

GC0091 – Demand Connection Code (DCC)



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Overview

- **DCC Background**
- **High Level Structure of Work**
- **Scope & Application**
- **General Requirements**
 - Frequency Range
 - Voltage Range
 - Short Circuit Requirements
 - Reactive Power Requirements
 - Protection Requirements
 - Control Requirements
 - Information Exchange
 - Low Frequency Demand Disconnection and Reconnection
 - Low Voltage Demand Disconnection
 - Blocking Disconnection and Reconnection
 - Disconnection and Power Quality
 - Simulation Models
- **Summary / Next Steps**

Demand Connection Code

- Sets rules and requirements for different classes of Demand facilities / Distribution facilities / systems
- Contributes to system security, facilitate use of renewable generation and allow more efficient use of the network and resources for the benefit of consumers
- Facilitates competition in the European internal electricity market.

High Level Structure of Work

- Title I – Articles – 1 - 11
 - Subject Matter, Definitions, Scope, Application to existing demand facilities, Pumped Storage, Regulatory Aspects, Multiple TSO's, Recovery of Costs, Public Consultation, Stakeholder Involvement, Confidentiality obligations
- Title II – Requirements for Transmission Connected Demand Facilities, Transmission Connected Distribution Facilities and Distribution Systems
 - Chapter 1 – General Requirements
 - Chapter 2 – Operational Notification Procedure
- Title III – Requirements of Demand Units / facilities to provide demand response services to the System Operator
 - Chapter 1 – General Requirements
 - Chapter 2 - Operational Notification Procedure (demand response)

High Level Structure of Work

- Title IV – Compliance
 - Chapter 1 – General Provisions
 - Chapter 2 – Compliance Testing
 - Chapter 3 – Compliance Simulation
 - Chapter 4 – Compliance Monitoring
- Title V – Applications and Derogations
 - Chapter 1 – Cost Benefit Analysis
 - Chapter 2 - Derogations
- Title VI – Non Binding Guidance and Monitoring of Implementation
- Title VII – Final Provisions

Scope of ENTSO-DCC

- Article 3 – Scope (ie who the Regulation applies to):-
 - New transmission – connected demand facilities
 - New transmission – connected distribution facilities
 - New distribution systems including closed distribution systems
 - New demand units used by a demand facility or a closed distribution system to provide demand response services relevant to system operators and relevant TSO's.
- It does not extend to the above demand / distribution facilities which are not operated synchronously with one of the European defined Synchronous Areas (eg GB, Continental Europe, Ireland, Nordic etc)
- Storage devices are not covered other than Pumped Storage (see - Article 5(2)).
- Aggregation rules apply to demand units, within a demand facility if they cannot be operated independently

Application to Existing Demand Facilities / Distribution Facilities

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- Article 4 - Existing Demand Facilities / Distribution Facilities are not subject to these requirements except if:-
 - It is above 1000V and has been substantially modified
 - The Regulatory Authority or Member State decides to make an existing demand facility / distribution facility to all or some of the requirements in accordance with Article 4 Paragraphs 3 – 5
 - An existing Demand / Distribution Facility is classed as:-
 - One which is already connected on the date of Entry into Force
 - One which has signed a final and binding contract for main plant within 2 years of entry into Force of this Regulation
 - A Member State under specified circumstances may determine if the Demand / Distribution Facility is new or existing
 - Where the requirements are deemed to apply to an existing Demand Facility / Distribution Facility they must be subject to a full and transparent cost benefit analysis
 - The relevant TSO may assess the application of some or all of the provisions of this Regulation to existing demand / distribution facilities every three years subject to Articles 3 – 5.

Pumped Storage Pant

- The Regulation does not apply to Pumped Storage Plant with both generating and pumping modes of operation
- Any pumping module within a pumped storage station that only provides pumping shall be treated as a Demand facility and will have to comply with the requirements of the Code
- For industrial sites, with an Embedded Power Generating Module may agree with the TSO on conditions for disconnection of critical loads

Title II – Technical Requirements Transmission Connected Distribution Facilities / Distribution System

- Article 12 - Frequency Range (Annex I)
- Article 13 - Voltage Ranges (Annex II)
- Article 14 - Short Circuit Requirements
- Article 15 - Reactive Power Requirements
- Article 16 - Protection Requirements
- Article 17 - Control Requirements
- Article 18 - Information Exchange (eg operational metering)
- Article 19 - Demand Disconnection and Reconnection
 - Low Frequency Demand Disconnection
 - Low Voltage Demand Disconnection
- Article 20 - Power Quality
- Article 21 - Simulation Models

Title III – Demand Response

Services provided to System Operators

- Remotely Controlled (Article 28)
 - Demand response active power control
 - Demand response reactive power control
 - Demand response transmission constraint management
- Autonomously controlled
 - Demand response system frequency control (Article 29)
 - Demand response very fast active power control (Article 30)

Title II – General Requirements



Article 12 – Frequency Range – Annex 1

Synchronous Area	Frequency Range	Time period for operation
Great Britain	47.0 Hz – 47.5 Hz	20 seconds
	47.5 Hz – 48.5 Hz	90 minutes
	48.5 Hz – 49.0 Hz	To be specified by each TSO, but not less than 90 minutes
	49.0 Hz – 51.0 Hz	Unlimited
	51.0 Hz – 51.5 Hz	90 minutes
	51.5 Hz – 52.0 Hz	15 minutes

Article 12 – Frequency Range

- Applies to all Transmission connected Demand Facilities, Transmission Connected distribution facilities and Transmission Connected distribution Systems.
- Wider frequency ranges or longer minimum operating times may be agreed with the Relevant TSO.
- Consistent with current requirements of CC.6.1.3 of Grid Code.
- Proposed time range in the frequency range 48.5Hz – 49Hz would be set at 90 minutes.

Article 13 – Voltage Range – Annex II

Synchronous Area	Voltage Range	Time period for operation
Great Britain	0.9 p.u – 1.1 p.u	Unlimited

Table 2- Voltage Ranges for Transmission Connected demand facilities and distribution Connected distribution facility / systems in p.u between 110kV and 300kV

Synchronous Area	Voltage Range	Time period for operation
Great Britain	0.9 p.u – 1.05 p.u	Unlimited
	1.05 p.u – 1.10 p.u	15 minutes

Table 2- Voltage Ranges for Transmission Connected demand facilities and distribution Connected distribution facility / systems in p.u between 300kV and 400kV

Article 13 – Voltage Range

- Applies to all Transmission connected Demand Facilities, Transmission Connected Distribution facilities and Transmission Connected Distribution Systems.
- If required by the relevant TSO a Demand Facility / Distribution Facility / System shall be capable of automatic disconnection at specified voltages. The terms and settings for automatic disconnection shall be agreed between the TSO and Demand Facility / DSO.
- For Connections below 110kV the voltage range at the Connection Point will be specified by the TSO. It is assumed current GB practice would continue to apply of $\pm 6\%$.
- Current GB proposals are consistent with DCC other than voltage range between 132kV and 110kV which in GB are $\pm 6\%$ and under DCC are $\pm 10\%$.

Article 14 – Short Circuit Requirements (1)

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- (1) Based on the rated short-circuit withstand capability of its transmission network elements, the relevant TSO shall specify the maximum short-circuit current at the connection point that the transmission-connected demand facility or the transmission-connected distribution system shall be capable of withstanding.
 - (2) The relevant TSO shall deliver to the transmission-connected demand facility owner or the transmission-connected distribution system operator an estimate of the minimum and maximum short-circuit currents to be expected at the connection point as an equivalent of the network.
 - (3) After an unplanned event, the relevant TSO shall inform the affected transmission-connected demand facility owner or the affected transmission-connected distribution system operator as soon as possible and no later than one week after the unplanned event, of the changes above a threshold for the maximum short-circuit current that the affected transmission-connected demand facility or the affected transmission-
 - (4) The threshold set in paragraph 3 shall either be specified by the transmission-connected demand facility owner for its facility, or by the transmission-connected distribution system operator for its network.

Article 14 – Short Circuit Requirements (2)

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- (5) Before a planned event, the relevant TSO shall inform the affected transmission-connected demand facility owner or the affected transmission-connected distribution system operator, as soon as possible and no later than one week before the planned event, of the changes above a threshold for the maximum short-circuit current that the affected transmission-connected demand facility or the affected transmission-connected distribution system shall be able to withstand from the relevant TSO's network, in accordance with paragraph 1.
 - (6) The threshold set in paragraph 5 shall either be specified by the transmission-connected demand facility owner for its facility, or by the transmission-connected distribution system operator for its network.
 - (7) The relevant TSO shall request information from a transmission-connected demand facility owner or a transmission-connected distribution system operator concerning the contribution in terms of short-circuit current from that facility or network. As a minimum, the equivalent modules of the network shall be delivered and demonstrated for zero, positive and negative sequences.

Article 14 – Short Circuit Requirements (3)

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- (8) After an unplanned event, the transmission-connected demand facility owner or the transmission-connected distribution system operator shall inform the relevant TSO, as soon as possible and no later than one week after the unplanned event, of the changes in short-circuit contribution above the threshold set by the relevant TSO.
 - (9) Before a planned event, the transmission-connected demand facility owner or the transmission-connected distribution system operator shall inform the relevant TSO, as soon as possible and no later than one week before the planned event, of the changes in short-circuit contribution above the threshold set by the relevant TSO.

Article 14 – Short Circuit Requirements

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- Article 14 of DCC does contain some requirements which on first appearance raise a number of questions particularly in relation to general practice and health and safety
 - During the drafting process these issues were discussed at length and it was agreed and accepted that current GB practice can continue to apply unchanged without causing a conflict with DCC.

Article 14 – Short Circuit Requirements – Comparison with GB

DCC Requirement	GB Grid Code
Article 14(1)	PC.4.3.2, PC.7.4, PC.A - Part 3, CC.7.7. It is not however clear if the Grid Code mandates the provision of plat withstand ratings.
Article 14(2)	PC.4.3.2, PC.7.4, PC.A - Part 3 – No obligation under GB Grid Code to provide minimum Short Circuit Currents
Article 14(3)	OC7, OC7.4.6, OC7.4.6.1, OC7.6, and OC10.4.1.2
Article 14(4)	OC7, OC7.4.6, OC7.6.6, OC7.6. and OC10.4.1.2
Article 14(5)	OC2, OC2.4.1.3.5
Article 14(6)	PC.A.2.2.6, OC2, PC.A.1.2
Article 14(7)	PC.A.2.2, PC.A.2.5.6
Article 14(8)	OC 7, OC.7.4.6, OC7.6 and OC10.4.1.1
Article 14(9)	PC.A.1.2, PC.A.2.5.6 / OC2 – Requires further checking.

Article 15 – Reactive Power Requirements (1)

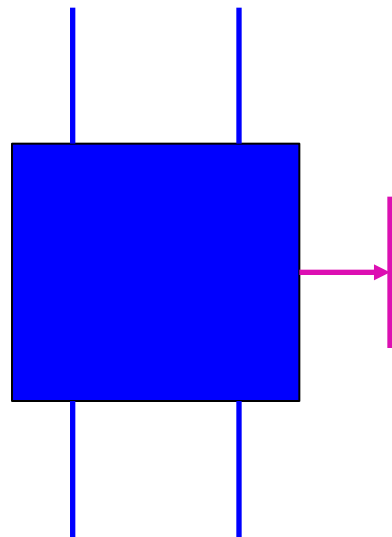
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- (1) Transmission-connected demand facilities and transmission-connected distribution systems shall be capable of maintaining their steady-state operation at their connection point within a reactive power range specified by the relevant TSO, according to the following conditions:
 - (a) for transmission-connected demand facilities, the actual reactive power range specified by the relevant TSO for importing and exporting reactive power shall not be wider than 48 percent of the larger of the maximum import capacity or maximum export capacity (0.9 power factor import or export of active power), except in situations where either technical or financial system benefits are demonstrated, for transmission-connected demand facilities, by the transmission-connected demand facility owner and accepted by the relevant TSO;
 - (b) for transmission-connected distribution systems, the actual reactive power range specified by the relevant TSO for importing and exporting reactive power shall not be wider than:
 - (i) 48 percent (i.e. 0.9 power factor) of the larger of the maximum import capability or maximum export capability during reactive power import (consumption); and
 - (ii) 48 percent (i.e. 0.9 power factor) of the larger of the maximum import capability or maximum export capability during reactive power export (production);
 - except in situations where either technical or financial system benefits are proved by the relevant TSO and the transmission-connected distribution system operator through joint analysis;

Article 15 – Reactive Power Requirements (2)

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- (c) the relevant TSO and the transmission-connected distribution system operator shall agree on the scope of the analysis, which shall address the possible solutions, and determine the optimal solution for reactive power exchange between their systems, taking adequately into consideration the specific system characteristics, variable structure of power exchange bidirectional flows and the reactive power capabilities in the distribution system
 - (d) the relevant TSO may establish the use of metrics other than power factor in order to set out equivalent reactive power capability ranges;
 - (e) the reactive power range requirement values shall be met at the connection point;
 - (f) by way of derogation from point (e), where a connection point is shared between a power generating module and a demand facility, equivalent requirements shall be met at the point defined in relevant agreements or national law.

Article 15(1) – Reactive Power Requirements (1)

Transmission Substation



Transmission Connected
Demand Facility or Distribution Facility/System
Maximum Power Factor Ranges

0.9 Power Factor Lead (48% Maximum Import)
0.9 Power Factor Lag (48% Maximum Export)

Example – A Connection Point to the Transmission System has an Import (Demand) of 100MW and an Export (Generation of 100MW).

The Maximum Reactive Power Range that the TO can specify at the Connection Point cannot exceed 0.9 Power Factor Lead to 0.9 Power Factor lag (or 48MVAR import to 48MVAR export)

Article 15(1) – Reactive Power Requirements (2)

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- This requirement is new to the GB Grid Code
 - Scope exists for optimal solutions on reactive power transfer between the TO and Demand Facility / Distribution System but the reactive range cannot be greater than 0.9 Power Factor lead to 0.9 Power Factor lag.
 - The Relevant TO may use other metrics other than power factor to set the equivalent ranges (eg %, p.u, Q/Pmax, MVA_r etc).
 - The requirements apply at the Connection Point
 - For connection points shared between Power Generating Modules and Demand Facilities any derogation sought in relation to the Connection Point shall be met at that Point and defined in the relevant agreements.

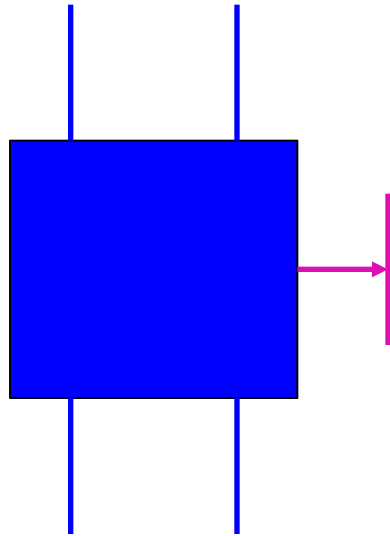
Article 15(2) - (4) – Reactive Power Requirements nationalgrid

- (2) The relevant TSO may require that transmission-connected distribution systems have the capability at the connection point to not export reactive power (at reference 1 pu voltage) at an active power flow of less than 25% of the maximum import capability. Where applicable, Member States may require the relevant TSO to justify its request through a joint analysis with the transmission-connected distribution system operator. If this requirement is not justified based on the joint analysis, the relevant TSO and the transmission-connected distribution system operator shall agree on necessary requirements according to the outcomes of a joint analysis.
- (3) Without prejudice to point (b) of paragraph 1, the relevant TSO may require the transmission-connected distribution system to actively control the exchange of reactive power at the connection point for the benefit of the entire system. The relevant TSO and the transmission-connected distribution system operator shall agree on a method to carry out this control, to ensure the justified level of security of supply for both parties. The justification shall include a roadmap in which the steps and the timeline for fulfilling the requirement are specified.
- (4) In accordance with paragraph 3, the transmission-connected distribution system operator may require the relevant TSO to consider its transmission-connected distribution system for reactive power management.

Article 15(2) – (4) – Reactive Power Requirements

nationalgrid

Transmission Substation



Transmission Connected Distribution System

The TSO may require that Transmission Connected Distribution Systems have the Capability at the connection point not to export reactive power (at reference 1p.u) at an active power flow of less than 25% of the maximum Import capacity.

Example – A Connection Point to the Transmission System has an Maximum Import Capacity (Demand) of 100MW. If the demand at that Connection Point falls to 25MW at a Point in time then there should be no export of Reactive Power at that Connection Point.

Article 15(2) - (4) – Reactive Power Requirements nationalgrid

- This requirement is new to the GB Grid Code
- Notwithstanding the requirements of Art 15 (1)(b) the Relevant TSO may require the Transmission connected distribution facility to actively control the exchange of reactive power at the connection point for the benefit of the entire system which shall be through joint collaboration between both parties – this would be expected through the Bilateral Agreement.
- The Transmission Connected Distribution System Operator may require the TSO to consider its Transmission Connected Distribution System for Reactive Power Management.
- Query - How would Power Factor ranges be treated regarding unusual loads such as traction supplies or industrial sites such as arc furnaces etc?

Protection Requirements – Article 16

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- (1) The relevant TSO shall specify the devices and settings required to protect the transmission network in accordance with the characteristics of the transmission connected demand facility or the transmission-connected distribution system. The relevant TSO and the transmission-connected demand facility owner or the transmission-connected distribution system operator shall agree on protection schemes and settings relevant for the transmission-connected demand facility or the transmission-connected distribution system.
 - (2) Electrical protection of the transmission-connected demand facility or the transmission-connected distribution system shall take precedence over operational controls while respecting system security, health and safety of staff and the public.
 - (3) Protection scheme devices may cover the following elements:
 - (a) external and internal short circuit;
 - (b) over- and under-voltage at the connection point to the transmission system;
 - (c) over- and under-frequency;
 - (d) demand circuit protection;
 - (e) unit transformer protection;
 - (f) back-up against protection and switchgear malfunction.
 - (4) The relevant TSO and the transmission-connected demand facility owner or the transmission-connected distribution system operator shall agree on any changes to the protection schemes relevant for the transmission-connected demand facility or the transmission-connected distribution system, and on the arrangements for the protection schemes of the transmission-connected demand facility or the transmission-connected distribution system

Article 16 – Protection Requirements – Comparison with GB

DCC Requirement	GB Grid Code
Article 16(1)	CC.6.2.3 & Bilateral Connection Agreement
Article 16(2)	New – Discussion required but believed to be implicit in protection philosophy.
Article 16(3)	Not explicitly defined in the GB Grid Code. Current Grid Code not in conflict with DCC as the DCC requirements are non exhaustive.
Article 16(4)	Not clearly defined in the GB Grid Code but covered under the Bilateral Agreement and Commissioning Process TP106.

- Further internal discussion required on protection issues within National Grid

Article 17 (1) – (3)

Control Requirements

- (1) The relevant TSO and the transmission-connected demand facility owner or the transmission-connected distribution system operator shall agree on the schemes and settings of the different control devices of the transmission-connected demand facility or the transmission-connected distribution system relevant for system security.
- (2) The agreement shall cover at least the following elements:
 - (a) isolated (network) operation;
 - (b) damping of oscillations;
 - (c) disturbances to the transmission network;
 - (d) automatic switching to emergency supply and restoration to normal topology;
 - (e) automatic circuit-breaker re-closure (on 1-phase faults).
- (3) The relevant TSO and the transmission-connected demand facility owner or the transmission-connected distribution system operator shall agree on any changes to the schemes and settings of the different control devices of the transmission-connected demand facility or the transmission-connected distribution system relevant for system security.

Article 17 (4)

Control Requirements

- (4) With regard to priority ranking of protection and control, the transmission-connected demand facility owner or the transmission-connected distribution system operator shall set the protection and control devices of its transmission-connected demand facility or its transmission-connected distribution system respectively, in compliance with the following priority ranking, organised in decreasing order of importance:
 - (a) transmission network protection;
 - (b) transmission-connected demand facility or transmission-connected distribution system protection;
 - (c) frequency control (active power adjustment);
 - (d) power restriction.

Article 17 – Control Requirements – nationalgrid

Comparison with GB

DCC Requirement	GB Grid Code
Article 17(1)	CC.6.2.3.3 and Bilateral Connection Agreement
Article 17(2)	Not explicitly covered in GB Grid Code although loose references are made in the Bilateral Connection Agreement. Some additional wording will be required in the Grid Code.
Article 17(3)	Specified in Bilateral Connection Agreement,
Article 17(4)	New – Not explicitly defined in the GB Grid Code.

Further internal discussion required on protection / Control issues within National Grid

Article 18 (1) – (3)

Information Exchange

- (1) Transmission-connected demand facilities shall be equipped according to the standards specified by the relevant TSO in order to exchange information between the relevant TSO and the transmission-connected demand facility with the specified time stamping. The relevant TSO shall make the specified standards publicly available.
- (2) Transmission-connected distribution system shall be equipped according to the standards specified by the relevant TSO in order to exchange information between the relevant TSO and the transmission-connected distribution system with the specified time stamping. The relevant TSO shall make the specified standards publicly available.
- (3) The relevant TSO shall specify the information exchange standards. The relevant TSO shall make publicly available the precise list of data required.

Article 18 – Control Requirements Comparison with GB

DCC Requirement	GB Grid Code
Article 18(1)	CC.6.5.6 & Bilateral Connection Agreement
Article 18(2)	CC.6.5.6 & Bilateral Connection Agreement
Article 18(3)	CC.6.5.6 & Bilateral Connection Agreement

Article 19(1)(a) – (f)

Low Frequency Demand

Disconnection and Reconnection

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- (1) All transmission-connected demand facilities and transmission-connected distribution systems shall fulfil the following requirements related to low frequency demand disconnection functional capabilities:
 - (a) each transmission-connected distribution system operator and, where specified by the TSO, transmission-connected demand facility owner, shall provide capabilities that enable automatic 'low frequency' disconnection of a specified proportion of their demand. The relevant TSO may specify a disconnection trigger based on a combination of low frequency and rate-of-change-of-frequency;
 - (b) the low frequency demand disconnection functional capabilities shall allow for disconnecting demand in stages for a range of operational frequencies;
 - (c) the low frequency demand disconnection functional capabilities shall allow for operation from a nominal Alternating Current ("AC") input to be specified by the relevant system operator, and shall meet the following requirements:
 - (i) frequency range: at least between 47-50 Hz, adjustable in steps of 0.05Hz;
 - (ii) operating time: no more than 150 ms after triggering the frequency setpoint;
 - (iii) voltage lock-out: blocking of the functional capability shall be possible when the voltage is within a range of 30 to 90% of reference 1 pu voltage;
 - (iv) provide the direction of active power flow at the point of disconnection;
 - (d) the AC voltage supply used in providing low frequency demand disconnection functional capabilities, shall be provided from the network at the frequency signal measuring point, as used in providing functional capabilities in accordance with paragraph 1(c), so that the frequency of the low frequency demand disconnection functional capabilities supply voltage is the same as the one of the network.

Article 19 (1)(a)– (d) Low Frequency Demand Disconnection Comparison with GB

DCC Requirement	GB Grid Code
Article 19(1)	Requirements for low frequency demand disconnection covered under CC.6.4.3 and OC6.6
Article 19(1)(a)	OC6.4.3, CC.A.5 and OC.6.6
Article 19(1)(b)	CC.A.5
Article 19(1)(c)(i)	CC.A.5.1.1
Article 19(1)(c)(ii)	CC.A.5.1.1(b)
Article 19(1)(c)(iii)	CC.A.5.1.1(c)
Article 19(1)(c)(iv)	Not specified in GB Grid Code
Article 19(1)(d)	CC.A.5.2

Article 19(2)(a) – (e)

Low Voltage Demand Disconnection

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- With regard to low voltage demand disconnection functional capabilities, the following requirements shall apply.
 - (a) The relevant TSO may specify, in coordination with the transmission-connected distribution system operators, low voltage demand disconnection functional capabilities for the transmission-connected distribution facilities:
 - (b) The relevant TSO may specify, in coordination with the transmission-connected demand facility owners, low voltage demand disconnection functional capabilities for the transmission-connected demand facilities;
 - (c) based on the TSO's assessment concerning system security, the implementation of on load tap changer blocking and low voltage demand disconnection shall be binding for the transmission-connected distribution system operators.
 - (d) if the relevant TSO decides to implement a low voltage demand disconnection functional capability, the equipment for both on load tap changer blocking and low voltage demand disconnection shall be installed in coordination with the relevant TSO;
 - (e) the method for low voltage demand disconnection shall be implemented by relay or relay or control room initiation.
 - (f) the low voltage demand disconnection functional capabilities shall have the following features:
 - (i) the low voltage demand disconnection functional capability shall monitor the voltage by measuring all three phases.
 - (ii) blocking of the relays operation shall be based on direction of either active power or reactive power flow.

Article 19 (2)(a)– (f) Low Voltage Demand Disconnection Comparison with GB

DCC Requirement	GB Grid Code
Article 19 (2)(a) – (f)	<p>The GB Grid Code does not specify the requirement for low voltage demand disconnection.</p> <p>DCC does not mandate the requirement for low voltage demand disconnection.</p> <p>Proposal – Explicitly define in the GB Grid Code that low voltage demand disconnection is not required.</p> <p>However should low voltage demand disconnection be required in the future it would need to be introduced via the GB Grid Code Governance process and consistent with the requirements of DCC in respect of new sites only.</p> <p>Low voltage demand disconnection at new sites only is likely to be of limited benefit.</p>

Blocking / Disconnection and Reconnection

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- (3) With regard to blocking of on load tap changers, the following requirements shall apply:
 - (a) if required by the relevant TSO, the transformer at the transmission-connected distribution facility shall be capable of automatic or manual on load tap changer blocking
 - (b) the relevant TSO shall specify the automatic on load tap changer blocking functional capability.
 - (4) All transmission-connected demand facilities and transmission connected distribution systems shall fulfil the following requirements related to disconnection or reconnection of a transmission connected demand facility or a transmission connected distribution system;
 - (a) with regard to the capability of reconnection after a disconnection, the relevant TSO shall specify the conditions under which a transmission connected demand facility or transmission connected distribution system is entitled to reconnect to the transmission system. Installation of automatic reconnection systems shall be subject to prior authorisation by the relevant TSO.
 - (b) With regard to reconnection of a transmission-connected demand facility or transmission connected distribution system, the transmission connected demand facility or transmission connected distribution system shall be capable of synchronisation for frequencies within the ranges set out in Article 12. The relevant TSO and the transmission connected demand facility owner or the transmission connected distribution system operator shall agree on the settings of synchronisation devices prior to connection of the transmission connected demand facility or the transmission connected distribution system, including voltage, frequency, phase angle range, and deviation of voltage and frequency;

Article 19(4)(c) & Article 20

Disconnection / Power Quality

- (c) A transmission connected demand facility or a transmission Connected distribution facility shall be capable of being remotely disconnected from the transmission system when required by the relevant TSO. If required, the automated disconnection equipment for reconfiguration of the system in preparation for block loading shall be specified by the relevant TSO. The relevant TSO shall specify the time required for remote disconnection.
- 20 Transmission-connected demand facility owners and transmission connected distribution system operators shall ensure that their connection to the network does not result in a determined level of distortion or fluctuation of the supply voltage on the network, at the connection point. The level of distortion shall not exceed that allocated to them by the relevant TSO. TSO's shall coordinate their power quality requirements with the requirements of adjacent TSO's.

Article 19(3)(4) & 20 Comparison with GB Code nationalgrid

DCC Requirement	GB Grid Code
Article 19(3)	Not explicitly defined
Article 19(4)(a)	OC.6.7 – Emergency Manual disconnection
Article 19(4)(b)	Synchronisation covered in Bilateral Connection Agreement and Relevant Electrical Standards
Article 19(4)(c)	Not explicitly defined in the Grid Code but requirements may be covered on a site specific basis in the Bilateral Connection Agreement – Eg Auto Switching Schemes / Islanding Schemes. OC6.6 applies to automatic low frequency demand disconnection.
Article 20	CC.6.1.5, CC.6.1.6 & CC.6.1.7

Article 21

Simulation Models

- (1) Transmission-connected demand facilities and transmission-connected distribution systems shall fulfil the requirements set out in paragraphs 3 and 4 related to the simulation models or equivalent information.
- (2) Each TSO may require simulation models or equivalent information showing the behaviour of the transmission-connected demand facility, or the transmission connected distribution system, or both in steady and dynamic states.
- (3) Each TSO shall specify the content and format of those simulation models or equivalent information. The content and format shall include:
 - (a) Steady and dynamic states, including 50Hz component;
 - (b) electromagnetic transient simulations at the connection point
 - (c) Structure and block diagrams.
- (4) For the purpose of dynamic simulations, the simulation model or equivalent information referred to in paragraph 3(a) shall contain the following sub-models or equivalent information;
 - (a) power control
 - (b) voltage control
 - (c) transmission-connected demand facility and transmission-connected distribution system protection models.
 - (d) the different types of demand, that is to say electro technical characteristics of the demand and
 - (e) Converter models.
- (5) Each relevant system operator or relevant TSO shall specify the requirements of the performance of the recordings of transmission connected distribution facilities, or both, in order to compare the response of the recordings.

Article 21 Comparison with GB Code

DCC Requirement	GB Grid Code
Article 21 (2)	Steady State data is covered under PC.A.4 and PC.A.6. Dynamic models are more unclear expect in relation to demand side response.
Article 21 (3)	Steady State data is covered under PC.A.4 and PC.A.6. Dynamic models are more unclear expect in relation to demand side response. Electromagnetic transient simulations are currently not required.
Article 21 (4)	Dynamic simulation models not explicitly covered in GB Code
Article 21 (5)	Currently not specified under GB Grid Code other than in respect of demand side response services which is covered by commercial contract..

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- Most of the DCC requirements are either new or map to existing GB Code requirements
 - There are a limited number of National Parameters to select unlike RfG or HVDC Code
 - Some more detailed work / drafting will be required in certain areas – eg Simulation Models.
 - For the new requirements it is considered that new text consistent with DCC would be applied in the GB Code.
 - Comments and feedback welcomed on proposed General Requirements
 - Consideration to be given to Demand Side Response Services – Articles 27 – 29 at the next meeting.