ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference

ENTSO-E Draft Network Code on High Voltage Direct Current Connections and DC-connected Power Park Modules

21-Oct-13

Notice

This document reflects the status of the work of Transmission System Operator experts as of 21 October 2013 in line with the ACER Framework Guidelines on Electricity Grid Connections published on 21July 2011, after the EC mandate letter was received by ENTSO-E on 29 April 2013. It reflects the comments received by ENTSO-E during the Call for Stakeholder Input consultation held between 7 May 2013 and 7 June 2013. Furthermore, it is based on the input received through extensive dialogue with stakeholders, as well as bilateral/ trilateral meetings with ACER and with the European Commission.

The document does not in any case represent a firm, binding or definitive ENTSO-E position on the content, the structure or the prerogatives of the Network Code on High Voltage Direct Current Connections and DC-connected Power Park Modules.

Such version of the draft Network Code will be released for public consultation in accordance with the provisions of the Article 10 of Regulation (EC) N°714/2009 in November 2013.

THE EUROPEAN COMMISSION,

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

Having regard to 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,

Having regard to Regulation (EC) No 713/2009 of the European Parliament and of the Council of 13 July 2009 establishing an Agency for the Cooperation of Energy Regulators (ACER),

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 and especially Article 6,

Having regard to the Framework Guideline on Electricity Grid Connections issued by the Agency for the Coordination of Energy Regulators on 21 July 2011,

Whereas:

(1) 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 and Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009 underline the need for an increased cooperation and coordination among transmission system operators within a European Network of Transmission System Operators for Electricity (ENTSO□E) to create Network Codes for providing and managing effective and transparent access to the transmission networks across borders, and to ensure coordinated and sufficiently forward-looking planning and sound technical evolution of the transmission system in the European Union, including the creation of interconnection capacities, with due regard to the environment.

(2) Transmission System Operators (TSO(s)) are according to Article 2 and 12 of Directive2009/72/EC responsible for providing and operating high and extra□high Voltage networks for long□distance transmission of electricity as well as for supply of lower□level regional distribution systems and directly connected customers. Besides this transmission and supply task it is also the TSO(s)'responsibility to ensure the system security with a high level of reliability and quality.

(3) ENTSO-E has drafted this Network Code on HVDC Connections and DC-connected Power Park Modules aiming at setting out clear and objective requirements for HVDC System Owners, Power Generating Facility Owners of DC-connected Power Park Modules, Transmission System Operators and National Regulatory Authorities in order to contribute to non-discrimination, effective competition and the efficient functioning of the internal electricity market and to ensure system security.

(4) This Network Code has been drafted in accordance with the Article 8(7) of Regulation (EC) N°714/2009 according to which the Network Codes shall be developed for cross-border issues and market integration issues and shall be without prejudice to the right of Member States to establish national network codes which do not affect cross-border trade.

(5) The Network Code provides for various requirements to be defined by the Relevant Network Operators. In those countries where the Transmission System Operators are entitled to define – read here to propose to the relevant bodies for its approval – the technical and instrumental operational procedures for the proper technical management of the power system or to give the necessary instructions to other entities, which need to be taken into account to ensure the necessary coordination of the system and maintain the overall system security, the Network Code does not affect the Transmission System Operators' competences and responsibilities.

(6) The Network Code provides for agreements by Relevant Network Operators on various technical requirements. In those countries where the Transmission System Operators are granted public authority or competence to adopt decisions when defining requirements for connecting Power Generating Modules which have to be taken into account for, and cannot be changed by, any subsequent Connection Agreement with the Relevant Network Operator, this Network Code does not affect the Transmission System Operators' decision making powers in those countries.

HAS ADOPTED THIS NETWORK CODE:

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CHAPTER 1 **GENERAL PROVISIONS**			
Article 1 **Subject matter** 1. This Network Code establishes common rules for HVDC Systems and DC-connected Power Park Modules which are significant according to the provisions of this Network Code. 2. The Network Code sets up a common framework for Network Connection Agreements between Network Operators and HVDC System Owners, and between Network Operators and Power Generating Facility Owners of DC-connected Power Park Modules. 3. In Member States where more than one transmission system operator exists, this regulation shall apply to all transmission system operators within that Member State. Where a transmission system operator does not have a function relevant to one or some obligations under this Network Code, Member States may under the national regulatory regime provide that the responsibility to comply with one or some obligations under this Network Code is assigned to one or more different transmission system operators. In case of such assignment, the Network Code shall apply accordingly to the transmission system operator(s) to which responsibility have been assigned.			
Article 2 **Definitions** 1. For the purpose of this Network Code, the definitions in Article 2 of Regulation (EC) N° 714/2009, Commission Regulations establishing Network Codes that have been adopted according to Article 6(11) of Regulation (EC) N°714/2009, as well as Article 2 of directive 2009/72/EC shall apply. **Connection Point** means the interface at which a HVDC System is connected to an AC transmission or distribution system or it is an interface point at which a Power Park Module is connected to a HVDC System, as identified in the Connection Agreement; **Relevant TSO** means the TSO in whose Control Area a HVDC System or a DC Connected Power Park Module is or will be connected to the Network at any voltage level. 2. The following definitions shall apply: **DC-connected Power Park Module** means a Power Park Module that is non-synchronously connected to one or more Synchronous Area(s) via HVDC System(s). Unless otherwise stated, Power Park Module referred to in this network code means a DC-connected Power Park Module; **DC-connected Power Park Module Owner** means a natural or legal entity owning a DC-connected Power Park Module**;** **Existing HVDC System** means an HVDC System which is not a New HVDC System; **Existing DC-connected Power Park Module** means a DC-connected Power Park Module which is not a New DC-connected Power Park Module; **HVDC Converter Station** means part of an HVDC System which consists of one or more Converter Units installed in a single location together with buildings, reactors, filters, reactive power devices, control, monitoring, protective, measuring and auxiliary equipment; **HVDC Converter Unit** means an operative unit comprising of 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; **HVDC System** means an electrical power system which transfers energy in the form of high-voltage direct current between two or more AC buses. A HVDC System comprises of at least two HVDC converter stations with DC transmission lines or cables or direct DC circuit connections between the pair of HVDC converter stations. It can also comprise at least two HVDC converter stations connected at the AC side of the converter transformers (multi-terminal). A HVDC System has at least two Connection Points; it can connect between two synchronous areas, within one synchronous area, or between a Power Park Module and a synchronous area; **HVDC System Owner** means a natural or legal entity owning a HVDC System; **New HVDC System** means a HVDC System for which - with regard to the provisions of the initial version of this Network code, a final and binding contract of purchase of the main plant has been signed after the day, which is two years after the day of the entry into force of this Network Code, or, - with regard to the provisions of the initial version of this Network code, no confirmation is provided by the HVDC System Owner, with a delay not exceeding thirty months as from the day of entry into force of this Network Code, that a final and binding contract of purchase of the main plant exists prior to the day, which is two years after the day of the entry into force of this Network Code, or, - with regard to the provisions of any subsequent amendment to this Network Code, a final and binding contract of purchase of the main plant has been signed after the day, which is two years after the entry into force of any subsequent amendment to this Network Code and/or after the entry into force of any change of thresholds pursuant to the re-assessment procedure of Article 3(7); **New DC-connected Power Park Module** means a DC-connected Power Park Module for which - with regard to the provisions of the initial version of this Network code, a final and binding contract of purchase of the main plant has been signed after the day, which is two years after the day of the entry into force of this Network Code, or, - with regard to the provisions of the initial version of this Network code, no confirmation is provided by the DC-connected Power Park Module Owner, with a delay not exceeding thirty months as from the day of entry into force of this Network Code, that a final and binding contract of purchase of the main plant exists prior to the day, which is two years after the day of the entry into force of this Network Code, or, - with regard to the provisions of any subsequent amendment to this Network Code, a final and binding contract of purchase of the main plant has been signed after the day, which is two years after the entry into force of any subsequent amendment to this Network Code and/or after the entry into force of any change of thresholds pursuant to the re-assessment procedure of Article 3(7); **Remote-end HVDC Converter Station** means a HVDC Converter Station which is synchronously connected to DC-connected Power Park Module(s); **Remote-end HVDC Converter Station Owner** means a natural or legal entity owning a Remote-end HVDC Converter Station.	A HVDC System can have two Connection Points		

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Article 3 **Scope**			
1. HVDC Systems which are categorized as follows, are within the scope of this Network Code: (a) HVDC Systems connecting Synchronous Areas or Control Areas, including back to back schemes; (b) HVDC Systems connecting Power Park Modules to the Network; (c) HVDC Systems embedded within one Control Area and connected to the Transmission Network; and (d) HVDC Systems embedded within one Control Area and connected to the Distribution Network when a cross-border impact is demonstrated by the Relevant TSO, while respecting the provisions of Article 4(3). The Relevant TSO shall consider the long-term development of the Network in this assessment.	This defines what is covered, i.e these are Significant Grid Users		
2. Power Park Modules which are AC collected but are DC connected to a Synchronous Area (at any AC transmission Voltage), are within the scope of this Network Code.			
3. Article 22 and Article 29 apply to Existing Power Generating Modules, Existing Distribution Networks, Existing Demand Facilities.	This is to collect information from existing users, including HVDC, to enable studies to be carried out		
4. The requirements set forth by this Network Code shall apply to New HVDC Systems and New DC-connected Power Park Modules in a Member State, which are significant according to the provisions of this Network Code unless otherwise provided in this Network Code.			
5. With regards to the HVDC Systems embedded within one Control Area referred to in paragraphs 1(c) and (d) above, when they fall into one of the categories listed below: i. HVDC systems owned by the Relevant TSO; ii. HVDC systems owned by an entity which exercises control over the Relevant TSO; or iii. HVDC systems owned by an entity directly or indirectly controlled by an entity which also exercises control over the Relevant TSO, the following shall apply:			
i. The provisions of Article 47 to Article 59 and Article 61 to Article 73 do not apply; and	This is to get out of having Relevant TSOs doing formal compliance testing on themselves		
ii. The HVDC System Owner shall ensure that the HVDC System is compliant with the requirements under Article 7 to Article 37 as well as Article 46 and Article 62 of this Network Code. This compliance shall be maintained throughout the lifetime of the facility.	This does not mean that TSO owned HVDC systems are not compliant, it just means TSOs have to ensure their compliance by other means.		
6. The requirements set forth in this Network Code shall apply to Existing HVDC Systems and Existing DC-connected Power Park Modules which are deemed significant according to the provisions of this Network Code. These requirements shall apply in accordance with Article 62, to the extent this has been decided by the Relevant National Regulatory Authority pursuant to Article 60 and Article 61, unless otherwise provided in this Network Code.	Article 3.1 indirectly defines Significant Grid Users		
7. With regard to HVDC Systems not yet connected to the Network: (a) Within a delay not exceeding thirty months as from the day of entry into force of this Network Code, the HVDC System Owner shall provide the Relevant TSO with a confirmation of final and binding contracts it has concluded for the construction, assembly or purchase of the main plant of a HVDC System with relevance to the provisions of this Network Code and which exists prior to the day, which is two years after the day of entry into force of this Network Code. (b) The confirmation shall at least indicate the contract title, its date of signature and of entry into force, and the specifications of the main plant to be constructed, assembled or purchased. (c) The Relevant TSO may demand that the National Regulatory Authority confirms the existence, relevance and finality of such a contract, i.e. that its material terms can no longer be changed by one of the parties to the contract unilaterally and that no party to the contract has the right to terminate it at will. The HVDC System Owner shall supply the National Regulatory Authority with all documents the National Regulatory Authority requests in order to ascertain that a binding and final contract exists. (d) The HVDC System shall be considered as an Existing HVDC System, provided that: i. In accordance with Article 3(7) (a) and (b) above, the Relevant TSO is provided with sufficient evidence of the existence of binding and final contracts for the construction, assembly or purchase of the main plant of a HVDC System prior to the day, which is two years after the day of entry into force of this Network Code; or ii. Following the verification performed by the National Regulatory Authority in accordance with Article 3(7) (c), it is ascertained that binding and final contracts for the construction, assembly or purchase of the main plant of a HVDC System exist prior to the day, which is two years after the day of entry into force of this Network Code. (e) In case the HVDC System Owner does not provide the Relevant TSO with the confirmation within the delay set forth in Article 3(7) (a), the HVDC System shall be considered as a New HVDC System.	Same defition as in RfG		Article 3.4
8. With regard to DC-connected Power Park Modules not yet connected to the Network: (a) Within a delay not exceeding thirty months as from the day of entry into force of this Network Code, the DC-connected Power Park Module Owner shall provide the Relevant TSO with a confirmation of final and binding contracts it has concluded for the construction, assembly or purchase of the main plant of a the DC-connected Power Park Module and/or the HVDC System(when the HVDC System Owner is the same as the DC-connected Power Park Module Owner and is built as part of the development of the DC-connected Power Park Module) with relevance to the provisions of this Network Code and which exists prior to the day, which is two years after the day of entry into force of this Network Code. (b) The confirmation shall at least indicate the contract title, its date of signature and of entry into force, and the specifications of the main plant to be constructed, assembled or purchased. (c) The Relevant TSO may demand that the National Regulatory Authority confirms the existence, relevance and finality of such a contract, i.e. that its material terms can no longer be changed by one of the parties to the contract unilaterally and that no party to the contract has the right to terminate it at will. The DC-connected Power Park Module Owner shall supply the National Regulatory Authority with all documents the National Regulatory Authority requests in order to ascertain that a binding and final contract exists. (d) The DC-connected Power Park Module shall be considered as an Existing DC-connected Power Park Module, provided that: i. In accordance with Article 3(8)(a) and (b) above, the Relevant TSO is provided with sufficient evidence of the existence of binding and final contracts for the construction, assembly or purchase of the main plant of a DC-connected Power Park Module and/or where applicable the HVDC System prior to the day, which is two years after the day of entry into force of this Network Code; or ii. Following the verification performed by the National Regulatory Authority in accordance with Article 3(8)(c), it is ascertained that binding and final contracts for the construction, assembly or purchase of the main plant of a DC-connected Power Park Module and where applicable the HVDC System exist prior to the day, which is two years after the day of entry into force of this Network Code. (e) In case the DC-connected Power Park Module Owner does not provide the Relevant TSO with the confirmation within the delay set forth in Article 3(8)(a), the DC-connected Power Park Module and as applicable HVDC System shall be considered as a New DC-connected Power Park Module and/or HVDC System.	Same defition as in RfG		

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Article 4 **Regulatory aspects** 1. The requirements established in this Network Code and their applications are based on the principle of non-discrimination and transparency as well as the principle of optimisation between the highest overall efficiency and lowest total cost for all involved parties. 2. Notwithstanding the above, the application of non-discrimination principle and the principle of optimization between the highest overall efficiency and lowest total costs for all involved parties shall be balanced with the aim of achieving the maximum transparency in issues of interest for the market and the assignment to the real originator of the costs. 3. Where reference is made to this paragraph, the terms and conditions for connection and access to networks or their methodologies shall be established by the National Regulatory Authorities, or by the Member States in accordance with the rules of national law implementing Directive 2009/72/EC, and with the principles of transparency, proportionality and non-discrimination. 4. Any decision by a Network Operator other than the Relevant TSO and any agreement between a Network Operator other than the Relevant TSO and either Power Generating Facility Owner of a DC-connected Power Park Module or a HVDC System Owner shall be exercised in compliance with and respecting the Relevant TSO's responsibility to ensure system security according to national legislation. Further details to ensure this principle may be specified either by national legislation, or by agreements between the Relevant TSO and the Network Operators in its Control Area, as the case may be. 5. The allocation of tasks between the Relevant Network Operators, as well as the legal framework under which they determine the grid connections requirements under this Network Code, are established pursuant to this Network Code. TSO(s) granted public authority or competence according to national law can adopt decisions when defining requirements under this Network Code while respecting Directive 2009/72/EC. 6. Any decision or agreement adopted pursuant to this Network Code and affecting more than one Member State shall be coordinated among the concerned TSOs and NRAs.			
Article 5 **Recovery of costs** 1. The costs related to the obligations referred to in this Network Code which have to be borne by regulated Network Operators shall be assessed by National Regulatory Authorities. 2. Costs assessed as efficient, reasonable and proportionate shall be recovered as determined by National Regulatory Authorities. 3. If requested by National Regulatory Authorities, regulated Network Operators shall, within three months of such a request, use best endeavours to provide such additional information as reasonably requested by National Regulatory Authorities to facilitate the assessment of the costs incurred.	Same as in RfG		Article 5
Article 6 **Confidentiality obligations** 1. Each Relevant TSO, DSO, HVDC System Owner or Power Generating Facility Owner shall preserve the confidentiality of the information and data submitted to them in connection with this Network Code and shall use them exclusively for the purpose they have been submitted in compliance with the Network Code. 2. Without prejudice to the obligation to preserve the confidentiality of commercially sensitive information obtained in the course of carrying out its activities, each TSO shall provide to the operator of any other transmission system with which its system is interconnected, sufficient information to ensure the secure and efficient operation, coordinated development and interoperability of the interconnected system. 3. In case of disclosure for other purposes than those described in Article 6(1) and/or 6(2), a Relevant TSO shall seek the consent of the owner of such information and data. This consent shall not be unreasonably withheld.			
CHAPTER 2 **GENERAL REQUIREMENTS FOR HVDC CONNECTIONS**			
SECTION 1 **REQUIREMENTS FOR ACTIVE POWER CONTROL AND FREQUENCY SUPPORT**			
Article 7 **Frequency ranges** 1. An HVDC System shall fulfil the following requirements referring to Frequency stability: (a) An HVDC System shall be capable of staying connected to the Network and remain operable within the Frequency ranges and time periods specified by Table 1. (b) While respecting the provisions of Article 4(3), wider Frequency ranges or longer minimum times for operation can be agreed between the Relevant TSO and the HVDC System Owner 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 consent of the HVDC Connection Owner shall not be unreasonably withheld. (c) Notwithstanding Article 7(1)(a) above, a HVDC System shall be capable of automatic disconnection at specified frequencies, if required by the Relevant TSO. While respecting the provisions of Article 4(3), terms and settings for automatic disconnection shall be agreed between the Relevant TSO and the HVDC System Owner. | Frequency Range	Time period for operation | |---|---| | 47.0 Hz – 47.5 Hz | 30 minutes | | 47.5 Hz – 51.5 Hz | Unlimited | | 51.5 Hz – 52.0 Hz | 30 minutes | *Table 1: This table shows the minimum time periods an HVDC System has to be able to operate for different frequencies deviating from a nominal value without disconnecting from the Network.*	Unlike the PPM ranges, the ranges here apply unversally and are not synchronous area dependent. The HVDC converters have the same or longer endurance than Generators so that they are the last to disconnect	CC.6.1.3	Article 8.1(a) Table 2
Article 8 **Rate-of-change-of-Frequency withstand capability** With regard to the rate of change of Frequency withstand capability, an HVDC System shall be capable of staying connected to the Network and operable at rates of change of Frequency up to a 2.5 Hz/s based on a rolling measurement of Frequency at the Connection Point over a 500 ms window value.	Not covered in the Grid Code. High rate is specified to cater for future significant non-synchronous generation penetration This rate is higher than for PPMs		

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Article 9 **Active power controllability; control range and ramping rate**			
1. With regard to the capability of controlling the transmitted active power: (a) The HVDC System shall be capable of adjusting the transmitted active power within the HVDC System maximum output following an Instruction from the Relevant TSO(s).	Frequency control and response capability, full range of HVDC is available	CC.6.3.6	
i. The Relevant TSO(s) shall have the right to specify, while respecting the provisions of Article 4(3), a minimum power resolution for adjusting the transmitted active power.			
ii. The Relevant TSO(s) have the right, while respecting the provisions of Article 4(3) to define a minimum active power transmission capability for both directions, below which active power transmission capability is not requested.	This recognises that LCC technology has a minimum limit		
iii. A procedure for adjusting the transmitted active power shall be defined by the Relevant TSO(s) and HVDC System Owner, defining in particular the maximal delay within which the HVDC System is capable of adjusting the transmitted active power upon receipt of request from the Relevant TSO(s). (b) In case of Disturbance in one of the connecting AC Networks, the HVDC System shall be capable of modifying the transmitted active power in accordance with pre-defined regulation sequences as fast as technically feasible with an initial delay as short as possible. If greater than 10 milliseconds after receiving the triggering signal, the delay shall be reasonably justified by the HVDC System Owner to the Relevant TSO(s).	Pre-programmed automatic control is envisaged		
(c) The Relevant TSO(s)have the right, while respecting the provisions of Article 4(3)to require the HVDC System to be capable of fast active power reversal. The power reversal shall be possible from the Maximum Capacity in one direction to the Maximum Capacity in the other direction as fast as technically feasible with and reasonably justified by the HVDC System Owner to the Relevant TSOs if greater than 2 seconds.	This does not rule out the use of LCC technology		
(d) For HVDC Systems linking various Control Areas or Synchronous Areas, the HVDC System shall be capable of providing FCR and FRR by static and/or dynamic means. They shall also be capable of allowing Imbalance Netting Power Interchange between the Relevant TSO(s).	As part of its frequency response capability, programmed to respond to LFCR Network Code requirements		
2. With regard to the capability of controlling ramping rate, the HVDC System shall be capable of adjusting the ramping rate of active power variations in accordance with instructions sent by the Relevant TSO(s).	Ramp rates dependent on local networks, hence left to Relevant TSO to specify	CC.A.3.4, PC.A.5.5.2 both refer to testing of ramp rates	
3. The Relevant TSO shall have the right to require, while respecting the provisions of Article 4(3), in coordination with adjacent TSO(s), that the control functions of a HVDC System shall be capable of taking automatic remedial actions including, but not limited to, stopping the ramping, blocking FSM, LFSM-O, LFSM-U or Frequency control. The triggering and blocking criteria shall be defined by the Relevant TSO(s).			
Article 10 **Synthetic inertia**			
1. With regard to the capability of providing Synthetic Inertia in response to a rate of change of Frequency: (a) The Relevant TSO shall have the right to require that a HVDC System shall be capable of providing synthetic inertia as a quantified 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, while respecting the provisions of Article 4(3) and Article 15(8)c) of [NC OS].	Very fast modulation of power to control frequency deviation in a low inertia system - not a mandatory requirement		
(b) The principle of this control system and the associated performance parameters shall be defined by the Relevant TSO while respecting the provisions of Article 4(3).			
(c) The Relevant TSO, where a need is demonstrated and the HVDC control means of delivery demonstrated as realistic, shall have the right to require the synthetic inertia to be delivered in a manner that contributes synchronising torque through emulating Synchronous Generator Performance in this respect. The Relevant TSO shall define the synchronising torque contribution parameters, while respecting the provisions of Article 4(3).	If other means of delivering synthetic inertia is feasible, TSO can specify if there is such a requirement		

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Article 11 **Frequency Sensitive Mode (FSM)**			
1. When operating in Frequency Sensitive Mode (FSM),the following shall apply: (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. The specification will be notified to the relevant National Regulatory Authority. (b) The adjustment of Active Power Frequency Response is limited by the minimum and maximum active power transmission capability limits of the HVDC System (in each direction).		CC.6.3.6 Different capacity is available for FSM (10% minimum), and the droop range is limited.	10.2 (a)

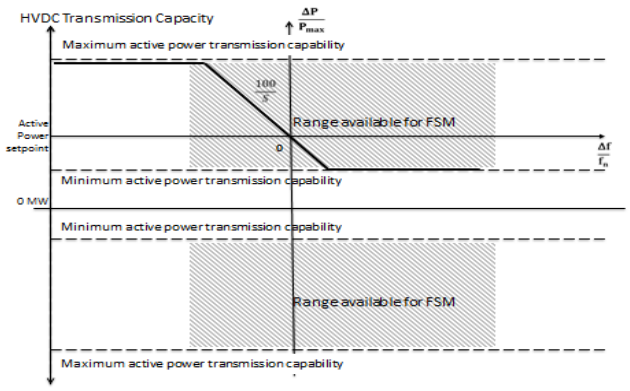

Figure 1: Active Power Frequency Response capability of a HVDC Connection Scheme in FSM illustrating the case of zero deadband and insensitivity. DP is the change in Active Power output from the HVDC System. f_n is the target Frequency in the AC Network where the FSM service is provided and Df is the Frequency deviation in the AC Network where the FSM service is provided.

Parameters	Ranges	Commentary
Frequency Response Deadband	0 – 500mHz	The wide deadband is effectively a means of disabling the response
Droop *S*	Minimum 0.1%	A minimum droop of 0.1% provides for a fast response

Table 2: Parameters for Active Power Frequency Response in FSM

(c) The Frequency Response Deadband of Frequency deviation and Droop are selected by the Relevant TSO and must be able to be reselected subsequently within the given frames in Table 2. The selection will be notified to the relevant National Regulatory Authority.

(d) The HVDC System shall be capable of adjusting the Active Power range available for FSM within the limits set by Article 11 (1) (a) and (b) following an instruction of the Relevant TSO.

(e)

a. As a result of a Frequency step change, the HVDC System shall be capable of adjusting full Active Power Frequency Response, at or above the solid line according to Figure 2 in accordance with the parameters specified by each TSO within the ranges according to Table 3. 10.2.(b)(3)

b. The HVDC System has to be able to adjust Active Power Output DP up to the limit of the Active Power range requested by the Relevant TSO in accordance with the times t_1 and t_2 with the values of $t_1$and t_2 being specified by the Relevant TSO according to the ranges in Table 3, where t_1 is the initial delay. t_2 is the time for full activation.

c. The specification will be notified to the Relevant National Regulatory Authority. The initial delay of activation shall be as short as possible. If greater than 0.5 second, the initial delay of activation shall be reasonably justified by the HVDC System Owner to the Relevant TSO and shall be approved by the Relevant TSO, while respecting the provisions of Article 4(3).

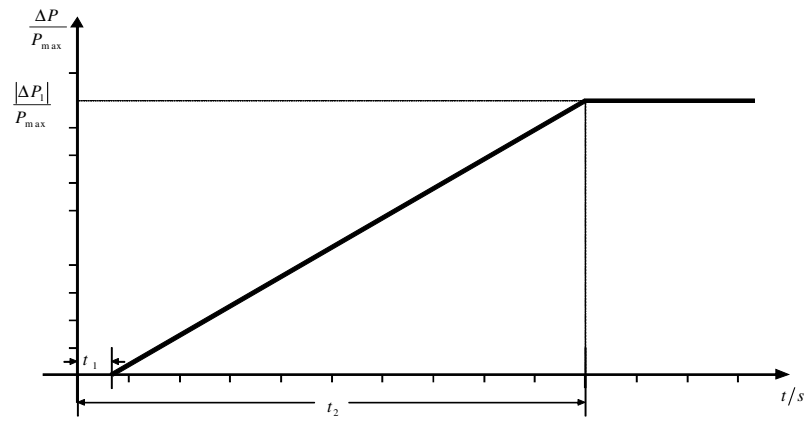

Figure 2: Active Power Frequency Response capability of HVDC System. DP is the change in Active Power triggered by the step change in Frequency..

Parameters	Time
Maximum admissible initial delay t_1	0.5 seconds
Maximum admissible choice of full activation time t_2, unless longer activation times are admitted by the Relevant TSO due to system stability reasons	30 seconds

Table 3: Parameters for full activation of Active Power Frequency Response resulted from Frequency step change.

(f) 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.
(g) As long as a Frequency deviation continues Active Power control shall not have any adverse impact on the Frequency response.

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Article 12 **Limited Frequency Sensitive Mode Overfrequency (LFSM-O)**			
1. In addition to Article 11 the following shall apply cumulatively with regard to Limited Frequency Sensitive Mode – Overfrequency (LFSM-O):		BC3.5.3	8.1.(c)
(a) The HVDC System shall be capable of adjusting Active Power transmission to the AC Network(s) according to Figure 3 at a Frequency threshold between and including 50.2 Hz and 50.5 Hz with a Droop Shaving a minimum value of 0.1 %. The actual Frequency threshold and Droop settings shall be determined by the Relevant TSO and will be notified to the Relevant National Regulatory Authority. The HVDC System shall be capable of adjusting Active Power Frequency Response as fast as technically feasible with an initial delay that shall be as short as possible. If greater than 0.5 seconds, the delay must be reasonably justified by the HVDC System Owner to the Relevant TSO and shall be approved by the Relevant TSO, while respecting the provisions of Article 4(3).	LFSM-O applies between 50.2 - 50.4 Hz	LFSM-O applies above 50.4 Hz	
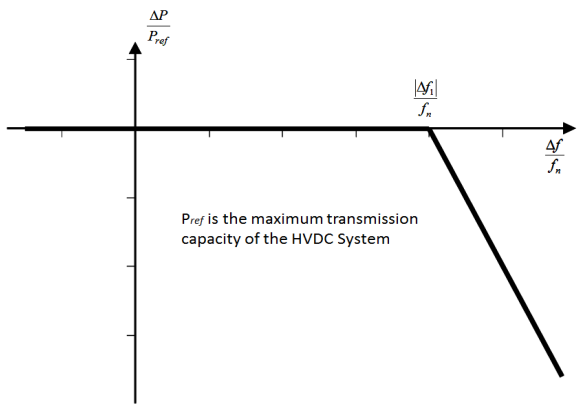			
Figure 3: Active Power Frequency Response of HVDC Systems in LFSM-O. DP is the change in Active Power output from the HVDC System. f_n is the nominal Frequency of the AC Network(s) the HVDC System is connected to and Df is the Frequency change in the AC Network(s) the HVDC is connected. At overfrequencies where Df is above Df_1 the HVDC System has to reduce Active Power according to the Droop setting.			
(b) 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 34.			
Article 13 **Limited Frequency Sensitive Mode Underfrequency (LFSM-U)**			
1. In addition to Article 11 the following shall apply cumulatively with regard to Limited Frequency Sensitive Mode – Underfrequency (LFSM-U):		No such requirement	10.2.(b)
(a) The HVDC System shall be capable of adjusting the Active Power Frequency Response to the AC Network(s) according to Figure 4 at a Frequency threshold between and including 49.8 Hz and 49.5 Hz with a Droop having a minimum value of 0.1 %. In the LFSM-U mode the HVDC System shall be capable of adjusting a power increase up to its Maximum Transmission Capacity. The actual Frequency threshold and Droop settings shall be determined by the Relevant TSO and will be notified to the Relevant National Regulatory Authority. The Active Power Frequency Response shall be activated as fast as technically feasible with an initial delay that shall be as short as possible. If greater than 0.5 second, the delay must be reasonably justified by the HVDC System Owner to the Relevant TSO and shall be approved by the Relevant TSO, while respecting the provisions of Article 4(3).			
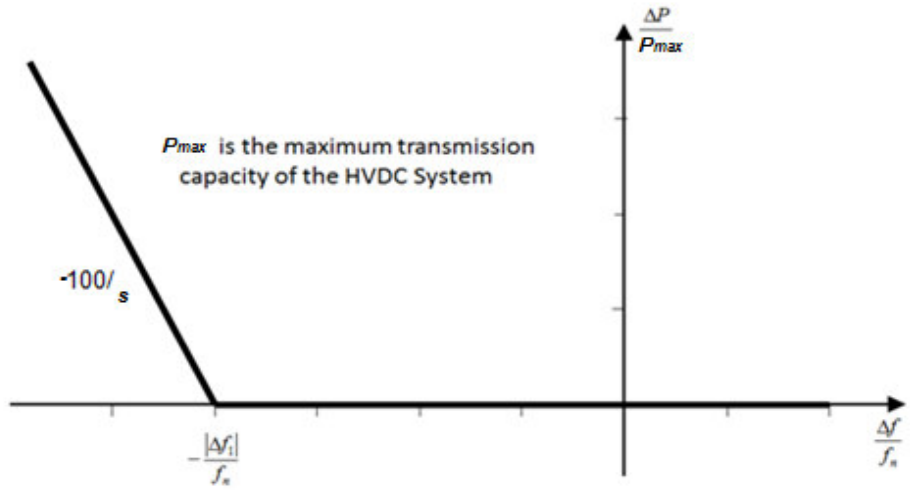			
Figure 4: Active Power Frequency Response capability of HVDC Systems in LFSM-U. DP is the change in Active Power output from the HVDC System. f_n is the nominal Frequency in the AC Network(s) the HVDC System is connected and Df is the Frequency change in the AC Network(s) the HVDC is connected. At underfrequencies where Df is below Df_1 the HVDC System has to increase Active Power output according to the Droop S.			
(b) 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 34.			
Article 14 **Frequency control**			
1. With regard to the capability of providing additional Frequency control above those defined in Articles 11, 12 and 13:			
(a) The Relevant TSO(s) shall have the right to require, while respecting the provisions of Article 4(3), that a HVDC System shall be equipped with an independent control mode to modulate the 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. (b) The operating principle of this control system, the associated performance parameters and the activation criteria shall be defined by the Relevant TSO(s) while respecting the provisions of Article 4(3).	This allows for different cases where needed		
Article 15 **Maximum loss of active power**			
1. The HVDC System shall be configured such that its loss of Active Power injection in a Synchronous Area, arising out of a transient or permanent fault, shall be limited to a value defined for each LFC Block by the Relevant TSOs, while respecting the provisions of Article 4(3).	This limits the maximum reserve required. Part of the SQSS requirement in GB but not insome other Member States, hence linked to NC LFCR. GB limit is 1.8 GW		

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference

SECTION 2

REQUIREMENTS FOR REACTIVE POWER CONTROL AND VOLTAGE SUPPORT

Article 16 **Voltage ranges**

1. HVDC Converter Stations shall be capable of fulfilling the following requirements with regard to steady state Voltage ranges*:*

(a) Notwithstanding the provisions of Article 23, a HVDC Converter Station shall be capable of staying connected to the Network and capable of operating at the maximum output of HVDC Converter Station 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 TSO(s).

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 decided by each TSO while respecting the provisions of **Error! Reference source not found.**(3), 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

Voltage range consistent with Grid Code for unlimited duration operation

Compared with RfG, duration extended in some cases where possible

CC6.1.4

Article 11.2 (a)

Table 4: This table shows the minimum time periods a HVDC System shall be capable of operating for Voltages deviating from the nominal value at the Connection Point(s) without disconnecting from the Network. The Voltage base for pu values below 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 decided by each TSO while respecting the provisions of **Error! Reference source not found.**(3), 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

Voltage range consistent with Grid Code for unlimited duration operation

Compared with RfG, duration extended in some cases where possible

CC6.1.4

Article 11.2 (a)

Table 5: This table shows the minimum time periods a HVDC System shall be capable of operating for Voltages deviating from the nominal value at the Connection Point(s) without disconnecting from the Network. The Voltage base for pu values from 300 kV to 400 kV (included).

(b) While respecting the provisions of Article 4(3), wider Voltage ranges or longer minimum times for operation can be agreed between the Relevant TSO and the HVDC System Owner to ensure the best use of the technical capabilities of a 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 consent of the HVDC System Owner shall not be unreasonably withheld.

(c) The Relevant TSO shall have the right to specify Voltages at the Connection Point at which a HVDC Converter Station shall be capable of automatic disconnection. The terms and settings for automatic disconnection shall be agreed between the Relevant TSO and the HVDC Owner, while respecting the provisions of Article 4(3).

(d) For Connection Point(s) at AC Voltages that are not included in the scope of Table 4 and Table 5, the Relevant TSO(s) shall define applicable requirements at the Connection Point(s), while respecting the provisions of Article 4(3).

Article 17 **Short circuit contribution during faults requirements**

1. HVDC Converter Stations shall fulfil the following requirements referring to short-circuit current:

(a) The Relevant TSO shall have the right to require Reactive Short Circuit Current contribution at the Connection Point of each of the HVDC Converter Stations of the HVDC System in the case of symmetrical (3-phase) faults.

i) The HVDC Converter Station shall be capable of providing this Reactive Short Circuit Current contribution at the Connection Point during the period of faults. In accordance with specifications by the Relevant TSO on the magnitude of this Current, depending on the deviation of the Voltage at the Connection point from its nominal value.

ii) Each HVDC System shall be capable of providing with each of its HVDC Converter Stations connected to the AC system at least 2/3 of the rated reactive current within a time period specified by the Relevant TSO(s)while respecting the provisions of Article 4(3). The target value of this reactive short circuit current contribution shall be reached within a time period and with an accuracy specified by the Relevant TSO(s)while respecting the provisions of Article 4(3).

(b) With regard to fast acting additional reactive Current injection in the case of asymmetrical (1-phase or 2-phase) faults, the Relevant TSO(s) shall have the right to introduce a requirement for asymmetrical Current injection, while respecting the provisions of Article 4(3).

This requirement is not mandatory - TSO assessed on a project by project basis.

This not intended to rule out LCC technology

CC.6.3.15 specifies Fault ride through though not detailed reactive current contribution

15.2 (b)

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
Article 18 **Reactive power capability**			
1. HVDC Converter Station shall fulfil the following requirements referring to Voltage stability, at the Connection Point(s): With regard to Reactive Power capability between Minimum active power transmission capability and Maximum Transmission Capacity: (a) The Relevant TSO(s) shall define while respecting the provisions of Article 4(3) the Reactive Power capability requirements in the context of varying Voltage. In doing so, the Relevant TSO(s) shall define a U-Q/Pmax-profile, within the boundary of which the HVDC Converter Station shall be capable of providing Reactive Power at its Maximum Capacity.	The reactive capability applies to the converter station between minimum and maximum active power transmission capacity Grid Code has zero requirement for off-shore converters but 0.95 PF lad and lag at the onshore connection point	CC.6.3.2. (b),(c)	
(b) The U-Q/Pmax-profile shall be defined by the Relevant TSO(s) while respecting the provisions of Article 4(3) in conformity with the following principles: - 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. - the dimensions of the U-Q/Pmax-profile envelope shall respect the values defined for each Synchronous Area in Table 6; and - the position of the U-Q/Pmax-profile envelope shall lie within the limits of the fixed outer envelope in Figure 5. (c) The HVDC System shall be capable of moving to any operating point within its U-Q/Pmax profile in appropriate timescales to target values requested by the Relevant TSO, while respecting the provisions of Article 4(3). -			
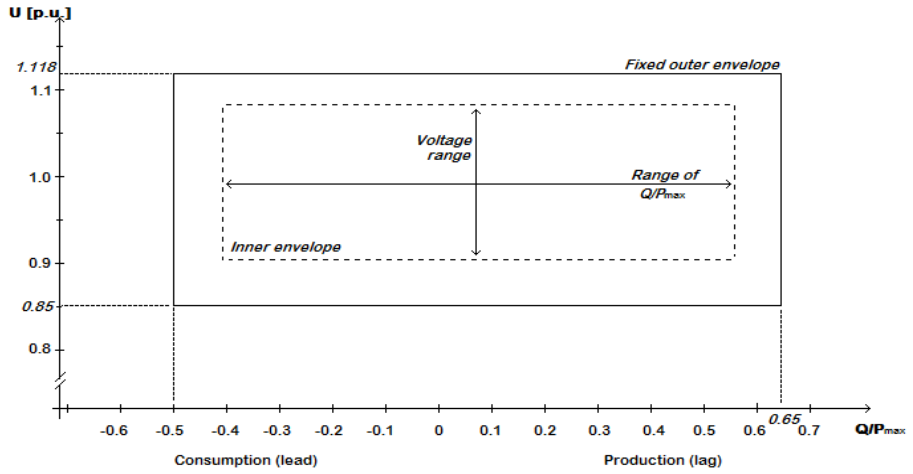			
Figure 5: U-Q/Pmax-profile of a HVDC System at the Connection Point. The diagram represents boundaries of a U-Q/Pmax-profile of the Voltage at the Connection Point[s], expressed by the ratio of its actual value to its nominal value in per unit, against the ratio of the Reactive Power (Q) to the Maximum Capacity (Pmax).The position, size and shape of the inner envelope are indicative. 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; at minimum or maximum Voltage point the reactive range is zero.			
Table 6: Parameters for the Inner Envelope in Figure 5	Table 6 parameters are the same as for synchronous machines in RfG (table 8)	13.2.(b)	

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

Article 19 **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 defined by the Relevant TSO(s), while respecting the provisions of Article 4(3). 2. The Reactive Power variation caused by the Reactive power control mode operation of the HVDC Converter Station, as listed in Article 20(1), shall not result in a Voltage step exceeding the allowed value at the Connection Point. This maximum tolerable Voltage step value shall be specified by the Relevant TSO, while respecting the provisions of Article 4(3).			
Article 20 **Reactive power control mode**			
1. Each HVDC Converter Station shall as a minimum be capable of operating in any of the following reactive-power-control modes: (a) Voltage Control mode; (b) Reactive-Power Control mode; (c) Power-Factor Control mode; 2. The Relevant TSO shall have the right to require other reactive power control mode capabilities, while respecting the provision of Article 4(3). 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 18 and 19, in accordance with the following control characteristics: (a) Set-point Voltage shall be specified to cover a specific operation range, either continuously or in steps, as defined by the Relevant TSO(s); (b) A Slope which shall be specified with a range and step defined by the Relevant TSO(s); (c) The Set-point Voltage may be operated with or without a dead band 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 TSO, while respecting the provisions of Article 4(3). (d) Following a step change in Voltage, the HVDC Converter Station shall be capable of achieving 90 % of the change in Reactive Power output within a time t1 to be specified by the Relevant TSO(s), while respecting the provisions of Article 4(3) in the range of 0.1 - 5 seconds and settle at the value defined by the operating Slope within a time t2 to be specified by the Relevant TSO in the range of 5 - 60 seconds, with a specified steady-state reactive tolerance in % of the maximum Reactive Power. (e) Voltage Control mode shall include the capability to modify the set point Voltage with the reactive power output in a linear way. The slope shall be specified by a range and step defined by the Relevant TSO(s). 4. The Relevant TSO(s) shall specify a Reactive Power range in Mvar or in % of full Reactive Power, as well as an associated accuracy of the control of the Reactive Power at the Connection Point(s). 5. For the purposes of Power Factor Control mode, the HVDC Converter Station shall be capable of controlling the Power Factor at the Connection Point utilising its capabilities, while respecting the provisions of Articles 18 and 19, with a target Power Factor in steps no greater than a maximum allowed step, specified by the Relevant TSO. 6. The Relevant TSO(s) shall define, while respecting the provisions of Article 4(3), any equipment needed to enable the remote selection of relevant Set-point(s) and control modes.	This would be difficult for LCC without installing, for example, SVC - not intended to rule out LCC. No requirement in Grid Code No such triple control ode requirement for onshore converters in Grid Code	CC.6.3.5.(b), CC.6.3.8.(a)(v)	

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
Article 21 **Priority to active or reactive power contribution**			
The Relevant TSO shall assess, while respecting the provisions of Article 4(3), 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.			
Article 22 **Power quality**			
All HVDC Systems 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(s), exceeding the level allocated to them by the Relevant TSO, while respecting the provisions of Article 4(3). The necessary contribution to studies determining these effects from the owners of Grid Users, including but not limited to Existing Power Generating Modules, Existing Distribution Networks, Existing Demand Facilities and Existing HVDC Systems shall not be unreasonably withheld.	Each converter should at least filter its own distortions, and not itroduce harmonics in breach of national specifications		
SECTION 3 REQUIREMENTS FOR FAULT RIDE THROUGH			
Article 23 **Fault ride through capability**			
1. With regard to fault-ride-through capability of HVDC System:		CC.6.3.15	11.3.(a)
(a) The Relevant TSO(s) shall define, while respecting the provisions of Article 4(3), a Voltage-against-time-profile according to Figure 6 and Table 7 at the Connection Point(s) for fault conditions under which the HVDC Converter Station shall stay connected to the Network and continue stable operation after the power system has recovered following fault clearance.	Fault Ride Through requirements are similarly stated in the Grid Code but the voltage profile is different; mac duration in GC could be upto 180 s, whereas in the HVDC code it is 10 s GC offers otpions on time-voltage profile	CC.A.4A.1	
(b) 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 Point(s) during a symmetrical fault, as a function of time before, during and after the fault.			
(c) The Relevant TSO(s) shall provide on request by the HVDC System Owner the pre-fault and post-fault conditions as defined in Article 30 regarding: - pre-fault minimum short circuit capacity at the Connection Point(s) expressed in MVA; - 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 Point[s]; - post-fault minimum short circuit capacity at the Connection Point[s] expressed in MVA. Alternatively, generic values for the above conditions derived from typical cases may be provided by the Relevant TSO(s).			

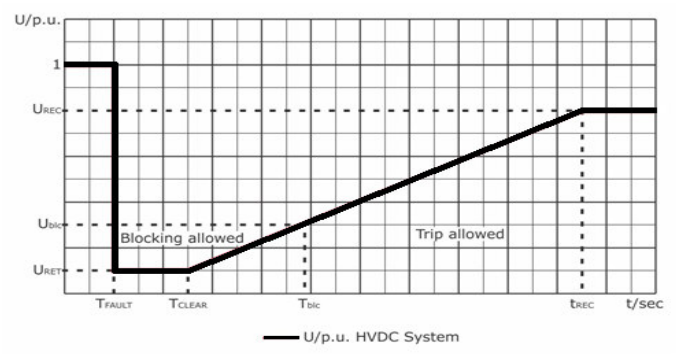

Figure 6: Fault-ride-through profile of a HVDC Converter Station. The diagram represents the lower limit of a Voltage-against-time profile at the Connection Point(s), expressed by the ratio of its actual value and its nominal value in per unit before, during and after a fault. Uret is the retained Voltage at the Connection Point(s) during a fault, Tclear is the duration of the fault, Urec, and trec specify a point of lower limits of Voltage recovery following fault clearance. Ublc is the blocking Voltage at the connection point at time Tblc, where Tblc is the instant when the HVDC System deblocks. The time values referred to are measured from Tfault.

Voltage parameters [pu]		Time parameters [seconds]	
Uret	0.00 – 0.30	Tclear	0.14-0.25
Urec	0.85	Trec	1.5 - 10.0
Ublc	0.0 – 0.75	Tblc	As defined by Figure 6

Table 7: Parameters for Figure 6 for fault-ride-through capability of HVDC Converter Station.

(d) 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(s) during a symmetrical fault, given the pre-fault and post-fault conditions described in Article 30, remain above the lower limit defined in Figure 6, unless the protection scheme for internal electrical faults requires the disconnection of the HVDC Converter Station from the Network. The protection schemes and settings for internal electrical faults shall be designed not to jeopardize fault-ride-through performance.

(e) While respecting the provisions of Article 4(3), the Relevant TSO(s) shall have the right to specify Voltages (Ublc), according to Table 7 at the Connection Point(s) 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 TSO(s) and the HVDC System Owner.

(f) Consistent with the provisions of Article 34, undervoltage protection, either fault-ride-through capability or minimum Voltage defined at the connection point Voltage, shall be set by the HVDC System Owner to the widest possible technical capability of the HVDC Converter Station. The Relevant TSO may require less wide settings according to Article 35. The agreed settings shall be justified by the HVDC System Owner.

(g) Fault-ride-through capabilities in case of asymmetrical faults shall be defined by each TSO while respecting the provisions of Article 4(3). The response of the HVDC Converter Station to asymmetrical faults shall be to contribute to the re-establishment of the phase-voltages in the fault-affected phases and avoid excitation of Voltages above an acceptable Voltage range in the phases which are unaffected by the fault.

Article 24 **Post fault active power recovery**			
1. Consistent with the provisions of Article 23, and while respecting the provisions Article 4(3),the Relevant TSO(s) shall specify the magnitude and time capability of active power recovery required from the HVDC System.			
Article 25 **Autoreclosure**			
1. Transient faults on HVAC lines in the Network adjacent or close to HVDC Systems shall not cause any of the equipment in the HVDC System to disconnect from the Network due to autoreclosure of lines in the Network. 2. HVDC Systems with overhead lines shall be capable of auto reclosing for 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 33.			

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
SECTION 4 REQUIREMENTS FOR CONTROL			
Article 26 **Converter energisation and synchronisation**			
1. Unless following an instruction by the Relevant TSO, the following shall apply: (a) During the energisation or synchronisation of an HVDC Converter Station to the AC network at the Connection Point(s), the HVDC converter Station shall smooth any Voltage transients to a steady-state level not exceeding 3 per cent of the pre-synchronisation AC Voltage. (b) During the connection of an energised HVDC Converter Station to an HVDC System, the HVDC Converter Unit or HVDC Converter Station shall smooth any Voltage transients, at any Connection Point of the HVDC System, to a steady-state level not exceeding 3 per cent of the pre-synchronisation AC Voltage.	This is really a voltage quality issue, similar 3% applies in Grid Code	CC.6.1.7	
Article 27 **Interaction between HVDC System(s) and other Grid Users**			
1. The Relevant TSO(s) shall have the right to require and to define the scope and extent of studies, if several HVDC Converter Stations and/or other Grid Users are within close electrical proximity, to demonstrate that no adverse interaction (such as, but not limited to interference with or jeopardisation of the operation of other HVDC Systems, Power Generation Modules or any protection devices in the adjacent AC grid) may occur. If adverse interaction is identified, the studies shall identify possible mitigating actions to be implemented to ensure compliance with the requirements of this Network Code.	Control systems of a User may have adverse interaction on existing User, hence this requirement is necessary.		
2. The studies shall be carried out by the connecting HVDC System Owner, with the participation of all other parties as identified by the TSO(s) 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 studies purposes.			
3. The Relevant TSO shall assess the result of the studies based on their scope and extent as defined in accordance with Article 27(1). If necessary for the assessment, the Relevant TSO shall have the right to request the HVDC System Owner to perform further studies in line with this same scope and extent.	Additional studies may be required if TSO thinks other issues need to be addressed		
4. Any necessary mitigating actions identified by the studies and reviewed by the Relevant TSO(s) shall be undertaken as part of the connection of the new HVDC Converter Station, while respecting the provisions of Article 4(3).			
5. In addition, in respect of the transient performance of the link for example for switching, load rejection and energisation the Relevant TSO shall have the right to specify levels of performance upon the individual HVDC System or collectively across HVDC Systems commonly impacted to both protect the integrity of TSO equipment and that of connected users to its system in a manner consistent with its own national code requirements.	This is particularly aimed at transient overvoltage conditions. GC has no such requirement but Users may have to provide information for transient overvoltage assessment by NGET	DRC Schedule 5	
Article 28 **Power oscillation damping capability**			
1. With regard to power oscillations damping control, the HVDC System shall be capable of contributing to the damping of power oscillations. The control system of the HVDC System shall not negatively affect the damping of power oscillations. The Relevant TSO(s) shall specify the network conditions, and a Frequency range of oscillations which the control scheme shall positively damp, considering the dynamic stability assessment studies as prescribed in Article 15 of [NC OS]; the control parameter settings shall be agreed between the Relevant TSO(s) and the HVDC System Owner.			
Article 29 **Sub-synchronous torsional interaction damping capability**			
1. With regard to sub-synchronous torsional interaction (SSTI) damping control, the HVDC System shall be capable of contributing to electrical damping of torsional frequencies. 2. The TSO shall define the necessary extent of SSTI studies and provide input parameters, to the extent available, related to the equipment and relevant system conditions in his network. The SSTI studies shall be provided by the HVDC System Owner; it should identify the conditions, if any, where SSTI exists and propose any necessary mitigation procedure. The necessary contribution to such studies from the owners of Grid Users, including but not limited to Existing Power Generating Modules, Existing Distribution Networks, Existing Demand Facilities and Existing HVDC Systems shall not be unreasonably withheld. The Relevant TSO shall assess the result of the SSTI studies. If necessary for the assessment, the Relevant TSO shall have the right to request the HVDC System Owner to perform further SSTI studies in line with this same scope and extent.			
Article 30 **Network characteristics**			
1. With regard to the Network characteristics, the following shall apply for the HVDC Systems during normal and disturbed conditions: (a) The Relevant TSO shall define and make publicly available, while respecting the provisions of Article 4(3), the method and the pre-fault and post-fault conditions for the calculation of at least minimum and maximum Short Circuit Power at the Connection Point(s). (b) The HVDC System shall be capable of operating within the range of short circuit power and network characteristics defined by the Relevant TSO. (c) Each Relevant TSO shall provide the HVDC System Owner with network equivalents representing the behaviour of the Network at the Connection Point, enabling the HVDC System Owners to design the system with regard to harmonics.			
Article 31 **HVDC System robustness**			
1. The HVDC System shall be capable of finding stable operation points with a minimum change in 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(s) shall specify the changes in the system conditions for which the HVDC Systems shall remain in stable operation. The changes include, but are not limited to: (a) loss of communication (b) reconfiguring the HVDC or AC system (c) changes in load flow (d) changes in DC Voltage (e) change of control mode (f) control system failure (g) trip of one pole or converter (h) extreme low short circuit power at the connection points 2. The HVDC System Owner shall ensure that the tripping or disconnection of the HVDC Converter Station does not result in transients at the Connection Point(s) beyond the limit specified by the Relevant TSO(s), while respecting the provisions of Article 4(3). 3. The HVDC System Owner(s) shall provide information to the Relevant TSO(s) on the resilience of the HVDC System(s) to system disturbances such that the modes of failure of the HVDC System(s) interfacing a Control Area may be identified by the Relevant TSO(s).			

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
SECTION 5 REQUIREMENTS FOR PROTECTION DEVICES AND SETTINGS			
Article 32 **Reconnection**			
1. With regard to capability of reconnection after an incidental disconnection due to a Network disturbance, the Relevant TSO shall define the conditions under which an HVDC System shall be capable of reconnecting to the Network, while respecting the provisions of Article 4(3). 2. Fast reconnection capability is required in case of disconnection of the HVDC System from the Network in line with the protection strategy agreed between the Relevant TSO and the HVDC System Owner. The Relevant TSO shall have the right to specify, while respecting the provisions of Article 4(3), a maximum time after which the HVDC System shall be ready to reconnect.			
Article 33 **Electrical protection schemes and settings**			
1. The Relevant TSO shall define the schemes and settings necessary to protect the Network taking into account the characteristics of the HVDC System. While respecting the provisions of Article 4(3), 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 TSO and the HVDC System Owner(s). 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 Network Code. 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. While respecting the provisions of Article 4(3), any change to the protection schemes relevant for the HVDC System and the Network and to the setting relevant for the HVDC System shall be agreed between the Relevant TSO and the HVDC System Owner before being implemented by the HVDC System Owner.			
Article 34 **Priority ranking of protection and control**			
1. While respecting the provisions of Article 4(3), a control scheme, defined by the HVDC System Owner and usually consisting of different control modes, including the settings of the specific parameters shall be coordinated and agreed between the Relevant TSO and the HVDC System Owner. 2. With regard to priority ranking of protection and control, the HVDC System Owner shall organize its protections and control devices in compliance with the following priority ranking, organized in decreasing order of importance, unless otherwise specified by the Relevant TSO(s): (a) Network system and HVDC System protection; (b) Active power control for emergency assistance (c) Synthetic Inertia, if applicable; (d) Ramp blocking; (e) LFSM; (f) FSM and Frequency control ; (g) Power gradient constraint;	TSO can specify ranking priority		
Article 35 **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 TSO(s) in accordance with Article 35(3). 2. While respecting the provisions of Article 4(3), 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 TSO(s) 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 TSO(s), while respecting the provisions of Article 4(3).			
SECTION 6 REQUIREMENTS FOR POWER SYSTEM RESTORATION			
Article 36 **Black start**			
1. If the Relevant TSO(s) deem(s) system security to be at risk due to a lack of Black Start Capability in a Control Area, the Relevant TSO shall have the right to obtain a quote from the HVDC System Owner. 2. An HVDC System with Black Start Capability shall be able to energize the remote AC-substation to which it is connected from shut down within a timeframe decided by the Relevant TSO(s) while respecting the provisions of Article 4(3), without any external energy supply. The HVDC System shall be able to synchronise within the Frequency limits defined in Article 7 and Voltage limits defined by the Relevant TSO or defined by Article 16, where applicable. Wider Frequency and/or 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.			
Article 37 **Isolated network operation**			
1. The capability to take part in Isolated Network Operation, if required by the Relevant TSO while respecting the provisions of Article 4(3), shall remain within the Frequency limits defined in Article 7, Voltage Limits according to Article 16 and the Network Characteristics according to Article 30. 2. If required, the HVDC System shall be capable of finding a new stable operating point within the P-Q-Capability Diagram, as much as inherently technically feasible, when either the HVDC System becomes isolated to house load operation only or when in case of an emergency situation the short circuit level of the interconnected AC-system is lower than agreed for normal operation.	When a system is split up, reduced short circuit infeed may render HVDC converters from operating normally. TSO can specify more stringent conditions for the converters in order to improve system security		

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
CHAPTER 3 **REQUIREMENTS FOR DC-CONNECTED POWER PARK MODULES AND REMOTE-END HVDC CONVERTER STATIONS**			
Article 38 **Scope**			
1. The requirements of Article 7 to Article 37 apply to Remote-end HVDC Converter Stations, with the modifications expressed in Article 39 to Article 45. 2. The requirements of [NC RfG] apply to DC-connected Power Park Modules, with the modifications expressed in Article 39 to Article 45.			
Article 39 **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, with less than 0.1 second from sending to activation of response. Frequency deviation shall be measured at the connection point in the Synchronous Area to which frequency response is being provided. 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 while respecting the provisions of Article 4(3).			
b) The Remote-end HVDC Converter Station shall be capable of driving the Network Frequency at the Connection Point.	The remote-end converter should be able to emulate the onshore frequency		
c) The DC-Connected Power Park Module(s) and Remote-end HVDC Converter Station(s) with Connection Points in the same synchronously connected Network shall be capable of delivering coordinated Frequency control as defined by the Relevant TSO(s).			
2. With regard to Frequency ranges and response:			
a) A DC-Connected Power Park Module shall be capable of staying connected to the Network and operating within the Frequency ranges and time periods specified by Table 8.	Aligns with Grid Code, except for 47.0-47.5 Hz which calls for a longer duration of 15 mins Requirements harmonised across all syncronous zones This applies to PPMs. The duration is either the same or longer for converters so that Converters should stay on longer compared to PPMs	CC.6.1.3	Article 8.1(a) Table 2

Frequency Range	Time period for operation
47.0 Hz – 47.5 Hz	15 minutes
47.5 Hz – 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 which a PPM shall be capable of operating for different frequencies deviating from a nominal value without disconnecting from the Network.			
b) While respecting the provisions of Article 4(3), wider Frequency ranges or longer minimum times for operation can be agreed between the Relevant TSO and the PPM 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 consent of the DC-Connected Power Park Module Owner shall not be unreasonably withheld.			
c) While respecting the provisions of Article 39(2)(a), a DC-Connected Power Park Module shall be capable of automatic disconnection at specified frequencies, if required by the Relevant TSO. While respecting the provisions of Article 4(3), Terms and settings for automatic disconnection shall be agreed between the Relevant TSO and the DC-Connected Power Park Module Owner.			
3. With regard to the Rate of Change of Frequency withstand capability, a DC-connected Power Park Module shall be capable of staying connected to the Network and operating at rates of change of Frequency up to 2 Hz/s based on a rolling measurement of frequency over a 500 ms window value at the point of connection of the DC-Connected Power Park Module at the remote end of the HVDC Converter Station.	ROCOF is less than that for converters		
4. Capability for Limited Frequency Sensitive Mode - Overfrequency (LFSM-O) shall be required in accordance with Article 8(1)(c) of the [NC RfG], subject to signals as specified in Article 39(1) of this Network Code.			
5. Capability of maintaining constant power shall be determined in accordance with Article 8(1)(d) of the [NC RfG].			
6. Active Power controllability shall be determined in accordance with Article 10(2)(a) of the [NC RfG].			
7. Capability for Limited Frequency Sensitive Mode - Underfrequency (LFSM-U)shall be determined in accordance with Article 10(2)(b) of the [NC RfG], subject to signals as specified in Article 39(1) of this Network Code.			
8. Capability for Frequency Sensitive Mode shall be determined in accordance with Article 10(2)(c) of the [NC RfG], subject to a fast signal response as specified in Article 39(1) of this Network Code.			
9. Capability for Frequency Restoration shall be determined in accordance with Article 10(2)(d) of the [NC RfG].			
10. Monitoring of FSM shall be determined in accordance with Article 10(2)(f) of the [NC RfG].			
11. The right to specify requirements for Synthetic Inertia shall be determined in accordance with Article 16 (2)(a) of [NC RfG].			

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
Article 40 **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 Network and operating within the Voltage ranges expressed by the Voltage at the Connection Point related to nominal Voltage (per unit), and time periods specified by Table 9 or Table 10.	These table take the most onerous ranges and duration from RfG and harmonise across all synchronous areas The durations are either the same or less onerous than that for the converters	CC6.1.4	Article 11.2 (a)

Voltage Range	Time period for operation
0.85 pu – 0.90 pu	60 minutes
0.90 pu – 1.12 pu	Unlimited
1.12 pu – 1.15 pu	To be decided by the Relevant TSO while respecting the provisions of **Error! Reference source not found.**(3), but not less than 20 minutes

Table 9: Minimum time periods for which a PPM shall be capable of operating for different Voltages deviating from a nominal value without disconnecting from the Network (for nominal Voltage below 300 kV).

Voltage Range	Time period for operation
0.85 pu – 0.90 pu	60 minutes
0.90 pu – 1.10 pu	Unlimited
1.10 pu – 1.15 pu	To be decided by the Relevant TSO, while respecting the provisions of **Error! Reference source not found.**(3)

Table 10: Minimum time periods for which a PPM 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).

		CC6.1.4	Article 11.2 (a)

b) While respecting the provisions of Article 4(3), wider Voltage 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 Voltage ranges or longer minimum times for operation are economically and technically feasible, the consent of the DC-connected Power Park Module Owner shall not be unreasonably withheld.

c) The Relevant TSO shall have the right to specify Voltages at the Connection 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 TSO and the DC-connected Power Park Module Owner, while respecting the provisions of Article 4(3).

d) For Connection Point(s) at AC Voltages that are not included in the scope of Table 9 and Table 10, the Relevant TSO(s) shall define applicable requirements at the Connection Point(s), while respecting the provisions of Article 4(3).

2. With respect to Reactive Power Capability for DC-Connected Power Park Modules, either point a) or b) below shall apply:

a) If the DC-Connected Power Park Module Owner can obtain an agreement with the owners of the HVDC Systems connecting the DC-Connected Power Park Module to a single point on a AC Network, it has to fulfil all of the following requirements:

40.2.(a) applies on for a single point connection to the onshore system.

i. it shall have the ability to meet the Reactive Power capabilities prescribed by the Relevant TSO according to Article 40(2)b) and it shall either:

- have the Reactive Power capabilities prescribed by the Relevant TSO already installed as part of the connection of the DC-Connected Power Park Module to the AC Network (during the ION stage referred to in CHAPTER 5) at the time of initial connection and commissioning; or

- demonstrate to, and then reach agreement with, the Relevant TSO on how the Reactive Power capability will be provided when the DC-Connected Power Park Module is connected to more than the single point in the AC Network, or has another DC-Connected Power Park Module with a different owner. This agreement will include a contract by the DC-Connected Power Park Module Owner (of 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 TSO. The DC-Connected Power Park Module Owner shall have the right to install a DC-Connected Power Park Module which does not feature the Reactive Power capability under the following conditions. The Relevant TSO shall first perform a CBA based on information supplied by DC-Connected Power Park Module Owner, and decide on the case. The CBA shall aim at verifying that the Reactive Power capability required under this Article is not required for the Network at the time of

Generator can either fit and be tested for reactive capability as defined in (b) or do not fit now but demostrate and agree with TSO how it can be provided in future if required later

ii. The Relevant TSO must account for the development time 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 will be provided by the DC-Connected Power Park Module Owner at the time connection to the AC Network.

b) All other DC-Connected Power Park Modules shall fulfil the following requirements referring to Voltage stability:

Generator without agreement has to meet Table 11

i. 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 TSO while respecting the provisions of Article 4(3) to compensate for the Reactive Power demand of the high-voltage line or cable between these two points from the responsible owner of this line or cable.

ii. With regard to Reactive Power capability at Maximum Capacity:

- The Relevant TSO shall define while respecting the provisions of Article 4(3) the Reactive Power provision capability requirements in the context of varying Voltage. For doing so, it shall define a U-Q/Pmax-profile that shall take any shape within the boundaries of which the Power Park Module shall be capable of providing Reactive Power at its Maximum Capacity.
- The U-Q/Pmax-profile is defined by each Relevant TSO while respecting the provisions of Article 4(3). The U-Q/Pmax-profile shall be within the range of Q/Pmax and steady state Voltage range in Table 11. The Relevant TSO shall consider the long term development of the Network when determining these ranges.

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference

Range of width of Q/Pmax profile	Range of steady-state Voltage level in pu
0.33 - 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

In case the Relevant TSO motivates in the relevant long-term development plan of the Network that the DC-connected PPM becomes AC connected to the Synchronous Area, either:

If there is going to be an additional HVAC connection later, Generator's requirement to be consistent with RfG, and can be provided now or agree with TSO on when and how for future provision

i) the PPM shall have the capabilities of Article 20(3) 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 (during the ION stage referred to in CHAPTER 5); or
ii) the PPM Owner shall demonstrate to, and then reach agreement with, the Relevant TSO on how the Reactive Power capability of Article 20(3) 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 .

3. All Remote-end HVDC Converter Stations shall fulfil the following requirements referring to Voltage stability, at the Connection Point(s) with regard to Reactive Power capability:

a) The Relevant TSO shall define, while respecting the provisions of Article 4(3), the Reactive Power provision capability requirements for various Voltage levels. In doing so, the Relevant TSO(s) shall define a U-Q/Pmax-profile that shall take any shape within the boundaries of which the DC-Connected HVDC Converter Station shall be capable of providing Reactive Power at its Maximum Capacity.

b) The U-Q/Pmax-profile is defined by each Relevant TSO while respecting the provisions of Article 4(3). The U-Q/Pmax-profile shall be the range of Q/Pmax and steady state Voltage range in Table 12, and the position of the U-Q/Pmax-profile envelope shall lie within the limits of the fixed outer envelope in Figure 5 of Article 18. The Relevant TSO shall consider the long term development of the Network when determining these ranges.

Converters meet Table 12 requirements

Range of Q/Pmax	Range of steady-state Voltage level in PU
0.33 - 0.95	0.1 - 0.225

Table 12: Maximum and Minimum range of both Q/Pmax and steady-state Voltage range for a Remote-end HVDC Converter Station

When the Relevant TSO motivates in the relevant long-term development plan of the Network that the Remote-end HVDC Converter Station becomes AC connected to the Synchronous Area, the HVDC Converter Station must have the ability to provide the Reactive Power according to Article 20(3) of the [NC RfG] and either:

If there is going to be an additional HVAC connection later, Generator's requirement to be consistent with RfG, and can be provided now or agree with TSO on when and how for future provision

have the capabilities of Article 20(3) of the [NC RfG] for that Synchronous Area already installed as part of the connection of the DC-Connected Power Park Module to the AC Network (during the ION stage referred to in CHAPTER 5) at the time of initial connection and commissioning; or
demonstrate to, and then reach agreement with the Relevant TSO on how the Reactive Power capability will be provided in the event that the DC-connected PPM becomes AC connected to the Synchronous Area.

4. Voltage stability for DC-Connected Power Park Modules shall be determined in accordance with Article 15(2) of the [NC RfG].
5. Reactive Power control modes for DC-Connected Power Park Modules shall be determined in accordance with Article 16(3)d) of the [NC RfG].
6. Priority of Active Power or Reactive Power contribution for DC-Connected Power Park Modules shall be determined in accordance with Article 16(3)e) of the [NC RfG].
7. Fault Ride Through for DC-Connected Power Park Modules shall be determined in accordance with Article 11(3) of the [NC RfG].

Article 41 **Control Requirements**

1. During the energisation or synchronisation of a Remote-end HVDC Converter Station or a Power Park Module to the AC collection Network at the Connection Point(s), the Remote-end HVDC Converter Station or Power Park Module shall smooth any Voltage transients to a steady-state level not exceeding 2 per cent of the pre-synchronisation AC Voltage.

Remote end limits are more onerous than onshore converter limits

2. During the synchronisation of an energised Remote-end HVDC Converter Station to an HVDC System, the Remote-end HVDC Converter Station shall smooth any Voltage transients, at any Connection Point of the HVDC System, to a steady-state level not exceeding 2 per cent of the pre-synchronisation AC Voltage
3. With regard to Active Power controllability and control range, the PPM control system shall be capable of adjusting an Active Power Setpoint as instructed by 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 National Regulatory Authority. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework. Automatic remote control equipment shall be duplicated to permit continued automatic remote control when any of the devices is out of service.
4. The HVDC System and DC-connected Power Park Module[s] shall have coordinated control. For this purpose, the DC-connected PPM Owner shall provide output signals as specified by the Relevant TSO, while respecting the provisions of Article 4(3).
5. Power oscillation damping capability of Power Park Modules shall be determined in accordance with Article 16(3)f) of the [NC RfG].

6. Sub-synchronous torsional interaction damping capability of Power Park Modules shall be determined by the Relevant TSO, while respecting the provisions of Article 4(3).

7. DC-connected Power Park Module shall be capable of staying connected to the Network and operating without power reduction, as long as Voltage and Frequency remain within the admissible limits pursuant to this Network Code.

8. Reconnection capability of Power Park Modules shall be determined in accordance with Article 9(4) of the [NC RfG].

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
Article 42 **Network characteristics**			
1. With regard to the Network characteristics, the following shall apply for the DC-connected Power Park Modules during normal and disturbed conditions: (a) Each Relevant TSO shall define and make publicly available, while respecting the provisions of Article 4(3), 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 operating within the range of short circuit power and Network characteristics defined by the Relevant TSO. (c) Each Relevant TSO shall provide the DC-connected Power Park Module Owner with equivalents representing the system, enabling the DC-connected Power Park Module Owners to design the system with regard to harmonics.			
Article 43 **Protection requirements**			
1. Electrical protection schemes and settings of Power Park Modules shall be determined in accordance with Article 9(5)b of the [NC RfG]. 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 TSO(s). 2. Priority ranking of protection and control of Power Park Modules shall be determined in accordance with Article 9(5)c of the [NC RfG] and agreed with the Relevant TSO(s).			
Article 44 **Power Quality**			
1. DC-connected Power Park Modules Owners and 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 TSO, while respecting the provisions of Article 4(3). The necessary contribution to such studies from the owners of Grid Users, including but not limited to Existing DC-connected Power Park Modules and Existing HVDC Systems shall not be unreasonably withheld.			
Article 45 **General System Management Requirements applicable to DC connected PPMs**			
1. 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 4 **INFORMATION EXCHANGE AND COORDINATION**			
SECTION 1 **MONITORING**			
Article 46 **Operation**			
1. With regard to instrumentations for the operation, each HVDC Converter Unit of the HVDC System shall be equipped with an automatic controller capable of receiving instructions from the Relevant TSO(s). This automatic controller shall be capable of operating the HVDC System in a coordinated way among the HVDC Converter Units. The Relevant TSO(s) shall define the automatic controller hierarchy per each HVDC Converter Unit. a) The signal types exchanged from the HVDC System and the automatic controller are: - operational signals; - urgent alarm signals; - severe alarm signals. i. With regard to operational signals, those are classified, but not limited to, by the following per each converter units, if applicable: - AC and DC Voltage; - AC and DC Current; - Active and Reactive AC power; - Active DC power; - Multi pole operational type at converter units level with regard to HVDC System; - FSM, LFSM-O and LFSM-U active power range; ii. With regard to urgent alarm signals, those are classified, but not limited to, by the following per each converter units, if applicable: - Startup; - Emergency blocking; - Ramp blocking; - Active power reversal; iii. With regard to severe alarm signals, those are classified, but not limited to, by the following per each converter units, if applicable: - Active power fast reversal; - HVDC System auxiliary service; b) The signal types exchanged from the Relevant TSO(s) to the automatic controller are: - operational signals; - urgent alarm signals; - severe alarm signals. i. With regard to operational signals, those are classified, but not limited to, by the following per each converter units, if applicable: - Active Power Set-points; - Frequency Sensitive modes; - Reactive Power, Voltage or similar set-points; - Reactive power control modes; - Power oscillation damping; - Synthetic inertia; ii. With regard to urgent alarm signals, those are classified, but not limited to, by the following per each converter units, if applicable: - Start-up command; - Emergency blocking command; - Ramp blocking command; - Active power flow direction; iii. With regard to severe alarm signals, those are classified, but not limited to, by the following per each converter units, if applicable: - Active power fast reversal command; c) With regards to each category of signal, the Relevant TSOs shall have the right to define, while respecting the provisions of Article 4(3), the quality of the supplied signal.			
Article 47 **Parameter setting**			
While respecting the provisions of Article 4(3), the parameters and settings of the main control functions of the HVDC System shall be agreed between the HVDC System Owner and the Relevant TSO(s).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: - Synthetic inertia, if applicable, defined within Article 10 and Article 39; - Frequency Sensitive Modes (FSM, LFSM-O, LFSM-U) defined in Articles 11, 12, 13 and 39; - Frequency Control, if applicable, defined within Article 14; - Reactive power control mode, if applicable, defined in Article 20; - Power oscillation damping capability, as defined in Article 28 and 41; - Sub-synchronous torsional interaction damping capability, defined in Article 29 and 41.			

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
Article 48 **Fault recording and Monitoring** 1. With regard to instrumentation: a) A HVDC System shall be equipped with a facility to provide fault recording and dynamic system behaviour monitoring of the following parameters for each converter station within a HVDC System: - AC and DC Voltage; - AC and DC Current; - Active Power; - Reactive Power; and - Frequency. The Relevant TSO shall have the right to define while respecting the provisions of Article 4(3) quality of supply parameters to be complied with provided a reasonable prior notice is given. While respecting the provisions of Article 4(3), the particulars of the fault recording equipment, including analogue and digital channels, the settings, including triggering criteria and the sampling rates shall be agreed between the HVDC System Owner and the Relevant TSO. All dynamic system behaviour monitoring shall include an oscillation trigger, specified by the Relevant TSO, for detecting poorly damped power oscillations. access the information electronically. While respecting the provisions of Article 4(3), the communications protocols for recorded data shall be agreed between the HVDC System Owner and the Relevant TSO.			
Article 49 **Simulation models** 1. While respecting the provisions of Article 4(3), the HVDC System Owner shall deliver simulation models to the Relevant TSO which properly reflect the behaviour of the HVDC System in both steady-state, dynamic simulations (50 Hz 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 TSO. 2. For the purpose of dynamic simulations, the models provided shall contain the following sub-models, depending on the existence of the mentioned components: - Converter models - DC System as physical representation - Voltage and power control - Special control features if applicable e.g. Power System Stabilizer (PSS) function, SSTR control - Multi terminal control, if applicable - HVDC System protection models as agreed between the Relevant TSO and the Power Generating Facility Owner, while respecting the provisions of Article 4(3) 3. The models shall be verified against the results of compliance tests carried out according to CHAPTER 6. They shall then be used for the purpose of verifying the requirements of this Network Code including but not limited to Compliance Simulations as of SECTION 7, and for use in studies for continuous evaluation in system planning and operation. 4. The Relevant TSO shall have the right to require, while respecting the provisions of Article 4(3), HVDC System recordings in order to compare the response of the models with these recordings. 5. The Relevant TSO(s) shall have the right, while respecting the provisions of Article 4(3), to require the HVDC System Owner to 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.			
CHAPTER 5 **OPERATIONAL NOTIFICATION PROCEDURE FOR CONNECTION** **SECTION 1 OPERATIONAL NOTIFICATION PROCEDURE FOR CONNECTION OF NEW HVDC SYSTEMS**			
Article 50 **General provisions** 1. The provisions of CHAPTER 5 shall apply to New HVDC Systems only. 2. The HVDC System Owner shall demonstrate to the Relevant TSO its compliance with the requirements referred to in CHAPTER 2 and CHAPTER 4 of this Network Code at the respective Connection Point by completing successfully the operational notification procedure for connection of the HVDC System as defined in Article 51 through to Article 54. 3. Further details of the operational notification procedure shall be defined and made publicly available by the Relevant TSO(s) while respecting the provisions of Article 4(3).			
Article 51 **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 Point(s). 2. An Energisation Operational Notification (EON) shall be issued by the Relevant TSO, subject to completion of preparation and the fulfilment of the requirements of the Relevant TSO in the relevant operational procedures. This preparation will include agreement on the protection control relevant to the Connection Point(s) between the Relevant TSO and the HVDC System Owner or HVDC Converter Units Owner.			
Article 52 **Interim Operational Notification (ION) for HVDC Systems** 1. Interim Operational Notification shall entitle the HVDC System Owner or HVDC Converter Unit Owner to operate the HVDC System or HVDC Converter Module by using the Network connection(s) that is defined by the Connection Point(s) for a limited period of time. 2. An Interim Operational Notification shall be issued by the Relevant TSO subject to the completion of data and study review process, if applicable. 3. For the purpose of the completion of data and study review, the Relevant TSO shall have the right to request the following from the HVDC System or HVDC Converter Unit: - interim Statement of Compliance; - detailed technical data of the HVDC System with relevance to the Network connection, that is defined by the Connection Point(s), as specified by the Relevant TSO; - Equipment Certificates of HVDC Systems or HVDC Converter Units where these are relied upon as part of the evidence of compliance; - simulation models as specified by Article 49 and as required by the Relevant TSO while respecting the provisions of Article 4(3); - studies demonstrating expected steady□state and dynamic performance as required by CHAPTER 2, CHAPTER 3 and CHAPTER 4 of this Network Code; - details of intended compliance tests according to Article 65. - details of intended practical method of completing compliance tests according to Chapter 6. 4. The maximum period for the HVDC System Owner or HVDC Converter Unit Owner to remain in the Interim Operational Notification status shall not exceed twenty four months. The Relevant TSO shall be entitled to specify a shorter Interim Operational Notification validity period in accordance with Article 4(2). In that case, an Interim Operational Notification extension shall be granted only if the HVDC System Owner or HVDC Converter Unit Owner demonstrates substantial progress towards full compliance of the Demand Unit. At the time of Interim Operational Notification extension, the outstanding issues should be explicitly identified. 5. A prolongation of the twenty four month period for the HVDC System Owner or HVDC Converter Unit Owner for the HVDC System or HVDC Converter Unit respectively to remain in the Interim Operational Notification status may be granted upon request for Derogation made to the Relevant TSO. The request shall be made before the expiry of the twenty four month period and in accordance with the Derogation procedure defined in the Code.			

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
Article 53 **Final Operational Notification (FON) for HVDC Systems**			
1. A Final Operational Notification (FON) shall entitle the HVDC System Owner to operate the HVDC System or HVDC Converter Unit(s) by using the grid connection that is defined by the Connection Point(s). 2. A Final Operational Notification (FON) shall be issued by the Relevant TSO, upon prior removal of all incompatibilities identified for the purpose of the Interim Operational Notification (ION) status and subject to the completion of data and study review process as required by this Network Code. 3. For the purpose of the completion of data and study review, the Relevant TSO shall have the right to request the following from the HVDC System Owner: - Statement of Compliance; and - Update of applicable technical data, simulation models and studies as referred to in Article 52, including use of actual measured values during testing. 4. In case of incompatibility identified for the purpose of the granting of the Final Operational Notification (FON), derogation may be granted upon request made to the Relevant TSO, in accordance with the derogation procedure according to CHAPTER 7. A Final Operational Notification (FON) shall be issued by the Relevant TSO, if the HVDC System is compliant with the provisions of the derogation. The Relevant TSO shall have the right to refuse the operation of the HVDC System or HVDC Converter Unit(s), whose owner's request for derogation was rejected, until the HVDC System Owner and the Relevant TSO have established a resolution of the incompatibility and the HVDC System is considered to be compliant by the Relevant TSO.			
Article 54 **Limited Operational Notification (LON) for HVDC Systems**			
1. HVDC System Owners to whom a Final Operational Notification (FON) has been granted shall inform the Relevant TSO immediately in the following circumstances: - it 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 - in case of equipment failures leading to non-compliance with some relevant requirements. 2. The HVDC System Owner shall apply to the Relevant TSO for a Limited Operational Notification (LON), if the HVDC System Owner reasonably expects the circumstances according to Article 54(1) to persist for more than three months. 3. A Limited Operational Notification (LON) shall be issued by the Relevant TSO with a clear identification of: - the unresolved issues justifying the granting of the Limited Operational Notification (LON); - 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 TSO has been made, which demonstrates that substantial progress has been made in terms of achieving full compliance. 4. The Final Operational Notification (FON) shall be suspended during the period of validity of the Limited Operational Notification (LON) with regard to the subjects for which the Limited Operational Notification (LON) has been issued. 5. A further prolongation of the period of validity of the Limited Operational Notification (LON) may be granted upon request for derogation made to the Relevant TSO, before the expiry of that period, in accordance with the derogation procedure according to Title xxx. 6. The Relevant TSO shall have the right to refuse the operation of the HVDC System Owner, if the Limited Operational Notification (LON) terminates without removal of the circumstances which caused its issuing. In such a case the Final Operational Notification (FON) shall automatically be invalid.			
SECTION 2 OPERATIONAL NOTIFICATION PROCEDURE FOR CONNECTION OF NEW DC-CONNECTED POWER PARK MODULES			
Article 55 **General provisions**			
1. The provisions of CHAPTER 5 shall apply to New DC-connected Power Park Modules only. 2. The DC-Connected Power Park Module Owner shall demonstrate to the Relevant TSO its compliance with the requirements referred to in CHAPTER 3 and CHAPTER 4 of this Network Code at the respective Connection Point by completing successfully the operational notification procedure for connection of the HVDC System as defined in Article 56 through Article 59. 3. Further details of the operational notification procedure shall be defined and made publicly available by the Relevant TSO(s) while respecting the provisions of Article 4(3).			
Article 56 **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 Point. 2. An Energisation Operational Notification (EON) shall be issued by the Relevant TSO, subject to completion of preparation including agreement on the protection and control settings relevant to the Connection Point between the Relevant TSO and the DC-connected Power Park Module.			
Article 57 **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 Interim Operational Notification (ION) shall be issued by the Relevant TSO, subject to the completion of data and study review process as required by this Network Code, if applicable. 3. With respect to data and study review the Relevant TSO shall have the right to request the following from the Power Generating Facility Owner: - itemized Statement of Compliance; - detailed technical data of the Power Park Module with relevance to the grid connection as specified by the Relevant TSO; - Equipment Certificates of Power Park Module, where these are relied upon as part of the evidence of compliance; - simulation models as specified by Article 45 and as required by the Relevant TSO while respecting the provisions of Article 4(3); - studies demonstrating expected steady□state and dynamic performance as required by CHAPTER 3 and CHAPTER 4 of this Network Code; and - details of intended compliance tests according to Article 66. 4. The maximum period for the DC-Connected Power Park Module Owner to remain in the Interim Operational Notification (ION) status shall not exceed twenty□four months. The Relevant TSO is entitled to specify a shorter ION validity period while respecting the provisions of Article 4(3). The ION validity period shall be subject to notification to the National Regulatory Authority. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework. ION extensions shall be granted only if the DC-Connected Power Park Module Owner has made substantial progress towards full compliance. At the time of ION extension, the outstanding issues should be explicitly identified. 5. A prolongation of the maximum period for the DC-Connected Power Park Module Owner to remain in the Interim Operational Notification (ION) status (beyond a total of twenty□four months) may be granted upon request for derogation made to the Relevant TSO before the expiry of that period in accordance with the derogation procedure defined in the Code.			

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
Article 58 **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 Final Operational Notification (FON) shall be issued by the Relevant TSO, upon prior removal of all incompatibilities identified for the purpose of the Interim Operational Notification (ION) status and subject to the completion of data and study review process as required by this Network Code. 3. For the purpose of the completion of data and study review, the Relevant TSO shall have the right to request the following from the DC-connected Power Park Module: - Statement of Compliance; and - Update of applicable technical data, simulation models and studies as referred to in Article 57(3), including use of actual measured values during testing. 4. In case of incompatibility identified for the purpose of the granting of the Final Operational Notification (FON), derogation may be granted upon request made to the Relevant TSO, in accordance with the derogation procedure according to CHAPTER 7. A Final Operational Notification (FON) shall be issued by the Relevant TSO, if the DC-connected Power Park Module is compliant with the provisions of the derogation. The Relevant TSO 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 TSO have established a resolution of the incompatibility and the DC-connected Power Park Module is considered to be compliant by the Relevant TSO.			
Article 59 **Limited Operational Notification (LON) for DC-connected Power Park Modules** 1. DC-connected Power Park Module Owners to whom a Final Operational Notification (FON) has been granted shall inform the Relevant TSO immediately in the following circumstances: - it 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 - 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 according to Article 59(1) to persist for more than three months. 3. A Limited Operational Notification (LON) shall be issued by the Relevant TSO with a clear identification of: - the unresolved issues justifying the granting of the Limited Operational Notification (LON); - 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 TSO has been made, which demonstrates that substantial progress has been made in terms of achieving full compliance. 4. The Final Operational Notification (FON) shall be suspended during the period of validity of the Limited Operational Notification (LON) with regard to the subjects for which the Limited Operational Notification (LON) has been issued. 5. A further prolongation of the period of validity of the Limited Operational Notification (LON) may be granted upon request for derogation made to the Relevant TSO, before the expiry of that period, in accordance with the derogation procedure according to CHAPTER 7. 6. The Relevant TSO shall have the right to refuse the operation of the DC-connected Power Park Module, if the Limited Operational Notification (LON) terminates without removal of the circumstances which caused its issuing. In such a case the Final Operational Notification (FON) shall automatically be invalid.			
SECTION 3 OPERATIONAL NOTIFICATION PROCEDURE FOR EXISTING HVDC SYSTEMS			

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
Article 60			
General provisions			
1. In order to assess the advantages of the applicability of any requirement set forth in this Network Code to Existing HVDC Systems, the Relevant TSO shall initiate a preparatory process aimed at identifying cases of merit with the phases defined in Article 60(2) to (8) below. This preparatory process shall consist of a qualitative comparison of costs and benefits related to the requirement under consideration for application to HVDC Systems taking into account Network-based or market-based alternatives, where applicable. If the Relevant TSO deems the cost of applying the requirement to be low and the benefit to be high then the case can proceed as defined below. If however, the cost is deemed high and or the benefit is deemed low then the Relevant TSO may not proceed further. 2. The TSO shall carry out a quantitative Cost-Benefit Analysis of a requirement under consideration for application to HVDC Systems that has demonstrated potential benefits as a result of the preparatory process according to Article 60(1) above. This Cost-Benefit Analysis shall be followed by a public consultation. The public consultation shall include, amongst others, a proposal for a transition period for applying a requirement to HVDC Systems. Such a transition period should not exceed two years from the decision of the National Regulatory Authority on the applicability. 3. Existing HVDC System Owners shall assist and contribute to this Cost-Benefit Analysis and provide the relevant data as requested by the Relevant TSO within three months after reception of the request, unless agreed otherwise. 4. The Cost-Benefit Analysis shall be undertaken using one or more of the following calculating principles: - net present value; - return on investment; - rate of return; and - time to break-even. The quantified benefits shall include any marginal socio-economic benefits in terms of improvement of security of supply including, but not limited to: - associated reduction in probability of loss of supply over the lifetime of the modification; - the probable extent and duration of such loss of supply; - the societal cost per hour of such loss of supply; as well as benefits to the internal market in electricity, cross-border trade and integration of renewable energies including, but not limited to: - Frequency response; - reserve holding; - Reactive Power provision; - congestion management; and - defence measures. The quantified costs shall include as appropriate, but are not limited to: - costs for implementing the requirement; - any attributable loss of opportunity; and/or - change in maintenance and operating costs. 5. If the socio-economic benefits outweigh the costs of applying the requirement under consideration to Existing HVDC Systems, the Relevant TSO shall summarise the analysis within three months in a report which shall include a recommendation on how to proceed. This report shall be subject to public consultation. If, taking due account of the outcome of the public consultation, the Relevant TSO decides to proceed with the issue, the report including such consultation outcome and a proposal on the applicability of the requirement under consideration to Existing HVDC Systems, shall be forwarded to the Relevant National Regulatory Authority within six months for decision. 6. The proposal by the Relevant TSO to the National Regulatory Authority according to Article 60(5) on applicability of any requirement of this Network Code to Existing HVDC Systems shall include the following: an operational notification procedure in order to demonstrate the implementation of the requirements by the Existing HVDC System Owner; an appropriate transition period for implementing the requirements. The determination of the transition period shall take into account the category of HVDC System according to Article 3(1) (a) to (d) and any underlying obstacles for efficient undertaking of the equipment modification/refitting. The Relevant National Regulatory Authority shall decide on the case within three months after receipt of the report and the recommendation of the Relevant TSO. The decision of the Relevant TSO on how to proceed with the issue and the decision of the National Regulatory Authority, if any, shall be published. 7. All relevant clauses in contracts and/or relevant clauses in general terms and conditions relating to the grid connection of Existing HVDC System Owners shall be amended to achieve compliance with the requirements of this Network Code, that shall apply to them according to Article 60(6). The relevant clauses shall be amended within three years after the decision of the National Regulatory Authority on the applicability according to Article 60(6). This requirement for amendment shall apply regardless of whether the relevant contracts or general terms and conditions provide for such an amendment. **SECTION 4 OPERATIONAL NOTIFICATION PROCEDURE FOR EXISTING DC-CONNECTED POWER PARK MODULES**			

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
Article 61 **General provisions**			
1. In order to assess the advantages of the applicability of any requirement set forth in this Network Code to Existing DC-Connected Power Park Modules, the Relevant TSO shall initiate a preparatory process aimed at identifying cases of merit with the phases defined in Article 61(2) to (8) below. This preparatory process shall consist of a qualitative comparison of costs and benefits related to the requirement under consideration for application to DC-Connected Power Park Modules taking into account network-based or market-based alternatives, where applicable. If the Relevant TSO deems the cost of applying the requirement to be low and the benefit to be high then the case can proceed as defined below. If however, the cost is deemed high and or the benefit is deemed low then the Relevant TSO may not proceed further. 2. The TSO shall carry out a quantitative Cost-Benefit Analysis of a requirement under consideration for application to DC-Connected Power Park Modules that has demonstrated potential benefits as a result of the preparatory stage according to Article 61(1) above. This Cost-Benefit Analysis shall be followed by a public consultation. The public consultation shall include, amongst others, a proposal for a transition period for applying a requirement to DC-Connected Power Park Modules. Such a transition period should not exceed two years from the decision of the National Regulatory Authority on the applicability. 3. Existing DC-connected Power Park Module Owners shall assist and contribute to this Cost-Benefit Analysis and provide the relevant data as requested by the Relevant TSO within three months after reception of the request, unless agreed otherwise. 4. The Cost-Benefit Analysis shall be undertaken using one or more of the following calculating principles: - net present value; - return on investment; - rate of return; and - time to break-even. The quantified benefits shall include any marginal socio-economic benefits in terms of improvement of security of supply including, but not limited to: - associated reduction in probability of loss of supply over the lifetime of the modification; - the probable extent and duration of such loss of supply; - the societal cost per hour of such loss of supply; as well as benefits to the internal market in electricity, cross-border trade and integration of renewable energies including, but not limited to: - Frequency response; - reserve holding; - Reactive Power provision; - congestion management; and - defence measures. The quantified costs shall include as appropriate, but are not limited to: - costs for implementing the requirement; - any attributable loss of opportunity; and/or - change in maintenance and operating costs. 5. If the socio-economic benefits outweigh the costs of applying the requirement under consideration to Existing DC-Connected Power Park Modules, the Relevant TSO shall summarise the analysis within three months in a report which shall include a recommendation on how to proceed. This report shall be subject to public consultation. If, taking due account of the outcome of the public consultation, the Relevant TSO decides to proceed with the issue, the report including such consultation outcome and a proposal on the applicability of the requirement under consideration to Existing DC-Connected Power Park Modules, shall be forwarded to the Relevant National Regulatory Authority within six months for decision. 6. The proposal by the Relevant TSO to the National Regulatory Authority on applicability of any requirement of this Network Code according to Article 61(5) to Existing DC-Connected Power Park Modules shall include the following: an operational notification procedure in order to demonstrate the implementation of the requirements by the Existing DC-Connected Power Park Modules Owner; an appropriate transition period for implementing the requirements. The determination of the transition period shall take into account any underlying obstacles for efficient undertaking of the equipment modification/refitting. The Relevant National Regulatory Authority shall decide on the case within three months after receipt of the report and the recommendation of the Relevant TSO. The decision of the Relevant TSO on how to proceed with the issue and the decision of the National Regulatory Authority, if any, shall be published. 7. All relevant clauses in contracts and/or relevant clauses in general terms and conditions relating to the grid connection of Existing DC-Connected Power Park Modules Owners shall be amended to achieve compliance with the requirements of this Network Code, that shall apply to them according to Article 61(6). The relevant clauses shall be amended within three years after the decision of the National Regulatory Authority on the applicability according to Article 61(6). This requirement for amendment shall apply regardless of whether the relevant contracts or general terms and conditions provide for such an amendment.			
Article 62 **Modernization, development and replacement**			
1. All Existing HVDC Systems, HVDC Converter Stations and DC-Connected Power Park Modules shall fulfil the following requirements related to equipment development, modernisation and replacement: b) An HVDC System Owner or DC-connected Power Park Module Owner intending to develop, modernise or replace a part or equipment of the Existing HVDC System, Existing HVDC Converter Station, Existing HVDC Converter Unit or Existing DC-Connected Power Park Module in a way that may have an impact on its performance and ability to meet the requirements of this Network Code shall notify the Relevant TSO. The notification shall take place in advance and in accordance with national timescales defined, while respecting the provisions of Article 4(3). c) With regard to changes to, modernization of or replacement of equipment of HVDC Systems, HVDC Converter Stations and DC-connected Power Park Modules, any HVDC System Owner or DC-connected Power Park Module Owner intending to change plant and equipment of the HVDC System, HVDC Converter Station or DC-connected Power Park Module that may have an impact on the grid connection and on the interaction, shall notify in advance (in accordance with agreed or decided national timescales) the Relevant TSO in case it is reasonable to foresee that these intended changes may be affected by the requirements of this Network Code and shall, while respecting the provisions of Article 4(3), agree on these requirements before the proposals are implemented with the Relevant TSO. In case of modernisation or replacement of equipment in existing HVDC Systems, HVDC Converter Stations and DC-connected Power Park Modules, the new equipment shall comply with the respective requirements which are relevant to the planned work. d) While respecting the provisions of Article 4(3), the use of existing spare components that do not comply with the requirements has to be agreed with the Relevant TSO in each case.			

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
CHAPTER 6 **COMPLIANCE** **SECTION 5 COMPLIANCE MONITORING**			
Article 63 **Responsibility of the HVDC System Owner**			
1. The HVDC System Owner or DC-connected Power Park Module Owner shall ensure that the HVDC System, HVDC Converter Station or DC-connected Power Park Module is compliant with the requirements under this Network Code. This compliance shall be maintained throughout the lifetime of the facility. 2. 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 Network Code shall be notified to the Relevant TSO by the HVDC System Owner or DC-connected Power Park Module Owner before initiating such modification. 3. Any operational incidents or failures of a HVDC System, HVDC Converter Station or DC-connected Power Park Module that have impact on its compliance to the requirements of this Network Code 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. 4. Any foreseen test schedules and procedures to verify compliance of a HVDC System, HVDC Converter Station or DC-connected Power Park Module with the requirements of this Network Code 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. 5. 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 64 **Tasks of the Relevant TSO**			
1. The Relevant TSO shall regularly assess the compliance of an HVDC System, HVDC Converter Station or DC-connected Power Park Module with the requirements under this Network Code 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. The Relevant TSO shall have the right to request that the HVDC System Owner or DC-connected Power Park Module Owner carries out compliance tests and simulations not only during the operational notification procedures according to CHAPTER 5, 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 while respecting the provisions of Article 4(3) or after any failure, modification or replacement of any equipment that may have impact on the compliance of the with the requirements under this Network Code. 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 TSO 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, notably, cover the following information, documents and requirements: - all documentation and certificates to be provided by the HVDC System Owner or DC-connected Power Park Module Owner; - details of the technical data of the HVDC System, HVDC Converter Station or DC-connected Power Park Module with relevance to the grid connection; - requirements for models for steady-state and dynamic system studies; - timely provision of system data required to perform the studies; - 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 CHAPTER 2, CHAPTER 3 and CHAPTER 4 of this Network Code; and - conditions and procedures including the scope for registering Equipment Certificates. - conditions and procedures for use of relevant Equipment Certificates by the Power Generating Facility Owner instead of part of the activity for compliance as described in this Network Code. 4. The Relevant TSO shall make publicly available the allocation of responsibilities to the HVDC System Owner or DC-connected Power Park Module Owner and to the Network Operator for compliance testing, simulation and monitoring. 5. The Relevant TSO may partially or totally assign the performance of its compliance monitoring to third parties. In this case, the Relevant TSO shall ensure compliance of Article 6 of this Network Code by appropriate confidentiality commitments with the assignee. 6. The Relevant TSO shall not withhold unreasonably any operational notification as per CHAPTER 5, if compliance tests or simulations cannot be performed as agreed between the Relevant TSO and the HVDC System Owner or DC-connected Power Park Module Owner due to reasons which are in the sole control of the Relevant TSO.			

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
SECTION 6 COMPLIANCE TESTING			
Article 65 **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 TSO.			
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 18(1)(b) and (c).			
b) The test is 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 of: - Minimum Stable Operating Level; - Maximum 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.			
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 20(3)a) and (e). 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 is 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 20(3)a) and (e) ; iii. the insensitivity of Voltage Control is not higher than 0.01 pu, according to Article 20(3)(d); 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 20(3)(d).			
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 Article 20(4). 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 is deemed passed, provided that the following conditions are cumulatively fulfilled: i. the Reactive Power Setpoint range and step is ensured according to Article 20(4); and ii. the accuracy of the regulation is compliant with the conditions as referred to in Article 20(4).			
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 Article 20(5) 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 is deemed passed, provided that the following conditions are cumulatively fulfilled: i. the Power Factor Setpoint range and step is ensured according to Article 20(5); ii. the time of Reactive Power activation as result of step Active Power change does not exceed the requirement according to Article 20(5); and iii. the accuracy of the regulation is compliant with the value, as referred to in Article 20(5).			
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 Capacity and Minimum Regulating Level 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 the whole Active Power Frequency response range, taking into account the Droop settings, the deadband and the Real Power headroom or deload (margin to Maximum Capacity in operational timescale). Simulated Frequency deviation signals shall be injected simultaneously into the references of both the speed governor and the load controller of the unit or plant control system if required, taking into account the speed governor and load controller scheme. c) The test is 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 11(1) (c); ii. undamped oscillations do not occur after the step change response; iii. the initial delay time has been according to Article 11(1) (c); iv. the Droop settings are available within the range defined in Article 11(1) (c) and deadband (thresholds) is not more than the value in Article 11(1) (c); and v. insensitivity of Active Power Frequency response at any relevant operating point does not exceed the requirements set forth in Article 11(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 Maximum Capacity change in Active Power, taking into account the Droop settings and the deadband. Simulated Frequency deviation signals shall be injected simultaneously at both the speed and power control loops of the control systems if required, taking in account the scheme of these control system. c) The test is 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 12(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 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 (e.g. 80 %) with low Frequency steps and ramps big enough to activate at least 10 % of Maximum Capacity Active Power change, taking into account the Droop settings and the deadband. Simulated Frequency deviation signals shall be injected simultaneously into both the speed governor and the load controller references if required, taking into account the speed governor and the load controller scheme. c) The test is 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 13(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 9(1)a) and d). b) The test shall be carried out by sending manual and automatic instructions by the Relevant TSO(s). c) The test is 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 by Relevant TSO(s) and HVDC System owner iii. The dynamic response of the HVDC System when receiving instructions aiming at providing FCR or FRR is compliant with the requirements for these products detailed in LFC&R code.			
10. With regard to the ramping rate modification test:			

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
a) The HVDC System shall demonstrate its technical capability to adjust the ramping rate according to Article 9(2). b) The test shall be carried out by sending instructions by the Relevant TSO(s) c) The test is 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 reconnection test: a) The HVDC System shall demonstrate its technical capability to reconnect to the Network after an incidental disconnection due to a Network disturbance according to Article 32(2). b) The test shall be carried out while the HVDC System operates from a stable operating point of at least 10% of the maximum transmission capacity of the HVDC System. c) The test is deemed passed, provided that the following condition is fulfilled: The HVDC System has demonstrated being able to reconnect within the time frame defined by the Relevant TSO. 12. With regard to the black start test, if applicable: a) The HVDC System shall demonstrate its technical capability to energise the remote AC substation to which it is connected, within a time frame specified by the Relevant TSO, without external energy supply, according to Article 36(2). b) The test shall be carried out while the HVDC System starts from shut down. c) The test is deemed passed, provided that the following conditions are cumulatively fulfilled: i. The HVDC System has demonstrated being able to energise the remote HVDC Converter ii. The HVDC System operates from a stable operating point at agreed capacity, according to the procedure of Article 36(3). 13. With regard to the isolated network operation, if applicable: a) The HVDC System shall demonstrate its technical capability to take part in isolated network operation, according to Article 37(1). b) The test shall be carried out while the HVDC System operates at a stable operation point of at least 10% of the maximum transmission capacity of the HVDC System. c) The test is deemed passed, provided that the following condition is fulfilled: The HVDC System has demonstrated continuous operation while the AC grid at the remote Converter Station changes suddenly to an isolated network, according to Article 37(2).			
Article 66 **Compliance testing for DC-connected Power Park Modules**			
1. The Equipment Certificate may be used instead of part of the tests below, provided that they are provided to the Relevant TSO. 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 40(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: 1) operation in excess of 60 % of Maximum Capacity for 30 minutes; 2) operation within the range of 30 – 50 % of Maximum Capacity for 30 minutes; and 3) operation within the range of 10 – 20 % of Maximum Capacity for 60 minutes. c) The test is deemed passed, provided that the following criteria are cumulatively fulfilled: 1) 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 66(2)b; 2) 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 3) 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 DC Connected 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 40(3). b) The test is deemed passed, provided that the following conditions are cumulatively fulfilled: 1) 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 Stable Operating Level; - Maximum Capacity; and - an Active Power operating point between those maximum and minimum ranges; 2) 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 3) 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 16(3) (d) point 2) of the [NC RfG]. b) The Voltage Control Mode test shall apply concerning the verification of the following parameters: 1) the implemented Slope and deadband of the static characteristic; 2) the accuracy of the regulation; 3) the insensitivity of the regulation; and 4) the time of Reactive Power activation. c) The test is deemed passed, provided that the following conditions are cumulatively fulfilled: 1) the implemented Slope and deadband of the static characteristic; 2) the range of regulation and adjustable the Droop and deadband is compliant with agreed or decided characteristic parameters, according to Article 16(3) (d) of the [NC RfG]; 3) the insensitivity of Voltage Control is not higher than 0.01 pu, according to Article 16(3) (d) of the [NC RfG]; and 4) 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 16(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 16(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: 1) the Reactive Power Setpoint range and step; 2) the accuracy of the regulation; and 3) the time of Reactive Power activation. d) The test is deemed passed, provided that the following conditions are cumulatively fulfilled: 1) the Reactive Power Setpoint range and step is ensured according to Article 16(3) (d) of the [NC RfG]; and 2) the accuracy of the regulation is compliant with the conditions as referred to in Article 16(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 16(3) (d) point 4) of the [NC RfG]. b) The Power Factor Control Mode test shall apply concerning the verification of the following parameters: 1) the Power Factor Setpoint range; 2) the accuracy of the regulation; and 3) the response of Reactive Power due to step change of Active Power. a) The test is deemed passed, provided that the following conditions are cumulatively fulfilled: 1) the Power Factor Setpoint range and step is ensured according to Article 16(3) (d) of the [NC RfG]; 2) the time of Reactive Power activation as result of step Active Power change does not exceed the requirement according to Article 16(3) (d) of the [NC RfG]; and 3) the accuracy of the regulation is compliant with the value, as referred to in Article 16(3) (d) of the [NC RfG]. 7. With regard to the tests identified in this Section in paragraphs (3), (4) and (5) the Relevant TSO may select only one of the three control options for testing.			
SECTION 7 COMPLIANCE SIMULATIONS			
Article 67 **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 TSO. 2. With regard to the fast acting additional reactive Current injection simulation: a) The HVDC Converter Unit or the HVDC Converter Station shall demonstrate its capability to simulate fast acting additional reactive Current injection in the conditions set forth in Article 17. b) The simulation is deemed passed, provided that compliance with the requirement according to Article 17(2) is demonstrated. 3. With regard to the fault-ride-through capability simulation: a) The HVDC System shall demonstrate its capability to simulate fault-ride-through capability in the conditions set forth in Article 23. b) The simulation is deemed passed, provided that compliance with the requirement according to Article 23 is demonstrated.			

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
4. With regard to the Post Fault Power Active Recovery simulation: a) The HVDC System shall demonstrate its capability to simulate post fault Active Power recovery in the conditions set forth in Article 24. b) The simulation is deemed passed, provided that compliance with the requirement according to Article 24 is demonstrated. 5. With regard to the Reactive Power capability simulation: a) The HVDC Converter Unit or the HVDC Converter Station shall demonstrate its capability to simulate leading and lagging Reactive Power capability in the conditions referred to in Article 18(1)(b) and (c). b) The simulation is 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 65; and ii. compliance with the requirements as referred to in Article 18(3) (b) and (c) is demonstrated. 6. With regard to the Power Oscillations Damping Control simulation: a) The HVDC System shall demonstrate the performance of its control system (PSS function) to damp power oscillations in the conditions set forth in Article 28. b) The tuning shall result in improved damping of corresponding Active Power response of the HVDC control in combination with the PSS function compared to the Active Power response of the HVDC control alone. c) The simulation is deemed passed, provided that the following conditions are cumulatively fulfilled: i. The PSS 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 sudden load reduction of the HVDC System from 1p.u. to 0.6p.u. of the Maximum Capacity has 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 shall demonstrate its technical capability to modify quickly Active Power according to Article 9(1)(b). b) The simulation is 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 time of adjustment of the Active Power is shorter than the value specified in Article 9(1)(b) or reasonably justified if greater 8. With regard to the fast active power reversal simulation: a) The HVDC System shall demonstrate its technical capability to modify quickly Active Power according to Article 9(1)(c). b) The simulation is 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 9. With regard to the fast acting additional reactive Current injection simulation: a) The HVDC System shall demonstrate its capability to simulate fast acting additional reactive Current injection in the conditions set forth in Article 17. b) The simulation is deemed passed, provided that compliance with the requirement according to Article 17 is demonstrated. 10. With regard to the fault-ride-through capability of HVDC System simulation: a) The HVDC System shall demonstrate its capability to simulate fault-ride-through capability in the conditions set forth in Article 23. b) The simulation is deemed passed, provided that compliance with the requirement according to Article 23 is demonstrated. 11. With regard to the Post Fault Power Active Recovery simulation: a) The HVDC System shall demonstrate its capability to simulate post fault Active Power recovery in the conditions set forth in Article 24. b) The simulation is deemed passed, provided that compliance with the requirement according to Article 24 is demonstrated.			

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
Article 68 **Compliance simulations for DC-connected Power Park Modules**			
1. DC-connected Power Park Modules are subject to the following compliance simulations. The Equipment Certificate may be used instead of part of the simulations below, provided that they are provided to the Relevant TSO. 2. With regard to the fast acting additional reactive Current injection simulation: a) The DC-Connected Power Park Module shall demonstrate its capability to simulate fast acting additional reactive Current injection in the conditions set forth in Article 15(2) (b) of the [NC RfG]. b) The simulation is deemed passed, provided that compliance with the requirement according to Article 15(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 shall demonstrate its capability to simulate post fault Active Power recovery in the conditions set forth in Article 15(3) (a) of the [NC RfG]. b) The simulation is deemed passed, provided that compliance with the requirement according to Article 15(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 shall demonstrate its capability to simulate leading and lagging Reactive Power capability in the conditions referred to in Article 16(3) (b) and (c) of the [NC RfG]. b) The simulation is deemed passed, provided that the following conditions are cumulatively fulfilled: 1) 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 42(6) of the [NC RfG]; and 2) compliance with the requirements as referred to in Article 16(3) (b) and (c) of the [NC RfG] is demonstrated. 5. With regard to the Reactive Power capability simulation of DC Connected HVDC Converter Units: a) The HVDC Converter Unit or the HVDC Converter Station shall demonstrate its capability to simulate leading and lagging Reactive Power capability in the conditions referred to in Article 40(3). b) The simulation is deemed passed, provided that the following conditions are cumulatively fulfilled: 1) 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 68(2)a); and 2) compliance with the requirements as referred to in Article 40(4) is demonstrated. 6. With regard to the power oscillations damping control simulation: a) The model of the DC-Connected Power Park Module shall demonstrate its capability to simulate power oscillations damping capability in the conditions as referred to in Article 16(3) (f) of the [NC RfG]. b) The simulation is deemed passed, provided that the model demonstrates compliance with the conditions of Article 16(3) (f) of the [NC RfG]. 7. The model of the DC-Connected Power Park Module shall demonstrate its capability to simulate fault-ride-through capability in the conditions as referred to in Article 11(3) (a) of the [NC RfG]. The simulation is deemed passed, provided that the model demonstrates compliance with the conditions of Article 11(3) (a) of the [NC RfG] respectively.			
CHAPTER 7 **DEROGATIONS**			
Article 69 **General Provisions** 1. The procedure for Derogation defined in this Chapter applies to all HVDC Systems, and DC-Connected Power Park Modules, both existing and new, to which the provisions of this Network Code are applicable pursuant to Article 70 to 73. 2. The request for Derogation in Article 69(1) can only be submitted by the HVDC System Owner for its HVDC System, HVDC Converter Station or HVDC Converter Unit, or by the DC-Connected Power Park Module Owner for its DC-Connected Power Park Module. 3. It shall also apply to Network Operators when requesting Derogations for classes of both existing and new HVDC Systems connected to their Network. 4. The Derogation process shall be transparent, non-discriminatory, non-biased, well documented and based in particular on the Cost Benefit Analysis performed in the conditions set forth by Article 50 by the Relevant TSO. A Cost Benefit Analysis may not be performed by the Relevant TSO if, on its reasoned request, an individual exception is granted to the Relevant TSO by the National Regulatory Authority. 5. Criteria for assessing the request for Derogation shall be set by the Relevant National Regulatory Authority taking into account the recommendation of the Relevant TSO. The criteria set by the Relevant National Regulatory Authority shall be non-discriminatory, objective and be published by the Relevant National Regulatory Authority.			
Article 70 **Request for Derogation** 1. HVDC System Owners to which the provisions of this Network Code apply may apply for Derogation. The request for Derogation may relate to one or several requirements of this Network Code. 2. The request for Derogation shall be submitted to the Relevant TSO. If the HVDC System is connecting Synchronous Areas or Control Areas, the request for Derogation shall be submitted to each of the Relevant TSOs of the affected Control Areas. 3. DC-connected Power Park Module Owners may apply for derogation in respect of one or more requirements of this Network Code by submitting a request to the Relevant TSO. 4. The request for Derogation, submitted by the HVDC System Owner or by the DC-connected Power Park Module Owner shall include all the information and documents which are required by the Relevant TSO, including, but not limited to: a) identification data of the applicant party, with reference contact person for any communications; b) the specific plant or site to which the request is referred to; c) the provision of the Network Code for which a Derogation is requested, with the detailed description of the requested Derogation; and d) detailed accompanying justification with all relevant documents supporting the derogation application.			

ENTSO-E Network Code Text as issued for Consultation	Commentary	GB Code Reference	NC RfG reference
Article 71 **Decision on Derogation** 1. Further to the request for derogation submitted by a HVDC System Owner or DC-connected Power Park Module Owner, the Relevant TSO shall assess the request and related documentation. If the request or the related documentation is considered to be incomplete the HVDC System Owner or DC-connected Power Park Module Owner shall submit the missing information as requested by the Relevant TSO. As from the day of the receipt of the complete request from the HVDC System Owner, or DC-connected Power Park Module Owner until the issuance of the decision granting or refusing the derogation by the National Regulatory Authority according to Article 71(5), the HVDC System, HVDC Converter Station, HVDC Converter Unit or DC-connected Power Park Module to which the request is referred to are deemed as compliant. 2. No later than six months after the receipt of the complete request according to Article 71(1) the TSO shall submit to the Relevant National Regulatory Authority its assessment of the request, including a reasoned opinion, together with a related documentation and, where applicable, a Cost-Benefit Analysis. 3. The above deadline shall be shortened to three months in case a reasoned request for exemption from Cost-Benefit Analysis is submitted by the Relevant TSO to the National Regulatory Authority. 4. If the Relevant TSO has requested an exemption from Cost-Benefit Analysis the National Regulatory Authority shall decide on granting or refusing the exemption within one month after the receipt of this request. If the request is rejected, the Relevant TSO shall provide a Cost-Benefit Analysis within three months following the decision of the National Regulatory Authority. 5. The National Regulatory Authority shall issue a motivated decision granting or refusing the derogation and specifying the duration of the derogation, including a reasoned opinion, within a further three months after receipt of the complete documentation. 6. The National Regulatory Authority shall communicate to the applicant, the Relevant TSO and the Agency the decision granting or rejecting the derogation. 7. The Agency shall monitor the procedures of derogation and the National Regulatory Authority shall cooperate with the Agency in this task and shall provide the Agency with all information necessary for this purpose. 8. The Agency may issue a reasoned recommendation to the National Regulatory Authority to revoke any derogation, which has been granted without due justification. 9. The National Regulatory Authority shall have the right to issue a motivated decision revoking the granted derogation under the conditions and pursuant to the provisions of national law reserving the vested interests of the concerned grid users, in the cases where the prerequisites for granting the derogation no longer exist for reasons attributable to the concerned grid users.			
Article 72 **Compliance of Existing HVDC Systems and Existing DC-connected Power Park Modules** 1. The owner of an Existing HVDC System, Existing HVDC Converter Station, Existing HVDC Converter Unit or Existing DC-connected Power Park Module System, deemed significant in accordance with the procedure set forth in Article 60 and Article 61, which is not compliant with at least one requirement of the Network Code, shall apply for a Derogation from these requirements in accordance with Article 64, within twelve months from the date the requirement, with which it is not compliant, becomes applicable. 2. If one month before the expiry of the twelve-month period set in Article 72(1), no application for Derogation has been received, the Relevant TSO shall, by formal notice, require the non-compliant Existing HVDC System, Existing HVDC Converter Station, Existing HVDC Converter Unit or Existing DC-connected Power Park Module System, to either conform with the requirement, or to apply for a Derogation. 3. If at the expiry of the twelve-month period, the Owner of the non-compliant Existing HVDC System, Existing HVDC Converter Station, Existing HVDC Converter Unit or Existing DC-connected Power Park Module System referred to in Article 72(1) has not applied for a Derogation, the Relevant TSO shall have the right to refuse operation of the Existing HVDC System, Existing HVDC Converter Station, Existing HVDC Converter Unit or Existing DC-connected Power Park Module System. The decision on refusal of operation shall be motivated.			
Article 73 **Register of derogations to the Network Code** 1. Each National Regulatory Authority shall maintain and publish a register of all Derogations granted or rejected and shall provide to the Agency an updated and consolidated register at least every 6 months, with a copy to ENTSO-E. 2. These registers shall contain in particular: a) the requirement(s) for which the derogation is granted or refused; b) content of the derogation; c) consequences of the granting of the derogation; d) reasons for granting or refusing the derogation; and e) whether the exemption from the performance of the cost-benefit analysis was granted.			
CHAPTER 8 **FINAL PROVISIONS**			
Article 74 **Amendment of contracts and general terms and conditions** All relevant clauses in contracts and/or relevant clauses in general terms and conditions relating to the Network connection of New HVDC Systems, New HVDC Converter Stations, New HVDC Converter Units or New DC-connected Power Park Module Systems shall be amended to achieve compliance with the requirements of this Network Code. The relevant clauses shall be amended within three years after the entry into force of this Network Code. This requirement for amendment shall apply regardless of whether the relevant contracts or general terms and conditions provide for such an amendment.			
Article 75 **Entry into force** This Network Code shall enter into force on the twentieth day following that of its publication in the Official Journal of the European Union. With the exception of Article 3(7) and (8), which shall apply thirty months after the entry into force, all provisions of this Network Code shall apply as from the day of expiration of a three year period following its publication. This Network Code shall be binding in its entirety and directly applicable in all Member States.			