

PRODUCED BY THE OPERATIONS DIRECTORATE OF ENERGY NETWORKS ASSOCIATION



Engineering Recommendation G59

Issue 3 Amendment ~~7~~X

01 September 2019

Recommendations for the Connection of
Generating Plant to the Distribution Systems of
Licensed Distribution Network Operators

2 Scope

- 2.1 This EREC provides guidance on the technical requirements for the connection of **Generating Plant** to the **Distribution Systems** of licensed **DNOs**. For the purposes of this EREC, a **Generating Plant** is any source of electrical energy, irrespective of the prime mover and **Generating Unit** type. This EREC applies to all **Generating Plant** which is not in the scope of EREC G83 or is not compliant with EREC G83 requirements.¹ EREC G59 describes a simplified connection procedure for connection of a **Type Tested single Generating Unit** of less than 17kW per phase or 50kW three phase, or the connection of multiple **Type Tested Generating Units** with a maximum aggregate capacity of less than 17kW per phase or 50kW three phase, per **Customer** installation, provided that any existing connected **Generating Units** are also **Type Tested**. This EREC G59/3-7 is effective from 1 September 2019.
- 2.2 This EREC does not provide advice for the design, specification, protection or operation of **Generating Plant** itself. These matters are for the owners of plant to determine.
- 2.3 Specific separate requirements apply to **Generating Plant** comprising **Generating Units** less than or equal to 16A per phase and these are covered in EREC G83. However, **Generating Units** $\leq 16A$ per phase that have not been **Type Tested** in accordance with EREC G83 or whose technology type is not covered by one of the EREC G83 annexes should comply with the requirements set in this document. Section 6 of this document provides more guidance on how to apply this document to **Generating Units** that are below the 16A threshold but do not meet the requirements of EREC G83.
- 2.4 The connection of mobile generation owned by the **DNO**, EREC G83 compliant **Generating Units** or offshore **Transmission Systems** containing generation are outside the scope of this Engineering Recommendation.
- 2.5 This document applies to systems where the **Generating Plant** can be paralleled with a **Distribution System** or where either the **Generating Plant** or a **Distribution System** with **Generating Plant** connected can be used as an alternative source of energy to supply the same electrical load.
- 2.6 The generic requirements for all types of **Generating Plant** within the scope of this document relate to the connection design requirements, connection application and notification process including confirmation of commissioning. The document does not attempt to describe in detail the overall process of connection from application, through agreement, construction and commissioning. It is recommended that the ENA publications entitled – “*Distributed Generation Connection Guides*” are consulted for more general guidance.

¹ Engineering Recommendation EREC G83 – Recommendations for the connection of small-scale embedded generators (up to and including 16 A per phase) in parallel with public low-voltage distribution networks. This Engineering Recommendation provides guidance on the technical requirements for the connection of **Generating Units** rated up to and including 16 A per phase, single or multi-phase, 230/400 Volts AC. The recommendations cover the connection of **Generating Units**, either single or multi-phase within a single Customer's installation up to the limit of 16A per phase, and multiple **Generating Units** in a close geographic region with a limit of 16A per phase in each customer installation, under a planned programme of work.

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- 2.7 **Medium and Large Power Stations** are, in addition to the general requirements of this EREC, bound by the requirements of the **Grid Code**. In the case of **Large Power Stations**, the **Grid Code** will generally apply in full. For **Medium Power Stations**, only a subset of the **Grid Code** applies directly, and the relevant clauses are listed in DPC7 of the **Distribution Code**.
- 2.8 This EREC is written principally from the point of view of the requirements in Great Britain. There are some differences in the requirements in Great Britain and Northern Ireland, which are reflected in the separate Grid Codes for Great Britain and Northern Ireland, and the separate Distribution Code for Northern Ireland. These documents should be consulted where necessary, noting that the numbering of sections within these documents is not necessarily the same as in the **Distribution Code** for Great Britain and the **Grid Code** for Great Britain.
- 2.9 The separate synchronous network operating in the Shetland Isles has specific technical challenges which are different to those of the Great Britain synchronous network. This EREC is not in itself sufficient to deal with these issues
- 2.10 EREC G59/3-7 (ie this version of G59) has been updated to require Generators to apply a RoCoF setting of 1Hzs^{-1} , 500 ms delay, and remove vector shift as an allowable loss of mains (LoM) for all future generation and to retrospectively apply this RoCoF setting and retrospectively remove vector shift as an allowed loss of mains for all existing generation that is not Type Tested
- 2.11 Generation commissioned on after 27 April 2019 must comply with EREC G99. EREC G59 is not applicable to generation commissioned on or after that date.
- 2.12 **Generating Units** which by agreement between the **Generator** and the **DNO** will have the capability to run in island mode, as described in section 9.8 and including those providing black start services to the **NETSO**, will need to comply with the general requirements of this EREC G59, although the specific technical requirements, particularly in relation to the earthing requirements of Section 8, the design requirements of Section 9 and the protection requirements of Section 10 shall be modified in accordance with any site-specific requirements that are specified in the agreement with the **DNO** and in any contract covering black start services.

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5 Legal Aspects

- 5.1 The operation and design of the electricity system in Great Britain is defined principally by the Electricity Act (1989 as amended), the Electricity Safety Quality and Continuity Regulations (ESQCR) 2002, as well as general considerations under the Health and Safety at Work Act (HASWA) 1974 and the Electricity at Work Regulations (EaWR) 1989. A brief summary of the main statutory obligations on **DNOs**, **Generators** and Users is included as Appendix 13.9.

- 5.2 Under section 21 of the Electricity Act, **Generators** may be required to enter into a bespoke **Connection Agreement** with the **DNO**. Such a **Connection Agreement** will specify the terms and conditions including technical, operating, safety and other requirements under which **Generating Plant** is entitled to remain connected to the **Distribution System**. It is usual to include site specific commercial issues, including recovery of costs associated with the connection, GDUoS (**Generator** Distribution Use of System) charges and the applicable energy loss adjustment factors, in **Connection Agreements**. It is also common practice by some **DNOs** to collect the technical issues into a subordinate “Technical and Operating Agreement” which is given contractual force by the **Connection Agreement**.
- 5.3 **DNOs** are required by their licences to have in force and comply with the **Distribution Code**. **Generators** will be bound by their licences or by their **Connection Agreements**, or both, to comply with the **Distribution Code**.
- 5.4 In accordance with DPC5.4 of the **Distribution Code**, when details of the interface between a **Generating Plant** and the **Distribution System** have been agreed a site responsibility schedule detailing ownership, maintenance, safety and control responsibilities will be drafted. The site responsibility schedule and operation drawing shall be displayed at the point of interconnection between the **DNO’s** and **Generator’s** systems, or as otherwise agreed.
- 5.5 The **DNOs** have statutory and licence obligations within which they have to offer the most economic, technically feasible option for connecting **Generating Plant** to their **Distribution Systems**. The main general design obligations imposed on the **DNOs** are to:
- a. maintain supplies to their **Customers** within defined statutory voltage and frequency limits;
 - ~~b. a. ensure that the **Distribution Systems** at all voltage levels are adequately earthed;~~
 - e. b. comply with the “Security of Supply” criteria defined in EREC P2;
 - d. c. meet improving standards of supply in terms of customer minutes lost (CMLs) and the number of customer interruptions (CIs);
 - ~~d. ensure that the **Distribution Systems** at all voltage levels are adequately earthed;~~
 - e. facilitate competition in the connection, generation and supply of electricity.
- 5.6 During a black start it is recognized that **DNOs** may relax some or all of the requirements (a) to (c) of 5.6 for the duration of the black start event for the purpose of re-establishing a stable network.
- 5.7 Failure to meet any of the above obligations will incur legal or regulatory penalties. The first two criteria, amongst others, define the actions needed to allow islanded operation of the **Generating Plant** or to ensure that the **Generating Plant** is rapidly disconnected from the **Distribution System** under islanded conditions. The next two criteria influence the type of connection that may be offered without jeopardising regulated standards.

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- 5.87 General conditions of supply to **Customers** are also covered by Regulation 23 of the ESQCR 2002. Under Regulation 26 of the ESQCR 2002 no **DNO** is compelled to commence or continue a supply if the **Customer's Installation** may be dangerous or cause undue interference with the **Distribution System** or the supply to other **Customers**. The same regulation empowers the **DNO** to disconnect any part of the **Customer's Installation** which does not comply with the requirements of Regulation 26. It should also be noted that each installation has to satisfy the requirements of the HASWA 1974 and the EaWR 1989.
- 5.98 Regulations 21 and 22 of the ESQCR 2002 require installations that have alternative sources of energy to satisfy Regulation 21 in relation to switched alternative supplies, and Regulation 22 in the case of sources of energy running in parallel with the **Distribution System**.
- 5.109 Under Regulation 22 of the ESQCR 2002, no person may operate **Generating Plant** in parallel with a public **Distribution System** without the agreement of the **DNO**.
- 5.110 All **Generators** have to comply with the appropriate parts of the ESQCR.
- 5.124 The general requirements for **Generators** wishing to connect their **Generating Plant** to a **Distribution System** are contained in the **Distribution Code**.
- 5.132 It is important to note that both the **Distribution Code** and **Grid Code** use the terms **Large, Medium and Small** in relation to **Power Stations**. These terms are defined in the Codes and various parts of the Codes apply to different size **Power Stations**, with generally no **Grid Code** requirements applying to **Small Power Stations**. Any collection of **Generating Plant** under the control of one owner or operator in one installation is classed in the Codes as a **Power Station**.
- 5.143 **Generators** with **Medium Power Stations** will have to comply with a few specific **Grid Code** clauses. The requirement for these clauses is contained in DPC7 of the **Distribution Code**.
- 5.154 **Power Stations** that are to be connected to a **Distribution System** and contain **Generating Units** that trade in the wholesale market as Balancing Mechanism Units or have for other reasons become a party to the Balancing and Settlement Code and/or National Grid's Connection and Use of System Code, will then have to comply with the **Grid Code** requirements for **Generating Plant**.
- 5.165 Information, which should assist **Generators** wishing to connect to the **Distribution System** at **High Voltage (HV)**, will be published by the **DNO** in accordance with condition 25 of the **Distribution Licence**. This is known as the Long Term Development Statement (LTDS). The general form and content of this statement is specified by Ofgem and covers the existing **Distribution System** as well as authorised changes in future years on a rolling basis.

- | 5.1~~76~~⁸⁷ Under the terms of the Electricity Act 1989 (as amended), generation of electricity is a licensed activity, although the Secretary of State, may by order² grant exemptions. Broadly, generating stations of less than 50MW are automatically exempt from the need to hold a licence, and those between 50MW and 100MW may apply to the Department for Business, Energy and Industrial Strategy for an exemption if they wish.

- | 5.1~~87~~⁹⁸ **Generators** who are licensed will be required to become parties to the Balancing and Settlement Code and to the Connection and Use of System Code. They will also be bound in their licences to comply with the **Grid Code** and the **Distribution Code**.

- | 5.1~~98~~²⁰⁴⁹ **Generators** will need appropriate contracts in place for the purchase of any energy that is exported from the **Generators' Power Stations**, and for any energy imported. For this purpose the **Generator** will need contracts with one or more **Suppliers**, and where the **Supplier** does not provide it, a meter operator agreement with the appropriate provider.

- | 5.2049 **Generators** wishing to trade ancillary services for National Grid purposes will need appropriate contracts in place with the National Grid Electricity Transmission in its role as Great Britain System Operator.

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9 NETWORK CONNECTION DESIGN AND OPERATION

9.1 General Criteria

- 9.1.1 As outlined in Section 5, **DNOs** have to meet certain statutory and **Distribution Licence** obligations when designing and operating their **Distribution Systems**. These obligations will influence the options for connecting **Generating Plant**.

- 9.1.2 The technical and design criteria to be applied in the design of the **Distribution System** and **Generating Plant** connection are detailed within the Distribution Planning and Connection Code (DPC) and the standards listed in Annex 1 of the **Distribution Code**. The criteria are based upon the performance requirements of the **Distribution System** necessary to meet the above obligations.

- 9.1.3 The **Distribution System**, and any **Generating Plant** connection to that System, shall be designed,
 - a. to comply with the obligations (to include security, frequency and voltage; voltage disturbances and harmonic distortion; auto reclosing and single phase protection operation).

 - b. according to design principles in relation to **Distribution System's** plant and equipment, earthing, voltage regulation and control, and protection as outlined in DPC4, subject to any modification to which the **DNO** may reasonably consent.

² see <http://www.opsi.gov.uk/si/si2001/20013270.htm>

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9.1.4 **Generating Plant** should meet a set of technical requirements in relation to its performance with respect to frequency and voltage, control capabilities, protection coordination requirements, phase voltage unbalance requirements, neutral earthing provisions, islanding and black start capability. These requirements are listed in DPC7.4 of the **Distribution Code**.

9.1.5 There are additional performance requirements that are specified in the **Grid Code** for all embedded **Medium and Large Power Stations**. The requirements for **Medium Power Stations** are referenced in DPC7.5 of the **Distribution Code**, and are all listed in CC3.3 to CC3.5 of the **Grid Code**.

9.1.6 As explained in 2.12 **DNOs** shall relax certain aspects of section 9 for island operation, and section 5.7 during a black start.

9.8 Island Mode

9.8.1 The provisions of this section 9.6.3 apply to situations where island mode operation is envisaged both for the mutual benefit of **DNOs** and relevant **Generators**. For **Generators** providing black start services, additional or conflicting technical requirements may be imposed, again by mutual agreement, and recorded in the black start services contract.

9.8.2 A fault or planned outage, which results in the disconnection of a **Generating Unit**, together with an associated section of **Distribution System**, from the remainder of the **Total System**, creates the potential for island mode operation. The key potential advantage of operating in Island Mode is to maintain continuity of supply to the portion of the **Distribution System** containing the **Generating Unit**. The principles discussed in this section generally also apply where **Generation Plant** on a **Customer's** site is designed to maintain supplies to that site in the event of a failure of the **DNO** supply.

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10 PROTECTION

10.1 General

10.1.1 The main function of the protection systems and settings described in this document is to prevent the **Generating Plant** supporting an islanded section of the **Distribution System** when it would or could pose a hazard to the **Distribution System** or **Customers** connected to it. The settings recognize the need to avoid nuisance tripping and therefore require a two stage approach where practicable, ie to have a long time delay for smaller excursions that may be experienced during normal **Distribution System** operation, to avoid nuisance tripping, but with a faster trip for greater excursions.

10.1.2 In accordance with established practice it is for the **Generator** to install, own and maintain this protection. The **Generator** can therefore determine the approach, ie per **Generating Unit** or per installation, and where in the installation the protection is sited.

Where a common protection system is used to provide the protection function for multiple **Generation Units** the complete installation cannot be considered to comprise **Type Tested Generating Units** as the protection and connections are made up on site and so cannot be factory tested or **Type Tested**.

10.1.3 In exceptional circumstance additional protection may be required by the **DNO** to protect the **Distribution System** from the **Generating Plant**.

10.1.4 Where a **Generator** has entered into an agreement with the **DNO** for island mode operation or has entered into a black start services contract, the **DNO** and the **Generator** shall agree variations to the standard arrangements described in this Section 10 to the extent necessary to facilitate the island mode and/or black start services.