, taking into account both speed governor and load controller scheme.

(c) the test shall be deemed successful if the following conditions are fulfilled:

(i) the test results, for both dynamic and static parameters, comply with the requirements laid down in Article 12(2) (c); and

(ii) undamped oscillations do not occur after the step change response.

4. With regard to the FSM response test the following requirements shall apply:

(a) the power park module's technical capability to continuously modulate active power over the full operating range between maximum capacity and minimum regulating level to contribute to frequency control shall be demonstrated. The steady-state parameters of regulations, such as insensitivity, droop, deadband and range of regulation, as well as dynamic parameters, including frequency step change response shall be verified;

(b) the test shall be carried out by simulating frequency steps and ramps big enough to trigger the whole active power frequency response range, taking into account the droop settings and the deadband. Simulated frequency deviation signals shall be injected to perform the test.

(c) The test shall be deemed successful if the following conditions are fulfilled:

(i) the activation time of the full active power frequency response range as a result of a step in frequency change is no longer than that required by point (d) of Article 12(2);

(ii) undamped oscillations do not occur after the step change response;

(iii) the initial delay is in line with point (d) of Article 12(2);

(iv) the droop settings are available within the ranges defined in point (d) of Article 12(2) and the deadband (threshold) is not higher than the value chosen by the relevant TSO; and

(v) the insensitivity of active power frequency response does not exceed the requirement set out in point (d) of Article 12(2).

5. With regard to the frequency restoration control test the following requirements shall apply:

(a) the power park module's technical capability to participate in frequency restoration control shall be demonstrated. The cooperation of both FSM and frequency restoration control shall be checked;

(b) the test shall be deemed successful if the results for both dynamic and static parameters comply with the requirements of point (e) of Article 12(2).

6. (...)

7. With regard to the voltage control mode test the following requirements shall apply:

(a) the power park module's capability to operate in voltage control mode referred to in the conditions set out in points (ii) to (iv) of Article 18(3) (d) shall be demonstrated;

(b) The voltage control mode test shall verify the following parameters:

(i) the implemented slope and deadband of the static characteristic;

(ii) the accuracy of the regulation;

(iii) the insensitivity of the regulation; and

(iv) the time of reactive power activation;

(c) The test shall be deemed successful if the following conditions are fulfilled:

(i) the implemented slope and deadband of the static characteristic;

(ii) the range of regulation and adjustable droop and deadband complies with the agreed or decided characteristic parameters set out in point (d) of Article 18(3);

(iii) the insensitivity of voltage control is not higher than 0.01 pu, in accordance with point (d) of Article 18(3); and

(iv) following a step change in voltage, 90% of the change in reactive power output has been achieved within the times and tolerances specified in point (d) of Article 18(3).

8. With regard to the reactive power control mode test the following requirements shall apply:

(a) the power park module's capability to operate in reactive power control mode, in accordance with point (v) of Article 18(3) (d), shall be demonstrated;

(b) the reactive power control mode test shall be complementary to the reactive power capability test;

(c) the reactive power control mode test shall verify the following parameters:

(i) the reactive power setpoint range and step;

(ii) the accuracy of the regulation; and

(iii) the time of reactive power activation.

(d) the test shall be deemed successful if the following conditions are fulfilled:

(i) the reactive power setpoint range and step are ensured in accordance with point (d) of Article 18(3); and

(ii) the accuracy of the regulation complies with the conditions set out in point (d) of Article 18(3).

9. With regard to the power factor control mode test the following requirements shall apply:

(a) the power park module's capability to operate in power factor control mode in accordance with point (vi) of Article 18(3) (d) shall be demonstrated;

(b) the power factor control mode test shall verify the following parameters:

(i) the power factor setpoint range;

(ii) the accuracy of the regulation; and

(iii) the response of reactive power due to step change of active power;

(c) the test shall be deemed successful if the following conditions are cumulatively fulfilled:

(i) the power factor setpoint range and step are ensured in accordance with point (d) of Article 18(3);

(ii) the time of reactive power activation as a result of step active power change does not exceed the requirement laid down in point (d) of Article 18(3); and

(iii) the accuracy of the regulation complies with the value specified in point (d) of Article 18(3).

10. With regard to the tests referred to in paragraphs 7, 8 and 9, the relevant network operator may select only one of the three control options for testing.

Article 46 (Compliance tests for offshore power park modules)

The compliance tests established in paragraph 2 of Article 43, as well as in paragraphs (2), (3), (4), (5), (7), (8) and (9) of Article 44 shall apply to offshore power park modules.

[Article 47 – 49]

Article 50 (Compliance simulations for type B power park modules)

1. (...)
2. (...)
3. With regard to the fast acting additional reactive current injection simulation the following requirements shall apply:
   (a) the power generating module's capability to simulate fast acting additional reactive current injection in accordance with the conditions set out in point (b) of Article 17(2) shall be demonstrated;
   (b) the simulation shall be deemed successful if compliance with the requirement laid down in point (b) of Article 17(2) is demonstrated.
4. (...)
5. The following requirements with regard to the post fault power active recovery simulation shall apply:
   (a) the power generating module's capability to simulate post fault active power recovery in accordance with the conditions set out in paragraph 3 of Article 17 shall be demonstrated;
   (b) The simulation shall be deemed successful if compliance with the requirement laid down in paragraph 3 of Article 17 is demonstrated.

Article 51 (Compliance simulations for type C power park modules)

1. (...)
2. (...)
3. (...)
4. With regard to the island operation simulation, the following requirements shall apply:
   (a) the power generating module's performance during island operation in accordance with the conditions set out in point (b) of Article 12(5) shall be demonstrated;
   (b) the simulation shall be deemed successful in the event that the power generating module reduces or increases the active power output from its previous operating point to any new operating point, within the P-Q-capability diagram and within the limits set out in point (b) of

Article 12(5), without disconnection of the power generating module from the island due to over-/underfrequency.

5. With regard to the simulation of the capability of providing synthetic inertia, the following requirements shall apply:

   (a) the model of the power generating module shall demonstrate that it can simulate the capability of providing synthetic inertia to a low frequency event as set out in point (a) of Article 18(2);

   (b) the simulation shall be deemed successful if the model demonstrates that it complies with the conditions set out in paragraph 2 of Article 18.

6. (...)

7. With regard to the power oscillations damping control simulation, the following requirements shall apply:

   (a) the model of the power generating module shall demonstrate that it can simulate power oscillations damping capability accordance with point (f) of Article 18(3);

   (b) the simulation shall be deemed successful in the event that the model demonstrates compliance with the conditions described in point (f) of Article 18(3).

Article 53 (Compliance simulations applicable to offshore power park modules)

The compliance simulations defined in paragraphs 3 and 5 of Article 50 as well as in paragraphs 4, 5 and 7 of Article 51 shall apply to any offshore power park module.

[Article 54 – 66]

Article 67 (Amendment of contracts and general terms and conditions)

1. All relevant clauses in contracts and general terms and conditions relating to the grid connection of new power generating modules shall be brought into compliance with the requirements of this Regulation.

2. Member States and national regulatory authorities shall ensure that national agreements between network operators and power generating facilities relating to grid connection requirements for power generating facilities, in particular in national network codes, reflect the requirements set out in this Regulation.

[Article 68]

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