PROPOSAL FOR NC HVDC REQUIREMENTS OF GENERAL APPLICATION

TSO proposal following Art. 5(4) of the NC HVDC

17 May 2018

TABLE OF CONTENTS

INTRODUCTION

Scope of this document

Article 5(4) of the NC HVDC [1] states that the relevant system operator or TSO submits a proposal for requirements of general application (or the methodology used to calculate or establish them), for approval by the competent entity, within two years of entry into force of the NC HVDC, i.e. 28 September 2018. A similar requirement is included in the two other connection Network Codes, namely in Art. 7(4) of the NC RfG [2] and in Art. 6(4) of the NC DCC [3].

The aim of this document is to synthetize the technical proposal of the TSO regarding the Belgian implementation of the non-exhaustive requirements stated in the NC HVDC. This document is the final version of the proposal for requirements of general application (hereafter named as 'general requirements'), in accordance with Art. 5(4) of the NC HVDC.

On 17 May 2018, Elia will submit the general requirements proposals for NC RfG, but also for NC DCC and NC HVDC to the competent authority (because this is the deadline for the submission of the general requirements NC RfG and the decision has been taken to submit the general requirements for the three codes together) together with the (track change) proposal of an amended Federal Grid Code [4] (and a formal proposal on maximum capacity thresholds of type B, C and D power-generating modules (PGM)). Elia organized beforehand a public consultation for all deliverables from 15 March up to and including 16/23 April 2018 (except for the public consultation on the maximum capacity thresholds B, C and D, that already took place from 19 May till 20 June 2017). This approach is in line with the vision of the Belgian Federal Administration (FOD/SPF Energy) [5].

This document should be considered as a technical and not legally binding document, focusing on the clarification of various technical general requirements that will be reflected in various grid codes, contracts, terms and conditions, regulatory documents and/or technical prescriptions.

The document follows the same logic as in the NC HVDC: the proposal is organized per technical topic and per category. As such the NC HVDC provides for requirements for HVDC connections and for DC-connected power park modules and remote-end HVDC converter stations.

The scope of this document contains especially, but is not limited to, the implementation proposal of the non-exhaustive requirements in the NC HVDC. To increase its readability, this document might also contain NC exhaustive requirements, implementation proposal of non-exhaustive requirements of the other connection NC, or other specific national/regional requirements for information purposes only, but certainly does not cover all of them. Furthermore, some non-exhaustive requirements foreseen in the HVDC NC are site-specific (and not general). A reference to those site-specific requirements is also included in this document. Some site-specific requirements require an agreement between the relevant system operator, the TSO and the owner of the unit in question. In such case, Article 5(5) of the NC HVDC shall apply, which foresees that the relevant parties shall then endeavor to seek an agreement within six months after a first proposal has been submitted by one party to the other parties. Site-specific requirements might, e.g., be taken up in a connection agreement.

For which regards the complete list of non-exhaustive requirements to be proposed as general requirements, Elia is taking as reference the ENTSO-e guidance document on 'Parameter of Non-exhaustive requirements' [6]. This document does not only mention the parameters to be defined per topic, but also sometimes which article of each connection NC should be considered as non-exhaustive and who should be seen as relevant system operator to define an implementation proposal. In theory, both the TSO and (C)DSOs can be considered as 'relevant system operator', depending on the requirement. In practice, however, HVDC systems will in Belgium currently be connected to the TSO-grid. Hence, when a reference is made in this document (or in the NC HVDC) to the relevant system operator, this will in the current situation be the TSO, i.e. Elia.

Current HVDC knowledge and translation of this knowledge in general or site-specific requirements

The current HVDC knowledge is limited:

- HVDC VSC converters: still experimental (limited European operational experience);
- Not yet any operational experience in Elia (NEMO: start foreseen in 2019);
- Academic & industrial research on DC-AC interactions still in early stages;
- Current proposals may not exclude future opportunities;
- International tendency to specify the least possible and gather experience.

This explains why the NC HVDC foresees a lot of site-specific requirements.

1. Scope of application

For the scope of application of the requirements of this document, please refer to Article 3 of the NC HVDC.

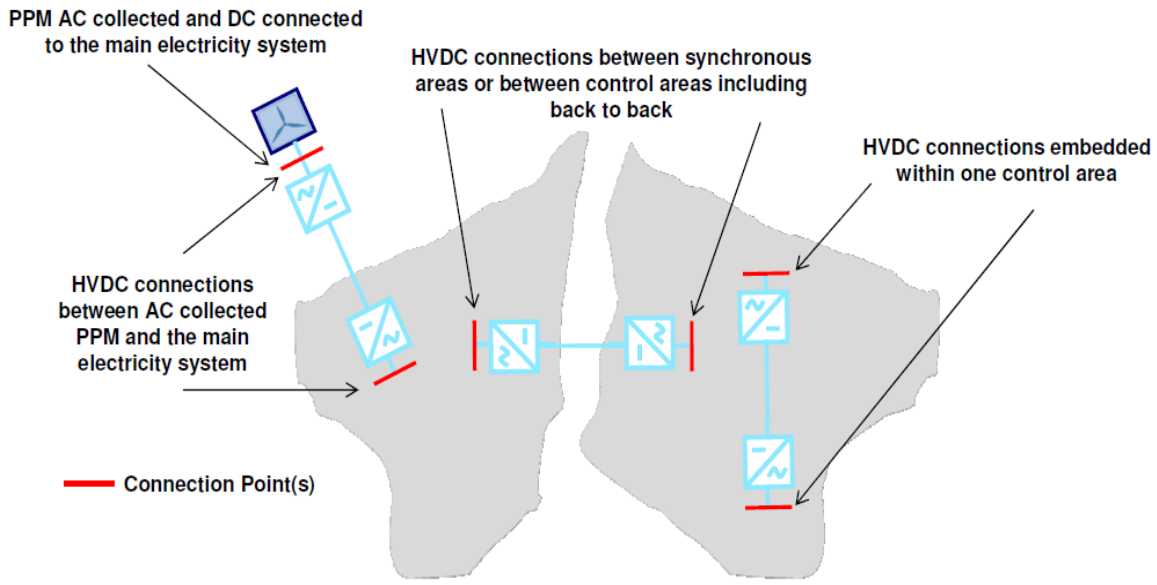

Figure 1 – The different HVDC applications as defined within the scope of application.

2. TITLE II: General Requirements for HVDC connections

2.1. Chapter 1:Requirements for active power control and frequency support

2.1.1. Article 11: Frequency ranges

2.1.1.1. Frequency Ranges §11.1

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

- In the range from 47.0 Hz to 47.5 Hz for 60 seconds
- In the range from 47.5 Hz to 48.5 Hz for unlimited time
- In the range from 48.5 Hz to 49.0 Hz for unlimited time
- In the range from 49.0 Hz to 51.0 Hz for unlimited time
- In the range from 51.0 Hz to 51.5 Hz for unlimited time
- In the range from 51.5 Hz to 52.0 Hz for 30 minutes

2.1.1.2. Wider frequency Ranges §11.2

The definition of wider frequency ranges and longer minimum times for operation is site specific. It may be agreed between the TSO and HVDC system owner on a case by case basis.

2.1.1.3. Automatic disconnection §11.3

This requirement is site specific. It is to be specified by the TSO on a case by case basis.

2.1.1.4. Maximum admissible active power output reduction §11.4

In case of technical limitation, when operating at an AC system frequency below 49 Hz, the maximum admissible active power output reduction from its operating point shall not go beyond 2%/Hz.

2.1.2. Article 13: Active power controllability, control range and ramping rate

2.1.2.1. Active power controllability §13.1(a)i

The definition of a maximum and minimum power step size for adjusting the transmitted active power is site specific. It may be specified by the TSO on case by case basis.

2.1.2.2. Active power controllability §13.1(a)ii

The definition of a minimum active power transmission capacity for each direction, below which active power transmission capability is not requested, is site specific. It may be specified by the TSO on case by case basis.

2.1.2.3. Active power controllability §13.1(a)iii

The definition of the maximum delay within which the HVDC system shall be capable of adjusting the transmitted active power is site specific. It is to be specified by the TSO on case by case basis.

2.1.2.4. Active power controllability §13.1(b)

The modalities according to which an HVDC system shall be capable of modifying the transmitted active power infeed in case of disturbances into one or more of the AC networks to which it is connected is site specific and shall be specified by the TSO on a case by case basis. If the initial delay prior to the start of the change is greater than 10 milliseconds from receiving the triggering signal sent by the relevant TSO, it shall be reasonably justified by the HVDC system owner to the relevant TSO.

2.1.2.5. Fast active power reversal §13.1(c)

HVDC systems shall be capable of fast active power reversal. Fast active power reversal shall be performed as fast as technically feasible but in less than 2 seconds.

2.1.2.6. Automatic remedial actions §13.3

The control functions of an HVDC system shall be capable of taking automatic remedial actions including, but not limited to, stopping the ramping and blocking FSM, LFSM-O, LFSM-U and frequency control.

Contingencies involving loss of generation or load may require emergency power control (EPC), i.e. an automatic reduction or increase in the power transfer including possible power reversal. The system owner shall design and supply a run-back (active power ramp-down) & run-up (active power ramp-up) control system that shall be able to activate in each station up to 10 distinct pre-programmed run-back cases and up to 10 run-up cases by external signals and each with a predefined setting for active power exchange [MW] and power ramp rate [MW/s] for the power setpoint change from the actual setting to the requested one. The relevant system operator or the TSO must be able to trigger any of the 10 run-up and 10 run-back systems at any given instant.

The triggering and blocking criteria are site specific and shall be specified by the TSO on a case by case basis after notification to the CREG.

2.1.3. Article 14: Synthetic inertia

2.1.3.1. Synthetic inertia §14.1

This requirement is site specific. It is to be specified by the TSO on a case by case basis.

2.1.3.2. Synthetic inertia §14.2

This requirement is site specific. It is to be specified by the TSO on a case by case basis.

2.1.4. Annex II: Requirements applying to frequency sensitive mode, limited frequency sensitive mode overfrequency and limited frequency sensitive mode underfrequency

2.1.4.1. Frequency Sensitive mode Annex II A1(a)

This requirement is site specific. It is to be specified by the TSO on a case by case basis after notification to the CREG.

2.1.4.2. Frequency Sensitive mode Annex II A1(d)(ii)

This requirement is site specific. It is to be specified by the TSO on a case by case basis after notification to the CREG.

2.1.4.3. LFSM-O Annex II B1(c)

With regard to limited frequency sensitive mode - overfrequency (LSM-O), the HVDC system shall be capable of adjusting active power frequency response as fast as inherently technically feasible, with an initial delay as short as possible and time for full activation set at 2 seconds. This is subject to a notification to the CREG.

2.1.4.4. LFSM-O Annex II B2

The frequency threshold referred to in point (a) of paragraph 1 shall be adjustable between 50.2 Hz and 50.5 Hz and the minimum droop setting is 0.1% (the exact value will be set in connection contract). This is subject to a notification to the CREG.

2.1.4.5. LFSM-U Annex II C1(c)

The initial delay is the shortest time within technical feasible limits and with a possibility to implement an additional adjustable delay to be at full activation at 2 seconds. This is subject to a notification to the CREG.

2.1.4.6. LFSM-U Annex II C2

The frequency threshold referred to in point (a) of paragraph 1 shall be adjustable between 49.8 Hz and 49.5Hz and the minimum droop setting is 0.1% (the exact value will be set in connection contract). This is subject to a notification to the CREG.

2.1.5. Article 16: Frequency control

2.1.5.1. Frequency control mode §16.1

This is a site-specific requirement and can be specified by the TSO on a case by case basis.

2.1.5.2. Frequency control mode §16.2

The operating principle, the associated performance parameters and the activation criteria of this frequency control are site specific and shall be specified by the TSO on a case by case basis.

2.1.6. Article 17: Maximum loss of active power

2.1.6.1. Maximum loss of active power §17.1

This is a site-specific requirement and can be specified by the TSO on a case by case basis.

2.2. Chapter 2: Requirements for reactive power control and voltage support

2.2.1. Article 18: Voltage ranges

2.2.1.1. Voltage ranges Annex III Table 4

HVDC systems connected between 110kV and 300kV shall remain connected for voltages between 1.118 pu – 1.15 pu for at least 10 hours.

2.2.1.2. Voltage ranges Annex III Table 5

HVDC systems connected between 300kV and 400kV shall remain connected for voltages between 1.05 pu – 1.0875 pu for at least 10 hours.

2.2.1.3. Agreement on wider voltage ranges or longer minimum times §18.2

The definition of wider voltage ranges and longer minimum times for operation is site specific. It may be agreed between RSO/TSO and HVDC system owner on a case by case level.

2.2.1.4. Automatic disconnection §18.3

The minimum requirement to stay connected is stated in the following table (stricter requirements may be specified on a case by case basis):

Time [ms]	Voltage amplitude [pu]
T<0 ms	1.0
0	0
250	0 (linearly rising to next point)
3000	0.9
∞	0.9

2.2.1.5. Voltage ranges §18.4

For connection points on voltages outside the range of 110 – 400kV, the same requirements as for 400kV connection points are taken.

2.2.2. Article 19: Short circuit contribution during faults

2.2.2.1. Short circuit contribution during faults §19.2(a)

This requirement is site specific. It is to be specified by the RSO/TSO on a case by case basis.

2.2.2.2. Short circuit contribution during faults §19.2(b)

This requirement is site specific. It is to be specified by the RSO/TSO on a case by case basis.

2.2.2.3. Short circuit contribution during faults §19.2(c)

This requirement is site specific. It is to be specified by the RSO/TSO on a case by case basis.

2.2.2.4. Short circuit contribution during faults §19.3

This requirement is site specific. It is to be specified by the RSO/TSO on a case by case basis.

2.2.3. Article 20: Reactive power capability

2.2.3.1. Reactive power capability §20.1

This requirement is site specific. It is to be specified by the RSO/TSO on a case by case basis.

2.2.3.2. Reactive power capability §20.3

An HVDC system shall be capable of moving to any operating point within its U-Q/Pmax profile in less than 100 ms.

2.2.4. Article 21: Reactive power exchanged with the network

2.2.4.1. Reactive power exchanged with the network §21.2

This requirement is site specific. It is to be specified by the RSO/TSO on a case by case basis.

2.2.5. Article 22: Reactive power control mode

2.2.5.1. Control modes §22.1

An HVDC converter station shall be capable of operating in the following modes:

(a) voltage control mode;

(b) reactive power control mode;

(c) power factor control mode.

2.2.5.2. Additional control modes §22.2

An HVDC converter station shall be capable of operating in the following additional control modes:

(a) voltage dependent reactive power control mode. The characteristics of this mode are subject of a mutual agreement between the relevant TSO and the HVDC system owner.

(b) STATCOM mode: all previously specified control modes (under 2.2.5.1 and 2.2.5.2) must be available without exchange of active power in the situation with our without the connection of the DC cable or overhead line.

2.2.5.3. Voltage control mode §22.3(b)

The set point deadband shall be adjustable in steps of 0.5%

2.2.5.4. Voltage step change §22.3(c)(i)

In voltage control mode following a voltage step change, an HVDC system is able to achieve 90% of the change of reactive power within maximum 100ms with disabled ramp rate limiter.

2.2.5.5. Voltage step change §22.3(c)(ii)

The HVDC system shall be equipped with a reactive power ramp rate limiter with settles the controlled AC voltage within the range of ±1% of the setpoint in a programmable time span ranging between 1s and 60s with steps of 0.1s.

2.2.5.6. Voltage control mode §22.3(d)

The slope of the instructed reactive power component shall be online adjustable in the range of 1 to 50 Mvar/s in steps of 0.1 Mvar/s.

2.2.5.7. Reactive power control mode §22.4

This requirement is site specific. It is to be specified by the RSO/TSO on a case by case basis.

2.2.5.8. Power factor control mode §22.5

The maximum step size for reactive power is less than 1Mvar and for the voltage less than 1kV.

2.2.5.9. Remote selection of control modes §22.6

This requirement is site specific. It is to be specified by the RSO/TSO on a case by case basis.

2.2.6. Article 23: Priority to active or reactive power contribution

2.2.6.1. Priority to active or reactive power contribution §23

Reactive power contribution shall have priority during low or high voltage operation and during faults for which fault-ride-through capability is required, taking into account the capabilities of the HVDC system.

2.2.7. Article 24: Power Quality

2.2.7.1. Power quality §24

This non-exhaustive requirement related to power quality will be based on the relevant Synergrid regulations regarding power quality, unless more stringent requirements are set forth in the connection contract.

2.3. Chapter 3: Requirements for fault ride through capability

2.3.1. Article 25: Fault ride through capability

2.3.1.1. Fault ride through capability §25.1

This requirement is site specific. It is to be specified by the RSO/TSO on a case by case basis. The terms and settings for automatic disconnection shall be agreed between RSO/TSO and HVDC system owner on a case by case basis.

The minimum requirement to stay connected is stated in the following table:

Time [ms]	Voltage amplitude [pu]
T<0 ms	1.0
0	0
250	0 (linearly rising to next point)
3000	0.9
∞	0.9

2.3.1.2. Fault ride through capability §25.2

TSO shall only provide this if requested by HVDC system owner

2.3.1.3. Fault ride through capability §25.4

Time is to be agreed between TSO and HVDC system owner, but TSO specifies the voltage levels on a case by case basis.

2.3.1.4. Fault ride through capability §25.5

This requirement is subject of an agreement between the system owner and the RSO/TSO on a case by case basis.

2.3.1.5. Fault ride through capability §25.6

The fault-ride through capabilities for asymmetrical faults of an HVDC system shall be the following

(a) The HVDC converter station shall be able to control negative sequence current and voltage components.

(b) It shall be possible to continue active power injection up to the maximum possible value.

(c) No second harmonic current distortion shall be transferred to the converters' DC side

(d) Automatic reclosure of AC overhead lines may not lead to the disconnection of the HVDC system.

2.3.2. Article 26: Post fault active power recovery

2.3.2.1. Post fault active power recovery §26

A HVDC system shall be able to recover active power transmission following fault clearance and reach the pre-fault set-points within maximum 200ms. The relevant TSO may set the recovery time and post-fault ramping rate in order to reach a slower recovery.

2.4. Chapter 4: Requirements for control

2.4.1. Article 28: Energisation and synchronisation of HVDC converter stations

2.4.1.1. Energisation and synchronisation of HVDC converter stations §28

During the energisation or synchronisation of an HVDC converter station to the AC network or during the connection of an energised HVDC converter station to an HVDC system, the HVDC converter station shall have the capability to limit any voltage changes to a steady-state level. That steady-state level and the maximum magnitude, duration and measurement window of the voltage transients are site specific and are to be specified by the RSO/TSO on a case by case basis. The steady-state level shall not exceed 5 per cent of the pre-synchronisation voltage.

2.4.2. Article 29: Interaction between HVDC systems or other plants and equipment

2.4.2.1. Interaction between HVDC systems or other plants and equipment §29.2

This requirement is site-specific and is to be specified by the RSO/TSO on a case by case basis.

2.4.2.2. Interaction between HVDC systems or other plants and equipment §29.7

This requirement is site-specific and is to be specified by the RSO/TSO on a case by case basis.

2.4.3. Article 30: Power oscillation damping capability

2.4.3.1. Power oscillation damping capability §30

This requirement is site specific. It has to be agreed between the TSO and the HVDC system owner on a case by case basis.

2.4.4. Article 31: Subsynchronous torsional interaction damping capability

2.4.4.1. Subsynchronous torsional interaction damping capability §31.2

This requirement is site specific and needs to be specified by the TSO on a case by case basis.

2.4.4.2. Subsynchronous torsional interaction damping capability §31.3

This requirement is site specific and needs to be specified by the TSO on a case by case basis.

2.4.5. Article 32: Network characteristics

2.4.5.1. Network characteristics §32.1

This requirement is site specific and needs to be specified by the TSO on a case by case basis.

2.4.6. Article 33: HVDC system robustness

2.4.6.1. HVDC system robustness §33.1

This requirement is site specific and needs to be specified by the TSO on a case by case basis.

2.4.6.2. Network characteristics §33.2

This requirement is site specific and needs to be specified by the TSO on a case by case basis.

2.5. Chapter 5: Requirements for protection devices and settings

2.5.1. Article 34: Electrical protection schemes and settings

2.5.1.1. Electrical protection schemes and settings §34.1

Following elements will need to be provided for under HVDC connection contract: Any scheme considered suitable for the HVDC system to meet the functional requirements may be proposed by the system owner. The system owner shall, with adequate explanatory descriptions, demonstrate that the proposed schemes meet the criteria of speed, dependability, security, sensitivity and maintainability requirements. The system owner shall provide proof that the protection scheme is not a prototype and has been successfully used in other similar installations. The relevant TSO reserves the right to adapt the protection scheme in mutual agreement with the system owner in order to coordinate with the protection system of the AC system at the PCC.

Protective relay settings shall be completed by the system owner and provided to the relevant TSO for review at least 3 months before the tests on completion program commencement date. Setting development explanations and calculations shall be provided with the protective relay settings.

2.5.1.2. Electrical protection schemes and settings §34.3

Idem §34.1

2.5.2. Article 35: Priority ranking of protection and control

2.5.2.1. Priority ranking of protection and control §35.1

A control scheme, specified by the HVDC system owner consisting of different control modes, including the settings of the specific parameters, shall be coordinated and agreed between the relevant TSO, the relevant system operator and the HVDC system owner on a case by case basis. The control scheme, its setting development explanations and calculations shall be provided to the relevant TSO for review at least 3 months before the tests on completion program commencement date.

2.5.2.2. Priority ranking of protection and control §35.2

This requirement is site specific. It has to be agreed between the TSO and the HVDC system owner on a case by case basis.

2.5.3. Article 36: Changes to protection and control schemes and settings

2.5.3.1. Changes to protection and control schemes and settings §36.1

The design of the HVDC converter shall permit modifying control characteristics, control loop responses, and protection settings etc. of the control and protection systems for the purpose of on-site optimization and when deemed required in the future using the engineering workstation. The system owner shall provide a secure method of preventing inadvertent change to implemented functions

2.5.3.2. Changes to protection and control schemes and settings §36.2

This requirement is site specific. It has to be agreed between the TSO and the HVDC system owner on a case by case basis.

2.5.3.3. Changes to protection and control schemes and settings §36.3

This requirement is site specific. It has to be specified by the TSO on a case by case basis.

2.6. Chapter 6: Requirements for power system restoration

2.6.1. Article 37: Black start

2.6.1.1. Black start §37.1

This requirement is site specific and needs to be specified by the TSO on a case by case basis.

2.6.1.2. Black start §37.2

This requirement is site specific and needs to be specified by the TSO on a case by case basis.

2.6.1.3. Black start §37.3

This requirement is site specific and needs to be specified by the TSO on a case by case basis.

3. TITLE III: Requirements for DC-connected power park modules and remote-end HVDC converter stations

3.1. Chapter 1: Requirements for DC-connected power park modules

3.1.1. Article 39: Frequency stability requirements

3.1.1.1. Frequency stability requirements §39.1

The requirement for DC-connected power park modules connected via HVDC systems which connect more than one control area to be capable of delivering coordinated frequency control is site specific and shall be specified by the TSO on a case by case basis.

3.1.1.2. Frequency ranges §39.2(a)

A nominal frequency other than 50 Hz or a frequency variable by design can be used, subject to agreement with the TSO. In that case, the applicable frequency ranges and time periods shall be specified by the TSO on a case by case basis.

3.1.1.3. Wider frequency ranges §39.2(b)

The definition of wider frequency ranges and longer minimum times for operation is site specific. It may be agreed between TSO and DC-connected power park module owner on a case by case level to ensure the best use of the technical capabilities of a DC-connected power park module if needed to preserve or restore system security.

3.1.1.4. Automatic disconnection §39.2(c)

This requirement is site specific. It may be specified by the TSO on a case by case basis.

3.1.1.5. LFSM-O §39.4

The same requirements of the RfD Type D will be applied

3.1.1.6. Constant power §39.5

The same requirements of the RfD Type D will be applied

3.1.1.7. Active power controllability §39.6

The same requirements of the RfD Type D will be applied

3.1.1.8. LFSM-U §39.7

The same requirements of the RfD Type D will be applied

3.1.1.9. FSM subject to a fast signal response §39.8

The same requirements of the RfD Type D will be applied

3.1.1.10. Frequency restoration §39.9

The same requirements of the RfD Type D will be applied

3.1.1.11. Frequencies other than 50Hz §39.10

This requirement is site specific. It may be specified by the TSO on a case by case basis.

3.1.2. Article 40: Reactive power and voltage requirements

3.1.2.1. Voltage ranges Annex VII Table 9 and 10

This requirement is site specific. It may be specified by the TSO on a case by case basis.

3.1.2.2. Agreement on wider voltage ranges or longer minimum times §40.1(b)

The definition of wider voltage ranges and longer minimum times for operation is site specific. It can be agreed between RSO/TSO and the owner of the DC-connected power park module on a case by case level.

3.1.2.3. Automatic disconnection §40.1(c)

This requirement is site specific. It is to be specified by the RSO/TSO on a case by case basis. The terms and settings for automatic disconnection shall be agreed between the relevant system operator, the TSO and DC-connected power park module owner.

3.1.2.4. Voltage ranges for other AC voltages §40.1(d)

This requirement is site specific. It may be specified by the TSO on a case by case basis.

3.1.2.5. Frequencies other than nominal 50Hz §40.1(e)

This requirement is site specific. It may be specified by the TSO on a case by case basis.

3.1.2.6. Reactive power capability §40.2(b)(i)

This requirement is site specific. It may be specified by the TSO on a case by case basis.

3.1.2.7. Reactive power capability §40.2(b)(ii)

This requirement is site specific. It may be specified by the TSO on a case by case basis.

3.1.2.8. Priority to active or reactive power contribution §40.3

This requirement is site specific. It may be specified by the TSO on a case by case basis.

3.1.3. Article 41: Control requirements

3.1.3.1. Synchronisation §41.1

During the energisation or synchronisation of a DC-connected power park module to the AC network , the DC-connected power park module shall have the capability to limit any voltage changes to a steady-state level. That steady-state level and the maximum magnitude, duration and measurement window of the voltage transients are site specific and are to be specified by the TSO on a case by case basis (eg in connection contract). The steady-state level shall not exceed 5 per cent of the pre-synchronisation voltage.

3.1.3.2. Output signals §41.2

This requirement is site specific. It shall be specified by the TSO on a case by case basis.

3.1.4. Article 42: Network characteristics

3.1.4.1. Method of pre-fault and post-fault conditions §42(a)

This requirement is site specific. It shall be specified by the TSO on a case by case basis.

3.1.4.2. Equivalents representing the system §42(c)

This requirement is site specific. It shall be specified by the TSO on a case by case basis.

3.1.5. Article 43: Protection requirements

3.1.5.1. Electrical protection schemes §43.1-2

This requirement will be specified based on article 14.5 of RfG NC.

3.1.6. Article 44: Power quality

3.1.6.1. Power quality §44

3.2. This requirement will be specified by the RSO/TSO on a case by case basis (respecting any applicable norm, standard or regulation in this respect). Chapter 2: Requirements for remote-end HVDC converter stations

3.2.1. Article 47: Frequency stability requirements

3.2.1.1. Frequency ranges §47.1

This requirement is site specific. It may be specified by the TSO on a case by case basis.

3.2.1.2. Frequency response §47.2

This requirement is site specific. It may be specified by the TSO on a case by case basis.

3.2.2. Article 48: Reactive power and voltage requirements

3.2.2.1. Reactive power and voltage ranges Annex VIII Table 12 and 13

This requirement is site specific. It may be specified by the TSO on a case by case basis.

3.2.2.2. Agreement on wider voltage ranges or longer minimum times §48.1(b)

The definition of wider voltage ranges and longer minimum times for operation is site specific. It can be agreed between RSO/TSO and DC-connected power park module owner on a case by case level.

3.2.2.3. Voltage ranges for other AC voltages §48.1(c)

This requirement is site specific. It may be specified by the TSO on a case by case basis.

3.2.2.4. Reactive power provision §48.2(a)

This requirement is site specific. It may be specified by the TSO on a case by case basis.

3.2.2.5. U-Q/Pmax – profile §48.2(a)

This requirement is site specific. It may be specified by the TSO on a case by case basis.

3.2.3. Article 50: Power quality

3.2.3.1. Power quality §50

This requirement will be specified by the RSO/TSO on a case by case basis (respecting any applicable norm, standard or regulation in this respect).

4. TITLE IV: Information Exchange and Coordination

4.1.1. Article 51: Operation of HVDC systems

4.1.1.1. Operation of HVDC systems §51.1

The automatic controller hierarchy is site specific. It will be specified by the TSO on a case by case basis.

4.1.1.2. Operation of HVDC systems §51.4

This requirement is site specific. It may be specified by the TSO on a case by case basis.

4.1.2. Article 52: Parameters and settings

This requirement is subject of a mutual agreement between the relevant TSO and the HVDC system owner on a case by case basis.

4.1.3. Article 53: Fault recording and monitoring

4.1.3.1. Fault recording and monitoring §53.2 to 53.5

This requirement is site specific. It may be specified by the TSO on a case by case basis.

4.1.4. Article 54: Simulation models

4.1.4.1. Simulation models §54.1

The stipulated simulation models always need to be provided to the RSO/TSO. The format shall be specified by the TSO on a case by case basis.

5. References

[1] 'Network Code on High Voltage Direct Current' or 'NC HVDC': Commission Regulation (EU) 2016/1447 of 26 August 2016 establishing a network code on requirements for grid connection of high voltage direct current systems and direct current-connected power park modules, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R1447&from=EN

[2] 'Network Code Requirements for Generators' or 'NC RfG': Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0631&from=EN

[3] 'Network Code on Demand Connection' or 'NC DCC': Commission Regulation (EU) 2016/1388 of 17 August 2016 establishing a Network Code on Demand Connection, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R1388&from=EN

[4] Federal Technical Reglement- 19 DECEMBER 2002. — Koninklijk besluit houdende een technisch reglement voor het beheer van het transmissienet van elektriciteit en de toegang ertoe, Arrêté royal établissant un règlement technique pour la gestion du réseau de transport de l'électricté et l'accès à celui-ci, http://www.elia.be/~/media/files/Elia/publications-2/grid-codes/Technisch%20reglement%20Federaal%202002.pdf

[5] Presentation FOD/SPF Energy in WG Belgian Grid (in Dutch): http://www.elia.be/~/media/files/Elia/users-group/WG%20Belgian%20Grid/20170307%20WG%20Belgian%20Grid/FOD_Vision-for_FederalGridCode.pdf

Minutes of Meeting WG Belgian Grid 7th March 2017 (in French): http://www.elia.be/~/media/files/Elia/users-group/WG%20Belgian%20Grid/20170421_WG%20BG/20170307_PV_WGBG_FR_FINAL_WRITTEN-APPROVED.pdf

[6] ENTSO-E Guidance document for national implementation for network codes on grid connection : Parameters of Non-exhaustive requirements, 16 November 2016: https://www.entsoe.eu/Documents/Network%20codes%20documents/NC%20RfG/161116_IGD_General%20guidance%20on%20parameters_for%20publication.pdf

6. Appendix - List of non-exhaustive articles for HVDC

This list is extracted from ENTSO-E Guidance document for national implementation for network codes on grid connection : Parameters of Non-exhaustive requirements [6]

Table 3 – HVDC Non-Exhaustive Requirements

Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing for Proposal	Proposer
FREQUENCY ISSUES	**FREQUENCY RANGES**		11.1	HVDC System	Time period for operation in the frequency ranges **Continental Europe** 47.5 - 48.5 Hz and 48.5 - 49 Hz **Nordic**:48.5 - 49 Hz **GB:**48.5 - 49 Hz **Ireland:**48.5 - 49 Hz **Baltic:** 47.5 - 48.5 Hz and 48.5 - 49 Hz and 51 - 51,5 Hz	Value - CNC national implementation	RSO
	WIDER FREQUENCY RANGES	**X**	11.2	HVDC System	Agreement on wider frequency ranges, longer minimum times for operation	Value - in due time for plant design	Agreement between TSO and HVDC System Operator
	AUTOMATIC DISCONNECTION		11.3	HVDC System	Frequencies to disconnect	Value and criteria - CNC national implementation	TSO
	MAXIMUM ADMISSABLE POWER OUTPUT	**X**	11.4	HVDC System	Maximum admissible power output below 49Hz	CNC national implementation and reviewed in due time for plant design	TSO
	ACTIVE POWER CONTROLLABILITY	**X**	13.1.(a)i	HVDC system	Maximum and minimum power step	Value - CNC national implementation	TSO
	ACTIVE POWER CONTROLLABILITY	**X**	13.1.(a)ii	HVDC System	Minimum active power transmission capacity	Value - CNC national implementation	TSO
		X	13.1.(a)ii	HVDC System	Maximum delay	Value - CNC national implementation	TSO
			13.1.(b)	HVDC System	Modification of transmitted active power	Principle - CNC national implementation Value and adjustable setting - in due time for plant design	TSO
	FAST ACTIVE POWER REVERSAL	**X**	13.1.(c)	HVDC System	Capability or not	CNC national implementation	TSO
	AUTOMATIC REMEDIAL ACTIONS	**X**	13.3	HVDC system	If required, and triggering and blocking criteria	Principle - CNC national implementation Value - in due time for plant design	TSO
	SYNTHETIC INERTIA	**X**	14.1	HVDC System	If required, and functionality	CNC national implementation	TSO

Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing for Proposal	Proposer
		X	14.2	HVDC System	Principle of control and performance parameters	CNC national implementation	Agreement between TSO and HVDC System Operator
	FREQUENCY SENSITIVE MODE		Annex II. 3.(e)	HVDC System	Frequency threshold and droop settings	Range – CNC national implementation Value – In due time for or post plant design and to be reselected as appropriate using the capabilities defined at CNC national implementation	TSO
			Annex II. A2.(d)(ii)	HVDC System	Active power response capability	CNC national implementation	TSO
	LFSM-O		Annex II. B.1.(c)	HVDC System	Time for full activation	CNC national implementation	TSO
			Annex II. B.2.	HVDC System	Frequency threshold and droop settings	Range – CNC national implementation Value – In due time for or post plant design and to be reselected as appropriate using the capabilities defined at CNC national implementation	TSO
	LFSM-U		Annex II. C.1(c)	HVDC System	Time for full activation	CNC national implementation	TSO
			Annex II. C.2	HVDC System	Frequency threshold and droop settings	Range – CNC national implementation Value – In due time for or post plant design and to be reselected as appropriate using the capabilities defined at CNC national implementation	TSO
	FREQUENCY CONTROL MODE	**X**	16.1	HVDC System	Need for independent control mode to modulate active power output	Principle - CNC national implementation	TSO
		X	16.1	HVDC System	Specify operating principle	Principle – in due time for	TSO

Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing for Proposal	Proposer
						plant design	
	MAX. LOSS OF ACTIVE POWER		17.1	HVDC System	specify limit for loss of active power injection	CNC national implementation	TSO
			17.2	HVDC System	Coordinate specified limit of active power injection	CNC national implementation	TSOs
	FREQUENCY STABILITY REQUIREMENTS		39.1	HVDC System	Specify coordinated frequency control capabilities	in due time for plant design	TSO
	FREQUENCY RANGES		39.2.(a)	DC-Connected Power Park Module	Nominal frequencies other than 50Hz will be provided	CNC national implementation	TSO
	WIDER FREQUENCY RANGES	**X**	39.2(b)	DC-Connected Power Park Module	Agreement on wider frequency ranges, longer minimum times for operation	Value - in due time for plant design	Agreement between TSO and HVDC System Operator
	AUTOMATIC DISCONNECTION		39.2(C)	DC-Connected Power Park Module	Frequencies to disconnect	Value - in due time for plant design	TSO
	LFSM-O		39.4	DC connected Power Park Modules	Frequency threshold and droop settings	Range – CNC national implementation Value – before plant commissioning and to be reselected as appropriate using the capabilities defined at CNC national implementation	TSO
					For PPM: Definition of Pref	CNC national implementation	TSO
		X			Requirements in case of expected compliance on an aggregate level	CNC national implementation	TSO
		X			Expected behaviour of the PGM once the minimum regulating level is reached	CNC national implementation	TSO
	CONSTANT POWER		39.5	DC-Connected Power Park Module	Specify parameters in accordance with Network Code RfG Article 13(3)	See RfG requirements in table 1	See RfG
	ACTIVE POWER CONTROLLABILITY		39.6	DC-Connected Power Park Module	Specify parameters in accordance with Network Code RfG Article 15(2)(a)	See RfG requirements in table 1	See RfG
	LFSM-U		39.7	DC-Connected Power Park Module	Specify parameters in accordance with Network Code RfG Article 15(2)(c)	See RfG requirements in table 1	See RfG
	FSM WITH SUBJECT TO A FAST SIGNAL RESPONSE		39.8	DC-Connected Power Park Module	Specify parameters in accordance with Network Code RfG Article 15(2)(d)	See RfG requirements in table 1	See RfG

Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing for Proposal	Proposer
	FREQUENCY RESTORATION		39.9	DC-Connected Power Park Module	Specify parameters in accordance with Network Code RfG Article 15(2)(e)	See RfG requirements in table 1	See RfG
	3-9 FOR FREQUENCIES OTHER THAN 50HZ		39.10	DC connected Power Park Modules	Define the parameters capabilities in Article 39.3-39.9 for frequencies other than 50Hz	CNC national implementation	TSO
	FREQUENCY RANGES		47.1	Remote-end HVDC converter stations	Nominal frequencies other than 50Hz will be provided accounting for Annex I requirements	CNC national implementation	TSO
VOLTAGE ISSUES	**VOLTAGE RANGES**		Annex III. Table 4	HVDC System	For Continental Europe time period for operation in the voltage range 1,118 pu-1,15 pu for PGM connected between 110kV and 300 kV	CNC national implementation	TSO
	VOLTAGE RANGES		Annex III. Table 5	HVDC System	For Continental Europe time period for operation in the voltage range 1,05 pu-1,0875 pu and Nordic time period for operation in the voltage range 1,05 pu-1,10pu both for PGM connected between 300kV and 400 kV	CNC national implementation	TSO
	AGREEMENT ON WIDER VOLTAGE RANGES OR LONGER MIN. TIMES		18.3	HVDC System	Wider voltage ranges or longer minimum time periods for operation may be agreed.	Value - in due time for plant design	Agreement between TSO and HVDC System Operator
	AUTOMATIC DISCONNECTION		18.3	HVDC System	Voltage criteria and technical parameters at the connection point for automatic disconnection	Value - in due time for plant design	Agreement between TSO and HVDC System Operator
	VOLTAGE RANGES		18.4	HVDC System	Specify 1PU applicable requirements at connection points	CNC national implementation	RSO with TSOs
		X	18.5	HVDC System	Decision on use continental Europe voltage ranges	CNC national implementation	Baltic TSOs
	SHORT CIRCUIT CONTRIBUTION DURING FAULTS	**X**	19.2.(a)	HVDC System	Specifications on voltage deviation	Value - CNC national implementation	TSO
		X	19.2.(b)	HVDC System	Characteristics of fast fault current	CNC national implementation	TSO
		X	19.2.(c)	HVDC System	timing and accuracy of fast fault current	Value - CNC national implementation	TSO
		X	19.3	HVDC System	Specify asymmetrical current injection for such faults	Value - CNC national implementation	RSO with TSO
	REACTIVE POWER CAPABILITY		20.1	HVDC Converter station	U-Q/Pmax profile at maximum capacity	Range - CNC national implementation	RSO with TSO
			20.3	HVDC Converter station	Provide timescale to move within U-Q/Pmax profile	Value - CNC national implementation	RSO with TSO
	REACTIVE POWER EXCHANGED		21.2	HVDC Converter	Specify maximum tolerable voltage step value	CNC national implementation	TSO

Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing for Proposal	Proposer
	WITH THE NETWORK			station			
	REACTIVE POWER CONTROL MODE		22.1	HVDC Converter station	Define which of the control modes are required	In due time for plant design	TSO
			22.2	HVDC Converter station	Define of any other control modes are required and if so what are they	In due time for plant design	TSO
			22.3.(b)	HVDC Converter station	For voltage control mode definition of adjustment steps required for dead band	Value - CNC national implementation	RSO with TSO
			22.3.(c)	HVDC Converter station	In voltage control mode time within which 90% of the change in reactive power is reached within 01-10secs	Value - CNC national implementation	RSO with TSO
			22.3.(c)	HVDC Converter station	In voltage control mode t2 = time within which 100% of the change in reactive power is reached within 1-60secs	Value - CNC national implementation	RSO with TSO
			22.3.(d)	HVDC Converter station	Voltage control slope specified by range and step	Range and Value - CNC national implementation	RSO with TSO
			22.4	HVDC System	Reactive power range in Mvar or %	Value - CNC national implementation	RSO
			22.5	HVDC System	Maximum allowable step size of set point	Value - CNC national implementation	RSO
			22.6	HVDC System	Equipment specification to enable remote control of control modes and set points	CNC national implementation	RSO with TSO
	PRIORITY TO ACTIVE OR REACTIVE POWER CONTRIBUTION		23	HVDC System	TSO decide active or reactive power has priority	Value – In due time for or post plant design and to be reselected as appropriate using the capabilities defined at CNC national implementation	TSO
	FAULT RIDE THROUGH CAPABILITY (FRT)		25.1	HVDC System	Specify voltage against time profile and conditions in which it applies	CNC national implementation	TSO
		X	25.2	HVDC System	On request provide pre and post fault conditions	CNC national implementation	RSO
		X	25.4	HVDC System	Voltages where HVDC system can block	CNC national implementation	Agreement between TSO and HVDC System Operator
			25.5	HVDC System	Acceptance of and narrower settings on under voltage protection	Value - in due time for plant design	Agreement between TSO and HVDC System Operator

Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing for Proposal	Proposer
			25.6	HVDC System	Specify FRT capabilities for asymmetrical faults	CNC national implementation	TSO
	POWER QUALITY		24	HVDC System	Specify fluctuation limits to be respected	Principle – CNC national implementation Value - in due time for plant design	TSO
			44	DC connected Power Park Modules	Specify voltage and distortion limits	Principle – CNC national implementation Value - in due time for plant design	RSO in coordination with TSO
			50	Remote-end HVDC converter stations	Specify voltage and distortion limits	Principle – CNC national implementation Value - in due time for plant design	RSO in coordination with TSO
	POST FAULT ACTIVE POWER RECOVERY		26	HVDC System	Active power recovery magnitude and time profile	CNC national implementation	TSO
	VOLTAGE RANGES		Annex VII. Table 9 and 10	DC connected Power Park Modules	Time period for operation in the voltage range 1.1-1.118pu and 1,118 pu-1,15 pu for DC connected PPM connected between 110kV and 300 kV and 1.05-1.15pu for DC connected PPM connected from 300kV to 400kV	CNC national implementation	RSO in coordination with TSO
	AGREEMENT ON WIDER VOLTAGE RANGES OR LONGER MIN. TIMES		40.1.(b)	DC connected Power Park Modules	Wider voltage ranges or longer minimum time periods for operation may be agreed.	Value - in due time for plant design	Agreement between TSO and DC connected PPM owner
	AUTOMATIC DISCONNECTION		40.1.(c)	DC connected Power Park Modules	Voltage criteria and technical parameters at the connection point for automatic disconnection	Value - in due time for plant design	Agreement between TSO and DC connected PPM owner
	VOLTAGE RANGES FOR OTHER AC VOLTAGES		40.1.(d)	DC connected Power Park Modules	Time period for operation in the voltage range for DC connected PPM	Value - CNC national implementation	TSO
	AGREEMENT HOW TO MEET REACTIVE POWER REQUIREMENTS (TODAY, FUTURE)		40.1.(i)	DC connected Power Park Modules	Reactive power capabilities	CNC national implementation	RSO in coordination with TSO
	REACTIVE POWER CAPABILITY		40.2.(b)(i)	DC connected Power Park Modules	Reactive power range within profile in table 11 of Annex VII and if applicable Reactive power range from Article 25(4) of the RfG	CNC national implementation	RSO in coordination with TSO

Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing for Proposal	Proposer
	REACTIVE POWER CONSUMPTION OF EXTRA HIGH VOLTAGE LINE		40.2.(b)(ii)	DC connected Power Park Modules	Supplementary reactive power requirements at connection point	Range CNC national implementation	RSO in coordination with TSO
	PRIORITY TO ACTIVE AND REACTIVE POWER CONTRIBUTION		40.3	DC connected Power Park Modules	RSO decide active or reactive power has priority	Adjustable setting in due time for plant design	RSO in coordination with TSO
	REACTIVE POWER AND VOLTAGE RANGES		Annex VIII. Table 12 and 13	Remote-end HVDC converter stations	Time period for operation in the voltage range 1.1-1.12pu and 1.2 pu-1.15 pu for remote end converters connected between 110kV and 300 kV and 1.05-1.15pu for remote end converters connected from 300kV to 400kV	Value - CNC national implementation	TSO
	AGREEMENT ON WIDER VOLTAGE RANGES OR LONGER MIN. TIMES		48.1(b)	Remote-end HVDC converter stations	Wider voltage ranges or longer minimum time periods for operation may be agreed.	In due time for plant design	Agreement between RSO, TSO and remote end converter owner
	VOLTAGE RANGES FOR OTHER AC VOLTAGES		48.1(c)	Remote-end HVDC converter stations	Time period for operation in the voltage range for DC connected PPM	Value - CNC national implementation	RSO in coordination with TSO
	REACTIVE POWER PROVISION		48.2.(a)	Remote-end HVDC converter stations	Reactive power capabilities for various voltage levels	Range - CNC national implementation	RSO in coordination with TSO
	U-Q/PMAX-PROFILE		48.2.(a)	Remote-end HVDC converter stations	Reactive power capabilities within the boundaries in Annex VIII, table 14	Range - CNC national implementation	RSO in coordination with TSO
SYSTEM RESTORATION	**ENERGISATION AND SYNCHRONISATION OF HVDC CONVERTER STATIONS**	**X**	28	HVDC Converter Station	If RSO specified, provide limits (including transient max. magnitude, duration and measurement window) of any voltage change to a steady-state level (>5% pre-synchronisation voltage)	In due time for plant design	RSO with TSO
	POWER OSCILLATION DAMPING CAPABILITY		30	HVDC System	Specify frequency range to test capability. Agree control parameter settings	In due time for plant design	TSO, Agreement between TSO and HVDC System Operator
			30.2	HVDC System	Specifications of extent of SSTI and parameters	In due time for plant design	TSO
			30.3	HVDC System	Identify all parties relevant at a connection point	In due time for plant design	TSO
	BLACK START	**X**	37.1	HVDC System Owner	Obtain quote for black start	In due time for plant design	TSO
		X	37.2	HVDC System	Timeframe and voltage limits to energise AC busbar with black start, with wider frequency and voltage ranges than Article 11/18 as required	In due time for plant design	TSO

Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing for Proposal	Proposer
		X	37.3	HVDC System Owner	Capacity and availability of black start	In due time for plant design	Agreement with TSO and HVDC System Owner
	STABLE OPERATION WITHIN MIN & MAX SC POWER		42.(b)	DC connected Power Park Modules	Specify minimum to maximum short circuit range	Range - CNC national implementation	RSO in coordination with TSO
INSTRUMENTATION SIMULATION MODELS AND PROTECTION	**INTERACTION BETWEEN HVDC SYSTEMS AND OTHER PLANTS/EQUIPMENTS**		29.2	HVDC Converter Station	Specify study required to examine interaction with adjacent equipment	In due time for or post plant design	TSO
			29.3	HVDC Converter Station	Specify all other relevant parties to the study	In due time for or post plant design	TSO
			29.4	TSO	Models/information for use in studies	In due time for or post plant design	Interacting 3rd Parties
			29.6	HVDC System	Specify transient levels of performance	In due time for or post plant design	TSO
	NETWORK CHARACTERISTICS		32.1	HVDC System	Method and pre-fault and post fault conditions for minimum and maximum short circuit power	Criteria - CNC national implementation	TSO
	HVDC SYSTEM ROBUSTNESS		33.1	HVDC System	Specify changes in system conditions for HVDC system to remain stable	At time of change	TSO
	ELECTRICAL PROTECTION SCHEMES AND SETTINGS		34.1	HVDC System	Specify schemes and settings	Control schemes: in due time for plant design Settings: Values - before plant commissioning and to be reselected as appropriate	TSO with RSO
			34.3	HVDC System	Acceptance of changes by owner to protection	In due time for plant design	TSO
			35.1	HVDC System	Control modes and parameters for a control scheme	Control schemes: in due time for plant design Settings: Values - before plant commissioning and to be reselected as appropriate	Agreement with RSO, TSO and HVDC System Owner
		X	35.2	HVDC System	Change to priority order of protection and control	In due time for plant design	TSO
	CHANGES TO PROTECTION AND	X	36.1	HVDC System	Changes to control modes or protections settings	At time of change	TSO

Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing for Proposal	Proposer
	CONTROL SCHEMES AND SETTINGS	**X**	36.2	HVDC System	Coordination of changes and agreement	At time of change	Agreement with RSO, TSO and HVDC System Owner
	CHANGES TO PROTECTION AND CONTROL SCHEMES AND SETTINGS	**X**	36.3	HVDC System	Equipment specification to enable remote control of control modes and set points	At time of change	TSO
	SYNCHRONIZATIO N		41.1	DC connected Power Park Modules	Provide limits (including transient max. magnitude, duration and measurement window) of any voltage change to a steady-state level (>5% pre-synchronisation voltage)	Value - in due time for plant design	RSO in coordination with TSO
	OUTPUT SIGNALS		41.2	DC connected Power Park Modules	Specify required output signals	Value - CNC national implementation	RSO in coordination with TSO
	METHOD OF PRE-FAULT AND POST-FAULT CONDITIONS		42.(a)	DC connected Power Park Modules	Method and pre-fault and post fault conditions for minimum and maximum short circuit power	Criteria - In due time for plant design	RSO in coordination with TSO
	EQUIVALENTS REPRESENTING THE COLLECTION GRID		42.(c)	DC connected Power Park Modules	Provide network equivalent for harmonic studies	In due time for plant design	RSO in coordination with TSO
	ELECTRICAL PROTECTION SCHEMES		43.1	DC connected Power Park Modules	Provide protection requirements	In due time for plant design	RSO in coordination with TSO
ISSUES GENERAL	**SCOPE**		38	DC connected Power Park Modules	Non-exhaustive requirements of Articles 11 to 22 of the Network Code RfG will apply	See RfG requirements in table 1	-
	SCOPE		46	Remote-end HVDC converter stations	Non-exhaustive requirements of Articles 11 to 39 will apply	See RfG requirements in table 1	-