EUROPEAN
COMMISSION

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COMMISSION REGULATION (EU) …/…

of XXX

establishing a network code on requirements for grid connections of high voltage direct current systems and DC-connected power park modules

(Text with EEA relevance)

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THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

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 8(6)(b) 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 for High-Voltage Direct Current (HVDC) systems and DC-connected power park modules. Those requirements that contribute to maintaining, preserving and restoring system security in order to facilitate proper functioning of the internal electricity marking 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 for grid connection for HVDC systems and DC-connected power park modules should be set out in order to provide a clear legal framework, facilitate Union-wide trade in electricity, ensure system security, facilitate the integration of renewable electricity sources, increase competition, and allow more efficient use of the network and resources, for the benefit of consumers.

(4) System security depends partly on the technical capabilities of HVDC systems and DC-connected power park modules, therefore regular coordination at the level of the transmission and distribution networks and adequate performance of equipment connected to the transmission and distribution 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.

[1] OJ L […], […], p. […].

(5) Secure system operation is only possible if there is close cooperation between HVDC systems and DC-connected power park modules with system operators. In particular, the functioning of the system under abnormal operating conditions depends on the response of the HVDC systems and DC-connected power park modules to deviations from nominal values of voltage and frequencies. In the context of system security, the networks and the HVDC systems and DC-connected power park modules should be considered as one entity from a system engineering point of view, given that these parts are independent. Therefore, concerning system security and as a prerequisite for grid connection relevant technical requirements should be set for HVDC systems and DC-connected power park modules.

(6) Regulatory authorities should consider the reasonable costs effectively incurred by system operators in the implementation of this Regulation when fixing or approving transmission or distribution tariffs or their methodologies 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 HVDC systems and DC-connected power park modules. 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 HVDC systems and new DC-connected power park modules but should not apply to HVDC systems and DC-connected power park modules at an advanced stage of planning but not yet completed unless the relevant regulatory authority or Member State decides otherwise.

(9) 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.

(10) To ensure system security, it should be possible for HVDC systems and DC-connected power park modules in each synchronous area of the interconnected system to remain connected to the system for specified ranges.

(11) Voltage ranges should be harmonised 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.

(12) Appropriate and proportionate compliance testing should be required by this Regulation so that system operators can ensure operational security.

(13) The relevant regulatory authorities and relevant system operators should ensure that the requirements for network connection are harmonised to the extent possible, in order to ensure full market integration. Where technical standards are established,

[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).

these should be taken into particular consideration in the development of connection requirements.

(14) When additional harmonisation is proportionate, amendments of this regulation under the procedure established in Regulation (EC) No 714/2009 should be considered. Where ENTSO for Electricity or the Agency establish that, based on market developments or experience gathered in the application of this Regulation, further harmonisation is advisable to promote market integration, they shall propose draft amendments to this Regulation pursuant to Article 7(1) of Regulation (EC) No 714/2009.

(15) 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 exceptional instances, for example, where compliance with those rules could jeopardise the stability of the local network or where the safe operation of an HVDC system or DC-connected power park module might require operating conditions that are not in line with this regulation.

(16) In the case of DC-connected power park modules, there is the possibility that new modules will in the future form part of a meshed off-shore grid connecting to more than one synchronous area. When this happens, to maintain system security they will need to meet certain technical requirements. This Regulation should, therefore, specify these requirements to provide regulatory certainty and ensure that future meshed networks can be developed cost-effectively. However, this needs to be balanced with the costs of complying with such requirements earlier than they are needed; for certain requirements, DC-connected power park modules should only be required to fit the equipment needed for system security at the time it becomes necessary.

(17) Therefore, DC-connected power park modules which are, or will be, connected to one synchronous area with a radial connection should have the opportunity to apply, via an expedited process, for derogations on requirements that will only be needed if and when they become connected to a meshed grid and which take account of case-by-case circumstances. Further, they should be given certainty as early as possible on whether they will qualify for a derogation so that they can build this in to their investment decision-making process. Regulatory authorities should therefore consider the options for providing such certainty, for example through 'minded to' decisions or letters of intent.

(18) This Regulation has been adopted on the basis of Regulation (EC) No 714/2009 which it supplements and of which it forms an integral part. References to Regulation (EC) No 714/2009 in other legal acts should be understood as also referring to this Regulation.

(19) 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 rules for High-Voltage Direct Current (HVDC) systems and DC-connected power park modules and a common framework for connection agreements between the owners of the systems or modules and system operators.

Article 2
Definitions

For the purpose of this Regulation, the definitions in Article 2 of Regulation (EC) N° 714/2009, Article 2 of Commission Regulation (EU) No 543/2013[3] and Article 2 of Directive 2009/72/EC [CACM, RfG, DCC] shall apply.

In addition, the following definitions shall apply:

(1) 'DC-connected power park module' means a power park module that is connected via one or more interface points to one or more HVDC systems. Unless otherwise stated, power park module referred to in this Regulation means a DC-connected power park module;

(2) 'DC-connected power park module owner' means a natural or legal entity owning a DC-connected power park module;

(3) 'Embedded HVDC system' means an HVDC system connected within a synchronous area or within a control area that is not installed for the purpose of connecting a DC-connected power park module at the time of installation, nor installed for the purpose of connecting a demand facility;

(4) 'HVDC system maximum current' means the highest phase current, associated with an operating point inside the U-Q/Pmax-profile of the HVDC converter station at maximum HVDC active power transmission capacity;

(5) 'HVDC converter station' means part of an HVDC system which consists of one or more HVDC converter units installed in a single location together with buildings, reactors, filters, reactive power devices, control, monitoring, protective, measuring and auxiliary equipment;

(6) 'HVDC converter unit' means a unit comprising one or more converter bridges, together with one or more converter transformers, reactors, converter unit control equipment, essential protective and switching devices and auxiliaries, if any, used for the conversion;

(7) 'HVDC system' means an electrical power system which transfers energy in the form of high-voltage direct current between two or more AC buses. An HVDC system comprises at least two HVDC converter stations with DC transmission lines or cables between the HVDC converter stations. In case of a back-to-back system the HVDC

[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).

system comprises only one HVDC converter station with direct DC circuit connection between the pair of HVDC converter units. An HVDC system has at least two interface points;

(8) 'Interface point' means an AC point in a network connecting equipment owned by two or more parties, at which technical specifications affecting the performance of the equipment of one or more parties can be prescribed;

(9) 'Maximum HVDC active power transmission capacity' (Pmax) means the maximum continuous active power which an HVDC system can exchange with the network at each connection point as defined in the connection agreement or as agreed between the relevant system operator and the HVDC system owner;

(10) 'Minimum HVDC active power transmission capacity' (Pmin) means the minimum continuous Active Power which an HVDC System can exchange with the Network at each Connection Point as defined in the Connection Agreement or as agreed between the relevant system operator and the HVDC System Owner.

Article 3
Scope

1. The requirements of this Regulation apply to:

   (a) HVDC systems connecting synchronous areas or control areas, including back-to-back schemes;

   (b) HVDC systems connecting power park modules to a transmission network or a distribution network, pursuant to paragraph 2;

   (c) embedded HVDC systems within one control area and connected to the transmission network; and

   (d) embedded HVDC systems within one control area and connected to the distribution network when a cross-border impact is demonstrated by the relevant TSO. The relevant TSO shall consider the long-term development of the network in this assessment.

2. The relevant system operator, in coordination with the relevant TSO, shall propose the application of this Regulation for power park modules connected to a transmission network or distribution network which is not part of a synchronous area for approval accordance with paragraph 1 of Article 5. All other power park modules which are AC collected but are DC connected to a synchronous area are considered DC-connected power park modules and are within the scope of this Regulation.

3. Articles 57 to 61, 68 to 73 and 83 shall not apply to HVDC systems within one control area referred in points (c) and (d) of paragraph 1 where:

   (a) the HVDC systems has at least one HVDC converter station owned by the relevant TSO;

   (b) the HVDC system is owned by an entity which exercises control over the relevant TSO; or

   (c) the HVDC system is owned by an entity directly or indirectly controlled by an entity which also exercises control over the relevant TSO.

4. The connection requirements for HVDC systems as stated in Title II apply, unless stated otherwise in this Regulation, at the AC connection points of such systems.

5. The connection requirements for DC-connected power park modules and remote-end HVDC converter stations as stated in Title III apply, unless stated otherwise in this regulation, at the interface point of such systems.

6. The relevant system operator shall refuse to allow the connection of a new HVDC system of DC-connected power park module which does not comply with the requirements set out in this Regulation and which is not covered by a derogation granted by the regulatory authority pursuant to Title VII. The relevant system operator shall communicate such refusal, by means of a reasoned statement in writing, to the HVDC system owner or DC-connected power park module owner and to the regulatory authority.

7. The requirements of this regulation shall not apply to HVDC systems whose connection point is below 110kV.

Article 4

Application to existing HVDC systems and DC-connected power park modules

1. Existing HVDC systems and exiting DC-connected power park modules are not subject to the requirements of this Regulation , except for Article 26, Article 31, Article 33 and Article 52 or where:

   (a) the HVDC system or DC-connected power park module has been modified to such an extent that its connection agreement must be substantially revised in accordance with the following procedure:

      (i) the HVDC system or DC-connected power park module owners who intend to undertake the modernisation of a plant or replacement of equipment impacting the technical capabilities of the DC-connected power park module or HVDC system shall report their plans to the relevant system operator in advance;

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

      (iii) the relevant regulatory authority or, where applicable, the Member State shall decide if the existing connection agreement needs to be revised or a new connection agreement is required and which requirements of this Regulation shall apply; or

   (b) a regulatory authority or, where applicable, the Member State decides to make an existing HVDC system or existing DC-connected power park 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, 4 and 5.

2. For the purposes of this Regulation, an HVDC system or DC-connected power park 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 HVDC system owner or DC-connected power park module owner has concluded a final and binding contract for the purchase of the main plant by [*two years after the entry into force of the Regulation*]. The HVDC system owner or DC-connected power park module owner must notify the relevant system operator and relevant TSO within [*30 months after the entry into force of the Regulation*].

The confirmation submitted by the HVDC system owner or DC-connected power park module owner to the relevant system operator and to the relevant TSO 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 regulatory authority may determine whether the HVDC system or DC-connected power park module is to be considered an existing or new HVDC system or DC-connected power park module.

3. Following a public consultation in accordance to Article 8 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 regulatory authority concerned, or where applicable, the Member State to extend the applicability of this Regulation to existing HVDC systems and/or DC-connected power park 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 67, which shall indicate:

(i) the costs, in regard to existing HVDC systems and DC-connected power park 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;

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

5. The relevant TSO shall take account of the legitimate expectations of power generating facility owners as part of the assessment of the application of this Regulation to existing HVDC systems or DC-connected power park modules.

6. The relevant TSO may assess the application of some or all of the provisions of this Regulation to existing HVDC systems or DC-connected power park modules every three years in accordance with the criteria and process set out in paragraphs 3 to 5.

Article 5
Regulatory Aspect

1. Unless otherwise provided in this Regulation, where a relevant system operator or TSO is required or permitted to specify, define or agree on specific terms and

conditions governing connection and access to systems or their methodologies, these terms and conditions or methodologies shall be approved by the responsible 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. For technical regulations pursuant to Article 1 (9) of Directive 98/34/EC, obligations pursuant to Article 8 of Directive 98/34/EC shall apply.

2. When applying the provisions of this Regulation, Member States, regulatory authorities and system 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; and

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

3. Where this Regulation provides that the relevant TSO, the HVDC system owner, DC-connector power park module owner and/or the distribution system operator shall agree, all mentioned parties shall seek agreement between them. If no agreement has been found within a reasonable timeframe, but in any case not later than [6 months] after the first proposal has been submitted by one party, each party may request the competent regulatory authority to issue a decision. The decision shall replace the required agreement.

4. Where this Regulation provides that the relevant system operator or TSO shall specify, define or agree on specific terms and conditions governing connection and access to systems or their methodologies, the initial definition shall be done within a reasonable timeframe, but in any case not later than [2 years] after the entry into force of this Regulation. Where approval of the definition requires regulatory approval pursuant to paragraph 1 of this Article, the deadline shall be deemed met if the submission for approval takes place within a reasonable timeframe, but no later than [2 years].

5. If the relevant system operator or TSO deems modifications to the initial definition under paragraph 3 to be necessary, a new assessment has to follow the same procedural requirements in paragraphs 1 to 3. At all stages of the procedure, due account shall be taken of legitimate expectations, if any, by demand facility owners, equipment manufacturers and other stakeholders based on the initial definition.

Article 6
Multiple TSOs

1. In Member States where more than one transmission system operator exists, this Regulation shall apply to all transmission system operators within that Member State.

2. Member States may under the national regulatory regime provide that the responsibility of a transmission system operator to comply with one or some obligations under this Regulation is assigned to one or more specific transmission system operators. In case of such assignment, this Regulation shall apply accordingly to the transmission system operators to which responsibilities have been assigned.

Article 7
Recovery of costs

1. The costs borne by regulated system operators subject to network tariff regulation and 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 accordance with Article 14 of Regulation EC (No) 714/2009.

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

Article 8
Consultation

1. Relevant system operators and TSOs shall consult stakeholders, including the relevant authorities of each Member State, on draft proposals, in accordance with Articles 4 or on cost benefit analysis, in accordance Article 67. The consultation shall last for a period of not less than one month.

2. The relevant system operators or TSOs in paragraph 1 shall duly consider the views of stakeholders resulting from the consultations undertaken, prior to its submission for approval in accordance with Article 5. In all cases, a clear and robust justification for including or not the views resulting from the consultation shall be developed in the submission and published in a timely manner before or simultaneously with the publication of the proposal.

Article 9
Stakeholder involvement

The Agency, in close cooperation with the ENTSO for Electricity, shall organise stakeholder involvement regarding the requirements for grid connection of HVDC systems and DC-connected power park modules, and other aspects of the implementation of this Regulation. This shall include regular meetings with stakeholders to identify problems and propose improvements notably related to the requirements for grid connection of power generating facilities.

Article 10
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.

5. This provision does not prevent the Agency, the regulatory authorities, ENTSO for electricity, or the European Commission to mutually exchange, for the purpose of applying this Regulation, any information received pursuant to this Regulation.

TITLE II
GENERAL REQUIREMENTS FOR HVDC CONNECTIONS

CHAPTER I
REQUIREMENTS FOR ACTIVE POWER CONTROL AND FREQUENCY SUPPORT

Article 11
Frequency ranges

1. An HVDC system shall be capable of staying connected to the network and remaining operable within the frequency ranges and time periods specified by

2. Table 1 for the short circuit power range as specified in Article 34(2).

3. The relevant TSO and HVDC system owner may agree on wider frequency ranges or longer minimum times for operation if needed to preserve or to restore system security. If wider frequency ranges or longer minimum times for operation are economically and technically feasible, the HVDC system owner shall not be unreasonably withhold consent.

4. Without prejudice to paragraph 1, an HVDC system shall be capable of automatic disconnection at frequencies specified by the relevant TSO..

5. The relevant TSO may specify a maximum admissible active power output reduction from its operating point if the system frequency falls below 49 Hz.

Frequency range	Time period for operation
47.0 Hz – 47.5 Hz	60 seconds
47.5 Hz – 48.5 Hz	To be specified by each relevant TSO , but longer than defined times for generation and demand according to [NC RfG] and [DCC] respectively, and longer than for DC-connected PPMs according to Article 41
48.5 Hz – 49.0 Hz	To be specified by each relevant TSO, but longer than defined times for generation and demand according to [NC RfG] and [DCC] respectively, and longer than for DC-connected PPMs according to Article 41
49.0 Hz – 51.0 Hz	Unlimited
51.0 Hz – 51.5 Hz	To be specified by each relevant TSO, but longer than defined times for generation and demand according to [NC RfG] and [DCC] respectively, and longer than for DC-connected PPMs according to Article 41
51.5 Hz – 52.0 Hz	To be defined by each relevant TSO , but longer than for DC-connected PPMs according to Article 41

Table 1: This table shows the minimum time periods an HVDC system shall be able to operate for different frequencies deviating from a nominal value without disconnecting from the network.

Article 12
Rate-of-change-of-frequency withstand capability

An HVDC system shall be capable of staying connected to the network and operable if the network frequency changes at a rate between -2.5 and +2.5 Hz/s (measured at any point in time as an average of the rate of change of frequency for the previous 1 second).

Article 13
Active power controllability, control range and ramping rate

1. With regard to the capability of controlling the transmitted Active Power:

   (a) An HVDC System shall be capable of adjusting the transmitted active power up to the maximum HVDC active power transmission capacity of the HVDC system in each direction following an instruction from the relevant TSO.

      (i) The relevant TSO may specify a maximum and minimum power step size for adjusting the transmitted active power.

      (ii) The relevant TSO may specify a minimum HVDC active power transmission capacity for each direction, below which active power transmission capability is not requested.

      (iii) The relevant TSO shall specify the maximum delay within which the HVDC system shall be capable of adjusting the transmitted active power upon receipt of request from the relevant TSO.

   (b) The relevant TSO shall specify a regulation sequence by which an HVDC system shall be capable of modifying the transmitted active power in case of disturbance in one or more of the connecting AC networks. If the initial delay

prior to the start of the change is greater than 10 milliseconds from receiving the triggering signal sent by the relevant TSO, it shall be reasonably justified by the HVDC system owner to the relevant TSO.

(c) The relevant TSO may specify that an HVDC system be capable of fast active power reversal. The power reversal shall be possible from the maximum active power transmission capacity in one direction to the maximum active power transmission capacity in the other direction as fast as technically feasible and reasonably justified by the HVDC system owner to the relevant TSOs if greater than 2 seconds.

(d) For HVDC systems linking various control areas or synchronous areas, the HVDC system shall be equipped with control functions enabling the relevant TSOs to modify the transmitted active power for the purpose of cross-border balancing.

2. An HVDC system shall be capable of adjusting the ramping rate of active power variations within its technical capabilities in accordance with instructions sent by relevant TSOs. In case of modification of active power according to points (b) and (c) of paragraph 1, there shall be no adjustment of ramping rate.

3. If specified by a relevant TSO, in coordination with adjacent TSOs, the control functions of an HVDC system shall be capable of taking automatic remedial actions including, but not limited to, stopping the ramping and blocking FSM, LFSM-O, LFSM-U and frequency control. The triggering and blocking criteria shall be defined by relevant TSO and subject to notification to the regulatory authority. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework.

Article 14
Synthetic inertia

1. If specified by a relevant TSO, an HVDC system shall be capable of providing synthetic inertia in response to frequency changes, activated in low and/or high frequency regimes by rapidly adjusting the active power injected to or withdrawn from the AC network in order to limit the rate of change of frequency. The requirement shall at least account for the results of the studies undertaken by TSOs to identify if there is a need to define minimum inertia.

2. The principle of this control system and the associated performance parameters shall be agreed between the relevant TSO and the HVDC system.

Article 15
Frequency sensitive mode (FSM)

1. When operating in frequency sensitive mode (FSM):

(a) the HVDC system shall be capable of responding to frequency deviations in each connected AC network by adjusting the active power transmission as indicated in Figure 1 and in accordance with the parameters specified by each TSO within the ranges shown in Table 2. This specification shall be subject to notification to the regulatory authority. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework.

(b) the adjustment of active power frequency response shall be limited by the minimum HVDC active power transmission capacity and maximum HVDC active power transmission capacity of the HVDC system (in each direction).

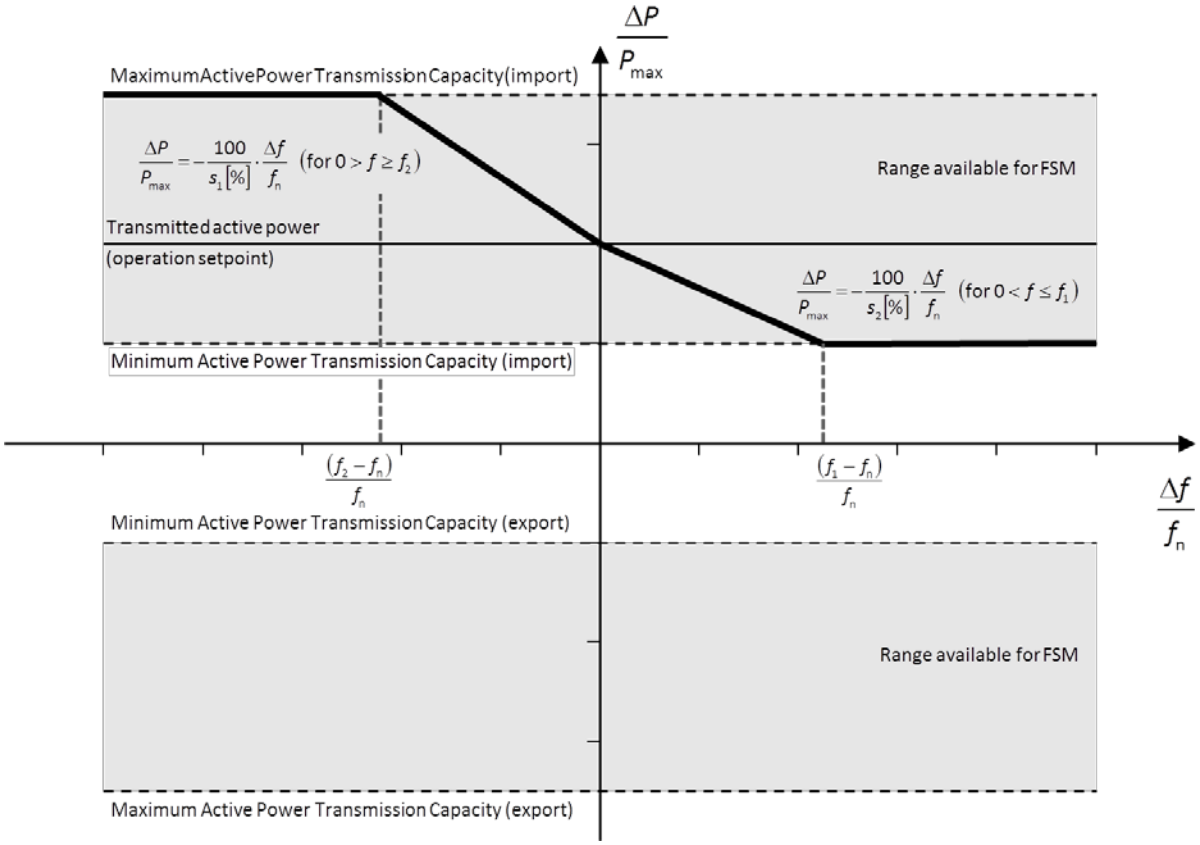

Figure 1: Active power frequency response capability of an HVDC system in FSM illustrating the case of zero deadband and insensitivity with a positive active power setpoint (import mode). ΔP is the change in active power output from the HVDC system. f_n is the target frequency in the AC network where the FSM service is provided and Δf is the frequency deviation in the AC network where the FSM service is provided.

Parameters	**Ranges**
Frequency response deadband	0 – ±500mHz
Droop s_1 (upward regulation)	Minimum 0.1%
Droop s_2 (downward regulation)	Minimum 0.1%
Frequency response insensitivity	Maximum 30 mHz

Table 2: Parameters for active power frequency response in FSM

(c) the HVDC system shall be capable, following an instruction from the relevant TSO, of adjusting the droops for upward and downward regulation, the frequency response deadband and the operational range of variation within the active power range available for FSM, defined in Figure 1 and more generally

within the limits set by Article 11 (1) (a) and (b). These values shall be subject to notification to the regulatory authority. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework.

(d) as a result of a frequency step change, the HVDC system shall be capable of adjusting active Power to the active power frequency response defined in Figure 1, such that the response is:

(i) as fast as inherently technically feasible; and

(ii) at or above the solid line according to Figure 2 in accordance with the parameters specified by each relevant TSO within the ranges according to Table 3:

- The HVDC system shall be able to adjust active power output ΔP up to the limit of the active power range requested by the relevant TSO in accordance with the times t_1 and t_2 according to the ranges in Table 3, where t_1 is the initial delay and t_2 is the time for full activation. The values of $t_1$and t_2 shall be specified by the relevant TSO, subject to notification to the regulatory authority. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework.
- If the initial delay of activation is greater than 0.5 second, the HVDC system owner shall reasonably justify it to the relevant TSO.

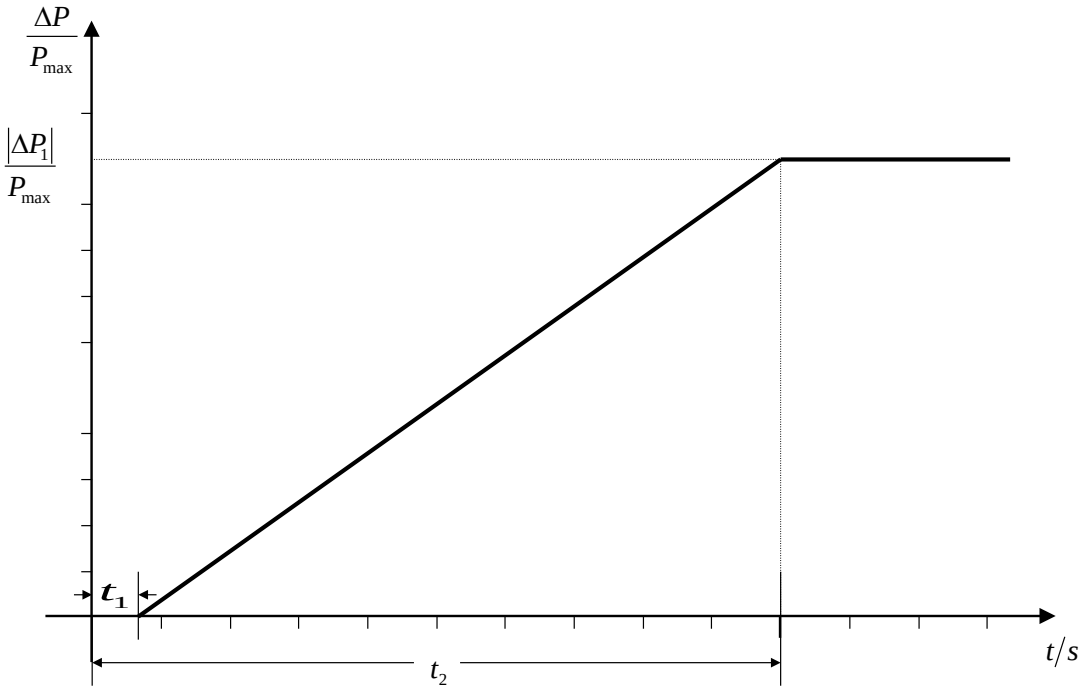

Figure 2: Active power frequency response capability of an HVDC system. ΔP is the change in active power triggered by the step change in frequency.

Parameters	Time
Maximum admissible initial delay t_1	0.5 seconds
Maximum admissible time for full activation t_2, unless longer activation times are specified by the relevant TSO	30 seconds

Table 3: Parameters for full activation of active power frequency response resulting from frequency step change.

(e) for HVDC systems linking various control areas or synchronous areas, in frequency sensitive mode operation the HVDC system shall be capable of adjusting full active power frequency response at any time and for a continuous time period.

(f) as long as a frequency deviation continues active power control shall not have any adverse impact on the active power frequency response.

Article 16

Limited frequency sensitive mode overfrequency (LFSM-O)

1. In addition to the requirements of Article 11 the following shall apply with regard to limited frequency sensitive mode – overfrequency (LFSM-O):

(a) the HVDC system shall be capable of adjusting active power exchange with the AC network or networks, during both import and export, according to Figure 3 at a frequency threshold f_1 between and including 50.2 Hz and 50.5 Hz with a droop S_3 adjustable from 0.1 % upwards;

(b) the HVDC system shall be capable of adjusting power down to its minimum HVDC active power transmission capacity;

(c) the HVDC system shall be capable of adjusting active power frequency response as fast as inherently technically feasible, with an initial delay and time for full activation determined by the relevant TSO and notified to the regulatory authority in accordance with the applicable national regulatory framework;

(d) the HVDC system shall be capable of stable operation during LFSM-O operation. When LFSM-O is active, hierarchy of control functions shall be organised in accordance with Article 37.

2. The frequency threshold and droop settings referred in point (a) of paragraph 1 shall be determined by the relevant TSO and notified to the regulatory authority in accordance with the applicable national regulatory framework.

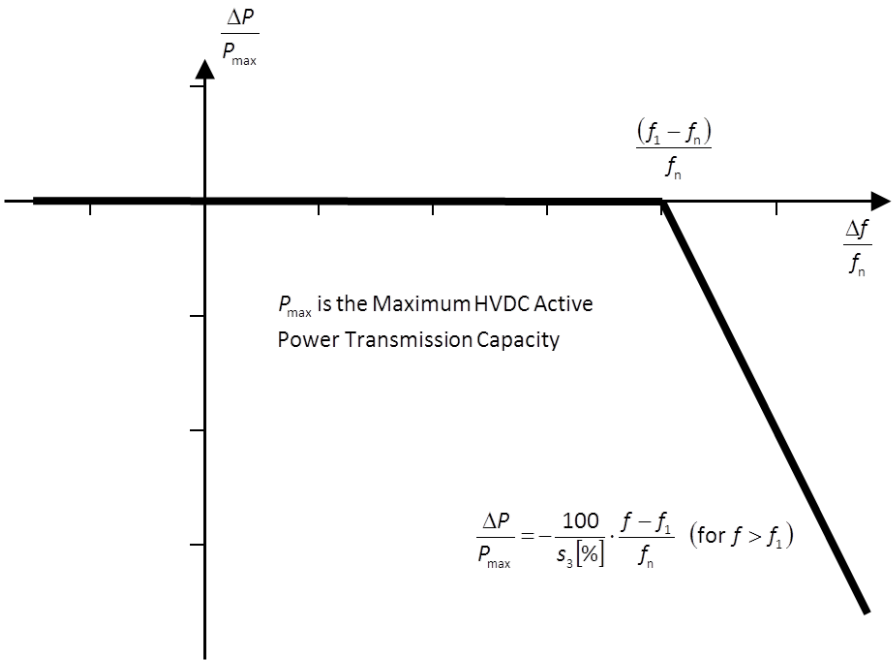

Figure 3: Active power frequency response of HVDC systems in LFSM-O. ΔP is the change in active power output from the HVDC system, depending on the operation condition a decrease of import power or an increase of export power. f_n is the nominal frequency of the AC network or networks the HVDC system is connected to and Δf is the frequency change in the AC network or networks the HVDC is connected to. At overfrequencies where f is above f_1 the HVDC system shall reduce active power according to the droop setting.

Article 17
Limited frequency sensitive mode underfrequency (LFSM-U)

1. In addition to the requirements of Article 11, the following shall apply with regard to limited frequency sensitive mode – underfrequency (LFSM-U):

   (a) the HVDC System shall be capable of adjusting the active power frequency response to the AC network or networks, during both import and export, according to Figure 4 at a frequency threshold f2 between and including 49.8 Hz and 49.5 Hz with a droop S4 adjustable from 0.1 % upwards.

   (b) in the LFSM-U mode the HVDC system shall be capable of adjusting power up to its maximum HVDC active power transmission capacity;

   (c) the active power frequency response shall be activated as fast as inherently technically feasible, with an initial delay and time for full activation determined by the relevant TSO and notified to regulatory authority in accordance with the applicable national regulatory framework;

   (d) the HVDC system shall be capable of stable operation during LFSM-U operation. When LFSM-U is active, hierarchy of control functions shall be organised in accordance with Article 37.

2. The frequency threshold and droop settings referred to in point (a) of paragraph 1 shall be determined by the relevant TSO and be notified to the regulatory authority in accordance with the applicable national regulatory framework.

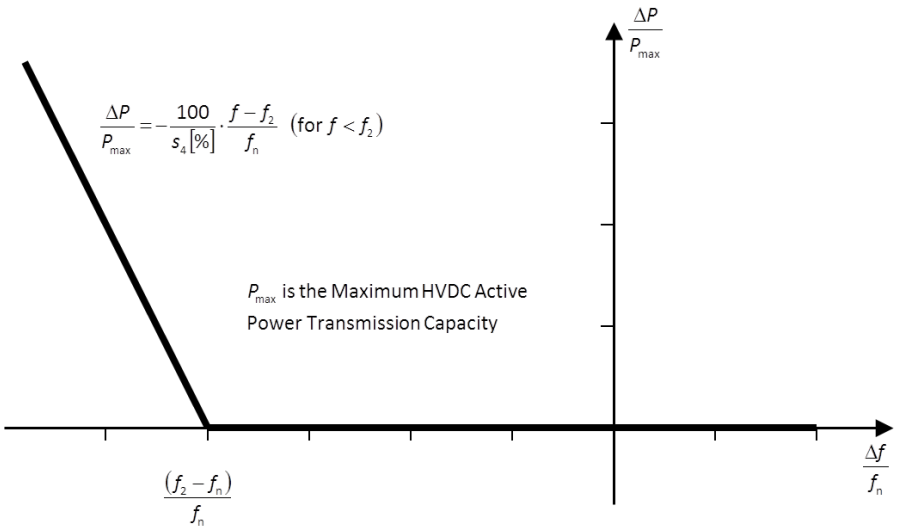

Figure 4: Active power frequency response capability of HVDC systems in LFSM-U. ΔP is the change in active power output from the HVDC system, depending on the operation condition a decrease of import power or an increase of export power. f_n is the nominal frequency in the AC network or networks the HVDC system is connected and Δf is the frequency change in the AC network or networks the HVDC is connected. At underfrequencies where f is below f_2, the HVDC system has to increase active power output according to the droop s_4.

Article 18
Frequency control

1. If specified by the relevant TSO, an HVDC system shall be equipped with an independent control mode to modulate the active power output of the HVDC converter station depending on the frequencies at all connection points of the HVDC system in order to maintain stable system frequencies

2. The relevant TSO shall specify the operating principle, the associated performance parameters and the activation criteria of the frequency control referred to in paragraph 1.

Article 19
Maximum loss of active power

1. An HVDC system shall be configured such that its loss of active power injection in a synchronous area shall be limited to a value defined by the relevant TSOs for their respective Load Frequency Control block, based on its impact on the system.

2. Where an HVDC system connects two or more LFC Blocks, the relevant TSOs shall consult each other in order to set a coordinated value of the maximum loss of active power injection as referred to in paragraph 1, taking into account common mode failures.

CHAPTER II
REQUIREMENTS FOR REACTIVE POWER CONTROL AND VOLTAGE SUPPORT

Article 20
Voltage ranges

1. Without prejudice to Article 27, an HVDC converter station shall be capable of staying connected to the network and capable of operating at HVDC system maximum current, 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 the time periods specified by Table 4 or Table 5. The establishment of the reference nominal voltage shall be subject to coordination between the adjacent relevant system operators.

Synchronous Area	***Voltage Range***	***Time period for operation***
Continental Europe	0.85 pu – 1.118 pu	Unlimited
	1.118 pu – 1.15 pu	To be defined by each relevant system operator, in coordination with the relevant TSO but not less than 20 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 – 1.12 pu	Unlimited
	1.12 pu – 1.15 pu	20 minutes

Table 4: This table shows the minimum time periods an HVDC system shall be capable of operating for voltages deviating from the nominal system value at the connection points without disconnecting from the network. This table applies in case of pu voltage base values at or above 110 kV and up to 300 kV.

Synchronous Area	Voltage Range	Time period for operation
Continental Europe	0.85 pu – 1.05 pu	Unlimited
	1.05 pu – 1.0875 pu	To be defined by each TSO, but not less than 60 minutes
	1.0875 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 – 1.10 pu	Unlimited
	1.10 pu – 1.15 pu	20 minutes

Table 5: This table shows the minimum time periods an HVDC system shall be capable of operating for voltages deviating from the nominal system value at the connection points without disconnecting from the network. This table applies in case of pu voltage base values from 300 kV to 400 kV (included).

2. The HVDC system owner and the relevant system operator, in coordination with the relevant TSO, may agree on wider voltage ranges or longer minimum times for operation than those specified in paragraph 1 in order to ensure the best use of the technical capabilities of an HVDC System if needed to preserve or to restore system security. If wider voltage ranges or longer minimum times for operation are economically and technically feasible, the HVDC system owner shall not unreasonably withhold consent.

3. An HVDC converter station shall be capable of automatic disconnection at connection point voltages specified by the relevant system operator, in coordination with the relevant TSO. The terms and settings for automatic disconnection shall be agreed between the relevant system operator in coordination with the relevant TSO and the HVDC system owner.

4. For connection points at nominal AC voltages not included in the scope of Table 4 and Table 5, the relevant system operator, in coordination with relevant TSOs, shall define applicable requirements at the connection points.

Article 21
Short circuit contribution during faults

1. If specified by the relevant system operator, in coordination with the relevant TSO, an HVDC system shall have the capability to provide fast fault current at a connection point in case of symmetrical (3-phase) faults where.

2. Where an HVDC is system is required to have the capability referred to in paragraph 1, the relevant system operator, in coordination with the relevant TSO, shall specify the following:

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

   (b) the characteristics of the fast fault current; and

   (c) the timing and accuracy of the fast fault current, which may include several stages.

3. The relevant system operator, in coordination the relevant TSO, may specify a requirement for asymmetrical current injection in the case or asymmetrical (1-phase or 2-phase) faults..

Article 22
Reactive power capability

1. The relevant system operator, in coordination with the relevant TSO, shall define the reactive power capability requirements at the connection points, in the context of varying voltage. The proposal shall include a U-Q/Pmax-profile, within the boundary of which the HVDC converter station shall be capable of providing reactive power at its maximum HVDC active power transmission capacity.

2. The U-Q/Pmax-profile referred to in paragraph 1 conform with the following principles:

   (a) the U-Q/Pmax-profile shall not exceed the U-Q/Pmax-profile envelope represented by the inner envelope in Figure 5, and does not need to be rectangular;

   (b) the dimensions of the U-Q/Pmax-profile envelope shall respect the values defined for each synchronous area in Table 6; and

   (c) the position of the U-Q/Pmax-profile envelope shall lie within the limits of the fixed outer envelope in Figure 5.

3. An HVDC system shall be capable of moving to any operating point within its U-Q/Pmax profile in timescales specified by the relevant system operator in coordination with the relevant TSO.

4. When operating at an active power output below the maximum HVDC active power transmission capacity (P<Pmax), the HVDC converter station shall be capable of operating in every possible operating point, as defined by the relevant system operator in coordination with the relevant TSO and in accordance with the reactive power capability defined by the U-Q/Pmax profile specified in paragraphs 1 to 3.

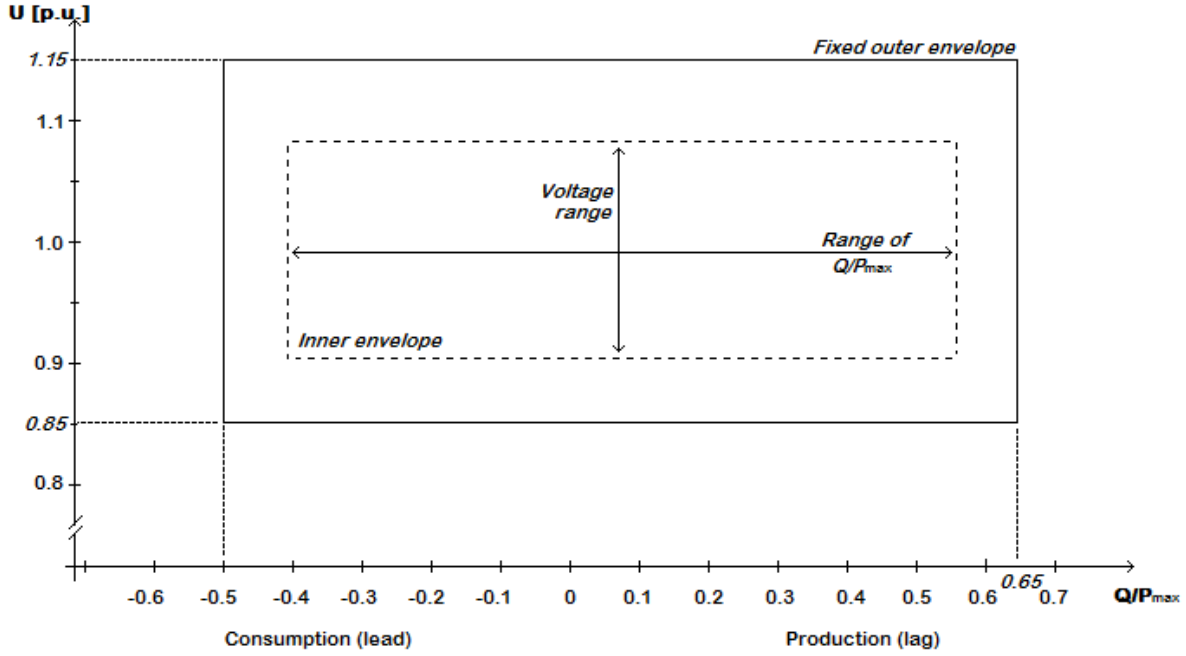

Figure 5: The diagram represents boundaries of a U-Q/Pmax-profile with U being the voltage at the connection points expressed by the ratio of its actual value to its nominal value in per unit, and Q/Pmax the ratio of the reactive power to the maximum HVDC active power transmission capacity. The position, size and shape of the inner envelope are indicative and shapes other than rectangular may be used within the inner envelope (and within the inner envelope lines are permitted). For profile shapes other than rectangular, the voltage range represents the highest and lowest voltage points in this shape. Such a profile would not give rise to the full reactive power range being available across the range of steady-state voltages.

Synchronous Area	Maximum range of Q/Pmax	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 6: Parameters for the Inner Envelope in Figure 5.

Article 23
Reactive power exchanged with the network

1. The HVDC system owner shall ensure that the reactive power of its HVDC converter station exchanged with the network at the connection point is limited to values specified by the relevant system operator in coordination with the relevant TSO.

2. The reactive power variation caused by the reactive power control mode operation of the HVDC converter Station, as listed in paragraph 1 of Article 24, shall not result in a voltage step exceeding the allowed value at the connection point. The relevant system operator, in coordination with the relevant TSO, shall specify this maximum tolerable voltage step value.

Article 24
Reactive power control mode

1. An HVDC converter station shall be capable of operating in one or more of the three following control modes, as specified by the relevant system operator in coordination with the relevant TSO:

   (a) voltage control mode;

   (b) reactive power control mode;

   (c) power factor control mode.

2. An HVDC convertor station shall be capable of operating in additional control modes specified by the relevant system operator in coordination with the relevant TSO.

3. For the purposes of voltage control mode, each HVDC converter station shall be capable of contributing to voltage control at the connection point utilising its capabilities, while respecting the provisions of Articles 22 and 23, in accordance with the following control characteristics:

   (a) a setpoint voltage at the connection point shall be specified to cover a specific operation range, either continuously or in steps, by the relevant system operator, in coordination with the relevant TSO;

   (b) the voltage control may be operated with or without a deadband around the setpoint selectable in a range from zero to +/-5 % of nominal network voltage. The dead band shall be adjustable in steps as specified by the relevant system operator in coordination with the relevant;

(c) following a step change in voltage, the HVDC converter station shall be capable of:

(i) achieving 90 % of the change in reactive power output within a time t1specied by the relevant system operator in coordination with the relevant TSO. The time t1 shall be in the range of 0.1 - 10 seconds; and

(ii) settling at the value defined by the operating slope within a time t2 defined by the relevant system operator in coordination with the relevant TSO. The time t2 shall be in the range of 1 - 60 seconds, with a specified steady-state tolerance given in % of the maximum reactive power.

(d) voltage control mode shall include the capability to change reactive power output based on a combination of a modified setpoint voltage and an additional instructed reactive power component. The slope shall be specified by a range and step defined by the relevant system operator in coordination with the relevant TSO.

4. With regard to reactive power control mode, the relevant system operator shall specify, a reactive power range in Mvar or in % of maximum reactive power, as well as its associated accuracy at the connection point, utilising the capabilities of the HVDC system, while respecting the provisions of Articles 22 and 23.

5. For the purposes of power factor control mode, the HVDC converter station shall be capable of controlling the power factor to a target at the connection point, while respecting the provisions of Articles 22 and 23. The available target values shall be available in steps no greater than a maximum allowed step specified by the relevant system operator.

6. The relevant system operator in coordination with the relevant TSO shall specify any equipment needed to enable the remote selection of control modes and relevant setpoints.

Article 25
Priority to active or reactive power contribution

Utilising the capabilities of the HVDC system defined according to this Regulation, the relevant TSO shall determine whether active power contribution or reactive power contribution shall have priority during low or high voltage operation and during faults for which fault-ride-through capability is required. If priority is given to active power contribution, its provision shall be established within a time from the fault inception as specified by relevant TSO .

Article 26
Power quality

An HVDC system owner shall ensure that its HVDC system connection to the network does not result in a level of distortion or fluctuation of the supply voltage on the network, at the connection point, exceeding the level specified by the relevant system operator in coordination with the relevant. The process for necessary studies to be conducted and relevant data to be provided by all grid users involved, as well as mitigating actions identified and implemented, shall be in accordance with the process in Article 27.

CHAPTER III
REQUIREMENTS FOR FAULT RIDE THROUGH

Article 27
Fault ride through capability

1. The relevant TSO shall define, while respecting the provisions of Article 20, a voltage-against-time-profile according to Figure 6 and Table 7 and having regard to the voltage-against-time-profile defined for power park modules according to [NC RfG]. This profile shall apply at connection points for fault conditions, under which the HVDC converter station shall be capable of staying connected to the network and continuing stable operation after the power system has recovered following fault clearance. This voltage-against-time-profile shall be expressed by a lower limit of the course of the phase-to-phase voltages on the network voltage level at the connection points during a symmetrical fault, as a function of time before, during and after the fault. The ride through period longer than t_{rec2} shall be defined by the relevant TSO consistent with the provisions of Article 20.

2. On request by the HVDC system owner, the relevant system operator shall provide the pre-fault and post-fault conditions as defined in Article 34 regarding:

   (a) pre-fault minimum short circuit capacity at the connection points expressed in MVA;

   (b) pre-fault operating point of the HVDC converter station expressed in active power output and reactive power output, and the operating voltage at the connection points; and

   (c) post-fault minimum short circuit capacity at the connection points expressed in MVA.

   Alternatively, generic values for the above conditions derived from typical cases may be provided by the relevant system operator.

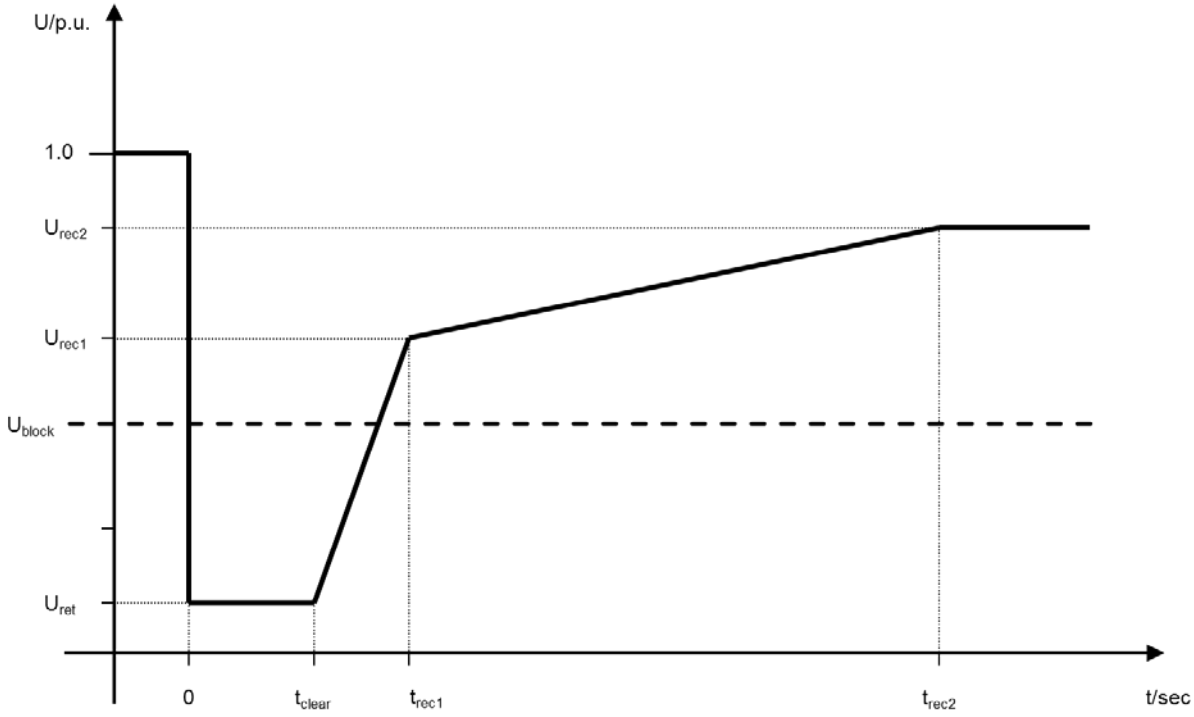

Figure 6: Fault-ride-through profile of an HVDC converter station. The diagram represents the lower limit of a voltage-against-time profile at the connection point, expressed by the ratio of its actual value and its nominal value in per unit before, during and after a fault. U_{RET} is the retained voltage at the connection point during a fault, T_{CLEAR} is the duration of the fault, U_{REC1} and t_{REC1} specify a point of lower limits of voltage recovery following fault clearance. U_{block} is the blocking voltage at the connection point. The time values referred to are measured from T_{FAULT}.

Voltage parameters [pu]		**Time parameters [seconds]**	
U_{RET}	0.00 – 0.30	t_{CLEAR}	0.14-0.25
U_{REC1}	0.25-0.85	t_{REC1}	1.5 – 2.5
U_{REC2}	0.85-0.90	t_{REC2}	t_{REC1} – 10.0

Table 7: Parameters for Figure 6 for the fault-ride-through capability of an HVDC converter station.

3. The HVDC converter station shall be capable of staying connected to the network and continue stable operation 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 described in Article 34, remain above the lower limit defined in Figure 6, unless the protection scheme for internal faults requires the disconnection of the HVDC converter station from the network. The protection schemes and settings for internal faults shall be designed not to jeopardize fault-ride-through performance.

4. The relevant TSO may specify voltages (Ublock) at the connection points under specific network conditions whereby the HVDC System is allowed to block. Blocking means remaining connected to the network with no active and reactive

power contribution for a time frame that shall be as short as technically feasible and which shall be agreed between the relevant TSOs and the HVDC system.

5. In accordance with the provisions of Article 36, undervoltage protection shall be set by the HVDC system owner to the widest possible technical capability of the HVDC converter station. The relevant system operator, in coordination with the relevant TSO, may specify narrower settings according to Article 36.

6. The relevant TSO shall define a fault-ride-through capabilities in case of asymmetrical faults.

Article 28
Post fault active power recovery

The relevant TSO shall specify the magnitude and time profile of active power recovery that the HVDC system shall be capable of providing, in accordance with the provisions of Article 27.

Article 29
Fast recovery of DC faults

HVDC systems, including DC overhead lines, shall be capable of fast recovery from transient faults within the HVDC system. Details of this capability shall be subject to coordination and agreements on protection schemes and settings according to Article 36.

CHAPTER IV
REQUIREMENTS FOR CONTROL

Article 30
Energisation and synchronisation of HVDC converter stations

Unless otherwise instructed by the relevant system operator, during the energisation or synchronisation of an HVDC converter station to the AC network or during the connection of an energised HVDC converter station to an HVDC system, the HVDC converter station shall have the capability to limit any voltage changes to a steady-state level specified by the relevant system operator in coordination with the relevant TSO. The level specified shall not exceed 5 per cent of the pre-synchronisation Voltage. The relevant system operator, in coordination with the relevant TSO, shall specify the maximum magnitude, duration and measurement window of the voltage transients.

Article 31
Interaction between HVDC systems or other plants and equipment

1. When several HVDC converter stations or other plants and equipment are within close electrical proximity, the relevant TSO may specify that a study is required, and the scope and extend of that study, to demonstrate that no adverse interaction will occur. If adverse interaction is identified, the studies shall identify possible mitigating actions to be implemented to ensure compliance with the requirements of this Regulation.

2. The studies shall be carried out by the connecting HVDC system owner with the participation of all other parties identified by the TSOs relevant to each new connection point. Such other parties shall contribute to the studies and shall provide their input as reasonably required to meet the purposes of the studies. The relevant TSO shall collect this input and pass it on to the party responsible for the studies in accordance with Article 10.

3. The relevant TSO shall assess the result of the studies based on their scope and extent as defined in accordance with paragraph 1. If necessary for the assessment, the relevant TSO may request the HVDC system owner to perform further studies in line with the scope and extent specified in accordance with paragraph 1.

4. The relevant TSO shall have the right to review or replicate the study. The HVDC system owner shall provide the relevant TSO all relevant data and models that allow such study to be performed.

5. Any necessary mitigating actions identified by the studies carried out in accordance with paragraph 2 and paragraph 4 and reviewed by the relevant TSO shall be undertaken as part of the connection of the new HVDC converter station.

6. The relevant TSO may specify transient levels of performance associated with events for the individual HVDC system or collectively across HVDC systems commonly impacted to both protect the integrity of TSO equipment and that of grid users in a manner consistent with its national code.

Article 32
Power oscillation damping capability

The HVDC system shall be capable of contributing to the damping of power oscillations in connected AC networks. The control system of the HVDC system shall not reduce the damping of power oscillations. The relevant TSO shall specify the network conditions and a frequency range of oscillations that the control scheme shall positively damp, at least accounting for any dynamic stability assessment studies undertaken by TSOs to identify the stability limits and potential stability problems in their transmission systems. The selection of the control parameter settings shall be agreed between the relevant TSO and the HVDC system owner.

Article 33
Subsynchronous torsional interaction damping capability

1. With regard to subsynchronous torsional interaction (SSTI) damping control, the HVDC system shall be capable of contributing to electrical damping of torsional frequencies.

2. The relevant TSO shall specify the necessary extent of SSTI studies and provide input parameters, to the extent available, related to the equipment and relevant system conditions in its network. The SSTI studies shall be provided by the HVDC system owner. The studies shall identify the conditions, if any, where SSTI exists and propose any necessary mitigation procedure. The necessary contribution to such studies from the owners of other plants and equipment, including but not limited to existing power generating modules, existing distribution networks, existing demand facilities, existing HVDC systems and existing DC-connected power park modules, shall not be unreasonably withheld. The relevant TSO shall collect this input and pass it on to the party responsible for the studies in accordance with Article 10.

3. The relevant TSO shall assess the result of the SSTI studies. If necessary for the assessment, the relevant TSO may request that the HVDC system owner perform further SSTI studies in line with this same scope and extent.

4. The relevant TSO may review or replicate the study. The HVDC system owner shall provide the relevant TSO all relevant data and models that allow such study to be performed.

5. Any necessary mitigating actions identified by the studies carried out in accordance with paragraph 2 or paragraph 4, and reviewed by the relevant TSOs, shall be undertaken as part of the connection of the new HVDC converter station.

Article 34
Network characteristics

1. The relevant system operator shall define and make publicly available the method and the pre-fault and post-fault conditions for the calculation of at least the minimum and maximum short circuit power at the connection points.

2. The HVDC system shall be capable of operating within the range of short circuit power and network characteristics defined by the relevant network.

3. Each relevant system operator shall provide the HVDC system owner with network equivalents describing the behaviour of the network at the connection point, enabling the HVDC system owners to design their system with regard to at least, but not limited to, harmonics and dynamic stability over the lifetime of the HVDC system.

Article 35
HVDC System robustness

1. The HVDC system shall be capable of finding stable operation points with a minimum change in active power flow and voltage level, during and after any planned or unplanned change in the HVDC system or AC network to which it is connected. The relevant TSO shall specify the changes in the system conditions for which the HVDC systems shall remain in stable operation.

2. The HVDC system owner shall ensure that the tripping or disconnection of an HVDC converter station, part of any multi-terminal or embedded HVDC system, does not result in transients at the connection point beyond the limit specified by the relevant TSO.

3. The HVDC system shall withstand transient faults on HVAC lines in the network adjacent or close to the HVDC System, and shall not cause any of the equipment in the HVDC system to disconnect from the network due to auto-reclosure of lines in the network.

4. The HVDC system owner shall provide information to the relevant system operator on the resilience of the HVDC system to AC system disturbances.

CHAPTER V
REQUIREMENTS FOR PROTECTION DEVICES AND SETTINGS

Article 36
Electrical protection schemes and settings

1. The relevant system operator shall define, in coordination with the relevant TSO, the schemes and settings necessary to protect the network taking into account the characteristics of the HVDC system. Protection schemes relevant for the HVDC system and the network, and settings relevant for the HVDC system, shall be coordinated and agreed between the relevant system operator, the relevant TSO and the HVDC system owner. The protection schemes and settings for internal electrical faults shall be designed so as not to jeopardize the performance of the HVDC system in accordance with this Regulation.

2. Electrical protection of the HVDC system shall take precedence over operational controls taking into account system security, health and safety of staff and the public and mitigation of the damage to the HVDC system.

3. Any change to the protection schemes or their settings relevant to the HVDC system and the network shall be agreed between the relevant system operator, the relevant TSO and the HVDC system owner before being implemented by the HVDC system owner.

Article 37
Priority ranking of protection and control

1. A control scheme, defined by the HVDC system owner consisting of different control modes, including the settings of the specific parameters, shall be coordinated and agreed between the relevant TSO, the relevant system operator and the HVDC system owner.

2. With regard to priority ranking of protection and control, the HVDC system owner shall organise its protections and control devices in compliance with the following priority ranking, listed in decreasing order of importance, unless otherwise specified by the relevant TSOs, in coordination with the relevant system operator:

   (a) network system and HVDC system protection;

   (b) active power control for emergency assistance;

   (c) synthetic inertia, if applicable;

   (d) automatic remedial actions as specified in Article 13(3);

   (e) LFSM;

   (f) FSM and frequency control; and

   (g) power gradient constraint;

Article 38
Changes to protection and control schemes and settings

1. The parameters of the different control modes and the protection settings of the HVDC system shall be able to be changed in the HVDC converter station, if required by the relevant system operator or the relevant TSO, and in accordance with paragraph 3.

2. Any change to the schemes or settings of parameters of the different control modes and protection of the HVDC system, including the procedure, shall be coordinated and agreed between the relevant system operator, the relevant TSO and the HVDC system owner.

3. The control modes and associated setpoints of the HVDC System shall be capable of being changed remotely, as defined by the relevant system operator, in coordination with the relevant TSO.

CHAPTER VI
REQUIREMENTS FOR POWER SYSTEM RESTORATION

Article 39
Black start

1. The relevant TSO may obtain a quote for black start capability from an HVDC system owner.

2. An HVDC system with black start capability shall be able to energise the busbar of the remote AC-substation to which it is connected, within a timeframe after shut down determined by the relevant TSOs. The HVDC system shall be able to synchronise within the frequency limits defined in Article 11 and within the voltage limits defined by the relevant TSO or defined by Article 20, where applicable. Wider frequency and voltage ranges can be defined by the relevant TSO where needed in order to restore system security.

3. The relevant TSO and the HVDC system owner shall agree on the capacity and availability of the black start capability and the operational procedure.

TITLE III
REQUIREMENTS FOR DC-CONNECTED POWER PARK MODULES AND REMOTE-END HVDC CONVERTER STATIONS

CHAPTER I
REQUIREMENTS FOR DC-CONNECTED POWER PARK MODULES

Article 40
Scope

The requirements of [NC RfG], as applicable to offshore PPMs with the exception of Articles 24 to 63 thereof, shall apply to DC-connected power park modules with the modifications expressed in Article 41 to Article 47 in this Regulation. These requirements shall apply at the interface points of the DC-connected PPM and the HVDC systems. The categorization in [Art X of NC RfG] shall apply to DC-connected PPMs.

Article 41
Frequency stability requirements

1. With regards to frequency response:

   (a) A DC-connected power park module shall be capable of receiving a fast signal from a connection point in the synchronous area to which frequency response is being provided, within 0.1 second from sending to completion of processing the signal for activation of the response. Frequency shall be measured at the connection point in the synchronous area to which frequency response is being provided.

   (b) DC-connected power park modules connected via HVDC systems which connect with more than one control area shall be capable of delivering coordinated frequency control as defined by the relevant TSO.

2. With regard to frequency ranges and response:

   (a) A DC-connected power park module shall be capable of staying connected to the remote-end HVDC converter station network and operating within the frequency ranges and time periods specified by Table 8 for the 50Hz nominal system. Where a nominal frequency other than 50Hz, or a frequency variable by design is used, subject to agreement with the relevant TSO, the applicable frequency ranges and time periods shall be specified by the relevant TSO taking into account specificities of the system and the principles laid down in Table 8.).

Frequency range	Time period for operation
47.0 Hz – 47.5 Hz	20 seconds
47.5Hz – 49.0 Hz	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

Table 8: Minimum time periods for the 50Hz nominal system for which a PPM shall be capable of operating for different frequencies deviating from a nominal value without disconnecting from the network.

(b) wider frequency ranges or longer minimum times for operation can be agreed between the relevant TSO and the DC-connected power park module owner to ensure the best use of the technical capabilities of a DC-connected power park module if needed to preserve or to restore system security. If wider frequency ranges or longer minimum times for operation are economically and technically feasible, the DC-connected power park module owner shall not unreasonably withhold consent.

(c) while respecting the provisions of point (a) of paragraph 2, a DC-connected power apark module shall be capable of automatic disconnection at specified frequencies, if specified by the relevant TSO. Terms and settings for automatic disconnection shall be agreed between the relevant TSO and the DC-connected power park module owner.

3. With regards to rate-of-change-of-frequency withstand capability, a DC-connected power park module shall be capable of staying connected to the remote-end HVDC converter station network and operable if the system frequency changes at a rate up to +/-2 Hz/s (measured at any point in time as an average of the rate of change of frequency for the previous 1 second) at the interface point of the DC-connected power park module at the remote end of the HVDC converter station for the 50Hz nominal system.

4. DC-connected power park modules shall be required to have limited frequency sensitive mode - overfrequency (LFSM-O) capability in accordance with Article [13(2) of the NC RfG], subject to fast signal response as specified in paragraph 1 for the 50Hz nominal system.

5. A capability for DC-connected power park modules to maintain constant power shall be determined in accordance with [Article 13(3) of the NC RfG] for the 50Hz nominal system.

6. A capability for active power controllability of DC-connected power park modules shall be determined in accordance with [Article 15(2)(a) of the NC RfG] for the 50Hz nominal system. Manual control shall be possible in the case that remote automatic control devices are out of service.

7. A capability for limited frequency sensitive mode - underfrequency (LFSM-U) for a DC-connected power park module shall be determined in accordance with [Article 15(2)(c) of the NC RfG], subject to fast signal response as specified in paragraph 1 for the 50Hz nominal system.

8. A capability for frequency sensitive mode for a DC-connected power park module shall be determined in accordance with [Article 15(2)(d) of the NC RfG], subject to a fast signal response as specified in paragraph 1 for the 50Hz nominal system.

9. A capability for frequency restoration for a DC-connected power park module shall be determined in accordance with [Article 15(2)(e) of the NC RfG] for the 50Hz nominal system.

10. Where a constant nominal frequency other than 50 Hz, a frequency variable by design or a DC system voltage is used, subject to the agreement of the relevant TSO, the capabilities listed in paragraphs 3 to 9 above and the parameters associated with such capabilities shall be specified by the relevant TSO.

Article 42
Reactive power and voltage requirements

1. With respect to voltage ranges:

   (a) a DC-connected power park module shall be capable of staying connected to the remote-end HVDC converter station network and operating within the Voltage ranges (per unit), for the time periods specified by Table 9 or Table 10. The applicable voltage range and time periods specified are selected based on the nominal voltage.

Voltage Range	Time period for operation
0.85 pu – 0.90 pu	60 minutes
0.90 pu – 1.10 pu	Unlimited
1.10 pu – 1.12 pu	Unlimited, unless specified otherwise by the relevant system operator, in coordination with the relevant TSO.
1.12 pu – 1.15 pu	To be specified by the relevant system operator, in coordination with the relevant TSO.

Table 9: Minimum time periods for which a DC-connected power park module shall be capable of operating for different voltages deviating from a nominal value without disconnecting from the network for nominal voltage between 110kV and below 300 kV.

Voltage Range	Time period for operation
0.85 pu – 0.90 pu	60 minutes
0.90 pu – 1.05 pu	Unlimited
1.05 pu – 1.15 pu	To be specified by the relevant system operator, in coordination with the relevant TSO and while respecting the provisions of paragraph 1 of Article 5(3). Various sub-ranges of voltage withstand capability can be defined.

Table 10: Minimum time periods for which a DC-connected power park module shall be capable of operating for different voltages deviating from a nominal value without disconnecting from the network for nominal voltage between 300 kV and 400 kV (included).

   (b) Wider voltage ranges or longer minimum times for operation can be agreed between the relevant system operator, the relevant TSO and the DC-connected power park module owner to ensure the best use of the technical capabilities of

a DC-connected power park module if needed to preserve or to restore system security, subject to approval in accordance with Article 5(1). If wider voltage ranges or longer minimum times for operation are economically and technically feasible, the DC-connected power park module owner shall not unreasonably withhold consent.

(c) For DC connected PPMs which have an interface point to the remote-end HVDC converter network, the relevant system operator, in coordination with the relevant TSO may specify voltages at the interface point at which a DC-connected power park module shall be capable of automatic disconnection. The terms and settings for automatic disconnection shall be agreed between the relevant system operator, the relevant TSO and the DC-connected power park module owner.

(d) For interface points at AC voltages that are not included in the scope of Table 9 and Table 10, the relevant system operator, in coordination with the relevant TSO shall define applicable requirements at the connection.

(e) Where frequencies other than nominal 50Hz are used, subject to relevant TSO agreement, the voltage ranges and time periods specified by the relevant system operator, in coordination with the relevant TSO shall be equitable in proportion to those in Table 9 and 10.

2. With respect to reactive power capability for DC-connected power park modules:

(a) If the DC-connected power park module owner can obtain a bilateral agreement with the owners of the HVDC systems connecting the DC-connected power park module to a single connection point on a AC network, it shall fulfil all of the following requirements:

(i) it shall have the ability with additional plant or equipment and/or software, to meet the reactive power capabilities prescribed by the relevant system operator, in coordination with the relevant TSO, according to point (b) and it shall either:

- have the reactive power capabilities prescribed by the relevant system operator, in coordination with the relevant TSO for some or all of their equipment in accordance with point (b) already installed as part of the connection of the DC-connected power park module to the AC network at the time of initial connection and commissioning; or

- demonstrate to, and then reach agreement with, the relevant system operator and the relevant TSO on how the reactive power capability will be provided when the DC-connected power park module is connected to more than a single connection point in the AC network, or the remote-end HVDC converter network has either another DC-connected power park module or HVDC system with a different owner connected to it. This agreement shall include a contract by the DC-connected power park module owner (or any subsequent owner), that it will finance and install reactive power capabilities required by this Article for its PPMs at a point in time defined by the relevant system operator, in coordination with the relevant TSO. The relevant system operator, in coordination with the relevant TSO shall inform the DC connected power park

module owner of the proposed completion date of any committed development which will require the DC connected PPM to install the full reactive power capability.

(ii) the relevant system operator, in coordination with the relevant TSO must account for the development time schedule of retrofitting the reactive power capability to the DC-connected power park module in specifying the point in time by which this reactive power capability retrofitting is to take place. The development time schedule shall be provided by the DC-connected power park module owner at the time of connection to the AC network.

(b) DC-connected power park modules shall fulfil the following requirements referring to voltage stability either at the time of connection or subsequently, according to the agreement as referred to in Article point (a):

(i) With regard to reactive power capability at maximum HVDC active power transmission capacity, DC-connected power park modules shall meet the reactive power provision capability requirements specified by the relevant system operator, in coordination with the relevant TSO, in the context of varying voltage. The relevant system operator shall define a U-Q/Pmax-profile that may take any shape with ranges in accordance with Table 11, of which the power park module shall be capable of providing reactive power at its maximum HVDC active power transmission capacity. The relevant system operator, in coordination with the relevant TSO, shall consider the long term development of the network when determining these ranges, as well as the potential costs for PPMs of delivering the capability of providing reactive power production at high voltages and reactive power consumption at low voltages.

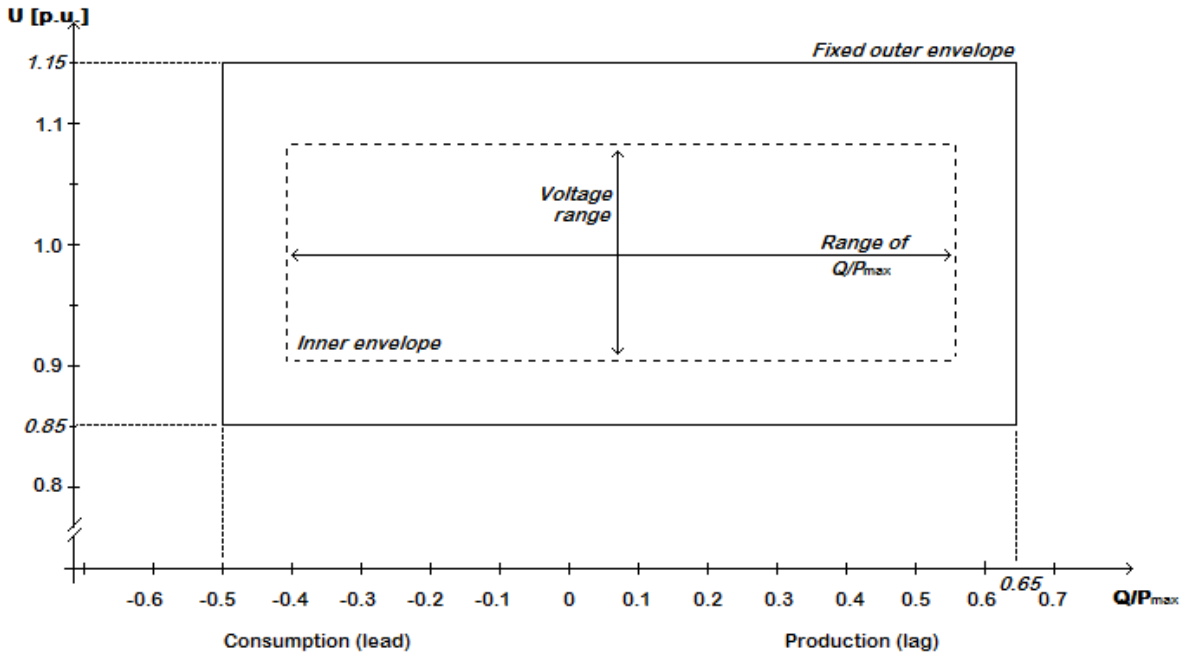

Figure 7: U-Q/Pmax-profile of a DC-connected power park module at the connection point. The diagram represents boundaries of a U-Q/Pmax-profile of the voltage at the connection point[s], expressed by the ratio of its actual value to its nominal value in per unit, against the ratio of the reactive power (Q) to the maximum capacity (Pmax).The position, size and shape

of the inner envelope are indicative and other than rectangular may be used within the inner envelope. For profile shapes other than rectangular, the voltage range represents the highest and lowest voltage points. Such a profile would not give rise to the full reactive power range being available across the range of steady-state voltages;

Range of width of Q/Pmax profile	Range of steady-state Voltage level in pu
0 - 0.95	0.1 - 0.225

Table 11: maximum and minimum range of both Q/Pmax and steady-state voltage level range for a DC-connected PPM

If the Ten-Year Network Development Plan developed in accordance with Art 8 of Regulation (EC) No 714/2009 or a national plan developed and approved in accordance with Article 22 of Directive 2009/72/EC specifies that that a DC-connected PPM will become AC-connected to the synchronous area, the relevant TSO may specify that either:

- the DC-connected power park module shall have the capabilities prescribed in [Article 25(4) of the NC RfG] for that synchronous area installed at the time of initial connection and commissioning of the DC-connected power park module to the AC-network; or
- the DC-connected power park module owner shall demonstrate to, and then reach agreement with, the relevant system operator and the relevant TSO on how the [reactive power capability prescribed in [Article 25(4) of the NC RfG] for that synchronous area will be provided in the event that the DC-connected PPM becomes AC-connected to the synchronous area.

(ii) With regard to reactive power capability, for power park modules where the connection point is not at the location of the high-voltage terminals of its step-up transformer, or where no step up transformer exists at the terminals of the high-voltage line or cable to the connection point at the power park module, supplementary reactive power may be required by the relevant system operator, in coordination with the relevant TSO, to compensate for the reactive power consumption of the high-voltage line or cable between these two points from the responsible owner of this line or cable.

3. With regard to priority to active or reactive power contribution for DC-connected power park modules, the relevant system operator, in coordination with the relevant TSO shall specify whether active power contribution or reactive power contribution has priority during faults for which fault-ride-through capability is required. If priority is given to active power contribution, its provision shall be established within a time from the fault inception as defined by the relevant system operator, in coordination with the relevant TSO.

Article 43
Control requirements

1. During the synchronisation of a DC-connected PPM to the AC collection network, the DC-connected PPM shall have the capability to limit any voltage changes to a steady-state level specified by the relevant system operator, in coordination with the relevant TSO. The level specified shall not exceed 5 per cent of the pre-synchronisation voltage. The relevant system operator, in coordination with the relevant TSO, shall define the maximum magnitude, duration and measurement window of the voltage transients.

2. With regard to active power controllability and control range, the DC-connected power park module control system shall be capable of adjusting an active power setpoint as instructed by the relevant system operator and the relevant TSO within a period specified and within a defined tolerance (subject to the availability of the prime mover resource), subject to notification to the regulatory authority. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework. The relevant system operator, in coordination with the relevant TSO shall provide the PPM owner with the defined minimum periods and tolerance.

3. The DC-connected PPM owner shall provide output signals as specified by the relevant system operator, in coordination with the relevant TSO.

Article 44
Network characteristics

1. With regard to the network characteristics, the following shall apply for the DC-connected power park modules:

   (a) Each relevant system operator shall define and make publicly available the method and the pre-fault and post-fault conditions for the calculation of minimum and maximum short circuit power at the connection point.

   (b) The DC-connected power park module shall be capable of stable operation within the minimum to maximum short circuit range of short circuit power and network characteristics of the connection point defined by the relevant system operator, in coordination with the relevant TSO.

   (c) Each relevant system operator and HVDC system owner shall provide the DC-connected power park module owner with equivalents representing the system, enabling the DC-connected power park module owners to design their system with regard to harmonics.

Article 45
Protection requirements

1. Electrical protection schemes and settings of DC-connected power park modules shall be determined in accordance with [Article 14(5)(b) of the NC RfG], where the network refers to the synchronous area network. The protection schemes have to be designed taking into account the system performance, grid specificities as well as technical specificities of the power park module technology and agreed with the relevant system operator, in coordination with the relevant TSO.

2. Priority ranking of protection and control of DC-connected power park modules shall be determined in accordance with [Article 14(5)© of the NC RfG], where the network refers to the synchronous area network, and agreed with the relevant system operator, in coordination with the relevant TSO.

Article 46
Power quality

DC-connected power park modules owners shall ensure that their connection to the network does not result in a level of distortion or fluctuation of the supply voltage on the network, at the connection point, exceeding the level specified by the relevant system operator, in coordination with the relevant TSO. The necessary contribution to such studies from the grid users, including but not limited to existing DC-connected power park modules and existing HVDC systems shall not be unreasonably withheld. The process for necessary studies to be conducted and relevant data to be provided by all grid users involved, as well as mitigating actions identified and implemented shall be in accordance with the process in Article 31.

Article 47
General system management requirements applicable to DC connected PPMs

With regard to general system management requirements, Articles 9(5), 10(6) and 11(4) of the [NC RfG] shall apply to any DC-connected power park module.

CHAPTER II
REQUIREMENTS FOR REMOTE-END HVDC CONVERTER STATIONS

Article 48
Scope

The requirements of Article 11 to Article 39 apply to remote-end HVDC converter stations, with the modifications expressed in Article 49 to Article 52.

Article 49
Frequency stability requirements

1. Where a nominal frequency other than 50Hz, or a frequency variable by design is used in the network connecting the DC-connected power park modules, subject to relevant TSO agreement , Article 11 shall apply to the remote-end HVDC converter station with the applicable frequency ranges and time periods specified by the relevant TSO, taking into account specificities of the system and the principles laid down in Table 1.

2. With regards to frequency response, the remote-end HVDC converter station owner and the DC-connected power park module owner shall agree on the technical modalities of the fast signal communication in accordance with Article 41(1). Where the relevant TSO requires, the HVDC system shall be capable of providing the network frequency at the connection point as a signal. For an HVDC system

connecting PPM the adjustment of active power frequency response is limited by the capability of the DC-connected power park module.

Article 50
Reactive power and voltage requirements

1. With respect to voltage ranges:

(a) A remote-end HVDC converter station shall be capable of staying connected to the remote-end HVDC converter station network and operating within the voltage ranges (per unit) and time periods specified by Table 12 or Table 13. The applicable voltage range and time periods specified are selected based on the nominal voltage.

Voltage range	Time period for operation
0.85 pu – 0.90 pu	60 minutes
0.90 pu – 1.10 pu	Unlimited
1.10 pu – 1.12 pu	Unlimited, unless specified otherwise by the relevant system operator, in coordination with the relevant TSO.
1.12 pu – 1.15 pu	To be specified by the relevant system operator, in coordination with the relevant TSO.

Table 12: Minimum time periods for which a remote-end HVDC converter shall be capable of operating for different voltages deviating from a nominal value without disconnecting from the network (for nominal voltage between 110kV and below 300 kV).

Voltage range	Time period for operation
0.85 pu – 0.90 pu	60 minutes
0.90 pu – 1.05 pu	Unlimited
1.05 pu – 1.15 pu	To be specified by the relevant system operator, in coordination with the relevant .. Various sub-ranges of voltage withstand capability may be defined.

Table 13: Minimum time periods for which a remote-end HVDC converter shall be capable of operating for different voltages deviating from a nominal value without disconnecting from the network (for nominal voltage between 300 kV and 400 kV, included).

(b) Wider voltage ranges or longer minimum times for operation may be agreed between the relevant system operator, in coordination with the relevant TSO, and the DC-connected power park module owner in accordance with Article 42.

(c) For interface points at AC voltages that are not included in the scope of Table 12 and Table 13, the relevant system operator, in coordination with the relevant TSO shall define applicable requirements at the connection points.

(d) Where frequencies other than nominal 50Hz are used, subject to relevant TSO the voltage ranges and time periods specified by the relevant system operator, in coordination with the relevant TSO, shall be equitable in proportion to those in Table 12 and 13.

2. A remote-end HVDC converter station shall fulfil the following requirements referring to voltage stability, at the connection points with regard to reactive power capability:

(a) The relevant system operator, in coordination with the relevant TSO shall define the reactive power provision capability requirements for various voltage levels. In doing so, relevant system operator, in coordination with the relevant TSO shall define a U-Q/Pmax-profile of any shape and within the boundaries of which the remote-end HVDC converter station shall be capable of providing reactive power at its maximum HVDC active power transmission capacity.

(b) The U-Q/Pmax-profile shall be defined by each relevant system operator, in coordination with the relevant. The U-Q/Pmax-profile shall be within the range of Q/Pmax and steady state voltage in Table 14, and the position of the U-Q/Pmax-profile envelope shall lie within the limits of the fixed outer envelope in Figure 5 in Article 22. The relevant system operator, in coordination with the relevant TSO shall consider the long term development of the network when determining these ranges.

Maximum range of Q/Pmax	**Maximum range of steady-state voltage level in PU**
0.95	0.225

Table 14: Maximum range of both Q/Pmax and steady-state voltage range for a remote-end HVDC converter station

Article 51
Network characteristics

With regard to the network characteristics, the remote-end HVDC converter station owner shall provide relevant data to any DC-collected power park module owner in accordance with Article 44.

Article 52
Power quality

Remote-end HVDC converter station owners shall ensure that their connection to the network does not result in a level of distortion or fluctuation of the supply voltage on the network, at the connection point, exceeding the level allocated to them by the relevant system operator, in coordination with the relevant TSO. The necessary contribution to such studies from the grid users, including but not limited to existing DC-connected power park modules and existing HVDC systems shall not be unreasonably withheld. The process for necessary studies to be conducted and relevant data to be provided by all grid users involved, as well as mitigating actions identified and implemented shall be in accordance with the process in Article 31.

TITLE IV
INFORMATION EXCHANGE AND COORDINATION

Article 53
Operation

1. With regard to instrumentation for the operation, each HVDC converter unit of an HVDC system shall be equipped with an automatic controller capable of receiving instructions from the relevant system operator and from the relevant TSO. This automatic controller shall be capable of operating the HVDC converter units of the HVDC system in a coordinated way. The relevant system operator shall define the automatic controller hierarchy per HVDC converter unit.

2. The automatic controller of the HVDC system referred to in paragraph 1 shall be capable of sending the following signal types to the relevant system operator:

   (a) operational signals, providing at least the following:

      (i) startup signals;

      (ii) AC and DC voltage measurements;

      (iii) AC and DC current measurements;

      (iv) active and reactive power measurements on the AC side;

      (v) active DC power measurements;

      (vi) multi-pole operational type at HVDC converter units level with regard to HVDC system;

      (vii) elements and topology status; and

      (viii) FSM, LFSM-O and LFSM-U active power ranges.

   (b) alarm signals, providing at least the following:

      (i) emergency blocking;

      (ii) ramp blocking;

      (iii) fast active power reversal.

3. The automatic controller referred to in paragraph 1 shall be capable of receiving the following signal types from the relevant system operator:

   (a) operational signals, receiving at least the following:

      (i) start-up command;

      (ii) active power setpoints;

      (iii) frequency sensitive mode settings;

      (iv) reactive power, voltage or similar setpoints;

      (v) reactive power control modes;

      (vi) power oscillation damping control; and

(vii) synthetic inertia.

(b) alarm signals, receiving at least the following:

(i) emergency blocking command;

(ii) ramp blocking command;

(iii) active power flow direction; and

(iv) fast active power reversal command.

4. with regards to each signal, the relevant system operator shall have the right to define the quality of the supplied signal.

Article 54
Parameter setting

1. The parameters and settings of the main control functions of an HVDC system shall be agreed between the HVDC system owner and the relevant system operator, in coordination with the relevant TSO. The parameters and settings shall be implemented within such a control hierarchy that makes their modification possible if necessary. These main control functions are at least:

(a) synthetic inertia, if applicable as defined in Article 14 and Article 41;

(b) frequency sensitive modes (FSM, LFSM-O, LFSM-U) defined in Articles 15, 16 and 17;

(c) frequency control, if applicable, defined in Article 18;

(d) reactive power control mode, if applicable as defined in Article 24;

(e) power oscillation damping capability, defined in Article 32; and

(f) subsynchronous torsional interaction damping capability, defined in Article 33.

Article 55
Fault recording and monitoring

1. An HVDC system shall be equipped with a facility to provide fault recording and dynamic system behaviour monitoring of the following parameters for each of its HVDC converter stations:

(a) AC and DC voltage;

(b) AC and DC current;

(c) active power;

(d) reactive power; and

(e) frequency.

2. The relevant system operator may specify quality of supply parameters to be complied with by the HVDC system, provided a reasonable prior notice is given.

3. The particulars of the fault recording equipment referred to in paragraph 1, including analogue and digital channels, the settings, including triggering criteria and the sampling rates shall be agreed between the HVDC system owner, the relevant system operator and the relevant TSO.

4. All dynamic system behaviour monitoring shall include an oscillation trigger, specified by the relevant system operator in coordination with the relevant TSO, for detecting poorly damped power oscillations.

5. The facilities for quality of supply and dynamic system behaviour monitoring shall include arrangements for the HVDC system owner and the relevant system operator to access the information electronically. The communications protocols for recorded data shall be agreed between the HVDC system owner, the relevant system operator and the relevant TSO.

Article 56
Simulation models

1. The relevant system operator in coordination with the relevant TSO may specify that an HVDC system owner deliver simulation models which properly reflect the behaviour of the HVDC system in both steady-state, dynamic simulations (fundamental frequency component) and in electromagnetic transient simulations.

   The format in which models shall be provided and the provision of documentation of models structure and block diagrams shall be defined by the relevant system operator in coordination with the relevant TSO.

2. For the purpose of dynamic simulations, the models provided shall contain at least, but not limited to the following sub-models, depending on the existence of the mentioned components:

   (a) HVDC converter unit models;

   (b) AC component models;

   (c) DC grid models;

   (d) Voltage and power control;

   (e) Special control features if applicable e.g. power oscillation damping (POD) function, subsynchronous torsional interaction (SSTI) control;

   (f) Multi terminal control, if applicable; and

   (g) HVDC system protection models as agreed between the relevant TSO and the HVDC system owner.

3. The HVDC system owner shall verify the models against the results of compliance tests carried out according to Title VI and a report of this verification shall be submitted to the relevant TSO. They shall then be used for the purpose of verifying the requirements of this Regulation including, but not limited to, compliance simulations as defined in Title VI and for use in studies for continuous evaluation in system planning and operation.

4. An HVDC system owner shall submit HVDC system recordings to the relevant system operator or relevant TSO if requested in order to compare the response of the models with these recordings.

5. An HVDC system Owner shall deliver a replica of the exact control system when adverse control interactions may result with HVDC converter stations and other connections in close electrical proximity if requested by the relevant system operator or relevant TSO.

TITLE V
OPERATIONAL NOTIFICATION PROCEDURE FOR CONNECTION

CHAPTER I
OPERATIONAL NOTIFICATION PROCEDURE FOR CONNECTION OF NEW HVDC SYSTEMS

Article 57
General provisions

1. The provisions of this Chapter shall apply to new HVDC systems only.

2. The HVDC system owner shall demonstrate to the relevant system operator its compliance with the requirements referred to in Title II to Title IV at the respective connection point by successfully completing the operational notification procedure for connection of the HVDC system as defined in Article 58 through to Article 61.

3. The relevant system operator shall define and further details of the operational notification procedure and make these details publically available.

4. The operational notification procedure for connection for each new HVDC system shall comprise:

   (a) energisation operational notification (EON);

   (b) interim operational notification (ION); and

   (c) final operational notification (FON).

Article 58
Energisation operational notification (EON) for HVDC systems

1. An energisation operational notification (EON) shall entitle the HVDC system owner to energise its internal network and auxiliaries and connect it to the network at its defined connection points.

2. An EON shall be issued by the relevant system operator, subject to completion of preparation and the fulfilment of the requirements defined by the relevant system operator in the relevant operational procedures. This preparation will include agreement on the protection control relevant to the connection points between the relevant system operator and the HVDC system owner.

Article 59
Interim operational notification (ION) for HVDC systems

1. An interim operational notification (ION) shall entitle an HVDC system owner or HVDC converter unit owner to operate the HVDC system or HVDC converter by using the network connections defined by the connection points for a limited period of time.

2. An ION shall be issued by the relevant system operator on the completion of the data and study review process.

3. For the purpose of the completion of data and study review, the HVDC system or HVDC converter unit shall provide the following upon request from the relevant system operator:

(a) itemized statement of compliance;

(b) detailed technical data of the HVDC system with relevance to the network connection, that is defined by the connection points, as specified by the relevant system operator, in coordination with the relevant TSOs;

(c) equipment certificates of HVDC systems or HVDC converter units where these are relied upon as part of the evidence of compliance;

(d) simulation models or a replica of the exact control system as specified by Article 56 and by the relevant system operator in coordination with the Relevant TSO(s);

(e) studies demonstrating expected steady-state and dynamic performance as required by Title II, Title III and Title IV;

(f) details of intended compliance tests according to Article 67; and

(g) details of intended practical method of completing compliance tests according to Title VI.

4. Except where paragraph 5 applies, the maximum period for the HVDC system owner or HVDC converter unit owner to remain in the ION status shall not exceed twenty four months. The Relevant system operator may specify a shorter ION validity period. The ION validity period shall be notified to the regulatory authority in accordance with the applicable national regulatory framework. ION extension shall be granted only if the HVDC system owner demonstrates substantial progress towards full compliance. At the time of ION extension, the outstanding issues shall be explicitly identified.

5. The maximum period for an HVDC system owner or HVDC converter unit owner to remain in the ION status may be extended beyond 24 months upon request for derogation made to the relevant system operator in accordance with the procedure in Title VII. The request shall be made before the expiry of the twenty four month period.

Article 60
Final operational notification (FON) for HVDC systems

1. A final operational notification (FON) shall entitle an HVDC system owner to operate the HVDC system or HVDC converter units by using the grid connection points.

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

3. For the purpose of the completion of data and study review, the HVDC system owner shall provide the following upon request from the relevant system operator in coordination with the relevant TSO:

(a) itemized statement of compliance; and

(b) update of applicable technical data, simulation models, a replica of the exact control system and studies as referred to in Article 59, including use of actual measured values during testing.

4. In case of incompatibility identified for the purpose of the granting of the FON, a derogation may be granted upon a request to the relevant system operator, in accordance with the derogation procedure according to Title VII. A FON shall be issued by the relevant system operator, if the HVDC system is compliant with the provisions of the derogation. The relevant system operator shall have the right to refuse the operation of the HVDC system or HVDC converter units, whose owner's request for derogation was rejected, until the HVDC system owner and the relevant system operator have resolved the incompatibility and the HVDC system is considered to be compliant by the relevant system operator.

Article 61
Limited operational notification (LON) for HVDC systems

1. HVDC system owners to whom a FON has been granted shall inform the relevant system operator immediately in the following circumstances:

   (a) the HVDC system is temporarily subject to either a significant modification or loss of capability, due to implementation of one or more modifications of significance to its performance; or

   (b) in case of equipment failures leading to non-compliance with some relevant requirements.

2. The HVDC system owner shall apply to the relevant system operator for a limited operational notification (LON) if the HVDC system owner reasonably expects the circumstances detailed in paragraph 1 to persist for more than three months.

3. A LON shall be issued by the relevant system operator with a clear identification of:

   (a) the unresolved issues justifying the granting of the limited operational notification (LON);

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

   (c) a maximum period of validity which shall not exceed twelve months. The initial period granted may be shorter, with possibility for extension, if evidence to the satisfaction of the relevant system operator has been made, which demonstrates that substantial progress has been made in terms of achieving full compliance.

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

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

6. The relevant system operator may refuse the operation of the HVDC system if the LON terminates and the circumstance which caused it to be issued remain. In such a case the FON shall automatically be invalid.

CHAPTER II
OPERATIONAL NOTIFICATION PROCEDURE FOR CONNECTION OF NEW DC-CONNECTED POWER PARK MODULES

Article 62
General provisions

1. The provisions of this Chapter shall apply to new DC-connected power park modules only.

2. The DC-connected power park module owner shall demonstrate to the relevant system operator its compliance with the requirements referred to in Title III at the respective connection points by successfully completing the operational notification procedure for connection of the DC-connected power park module in accordance with Article 63 through to Article 66.

3. The relevant system operator shall define further details of the operational notification procedure and make these details publically available.

4. The operational notification procedure for connection for each New DC-connected power park module shall comprise:

   (a) energisation operational notification (EON);

   (b) interim operational notification (ION); and

   (c) final operational notification (FON)

Article 63
Energisation operational notification (EON) for DC-connected power park modules

1. An energisation operational notification (EON) shall entitle the owner of a DC-connected power park module to energise its internal network and auxiliaries by using the grid connection that is defined by the connection points.

2. An EON shall be issued by the relevant system operator, subject to completion of preparation including agreement on the protection and control settings relevant to the connection points between the relevant system operator and the DC-connected power park module.

Article 64
Interim operational notification (ION) for DC-connected power park modules

1. An interim operational notification (ION) shall entitle the DC-connected power park module owner to operate the DC-connected power park module and generate power by using the grid connection for a limited period of time.

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

3. With respect to data and study review, the DC-connected power park module owner shall provide the following from upon request from the relevant system operator:

(a) itemized statement of compliance;

(b) detailed technical data of the power park module with relevance to the grid connection, that is defined by the connection points as specified by the relevant system operator in coordination with the relevant TSO;

(c) equipment certificates of power park module, where these are relied upon as part of the evidence of compliance;

(d) simulation models as specified by Article 47 and as required by the Relevant System operator(s) in coordination with the relevant TSO;

(e) studies demonstrating expected steady-state and dynamic performance as required by Title 3; and

(f) details of intended compliance tests according to Article 72.

4. Except where paragraph 5 applies, the maximum period for the DC-connected power park module owner to remain in the ION status shall not exceed twenty-four months. The relevant system operator may specify shorter ION validity. The ION validity period shall be notified to the regulatory authority in accordance with the applicable national regulatory framework. ION extensions shall be granted only if the DC-connected power park module owner demonstrates substantial progress towards full compliance. At the time of ION extension, any outstanding issues should be explicitly identified.

5. The maximum period for a DC-connect power park module owner to remain in the ION status may be extended beyond 24 months upon request for derogation made to the relevant system operator in accordance with the procedure in Title VII.

Article 65

Final operational notification (FON) for DC-connected power park modules

1. A final operational notification (FON) shall entitle the DC-connected power park module owner to operate the DC-connected power park module by using the grid connection that is defined by the connection point.

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

3. For the purpose of the completion of data and study review, the DC-connected power park module owner shall provide the following upon request from the relevant system operator:

(a) itemized Statement of compliance; and

(b) update of applicable technical data, simulation models and studies as referred to in Article 64(3), including use of actual measured values during testing.

4. In case of incompatibility identified for the purpose of the granting of the FON, derogation may be granted upon request made to the relevant system operator, in accordance with the derogation procedure according to Title VII. A FON shall be issued by the relevant system operator, if the DC-connected power park module is compliant with the provisions of the derogation. The relevant system operator shall

have the right to refuse the operation of the DC-connected power park module, whose owner's request for derogation was rejected, until the DC-connected power park module owner and the relevant system operator have resolved the incompatibility and the DC-connected power park module is considered to be compliant by the relevant system operator.

Article 66

Limited operational notification (LON) for DC-connected power park modules

1. DC-connected power park module owners to whom a FON has been granted shall inform the relevant system operator immediately in the following circumstances:

   (a) the DC-connected power park module is temporarily subject to either a significant modification or loss of capability, due to implementation of one or more modifications of significance to its performance, or

   (b) in case of equipment failures leading to non-compliance with some relevant requirements.

2. The DC-connected power park module owner shall apply to the relevant TSO for a limited operational notification (LON), if the DC-connected power park module owner reasonably expects the circumstances detailed in paragraph 1 to persist for more than three months.

3. A LON shall be issued by the relevant TSO with a clear identification of:

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

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

   a maximum period of validity which shall not exceed twelve months. The initial period granted may be shorter, with possibility for extension, if evidence to the satisfaction of the relevant system operator has been made, which demonstrates that substantial progress has been made in terms of achieving full compliance.

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

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

6. The relevant system operator may refuse the operation of the DC-connected power park module if the LON terminates and the circumstance which caused it to be issued remain. In such a case the FON shall automatically be invalid.

CHAPTER III
COST BENEFIT ANALYSIS

Article 67

Identification of costs and benefits of application of rules to existing HVDC systems or DC-connected power park modules or for a request for a derogation

1. In order to assess the costs and benefits of the application of any requirement set out in this Regulation to existing HVDC systems and existing DC-connected PPMs in

accordance with paragraph 3 of Article 4, or in order to assess the costs and benefits of a request for derogation pursuant to Articles 78 and 79, the process shall be initiated with a preparatory stage aimed at identifying cases of merit in accordance with the phases set out in paragraphs 2 to 10.

2. For the application of any requirement set out in this Regulation to existing power HVDC systems or DC-connected power park modules, 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 HVDC systems or existing DC-connected power park 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 4 to 7, 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.

3. In order to assess the costs and benefits of a request for derogation pursuant to Article 78, in the preparatory stage, the HVDC system owner or DC-connected power park module owner shall undertake a qualitative comparison of costs and benefits related to the requested derogation which shall take into account available network-based or market-based alternatives, and shall submit this analysis to the relevant TSO. The relevant TSO shall comment on this qualitative analysis within three months. If the qualitative comparison does not indicate that the likely benefits exceed the likely costs, the TSO shall recommend that the HVDC system owner or DC-connected power park module owner not proceed to a quantitative cost-benefit analysis, as described in paragraphs 4 to 7 and withdraw the request for a derogation. After having received the comments, the HVDC system owner or DC-connected power park module owner shall decide whether to proceed to a quantitative cost-benefit analysis.

4. Following an assessment under paragraph 2, the relevant TSO shall carry out a quantitative cost-benefit analysis of any requirement under consideration for application to existing HVDC systems or DC connected power park modules that have demonstrated potential benefits as a result of the preparatory stage according to paragraph 1. That cost-benefit shall include, inter alia, a proposal for a transitional period for applying the requirement to existing HVDC systems or existing power park modules. That transitional period shall not be more than two years from the date of the decision of the regulatory authority or, where applicable, the Member State on the requirement's applicability.

   Following an assessment under paragraph 3, the HVDC system owner or DC-connected power park module owner may, taking into consideration the comments and recommendation from the relevant TSO, decide to carry out a quantitative cost-benefit analysis of any requirement under consideration for derogation from this Regulation. That cost-benefit analysis shall be followed by a public consultation in accordance with Article 8.

5. HVDC system owners, existing DC-connected power park modules and distribution system operators, including Closed Distribution System Operators (CDSO) 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. For the preparation of a cost-benefit-analysis by a HVDC system owner or DC-connected power park module owner assessing a potential derogation pursuant to

Article X, the relevant TSO and DSO, including CDSO, shall assist and contribute to the cost-benefit analysis and provide the data requested by the power generating facility owner within three months of receiving a request, unless agreed otherwise.

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

(a) the relevant TSO, HVDC system owner or DC-connected power park module owner 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, HVDC system owner or DC-connected power park module owner 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, HVDC system owner or DC-connected power park module owner 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, HVDC system owner or DC-connected power park module owner shall quantify the costs of applying the necessary rules to existing HVDC systems or DC-connected power park 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.

7. Within three months of concluding the cost-benefit analysis, the relevant TSO, or for the purpose of derogations under Article 78 the HVDC system owner or DC-connected power park module owner, shall summarise the findings in a report which shall:

(a) include a recommendation on how to proceed;

(b) be subject to public consultation in accordance with Article 8.

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 HVDC systems or DC-connected power park modules. The report and proposal shall be notified to the regulatory authority or, where applicable, the Member State and the HVDC system owner or DC-connected power park module owner shall be informed on its content. For the purpose of derogations under Article 78, the power generating facility owner shall prepare the report and proposal, which shall be notified to the regulatory authority and the relevant TSO shall be informed on its content

8. The proposal made by the relevant TSO to the regulatory authority or, where applicable, the Member State on the applicability of any requirement of this Regulation to existing HVDC systems or DC-connected power park modules according to paragraph 3 of Article 4 shall include the following:

   (c) an operational notification procedure for demonstrating the implementation of the requirements by the existing HVDC system owner or DC-connected power park module owner;

   (d) a transitional period for implementing the requirements which shall take into account the category of HVDC system or DC-connected power park module according to and any underlying obstacles to the efficient implementation of the equipment modification/refitting.

9. The relevant regulatory authority shall decide on the case within three months of receipt of the report and the recommendation of the relevant TSO, HVDC system owner or DC-connected power park module owner.

   The decision of the regulatory authority shall be published.

TITLE VI
COMPLIANCE

CHAPTER I
COMPLIANCE MONITORING

Article 68

Responsibility of the HVDC system owner and DC-connected power park module owner

1. The HVDC system owner shall ensure that the HVDC system and HVDC converter stations are compliant with the requirements under this Regulation. This compliance shall be maintained throughout the lifetime of the facility.

2. The DC-connected power park module owner shall ensure that the DC-connected power park module is compliant with the requirements under this Regulation. This compliance shall be maintained throughout the lifetime of the facility.

3. Planned modifications of the technical capabilities of the HVDC system, HVDC converter station or DC-connected power park module with possible impact on its compliance to the requirements under this Regulation shall be notified to the relevant TSO by the HVDC system owner or DC-connected power park module owner before initiating such modification.

4. Any operational incidents or failures of an HVDC system, HVDC converter station or DC-connected power park module that have impact on its compliance to the requirements of this Regulation shall be notified to the relevant TSO by the HVDC system owner or DC-connected power park module owner as soon as possible without any delay after the occurrence of such an incident.

5. Any foreseen test schedules and procedures to verify compliance of an HVDC system, HVDC converter station or DC-connected power park module with the requirements of this Regulation shall be notified to the relevant TSO by the HVDC system owner or DC-connected power park module owner in due time and prior to their launch and shall be approved by the relevant TSO.

6. The relevant TSO shall be facilitated to participate in such tests and may record the performance of the HVDC systems, HVDC converter stations or DC-connected power park modules.

Article 69
Tasks of the relevant system operator

1. The relevant system operator shall regularly assess the compliance of an HVDC system, HVDC converter station and DC-connected power park module with the requirements under this Regulation throughout the lifetime of the HVDC system, HVDC converter station or DC-connected power park module. The HVDC system owner or DC-connected power park module owner shall be informed of the outcome of this assessment.

2. Where requested by the relevant system operator, the HVDC system owner or DC-connected power park module owner shall carry out compliance tests and simulations, not only during the operational notification procedures according to Title V, but repeatedly throughout the lifetime of the HVDC system, HVDC converter station or DC-connected power park module according to a plan or general scheme for repeated tests and simulations defined or after any failure, modification or replacement of any equipment that may have impact on the compliance with the requirements under this Regulation. The HVDC system owner or DC-connected power park module owner shall be informed of the outcome of these compliance tests and simulations.

3. The relevant system operator shall make publicly available the list of information and documents to be provided as well as the requirements to be fulfilled by the HVDC system owner or DC-connected power park module owner in the frame of the compliance process. Such list shall cover at least the following information, documents and requirements:

   (a) all documentation and certificates to be provided by the HVDC system owner or DC-connected power park module owner;

   (b) details of the technical data of the HVDC system, HVDC converter station or DC-connected power park module with 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 HVDC system owner or DC-connected power park module owner for demonstrating expected steady-state and dynamic performance referring to the requirements set forth in Title II, Title III and Title IV; and

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

(g) conditions and procedures for use of relevant equipment certificates by the DC-connected power park module owner instead of part of the activity for compliance as described in this Regulation.

4. The relevant system operator shall make publicly available the allocation of responsibilities to the HVDC system owner or DC-connected power park module owner and to the system operator for compliance testing, simulation and monitoring.

5. The relevant system operator may partially or totally assign the performance of its compliance monitoring to third parties. In this case, the relevant system operator shall ensure compliance with Article 10 by appropriate confidentiality commitments with the assignee.

6. The relevant system operator shall not unreasonably withhold any operational notification as per Title V, if compliance tests or simulations cannot be performed as agreed between the relevant system operator and the HVDC system owner or DC-connected power park module owner due to reasons which are in the sole control of the relevant system operator.

7. The relevant system operator shall provide the relevant TSO when requested the compliance test and simulation results referred to in this Chapter.

CHAPTER II
COMPLIANCE TESTING

Article 70
Compliance testing for HVDC systems

1. The equipment certificate may be used instead of part of the tests below, provided that they are provided to the relevant system operator.

2. With regard to the reactive power capability test:

(a) the HVDC converter unit or the HVDC converter station shall demonstrate its technical capability to provide leading and lagging reactive power capability according to Article 22.

(b) the reactive power capability test shall be carried out at maximum reactive power, both leading and lagging, and concerning the verification of the following parameters:

(i) Operation at minimum HVDC active power transmission capacity;

(ii) Operation at maximum HVDC active power transmission capacity; and

(iii) Operation at active power setpoint between those minimum and maximum HVDC active power transmission capacity.

(c) the test shall be deemed passed, provided that the following conditions are cumulatively fulfilled:

(i) the HVDC converter unit or the HVDC converter station has been operating no shorter than 1 hour at maximum reactive power, both leading and lagging, for each parameter as referred to in point b);

(iii) the HVDC converter unit or the HVDC converter station demonstrates its capability to change to any reactive power target value within the applicable reactive power range within the specified performance targets of the relevant reactive power control scheme; and

(iii) no action of any protection within the operation limits defined by reactive power capacity diagram occurs.

3. With regard to the voltage control mode test:

(a) the HVDC converter unit or the HVDC converter station shall demonstrate its capability to operate in voltage control mode in the conditions set forth in Article 24(3).

(b) the voltage control mode test shall apply concerning the verification of 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 passed, provided that the following conditions are cumulatively fulfilled:

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

(ii) the range of regulation and adjustable the droop and deadband is compliant with agreed or decided characteristic parameters, according to paragraph 3 of Article 24;

(iii) the insensitivity of voltage control is not higher than 0.01 pu, according to paragraph 3 of Article 24; and

(iv) following a step change in voltage, 90 % of the change in reactive power output has been achieved within the times and tolerances according to paragraph 3 of Article 24.

4. With regard to the reactive power control mode test:

(a) the HVDC converter unit or the HVDC converter station shall demonstrate its capability to operate in reactive power control mode, according to the conditions referred to in paragraph 4 of Article 24.

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

(c) the reactive power control mode test shall apply concerning the verification of 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 passed, provided that the following conditions are cumulatively fulfilled:

(i) the reactive power setpoint range and step is ensured according to paragraph 4 of Article 24; and

(ii) the accuracy of the regulation is compliant with the conditions as referred to in paragraph 3 of Article 24.

5. With regard to the power factor control mode test:

(a) the HVDC converter unit or the HVDC converter station shall demonstrate its capability to operate in power factor control mode according to the conditions referred to in paragraph 5 of Article 24;

(b) the power factor control mode test shall apply concerning the verification of 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 passed, provided that the following conditions are cumulatively fulfilled:

(i) the power factor setpoint range and step is ensured according to Article paragraph 5 of 20;

(ii) the time of reactive power activation as result of step active power change does not exceed the requirement according to paragraph 5 of Article 24; and

(iii) the accuracy of the regulation is compliant with the value, as referred to in paragraph 5 of Article 24.

6. With regard to the FSM response test:

(a) the HVDC system shall demonstrate its technical capability to continuously modulate active power over the full operating range between maximum HVDC active power transmission capacity and minimum HVDC active power transmission capacity to contribute to frequency control and shall verify 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.

(b) the test shall be carried out by simulating frequency steps and ramps big enough to activate at least 10% of the full active power frequency response range, taking into account the droop settings and the deadband. Simulated frequency deviation signals shall be injected into the controller of the HVDC converter unit or the HVDC converter station.

(c) the test shall be deemed to be passed, provided that the following conditions are all fulfilled:

(i) activation time of full active power frequency response range as result of a step frequency change has been no longer than required by Article 15(1) (c);

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

(iii) the initial delay time has been according to Article 15(1) (c) and (d);

(iv) the droop settings are available within the range defined in Article 15(1) (c) and deadband (thresholds) is not more than the value in Article 15(1) (c); and

(v) insensitivity of active power frequency response at any relevant operating point does not exceed the requirements set forth in Article 15(1) (c).

7. With regard to the LFSM-O response test:

(a) the HVDC system shall demonstrate its technical capability to continuously modulate active power to contribute to frequency control in case of large increase of frequency in the system and shall verify the steady-state parameters of regulations, such as droop and deadband, and dynamic parameters, including frequency step change response.

(b) the test shall be carried out by simulating frequency steps and ramps big enough to activate at least 10 % of the full operating range for active power in each direction, taking into account the droop settings and the deadband. Simulated frequency deviation signals shall be injected into the controller of the HVDC converter unit or the HVDC converter station.

(c) the test shall be deemed passed, provided that the following conditions are both fulfilled:

(i) the test results, for both dynamic and static parameters, are in line with the requirements as referred to in Article 16(1); and

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

8. With regard to the LFSM-U response test:

(a) the HVDC system shall demonstrate its technical capability to continuously modulate active power at operating points below maximum HVDC active power transmission capacity to contribute to frequency control in case of large drop of frequency in the system.

(b) the test shall be carried out by simulating at appropriate active power load points with low frequency steps and ramps big enough to activate at least 10 % of the full operating range for active power, taking into account the droop settings and the deadband. Simulated frequency deviation signals shall be injected into the controller of the HVDC converter unit or the HVDC converter station.

(c) the test shall be deemed passed, provided that the following conditions are both fulfilled:

(i) the test results, for both dynamic and static parameters, are in line with the requirements as referred to in Article 17(1); and

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

9. With regard to the active power controllability test:

(a) the HVDC system shall demonstrate its technical capability to continuously modulate active power over the full operating range according to Article 13 (1)(a) and (d).

(b) the test shall be carried out by sending manual and automatic instructions by the relevant TSO.

(c) the test shall be deemed passed, provided that the following conditions are cumulatively fulfilled:

(i) the HVDC system has demonstrated stable operation

(ii) the time of adjustment of the active power is shorter than the delay defined according to Article 13(1)(a).

(iii) the dynamic response of the HVDC system when receiving instructions aiming at performing exchange and sharing FCR, FRR or RR or participation in imbalance netting process is compliant with the requirements for these products detailed in LFC&R code.

10. With regard to the ramping rate modification test:

(a) the HVDC system shall demonstrate its technical capability to adjust the ramping rate according to Article 13(2).

(b) the test shall be carried out by sending instructions of ramping modifications by the relevant TSO

(c) the test shall be deemed passed, provided that the following conditions are cumulatively fulfilled:

(i) ramping rate is adjustable

(ii) the HVDC system has demonstrated stable operation during ramping periods

11. With regard to the black start test, if applicable:

(a) the HVDC system shall demonstrate its technical capability to energise the busbar of the remote AC substation to which it is connected, within a time frame specified by the relevant TSO, according to Article 39(2).

(b) the test shall be carried out while the HVDC system starts from shut down.

(c) the test shall be deemed passed, provided that the following conditions are cumulatively fulfilled:

(i) the HVDC system has demonstrated being able to energise the busbar of the remote AC-substation to which it is connected

(ii) the HVDC system operates from a stable operating point at agreed capacity, according to the procedure of Article 39(3).

Article 71

Compliance testing for DC-connected power park modules and remote-end HVDC converter units

1. The equipment certificate may be used instead of part of the tests below, provided that they are provided to the relevant system operator.

2. With regard to the reactive power capability test of DC-connected PPMs:

(a) the DC-connected power park module shall demonstrate its technical capability to provide leading and lagging reactive power capability according to Article 42(2).

(b) the reactive power capability test shall be carried out at maximum Reactive Power, both leading and lagging, and concerning the verification of the following parameters:

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

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

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

(c) the test shall be deemed passed, provided that the following criteria are cumulatively fulfilled:

(i) the DC-connected power park module has been operating no shorter than requested duration at maximum reactive power, both leading and lagging, in each parameter as referred to in Article point (b);

(ii) the DC-connected power park module has demonstrated its capability to change to any reactive power target value within the agreed or decided reactive power range within the specified performance targets of the relevant reactive power control scheme; and

(iii) no action of any protection within the operation limits defined by reactive power capacity diagram occurs.

3. With regard to the reactive power capability test of remote-end HVDC converter units:

(a) the HVDC converter unit or the HVDC converter station shall demonstrate its technical capability to provide leading and lagging reactive power capability according to Article 50(2).

(b) the test shall be deemed passed, provided that the following conditions are cumulatively fulfilled:

(i) the HVDC converter unit or the HVDC converter station has been operating no shorter than 1 hour at maximum reactive power, both leading and lagging, at:

- minimum HVDC active power transmission capacity;
- maximum HVDC active power transmission capacity; and
- an active power operating point between those maximum and minimum ranges;

(ii) the HVDC converter unit or the HVDC converter station demonstrates its capability to change to any reactive power target value within the agreed or decided reactive power range within the specified performance targets of the relevant reactive power control scheme; and

(iii) no action of any protection within the operation limits defined by reactive power capacity diagram occurs.

4. With regard to the voltage control mode test:

(a) the DC-connected power park module shall demonstrate its capability to operate in voltage control mode in the conditions set forth in [Article 21 of the NC RfG].

(b) the voltage control mode test shall apply concerning the verification of 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 passed, provided that the following conditions are cumulatively fulfilled:

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

(ii) the range of regulation and adjustable the droop and deadband is compliant with agreed or decided characteristic parameters, according to [Article 21(3) (d) of the NC RfG];

(iii) the insensitivity of voltage control is not higher than 0.01 pu, according to [Article 21(3) (d) of the NC RfG]; and

(iv) following a step change in voltage, 90 % of the change in reactive power output has been achieved within the times and tolerances according to [Article 21(3) (d) of the NC RfG].

5. With regard to the reactive power control mode test:

(a) the DC-connected power park module shall demonstrate its capability to operate in reactive power control mode, according to the conditions referred to in [Article 21(3) (d) point 3) of the NC RfG].

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

(c) the reactive power control mode test shall apply concerning the verification of 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 passed, provided that the following conditions are cumulatively fulfilled:

(i) the reactive power setpoint range and step is ensured according to [Article 21(3) (d) of the NC RfG]; and

(ii) the accuracy of the regulation is compliant with the conditions as referred to in [Article 21(3) (d) of the NC RfG].

6. With regard to the power factor control mode test:

(a) the DC-connected power park module shall demonstrate its capability to operate in power factor control mode according to the conditions referred to in [Article 21(3) (d) point 4) of the NC RfG].

(b) the power factor control mode test shall apply concerning the verification of 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 passed, provided that the following conditions are cumulatively fulfilled:

(i) the power factor setpoint range and step is ensured according to [Article 21(3) (d) of the [NC RfG];

(ii) the time of reactive power activation as result of step active power change does not exceed the requirement according to [Article 21(3) (d) of the NC RfG]; and

(iii) the accuracy of the regulation is compliant with the value, as referred to in [Article 21(3) (d) of the NC RfG].

7. With regard to the tests identified in this Section in paragraphs), 4 and 5 the relevant TSO may select only two of the three control options for testing.

8. With regard to LFSM-O response of DC-connected power park module, the tests shall be carried out in accordance with [Article 46(2) of NC RfG].

9. With regard to LFSM-U response of DC-connected power park module, the tests shall be carried out in accordance with [Article 47(3) of NC RfG].

10. With regard to active power controllability of DC-connected power park module, the tests shall be carried out in accordance with [47(2) of NC RfG].

11. With regard to FSM response of DC-connected power park module, the tests shall be carried out in accordance with [Article 47(4) of NC RfG].

12. With regard to Frequency restoration control of DC-connected power park module, the tests shall be carried out in accordance with [Article 47(5) of NC RfG].

13. With regard to fast signal response of DC-connected power park mmodule, the test shall be deemed passed if the DC-connected power park module can demonstrate its response within the time specified in Article 41(1)(a).

14. With regard to tests for DC-connected power park modules where the AC collector system is not at nominal 50 Hz frequency, the relevant system operator, in coordination with the relevant TSO, shall agree with the DC-connected power park module owner the compliance tests required. .

CHAPTER III
COMPLIANCE SIMULATIONS

Article 72
Compliance simulations for HVDC systems

1. The equipment certificate may be used instead of part of the simulations below, provided that they are provided to the relevant system operator.

2. With regard to the fast acting additional reactive current injection simulation:

(a) the HVDC converter unit owner or the HVDC converter station owner shall simulate the capability for fast acting additional reactive current injection in the conditions set forth in Article 21; and

(b) the simulation is deemed passed, provided that compliance with the requirement according to Article 21 is demonstrated.

3. With regard to the fault-ride-through capability simulation:

(a) the HVDC system owner shall simulate the capability for fault-ride-through capability in the conditions set forth in Article 27; and

(b) the simulation is deemed passed, provided that compliance with the requirement according to Article 27 is demonstrated.

4. With regard to the post fault power active recovery simulation:

(a) the HVDC system owner shall simulate the capability for post fault active power recovery in the conditions set forth in Article 28; and

(b) the simulation is deemed passed, provided that compliance with the requirement according to Article 28 is demonstrated.

5. With regard to the reactive power capability simulation:

(a) the HVDC converter unit owner or the HVDC converter station owner shall simulate the capability for leading and lagging reactive power capability in the conditions referred to in Article 22(2)-(4);

(b) the simulation shall be deemed passed, provided that the following conditions are cumulatively fulfilled:

(i) the simulation model of the HVDC converter unit or the HVDC converter station is validated against the compliance tests for reactive power capability at the as referred to in Article 70; and

(ii) compliance with the requirements as referred to in Article 22(2)-(4) is demonstrated.

6. With regard to the power oscillations damping control simulation:

(a) the HVDC system owner shall demonstrate the performance of its control system (POD function) to damp power oscillations in the conditions set forth in Article 32;

(b) the tuning shall result in improved damping of corresponding active power response of the HVDC control in combination with the POD function compared to the active power response of the HVDC control alone; and

(c) the simulation shall be deemed passed, provided that the following conditions are cumulatively fulfilled:

(i) the POD function damps the existing power oscillations of the HVDC system within a frequency range specified by the relevant TSO. This frequency range shall include the local mode frequency of the HVDC system and the expected network oscillations; and

(ii) a change of active power transfer of the HVDC system as specified by the relevant TSO does not lead to undamped oscillations in active or reactive power of the HVDC system.

7. With regard to the simulation of active power modification in case of disturbance:

(a) the HVDC system owner shall simulate the capability to quickly modify Active Power according to Article 13(1)(b); and

(b) the simulation shall be deemed passed, provided that the following conditions are cumulatively fulfilled:

(i) the HVDC system has demonstrated stable operation when following the pre-defined sequence of active power variation.

(ii) the initial delay of the adjustment of the active power is shorter than the value specified in Article 13(1)(b) or reasonably justified if greater

8. With regard to the fast active power reversal simulation, as applicable:

(a) the HVDC system owner shall simulate the capability to quickly modify active power according to Article 9(1)(c); and

(b) the simulation shall be deemed passed, provided that the following conditions are cumulatively fulfilled:

(i) The HVDC system has demonstrated stable operation

(ii) The time of adjustment of the active power is shorter than the value specified in Article 9(1)(c) or reasonably justified if greater

Article 73

Compliance simulations for DC-connected power park modules and remote-end HVDC converter units

1. DC-connected power park modules are subject to the compliance simulations detailed in this Article. The equipment certificate may be used instead of part of the simulations described below, provided that they are provided to the relevant system operator.

2. With regard to the fast acting additional reactive current injection simulation:

(a) the DC-connected power park module owner shall simulate the capability for fast acting additional reactive current injection in the conditions set forth in [Article 20(2) (b) of the NC RfG]; and

(b) the simulation shall be deemed passed, provided that compliance with the requirement according to [Article 20(2) (b) of the NC RfG] is demonstrated.

3. With regard to the post fault power active recovery simulation:

(a) the DC-connected power park module owner shall simulate the capability for post fault active power recovery in the conditions set forth in [Article 20(3) (a) of the NC RfG]; and

(b) the simulation shall be deemed passed, provided that compliance with the requirement according to [Article 20(3) (a) of the NC RfG] is demonstrated.

4. With regard to the reactive power capability simulation of DC connected PPMs:

(a) the DC-connected power park module owner shall simulate the capability for leading and lagging reactive power capability in the conditions referred to in Article 42(2); and

(b) the simulation shall be deemed passed, provided that the following conditions are cumulatively fulfilled:

(i) the simulation model of the DC-connected power park module is validated against the compliance tests for reactive power capability at the as referred to in Article 71(2); and

(ii) compliance with the requirements as referred to in Article 42(2) is demonstrated.

5. With regard to the reactive power capability simulation of remote-end HVDC converter units:

(a) the remote-end HVDC converter unit owner or the remote-end HVDC converter station owner shall simulate the capability for leading and lagging reactive power capability in the conditions referred to in Article 50(2); and

(b) the simulation shall be deemed passed, provided that the following conditions are cumulatively fulfilled:

(i) the simulation model of the remote-end HVDC converter unit or the HVDC converter station is validated against the compliance tests for reactive power capability at the as referred to in Article 71(3); and

(ii) compliance with the requirements as referred to in Article 50(2) is demonstrated.

6. With regard to the power oscillations damping control simulation:

(a) the owner shall simulate the capability for power oscillations damping under the conditions as referred to in [Article 21(3) (f) of the NC RfG]; and

(b) the simulation shall be deemed passed, provided that the model demonstrates compliance with the conditions of [Article 21(3) (f) of the NC RfG].

7. With regard to fault-ride-through capability simulation:

(a) the model of the DC-connected power park module owner shall simulate the capability for fault-ride-through capability under the conditions as referred to in [Article 16(3) (a) of the NC RfG]; and

(b) the simulation shall deemed passed, provided that the model demonstrates compliance with the conditions of [Article 16(3) (a) of the NC RfG] respectively.

CHAPTER IV

NON-BINDING GUIDANCE AND MONITORING OF IMPLEMENTATION

Article 74

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 system 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 75
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:

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

   (d) assessment of whether the choice of values and ranges in the requirements applicable to HVDC systems and DC-connected power park modules under this Regulation continues to be valid.

2. The Agency, in cooperation with ENTSO for Electricity, shall produce by [*twelve 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 system operators and relevant TSOs shall submit to ENTSO for Electricity the information required to perform the tasks referred to in paragraphs 1 and 2.

4. Where ENTSO for Electricity or the Agency establish areas subject to this Regulation where, based on market developments or experience gathered in the application of this Regulation, further harmonisation of the requirements under this Regulation is advisable to promote market integration, they shall propose draft amendments to this Regulation pursuant to Article 7 (1) of Regulation (EC) No 714/2009.

TITLE VII
DEROGATIONS

Article 76
Power to grant derogations

Regulatory authorities or, where applicable, the Member State, may, at the request of a HVDC system owner, DC-connected power park module owner, relevant system operator or relevant TSO, grant relevant system operators or relevant TSOs derogations from one or more requirements of this Regulation for new and existing HVDC system and/or DC-connected power park modules in accordance with Articles 77 to 81.

Article 77
General Provisions

1. Each regulatory authority or, where applicable, the Member State shall specify, after consulting the parties concerned, including system operators, the criteria for granting derogations pursuant to paragraph 4 of Article 62. It shall publish those criteria and notify them to the Commission by [*6 months following the entry into force of this Regulation*]. The Commission may require the regulatory authority or, where applicable, the Member State to amend the criteria if it considers that they are not in line with this Regulation or its objectives.

2. If the regulatory authority or, where applicable, the Member State deems that it is necessary due to a change in circumstances, it may review and amend at most once every year the criteria for granting derogations in accordance with the process in paragraph 1.

3. The regulatory authority or, where applicable, the Member State may decide that HVDC systems or DC-connected power park modules for which a request for derogation has been filed pursuant to Article 78 to Article 80 do not need to comply with the requirements of this Regulation from the day of filing the request until the regulatory authority's or where applicable, Member State's, decision is issued.

Article 78
Request for derogation by an HVDC system owner, DC-connected power park module owner

1. HVDC system owners, DC-connected power park module owners, and distribution system operators may request a derogation to one or several requirements of this Regulation.

2. HVDC system owners or DC-connected power park module owners shall file their request for derogations with the relevant system operator. Each request for a derogation shall include:

   (a) an identification of the HVDC system owner or DC-connected power park module owner, and a contact person for any communications;

   (b) a description of the HVDC system or DC-connected power park 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, and cost-benefit analysis pursuant to the requirements of Article 67;

   (e) demonstration 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 system operator shall confirm to the HVDC system owner or DC-conned power park module owner whether the request is complete. If the relevant system operator considers that the request is incomplete, the HVDC system owner or DC-connected power park module owner shall submit the additional required information within one month from the receipt of the request for additional information.

4. The relevant system operator shall, in coordination with the relevant TSO and any affected adjacent DSO or DSOs, assess the request for derogation and the provided

cost-benefit analysis, taking into account the criteria determined by the regulatory authority or, where applicable, the Member State pursuant to Article 77.

5. Within six months of receipt of a request for derogation, the relevant system operator shall forward the request to the regulatory authority and submit the assessment prepared in accordance with paragraphs 4. That period may be extended by one month where the relevant system operator seeks further information from the HVDC system owner or DC-connected power park module owner, and by two months where the relevant system operator requests the relevant TSO to submit an assessment of the request for derogation.

6. The regulatory authority or, where applicable, the Member State 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 regulatory authority or, where applicable, the Member State requires further information from the HVDC system owner, DC-connected power park module owner or from any other interested parties. The additional period shall begin when the complete information has been received.

7. The HVDC system owner or DC-connected power park module owner shall submit any additional information requested by the regulatory authority or, where applicable, the Member State within two months of such request. If the The HVDC system owner or DC-connected power park module 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 regulatory authority or, where applicable, the Member State decides to provide an extension; or

   (b) the HVDC system owner or DC-connected power park module owner informs the regulatory authority or, where applicable, the Member State by means of a reasoned submission that the request for derogation is complete.

8. The regulatory authority or, where applicable, the Member State shall issue a reasoned decision concerning a request for derogation. Where the regulatory authority or, where applicable, the Member State grants derogation, it shall specify its duration.

9. The regulatory authority or, where applicable, the Member State shall notify its decision to the HVDC system owner or DC-connected power park module owner, the relevant system operator, the relevant TSO and the Agency.

10. A regulatory authority or, where applicable, the Member State may revoke a decision granting derogation if the circumstances and underlying reasons no longer apply or upon a reasoned recommendation of the Commission or reasoned recommendation by the Agency pursuant to paragraph 2 of Article 82.

Article 79

Request for derogation by a relevant system operator or relevant TSO

1. Relevant system operators or relevant TSOs may request derogations for classes of HVDC systems or DC-connected power park modules connected or to be connected to their network.

2. Relevant system operators or relevant TSO shall file their requests for derogation with the regulatory authority or, where applicable, the Member State. Each request for derogation shall include:

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

   (b) a description of the HVDC systems or DC-connected power park modules for which a derogation is requested and the total installed capacity and number of HVDC systems or DC-connected power park 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) demonstration that the requested derogation would have no adverse effect on cross-border trade; and

   (f) a cost-benefit analysis pursuant to the requirements of paragraphs 4 and 5 of Article 67. 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 regulatory authority or, where applicable, the Member State 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 regulatory authority or, where applicable, the Member State pursuant to Article 77.

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 regulatory authority or, where applicable, the Member State its assessment, including any relevant documentation. The six-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 regulatory authority or, where applicable, the Member State 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 regulatory authority or, where applicable, the Member State requests further information from the relevant system 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.

8. The relevant system operator shall provide any additional information requested by the regulatory authority or, where applicable, the Member State within two months from the date of the request. If the relevant system 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 regulatory authority or, where applicable, the Member State decides to provide an extension; or

(b) the relevant system operator informs the regulatory authority or, where applicable, the Member State by means of a reasoned submission that the request for derogation is complete.

9. The regulatory authority or, where applicable, the Member State shall issue a reasoned decision concerning a request for derogation. Where the regulatory authority or, where applicable, the Member State grants derogation, it shall specify its duration.

10. The regulatory authority or, where applicable, the Member State shall notify its decision to the relevant system operator requesting the derogation, the relevant TSO and the Agency.

11. Regulatory authorities or, where applicable, Member States may lay down further requirements concerning the preparation of requests for derogation by relevant system operators. In doing so, regulatory authority or, where applicable, the Member State shall take into account the delineation between the transmission network and the distribution network at the national level and shall consult with relevant system operator, power generating facility owners and stakeholders, including manufacturers.

12. A regulatory authority or, where applicable, the Member State may revoke a decision granting derogation if the circumstances and underlying reasons no longer apply or upon a reasoned recommendation of the Commission or reasoned recommendation by the Agency pursuant to paragraph 2 of Article 82.

Article 80
Request for derogation from the provisions of Title III of the Regulation by a DC-connected power park module owner

1. If DC-connected power park module owner whose connections with a synchronous area is or will be [radial] requests derogations to one or more requirements contained in Article 41, Article 42, Article 43, Article 44, Article 45, Article 46 or Article 47 of the Regulation, such request shall not be subject to the provisions of Article 78(2)(d) and Article78(2)(e) of this Regulation.

2. When adopting a decision concerning request for derogation specified in paragraph 1 above, and attaching any conditions to that decision, the regulatory authority or, where applicable, the Member State shall take into utmost account the legitimate expectations of the DC-connected power park module owner. The conditions of such a derogation being granted may include that development of the connection into a multi-terminal network, or connection of a further power park module at the same point, may cause the derogation to be evaluated by the regulatory authority or to expire.

Article 81

Register of derogations from requirements of this Regulation

1. Each regulatory authority or, where applicable, the Member State, 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 the derogation is granted or refused;

   (b) the content of the derogation;

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

   (d) the consequences resulting from granting the derogation.

Article 82

Monitoring of derogations from requirements of this Regulation

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

2. The Agency may issue a reasoned recommendation to a regulatory authority to revoke a derogation due to a lack of justification. The Commission may issue a reasoned recommendation to a regulatory authority or relevant authority of the Member State to revoke derogation due to a lack of justification

3. The Commission may request the Agency to report on the application of paragraphs 1 and 2 and to provide reasons for requesting or not requesting derogations to be revoked.

TITLE VIII
FINAL PROVISIONS

Article 83

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 HVDC systems or new DC-connected power park modules shall be brought into compliance with the requirements of this Regulation.

2. All relevant clauses in contracts and relevant clauses of general terms and conditions relating to the grid connection of existing HVDC systems or existing DC-connected power park modules subject to all or some of the requirements of this Regulation 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 regulatory authority or Member State. The requirement for amendment shall apply regardless of whether the relevant contracts or general terms and conditions provide for such an amendment.

3. Member States and regulatory authorities shall ensure that national agreements between system operators and new or existing HVDC systems and DC-connected power park modules subject to this Regulation and relating to grid connection requirements for HVDC systems and DC-connected power park modules, in particular in national network codes, reflect the requirements set out in this Regulation.

Article 84

HVDC System or DC-connected power park modules connecting with synchronous areas or control areas not bound by EU legislation

1. Where an HVDC system to which the requirements of this Regulation apply is connecting synchronous areas or control areas, with at least one synchronous area or one control area not falling under the scope of application of EU legislation, the relevant TSO or, as the case may be, the HVDC system owner shall endeavour to implement an agreement to ensure that the owners of HVDC systems with no legal obligation to comply with this Regulation also cooperate to fulfil the requirements.

2. If an agreement according to paragraph 1 cannot be implemented, the relevant TSO or, as the case may be, the HVDC system owner concerned shall use all available means to comply with the requirements of this Regulation.

Article 85

Entry into force

This Regulation shall enter into force on the 20th day following that of its publication in the *Official Journal of the European Union*.

This Regulation shall apply from [*3 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