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COMMISSION REGULATION (EU) No …/..

of XXX

establishing a network code
on requirements for grid connection of generators

(Text with EEA relevance)

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THE EUROPEAN COMMISSION,

Having regard to Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003[1], and in particular Article 6(11) thereof,

Whereas:

(1) The swift completion of a fully functioning and interconnected internal energy market is crucial to maintaining security of energy supply, increasing competitiveness and ensuring that all consumers can purchase energy at affordable prices.

(2) Regulation (EC) No 714/2009 sets out non-discriminatory rules governing access to the network for cross-border exchanges in electricity with a view to ensuring the proper functioning of the internal market in electricity. In order to provide system security within the interconnected transmission system, it is essential to establish a common understanding of the requirements applicable to power generating modules. Those requirements that contribute to maintaining, preserving and restoring system security in order to facilitate proper functioning of the internal electricity market within and between synchronous areas, and to achieve cost efficiencies, should be regarded as cross-border network issues and market integration issues.

(3) Harmonised rules on grid connection for power generating modules should be set out in order to provide a clear legal framework for grid connections, facilitate Union-wide trade in electricity, ensure system security, facilitate the integration of renewable electricity sources, allow more efficient use of the network and increase competition, for the benefit of consumers.

(4) System security depends partly on the technical capabilities of power generating modules, therefore regular coordination at the level of generation and adequate performance of equipment connected to the networks with sufficient robustness to cope with disturbances and to help to prevent any major disruption or to facilitate restoration of the system after a collapse are fundamental prerequisites for system security.

(5) Secure system operation is only possible if there is close cooperation between power generating facility owners and network operators. In particular, the functioning of the system under abnormal operating conditions depends on the response of power

[1] OJ L 211, 14.8.2009, p. 15.

generating modules to deviations from nominal values of voltage and frequency. In the context of system security, the networks and the power generating modules should be considered as one entity from a system engineering point of view, given that both parts of the system are interdependent. Therefore, concerning system security and as a prerequisite for grid connection relevant technical requirements should be set for power generating modules.

(6) National regulatory authorities should consider the reasonable costs effectively incurred by network operators in the implementation of this Regulation when fixing or approving transmission or distribution tariffs or when approving the terms and conditions for connection and access to national networks in accordance with Article 37(1) and (6) of Directive 2009/72/EC of the European Parliament and of the Council[2] and with Article 14 of Regulation (EC) No 714/2009.

(7) Different synchronous electricity systems in the Union have different characteristics which need to be taken into account when setting the requirements for generators. It is therefore appropriate to consider regional specificities when establishing network connection rules as required by Article 8(6) of Regulation (EC) No 714/2009.

(8) In view of the need to provide regulatory certainty, the requirements of this Regulation should apply to new generating facilities but should not apply to existing generating facilities and generating facilities already at an advanced stage of planning but not yet completed unless the relevant national regulatory authority or Member State decides otherwise.

(9) In view of the different voltage level at which generators are connected and their maximum generating capacity, this Regulation should make a distinction between different types of generators by establishing different levels of requirements.

(10) The requirements applicable to type A power generating modules should be of a basic level necessary to ensure capability of generation over operational ranges with limited automated response and minimal system operator control of generation. They should ensure that there is no large-scale loss of generation over system operational ranges, thereby minimising critical events, and include requirements necessary for widespread intervention during system-critical events.

(11) The requirements applicable to type B power generating modules should provide for a wider range of automated dynamic response with greater resilience to more specific operational events in order to ensure the use of this more dynamic response and a higher level of system operator control and information to utilise those capabilities. They ensure an automated response to mitigate the impact of, and maximise dynamic generation response to, system events.

(12) The requirements applicable to type C power generating modules should provide for a refined, stable and highly controllable real-time dynamic response aiming to provide principle ancillary services to ensure security of supply. Those requirements should cover all operational network states with consequential detailed specification of interactions of requirements, functions, control and information to utilise those capabilities and ensure the real time system response necessary to avoid, manage and respond to system events. Those requirements should also provide sufficient

[2] Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC (OJ L 211, 14.08.2009, p. 55).

generation functionality to respond to both intact and system disturbed situations, and should provide the information and control necessary to utilise generation in different situations.

(13) The requirements applicable to type D power generating modules should be specific to higher voltage connected generation with an impact on control and operation of the entire system They should ensure stable operation of the interconnected network, allowing the use of ancillary services from generation Europe-wide.

(14) The requirements should be based on the principles of non-discrimination and transparency as well as on the principle of optimisation between the highest overall efficiency and lowest total cost for all involved parties, taking into account the impact on individual parties and the need to ensure that, as much as possible, costs are borne by the party from which they originate. Therefore those requirements should reflect the differences in the treatment of generation technologies with different inherent characteristics, and avoid unnecessary investments in some geographical areas in order to take into account their respective regional specificities. Transmission system operators ('TSOs'), distribution system operators ('DSOs') and closed distribution system operators ('CDSOs') can take those differences into account when defining the requirements in accordance with the provisions of this Regulation.

(15) Due to its cross-border impact, this Regulation should aim at the same frequency for all voltage levels, at least across a synchronous area. That is necessary because, within a synchronous area, a change in frequency in one Member State would immediately impact frequency and potentially damage equipment in all other Member States.

(16) To ensure system security, it should be possible for power generating modules in each synchronous area of the interconnected system to remain connected to the system for specified ranges.

(17) This Regulation should provide for ranges of parameters for national choices for fault-ride-through capability to maintain a proportionate approach reflecting varying system needs such as the level of renewable energy sources ('RES') and existing network protection schemes, both transmission and distribution. In view of the configuration of some networks, the upper limit for fault-ride-through requirements should be 250 milliseconds. However, given that the most common fault clearing time in Europe is currently 150 milliseconds it leaves scope for national regulatory authorities to verify that a longer requirement is necessary before approving it.

(18) When defining the pre-fault and post-fault conditions for the fault-ride-through capability, in view of the need to strike a balance on costs, technical burdens and necessity, the relevant TSO should decide whether priority is given to pre-fault operating conditions of power generating modules or to longer fault clearance times taking into account system characteristics such as network topology and generation mix.

(19) Ensuring appropriate reconnection after an incidental disconnection due to a network disturbance is important to the functioning of the interconnected system. Proper network protection is essential for maintaining system stability and security, particularly in case of disturbances to the system. Protection schemes can prevent aggravation of disturbances and limit their consequences.

(20) Adequate information exchange between network operators and power generating module operators is a prerequisite for enabling network operators to maintain system stability and security. Network operators need to have a continuous overview of the

state of the system, which includes information on the operating conditions of power generating modules, as well as the possibility to communicate with them in order to direct operational instructions.

(21) In emergency situations which could endanger system stability and security, network operators should have the possibility to instruct that the output of power generating modules be able to meet their responsibilities for system security.

(22) Voltage ranges should be coordinated between interconnected networks because voltage ranges are crucial to secure planning and operation of a power system within a synchronous area. Disconnections because of voltage disturbances have an impact on neighbouring systems. Failure to define voltage ranges could lead to widespread uncertainty in planning and operation of the system with respect to operation beyond normal operating conditions.

(23) The reactive power capability needs depend on several factors including the degree of network meshing and the ratio of in-feed and consumption, which should be taken into account when establishing reactive power requirements. When regional system characteristics vary within the area of responsibility of a network operator, more than one profile could be appropriate. Reactive power production, known as lagging, at high voltages and reactive power consumption, known as leading, at low voltages might not be necessary. Reactive power requirements could put constraints on power generation design and operation. Therefore it is important that the capabilities actually required for efficient system operation be thoroughly assessed.

(24) Synchronous power generating modules have an inherent capability to resist or slow down frequency changes, a characteristic which many RES technologies do not have. Therefore countermeasures should be adopted, to avoid a larger rate of change of frequency during high RES production. Synthetic inertia could facilitate further expansion of RES, which does not naturally contribute to inertia.

(25) Appropriate compliance testing should be required by this Regulation so that network operators can ensure operational security.

(26) A framework for derogations from the rules should be set out in this Regulation to take into account local circumstances. Those derogations could relate to instances where compliance with those rules could jeopardise the stability of the local network or where the safe operation of a power generating module might require operating conditions that are not in line with the Regulation. In the case of particular combined heat and power plants, which bring wider efficiency benefits, applying the rules set out in this Regulation could result in disproportionate costs and lead to the loss of those efficiency benefits.

(27) Subject to approval by the relevant regulatory authority, network operators should be allowed to propose derogations for certain classes of power generating modules.

(28) The measures provided for in this Regulation are in accordance with the opinion of the Committee referred to in Article 23(1) of Regulation (EC) No 714/2009,

HAS ADOPTED THIS REGULATION:

TITLE I

GENERAL PROVISIONS

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[3] 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;

[3] Commission Regulation (EU) No 543/2013 of 14 June 2013 on submission and publication of data in electricity markets and amending Annex I to Regulation (EC) No 714/2009 of the European Parliament and of the Council (OJ L 163, 15.6.2013, p. 1).

(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) ‘power generating module document’ or ‘PGMD’ means a document issued by the power generating facility owner to the relevant network operator for a type B or C power generating module which confirms that the power generating module’s compliance with the technical criteria set out in this Regulation has been demonstrated and provides the necessary data and statements, including a statement of compliance;

(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;

(11) ‘network’ means a plant and apparatus connected together in order to transmit or distribute electricity;

(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;

(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) ‘synchronous compensation operation’ means the operation of an alternator without prime mover to regulate voltage dynamically by production or absorption of reactive power;

(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) ‘minimum stable operating 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, at which the power generating module can be operated stably for an unlimited time;

(52) ‘overexcitation limiter’ means a control device within the AVR which prevents the rotor of an alternator from overloading by limiting the excitation current;

(53) ‘underexcitation limiter’ means a control device within the AVR, the purpose of which is to prevent the alternator from losing synchronism due to lack of excitation;

(54) ‘automatic voltage regulator’ or ‘AVR’ means the continuously acting automatic equipment controlling the terminal voltage of a synchronous power generating module by comparing the actual terminal voltage with a reference value and controlling the output of an excitation control system, depending on the deviations;

(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) ‘installation document’ means a simple structured document containing information about a type A power generating module and confirming its compliance with the relevant requirements set out in this Regulation.

(62) ‘statement of compliance’ means a document provided by the power generating facility owner to the network operator stating the current status of compliance with each relevant specification and requirement set out in this Regulation;

(63) ‘final operational notification’ or ‘FON’ means a notification issued by the relevant network operator to a power generating facility owner, demand facility owner, distribution system operator or HVDC system owner who complies with the relevant specifications and requirements, allowing them to operate respectively a power generating module, demand facility, distribution network or HVDC system by using the grid connection;

(64) ‘energisation operational notification’ or ‘EON’ means a notification issued by the relevant network operator to a power generating facility owner, demand facility owner, distribution system operator or HVDC system owner prior to energisation of its internal network;

(65) ‘interim operational notification’ or ‘ION’ means a notification issued by the relevant network operator to a power generating facility owner which allows them to operate a power generating module by using the grid connection for a limited period of time and to initiate compliance tests to ensure compliance with the relevant specifications and requirements set out in this Regulation;

(66) ‘limited operational notification’ or ‘LON’ means a notification issued by the relevant network operator to a power generating facility owner who had previously attained FON status but is temporarily subject to either a significant modification or loss of capability resulting in non-compliance with the relevant specifications and requirements set out in this Regulation.

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 areas	**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
Great Britain	1 MW	50 MW	75 MW
Nordic	1.5 MW	10 MW	30 MW
Ireland	0.1 MW	5 MW	10 MW
Baltic	0.5 MW	10 MW	15 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

Application to synchronous power generating modules, pump-storage power generating modules, combined heat and power facilities, and industrial sites

1. Offshore synchronous power generating modules not connected to the interconnected system via a high voltage direct current connection shall meet the requirements for onshore synchronous power generating modules, unless the requirements are modified for this purpose by the relevant network operator in accordance with Article 7. The categories to be taken into account for offshore power park modules for the purpose of this Regulation are defined in paragraph 3 of Article 20.

2. Pump-storage power generating modules shall fulfil all the relevant requirements in both generating and pumping operation mode. Synchronous compensation operation of pump-storage power generating modules shall not be limited in time by the technical design of power generating modules. Pump-storage variable speed power generating modules shall fulfil the requirements applicable to synchronous power generating modules as well as those set out in point (b) of Article 17(2), if they qualify as type B, C or D.

3. With respect to power generating modules embedded in the networks of industrial sites, power generating facility owners, network operators of industrial sites and relevant network operators whose network is connected to the network of an industrial site shall have the right to agree on conditions for disconnection of such power generating modules together with critical loads, which secure production processes, from the relevant network operator’s network. The exercise of this right shall be coordinated with the relevant TSO and comply with Article paragraph 1 of Article 7.

4. Requirements relating to the capability to maintain constant active power output or to modulate active power output other than under paragraphs 2 and 4 of Article 10 shall not apply to power generating modules of facilities for combined heat and power production embedded in the networks of industrial sites, where all of the following criteria are met:

   (a) the primary purpose of those facilities is to produce heat for production processes of the industrial site concerned;

(b) heat and power generation is inextricably interlinked, that is to say any change of heat generation results inadvertently in a change of active power generation and vice versa;

(c) the power generating modules are of type A, B or C in accordance with points (a) to (c) of Article 5(2).

5. Combined heat and power generating facilities shall be assessed on the basis of their electrical maximum capacity.

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
Recovery of costs

1. The costs borne by regulated network operators stemming from the obligations laid down in this Regulation shall be assessed by the competent regulatory authorities. Costs assessed as reasonable, efficient and proportionate shall be recovered in a timely manner through network tariffs or other appropriate mechanisms as determined by the competent regulatory authorities.

2. If requested by the competent regulatory authorities, regulated network operators shall, within three months of the request, provide the information necessary to facilitate assessment of the costs incurred.

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.

TITLE II

REQUIREMENTS

CHAPTER I

GENERAL REQUIREMENTS

Article 10

General requirements for type A power generating modules

1. Type A power generating modules 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
Nordic	47.5 Hz – 48.5 Hz	30 minutes
	48.5 Hz – 49.0 Hz	To be defined by each TSO in accordance with Article 7(1), but not less than 30 minutes
	49.0 Hz – 51.0 Hz	Unlimited
	51.0 Hz – 51.5 Hz	30 minutes
Great Britain	47.0 Hz – 47.5 Hz	20 seconds
	47.5 Hz – 48.5 Hz	90 minutes
	48.5 Hz – 49.0 Hz	To be defined by each TSO in accordance with Article 7(1), but not less than 90 minutes
	49.0 Hz – 51.0 Hz	Unlimited
	51.0 Hz – 51.5 Hz	90 minutes
	51.5 Hz – 52.0 Hz	15 minutes
Ireland	47.5 Hz – 48.5 Hz	90 minutes
	48.5 Hz – 49.0 Hz	To be defined by each TSO in accordance with Article 7(1), but not less than 90 minutes
	49.0 Hz – 51.0 Hz	Unlimited
	51.0 Hz – 51.5 Hz	90 minutes
Baltic	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 in accordance with 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	To be defined by each TSO in accordance with Article 7(1), but not less than 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.

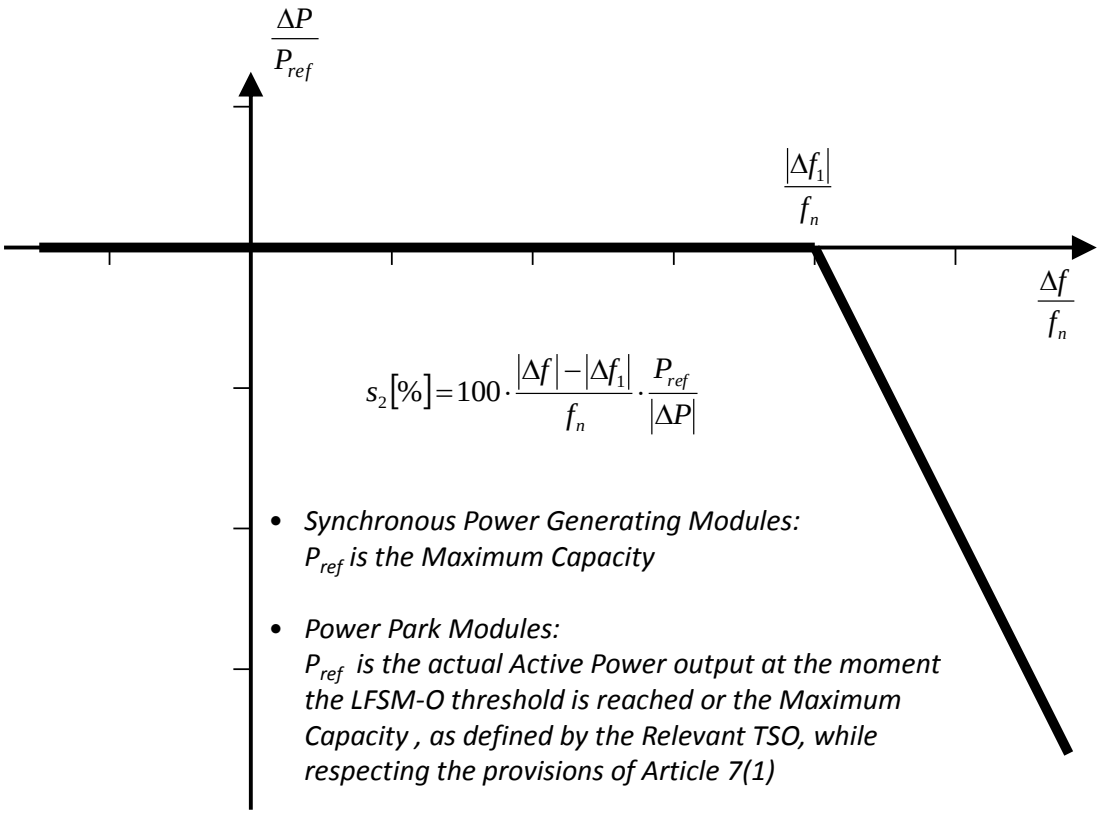

Figure 1: active power frequency response capability of power generating modules in LFSM-O. P_{ref} is the reference active power to which ΔP is related and may be defined differently for synchronous power generating modules and power park modules. ΔP is the change in active power output from the power 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.

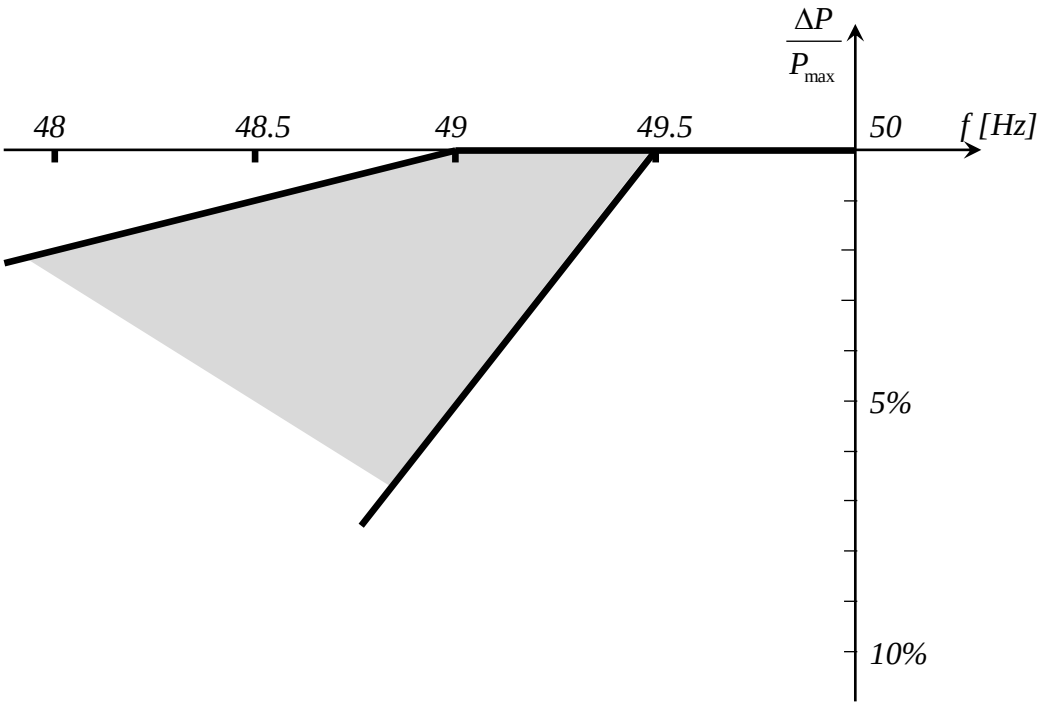

Figure 2: Maximum power capability reduction with falling frequency. The diagram represents the boundaries defined by the relevant TSO while complying with the provisions of paragraph 1 of Article 7.

6. The power generating module shall be equipped with a logic interface (input port) in order to cease active power output within five seconds following an instruction being received at the input port. In accordance with paragraphs 1 Article 7, the relevant network operator shall have the right to define requirements for equipment to make this facility operable remotely.

7. The relevant TSO shall define the conditions under which a power generating module is capable of connecting automatically to the network, in accordance with paragraph 2 of Article 7. Those conditions shall include:

(a) frequency ranges within which an automatic connection is admissible, and a corresponding delay time; and

(b) maximum admissible gradient of increase in active power output.

Automatic connection is allowed unless determined otherwise by the relevant network operator in coordination with the relevant TSO.

Article 11
General requirements for type B power generating modules

1. Type B power generating modules shall fulfil the requirements set out in Article 10.

2. Type B power generating modules shall fulfil the following requirements in relation to frequency stability**:**

(a) to control active power output, the power generating module shall be equipped with an interface (input port) in order to be able to reduce active power output following an instruction at the input port; and

(b) in compliance with the provisions of paragraph 1 of Article 7, the relevant network operator shall have the right to define the requirements for further equipment to allow active power output to be remotely operated.

3. Type B power generating modules 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;

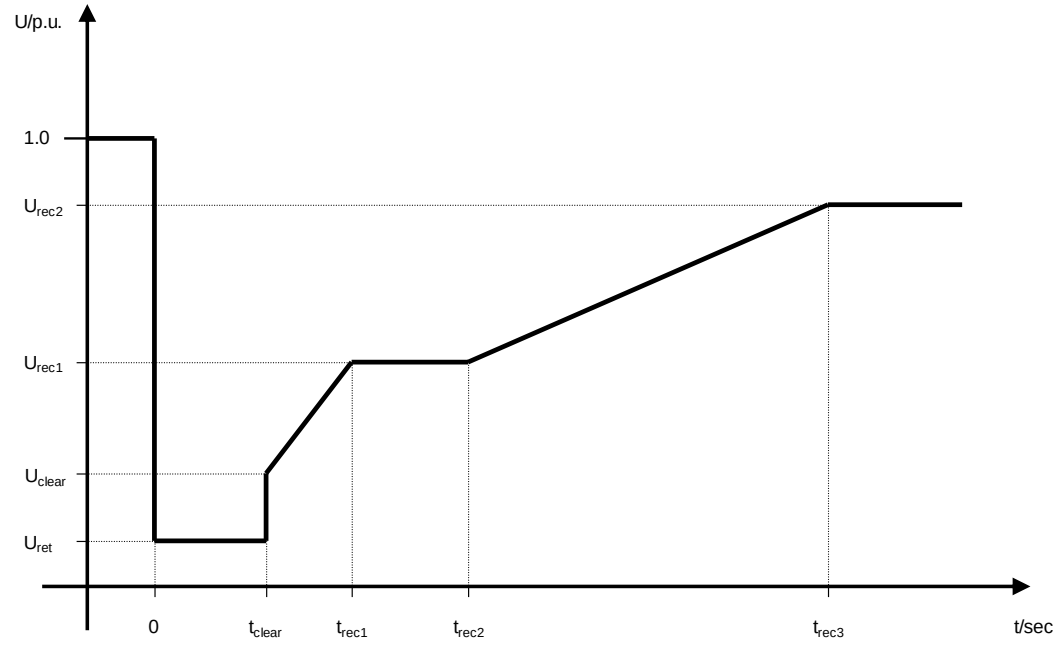

Figure 3: Fault-ride-through profile of a power generating module. The diagram represents the lower limit of a voltage-against-time profile of the voltage at the connection point, expressed as the ratio of its actual value and its nominal value per unit before, during and after a fault. U_{ret} is the 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;

(b) Fault-ride-through capabilities in case of asymmetrical faults shall be defined by each TSO in accordance with paragraph 1 of Article 7.

4. Type B power generating modules 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 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. Type C power generating modules shall fulfil the requirements laid down in Articles 10 and 11, except paragraph 6 of Article 10 and paragraph 2 of Article 11.

2. Type C power generating modules 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;

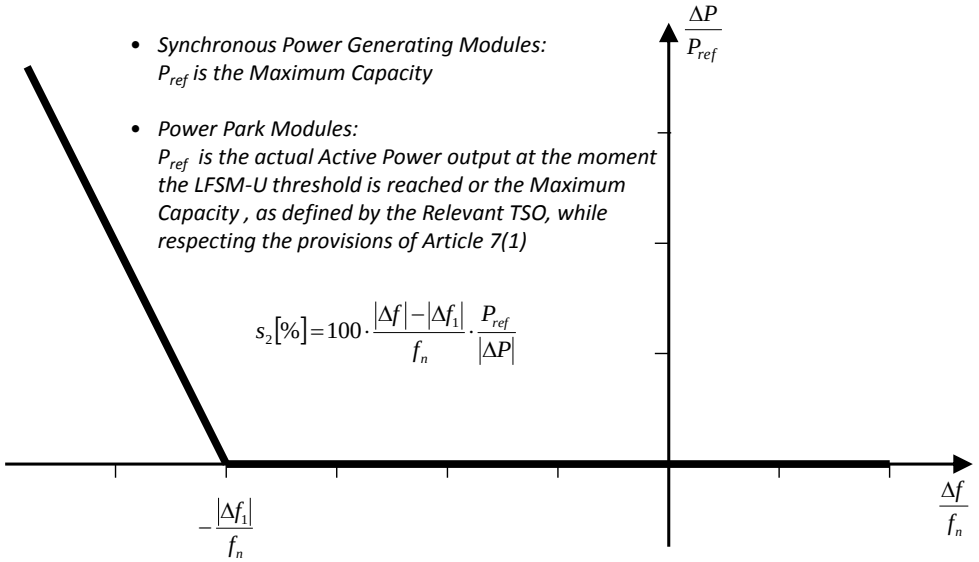

Figure 4: active power frequency response capability of power generating modules in LFSM-U. P_{ref} is the reference active power to which ΔP is related and may be defined differently for synchronous power generating modules and power park modules. ΔP is the change in active power output from the power 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)

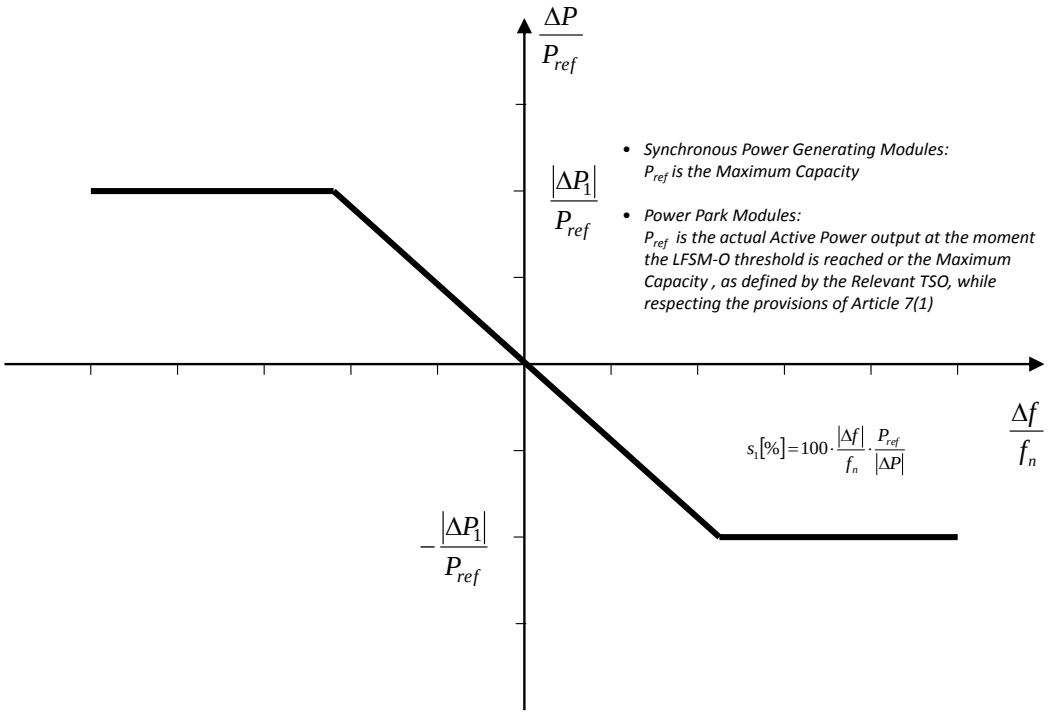

Figure 5: Active power frequency response capability of power generating modules in FSM illustrating the case of zero deadband and insensitivity. P_{ref} is the reference active power to which ΔP is related. ΔP is the change in active power output from the power generating module. f_n is the nominal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

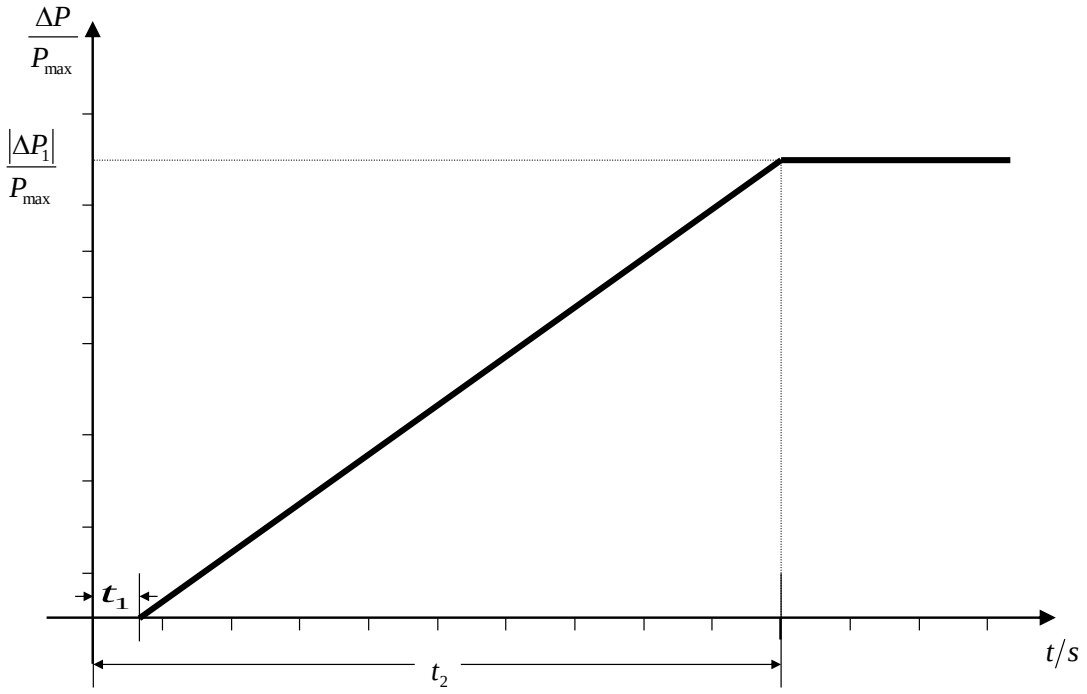

Figure 6: Active power frequency response capability. P_{max} is the maximum capacity to which ΔP relates. ΔP is the change in active power output from the power generating module. The power generating module has to provide active power output ΔP up to the point $ΔP_1$ in accordance with the times t_1 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. With regard to voltage stability, type C power generating modules shall be capable of automatic disconnection when voltage at the connection point reaches levels specified by the relevant network operator in coordination with the relevant TSO.

The terms and settings for actual automatic disconnection of power generating modules shall be defined by the relevant network operator in coordination with the relevant TSO, in accordance with paragraph 1 of Article 7.

4. Type C power generating modules 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 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 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. In addition to fulfilling the requirements listed in Article 10, except for paragraphs 6 and 7 of Article 10, Article 11, except for paragraph 2 of Article 11, and Article 12, except for paragraph 3 of Article 12, type D power generating modules shall fulfil the requirements set out in this Article.

2. Type D power generating modules shall fulfil the following requirements relating to voltage stability:

(a) with regard to voltage ranges:

(i) without prejudice to point (a) of Article 11(3) and point (a) of Article 13(3), a power generating 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 for the time periods specified in Tables 6.1 and 6.2;

(ii) notwithstanding the provisions of paragraph 1 of Article 7, the relevant TSO may determine shorter periods of time during which power generating modules are required to remain connected to the network in the event of simultaneous overvoltage and underfrequency or simultaneous undervoltage and overfrequency;

(iii) notwithstanding the provisions of point (i), the relevant TSO in Spain may require power generating modules to remain connected to the network in the voltage range between 1.05 pu and 1.0875 pu for an unlimited period;

(iv) for the 400 kV grid voltage level (or alternatively commonly referred to as 380 kV level) the reference 1 per unit value is 400 kV, for other grid voltage levels the reference 1 per unit voltage may differ for each TSO in the same synchronous area.

Synchronous area	Voltage range	Time period for operation
Continental Europe	0.85 pu – 0.90 pu	60 minutes
	0.90 pu – 1.118 pu	Unlimited
	1.118 pu – 1.15 pu	To be decided by each TSO with due regard to the provisions of Article 7(1) but not more than 60 minutes
Nordic	0.90 pu – 1.05 pu	Unlimited
	1.05 pu – 1.10 pu	60 minutes
Great Britain	0.90 pu–1.10 pu	Unlimited
Ireland	0.90 pu – 1.118 pu	Unlimited
Baltic	0.85 pu – 0.90 pu	30 minutes
	0.90 pu – 1.12 pu	Unlimited
	1.12 pu – 1.15 pu	20 minutes

Table 6.1: The table shows the minimum time periods during which a power generating module must be capable of operating for voltages deviating from the nominal value at the connection point without disconnecting from the network, where the voltage base for pu values is from 110 kV to 300 kV.

Synchronous area	Voltage range	Time period for operation
Continental Europe	0.85 pu – 0.90 pu	60 minutes
	0.90 pu – 1.05 pu	Unlimited
	1.05 pu – 1.10 pu	60 minutes
Nordic	0.90 pu – 1.05 pu	Unlimited
	1.05 pu – 1.10 pu	60 minutes
Great Britain	0.90 pu – 1.05 pu	Unlimited
	1.05 pu – 1.10 pu	15 minutes
Ireland	0.90 pu – 1.05 pu	Unlimited
Baltic	0.88 pu – 0.90 pu	20 minutes
	0.90 pu – 1.10 pu	Unlimited
	1.10 pu – 1.15 pu	20 minutes

Table 6.2: The table shows the minimum time periods during which a power generating module must be capable of operating for voltages deviating from the nominal value at the connection point without disconnecting from the network where the voltage base for pu values is from 300 kV to 400 kV.

(b) in accordance with paragraph 1 of Article 7, wider voltage ranges or longer minimum time periods for operation may be agreed between the relevant network operator and the power generating facility owner in coordination with the relevant TSO. If wider voltage ranges or longer minimum times for operation are economically and technically feasible, the power generating facility owner shall not unreasonably withhold an agreement;

(c) Without prejudice to point (a), the relevant network operator in coordination with the relevant TSO shall have the right to specify voltages at the connection point at which a power generating module is capable of automatic disconnection. The terms and settings for automatic disconnection shall be agreed between the relevant network operator and the power generating facility owner, in accordance with paragraph 1 of Article 7.

3. Type D power generating modules 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.

(b) 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) of Article 11(3) (a) regarding:

(i) pre-fault minimum short circuit capacity at each connection point expressed in MVA;

(ii) pre-fault operating point of the power generating module expressed as active power output and reactive power output at the connection point and voltage at the connection point; and

(iii) post-fault minimum short circuit capacity at each connection point expressed in MVA;

(c) fault-ride-through capabilities in case of asymmetrical faults shall be defined by each TSO, in accordance with paragraph 1 of Article 7.

4. Type D power generating modules 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.

CHAPTER II

REQUIREMENTS FOR SYNCHRONOUS POWER GENERATING MODULES

Article 14

Requirements for type B synchronous power generating modules

1. Type B synchronous power generating modules shall fulfil the requirements listed in Articles 10 and 11.

2. Type B synchronous power generating modules shall fulfil the following additional requirements relating to voltage stability:

(a) with regard to reactive power capability, the relevant network operator shall have the right to define the capability of a synchronous power generating module to provide reactive power, in accordance with paragraph 1 of Article 7;

(b) with regard to the voltage control system, a synchronous power generating module shall be equipped with a permanent automatic excitation control system that can provide constant alternator terminal voltage at a selectable setpoint without instability over the entire operating range of the synchronous power generating module.

3. The relevant TSO shall define the magnitude and time for active power recovery that the type B synchronous power generating module is capable of providing, in accordance with paragraph 1 of Article 7.

Article 15
Requirements for type C synchronous power generating modules

1. Type C synchronous power generating modules shall fulfil the requirements laid down in Articles 10, 11, 12 and 14, except for Article 10(6), Article 11(2) and Article 14(2) (a).

2. Type C synchronous power generating modules shall fulfil the following additional requirements in relation to voltage stability:

(a) in accordance with paragraph 1 of Article 7, the relevant network operator may define supplementary reactive power to compensate for the reactive power demand of the high-voltage line or cable between these two points from the responsible owner of that line or cable. With regard to reactive power capability, the relevant network operator may define such supplementary reactive power for synchronous power generating modules where the connection point is neither at the location of the high-voltage terminals of the step-up transformer to the voltage level of the connection point nor at the alternator terminals, if no step-up transformer exists.

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

(i) in accordance with paragraph 1 of Article 7, the relevant network operator in coordination with the relevant TSO shall define the reactive power provision capability requirements in the context of varying voltage. For that purpose the relevant network operator shall define a U-Q/P_{max}-profile within the boundaries of which the synchronous power generating module shall be capable of providing reactive power at its maximum capacity. 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;

(ii) in accordance with paragraph 1 of Article 7, the U-Q/P_{max}-profile shall be defined by the 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 7;

– the dimensions of the U-Q/P_{max}-profile envelope (Q/P_{max} range and voltage range) shall be within the range defined for each synchronous area in Table 8; and

– the position of the U-Q/P_{max}-profile envelope shall be within the limits of the fixed outer envelope in Figure 7;

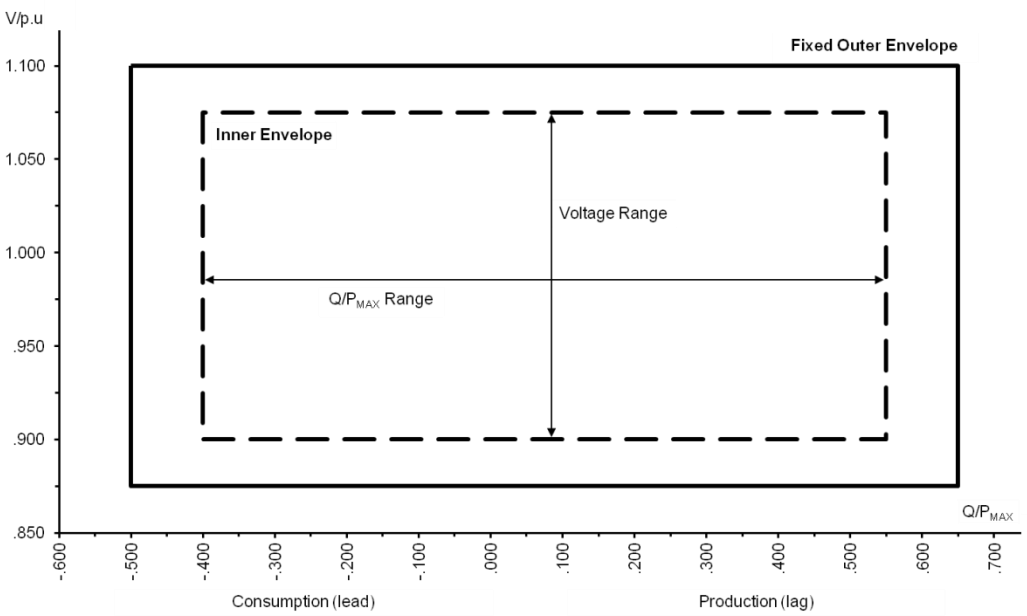

Figure 7: U-Q/P_{max}-profile of a synchronous power generating module. The diagram represents boundaries of a U-Q/P_{max}-profile by the voltage at the connection point, expressed by the ratio of its actual value and its nominal value in per unit, against the ratio of the reactive power (Q) and the 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	0.95	0.225
Nordic	0.95	0.150
Great Britain	0.95	0.100
Ireland	1.08	0.218
Baltic States	1.0	0.220

Table 8: Parameters for the inner envelope in Figure 7

(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;

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

(c) with regard to reactive power capability below maximum capacity, when operating at an active power output below the maximum capacity ($P<P_{max}$), the synchronous power generating modules shall be capable of operating at every possible operating point in the P-Q-capability diagram of the alternator of that synchronous power generating module, at least down to minimum stable operating level. Even at reduced active power output, reactive power supply at the connection point shall correspond fully to the P-Q-capability diagram of the alternator of that synchronous power generating module, taking the auxiliary supply power and the active and reactive power losses of the step-up transformer, if applicable, into account.

Article 16

Requirements for type D synchronous power generating modules

1. Type D synchronous power generating modules shall fulfil the requirements laid down in Articles 10, 11, 12, 13, 14 and 15, except for Article 10(6), Article 11(2), Article 12(3), and Article 14(2).

2. type D synchronous power generating modules shall fulfil the following additional requirements in relation to voltage stability:

(a) in accordance with paragraph 1 of Article 7, the parameters and settings of the components of the voltage control system shall be agreed between the power generating facility owner and the relevant network operator, in coordination with the relevant TSO;

(b) the agreement referred to in subparagraph (a) shall cover the specifications and performance of an automatic voltage regulator ('AVR') with regard to steady-state voltage and transient voltage control and the specifications and performance of the excitation control system. The latter shall include:

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

(ii) an underexcitation limiter to prevent the automatic voltage regulator from reducing the alternator excitation to a level which would endanger synchronous stability;

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

(iv) a stator current limiter; and

(v) a PSS function to attenuate power oscillations, if the synchronous power generating module size is above a value of maximum capacity defined by the relevant TSO in accordance with paragraph 1 of Article 7.

3. In accordance with paragraph 1 of Article 7, the relevant TSO and the power generating facility owner shall enter into an agreement regarding technical

capabilities of the power generating module to aid angular stability under fault conditions.

CHAPTER III

REQUIREMENTS FOR POWER PARK MODULES

Article 17
Requirements for type B power park modules

1. Type B power park modules shall fulfil the requirements laid down in Articles 10 and 11.

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

   (a) with regard to reactive power capability, the relevant network operator shall have the right to define, in accordance with paragraph 1 of Article 7, the capability of a power park module to provide reactive power;

   (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 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. Type C power park modules shall fulfil the requirements listed in Articles 10, 11, 12 and 17, except for paragraph 6 of Article 10, paragraph 2 of Article 11, and point (a) of Article 17(2) unless referred to otherwise in points (d) and (v) of paragraph (3) (d).

2. Type C power park modules 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 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;

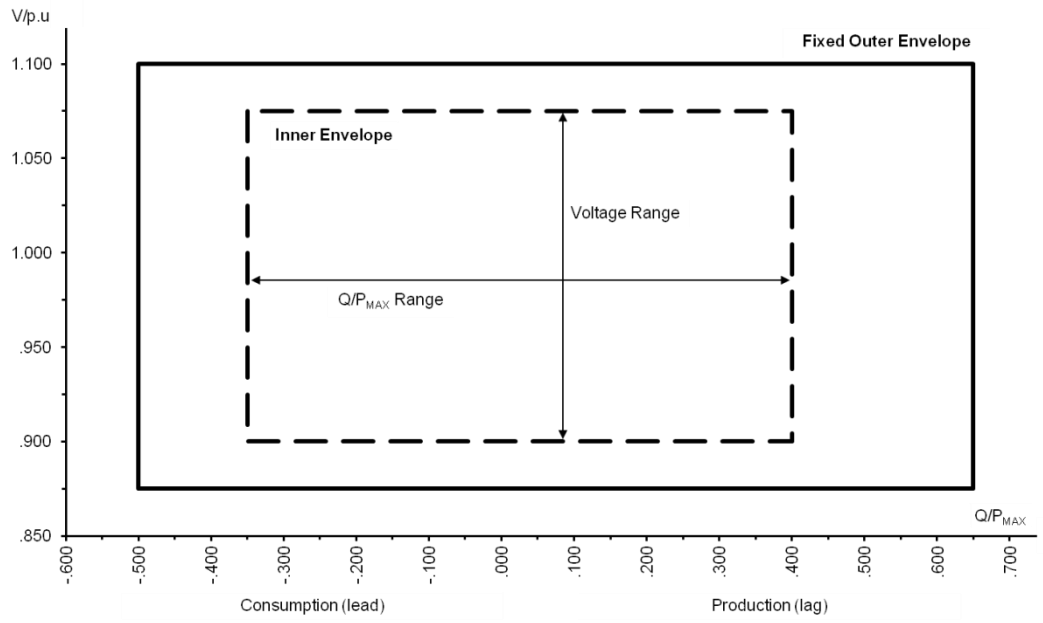

Figure 8: U-Q/P_{max}-profile of a power park module. The diagram represents boundaries of a U-Q/P_{max}-profile by the voltage at the connection point, expressed by the ratio of its actual value and its nominal value per unit, against the ratio of the reactive power (Q) and the maximum capacity (P_{max}). 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
Nordic	0.95	0.150
Great Britain	0.66	0.100
Ireland	0.66	0.218
Baltic States	0.80	0.220

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 $P\text{-}Q/P_{max}$-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 $P\text{-}Q/P_{max}$-profile shall be defined by each relevant network operator in coordination with the relevant TSO, in conformity with the following principles:

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

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

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

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

– the position of the $P\text{-}Q/P_{max}$-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 $P\text{-}Q/P_{max}$-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;

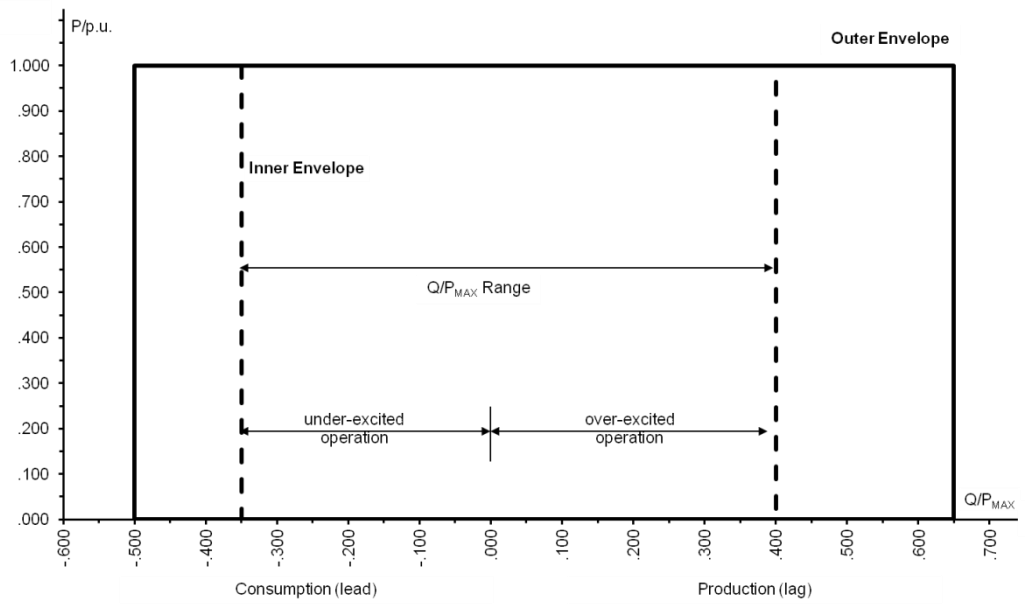

Figure 9: P-Q/P_{max}-profile of a power park module. The diagram represents boundaries of a P-Q/P_{max}-profile at the connection point by the active power, expressed by the ratio of its actual value and the maximum capacity per unit, against the ratio of the reactive power (Q) and the maximum capacity (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
Requirements for type D power park modules

Type D power park modules shall fulfil the requirements listed in Articles 10, 11, 12, 13, 17 and 18, except for paragraph 6 of Article 10, paragraph 3 of Article 11, paragraph 3 of Article 12 and point (a) of Article 17(2).

CHAPTER IV

REQUIREMENTS FOR OFFSHORE POWER PARK MODULES

Article 20
General provisions

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. Notwithstanding the provisions of paragraph 1, the relevant TSO in Spain may require power generating modules to remain connected to the network in the voltage range between 1.05 pu and 1.0875 pu for an unlimited period.

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
Nordic	0.90 pu – 1.05 pu	Unlimited
	1.05 pu – 1.10 pu	60 minutes
Great Britain	0.90 pu – 1.10 pu*	Unlimited
	0.90 pu – 1.05 pu**	Unlimited
	1.05 pu – 1.10 pu**	15 minutes
Ireland	0.90 pu – 1.10 pu	Unlimited
Baltic	0.85 pu – 0.90 pu*	30 minutes
	0.90 pu – 1.12 pu*	Unlimited
	1.12 pu – 1.15 pu*	20 minutes
	0.88 pu – 0.90 pu**	20 minutes
	0.90 pu – 1.10 pu**	Unlimited
	1.10 pu – 1.15 pu**	20 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
Nordic	0.95	0.150
Great Britain	0* 0.33**	0.100
Ireland	0.66	0.218
Baltic States	0.8	0.22

*) at the offshore connection point for configuration 1

**) at the offshore connection point for configuration 2

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.

TITLE III

OPERATIONAL NOTIFICATION PROCEDURE FOR CONNECTION

CHAPTER I

CONNECTION OF NEW POWER GENERATING MODULES

Article 26
General provisions

1. The power generating facility owner shall demonstrate to the relevant network operator that it has complied with the requirements set out in Title 2 of this Regulation by completing successfully the operational notification procedure for connection of each power generating module described in Articles 27 to 34.

2. The relevant network operator shall clarify and make publicly available the details of the operational notification procedure, in accordance with paragraph 1 of Article 7.

Article 27
Operational notification of type A power generating modules

1. The operational notification procedure for connection of each new type A power generating module shall consist of submitting an installation document. The power generating facility owner shall fill in the required information on an installation document obtained from the relevant network operator and shall submit it to the network operator. Separate installation documents shall be provided for each power generating module within the power generating facility.

   The relevant network operator shall ensure that the required information can be submitted by third parties, including aggregators, on behalf of the power generating facility owner.

2. The relevant network operator shall define, in accordance with paragraph 1 of Article 7, the content of the installation document, which shall have at least the following information:

   (a) the location at which the connection is made;

   (b) the date of the connection;

   (c) the maximum capacity of the installation in kW;

   (d) the type of primary energy source;

   (e) the classification of the power generating module as an emerging technology according to Title 6 of this Regulation;

   (f) reference to equipment certificates used in the site installation;

   (g) as regards equipment used, for which an equipment certificate has not been received, information shall be provided as directed by the relevant network operator; and

   (h) the contact details of the power generating facility owner and the installer and their signatures.

3. The power generating facility owner shall notify the relevant network operator about the permanent decommissioning of a power generating module.

   The relevant network operator shall ensure that such notification can be made by third parties, including aggregators.

4. The relevant network operator shall ensure that the operation and decommissioning of power generating modules can be notified electronically.

Article 28

Operational notification of type B, C and D power generating modules

The operational notification procedure for connection of each new type B, C and D power generating module shall allow the use of equipment certificates.

Article 29

Procedure for type B and C power generating modules

1. For the purpose of operational notification for connection of each new type B and C power generating module, a power generating module document ('PGMD') shall be provided by the power generating facility owner to the relevant network operator and shall include a statement of compliance.

   For each power generating module within the power generating facility, separate independent PGMDs shall be provided.

2. The format of the PGMD and the information to be given therein shall be defined by the relevant network operator, in accordance with paragraph 1 of Article 7. The relevant network operator shall have the right to request that the power generating facility owner include the following in the PGMD:

   (a) evidence of an agreement on the protection and control settings relevant to the connection point between the relevant network operator and the power generating facility owner;

   (b) itemised statement of compliance;

   (c) detailed technical data of the power generating module with relevance to the grid connection as specified by the relevant network operator;

   (d) equipment certificates in respect of power generating modules, where these are relied upon as part of the evidence of compliance;

   (e) simulation models pursuant to point (c) of Article 12(6);

   (f) compliance test reports demonstrating steady-state and dynamic performance as required by Chapters 2, 3 and 4 of Title IV, including use of actual measured values during testing, to the level of detail required by the relevant network operator, in accordance with the provisions of paragraph 1 of Article 7; and

   (g) studies demonstrating steady-state and dynamic performance as required by Chapters 5, 6 or 7 of Title IV, to the level of detail required by the relevant network operator, in accordance with paragraph 1 of Article 7.

3. The relevant network operator, on acceptance of a complete and adequate PGMD, shall issue a final operational notification to the power generating facility owner.

4. The power generating facility owner shall notify the relevant network operator about the permanent decommissioning of a power generating module.

5. The relevant network operator shall ensure that the operation and decommissioning of power generating modules can be notified electronically.

Article 30

Procedure for type D power generating modules

The operational notification procedure for connection of each new type D power generating module shall comprise:

(a) energisation operational notification ('EON');

(b) interim operational notification ('ION'); and

(c) final operational notification ('FON').

Article 31

Energisation operational notification for type D power generating modules

1. An EON shall entitle the power generating facility owner to energise its internal network and auxiliaries for the power generating modules by using the grid connection that is defined by the connection point.

2. An EON shall be issued by the relevant network operator, subject to completion of preparations including agreement on the protection and control settings relevant to the connection point between the relevant network operator and the power generating facility owner.

Article 32

Interim operational notification for type D power generating modules

1. An ION shall entitle the power generating facility owner to operate the power generating module and generate power by using the grid connection for a limited period of time.

2. An ION shall be issued by the relevant network operator, subject to completion of the data and study review process as required by this Article.

3. With regard to the data and study review, the relevant network operator shall have the right to request that the power generating facility owner provide the following:

(a) itemised statement of compliance;

(b) detailed technical data on the power generating module of relevance to the grid connection as specified by the relevant network operator;

(c) equipment certificates in respect of power generating modules, where they are relied upon as part of the evidence of compliance;

(d) simulation models, as specified by point (c) of Article 12(6) and required by the relevant network operator, in accordance with paragraph 1 of Article 7;

(e) studies demonstrating the expected steady-state and dynamic performance as required by Chapter 5, 6 or 7 of Title IV; and

(f) details of intended compliance tests in accordance with Chapters 2, 3 and 4 of Title IV.

4. The maximum period during which the power generating facility owner may maintain ION status shall be 24 months. In accordance with paragraph 1 of Article 7, the relevant network operator is entitled to specify a shorter ION validity period. The ION validity period shall be subject to notification to the relevant national regulatory authority. The modalities of that notification shall be determined in accordance with

the applicable national regulatory framework. An extension of the ION shall be granted only if the power generating facility owner has made substantial progress towards full compliance. Outstanding issues shall be clearly identified at the time of requesting extension.

5. An extension of the period during which the power generating facility owner may maintain ION status, beyond the period established in paragraph 4, may be granted if a request for derogation is made to the relevant network operator before the expiry of that period in accordance with the derogation procedure laid down in Article 56.

Article 33

Final operational notification for type D power generating modules

1. A FON shall entitle the power generating facility owner to operate a power generating module by using the grid connection.

2. A FON shall be issued by the relevant network operator, upon prior removal of all incompatibilities identified for the purpose of ION status and subject to completion of the data and study review process as required by this Article.

3. For the purposes of the data and study review, the power generating facility owner must submit the following to the relevant network operator:

   (a) an itemised statement of compliance; and

   (b) an update of applicable technical data, simulation models and studies as referred to in points (b), (c), (d) and (e) of Article 32(3), including the use of actual measured values during testing.

4. If incompatibility is identified in connection with the issuing of the FON, a derogation may be granted upon a request made to the relevant network operator, in accordance with the derogation procedure described in Title 5. A FON shall be issued by the relevant network operator if the power generating module complies with the provisions of the derogation. Where a request for derogation is rejected, the relevant network operator shall have the right to refuse to allow the operation of the power generating module until the power generating facility owner and the relevant network operator resolve the incompatibility and the relevant network operator considers that the power generating module complies with the provisions of the derogation.

Article 34

Limited operational notification for type D power generating modules

1. Power generating facility owners to whom a FON has been granted shall inform the relevant network operator immediately in the following circumstances:

   (a) the facility is temporarily subject to either significant modification or loss of capability affecting its performance; or

   (b) in the event of equipment failure leading to non-compliance with some relevant requirements.

2. The power generating facility owner shall apply to the relevant network operator for a LON, if the power generating facility owner reasonably expects the circumstances described in paragraph 1 to persist for more than three months.

3. A LON shall be issued by the relevant network operator and shall contain the following information which shall be clearly identifiable:

   (a) the unresolved issues justifying the granting of the LON;

   (b) the responsibilities and timescales for the expected solution; and

   (c) a maximum period of validity which shall not exceed 12 months. The initial period granted may be shorter with the possibility of an extension if evidence is submitted to the satisfaction of the relevant network operator demonstrating that substantial progress has been made towards achieving full compliance.

4. The FON shall be suspended during the period of validity of the LON with regard to the items for which the LON has been issued.

5. A further extension of the period of validity of the LON may be granted upon a request for derogation made to the relevant network operator before the expiry of that period, in accordance with the derogation procedure described in Title V.

6. The relevant network operator shall have the right to refuse to allow the operation of the power generating module, once the LON is no longer valid. In such cases, the FON shall automatically become invalid.

CHAPTER II

COST BENEFIT ANALYSIS

Article 35

Identification of costs and benefits of application of rules to existing power generating modules

1. In order to assess the costs and benefits of the application of any requirement set out in this Regulation to existing power generating modules, the relevant TSO shall initiate the process described in paragraph 3 of Article 4 with a preparatory stage aimed at identifying cases of merit in accordance with the phases set out in paragraphs 2 to 7. In the preparatory stage, the relevant TSO shall undertake a qualitative comparison of costs and benefits related to the requirement under consideration for application to existing power generating modules which shall take into account available network-based or market-based alternatives. The relevant TSO may only proceed to undertake a quantitative cost-benefit analysis, as described in paragraphs 2 to 5, if the qualitative comparison indicates that the likely benefits exceed the likely costs. If, however, the cost is deemed high or the benefit is deemed low, then the relevant TSO may not proceed further.

2. The relevant TSO shall carry out a quantitative cost-benefit analysis of any requirement under consideration for application to existing power generating modules that has demonstrated potential benefits as a result of the preparatory stage according to paragraph 1. That cost-benefit analysis shall be followed by a public consultation which shall include, inter alia, a proposal for a transitional period for applying the requirement to existing power generating modules. That transitional period shall not be more than two years from the date of the decision of the national regulatory authority on the requirement's applicability.

3. Power generating facility owners, DSOs and CDSOs shall assist and contribute to the cost-benefit analysis and provide the data requested by the relevant TSO within three months of receiving a request, unless agreed otherwise.

4. The cost-benefit analysis shall be in line with the following principles:

(a) the relevant TSO shall base its cost-benefit analysis on one or more of the following calculating principles:

(i) the net present value;

(ii) the return on investment;

(iii) the rate of return; and

(iv) the time needed to break even;

(b) the relevant TSO shall also quantify socio-economic benefits in terms of improvement in security of supply and shall include at least:

(i) the associated reduction in probability of loss of supply over the lifetime of the modification;

(ii) the probable extent and duration of such loss of supply; and

(iii) the societal cost per hour of such loss of supply;

(c) the relevant TSO shall quantify the benefits to the internal market in electricity, cross-border trade and integration of renewable energies, including at least:

(i) the frequency response;

(ii) the reserve holding;

(iii) the reactive power provision;

(iv) congestion management; and

(v) defence measures;

(d) the relevant TSO shall quantify the costs of applying the necessary rules to existing power generating modules, including at least:

(i) the direct costs incurred in implementing a requirement;

(ii) the costs associated with attributable loss of opportunity; and

(iii) the costs associated with resulting changes in maintenance and operation.

5. Within three months of concluding the cost-benefit analysis, the relevant TSO shall summarise the findings in a report which shall:

(a) include a recommendation on how to proceed;

(b) be subject to public consultation.

No later than six months after the end of the public consultation, the relevant TSO shall prepare a report explaining the outcome of the consultation and making a proposal on the applicability of the requirement under consideration to existing power generating modules. The report and proposal shall be notified to the national regulatory authority.

6. The proposal made by the relevant TSO to the national regulatory authority on the applicability of any requirement of this Regulation to existing power generating modules according to paragraph 3 of Article 4 shall include the following:

(a) an operational notification procedure for demonstrating the implementation of the requirements by the power generating facility owner;

(b) a transitional period for implementing the requirements which shall take into account the category of the power generating module as defined in paragraph 2 of Article 5 and paragraph 1 of Article 6 and any underlying obstacles to the efficient implementation of the equipment modification/refitting.

7. The relevant national regulatory authority shall decide on the case within three months of receipt of the report and the recommendation of the relevant TSO.

The decision of the national regulatory authority shall be published.

8. All relevant clauses in contracts and relevant clauses of general terms and conditions relating to the grid connection of existing power generating modules shall be amended in order to comply with the requirements of this Regulation. The relevant clauses shall be amended within three years following the decision of the national regulatory authority or Member State as referred to in paragraph 1 of Article 4. The requirement for amendment shall apply regardless of whether the relevant contracts or general terms and conditions provide for such an amendment.

TITLE IV

COMPLIANCE

CHAPTER I

COMPLIANCE MONITORING

Article 36

Responsibility of the power generating facility owner

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.

CHAPTER II

COMPLIANCE TESTING FOR SYNCHRONOUS POWER GENERATING MODULES

Article 40

Compliance tests for type B synchronous power generating modules

1. Power generating facility owners shall undertake LFSM-O response compliance tests in relation to type B synchronous power generating modules.

   Instead of carrying out the relevant test, power generating facility owners may rely upon equipment certificates to demonstrate compliance with the relevant requirement. In such a case, the equipment certificate shall be provided to the relevant network operator.

2. The following requirements with regard to the LFSM-O response test shall apply:

   (a) the power generating module's technical capability to continuously modulate active power to contribute to frequency control in case of any large increase of frequency in the system shall be demonstrated. The steady-state parameters of regulations, such as droop and deadband and 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 at least 10 % of maximum capacity change in active power, taking into account the droop settings and the deadband. If required, simulated frequency deviation signals shall be injected simultaneously at both the speed and power control loops of the control systems, taking into account the scheme of those control systems;

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

      (i) the test results, for both dynamic and static parameters, meet the requirements set out in paragraph 2 of Article 10; and

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

Article 41

Compliance tests for type C synchronous power generating modules

1. In addition to the compliance tests for type B synchronous power generating modules described in Article 40, power generating facility owners shall undertake the compliance tests set out in paragraphs 2, 3, 4 and 6 of this Article in relation to type C synchronous power generating modules. Where a power generating module provides black start capability, power generating facility owners shall also undertake the tests referred to in paragraph 5. Instead of the relevant test, the power generating facility owner may use equipment certificates to demonstrate compliance with the relevant requirement. In that case, the equipment certificate shall be provided to the relevant network operator.

2. The following requirements with regard to the LFSM-U response test shall apply:

(a) it shall demonstrate that the power generating module is technically capable of continuously modulating active power at operating points below maximum capacity to contribute to frequency control in case of a large frequency drop in the system;

(b) the test shall be carried out by simulating appropriate active power load points, with low frequency steps and ramps big enough to trigger at least 10 % of maximum capacity active power change, taking into account the droop settings and the deadband. If required, simulated frequency deviation signals shall be injected simultaneously into both the speed governor and the load controller references, taking into account the speed governor and the 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 point (c) of Article 12(2); and

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

3. The following requirements with regard to the FSM response test shall apply:

(a) it shall demonstrate that the power generating module is technically capable of continuously modulating 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 droop and deadband and dynamic parameters, including robustness through frequency step change response and large, fast frequency changes 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, the deadband and the real power headroom or deload, that is to say the margin to maximum capacity in operational timescale. If required, simulated frequency deviation signals shall be injected simultaneously into the references of both the speed governor and the load controller of the unit or plant control system, taking into account the speed governor and load controller scheme.

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

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

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

(iii) the initial delay time complies with point (d) of Article 12(2);

(iv) the droop settings are available within the range defined in point (d) of Article 12(2) and the deadband (threshold) is not higher than the value specified in that Article; and

(v) the insensitivity of active power frequency response at any relevant operating point does not exceed the requirements set out in point (d) of Article 12(2).

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

   (a) the power generating module's technical capability to participate in frequency restoration control shall be demonstrated and the cooperation of 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).

5. With regard to the black start capability test the following requirements shall apply:

   (a) for power generating modules with black start capability, this technical capability to start from shut down without any external energy supply shall be demonstrated;

   (b) the test shall be deemed successful if the start-up time is kept within the timeframe set out in points (iii) of Article 12(5)(a).

6. With regard to the tripping to houseload test the following requirements shall apply:

   (a) the power generating modules' technical capability to trip to and stably operate on house load shall be demonstrated;

   (b) the test shall be carried out at the maximum capacity and nominal reactive power of the power generating module before load shedding;

   (c) in accordance with paragraph 1 of Article 7, the relevant network operator shall have the right to set additional conditions , taking into account point (c) of Article 12(5).

   (d) The test shall be deemed successful if tripping to house load is successful, stable houseload operation has been demonstrated in the time period set out in point (c) of Article 12(5) and re-synchronisation to the network has been performed successfully.

7. With regard to the reactive power capability test the following requirements shall apply:

   (a) the power generating module's technical capability to provide leading and lagging reactive power capability in accordance with points (b) and (c) of Article 15(2) shall be demonstrated;

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

      (i) the power generating module operates at maximum reactive power for at least one hour, both leading and lagging, for:

      – minimum stable operating level;

      – maximum capacity; and

      – an active power operating point between those maximum and minimum ranges;

      (ii) the power generating module's capability to change to any reactive power target value within the agreed or decided reactive power range in relation to the specified performance targets of the relevant reactive power control scheme is demonstrated.

Article 42

Compliance tests for type D synchronous power generating modules

1. Type D synchronous power generating modules are subject to the compliance tests for type B and C synchronous power generating modules described in Articles 40 and 41.

2. Instead of the relevant test, the power generating facility owner may use equipment certificates to demonstrate compliance with the relevant requirement. In such a case, the equipment certificate shall be provided to the relevant network operator.

CHAPTER III

COMPLIANCE TESTING FOR POWER PARK MODULES

Article 43

Compliance tests for type B power park modules

1. Power generating facility owners shall undertake LFSM-O response compliance tests in relation to type B power park modules.

   Instead of the relevant test, the power generating facility owner may use equipment certificates to demonstrate compliance with the relevant requirement. In that case, the equipment certificate shall be provided to the relevant network operator.

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. With regard to the LFSM-O response tests 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 increase of frequency in the system shall be demonstrated and the steady-state parameters of regulations, such as droop and deadband, and 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 at least 10 % of maximum capacity change in active power, taking into account the droop settings and the deadband. To perform this test simulated frequency deviation signals shall be injected.

   (c) The test shall be deemed successful in the event that the test results, for both dynamic and static parameters, comply with the requirements set out in paragraph 2 of Article 10.

Article 44

Compliance tests for type C power park modules

1. In addition to the compliance tests for type B power park modules described in Article 43, power generation facility owners shall undertake the compliance tests set out in paragraphs 2 to 9 in relation to type C power park modules. Instead of the relevant test, the power generating facility owner may use equipment certificates to demonstrate compliance with the relevant requirement. In such a case, the equipment certificate shall be provided to the relevant network operator.

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. With regard to the reactive power capability test the following requirements shall apply:

(a) the power park module's technical capability to provide leading and lagging reactive power capability in accordance with points (b) and (c) of Article 18(3) shall be demonstrated;

(b) it shall be carried out at maximum reactive power, both leading and lagging, and shall verify the following parameters:

(i) operation in excess of 60 % of maximum capacity for 30 min;

(ii) operation within the range of 30 – 50 % of maximum capacity for 30 min; and

(iii) operation within the range of 10 – 20 % of maximum capacity for 60 min;

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

(i) the power park module operates for a duration no shorter than the requested duration at maximum reactive power, both leading and lagging, in each parameter specified in paragraph (6) (b);

(ii) the power park module's capability to change to any reactive power target value within the agreed or decided reactive power range in the specified performance targets of the relevant reactive power control scheme is demonstrated; and

(iii) no protection action takes place within the operation limits defined by the reactive power capacity diagram.

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 45
Compliance tests for type D power park modules

1. Type D power park modules are subject to the compliance tests for type B and C power park modules in accordance with the conditions set out in Articles 43 and 44.

2. Instead of the relevant test, the power generating facility owner may use equipment certificates to demonstrate compliance with the relevant requirement. In that case, the equipment certificate shall be provided to the relevant network operator.

CHAPTER IV

COMPLIANCE TESTING FOR OFFSHORE POWER PARK MODULES

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.

CHAPTER V

COMPLIANCE SIMULATIONS FOR SYNCHRONOUS POWER GENERATING MODULES

Article 47
Compliance simulations for type B synchronous power generating modules

1. Power generating facility owners shall undertake LFSM-O response simulations in relation to type B synchronous power generating modules. Instead of the relevant simulations, the power generating facility owner may use an equipment certificate to demonstrate compliance with the relevant requirement. In that case, the equipment certificate shall be provided to the relevant network operator.

2. With regard to the LFSM-O response simulation the following requirements shall apply:

(a) the power generating module's capability to simulate active power modulation at high frequency in accordance with paragraph 2 of Article 10 shall be demonstrated;

(b) the simulation shall be carried out by means of high frequency steps and ramps reaching minimum regulating level, taking into account the droop settings and the deadband;

(c) the simulation shall be deemed successful in the event that:

(i) the simulation model of the power generating module is validated against the compliance test for LFSM-O response described in paragraph 2 of Article 40; and

(ii) compliance with the requirement set out in paragraph 2 of Article 10 is demonstrated.

3. With regard to the type B fault-ride-through capability of synchronous power generating modules simulation the following requirements shall apply:

(a) the power generating module's capability to simulate fault-ride-through capability referred to in the conditions set out in subparagraph (a) of Article 11(3) shall be demonstrated;

(b) the simulation shall be deemed successful if compliance with the requirement set out in point (a) of Article 11(3) is demonstrated.

4. With regard to the post fault power active recovery simulation the following requirements shall apply:

(a) the power generating module's capability to simulate post fault active power recovery referred to in the conditions set out in paragraph 3 of Article 14 shall be demonstrated;

(b) the simulation shall be deemed successful if compliance with the requirement set out in paragraph 3 of Article 14(3) is demonstrated.

Article 48

Compliance simulations for type C synchronous power generating modules

1. In addition to the compliance simulations for type B synchronous power generating modules set out in Article 47, type C synchronous power generating modules shall be subject to the compliance simulations detailed in paragraphs 2 to 5. Instead of all or part of those simulations, the power generating facility owner may use equipment certificates, which must be provided to the relevant network operator.

2. With regard to the LFSM-U response simulation the following requirements shall apply:

(a) the power generating module's capability to simulate active power modulation at low frequencies in accordance with point (c) of Article 12(2) shall be demonstrated;

(b) the simulation shall be carried out by means of low frequency steps and ramps reaching maximum capacity, taking into account the droop settings and the deadband;

(c) the simulation shall be deemed successful in the event that:

(i) the simulation model of the power generating module is validated against the compliance test for LFSM-U response described in paragraph 2 of Article 41; and

(ii) compliance with the requirement of point (c) of Article 12(2) is demonstrated.

3. With regard to the FSM response simulation the following requirements shall apply:

(a) the power generating module's capability to modulate active power over the full frequency range in accordance with point (d) of Article 12(2) shall be demonstrated;

(b) the simulation 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;

(c) the simulation shall be deemed successful in the event that:

(i) the simulation model of the power generating module is validated against the compliance test for FSM response described in paragraph 3 of Article 41; and

(ii) compliance with the requirement of point (d) of Article 12(2) is demonstrated.

4. With regard to the island operation simulation the following requirements shall apply:

(a) the power generating module's performance during island operation referred to in the conditions set out in point (b) of Article 12(5) shall be demonstrated;

(b) the simulation shall be deemed successful if 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 within the limits of point (b) of Article 12(5), without disconnection of the power generating module from the island due to over or under-frequency.

5. With regard to the reactive power capability simulation the following requirements shall apply:

(a) the power generating module's capability to simulate leading and lagging reactive power capability in accordance with the conditions set out in points (b) and (c) of Article 15(2) shall be demonstrated;

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

(i) the simulation model of the power generating module is validated against the compliance tests for reactive power capability described in paragraph 7 of Article 41; and

(ii) compliance with the requirements of points (b) and (c) of Article 15(2) is demonstrated.

Article 49

Compliance simulations for type D synchronous power generating modules

1. In addition to the compliance simulations for type B and C synchronous power generating modules set out in Articles 47 and 48, except for the type B fault-ride-through capability of synchronous power generating modules as referred to in paragraph 3 of Article 47, type D synchronous power generating modules are subject to the compliance simulations set out in paragraphs 2 and 3. Instead of all or part of those simulations, the power generating facility owner may use equipment certificates, which must be provided to the relevant network operator.

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

(a) it shall be demonstrated that the power generating module's performance in terms of its control system ('PSS function') is capable of damping power oscillations in accordance with the conditions set out in paragraph 2 of Article 16 shall;

(b) the tuning must result in improved damping of corresponding active power response of the AVR in combination with the PSS function, compared to the active power response of the AVR alone;

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

(i) the PSS function damps the existing power oscillations of the power generating module within a frequency range specified by the relevant TSO. That frequency range shall include the local mode frequency of the power generating module and the expected network oscillations; and

(ii) a sudden load reduction of the power generating module from 1p.u. to 0.6p.u. of the maximum capacity does not lead to undamped oscillations in active or reactive power of the power generating module.

3. With regard to the type D fault-ride-through capability simulation of synchronous power generating modules the following requirements shall apply:

(a) the power generating module's capability to simulate fault-ride-through in accordance with the conditions set out in point (a) of Article 13(3) shall be demonstrated;

(b) the simulation shall be deemed successful if compliance with the requirement laid down in point (a) of Article 13(3) is demonstrated.

CHAPTER VI

COMPLIANCE SIMULATIONS FOR POWER PARK MODULES

Article 50
Compliance simulations for type B power park modules

1. Type B power park modules are subject to the compliance simulations in paragraphs 2 to 5. Instead of all or part of those simulations, the power generating facility owner may use equipment certificates, which must be provided to the relevant network operator.

2. With regard to the LFSM-O response simulation the following requirements shall apply:

(a) the power park module's capability to simulate active power modulation at high frequency in accordance with paragraph 2 of Article 10 shall be demonstrated;

(b) the simulation shall be carried out by means of high frequency steps and ramps reaching minimum regulating level, taking into account the droop settings and the deadband;

(c) the simulation shall be deemed successful in the event that:

(i) the simulation model of the power park module is validated against the compliance test for LFSM-O response set out in paragraph 2 of Article 43(2); and

(ii) compliance with the requirement laid down in paragraph 2 of Article 10 is demonstrated.

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. With regard to the type B fault-ride-through capability of power park modules simulation the following requirements shall apply:

(a) the power generating module's capability to simulate fault-ride-through in accordance with the conditions set out in point (a) of Article 11(3) shall be demonstrated;

(b) the simulation shall be deemed successful if compliance with the requirement laid down in point (a) of Article 11(3) is demonstrated.

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. In addition to the compliance simulations for type B power park modules set out in Article 50, type C power park modules are subject to the compliance simulations set out in paragraphs 2 to 7. Instead of all or part of those simulations, the power generating facility owner may use equipment certificates, which must be provided to the relevant network operator.

2. With regard to the LFSM-U response simulation the following requirements shall apply:

(a) the power park module's capability to simulate active power modulation at low frequencies in accordance with point (c) of Article 12(2) shall be demonstrated;

(b) the simulation shall be carried out by simulating low frequency steps and ramps reaching maximum capacity, taking into account the droop settings and the deadband;

(c) the simulation shall be deemed successful in the event that:

(i) the simulation model of the power park module is validated against the compliance test for LFSM-U response set out in paragraph 3 of Article 44; and

(ii) compliance with the requirement laid down in point (c) of Article 12(2) is demonstrated.

3. With regard to the FSM response simulation the following requirements shall apply:

(a) the power park module's capability to modulate active power over the full frequency range as referred to in point (d) of Article 12(2) shall be demonstrated;

(b) the simulation 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;

(c) the simulation shall be deemed successful in the event that:

(i) the simulation model of the power park module is validated against the compliance test for LFSM-U response set out in paragraph 4 of Article 44; and

(ii) compliance with the requirement laid down in point (d) of Article 12(2) is demonstrated.

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. With regard to the reactive power capability simulation, the following requirements shall apply:

(a) the power park module shall demonstrate that it can simulate leading and lagging reactive power capability as set out in points (b) and (c) of Article 18(3).

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

(i) the simulation model of the power park module is validated against the compliance tests for reactive power capability set out in paragraph (6) of Article 44; and

(ii) compliance with the requirements laid down in points (b) and (c) of Article 18(3) is demonstrated.

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 52
Compliance simulations for type D power park modules

1. In addition to the compliance simulations for type B and C power park modules in set out in Articles 50 and 51, except for the type B fault-ride-through capability of power park modules referred to in paragraph 4 of Article 50, type D power park modules are subject to the fault-ride-through capability of power park modules compliance simulation.

2. Instead of all or part of the simulations mentioned in paragraph 1, the power generating facility owner may use equipment certificates, which must be provided to the relevant network operator.

3. The model of the power generating module shall demonstrate that it can simulate the fault-ride-through capability in accordance with point (a) of Article 13(3).

4. The simulation shall be deemed successful if the model demonstrates compliance with the conditions set out in point (a) of Article 13(3).

CHAPTER VII

COMPLIANCE SIMULATIONS FOR OFFSHORE POWER PARK MODULES

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.

CHAPTER VIII

NON-BINDING GUIDANCE AND MONITORING OF IMPLEMENTATION

Article 54

Non-binding guidance on implementation

1. No later than [*6 months after the entry into force of this Regulation*], the ENTSO for Electricity shall prepare and thereafter every two years provide non-binding written guidance to its members and other network operators concerning the elements of this Regulation requiring national decisions. The ENTSO for Electricity shall publish this guidance on its website.

2. ENTSO for Electricity shall consult stakeholders when providing non-binding guidance.

3. The non-binding guidance shall explain the technical issues, conditions and interdependencies which need to be considered when complying with the requirements of this Regulation at national level.

Article 55

Monitoring

1. ENTSO for Electricity shall monitor the implementation of this Regulation in accordance with paragraph 8 of Article 8 of Regulation (EC) No 714/2009. Monitoring shall cover in particular the following matters:

   (a) identification of any divergences in the national implementation of this Regulation; and

   (b) assessment of whether the choice of values and ranges in the requirements applicable to power generating modules under this Regulation continues to be valid.

2. The Agency, in cooperation with ENTSO for Electricity, shall produce by [*three months after the entry into force of this Regulation*] a list of the relevant information to be communicated by ENTSO for Electricity to the Agency in accordance with paragraph 9 of Article 8 and paragraph 1 of Article 9 of Regulation (EC) No 714/2009. This list of relevant information is without prejudice to the Agency's right to request from ENTSO for Electricity additional information necessary to fulfil its tasks under paragraph 1 of Article 9 of Regulation (EC) No 714/2009. ENTSO for Electricity shall maintain a comprehensive, standardised format, digital data archive of the information required by the Agency.

3. Relevant network operators shall submit to ENTSO for Electricity the information required to perform the tasks referred to in paragraphs 1 and 2.

4. Where necessary, to supplement the information obtained by the Agency and the regulatory authorities in the context of their respective implementation monitoring tasks, DSOs shall, at its request, submit to ENTSO for Electricity the information required for monitoring purposes in accordance with paragraph 2.

TITLE V

DEROGATIONS

Article 56
Power to grant derogations

National regulatory authorities may, at the request of a power generating facility owner, relevant network operator or relevant TSO, grant relevant network operators or relevant TSOs derogations from one or more requirements of this Regulation for new and existing power generating modules in accordance with Articles 57 to 59.

Article 57
General provisions

1. Each national regulatory authority shall specify, after consulting the parties concerned, including network operators, the criteria for granting derogations pursuant to paragraph 4 of Article 58. It shall publish those criteria and notify them to the Commission by [*6months following the entry into force of this Regulation*]. The Commission may require the national regulatory authority to amend the criteria if it considers that they are not in line with this Regulation or its objectives.

2. The national regulatory authority may decide that power generating modules for which a request for derogation has been filed pursuant to Articles 58 or 59 do not need to comply with the requirements of this Regulation from the day of filing the request until the national regulatory authority's decision is issued.

Article 58
Request for derogation by a power generating facility owner

1. Power generating facility owners may request derogations for power generating modules within their facilities.

2. Power generating facility owners shall file their requests for derogations with the relevant network operator. Each request for derogation shall include:

   (a) an identification of the power generating facility owner, and a contact person for any communications;

   (b) a description of the power generating module or modules for which a derogation is requested;

   (c) a reference to the requirement or requirements of this Regulation from which a derogation is requested and a detailed description of the requested derogation;

   (d) detailed reasoning, with relevant supporting documents;

   (e) proof that the requested derogation would have no adverse effect on cross-border trade.

3. Within two weeks of receipt of a request for derogation, the relevant network operator shall confirm to the power generating facility owner whether the request is complete. If the relevant network operator considers that the request is incomplete, the power generating facility owner shall submit the additional required information within one month from the receipt of the request for additional information.

4. The relevant network operator shall, in coordination with the relevant TSO and any affected adjacent DSO or DSOs, assess the request for derogation, taking into account the criteria determined by the national regulatory authority pursuant to Article 57 and on the basis of a cost-benefit analysis meeting the requirements of Article 35.

5. If a request for derogation concerns a type C or D power generating module connected to a distribution network or to a closed distribution system, the relevant network operator's assessment must be accompanied by an assessment of the request for derogation by the relevant TSO. The relevant TSO shall provide its assessment within two months of being requested to do so by the relevant network operator.

6. Within eight months of receipt of a request for derogation, the relevant network operator shall forward the request to the national regulatory authority and submit the assessment prepared in accordance with paragraphs 4 and 5. That period may be extended by one month where the relevant network operator seeks further information from the power generating facility owner, and by two months where the relevant network operator requests the relevant TSO to submit an assessment of the request for derogation.

7. The national regulatory authority shall adopt a decision concerning any request for derogation within three months from the day after it is received. That time limit may be extended by three months before its expiry where the national regulatory authority requires further information from the power generation facility owner or from any other interested parties. The additional period shall begin when the complete information has been received.

   The power generating facility owner shall submit any additional information requested by the national regulatory authority within two months of such request. If the power generating facility owner does not supply the requested information within that time limit, the request for derogation shall be deemed withdrawn unless, before its expiry:

   (a) the national regulatory authority decides to provide an extension; or

   (b) the power generating facility owner informs the national regulatory authority by means of a reasoned submission that the request for derogation is complete.

8. The national regulatory authority shall issue a reasoned decision concerning a request for derogation. Where the national regulatory authority grants derogation, it shall specify its duration.

9. The national regulatory authority shall notify its decision to the relevant power generating facility owner, the relevant network operator, the relevant TSO and the Agency.

10. A national regulatory authority may revoke a decision granting a derogation if the circumstances and underlying reasons no longer apply.

Article 59

Request for derogation by a relevant network operator or relevant TSO

1. Relevant network operators or relevant TSO may request derogations for classes of power generating modules connected or to be connected to their network.

2. Relevant network operators or relevant TSO shall file their requests for derogation with the national regulatory authority. Each request for derogation shall include:

   (a) identification of the relevant network operator or relevant TSO, and a contact person for any communications;

   (b) a description of the power generating modules for which a derogation is requested and the total installed capacity and number of power generating modules;

(c) the requirement or requirements of this Regulation for which a derogation is requested, with a detailed description of the requested derogation;

(d) detailed reasoning, with all relevant supporting documents;

(e) proof that the requested derogation would have no adverse effect on cross-border trade;

(f) a cost-benefit analysis pursuant to the requirements of paragraphs 4 and 5 of Article 35. If applicable, the cost-benefit analysis shall be carried out in coordination with the relevant TSO and any adjacent DSO or DSOs.

3. Where the request for derogation is filed by a relevant DSO or CDSO, the national regulatory authority shall, within two weeks from the day after receipt of that request, ask the relevant TSO to assess the request for derogation in the light of the criteria determined by the national regulatory authority pursuant to Article 57.

4. Within two weeks from the day after the receipt of such request for assessment, the relevant TSO shall confirm to the relevant DSO or CDSO whether the request for derogation is complete. If the relevant TSO considers that it is incomplete, the relevant DSO or CDSO shall submit the required additional information within one month from the receipt of the request for additional information.

5. Within six months of receipt of a request for derogation, the relevant TSO shall submit to the national regulatory authority its assessment, including any relevant documentation. The four-month time limit may be extended by one month where the relevant TSO seeks further information from the relevant DSO or from the relevant CDSO.

6. The national regulatory authority shall adopt a decision concerning a request for derogation within three months of receipt of the request by the relevant TSO. Where the request for derogation is filed by the relevant DSO or CDSO, the three-month time limit runs from the day following receipt of the relevant TSO's assessment pursuant to paragraph 5.

7. The three-month time limit referred to in paragraph 6 may, before its expiry, be extended by an additional three months where the national regulatory authority requests further information from the network operator requesting the derogation or from any other interested parties. That additional period shall run from the day following the date of receipt of the complete information.

The network operator shall provide any additional information requested by the national regulatory authority within two months from the date of the request. If the network operator does not provide the requested additional information within that time limit, the request for derogation shall be deemed withdrawn unless, before expiry of the time limit:

(a) the national regulatory authority decides to provide an extension; or

(b) the network operator informs the national regulatory authority by means of a reasoned submission that the request for derogation is complete.

8. The national regulatory authority shall issue a reasoned decision concerning a request for derogation. Where the national regulatory authority grants derogation, it shall specify its duration.

9. The national regulatory authority shall notify its decision to the network operator requesting the derogation, the relevant TSO and the Agency.

10. National regulatory authorities may lay down further requirements concerning the preparation of requests for derogation by network operators. In doing so, national regulatory authorities shall take into account the delineation between the transmission network and the distribution network at the national level and shall consult with network operators, power generating facility owners and stakeholders, including manufacturers.

11. A national regulatory authority may revoke a decision granting a derogation if the circumstances and underlying reasons no longer apply.

Article 60
Register of derogations from the requirements of this Regulation

1. Each national regulatory authority shall maintain a register of all derogations it has granted or refused and shall provide the Agency with an updated and consolidated register at least once every six months, a copy of which shall be given to ENTSO for Electricity.

2. The register shall contain, in particular:

   (a) the requirement or requirements for which a derogation is granted or refused;

   (b) the content of the derogation;

   (c) the consequences resulting from granting the derogation;

   (d) the reasons for granting or refusing the derogation; and

Article 61
Monitoring of derogations from requirements of this Regulation

1. The Agency shall monitor the derogation process with the cooperation of the national regulatory authorities. Those national regulatory authorities shall provide the Agency with all the information necessary for that purpose.

2. The Agency may issue a reasoned recommendation to a national regulatory authority to revoke a derogation due to a lack of justification.

TITLE VI

TRANSITIONAL ARRANGEMENTS FOR EMERGING TECHNOLOGIES

Article 62
Emerging technologies

1. With the exception of Article 27, the requirements of this Regulation shall not apply to power generating modules classified as an emerging technology at the time of their connection to a network, in accordance with the procedures set out in this Title.

2. A power generating module shall be eligible to be classified as an emerging technology pursuant to Article 65, provided that:

   (a) it is of type A;

   (b) it is a commercially viable power generating module technology; and

(c) the accumulated sales of the power generating module technology within a synchronous area at the time of application for classification as an emerging technology do not exceed 25 % of the maximum level of cumulative maximum capacity established pursuant to paragraph 1 of Article 63.

Article 63

Establishment of thresholds for classification as emerging technologies

1. The maximum level of cumulative maximum capacity of power generating modules for emerging technologies in a synchronous area shall be 0.1 % of the annual maximum load in the previous year in that synchronous area at the time of entry into force of this Regulation.

2. The maximum level of cumulative maximum capacity of power generating modules for emerging technologies shall be allocated per Member State and calculated by multiplying the maximum level of cumulative maximum capacity of power generating modules for emerging technologies of a synchronous area with the ratio of annual electrical energy generated in the previous year in the Member State to the total previous annual electrical energy generated in the respective synchronous area the Member State belongs to.

   For Member States belonging to parts of different synchronous areas, the calculation shall be carried out on a pro rata basis for each of those parts and combined to give the total allocation to that Member State.

Article 64

Application for classification as an emerging technology

1. Within [*six months of the entry into force of this Regulation*] manufacturers of Type A power generating modules may submit to the relevant national regulatory authority a request for classification of their power generating module technology as an emerging technology.

2. In connection with a request pursuant to paragraph 1, the manufacturer shall inform the relevant national regulatory authority of the accumulated sales of the respective power generating module technology within the synchronous areas at the time of application for classification as an emerging technology.

3. Proof that a request submitted pursuant to paragraph 1 complies with the eligibility criteria laid down in Articles 62 and 63 shall be provided by the manufacturer.

Article 65

Assessment and approval of requests for classification as an emerging technology

1. By [*12 months of the entry into force of this Regulation*], the relevant national regulatory authority shall decide, in coordination with all the other national regulatory authorities of a synchronous area, which power generating modules, if any, should be classified as an emerging technology. Any national regulatory authority of the relevant synchronous area may request a prior opinion from the Agency, which shall be issued within three months of receipt of the request. The decision of the relevant national regulatory authority shall take into account the opinion of the Agency.

2. A list of power generating modules approved as emerging technologies shall be published by each national regulatory authority of a synchronous area.

Article 66
Revocation of classification as an emerging technology

1. From the date of the decision of the national regulatory authorities pursuant to paragraph 1 of Article 65, the manufacturer of any power generating module classified as an emerging technology shall submit on a monthly basis to the national regulatory authority updates of the sales of the module by Member States in the past month. The national regulatory authority shall make publicly available the cumulative maximum capacity of power generating modules classified as emerging technologies.

2. In the event that the cumulative maximum capacity of all power generating modules classified as emerging technologies connected to networks exceeds the threshold established in Article 63, the classification as an emerging technology shall be revoked by the relevant national regulatory authority. The revocation decision shall be published.

3. Without prejudice to the provisions of paragraph 1 and 2, all national regulatory authorities of a synchronous area may decide in a coordinated manner to revoke a classification as emerging technology. The national regulatory authorities of the synchronous area concerned may request a prior opinion from the Agency, which shall be issued within three months of receipt of the request. The coordinated decision of the national regulatory authorities shall take into account the opinion of the Agency. The revocation decision shall be published by each national regulatory authority of a synchronous area.

   Power generating modules classified as emerging technologies and connected to the network prior to the date of revocation of that classification as an emerging technology shall be considered as existing power generating modules and shall therefore only be subject to the requirements of this Regulation pursuant to the provisions of paragraph 2 of Article 4 and Article 35.

TITLE VII

FINAL PROVISIONS

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
Entry into force

This Regulation shall enter into force on the twentieth day following that of its publication in the *Official Journal of the European Union.*

Without prejudice to point (b) of Article 4(2), Article 54, Article 55, Article 57 and Title 6 this Regulation shall apply from [*2 year period after publication*]. This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Brussels,

For the Commission
The President