European Network of
Transmission System Operators
for Electricity

NETWORK CODE

ON DEMAND CONNECTION

-

JUSTIFICATION OUTLINES

21 DECEMBER 2012

Disclaimer: This document is not legally binding. It only aims at clarifying the content of the network code for demand connection. This document is not supplementing the final network code nor can be used as a substitute to it.

Requirement:	Frequency Ranges			
Reference to NC DCC:	Article 13(1) (a)			
Cross-border impact:	Frequency without any doubt is the parameter of an interconnected electricity transmission and distribution system, which has the largest cross-border impact. Frequency is the same across a synchronous area and across all voltage levels. Deviations of frequency from its nominal value due to generation/load imbalances therefore occur everywhere at the same time and affect all demand units immediately in a common way regardless of their size and voltage level of connection.			
Exhaustive requirement:	X	**Non-exhaustive requirement:**		
Justification:	• Due to the frequency sensitivity of some demand users and the rights of consumers to disconnect their load demand at their own discretion, the requirements are limited to designing by the owner of their facility and/or network to be able to deal with the frequency ranges through for example equipment specification or appropriate control or protection measures. If the Demand facility is not capable to withstand the frequency ranges, the owner must protect his facility and may disconnect partially or totally. • For practical reasons (compliance enforcement), the requirement is limited in this Network Code to Transmission Connected Demand Facilities. All Distribution Networks are required to follow the same design requirement due to their responsibility in connecting embedded generation and demand providing DSR which both do have an obligation to withstand the same ranges. • Due to their immediate cross-border impact, frequency requirements need to be harmonised as much as possible at least on the level of a synchronous area. • System Frequency is impacted by both generation and demand balance and the linking network, therefore certainty is needed to the response of each party to changes in frequency to be able to positively respond to restore frequency to nominal. Particular, the range for unlimited operation needs to be identical to share the burdens of deviations equally. • The ranges and time periods where time-limited operation of demand units is requested however may vary and shall take into account regional characteristics and the network operators' operational requirements, because these ranges are primarily needed for management of system disturbances and restoration. • Inherent inertia of the electricity supply system will decrease due to less synchronous generators connected in future, consequently larger sudden frequency deviations occur in case of load imbalances. •			
Principle/Methodology only:		**(Ranges of) values/parameters given:**	X	
Justification:	• Frequency is the same across a synchronous area and across all voltage levels. • Deviations of frequency from its nominal occur everywhere at the same			

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	time and affect all demand units immediately in a common way regardless of their size and voltage level of connection.
Alternative solutions:	• Limitations on penetration of (RES) generation without inherent inertia, however this will jeopardize achieving EU energy policy targets. • Increased need for transmission connected reserves. (see also Options to increase RES integration in "DCC – Explanatory Note")
Link to FWGL:	• paragraph 2.1: *"… Furthermore, the network code(s)shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, including … Frequency and voltage parameters; …"*

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Requirement:	Voltage Ranges
Reference to NC DCC:	Article 14(1) (a)
Cross-border impact:	Voltage ranges are critical to secure planning and operation of a power system within a synchronous area. These need to be coordinated between adjacent interconnected networks. This can often be a cross border issue, especially for Demand Facilities or Distribution networks connected at or above 110 kV.

Exhaustive requirement:	X	**Non-exhaustive requirement:**		
Justification:	This requirement is given exhaustively in tables 3.1 and 3.2. It concerns only Demand Facilities or Distribution networks connected at transmission level and at or above 110 kV. There is an exception for a few voltage ranges in Continental Europe. Because of the size of this system, there is room for limited variation, while retaining wider coordination. The DCC does not prescribe a requirement for demand at a voltage below 0.9 pu. Behaviour of the system at these low levels is very region-specific. Alternative measures (prescribed by national codes or contractual agreements) may be better suited. Note that the NC RfG also allows for case-specific measures at the most extreme voltage (and frequency) deviations. Due to voltage sensitivity of some loads within facilities/networks voltage requirements are restricted to the equipment at the connection point to ensure that the facility/network remains in parallel with the transmission network. This permits the many inherent non-sensitive loads and/or embedded generation to continue to use the connection point to absorb of provide power.			

Principle/Methodology only:		**(Ranges of) values/parameters given:**	X	
Justification:	• Details are given for in tables 3.1 and 3.2. • There is a clear need to coordinate between adjacent interconnected networks and therefore operating ranges need to be specified.			

Alternative solutions:	Have no defined voltage ranges. However, this would lead to widespread uncertainty in planning and operation of the system with respect to operation beyond normal operating conditions.
Link to FWGL:	• Paragraph 2.1*: "… The network code(s) shall define the physical connection point between the significant grid user's equipment and the network to which they apply. Furthermore, the network code(s) shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, including:* • *Frequency and voltage parameters; …"* • *Paragraph 2.1.1: "For DSOs that are defined as significant grid users, the network code(s) shall set out minimum standards and requirements for their equipment installed at the connection point between the transmission and distribution system networks."*

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Requirement:	Short Circuit			
Reference to NC DCC:	Article 15(1) (a-f)			
Cross-border impact:	Current flow in a fault is determined by the short circuit contribution of all connections in a synchronous system area. Similarly the short circuit withstand capability that facilities and networks must be designed for is also impacted by all connections in a synchronous system. Consequently short circuit capability and contribution is a cross border issue.			
Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• Each connecting party provides a short circuit contribution which must be considered in aggregate to determine the safe and adequate design of transmission, distribution and demand facilities. • The design level of connections to a transmission network are based its design which is in itself based on the topography and geography of the country, and the point of connection to the network (e.g. voltage level). Therefore withstand limits vary significantly and are best set nationally.			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	• The design level of connections to a transmission network are based its design which is in itself based on the topography and geography of the country, and the point of connection to the network (e.g. voltage level). Therefore withstand limits vary significantly and are best set nationally.			
Alternative solutions:	Have no defined requirement to provide short circuit contribution for the design of safe and technically adequate networks and facilities. However this would lead to widespread uncertainty in planning and operation of the system with respect to operation beyond normal operating conditions, and result in a conservative and uneconomic design of networks and facilities to ensure their safety and reliability.			
Link to FWGL:	• Paragraph 2.1*: "… The network code(s) shall define the physical connection point between the significant grid user's equipment and the network to which they apply. Furthermore, the network code(s) shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, including:* *Short circuit current; …"* • *Paragraph 2.1.1: "For DSOs that are defined as significant grid users, the network code(s) shall set out minimum standards and requirements for their equipment installed at the connection point between the transmission and distribution system networks."*			

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Requirement:	Reactive Power			
Reference to NC DCC:	Article 16(1) (a)			
Cross-border impact:	Reactive power is a key component in terms of voltage stability, which in turn is the foundation for cross-border trading. The most influential point to overall system voltage stability is the connection point of others facilities and networks to the transmission network and hence requirements reflect this.			
Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• Each connected Demand Facility or Distribution Network exchanges reactive power either into or from the transmission network which must be considered in aggregate to determine the overall system voltage stability. • The design level of connections to a transmission network are based on the design which is in itself based on the topography and geography of the country, and the point of connection to the network (e.g. voltage level). Therefore specific capabilities are best set nationally.			
Principle/Methodology only:		**(Ranges of) values/parameters given:**	X	
Justification:	• Defining a maximum European range of acceptable reactive power exchange and the principles for setting the eventual requirement or possible exceptions in a transparent manner, ensures non-discrimination of Transmission Connected Demand Facilities and/or Distribution Networks, whilst allowing for regional flexibility to account for network design. • To ensure that site-specific exceptions can be covered by a transparent, non-discriminatory process the code allows for situations where either technical or financial system benefits are demonstrated. Regarding Transmission Connected Distribution Networks also the scope of the analysis will be agreed between the Relevant TSO and DNO and will consider the possible solutions and determine the optimal solution for reactive power exchange between their networks taking adequately in consideration the specific network characteristics, variable structure of power exchange, bidirectional flows and the reactive capabilities in the distribution grid, while respecting the provisions of Article 9(3);			
Alternative solutions:	• Rely upon markets to deliver adequate reactive capability to ensure demand requirements are met. However, for wider ranges reactive power provision becomes very challenging given the capabilities of renewable power. This coupled with experience that has shown that markets are better suited to optimise the use of reactive power than ensure adequate capability and therefore liquidity in the market reduces viability of this solution. • Develop significant new reactive compensation devices on the transmission network, which has been shown to be a sub-optimal cost effective solution following 'Call for evidence', stage 1 consultation			
Link to FWGL:	• paragraph 2.1: *"… The network code(s) shall define the requirements on significant grid users in relation to the relevant system parameters*			

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	contributing to secure system operation, including: ○ *Requirements for reactive power; …"*

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Requirement:	Reactive Power			
Reference to NC DCC:	Article 16(1) (b)			
Cross-border impact:	Reactive power is a key component in terms of voltage stability, which in turn is the foundation for cross-border trading. The most influential point to overall system voltage stability is the connection point of others facilities and networks to the transmission network and hence requirements reflect this.			
Exhaustive requirement:	X	**Non-exhaustive requirement:**		
Justification:	• Each connected Distribution Network exchanges reactive power either into or from the transmission network which must be considered in aggregate to determine the overall system voltage stability. • Changes to network development architecture, notably through the introduction of cables coupled with reduced inherent generation reactive power capabilities during normal merit order dispatch (due to embedded and renewable generation) means that voltages are becoming un-sustainable on the transmission network. The most effective solutions demonstrated in 'Call for evidence', Stage 1 Consultation is reactive compensation of network architecture at source. • The design level of connections to a transmission network are based on the design which is in itself based on the topography and geography of the country, and the point of connection to the network (e.g. voltage level). Therefore specific capabilities are best set nationally.			
Principle/Methodology only:		**(Ranges of) values/parameters given:**	X	
Justification:	• The case studies, including cost benefit analyses, given in the "DCC – Frequently Asked Questions" indicate that compensation of reactive power consumption at low load are most cost effective and technically most resilient solution.[1]			
Alternative solutions:	• Rely upon markets to deliver adequate reactive capability to ensure demand requirements are met. However, for wider ranges reactive power provision becomes very challenging given the capabilities of renewable power. This coupled with experience that has shown that markets are better suited to optimise the use of reactive power than ensure adequate capability and therefore liquidity in the market reduces viability of this solution. • Develop significant new reactive compensation devices on the transmission network, which has been shown to be a sub-optimal cost effective solution following 'Call for evidence', stage 1 consultation			
Link to FWGL:	• paragraph 2.1: *"… The network code(s) shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, including:* ○ *Requirements for reactive power; …"*			

[1] Feedback asked for in the DCC – Call for Stakeholder Input
Level of 25% as baseline for minimum load across Europe has been discussed and agreed with the DSO Technical Expert Group. The requirement itself has been extensively discussed with the DSO Technical Expert Group as well, resulting in the given wording of the final DCC. See publicly available stakeholder Minutes of Meetings.

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Requirement:	Reactive Power			
Reference to NC DCC:	Article 16(1) (c)			
Cross-border impact:	Reactive power is a key component in terms of voltage stability, which in turn is the foundation for cross-border trading. The most influential point to overall system voltage stability is the connection point of others facilities and networks to the transmission network and hence requirements reflect this.			
Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• Each connected Distribution Network exchanges reactive power either into or from the transmission network which must be considered in aggregate to determine the overall system voltage stability. • The design level of connections to a transmission network are based on the design which is in itself based on the topography and geography of the country, and the point of connection to the network (e.g. voltage level). Therefore withstand limits vary significantly and are best set nationally. • Moving to a dynamic control of reactive power at the Distribution to Transmission network interface maximises the contribution of the Distribution network to the overall management of the transmission and synchronous networks. It becomes possible because of the development of generation connected to the transmission network. • Cost efficient solution should be justified in many cases given appropriate implementation time to move to dynamic operation.			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	• Due to the bespoke capabilities of a Distribution Network to perform dynamic operation, relating to the topography, level of generation demand and demand side response that will be available in a network the time plan, justification and final capability of each Distribution network should be optimised on a bespoke basis.			
Alternative solutions:	• Rely upon markets to deliver adequate reactive capability to ensure demand requirements are met. However, for wider ranges reactive power provision becomes very challenging given the capabilities and location (i.e. embedded in distribution networks) of renewable power. This coupled with experience that has shown that markets are better suited to optimise the use of reactive power than ensure adequate capability and therefore liquidity in the market reduces viability of this solution.			
Link to FWGL:	• paragraph 2.1: *"… The network code(s) shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, including:* ○ *Requirements for reactive power; …"*			

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Requirement:	Reactive Power			
Reference to NC DCC:	Article 16(1) (d)			
Cross-border impact:	Reactive power is a key component in terms of voltage stability, which in turn is the foundation for cross-border trading. The most influential point to overall system voltage stability is the connection point of others facilities and networks to the transmission network and hence requirements reflect this.			
Exhaustive requirement:	X	**Non-exhaustive requirement:**		
Justification:	• The applicability of the provisions of paragraph 1 c) to the Transmission Connected Distribution Network shall exclude the applicability of paragraph 1 a) to this Network			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	• It is not possible for both Article 10(1) (a) and Article 10(1) (c)			
Alternative solutions:	N/A			
Link to FWGL:	• paragraph 2.1: *"… The network code(s) shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, including:* o *Requirements for reactive power; …"*			

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Requirement:	Protection and Control			
Reference to NC DCC:	Article 17(1) (a-c)			
Cross-border impact:	Proper network protection is essential for maintaining system stability and security, in particular in case of disturbances to the system. Protection schemes shall prevent from aggravation of disturbances and limit their consequences (e. g. selective short-circuit fault clearance).			
Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• Maintaining system stability and security is a responsibility of the Relevant Network Operator. • Protection schemes and settings of the network, Demand Facilities and Distribution Networks need to be well coordinated in order to fulfil its purpose of maintaining system stability and security. The schemes and settings depend on the Demand facility or Distribution Network and the network's protection strategies, as well as regional system characteristics and thus have to be further specified at the level of the Relevant Network Operator.			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	• Protection schemes and settings of the network and of Demand Facilities or Distribution Networks depend on the Demand facility or Distribution Network combined with the network's protection strategies, as well as regional system characteristics. • Only the principle/methodology can be described in the network code, the detailed values and parameters, which need to be coordinated and agreed upon, depend on the individual scheme and system characteristics.			
Alternative solutions:	Leave this requirement to market incentives to deliver the necessary stability. However, there would be no certain basis upon which to plan and operate the system.			
Link to FWGL:	• paragraph 2.1: *"… Furthermore, the network code(s) shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, including … Requirements for protection devices and settings; …"*			

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Requirement:	Protection and Control			
Reference to NC DCC:	Article 17(2) (a-c)			
Cross-border impact:	Dynamic behaviour of all the demand users of the transmission network, in particular in disturbed system operating conditions is crucial combined with dynamic behaviour of generation for system stability as a whole. This dynamic behaviour is largely determined by the each users control schemes and settings.			
Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• Maintaining transmission system stability is a responsibility of the Relevant TSO. • Control schemes and settings of Demand Facilities and Distribution Networks are designed individually; therefore they cannot be described exhaustively on a European level with their impact on transmission system stability. This impact needs to be evaluated taking into account regional system characteristics and shall be agreed with the Relevant Network Operator and the Relevant TSO.			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	• Control schemes and settings of Demand Facilities and Distribution Networks are designed individually. • Only the principle/methodology can be described in the network code, the detailed values and parameters, which need the network operator's consent, depend on the individual scheme.			
Alternative solutions:	Leave this requirement to market incentives to deliver the necessary stability. However, there would be no certain basis upon which to plan and operate the system.			
Link to FWGL:	• paragraph 2.1: *"… Furthermore, the network code(s) shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, including … Requirements for protection devices and settings; …"*			

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Requirement:	Protection and Control			
Reference to NC DCC:	Article 17(3)			
Cross-border impact:	Protection of the network and the Demand Facilities and Distribution Networks need to have highest priority in order to maintain system stability and security, as well as health and safety of staff and the public.			
Exhaustive requirement:		**Non-exhaustive requirement:**		
Justification:	• A ranking needs to be given in order to specify which capabilities shall take precedence when designing the protection and control schemes, if conflicting otherwise. • A harmonised ranking shall apply to achieve a common basis for operational strategies for secure system operation.			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	• A ranking specifies the priority of certain (types of) requirements. No values/parameters are given by such a priority list.			
Alternative solutions:	Leave this requirement to market incentives to deliver the necessary stability. However, there would be no certain basis upon which to plan and operate the system.			
Link to FWGL:	• paragraph 2.1: *"… Furthermore, the network code(s)shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, including … Requirements for protection devices and settings; …"*			

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Requirement:	Information Exchange			
Reference to NC DCC:	Article 18(3)			
Cross-border impact:	Adequate information exchange between network operators and Demand Facilities operators and/or Distribution Networks operators is a prerequisite for network operators to maintain system stability and security. Network operators need to have continuously an overview over the state of the system, which includes information on the operating conditions of Demand Facilities and Distribution Networks as well as the possibility to communicate with them in order to direct operational instructions.			
Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• The mere capability to exchange information is required. Details on the information to be exchanged depend on the operational strategies of the Relevant Network Operator and the Relevant TSO.			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	Further specifications beside the general principle/methodology depend on operational strategy and communication infrastructure in the responsibility area of each network operator and TSO and can be specified at that level only.			
Alternative solutions:	Have no requirement and leave capability to the market. However, it is unlikely, based on extensive experience, that the required minimum capability will be made available without detailing what is required.			
Link to FWGL:	• paragraph 3.1: *"… The network code(s) shall set out the procedures and requirements to coordinate and ensure information sharing between … System operator and significant grid user …"* • paragraph 3.2: *"… The network code(s) shall set the requirement for every significant grid user to be able and obliged to provide the necessary real-time operational information to the DSO and TSO that their connection has significant impact upon. The network code(s) shall set the requirement for every significant grid user to be able to receive and to execute the instructions sent by the TSO and/or DSO, on a contractual basis or in critical operating state."*			

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Requirement:	Development			
Reference to NC DCC:	Article 19(1)			
Cross-border impact:	The requirements of this network code are needed in order to maintain system stability and security, which is the overall objective of this network code. To achieve this purpose new development of Demand Facilities and Distribution Networks in a way that may have an impact on its performance and ability to meet the requirements of this Network Code, shall meet these requirements.			
Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• The Relevant Network Operator and/or the Relevant TSO need to be aware of changes due to further development of Demand facilities and/or Distribution networks as far as they relate to requirements of this network code, because of the impact on system stability and security. If reasonably possible, compliance with the relevant requirements of this network code shall be achieved in such a case. • The need for compliance testing following further development of an existing Demand Facilities and/or Distribution Networks with the requirements of this network code need an investigation of the individual case, which shall be initiated by this requirement.			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	The requirement itself describes a principle/methodology. No values/parameters are to be given. The investigation of the individual case will reveal, whether values/parameters for this specific case are needed.			
Alternative solutions:	Do nothing. However it is rather common practise of Demand Facilities and/or Distribution Networks to further develop their installations and this often includes an increase of the demand and/or network installed generation capacity. While it is acceptable, that existing facilities and networks shall not be enforced to meet the requirements of this network code (except for an application for retroactive application is made) for their remaining lifetime, it is on the other hand appropriate to require compliance in cases of new development, because such investments are in effect new Demand Facilities or sections of a Distribution Network for which the requirements apply. This avoids discriminatory treatment due to site location of plant and equipment with the same purpose and life expectancy.			
Link to FWGL:	• paragraph 2.1: *"… The network code(s) shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, …"*			

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Requirement:	Modernisation and Equipment Replacement			
Reference to NC DCC:	Article 19(2)			
Cross-border impact:	The requirements of this network code are needed in order to maintain system stability and security, which is the overall objective of this network code. To achieve this purpose in modernization/replacement of Demand Facilities and Distribution Networks in a way that may have an impact on its performance and ability to meet the requirements of this Network Code, the equipment relevant to the planned work shall meet these requirements.			
Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• The Relevant Network Operator and/or the Relevant TSO need to be aware of such changes to Demand facilities and/or Distribution networks due to modernisation/replacements as far as they relate to requirements of this network code, because of the impact on system stability and security. If reasonably possible, compliance with the relevant requirements of this network code shall be achieved in such a case. • Further specifications on compliance of modernised existing Demand Facilities and/or Distribution Networks with the requirements of this network code need an investigation of the individual case, which shall be initiated by this requirement.			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	The requirement itself describes a principle/methodology. No values/parameters are to be given. The investigation of the individual case will reveal, whether values/parameters for this specific case are needed.			
Alternative solutions:	Do nothing. However it is rather common practise of Demand facilities and/or Distribution Networks to modernise/reinforce their installations and this often includes an increase of the demand and/or network installed generation capacity (e.g. modernisation/development of production plant to provide new or enhanced products). While it is acceptable, that existing facilities and networks shall not be enforced to meet the requirements of this network code (except for an application for retroactive application is made) for their remaining lifetime, it is on the other hand appropriate to require compliance in cases of modernisation/reinforcement, because such investments target, amongst others, at extending the lifetime of plant, for which this set of requirements is needed.			
Link to FWGL:	• paragraph 2.1: *"… The network code(s) shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, …"*			

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Requirement:	Demand Disconnection For System Defence and Demand Reconnection			
Reference to NC DCC:	Article 20(1)			
Cross-border impact:	Frequency without any doubt is the parameter of an interconnected electricity transmission and distribution system, which has the largest cross-border impact. Frequency is the same across a synchronous area and across all voltage levels. Deviations of frequency from its nominal value due to load imbalances therefore occur everywhere at the same time and affect all Demand Facilities and Distribution Networks immediately in a common way regardless of their size and voltage level of connection. If load imbalances are not removed and frequency deviations increase, masses of Demand users will disconnect due to frequency, which is out of the range of their design for operation. This will result in an endangerment of system stability and security, which can be overcome by load disconnections at low frequencies.			
Exhaustive requirement:	X	**Non-exhaustive requirement:**		
Justification:	• Low Frequency Demand Disconnection (LFDD) is essential to provide a last measure to retain as many customers as possible in an emergency situation by restoring the balance between generation and load demand.			
Principle/Methodology only:		**(Ranges of) values/parameters given:**	X	
Justification:	• Load disconnection at low frequencies is a common practise emergency feature to restore a balance in load and generation. • As frequency defence plans should be non-discriminatory and co-ordinated across a synchronous area developing the same specification for the schemes permits this principle to be applied. • The growth of RES, changes the needs and hence capabilities for Low Frequency Demand Disconnection necessitating these capabilities to be fitted in future.			
Alternative solutions:	Excessive active power frequency response reserves to be contracted, which has adverse impact on cost-effectiveness. Acceptance of wide spread black outs incidents in areas of the network which may have been avoided.			
Link to FWGL:	• paragraph 2.1: "… Furthermore, the network code(s)shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, including … o Frequency and voltage parameters; … o Load-Frequency control related issues …"			

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Requirement:	Demand Disconnection For System Defence and Demand Reconnection			
Reference to NC DCC:	Article 20(2)			
Cross-border impact:	Frequency without any doubt is the parameter of an interconnected electricity transmission and distribution system, which has the largest cross-border impact. Frequency is the same across a synchronous area and across all voltage levels. Deviations of frequency from its nominal value due to load imbalances therefore occur everywhere at the same time and affect all Demand Facilities and Distribution Networks immediately in a common way regardless of their size and voltage level of connection. If load imbalances are not removed and frequency deviations increase, masses of Demand users will disconnect due to frequency, which is out of the range of their design for operation. This will result in an endangerment of system stability and security, which can be overcome by load disconnections at low frequencies.			
Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• The correct measurement and hence operation of Load Frequency Demand Disconnection (LFDD) is essential to provide a last measure to retain as many customers as possible in an emergency situation by restoring the balance between generation and load demand.			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	• Mal operation of LFDD would result in either the unnecessary disconnection of demand or in emergency situations a failure to operate when required risking further unnecessary loss of demand			
Alternative solutions:	Excessive active power frequency response reserves to be contracted, which has adverse impact on cost-effectiveness. Acceptance of wide spread black outs incidents in areas of the network which may have been avoided.			
Link to FWGL:	• paragraph 2.1: "… Furthermore, the network code(s)shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, including … ○ Frequency and voltage parameters; … ○ Load-Frequency control related issues …"			

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Requirement:	Demand Disconnection For System Defence and Demand Reconnection			
Reference to NC DCC:	Article 20(3)			
Cross-border impact:	Voltage ranges are critical to secure planning and operation of a power system within a synchronous area. These needs to be coordinated between adjacent interconnected networks. This can often be a cross border issue. Voltage collapse has been shown to have a cascading effecting which spreads from a voltage stability problem into frequency related stability problems and result in wide spread black outs. (See also ENTSO-E Technical background and recommendations for defence plans in the Continental Europe synchronous area, 2011)			
Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• Low Voltage Demand Disconnection (LVDD) is essential to provide a last measure to retain as many customers as possible in an emergency situation by alleviating voltage depression caused by imbalance between generation and load demand in an area. • The correct measurement and hence operation of Load Voltage Demand Disconnection (LVDD) is essential to provide a last measure to retain as many customers as possible in an emergency situation by alleviating the voltage depression in an area becoming more wide spread and effecting overall system performance.			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	• Load disconnection at low voltages is an emergency feature to restore a balance in load and generation currently in practice and expected to become a wide spread requirement in future. • As defence plans to cope with emergency situations should be non-discriminatory and co-ordinated across a synchronous area. The capabilities of relevant equipment should follow the same principles and allow for the implementation of defence plans that could be reasonably expected. • The growth of RES, changes the needs and hence capabilities for Low Voltage Demand Disconnection necessitating these capabilities to be fitted in future. • Incorrect operation of an LVDD scheme would result in either the unnecessary disconnection of demand or in emergency situations a failure to operate when required risking further unnecessary loss of demand			
Alternative solutions:	Acceptance of wide spread black outs incidents in areas of the network which may have been avoided.			
Link to FWGL:	• paragraph 2.1: "… Furthermore, the network code(s)shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, including … o Frequency and voltage parameters; … o Load-Frequency control related issues …"			

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Requirement:	Demand Disconnection For System Defence and Demand Reconnection			
Reference to NC DCC:	Article 20(4)			
Cross-border impact:	Voltage ranges are critical to secure planning and operation of a power system within a synchronous area. These needs to be coordinated between adjacent interconnected networks. This can often be a cross border issue. Voltage collapse has been shown to have a cascading effecting which spreads from a voltage stability problem into frequency related stability problems and result in wide spread black outs. (See also ENTSO-E Technical background and recommendations for defence plans in the Continental Europe synchronous area, 2011)			
Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• On Load Tap Change (OLTC) blocking is required in many cases in combination with Low Voltage Demand Disconnection (LVDD) in order to avoid interaction from On Load Tap Changers trying to regulate voltage during emergency situations resulting in a further depression of voltage levels across a wider part of the system. • The growth of RES, changes the needs and hence capabilities for Low Voltage Demand Disconnection necessitating these capabilities to be fitted in future.			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	• Further specifications beside the general principle/methodology depend on operational strategy and communication infrastructure in the responsibility area of each network operator and TSO and can be specified at that level only. • The growth of RES, changes the need for and hence location of OLTC Blocking with LVDD necessitating these capabilities to be fitted in future.			
Alternative solutions:	Acceptance of wide spread black outs incidents in areas of the network which may have been avoided.			
Link to FWGL:	• paragraph 2.1: "… Furthermore, the network code(s)shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, including … ○ Frequency and voltage parameters; … ○ Load-Frequency control related issues …"			

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Requirement:	Demand Disconnection For System Defence and Demand Reconnection			
Reference to NC DCC:	Article 20(5)			
Cross-border impact:	Reconnection after an incidental disconnection due to a network disturbance must fit the circumstances. The absence of this capability was demonstrated as a cross border issue in Continental Europe during the major 3 way system split 4 November 2006. Following the system split uncontrolled reconnections of large amounts of wind generation caused the restoration of the system to be prolonged as the TSOs were hindered in resynchronising the islands (with mass consumer disconnections as a consequence prolonged in many countries). To ensure correct resynchronization of embedded generation (see NC RfG), this needs to be coordinated as well with the resynchronization of Distribution Networks (DCC).			
Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• The TSO decision pursuant to Article 4(3) defining specific conditions for disconnecting, reconnecting, and also define that automatic reconnection shall be subject to prior authorisation by the Relevant Network Operator. • The TSO decision defining specific conditions for the installation synchronising equipment is necessary to ensure the safe reconnection of isolated portions of the network which do or may be operating in an out of synchronism isolated manner from the system before reconnection (i.e. with local generation or only temporarily via DC connection). • The above limitation in the requirement is necessary in order to be proportionate and fit for local circumstances.			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	It is important that the local conditions are taken into account when considering the best approach for the required coordination between TSOs, DSOs and Demand Facility Owners and/or Distribution Network Owners.			
Alternative solutions:	Business as usual with less coordination across the system			
Link to FWGL:	• *paragraph 2.2: "… The network code(s) shall specify a requirement on DSOs to execute (manually or automatically, depending on the purpose) the instructions given by the TSO. The TSO and the DSO shall agree how these instructions are delivered in practice. This applies also for those DSOs connected to another DSO network….'* • *Paragraph 4: "…ENTSO-E shall ensure coherence and compatibility of the grid connection network code(s) with the following provisions,…* ○ *Besides automatically-activated load shedding, there must be a possibility for the TSO and/or DSO to perform manual load shedding if operational security is endangered;…"*			

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Requirement:	General Demand Side Response services			
Reference to NC DCC:	Article 21(2)			
Cross-border impact:	Frequency without any doubt is the parameter of an interconnected electricity transmission and distribution system, which has the largest cross-border impact. Frequency is the same across a synchronous area and across all voltage levels. Deviations of frequency from its nominal value due to generation/load imbalances therefore occur everywhere at the same time and may be impacted by changes in demand usage or generation production whether by large scale actions or aggregated smaller actions. Similarly voltage stability, a foundation for cross-border trading and network stability may be maintained during generation/load imbalances by changes in load demand. Demand Side response therefore regardless of scale or connection voltage can contribute to correcting generation/load demand imbalance.			
Exhaustive requirement:	X	**Non-exhaustive requirement:**		
Justification:	• Demand offered for Demand Side management has already been selected by the Demand Facility Owner and therefore is available for changes in demand. Adjustment of this demand in emergency situations for Low Frequency Demand Disconnection (LFDD) and Low Voltage Demand Disconnection (LVDD) purposes in advance of disconnection of other load demand is the most efficient, lowest consumer impact response in these circumstances.			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	• It is important that the network conditions are taken into account when considering the best approach for the required coordination between TSOs, DSOs and Demand Facility Owners and/or Distribution Network Owners.			
Alternative solutions:	Utilise existing LFDD and LVDD methods of unselective loss of individual Demand Facilities load demand creating a unnecessary wide spread impact and poorer quality of supply by not targeting non-essential (i.e. non selected for DSR) load demand			
Link to FWGL:	• paragraph 2.1.: "…the network code(s) shall define the requirements in relation to the relevant system parameters in order to contribute to secure system operation of grid users, including: ○ Load-frequency control related issues; ○ Provision of ancillary services."			

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Requirement:	Demand Side Response – Active Power Control (selection procedure for significant devices)			
Reference to NC DCC:	Article 21(4)			
Cross-border impact:	Frequency without any doubt is the parameter of an interconnected electricity transmission and distribution system, which has the largest cross-border impact. Frequency is the same across a synchronous area and across all voltage levels. Deviations of frequency from its nominal value due to generation/load imbalances therefore occur everywhere at the same time and affect all demand units immediately in a common way regardless of their size and voltage level of connection. Similarly voltage stability, a foundation for cross-border trading and network stability may be maintained during generation/load imbalances by changes in load demand.			
Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• The need for DSR APC capabilities has been identified in the 'Call for Stakeholder Input' stage 1 consultation for the Demand Connection Code as a necessity for the acceptance of further RES integration. • Installation of specific enabling capabilities in significant devices to allow DSR Active Power Control scheme development ensures efficient and viable resources of DSR to be developed.			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	• The significance test of development of Demand Side Response capabilities and the need for socio-economic supporting analysis ensure the demonstration of benefit before deeming devices significant			
Alternative solutions:	Retrofit of devices for DSR APC operation at a later stage which is generally not feasible and/or not cost effective.			
Link to FWGL:	• *paragraph 2.1: "…These shall be based on a predefined set of parameters which measure the degree of their impact on cross-border system performance via influence on control area`s security of supply, including provision of ancillary services ("significance test"). This process, undertaken by each individual TSO and reviewed by the respective National Regulatory Authority (NRA), shall require coordination with the adjacent TSOs and relevant DSOs..."* • paragraph 2.1.: "…the network code(s) shall define the requirements in relation to the relevant system parameters in order to contribute to secure system operation of grid users, including: o Load-frequency control related issues; o Provision of ancillary services." • paragraph 2.1.: "…For avoidance of doubt, the network code(s) shall also contain all the necessary provisions applicable to significant grid users that are connected to distribution networks, but that also affect the transmission network, because, for example, ... they significantly influence the need for reserve capacity." • *Paragraph 2.1.1: "...The network code(s) shall set out necessary minimum standards and requirements to be followed when connecting a*			

	consumption unit to the grid, to enable demand response and/or participation of consumption units in other grid services, on a contractually-agreed basis. The responsibility for the compliance of the features and performance of the equipment with the requirements set by the TSO or DSO shall be with the consumption unit..."

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Requirement:	Demand Side Response – System Frequency Control (selection procedure for significant devices)			
Reference to NC DCC:	Article 21(5)			
Cross-border impact:	Frequency without any doubt is the parameter of an interconnected electricity transmission and distribution system, which has the largest cross-border impact. Frequency is the same across a synchronous area and across all voltage levels. Deviations of frequency from its nominal value due to generation/load imbalances therefore occur everywhere at the same time and affect all demand units immediately in a common way regardless of their size and voltage level of connection.			
Exhaustive requirement:		**Non-exhaustive requirement:**		
Justification:	• The need for DSR SFC capabilities has been identified in the 'Call for Stakeholder Input' stage 1 consultation for the Demand Connection Code as a necessity for the acceptance of further RES integration. • Installation of specific enabling capabilities in significant devices to allow DSR System Frequency Control scheme development ensures efficient and viable resources of DSR to be developed.			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	• The significance test of development of Demand Side Response capabilities and the need for socio-economic supporting analysis ensure the demonstration of benefit before deeming devices significant			
Alternative solutions:	Apply a mandatory solution following a European significance test. Retrofit of devices for DSR SFC operation at a later stage which is generally not feasible and/or not cost effective.			
Link to FWGL:	• *paragraph 2.1: "…These shall be based on a predefined set of parameters which measure the degree of their impact on cross-border system performance via influence on control area`s security of supply, including provision of ancillary services ("significance test"). This process, undertaken by each individual TSO and reviewed by the respective National Regulatory Authority (NRA), shall require coordination with the adjacent TSOs and relevant DSOs..."* • paragraph 2.1.: "…the network code(s) shall define the requirements in relation to the relevant system parameters in order to contribute to secure system operation of grid users, including: o Load-frequency control related issues; o Provision of ancillary services." • paragraph 2.1.: "…For avoidance of doubt, the network code(s) shall also contain all the necessary provisions applicable to significant grid users that are connected to distribution networks, but that also affect the transmission network, because, for example, ... they significantly influence the need for reserve capacity." • *Paragraph 2.1.1: "...The network code(s) shall set out necessary minimum standards and requirements to be followed when connecting a consumption unit to the grid, to enable demand response and/or participation of consumption units in other grid services, on a*			

	contractually-agreed basis. The responsibility for the compliance of the features and performance of the equipment with the requirements set by the TSO or DSO shall be with the consumption unit..."

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Requirement:	Demand Side Response Active and Reactive Power Control and Transmission Constraint Management
Reference to NC DCC:	Article 22(1)
Cross-border impact:	Frequency without any doubt is the parameter of an interconnected electricity transmission and distribution system, which has the largest cross-border impact. Frequency is the same across a synchronous area and across all voltage levels. Deviations of frequency from its nominal value due to generation/load imbalances therefore occur everywhere at the same time and affect all demand units immediately in a common way regardless of their size and voltage level of connection. Similarly voltage stability, a foundation for cross-border trading and network stability may be maintained during generation/load imbalances by changes in load demand.

Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• Selection of suitability to provide DSR by the TSO ensures the ability of DSR Active Power Control, Reactive Power Control and Transmission Constraint Management to be usable and hence cost effectively provided. • Adequate frequency and voltage ranges as specified in Article 7 and 8, is required for DSR Active Power Control, Reactive Power Control and Transmission Constraint Management to be a viable replacement for generation during not only normal but more importantly during disturbed network situations. • Certainty of action is vital to the timely and scaled response by TSOs to incidents on the transmission network. • The time of response to frequency and voltage deviations is critical to the recovery of the network. Pre-set frequency response schemes allow for a number of timely corrective actions to be assured where manual commands may not be possible in the available time. It is therefore vital that pre-alert frequency and voltage response can be instructed by the TSO to be ready to perform its action and information is exchanged of this action. • The time of response to voltage deviations is critical to the recovery of the network. Therefore capability to control compensation devices which will provide this action is vital to the timely and scaled response by TSOs to incidents on the transmission network. • The rate of change capability of demand usage must be co-ordinated to ensure that the rate of change does not either over compensate or under respond to system incidents. • The quantity of available DSR services is required by system operators to ensure security of supply, both in planning and operating the network. • The rate of change of frequency withstand capability of demand must be sufficient during system incidents to avoid the loss of demand, which has the capability of balancing services and may respond to these incidents.			

Principle/Methodology only:		**(Ranges of) values/parameters given:**	X	
Justification:	• Given the different topographical and geographical design of transmission networks and synchronous system the rate of change capabilities, the acceptable scale of and action of DSR APC, DSR RPC and			

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	DSR TCM of Demand Facilities and Distribution Networks can only be set nationally. • Frequency and voltage capability, information to be exchanged, and necessary internal reaction time of Demand Facilities and Distribution Networks are either driven by the whole synchronous system and are therefore consistently applied and defined in the requirements.
Alternative solutions:	Have no requirement and leave capability to the market. However, it is unlikely, based on extensive experience, that the required minimum capability will be made available without detailing what is required.
Link to FWGL:	• paragraph 2.1.: "…the network code(s) shall define the requirements in relation to the relevant system parameters in order to contribute to secure system operation of grid users, including: o Load-frequency control related issues; o Provision of ancillary services." • paragraph 2.1.: "…For avoidance of doubt, the network code(s) shall also contain all the necessary provisions applicable to significant grid users that are connected to distribution networks, but that also affect the transmission network, because, for example, ... they significantly influence the need for reserve capacity." • *Paragraph 2.1.1: "...The network code(s) shall set out necessary minimum standards and requirements to be followed when connecting a consumption unit to the grid, to enable demand response and/or participation of consumption units in other grid services, on a contractually-agreed basis. The responsibility for the compliance of the features and performance of the equipment with the requirements set by the TSO or DSO shall be with the consumption unit..."*

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Requirement:	Demand Side Response System Frequency Control			
Reference to NC DCC:	Article 23(1)			
Cross-border impact:	Frequency without any doubt is the parameter of an interconnected electricity transmission and distribution system, which has the largest cross-border impact. Frequency is the same across a synchronous area and across all voltage levels. Deviations of frequency from its nominal value due to generation/load imbalances therefore occur everywhere at the same time and affect all demand units immediately in a common way regardless of their size and voltage level of connection.			
Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• The need for DSR SFC capabilities has been identified in the 'Call for Stakeholder Input' stage 1 consultation for the Demand Connection Code as a necessity for the acceptance of further RES integration.			
Principle/Methodology only:		**(Ranges of) values/parameters given:**	X	
Justification:	• To enable DSR SFC to be designed in a European context, whilst allowing for settings suitable for each synchronous network in Europe to National applied, specific parameters are both specified and left for National implementation.			
Alternative solutions:	Have no requirement and leave capability design to the market. However, it is unlikely, based on extensive experience that the required minimum capability will be made available without detailing what is required and/or different market designs will not interlock to provide a comprehensive response to frequency deviations.			
Link to FWGL:	• paragraph 2.1.: "…the network code(s) shall define the requirements in relation to the relevant system parameters in order to contribute to secure system operation of grid users, including: o Load-frequency control related issues; o Provision of ancillary services." • paragraph 2.1.: "…For avoidance of doubt, the network code(s) shall also contain all the necessary provisions applicable to significant grid users that are connected to distribution networks, but that also affect the transmission network, because, for example, ... they significantly influence the need for reserve capacity." • *Paragraph 2.1.1: "...The network code(s) shall set out necessary minimum standards and requirements to be followed when connecting a consumption unit to the grid, to enable demand response and/or participation of consumption units in other grid services, on a contractually-agreed basis. The responsibility for the compliance of the features and performance of the equipment with the requirements set by the TSO or DSO shall be with the consumption unit..."*			

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Requirement:	Demand Side Response System Frequency Control			
Reference to NC DCC:	Article 23(2)			
Cross-border impact:	Frequency without any doubt is the parameter of an interconnected electricity transmission and distribution system, which has the largest cross-border impact. Frequency is the same across a synchronous area and across all voltage levels. Deviations of frequency from its nominal value due to generation/load imbalances therefore occur everywhere at the same time and affect all demand units immediately in a common way regardless of their size and voltage level of connection.			
Exhaustive requirement:	X	**Non-exhaustive requirement:**		
Justification:	• Accurate response to deviation in system frequencies by DSR System Frequency Control is imperative to provide timely and correctly scaled response.			
Principle/Methodology only:		**(Ranges of) values/parameters given:**	X	
Justification:	• The requirement sets out frequency measurement accuracy at a European level which ensures the correct level of accuracy for all the synchronous systems within Europe and provides cost effective development of single devices suitable across Europe.			
Alternative solutions:	Have no requirement and leave capability to the market. However, it is unlikely, based on extensive experience, that the required minimum capability will be made available without detailing what is required.			
Link to FWGL:	• paragraph 2.1.: "…the network code(s) shall define the requirements in relation to the relevant system parameters in order to contribute to secure system operation of grid users, including: o Load-frequency control related issues; o Provision of ancillary services." • paragraph 2.1.: "…For avoidance of doubt, the network code(s) shall also contain all the necessary provisions applicable to significant grid users that are connected to distribution networks, but that also affect the transmission network, because, for example, ... they significantly influence the need for reserve capacity." • *Paragraph 2.1.1: "...The network code(s) shall set out necessary minimum standards and requirements to be followed when connecting a consumption unit to the grid, to enable demand response and/or participation of consumption units in other grid services, on a contractually-agreed basis. The responsibility for the compliance of the features and performance of the equipment with the requirements set by the TSO or DSO shall be with the consumption unit..."*			

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Requirement:	Demand Side Response Very Fast Active Power Control			
Reference to NC DCC:	Article 24(1)			
Cross-border impact:	Frequency is the parameter of an interconnected electricity transmission and distribution system which has the largest cross-border impact. The frequency is the same across a synchronous area and across all voltage levels. Deviations of frequency from its nominal value due to load imbalances therefore occur everywhere at the same time. Synchronous Generators have an inherent capability to resist / slow down frequency changes which many RES technologies do not have. This will result in larger rate of change of frequency during high RES production, at least unless counter measures are taken. Counter measures should be delivered by the most appropriate source and as a result synthetic inertia and/or rapid changes in active power demand can provide the necessary response to permit further expansion of RES.			
Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• This is an area which is still under development. It is therefore appropriate to allow developing experience to be introduced at a national level.			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	From the combination of circumstances of a topic which is under rapid development (not mature) and varied needs between synchronous areas, this requirement is stated only as a high level principle. This also allows alternative methods such as fast acting frequency response to be considered, if adequate for the expected system conditions.			
Alternative solutions:	Leave topic out and allow market to deliver solutions when mature. However, due to the critical nature of this topic in context of allowing RES integration to progress, it is important to provide a firm signal about the system need at this stage.			
Link to FWGL:	• paragraph 2.1: *"… Furthermore, the network code(s)shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, including … Frequency and voltage parameters; …"*			

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Requirement:	Power Quality			
Reference to NC DCC:	Article 25(1)			
Cross-border impact:	Power and Voltage Quality is determined by the level of distortion measured at the connection equipment of all connections in a synchronous system area. The scale of this distortion is an aggregated effect of all these connections, and simultaneously the aggregated distortion levels inversely impacts on all connected parties, particularly demand consumers given the sensitivity of many demand units to power and voltage quality. Consequently power and voltage quality contribution and withstand capability is a cross border issue.			
Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• The requirement for power and voltage quality is impacted by the scale of a synchronous network, the effective system strength of the network, its topography and component parts. • Requirements may need to be altered to provide efficient and effective management of power and voltage quality for the connecting Demand facility or Distribution Network or to meet the acceptable distortion levels for those with an existing connection.			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	• Power and voltage quality distortion levels needs to applied accounting for varying network factors to ensure the aggregated impact across the synchronous system is acceptable both in terms of individual contribution to and the aggregated impact of these distortions.			
Alternative solutions:	Have no requirement and leave capability to the market or perceived national needs. However, it is unlikely, based on extensive experience, that the required minimum capability will be made available without detailing what is required.			
Link to FWGL:	• paragraph 2.1: *"… The network code(s) shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, including:* o *Frequency and voltage requirements; …"*			

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Requirement:	Simulation Models			
Reference to NC DCC:	Article 26(1)			
Cross-border impact:	Network operators need to simulate the system behaviour with regard to system stability and security in order to detect early possible weaknesses or threats. For such simulations models of all components of the system need to be mathematically modelled. In addition network operators need to simulate the compliance of Demand Facilities and Distribution Networks with the provisions of this network code, if compliance tests are not possible or not sufficient.			
Exhaustive requirement:		**Non-exhaustive requirement:**	X	
Justification:	• The steady-state and dynamic behaviour of Demand Facilities and Distribution Networks has a significant impact on system stability and security. Hence, they need to be adequately modelled for the corresponding simulations, which are performed regularly by the network operators when developing the network. The requirements for such models depend on the scope of the simulations to be performed. • Depending on the scope of simulations to be performed by the network operator, simple standard models or more sophisticated models are needed. If more comprehensive and detailed models are needed in particular for dynamic studies, the information to create or the models need to be explicitly required from the Demand Facility or Distribution Network Owner. The requirement for simulation models or equivalent information from Distribution Networks covers the basic behaviour of the Network assets, embedded generation and demand with DSR, as seen in aggregate at the transmission-distribution interface			
Principle/Methodology only:	X	**(Ranges of) values/parameters given:**		
Justification:	The details of the simulation models or equivalent information depend on the scope of the simulations and can only be specified in this context.			
Alternative solutions:	Have no requirement and leave capability to the market. However, it is unlikely, based on extensive experience, that the required minimum capability will be made available without detailing what is required.			
Link to FWGL:	• paragraph 3.1: *"… The network code(s) shall set out the procedures and requirements to coordinate and ensure information sharing between … System operator and significant grid user …"*			

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