Appendix 4

THE DISTRIBUTION CODE

OF LICENSED DISTRIBUTION NETWORK OPERATORS OF GREAT BRITAIN

Issue ~~43~~ 44 - TBC 2019

ANNEX 1 - QUALIFYING STANDARDS

This Annex forms part of the **Distribution Code** technical requirements.

Distribution Code Requirements Implemented via Electricity Supply Standards

Copies of the following Engineering Recommendations and Technical Specifications are freely available from the **Distribution Code** website at **http://www.dcode.org.uk/** or from Energy Networks Association, 4 More London Riverside, London SE1 2AU, http://**www.energynetworks.org**/. A copy of Engineering Memorandum PO-PS-037 is available from Scottish Hydro Electric Power Distribution Ltd on request.

1 **Engineering Recommendation G5/4-1**

Planning levels for harmonic voltage distortion and the connection of non-linear equipment to transmission and distribution systems in the United Kingdom.

2 **Engineering Recommendation G12/4-1**

Requirements for the application of protective multiple earthing to low voltage networks.

3 **Engineering Recommendation G59/3-7**

Recommendation for the connection of generating plant to the distribution systems of licensed distribution network operators

4 (a) **Engineering Recommendation P2/7**

Security of Supply.

(b) **PO-PS-037**

Distribution planning standards of voltage and of security of supply. (Parts of Scottish Hydro Electric Power Distribution Ltd Area)

5 **Engineering Recommendation P24**

AC traction supplies to British Rail.

6 **Engineering Recommendation P25**

The short-circuit characteristics of single-phase and three-phase low voltage distribution networks

7 **Engineering Recommendation P28 Issue 2**

Voltage fluctuations and the connection of disturbing equipment to transmission systems and distribution networks in the United Kingdom

8 **Engineering Recommendation P29**

Planning limits for voltage unbalance in the United Kingdom for 132kV and below.

9 **Technical Specification 41-24 Issue 2**

Guidance for the design, installation, testing and maintenance of main earthing systems in substations

10 **Engineering Recommendation S34 Issue 2**

A guide for assessing the rise of earth potential at electrical installations.

11 **Engineering Recommendation G83/2-3**

Recommendations For The Connection of Type Tested Small-Scale Embedded Generators (Up To 16 A Per Phase) In Parallel With Public Low-Voltage Distribution Networks.

12 **Engineering Recommendation G98 Issue 1 Amendment 4**

Requirements for the connection of type-tested micro generators (up to and including 16 A per phase) in parallel with public low voltage distribution networks on or after 27 April 2019

13 **Engineering Recommendation G99 Issue 1 Amendment ~~5~~6**

Requirements for the connection of generating equipment in parallel with public distribution networks on or after 27 April 2019

Schedule 5b

DATA REGISTRATION CODE

Power Generating Module DATA FOR ALL EMBEDDED Power Generating ModuleS

DATA DESCRIPTION **5b Power Generating Module Data**	**UNITS**	**Data Category for Generators connected at LV**	**Data Category for Generators Connected at HV**
Power Generating Module GENERAL DATA			
Number of **Power Generating Modules** to which this data applies	Value	**SPD**	**SPD**
Type of **Power Generating Module**: Synchronous Generator, Fixed Speed Induction Generator, Double Fed Induction Generator, Series Convertor Connected Generator, Other (provide details)	Text	**SPD**	**SPD**
Technology/Production type (see note 1)	Text	**SPD**	**SPD**
Operating regime – intermittent or non-intermittent (see note 2)	Text	**SPD**	**SPD**
Power Generating Module OUTPUT DATA			
Rated terminal voltage (generator)	V	**SPD**	**SPD**
Rated terminal current (generator)	A	**SPD**	**SPD**
Power Generating Module Registered Capacity	MW	**SPD**	**SPD**
Power Generating Module apparent power rating (to be used as base for generator parameters)	MVA	**SPD**	**SPD**
Power Generating Module rated **Active Power**	MW	**SPD**	**SPD**
Maximum measured **Active Power** P_{60} (see note 3)	MW	**DPD**	**DPD**
Maximum measured **Active Power** $P_{0.2}$ (see note 3)	MW	**DPD**	**DPD**
Minimum Generation (set connected; net of auxiliary loads)	MW	**DPD**	**DPD**
Power Generating Module Reactive Power capability at rated **Active Power** (gross, at generator terminals)			
Maximum **Reactive Power** export (lagging)	MVAr	**DPD**	**SPD**
Maximum **Reactive Power** import (leading)	MVAr	**DPD**	**SPD**
Power Generating Module performance chart (gross, at either the **Power Generating Module** terminals or **Connection Point** as agreed between the **DNO** and **Generator**, as per DPC7 Figure 1)	Figure	**DPD**	**DPD**

DATA DESCRIPTION **5b Power Generating Module Data**	UNITS	Data Category for Generators connected at LV	Data Category for Generators Connected at HV
Power Generating Module MAXIMUM FAULT CURRENT CONTRIBUTION (see note 4)			
Peak asymmetrical short circuit current at 10ms (i_p) for a 3φ short circuit fault at the **Power Generating Module** terminals	kA	None	**SPD**
RMS value of the initial symmetrical short circuit current (I_k") for a 3φ short circuit fault at the **Power Generating Module** terminals	kA	None	**SPD**
RMS value of the symmetrical short circuit current at 100ms ($I_{k(100)}$) for a 3φ short circuit fault at the **Power Generating Module** terminals	kA	**SPD**	**SPD**
Short circuit time constant T", corresponding to the change from I_k" to $I_{k(100)}$	s	None	**DPD**
Positive sequence X/R ratio at the instant of fault	-	None	**DPD**
Power Generating Module VOLTAGE CONTROL			
If operating in **Power Factor** control mode, allowable **Power Factor** range		**SPD**	**SPD**
If operating in **Power Factor** control mode, target **Power Factor**		**SPD**	**SPD**
If operating in voltage control mode, voltage set point	V	**SPD**	**SPD**
If operating in reactive power control mode, reactive power set point	VA	**SPD**	**SPD**
If operating to any other control mode, description of parameters and set points.	Text	**SPD**	**SPD**
Frequency Response Settings			
Frequency response droop setting in LFSM-O	Per cent	**DPD**	**DPD**
Frequency response droop setting in LFSM-U	Per cent	**DPD**	**DPD**
Frequency response droop setting in FSM (if applicable)	Per cent	**DPD**	**DPD**
Frequency response mode, ie LFSM or FSM	text	**DPD**	**DPD**
Power Generating Module INSTALLED INTERFACE PROTECTION (see note 5)			
U/V Stage 1	V and s	**SPD**	**SPD**

DATA DESCRIPTION **5b Power Generating Module Data**	**UNITS**	**Data Category for Generators connected at LV**	**Data Category for Generators Connected at HV**
U/V Stage 2	V and s	**SPD**	**SPD**
O/V Stage 1	V and s	**SPD**	**SPD**
O/V Stage 2 (if fitted)	V and s	**SPD**	**SPD**
U/F Stage 1	Hz and s	**SPD**	**SPD**
U/F Stage 2	Hz and s	**SPD**	**SPD**
O/F Stage 1	Hz and s	**SPD**	**SPD**
O/F Stage 2 (if fitted)	Hz	**SPD**	**SPD**
LoM (RoCoF)	Hzs^{-1} and s	**SPD**	**SPD**
LoM (Vector Shift)	degrees	**SPD**	**SPD**
LoM – other	Text	**SPD**	**SPD**

Notes:

1. The Production Type should be quoted for all new connections on or after 1 January 2015 and selected from the list below derived from the Manual of Procedures for the ENTSO-E Central Information Transparency Platform:
   - Biomass;
   - Fossil brown coal/lignite;
   - Fossil coal-derived gas;
   - Fossil gas;
   - Fossil hard coal;
   - Fossil oil;
   - Fossil oil shale;
   - Fossil peat;
   - Geothermal;
   - Hydro pumped storage;
   - Hydro run-of-river and poundage;
   - Hydro water reservoir;
   - Marine;
   - Nuclear;
   - Other renewable;
   - Solar;

- Waste;
- Wind offshore;
- Wind onshore; or
- Other.

For connections made before 1 January 2015, the technology type(s) used, selected from the list set out at paragraph 2.23 in Version 2 of the Regulatory Instructions and Guidance relating to the distributed generation incentive, innovation funding incentive and registered power zones, reference 83/07, published by Ofgem, in April 2007, may be submitted as an alternative to the production type.

2. Intermittent and Non-intermittent Generation is defined in ENA EREP 130 as follows:

   - Intermittent Generation: Generation plant where the energy source for the prime mover can not be made available on demand

   - Non-intermittent Generation: Generation plant where the energy source for the prime mover can be made available on demand

3. For wind turbines only - IEC 61400-21 (P_{60} and $P_{0.2}$)

4. See ER G74, ETR 120 and IEC 60909 for guidance on fault current data. Additionally, fault current contribution data may be provided in the form of detailed graphs, waveforms and/or tables. This information need not be provided where detailed fault level contribution / impedance data is provided for the site in Schedule 5a or for each **Power Generating Module** in Schedules 5c.

5. This information need not be provided where the interface protection is provided on a per **Power Station** basis. In such cases the information should be provided in Schedule 5a.

Schedule 5c (i)

DATA REGISTRATION CODE

Power Generating Module DATA FOR EMBEDDED Power Generating Modules

DATA DESCRIPTION **5c (i) Synchronous Power Generating Modules (or Equivalent Synchronous Power Generating Modules –see note 1)**	**UNITS**	**Data Category for Generators connected at LV**	**Data Category for Generators Connected at HV**
Power Generating Module MODEL DATA			
Power Generating Module identifier	Text	**SPD**	**SPD**
Type of **Power Generating Module** (round rotor, salient pole or asynchronous equivalent – see note 1)	Text	**SPD**	**SPD**
Positive sequence (armature) resistance	per unit	**DPD**	**SPD**
Short circuit ratio (see note 2)	Number	**DPD**	**DPD**
Inertia constant (**Power Generating Module** and Prime Mover)	MWsec/ MVA	**DPD**	**SPD**
Direct axis reactances:			
Sub-transient (X''_d) – unsaturated / saturated	per unit	**SPD / SPD**	**SPD / SPD**
Transient (X'_d) – unsaturated / saturated	per unit	**DPD / DPD**	**SPD / SPD**
Synchronous (X_d) – unsaturated / saturated	per unit	**DPD / DPD**	**SPD / SPD**
Quadrature axis reactances:			
Sub-transient (X''_q) – unsaturated / saturated	per unit	None	**DPD / DPD**
Transient (X'_q) – unsaturated / saturated	per unit	None	**DPD / DPD**
Synchronous (X_q) – unsaturated / saturated	per unit	None	**DPD / DPD**
Time constants:			
State whether time constants are open or short circuit	Text	**DPD**	**SPD**
D-axis sub-transient – unsaturated / saturated	s	**DPD / DPD**	**SPD / SPD**
D-axis transient – unsaturated / saturated	s	**DPD / DPD**	**SPD / SPD**
Q-axis sub-transient – unsaturated / saturated	s	None	**DPD / DPD**
Q-axis transient – unsaturated / saturated	s	None	**DPD / DPD**
Stator leakage reactance (unsaturated)	per unit	None	**DPD**
Zero sequence resistance (earthed star only, including any neutral earthing resistance)	per unit	**DPD**	**DPD**
Zero sequence reactance (earthed star only, including any neutral earthing reactance)	per unit	**DPD**	**DPD**
Negative sequence resistance	per unit	**DPD**	**DPD**
Negative sequence reactance	per unit	**DPD**	**DPD**
Rated field current	A	**DPD**	**DPD**

DATA DESCRIPTION **5c (i) Synchronous Power Generating Modules (or Equivalent Synchronous Power Generating Modules –see note 1)**	**UNITS**	**Data Category for Generators connected at LV**	**Data Category for Generators Connected at HV**
Field current open circuit saturation curve (from 50% to 120% of rated terminal voltage)	Graph	**DPD**	**DPD**
Potier reactance (if saturation factor available – see note 3)	per unit	**DPD**	**DPD**
Saturation factor (pu field current to produce 1.2pu terminal voltage on open circuit)	per unit	**DPD**	**DPD**
~~Frequency response droop setting~~	~~Per cent~~	~~**DPD**~~	~~**DPD**~~
~~Frequency response mode, ie LFSM-O or FSM~~	~~text~~	~~**DPD**~~	~~**DPD**~~
Power Generating Module MODELS			
Governor and prime mover model (see note 4)	Model	**DPD**	**DPD**
AVR / excitation model (see note 4)	Model	**DPD**	**DPD**

Notes:

1. Asynchronous generators may be represented here by an equivalent synchronous generator data set
2. The short circuit ratio (SCR) of a **Power Generating Module** is one measure of the performance of a machine under short circuit conditions and is important in determining the unit's stability performance. The reciprocal of the per unit on rating saturated synchronous reactance, Xd(sat), is equal to the SCR.
3. The Potier reactance is only required if the saturation factor is available. The saturation factor is defined as the pu value of field current required to generate 1.2pu stator terminal voltage on open circuit.
4. **SPD** will normally be sufficient, except where the **DNO** considers that the stability and security of the network is at risk. Sufficient **DPD** should then be provided in order to build up a suitable **Power Generating Module** dynamic model for analysis. Alternatively a 'Black Box' dynamic model of the **Power Generating Module** may be provided. All models should be suitable for the software analysis package used by the **DNO**.

39	23/05/19	Update to reflect modification to EREC P28. • Annex 1 - Qualifying Standards • DPC4.2.3.2 – Voltage Disturbances • DPC4.2.3.3 – Voltage Step Changes
40	16/06/19	Annex 1 updated to reflect new versions of ERECs G59, G83, G98, and G99.
41	10/08/19	Update to Annex 1 to replace ER P2/6 with EREC P2/7. Consequential removal of Guidance Note 1. Update of Annex 2 to replace ETR 130 with EREP 130. Both updates include the following consequential changes: • Clarifying EREC P2 as being a standard defining the security of supply that is to be achieved and EREP 130 the guidance as how this is achieved. • Formally incorporating Distributed Energy Resources (DER) into EREC P2 and EREP 130; • Removal of F-Factors and other tables associated with assessing the security contribution from Distributed Generation from EREC P2 whilst retaining and updating in EREP 130; • Refreshing the definition of demand to appropriately include consideration and treatment of flexible resources such as Distributed Generation (DG) and Demand Side Response (DSR); and • Specifically excluding the security of supply to DG installations from the scope of EREC P2 as justified by the consortiums analysis and findings.
42	01/09/19	Update reference to EREC G59/3-7 and EREC G83/3-5 in Annex 1 and consequential amendments in GN2, DPC7.2.1, DPC7.4.9.2.
43	TBC	Update reference to EREC G99/1-5 in Annex 1
44	TBA	Update reference to EREC G99/1-6 In Annex 1 Modification to DDRC 5b to add LFMS-O and LFMS-U droop as separate values; deletion of droop from DDRC 5c(i).

END