European Network of
Transmission System Operators
for Electricity

entsoe

Parameters of Non-exhaustive requirements

ENTSO-E Guidance document for national implementation for network codes on grid connection

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Table of Contents

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DESCRIPTION

Code(s) & Article(s)	Network Codes (NCs) Requirements for Generators (RfG), Demand Connection Code (DCC) and High Voltage Direct Current (HVDC) All articles with non-exhaustive requirements for which a national choice is expected to be requested (see indicative tables per code below)
Introduction	This is a general guidance document that provides a reference to all non-exhaustive parameters. It is aimed to provide the general considerations that are considered relevant in defining nationally these parameters and the principles of coordination between users and system operators to achieve this. This IGD provides only guidance and could not be construed as binding for the implementation of the CNCs at the national level by Member States, NRAs, system operators and all other relevant stakeholders. This general guidance also provides the most generic principles for determining all non-exhaustive parameters, and should be read in conjunction with the more specific guidance on major issues, clustered into the following separate IGDs: - Parameters related to Voltage issues - Parameters related to Frequency issues - Restoration issues - Active and reactive power control - Instrumentation, simulation models and protection For those clusters, general guidance in order to help the Transmission System Operators (TSOs) to define their own parameters has been provided in their own IGDs. Within these clusters are a number of requirements many of which have their own specific IGDs. Those IGDs (found in Active Library) have been developed for specific non-exhaustive requirements and for some activities that have to be carried out for the national implementation (for example cost benefit analysis).
NC frame	The non-exhaustive topics are those for which the European level CNCs do not contain all the information or parameters necessary to apply the requirements immediately. These requirements are typically described in the CNC as “TSO / relevant system operator shall define” or “defined by / determined by / in coordination with the TSO / relevant TSO”. Some of them need a choice at national level, but wider sharing and in some cases collaboration on the criteria can be necessary. ENTSO-E understands that parameters for non-exhaustive requirements shall apply uniformly across different types of significant grid users, except where otherwise specified. For example, FRT capability parameters are different for synchronous power generating modules and power park modules and furthermore vary between Type B/C and Type D power generating modules. However, different parameters of non-exhaustive requirements may be applied regionally. In such cases of varying applications, these need to be justified, comply with the network codes and do not lead to rules that would be incompatible with the

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	network codes. See tables below.
Further info	IGD Parameters related to frequency stability IGD Instrumentation simulation models and protection IGD Voltage-related parameters IGD System Restoration IGD Harmonisation

INTERDEPENDENCIES

Between the NCs	Several requirements exist in all three CNCs, RfG, DCC and HVDC. Many of these requirements will need to be considered in aggregate to ensure that when requirements are defined they provide the necessary functional requirements to ensure the system is secure and operable. Consistency in the national choices shall be ensured also through the NRA's monitoring/approval role on the national implementation.
In other NCs	There are many links nationally to the implementation of the codes applying the connection capabilities in both system and market operation (System Operation Committee and Market Committee topics). In some cases these topics are expected to be at a national level contained in combined documents (e.g. broader content Grid Codes). Consistency needs to be maintained in these cases, i.e. it needs to be ensured that national connection code frequency capabilities are actually defined so that the settings that need to be applied can be developed through system and market operation codes.
System characteristics	System characteristics and its likely evolution have to be taken into consideration for the definition at national level of non-exhaustive requirements The choice of most of the non-exhaustive parameters in each country at the entry into force of the NC will need to take into account the immediate and future system characteristics (for example RES penetration), including both the networks development and that of its portfolio of users. These are expected to change continuously and differently in each country. It is recommended to consider at national level the expected changes in network needs over the next 15-20 years, in order to define these parameters. Some choices will be also influenced by the proportion of the different types of generators within the country (type A/B versus C/D). In general, determining factors to be considered for the definition at national level of the non-exhaustive requirements, could be: - Maintaining existing requirements and performance, that are already foreseen from previous national regulations where their need and benefit is demonstrated by operational experience - Taking into consideration national generation portfolio characteristics and their evolution (e.g. level of penetration of renewable energy sources)

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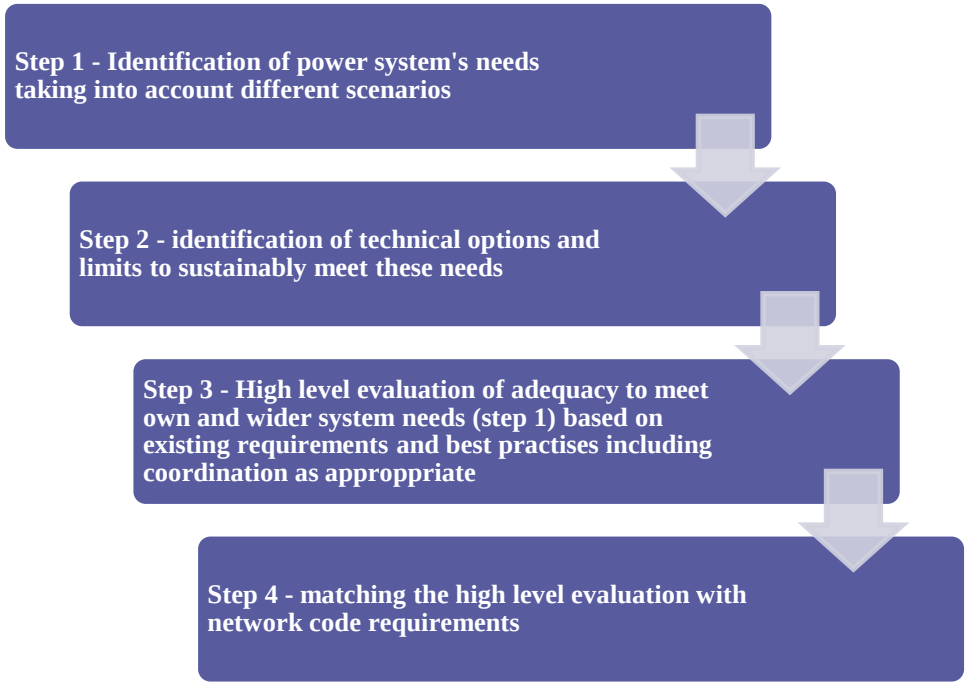
	- Taking into consideration national system characteristics and its evolution (e.g. rural/urban conditions, density of load and generation) - Ensuring that requirements needed for guaranteeing security of supply will be fulfilled at any time even considering the peculiarity of each electricity system (such as negative balance of each country)
Technology characteristics	Specification of non-exhaustive parameters for the functional requirements will typically be unaffected by the technology being used.

COLLABORATION

Methodology principles recommended for specifying non-exhaustive requirements



TSO – TSO	Many parameters for non-exhaustive requirements should require co-ordination between TSOs. in terms of criteria to be considered for the national implementation Some requirements could require collaboration at synchronous area level, other requirements require collaboration between adjacent TSO, to ensure an efficient behaviour of the facilities connected near the border of these TSOs.
TSO – DSO	Many parameters for non-exhaustive requirements should require co-ordination between the TSO and Distribution System Operator (DSO) to ensure their function to meet the functional requirements in the CNCs. These will be identified in the associated tables. It is recommended to TSOs and DSOs to engage with each other at an early stage of national implementation already to explore interdependencies and possible impacts on transmission and distribution systems.

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Relevant System Operator (RSO) – Grid User	Many parameters for non-exhaustive requirements should require co-ordination between the RSO and end user to ensure their function to meet the functional requirements in the CNCs. These will be identified in the associated tables. It is recommended to system operators to engage with grid users at an early stage of national implementation to raise awareness on system engineering aspects and inform about system challenges. Early involvement supports transparency of the implementation processes and helps to mitigate concerns about discretionary decisions during implementation. It enables stakeholders to contribute actively to solutions and to make use of their expertise, e.g. manufacturers' knowledge about technical capabilities and constraints of certain technologies. Factual discussions on technical / procedural challenges based on expertise and best practice are thus facilitated.

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Table 1 – RfG Non-Exhaustive Requirements

Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing of proposal	Proposer
FREQUENCY ISSUES	**FREQUENCY RANGES**		13.1.a.(i)	A, B, C, D	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	TSO
		X	13.1.a.(ii)	A, B, C, D	Agreement on wider frequency ranges, longer minimum times for operation or specific requirements for combined frequency and voltage deviations	Value - in due time for plant design	agreement between the RSO (DSO or TSO), in coordination with the TSO, and the Power Generating Facility Owner (PGFO)
	RATE OF CHANGE OF FREQUENCY (ROCOF) WITHSTAND CAPABILITY		13.1.(b)	A, B, C, D	- Maximum ROCOF for which the Power Generating Module (PGM) shall stay connected	Value - CNC national implementation	TSO
					specify ROCOF of the loss of main protection	In due time for plant design	RSO in coordination with the TSO
	LIMITED FREQUENCY SENSITIVE MODE (LFSM)-O		13.2.(a)	A, B, C, D	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
		X	13.2(b)	A	Use of automatic disconnection and reconnection	Value and criteria - CNC national implementation	TSO
		X	13.2(f)	A, B, C, D	Expected behaviour of the PGM once the minimum regulating level is reached	CNC national implementation	TSO
	ADMISSIBLE ACTIVE POWER REDUCTION FROM MAXIMUM OUTPUT WITH FALLING FREQUENCY		13.4	A, B, C, D	Admissible active power reduction from maximum output with falling frequency	CNC national implementation and reviewed in due time for plant design	TSO
			13.5	A, B, C, D	definition of the ambient conditions applicable when defining the admissible active power reduction and take	CNC national implementation and reviewed in due time for	TSO

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Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing of proposal	Proposer
					account of the technical capabilities of power-generating modules	plant design	
	LOGIC INTERFACE	**X**	13.6	A, B, C, D	Requirements for the additional equipment necessary to allow active power output to be remotely operable	In due time for plant design	RSO
	AUTOMATIC CONNECTION TO THE NETWORK		13.7	A, B, C, D	Conditions for automatic connection to the network, including: - frequency ranges and corresponding delay time - Maximum admissible gradient of increase in active power output	CNC national implementation	TSO
	LOGIC INTERFACE	**X**	14.2.b	B, C, D	Requirements for the equipment necessary to make the logic interface (to cease active power output) remotely operable	In due time for plant design	RSO
	FREQUENCY STABILITY		15.2.(a)	C, D	Time period for reaching x% of the target output	CNC national implementation	TSO
	LFSM-U		15.2.c	C, D	Definition of the frequency threshold and droop	Range – CNC national implementation Adjustable Setting – In due time for plant design and to be reselected as appropriate using the capabilities defined at CNC national implementation	TSO
				C, D	Definition of Pref	CNC national implementation	TSO
	FREQUENCY SENSITIVE MODE		15.2.d.(i)	C, D	Parameters of the Frequency Sensitive Mode (FSM): - Active power range related to maximum capacity - Frequency response insensitivity - Frequency response dead band - Droop	Range – CNC national implementation Adjustable Setting – In due time for plant design and to be reselected as appropriate using the capabilities defined at CNC national implementation	TSO
			15.2.d.(iii)	C, D	Maximum admissible full activation time	CNC national implementation	TSO
		X	15.2.d.(iv)	C, D	Maximum admissible initial delay for power generating modules without inertia	CNC national implementation	TSO

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Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing of proposal	Proposer
			15.2.d.(v)	C, D	time period for the provision of full active power frequency response	CNC national implementation	TSO
	FREQUENCY RESTORATION CONTROL		15.2.e	C, D	Specifications of the Frequency Restoration Control	CNC national implementation	TSO
	REAL-TIME MONITORING OF FSM		15.2.g	C, D	List of the necessary data which will be sent in real time	In due time for plant design	RSO (DSO or TSO) or TSO
		X			definition of additional signals	In due time for plant design	RSO (DSO or TSO) or TSO
	RATES OF CHANGE OF ACTIVE POWER OUTPUT		15.6.e	C, D	Definition of the minimum and maximum limits on rates of change of active power output (ramping limits) in both an up and down direction, taking into consideration the specific characteristics of the prime mover technology	CNC national implementation and reviewed in due time for plant design	RSO in coordination with the TSO
	SYNTHETIC INERTIA CAPABILITY FOR POWER PARK MODULE (PPM)	**X**	21.2	PPM: C, D	Definition of the operating principle of control systems to provide synthetic inertia and the related performance parameters	CNC national implementation	TSO
VOLTAGE ISSUES	**FAULT RIDE THROUGH CAPABILITY**		14.3.a	B, C, D	Voltage-against-time profile	CNC national implementation	TSO
			14.3.a	B, C, D	pre-fault and post-fault conditions	CNC national implementation	TSO
			14.3.b	B, C, D	Voltage-against-time profile for asymmetric faults	CNC national implementation	TSO
			16.3.a.(i)	D	voltage-against-time profile	CNC national implementation	TSO
			16.3.a.(ii)	D	pre-fault and post-fault conditions	CNC national implementation	TSO
			16.3.c	D	Voltage-against-time profile for asymmetric faults	CNC national implementation	TSO
	ACTIVE POWER CONTROLLABILTY AND CONTROL RANGE		15.2.a	C, D	Time period to reach the adjusted active power set point Tolerance applying to the new set point and the time to reach it.	CNC national implementation	RSO (DSO or TSO) or TSO
	AUTOMATIC DISCONNECTION DUE TO VOLTAGE LEVEL		15.3	C, D	Voltage criteria and technical parameters at the connection point for automatic disconnection	Value - in due time for plant design	RSO (DSO or TSO), in coordination with the TSO
	VOLTAGE RANGES		16.2.a.(i)	D	**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**	Value - CNC national implementation	TSO
		X	16.2.a.(ii)	D	Determination of shorter time periods in the event of simultaneous overvoltage and under frequency or simultaneous under voltage and over frequency	CNC national implementation	relevant TSO

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Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing of proposal	Proposer
		X	16.2.a.(iii)	D	**For Spain** time period for operation in the voltage range 1,05 pu-1,0875 pu for PGMs connected between **300kV and 400 kV may be specified as unlimited**	Value - CNC national implementation	TSO
		X	16.2.a.(v)	D	**For Baltic** voltage ranges and time period for operation may be specified in line with continental Europe for facilities connected for **400 kV**	Value - CNC national implementation	TSO
			16.2.b	D	Wider voltage ranges or longer minimum time periods for operation may be agreed.	Value - in due time for plant design	agreement between the RSO and the PGFO, in coordination with the TSO
	REACTIVE POWER CAPABILITY FOR SYNCHRONOUS PGM	X	17.2.a	Synchronous B, C, D	Capability to supply or absorb reactive power	Range -CNC national implementation	RSO
	SUPPLEMENTARY REACTIVE POWER FOR SYNCHRONOUS PGM	X	18.2.a	Synchronous C, D	Definition of supplementary reactive power to compensate for the reactive power demand of the high-voltage line or cable when the connection point is not located at the HV side of the step-up transformer	Range - CNC national implementation	RSO
	REACTIVE POWER CAPABILITY AT MAXIMUM CAPACITY FOR SYNCHRONOUS PGM		18.2.b.(i)	Synchronous C, D	Definition of a U-Q/Pmax-profile at maximum capacity	Range of capability - CNC national implementation	RSO in coordination with the TSO
			18.2.b.(iv)	Synchronous C, D	appropriate timescale to reach the target value	Value -CNC national implementation	RSO
	VOLTAGE STABILITY FOR SYNCHRONOUS PGM		19.2.b.(v)	Synchronous D	Power threshold above which a PSS function is to be specified	Value -CNC national implementation	TSO
	REACTIVE POWER CAPABILITY FOR PPM	X	20.2.a	PPM: B, C, D	Capability to supply or absorb reactive power	Range of capability - CNC national implementation	RSO

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Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing of proposal	Proposer
	FAST FAULT CURRENT INJECTION FOR PPM	**X**	20.2.b	PPM: B, C, D	Specifications of: - how and when a voltage deviation is to be determined as well as the end of the voltage deviation - Fast fault current characteristics - Timing and accuracy of the fast fault current, which may include several stages during a fault and after its clearance	Values -CNC national implementation	RSO in coordination with the TSO
		X	20.2.c	PPM: B, C, D	Specifications for asymmetrical current injection, in case of asymmetric faults (1-phase or 2-phase)	Value -CNC national implementation	RSO in coordination with the TSO
	SUPPLEMENTARY REACTIVE POWER FOR PPM	**X**	21.3.a	PPM: C, D	Definition of supplementary reactive power for a PPM whose connection point is not located at the high-voltage terminals of its step-up transformer nor at the terminals of the high-voltage line or cable to the connection point at the PPM, if no step-up transformer exists	Range -CNC national implementation	RSO
	REACTIVE POWER CAPABILITY AT MAXIMUM CAPACITY FOR PPM		21.3.b	PPM: C, D	Definition of a U-Q/Pmax-profile at maximum capacity	Range of capability - CNC national implementation	RSO in coordination with the TSO
	REACTIVE POWER CAPABILITY BELOW MAXIMUM CAPACITY FOR PPM		21.3.c.(i) 21.3.c.(ii)	PPM: C, D	definition of a P-Q/Pmax-profile below maximum capacity	Range of capability- CNC national implementation	RSO in coordination with the TSO
			21.3.c.(iv)	PPM: C, D	appropriate timescale to reach the target values	Value - CNC national implementation	RSO
	REACTIVE POWER CONTROL MODES FOR PPM		21.3.d.(iv)	PPM: C, D	In voltage control mode: t1 = time within which 90% of the change in reactive power is reached t2 = time within which 100% of the change in reactive power is reached	Values - CNC national implementation	RSO
			21.3.d.(vi)	PPM: C, D	In power factor control mode: - Target power factor - Time period to reach the set point - Tolerance	Ranges - CNC national implementation	RSO
			21.3.d.(vii)	PPM: C, D	Specifications of which of the above three reactive power control mode options and associated set points is to apply, and what further equipment is needed to make the adjustment of the relevant set point operable remotely;	in due time for plant design	RSO, in coordination with the TSO and the PGFO
	PRIORITY TO ACTIVE OR REACTIVE POWER CONTRIBUTION FOR PPM		21.3.e	PPM: C, D	Specification of whether active power contribution or reactive power contribution has priority during faults for which fault-ride-through capability is required.	CNC national implementation	relevant TSO

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Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing of proposal	Proposer
	VOLTAGE RANGES FOR OFFSHORE PPM		25.1	Offshore	**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**	Value - CNC national implementation	TSO
	VOLTAGE CONTROL SYSTEM FOR SYNCHRONOUS PGM		19.2.a	Synchronous D	- Parameters and settings of the components of the voltage control system - Specifications of the AVR	Ranges - in due time for plant design	agreement between the PGFO and the RSO, in coordination with the TSO
	VOLTAGE RANGES		25.1	Offshore	**For Continental Europe** time period for operation in the voltage range 1,118 pu-1,15 pu, 1,05pu-1,10pu for PGM For Nordic time period for operation in the voltage range 1,05pu-1,10pu for PGM	Value - CNC national implementation	TSO
		X	16.2.a.(iii)	Offshore	**For Spain** time period for operation in the voltage range 1,05 pu-1,0875 pu for PGMs connected between **300kV and 400 kV may be specified as unlimited**	Value - CNC national implementation	TSO
		X	16.2.a.(v)	Offshore	**For Baltic** voltage ranges and time period for operation may be specified in line with continental Europe for facilities connected for **400 kV**	Value - CNC national implementation	TSO
	REACTIVE POWER CAPABILITY AT MAXIMUM CAPACITY FOR OFFSHORE PPM		25.5	Offshore	Definition of the U-Q/Pmax-profile at Pmax	Range of capability- CNC national implementation	TSO
SYSTEM RESTORATION	**CAPABILITY OF RECONNECTION AFTER AN INCIDENTAL DISCONNECTION CAUSED BY A NETWORK DISTURBANCE**		14.4.a	B, C, D	Conditions for reconnection to the network after an incidental disconnection caused by network disturbance	CNC national implementation	TSO
			14.4.b	B, C, D	Conditions for automatic reconnection	CNC national implementation	TSO
	BLACK START CAPABILITY	**X**	15.5.a.(ii)	C, D	Technical specifications for a quotation for Black Start Capability	Principle - CNC national implementation in due time for plant design	TSO
		X	15.5.a.(iii)	C, D	Timeframe within which the PGM is capable of starting from shutdown without any external electrical energy supply	Value - CNC national implementation	RSO (DSO or TSO) in coordination with the TSO

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Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing of proposal	Proposer
		X	15.5.a.(iv)	C, D	voltage limits for synchronisation when art.16.2 non applicable	Range - CNC national implementation	RSO (DSO or TSO)
	CAPABILITY TO TAKE PART IN ISLAND OPERATION	X	15.5.b.(iii)	C, D	Methods and criteria for detecting island operation	In due time for plant design	agreement between the PGFO and the RSO (DSO or TSO), in coordination with the TSO
	OPERATION FOLLOWING TRIPPING TO HOUSELOAD		15.5.c.(iii)	C, D	Minimum operation time within which the PGM is capable of operating after tripping to house load	Value - CNC national implementation	RSO (DSO or TSO), in coordination with the TSO
	ACTIVE POWER RECOVERY FOR SYNCHRONOUS PGM		17.3	Synchronous B, C, D	Definition of the magnitude and time for active power recovery	Value - CNC national implementation	TSO
	POST FAULT ACTIVE POWER RECOVERY FOR PPM		20.3.a	PPM: B, C, D	Specifications of the post-fault active power recovery Following specifications: - when the post-fault active power recovery begins, based on a voltage criteria - a maximum allowed time for active power recovery - a magnitude and accuracy for active power recovery	Value - CNC national implementation	TSO
INSTRUMENTATION SIMULATION MODELS AND PROTECTION	**CONTROL SCHEME AND SETTINGS**		14.5.a	B, C, D	control schemes and settings of the control devices	Control schemes: in due time for plant design Settings: Values - before plant commissioning and to be reselected as appropriate	agreement and coordination between the TSO, the RSO (TSO and DSO) and the PGFO
	ELECTRICAL PROTECTION SCHEMES AND SETTINGS		14.5.b	B, C, D	protection schemes and settings	Protection schemes: in due time for plant design Settings: Values - before plant commissioning and to be reselected as appropriate	agreement and coordination between the RSO and the PGFO
	INFORMATION EXCHANGES		14.5.d	B, C, D	Content of information exchanges and precise list and time of data to be facilitated.	Principle - CNC national implementation	RSO (DSO or TSO) or TSO

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Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing of proposal	Proposer
						Value - in due time for plant design	
	MANUAL, LOCAL MEASURES WHERE THE AUTOMATIC REMOTE DEVICES ARE OUT OF SERVICE		15.2.b	C, D	Time period and tolerance requested to reach the set point in cases where the automatic remote control devices are out of service	Value - in due time for plant design	RSO (DSO or TSO) or TSO
	LOSS OF ANGULAR STABILITY OR LOSS OF CONTROL		15.6.a	C, D	criteria to detect loss of angular stability or loss of control	Value - in due time for plant design	Agreement between the PGFO and the RSO (DSO or TSO), in coordination with the TSO.
	INSTRUMENTATIO N	**X**	15.6.b.(i)	C, D	Definition of the quality of supply parameters	in due time for plant design	RSO
			15.6.b.(ii)	C, D	Settings of the fault recording equipment, including triggering criteria and the sampling rates	Value - in due time for plant design	Agreement between the PGFO and the RSO (DSO or TSO), in coordination with the TSO.
			15.6.b.(iii)	C, D	Specifications of the oscillation trigger detecting poorly damped power oscillations	Value - in due time for plant design	RSO in coordination with the TSO
			15.6.b.(iv)	C, D	Protocols for recorded data.	in due time for plant design	agreement between the PGFO, the RSO and the relevant TSO
	SIMULATION MODELS	**X**	15.6.c.(iii)		Specifications of the simulation models	CNC national implementation	RSO in coordination with the TSO
	INSTALLATION OF DEVICES FOR SYSTEM OPERATIONS AND SYSTEM SECURITY	**X**	15.6.d	C, D	Definition of the devices needed for system operation and system security	In due time for plant design	RSO or TSO and PGFO
	NEUTRAL-POINT AT THE NETWORK SIDE OF STEP-UP TRANSFORMERS		15.6.f	C, D	Specifications of the earthing arrangement of the neutral-point at the network side of step-up transformers	Principle - CNC national implementation Value - in due time for plant design and to be reselected as appropriate	RSO
	AUTOMATIC DISCONNECTION	**X**	16.2.c	D	Definition of the threshold for automatic disconnection	Value - in due time for plant design	RSO in coordination with the TSO

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Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing of proposal	Proposer
					Definition of the parameters	Values - in due time for plant design	agreement between le RSO and the PGFO
	SYNCHRONISATION		16.4	D	Settings of the synchronisation devices	Range – CNC national implementation Value – before plant commissioning and to be reselected as appropriate	agreement between le RSO et the PGFO
	ANGULAR STABILITY UNDER FAULT CONDITIONS		19.3	Synchronous	Agreement for technical capabilities of the PGM to aid angular stability.	In due time for plant design	agreement between the TSO and the PGFO
	SYNTHETIC INERTIA CAPABILITY FOR PPM	**X**	21.2	PPM: C, D	- Definition of the operating principle of control systems to provide synthetic inertia and the related performance parameters	CNC national implementation	TSO

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Table 2 – DCC Non-Exhaustive Requirements

Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing of Proposal	Proposer
FREQUENCY ISSUES	**FREQUENCY RANGES**		12.1	Transmission Connected Demand Facility (DF) and DSO	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	TSO
		X	12.2	Transmission Connected DF and DSO	Agreement on wider frequency ranges, longer minimum times for operation	Value - in due time for plant design	agreement between the DSO, Transmission Connected Demand Facility (TCDF) and the TSO
		X	29.2 (a)	DF and Closed Distribution System (CDS) offering Demand Response (DR)	definition of a extended frequency range	Value - CNC national implementation	agreement between TSO and TC DSO or TC DF
	DEMAND RESPONSE SFC	**X**	29.2 (c)	Demand Unit (DU) offering DR	for DU connected below 110 kV: definition of the normal operating range	Value - CNC national implementation	RSO
		X	29.2 (c)	DU offering DR	definition of the allowed frequency dead band	Value - CNC national implementation	TSO, in consultation with the TSO of the synchronous area
		X	29.2 (e)	DU offering DR	definition of the frequency range for DR System Frequency Control (SFC) and definition of the maximum frequency deviation to respond	Value - CNC national implementation	TSO, in consultation with the TSO of the synchronous area
		X	21.2 (g)	DU offering DR	definition of the rapid detection and response to frequency system changes	CNC national implementation	TSO, in consultation with the TSO of the synchronous area
ISSUES VOLTAGE	**VOLTAGE RANGES**		13.1 and ANNEX II	Transmission Connected DF and Transmission connected DSO **above 110kV**	**For Continental Europe** time period for operation in the voltage range 1,118 pu-1,15 pu for facilities connected between **110kV and 300 kV**	Value - CNC national implementation	TSO

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Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing of Proposal	Proposer
		X	13.4	Transmission Connected DF and Transmission connected DSO **above 110kV**	**For Spain** time period for operation in the voltage range 1,05 pu-1,0875 pu for facilities connected between **300kV and 400 kV may be specified as unlimited**	Value - CNC national implementation	TSO
		X	13.5	Transmission Connected DF and Transmission connected DSO **above 110kV**	**For Baltic** voltage ranges and time period for operation may be specified in line with continental Europe for facilities connected for **400 kV**	Value - CNC national implementation	TSO
	AUTOMATIC DISCONNECTION DUE TO VOLTAGE LEVEL		13.6	Transmission Connected DF and Transmission connected DSO	Voltage criteria and technical parameters at the connection point for automatic disconnection	Value - in due time for plant design	agreement between TCDF or TCDSO and the TSO
	REACTIVE POWER CAPABILITY FOR TRANSMISSION CONNECTED DEMAND FACILITY AND TRANSMISSION CONNECTED DISTRIBUTION SYSTEM		15.1 (a)	Transmission Connected DF	definition of the actual reactive power range for DF without onsite generation	Value - in due time for plant design	TSO
			15.1 (b)	Transmission Connected DSO	definition of the actual reactive power range for DF with onsite generation	Value - in due time for plant design	TSO
	REACTIVE POWER CAPABILITY FOR TRANSMISSION CONNECTED DISTRIBUTION SYSTEM		15.1 (c)	Transmission Connected DSO	Definition of the scope of the analysis to find the optimal solution for reactive power	At connection application	agreement between TSO and TC DSO
		X	15.1 (d)	Transmission Connected DF and DSO	Define other metrics than power factor	Value - CNC national implementation	TSO
		X	15.1 (e)	Transmission connected DF and Transmission connected DSO	use of other metrics	Value - CNC national implementation	TSO
	DEMAND RESPONSE APC, RPC and TRANSMISSION CONSTRAINT MANAGEMENT (TCM)	**X**	28.2 (a)	DF and CDS offering DR	definition of a extended frequency range	Value - in due time for plant design	agreement between TSO and TC DSO or TC DF
		X	28.2 (c)	DF and CDS offering DR	for DF or CDS connected below 110 kV: definition of the normal operating range	Value - CNC national implementation	RSO
		X	20.2 €, (l)	DF and CDS offering DR	technical specifications to enable the transfer of information for DR LFDD and Low Voltage Demand Disconnection (LVDD), for DR Active Power Control (APC) and DR Reactive Power Control	Value - CNC national implementation	RSO

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Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing of Proposal	Proposer
		X	20.2 (f), (j)	DF and CDS offering DR	definition of the time period to adjust the power consumption	Value - CNC national implementation	TSO
		X	20.2 (i)	DF and CDS offering DR	definition of the modalities of notification in case of a modification of the DR capability	Value - CNC national implementation	RSO or TSO
		X	20.2 (o)	DF and CDS offering DR	definition of the ROCOF maximum value	Value - CNC national implementation	TSO
	POWER QUALITY		20	Transmission connected DF and Transmission connected DSO	allocated level of voltage distortion	Principle - CNC national implementation Value - in due time for plant design	TSO
SYSTEM RESTORATION	**SHORT CIRCUIT REQUIREMENTS**		14.1	Transmission Connected DF and Transmission connected DSO	maximum short-circuit current at the connection point to be withstood	Value - CNC national implementation	TSO
			14.3		unplanned events: threshold of the maximum short circuit current inducing an information from the TSO in case of a change above this threshold	Value – In due time for or post plant design	TCDF or TCDSO
			14.5		planned events: threshold of the maximum short circuit current inducing an information from the TSO in case of a change above this threshold	Value – In due time for or post plant design	TCDF or TCDSO
			14.8		unplanned events: threshold of the maximum short circuit current inducing an information from the TC DF or TC DSO in case of a change above this threshold	Value – In due time for or post plant design	TSO
			14.9		planned events: threshold of the maximum short circuit current inducing an information from the TC DF or TC DSO in case of a change above this threshold	Value – In due time for or post plant design	TSO
	DEMAND DISCONNECTION FOR SYSTEM DEFENSE		19.1	Transmission connected DF and Transmission connected DSO	Definition the capabilities of Low Frequency Demand Disconnection (LFDD) scheme	Principle - CNC national implementation Capability - in due time for plant design	TSO
			19.2 (a)	Transmission connected DSO	Definition of the LVDD scheme	Principle - CNC national implementation Value - in due time for plant design	TSO, in coordination with the TC DSO
			19.2 (b)	Transmission connected DF	Definition of the LVDD scheme	Principle - CNC national implementation Value - in due time for plant	TSO, in coordination with the TC DFO

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Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing of Proposal	Proposer
						design	
		X	19.3(b)	Transmission connected DSO	Definition of the automatic on load tap changer blocking scheme	Principle - CNC national implementation Value - in due time for plant design	TSO
			19.4 (a)	Transmission connected DF and Transmission connected DSO	Definition of the conditions for reconnection after a disconnection	CNC national implementation	TSO
			19.4 (b)	Transmission connected DF and Transmission connected DSO	Settings of the synchronisation devices (including frequency, voltage, phase angle range and deviation of voltage and frequency)	Value - in due time for plant design and to be reselected as appropriate	agreement between TSO and TC DSO or TC DF
		X	19.4 (c)	Transmission connected DF and Transmission connected DSO	definition of the automated disconnection equipment time for remote disconnection	Value - in due time for plant design	TSO
INSTRUMENTATION SIMULATION MODELS AND PROTECTION	**ELECTRICAL PROTECTION SCHEMES AND SETTINGS**		16.1	Transmission connected DF and Transmission connected DSO	protection schemes and settings	Protection schemes: in due time for plant design Settings: Values - before plant commissioning and to be reselected as appropriate	agreement between TSO and TC DSO or TC DF
	CONTROL REQUIREMENTS		17.1	Transmission connected DF and Transmission connected DSO	schemes and settings of the control devices	Control schemes: in due time for plant design Settings: Values - before plant commissioning and to be reselected as appropriate	agreement between TSO and TC DSO or TC DF
	INFORMATION EXCHANGES		18.1	Transmission connected DF and Transmission connected DSO	definition of the standards to exchange information and time stamping	Value - CNC national implementation	TSO

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Type	Non-Exhaustive Requirement	Non-Mandatory Requirement	Article	Applicability	Parameters to be defined	Timing of Proposal	Proposer
			18.2	Transmission connected DF and Transmission connected DSO	definition of the standards to exchange information and time stamping	Value - CNC national implementation	TSO
			18.3	Transmission connected DF and Transmission connected DSO	Make information exchange standards publically available	Value - CNC national implementation	TSO
	SIMULATION MODELS	**X**	21.3	Transmission connected DF, distribution systems and DF above 1000V providing DR	Content and format of the simulation models or equivalent information	Value - CNC national implementation	TSO
		X	21.5	Transmission connected DF, distribution systems and DF above 1000V providing DR	Definition of the requirements for the recordings to be compared with the response of the model.	Value - in due time for plant design	RSO or TSO

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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

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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

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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

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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

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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

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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

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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

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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

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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
GENERAL ISSUES	**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	-

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