Distribution Code Consultation DCRP/19/08/PC

Title: G99 – Minor Corrections and Housekeeping Modifications

Target Audience: All current and prospective manufacturers, developers, owners and operators of generation (and storage) of any size connecting new generation equipment to distribution networks.

Date Published: 12 September 2019

Deadline for responses: 04 October 2019

Summary:

This Distribution Code public consultation is seeking the views from stakeholders on proposed modifications to EREC G99 which have been identified by DNOs and stakeholders in the months since these documents were first published.

1 Introduction

Ofgem approved the implementation of the EU Network Code "Requirements for Generators" (RfG) on 15 May 2018 (with compliance required from 27 April 2019). The implementation consisted of parallel changes to the Grid and Distribution Codes, and the introduction of EREC G99. Given the novelty of some of the requirements in G99 there has been an ongoing review with stakeholders of both the underlying requirements and their expression in the drafting of G99, and a number of changes have been made in three updates since May 2018.

To help stakeholders manage the transition to the new requirements the ENA has been running a Distributed Energy Resources Technical Forum (DER TF), generally meeting on a monthly basis since November 2018. The details of the discussions at the DER TF can be found at the web address here.

Many of the issues discussed in the DER TF are points of clarification and explanation, but some have identified places where changes to G99 would be beneficial.

Included in this consultation document are the following appendices:

1. A table of examples of retrospective application of G99
2. A table summarising the G99 requirements for reactive power and voltage control
3. The proposed revised G99
4. The consequential amendments to the Distribution Code.

2 The Defects

The defects identified by the DER TF have been split into three types; those which are of a more significant change to G99 and which do all merit appropriate considered focus by stakeholders; those of a much more minor clarificatory nature, and simple typos.

2.1 Significant Change

2.1.1 Retrospective application

The question of retrospective compliance with G99 has been raised in two guises in recent months. One set of queries relates to the issues that are raised by the management of the gas resource in landfill gas generation sites, and the other is a more generic point about compliance when generation is updated during its lifetime.

The particular challenge for landfill gas is the existing practice of owners of a portfolio of sites moving generation equipment around between sites as the gas volumes change over the life of the site. In general the gas production declines over the life of the site, and it has been the owners' practice to relocate smaller generating modules from one declining site to a more recently declining site, thus maximizing the utilization of generation assets.

If a relocated generating unit was to be treated as new generation it would need to be G99 compliant. Whereas the generation is existing as G59 and connected to the network, and after location it would be replacing a larger G59 generating module. The following text changes are proposed to G99 to deal with these cases:

2.1 …..The requirements set out in this EREC G99 shall apply to Generators owning any Power Generating Module which has been substantially modified on or after 27 April 2019. ~~to s~~Such a modification will generally require ~~an extent that~~ it~~'~~s Connection Agreement ~~must~~ to be substantially revised or replaced (for example a change to a technical appendix in a Connection Agreement). Section 20.3 contains further details and Annex A.6 provides guidance on what modifications are considered substantial.

And

20.3.4 Where a Power Generating Module installed under EREC G59 is substantially modified (which generally result in a modified Connection Agreement) then it will be necessary for that Power Generating Module to be modified to be compliant with EREC G99. Modifications to a EREC G59 compliant Power Generating Module that are not considered substantial can remain compliant with EREC G59. Annex A.6 provides guidance on what modifications are considered substantial.

20.3.5 For the special case where an existing Power Generating Module of less than 10MW Registered Capacity (ie of a size that is less than Type C) that complies with EREC G59 is being relocated to another existing site to replace an existing EREC G59 compliant Power Generating Module(s) on that other site, then in those cases the relocated Power Generation Module will only need to comply with EREC G59 provided that the relocated Power Generating Module has a Registered Capacity less than or equal to the Registered Capacity of the Power Generating Module it is replacing

If an existing Power Generating Module is being relocated to an existing site where it has a greater Registered Capacity than the Power Generating Module it is replacing, or it is being relocated to a new site, then full compliance with EREC G99 will be required in either case.

The existing 20.3.4 will be retained and renumbered 20.3.6.

The other query was raised at the DCRP in April 2018 and points out that although G99 continues the approach where the level of investment is a consideration in deciding whether to retrospectively require compliance with electricity regulations, the EU Network Code RfG only includes types C and D in its retrospective application. This a long standing approach in G59 the D Code, in harmony with the principle that when significant investment is being made in an asset it should be brought up to modern requirements. This principle is clearly stated in industry documentation going back to the 1988 Electricity Supply Regulations and the 1990 Master Connexion and Use of System Agreement (now the CUSC). During the development of G99 it was widely noted that pre-existing GB requirements in the technical codes would persist unless they were in direct conflict with RfG requirements. This stems from Article 5 of the Third Package directive (2009/72/EC) and was accepted in the development of G99 and the parallel Grid Code modifications by Ofgem.

However this principle is not easy to interpret practically – hence the desire to agree a broad set of examples.

The DER Technical Forum have created and reviewed a set of examples that attempt to cover off the application of the principles above to a reasonably comprehensive range of practical examples. It is proposed to include this in G99, as the new Annex A6, where it can provide authoritative guidance and minimise interpretation disputes. The proposed G99 Annex A6 is attached as Appendix 1 to this consultation paper. Comments on the concept, format and the details of the examples will be welcome.

2.1.2 Small hydro with slow acting response times.

A particular problem was identified for owners of small and micro hydro in that it is hard to achieve a sufficiently rapid response in output power for LFSM-O. This was raised in the DER Technical forum Issue34 in particular but also 22 and 24.

Following discussion with NGESO, DNOs and representatives of small hydro installers a modified compliance and testing régime was suggested. This has been widely circulated via the DER Technical Forum and has now been incorporated in the revised draft of G99 in A.7.2.5.

2.1.3 LFSM-O tolerances

When checking compliance with LFMS-O requirements the tolerances to power output, droop and speed of response can be quite critical, especially at the high end of droop (ie 10%) that is likely to be chosen as default.. This was raised in the Technical Forum as issues 54 and 86.

This issue might need more consideration in the longer term, particularly when CENELEC publish their next iteration of EN50549 part 10. However from a review of EN50549 pt 1 and other considerations, the DNOs are proposing the following tolerances to be used in the tests described in A.7.1.3 in G99 (and A.1.2.8 in G98 in due course):

- Tolerance of frequency measurement should be ±0.05Hz;
- Tolerance of power output should be ±10% of the required step change;
- Response should be measured over a single step between 50.40Hz and 51.15Hz.

This gives a tolerance band for 10% droop of -1.5% + 2.8%, ie 8.5% to 12.8%.

The revised text is the addition of the following text to A.7.1.3:

……The **Droop** should be determined from the measurements between 50.4 Hz and 51.15 Hz. The allowed tolerance for the frequency measurement shall be ± 0.05 Hz. The allowed tolerance for **Active Power** output measurement shall be be ±10% of the required change in **Active Power**. The resulting overall tolerance range for a nominal 10% **Droop** is +2.8% and – 1.5%, ie a **Droop** less than 12.8% or greater than 8.5%.

2.2 Minor clarifications

2.2.1 Asterisks in the Interface Document

The drafts of G99 up to now have included asterisks in forms A2-1, A2-2 and A2-3 suggesting what might be tested by the manufacturer versus what might be tested on site. It has been pointed out in the DER Technical Forum (issue 79) that in some cases these are confusing. It is now proposed to remove all these asterisks from A2-1, A2-2, A2-3.

2.2.2 Reactive power control and NGESO

C.5.6 and C.5.7 refer to agreement with NGESO. This is only appropriate when the Power Generating Facility is caught by the Grid Code. This was raised in the Technical Forum as issue 66.

It is proposed to modify these clauses thus:

C.5.6.1 As defined in Grid Code ECC.6.3.8.3.4, Reactive Power control mode of operation is not required in respect of Power Park Modules unless otherwise specified by the ~~NETSO~~ DNO (in coordination with the ~~DNO~~NETSO for Power Park Modules that need to comply with the Grid Code). However where there is a requirement for Reactive Power control mode of operation, the following requirements shall apply.

C.5.7.1 As defined in Grid Code ECC.6.3.8.4.3, Power Factor control mode of operation is not required in respect of Power Park Modules unless otherwise specified by the DNO (in coordination with the NETSO for Power Park Modules that need to comply with the Grid Code). However where there is a requirement for Power Factor control mode of operation, the following requirements shall apply.

2.2.3 Reactive power requirements

Stakeholders have been confused by some of the new reactive power requirements in G99. Sections 11.1.6, 12.5.1 has been cited particularly, and there has been more general confusion around reactive power requirements.

The phrase "relate to the maximum level of Active Power delivered to the DNO's Distribution Network" in the definition of Registered Capacity has confused stakeholders, so we propose to delete it.

These points have been raised in the DER Technical Forum as issues: 42, 53, 56, 57 and 83.

To address these points a revised paragraph 11.1.6 is proposed:

11.1.6 As part of the connection application process the **Generator** shall agree with the **DNO** the set points of the control scheme for voltage control, **Power Factor** control or **Reactive Power** control as appropriate. The control scheme, the~~se~~ settings, and any changes to the~~se~~ settings, shall be agreed with the **DNO** and recorded in the **Connection Agreement**. The information to be provided is detailed in Schedule 5a and Schedule 5b of the Data Registration Code.

A new para 12.5.3 is proposed:

12.5.3 Where the Power Generating Module is contained within a larger installation comprising both demand and generation the DNO will advise the Generator if it is more appropriate for the Power Factor requirements to be specified for the installation, rather than the Power Generating Module, at the Connection Point, and what those requirements are.

And the definition of Registered Capacity is proposed to be changed:

Registered Capacity (P_{max})
The normal ~~full load~~ maximum **Active Power** capacity of a either a **Power Generating Module** (or in the case of a **Power Park Module**, the lesser of the **Inverter**(s) rating or the rating of the energy source), or of a **Power Generating Facility**, as declared by the **Generator** ~~less the MW~~taking into account the **Active Power** consumed when producing the same and the production of the required **Reactive Power** at the **Connection Point**. ~~This will relate to the maximum level of **Active Power** deliverable to the **DNO**'s **Distribution Network**.~~

~~For **Power Generating Module**s connected to the **DNO**'s **Distribution Network** via an **Inverter**, the **Inverter** rating is deemed to be the **Power Generating Module**'s rating.~~

In discussing the above issues in the DER Technical Forum it was agreed that it would be useful to summarize the different reactive power and voltage control requirements that apply to each of the different Types of power generating module size. A new paragraph describing this has been included as 9.8, and a summary table included as Annex D.4. The proposed summary table is attached to this consultation as Appendix 2.

9.8 Reactive Power and Voltage Control

The requirements for reactive power and voltage control vary by both the Power Generating Module Type (ie, A, B, C, D) as well as what is mutually required by the Generator and DNO at any particular point in the network. The requirements for each type are include in Sections 11.4, 12.4, 12,5, 13.4 and 13.5. They are also summarized in Annex D.4.

2.2.4 CE marking

G99 (and G98 as well as G59 and G83) have always required compliance with the CE marking legislation. This is an unnecessary imposition, and actively works against some emerging technologies. This was raised as issues 35 and 36 in the Technical Forum.

It is accepted by DNOs that compliance with the low voltage directive and other safety legislation is primarily an issue for manufacturers and developers, and is not generally helpful to make it such a specific blanket requirement of G98 and G98.

It is proposed to redraft 16.1.6 in G99 as:

16.1.6 The Power Generating Module shall comply with all relevant UK and European Directives and should be labelled ~~with a corresponding CE marking~~in accordance with those requirements.

2.2.5 Validated Models for Simulations

It is not necessarily clear that validated models for simulations are required in all cases. This was raised in the Technical Forum as issue 52. It is proposed to add a new clause 6.3.9.1 and renumber the rest of 6.3.9.

6.9.3.1 All simulation models used to demonstrate compliance with this EREC G99 must be validated.

2.2.6 LFSM and FSM

We have been asked to make it clear that Type C and Type D generators have to be capable of operating in both LFSM and FSM, but that by default they will operate in LFSM unless they have a contact (with NGESO) to operate in FSM. This was raised in the Technical Forum as issue 3. We propose to add a new paragraph 13.2.6.1 and renumber rest of 13.2.6 (and renumber the 2 references to it).

13.2.6.1 Each Power Generating Module will be capable of FSM in addition to LFSM-O and LFSM-U. By default Power Generating Modules will be set to operate in LFSM, unless the Generator has a specific contract with the NETSO to operate in FSM.

2.2.7 Choice of droop for LFSM-U and LFSM-O

It has been pointed out that Generators might choose a different droop for LFSM-O than that which they choose for LFSM-U. The SAF has already been updated to allow for this. It will be necessary to add a couple of lines to the DDRC in the Distribution Code to make this formal.

DDRC Schedule 5b:

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**

DDRC Schedule 5c(i) repeats the request for droop settings. As these are covered in DDCR 5b they can be deleted from Schedule 5c(i)

DDRC Schedule 5c(i)

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**~~
Error! Reference source not found. MODELS			
Governor and prime mover model (see note 4)	Model	**DPD**	**DPD**
AVR / excitation model (see note 4)	Model	**DPD**	**DPD**

2.2.8 Power quality and transformer ratings

The forms in Appendix A have a short phrase about transformer ratings and power quality. Section 9.4.3.2 of G99 has an explanation of this transformer which is to ensure an adequate ratio between the source fault level and the size of the Power Generating Module It has been raised at the Technical Forum as issue 38, and agreed that it is misleading in A2-1 and A2-3, and therefore should be removed from A2-1 and A2-3 where it occurs.

Form A2-1 and A2-3 to be modified as follows:

2. Power Quality – Harmonics: The test requirements are specified in A.7.2.~~5~~6. These tests should be carried out as specified in BS EN 61000-3-12. The results need to comply with the limits of Table 2 of BS EN 61000-3-12 for single phase equipment and Table 3 of BS EN 610000-3-12 for three phase equipment.

~~**Power Generating Module**s with emissions close to the limits laid down in BS EN 61000-3-12 may require the installation of a transformer between 2 and 4 times the rating of the **Power Generating Module** in order to accept the connection to a **Distribution Network.**~~

2.2.9 Monitoring of tripping supplies

It has been noticed that the longstanding requirement in the site commissioning forms A3, B3, C3 for the protection tripping supplies to be monitored is not a requirement of Section 10.

10.3.8 The health of protection tripping and/or auxiliary supplies must be monitored such that any failure of these supplies is either brought to the immediate attention of the **Generator** via an automatic alarm that is monitored by the **Generator** in real time, or the failure of the protection tripping and/or auxiliary supplies causes the **Power Generation Module** to be tripped, and reconnection prevented before restoration of the protection tripping and/or auxiliary supplies that have been lost.

2.2.10 Guidance on transient voltage control

It has been suggested that more guidance the exciter transient voltage control would be more appropriate, based on NGESO practice.

Add a new table as below, referenced from C.4.2.3.2

Type of Exciter	Typical Rise Time
Static Fed from machine terminals DC supply via power electronics	50 ms
Rotating Brushless Excitation from separate DC machine fixed to main rotor	300 ms

And new table below referenced from C4.2.3.3

Type of Exciter	Normal Ceiling Voltage
Static Fed from machine terminals DC supply via power electronics	2 pu
Rotating Brushless Excitation from separate DC machine fixed to main rotor	2pu

If short circuit level is low, the ceiling might need to be 3pu – this can be determined by a stability study ensuring 2pu is stable

Significant improvement in stability result in ceiling voltage change from 2 to 3 pu, more limited between 3 and 4 pu.

Higher pu excitation requires increased insulation

2.2.11 Post event recording clarification

Sections C.6.2.5.1.2 and C.6.2.5.1.5 refer to Post Event recording – it would be useful to confirm that recordings at a minute interval but capturing each 20 ms cycle is compliant. The following phrase sentence will be added to both these clauses.

Alternatively capturing each 20ms cycle in a fixed repeating period (eg 1 minute) would satisfy this requirement.

2.2.12 Recording of Type Tested Protection Relays

Some stakeholders have been wondering how to submit compliance data for components, especially interface protection relays, rather than complete generation units or modules. This was raised in the Technical Forum as issue 71.

It is therefore proposed to modify the start of forms A2-1, A2-2 and A2-3 as below:

2. To obtain **Type Tested** status for a product

This form can be used by the **Manufacturer** to obtain **Type Tested** status for a product which is used in a **Power Generating Module** by registering this form with the relevant parts completed with the Energy Networks Association (ENA) Type Test Verification Report Register.
For interface protection devices the appropriate section of Form A2-4 should be used.

2.2.13 Standard Application Form in preference to A1-1

For some small generation <50kW the one off nature of some developments will mean that it is more appropriate to use the SAF for collecting necessary equipment data when applying for connexion rather than form A1-1 in G99. This was raised in the Technical Forum as issue 85.

It is proposed to change the last sentence of the rubric on Form A1-1 thus:

If the Power Generating Module is neither Fully Type Tested or Type Tested then and Form A2-1 or A2-2 or A2-3 should be submitted to the DNO with this form. If this is not possible then the SAF should be submitted instead of this form.

2.2.14 Description of controller models

The description of controller models in 17.4.1(b) (and 18.4.1 and 19.5.3.1) has proved confusing to some manufacturers and stakeholders. It is proposed to change the text of these paragraph thus:

(b) evidence to the DNO's satisfaction that demonstrates that the Controller simulation models and/or parameters within the simulation model (as required under DDRC schedule 5c) supplied to the DNO provide a reasonable representation of the behaviour of the Generator's plant and apparatus;

2.2.15 Term "Controller" used erroneously

A.7.2.1

….Currently there are no harmonised functional standards that apply to the Power Generating Module Interface Protection, therefore in order to achieve Type Tested status the Controller and any separate Interface Protection unit will require their functionality to be Type Tested as part of the Power Generating Module as described in this Annex, and recorded in format similar to that shown in Annex A.2-1….

….The Interface Protection may be incorporated into the Controller and/or Power Generating Module in which case it should be tested as part of the Controller and/or Power Generating Module. Alternatively, the constituent devices that form the Interface Protection may be discrete in which case the tests may be carried out on the discrete protection devices independently from the Controller and/or Power Generating Module ….

A7.2.2.2

The Interface Protection shall be tested by operating the ~~Controller~~ Power Generating Module in parallel with a variable AC test supply, as an example see Figure A.7.5. Correct protection and ride-through operation shall be confirmed. The set points for over and under voltage at which the Interface Protection disconnects from the supply, will be established by varying the frequency of the AC supply voltage. The

disconnect sequence should be initiated when the network conditions mean the protection should trip in accordance with the settings in Table 10.1, otherwise normal operation should continue…..

A7.2.2.3

…. The Interface Protection shall be tested by operating the ~~Controller~~ Power Generating Module in parallel with a low impedance, variable frequency test supply system, as an example, see Figure A.7.6. Correct protection and ride-through operation should be confirmed during the test. The set points for over and under frequency at which the Interface Protection disconnects from the supply will be established by varying the test supply frequency.

2.2.16 Use of Annex A.7.2.4 LFSM-O test for > 50 kW Power Generating Modules

Form A2-2 for PGMs > 50 kW references Annex A.7.2.4 for the LFSM-O test. Annex A.7 is for Synchronous Power Generating Modules < 50 kW, although in this case the test is suitable for all Type A Synchronous Power Generating Modules.

It is proposed to add clarification to this effect at the beginning of Annex A.7.2.4:

The tests described in this Annex A.7.2.4 are also suitable for **Type A Power Generating Modules** > 50 kW.

2.2.17 Splitting of National Grid's licence

Following the splitting of their transmission licence, National Grid ESO is the system operator of the national electricity and should be referred to as such in the definitions. The definitions are proposed to be updated as:

CUSC
Has the meaning set out in ~~NGET's~~ the **Transmission Licence**

National Electricity Transmission System Operator (NETSO)
National Grid Electricity ~~Transmission (NGET)~~System Operator in its capacity as operator of the National **Transmission System**.

2.2.18 BE EN 50549

EN50459 parts 1 and 2 have been published and will be added to the list of references in Section 3.

2.3 Typographical etc errors

2.3.1 11.1.5

11.1.5 When operating at ~~**rated power**~~ **Registered Capacity** the **Power Generating Module** shall be capable of operating at a **Power Factor** within the range 0.95 lagging to 0.95 leading relative to the voltage waveform unless otherwise agreed with the **DNO**.

2.3.2 Duplicate 12.2.4.1

There are two paragraphs so numbered – to be corrected.

2.3.3 A2-3

There is a typo in form A2-3 in the LFSM-O section: Alternatively ~~simulation~~ test results should be noted below

2.3.4 PDGM forms

The PGMDs (forms B2-1 and C2-1 for Type B and Type C/D) should have "S" added to the evidence for Power Quality.

The PGMDs (forms B2-1 and C2-1 for Type B and Type C/D) – remove TV from Reactive Power Simulation

2.3.5 B.6.2.1(a)

The term “Manufacturer’s Data and Performance Report” is only partially bold in B.6.2.1(a). It is defined term. We propose to make the whole term bold.

2.3.6 C4.2.3.4.(i)

C.4.2.3.4 If a static type **Exciter** is employed:

(i) the field voltage should be capable of attaining a negative ceiling level specified in the **Connection Agreement** after the removal of the step disturbance of C.4.2.4.~~3~~2. The specified value will be 80% of the value specified in C.4.2.4.~~3~~2. The **DNO** may specify a value outside the above limits where the **DNO** identifies a system need.

2.3.7 Table C.6.3

Table C.6.3 has an incorrect title (copy and paste error from Table C.6.2).

Table C.6.3 Dynamic system event ~~half-cycle~~ waveform triggering

3 Applicable Distribution Code Objectives

Impact of the modification on the Applicable Distribution Code Objectives:	
Relevant Objectives	Identified impact
To permit the development, maintenance and operation of an efficient, coordinated and economical system for the distribution of electricity	Positive
To facilitate competition in the generation and supply of electricity	Positive
To efficiently discharge the obligations imposed upon distribution licensees by the distribution licences and comply with the Regulation and any relevant legally binding decision of the European Commission and/or the Agency for the Co-operation of Energy Regulators;	Positive
To promote efficiency in the implementation and administration of the Distribution Code	Positive

4 Consultation Questions

i. Do you agree that all these modifications should be made?

ii. If not, please explain which you think should not be made and the reasons for your view.

iii. Would you suggest any alternative wording etc to any of the proposed amendments? And if so, please include the text you suggest.

iv. Are there any other housekeeping or minor corrections you believe should also be made at this time?

v. Do you have any views on how this amendment addresses the above relevant Distribution Code Objectives?

5 Next Steps

Responses to this consultation should be sent to the Distribution Code Review Panel Secretary at dcode@energynetworks.org by **1700 on Friday 04 October 2019** on the pro-forma provided expressly for the purpose, or via any other convenient means. Responses after this date may not be considered.

For more information, please contact:

Vincent Hay – Code Administrator – 02077065105 – **dcode@energynetworks.org**

Appendix 1 – Examples of Retrospective Application of G99

	Scenario	DNO position	EREC G99?	Rationale
1	Small EREC G59 **PGM** (ie a few hundred kW or less connected where **DNO** has waived witnessing) connected post 27/04/19. **DNO** becomes aware on receipt of Commissioning Forms from **Generator**.	**DNO** gives notice to **Generator** to make compliant with EREC G99 within a reasonable time (6 months).	✓	Any new **PGM** should, unless compliant with the RfG agreed process, be EREC G99 compliant. In this case had the **DNO** witnessed the commissioning it would have been picked up earlier.
2	EREC G59 phased installation with a **Connection Agreement** for the capacity of the whole site (all **PPM**s), where the full capacity is built in a single build spanning 27/04/19. Contracts for the major plant placed before 17/05/18. (Not where the site is effectively complete but at a lower **Registered Capacity** than in the connection agreement – see scenario 3).	Connection under EREC G59 permitted.	×	This is effectively a single site that just happens to be constructed across the 27/04/19 date – but the arrangements are all compliant with the RfG.
3	EREC G59 **Connection Agreement** for a **PPM**. Project built is significantly less than contracted. Additional new generating units to be added post 27/04/19.	The additional generating units added significantly after the first build should be treated as a new **PPM** and be EREC G99 compliant.	✓	If the build (and investment) has essentially stopped, then the next phase should be considered as new build for the purposes of EREC G99 (and RfG) compliance.
4	EREC G59 phased installation with a **Connection Agreement** for capacity of the whole site – all **Synchronous PGM**s.	**Synchronous PGM**s commissioned after 27/4/19 must be compliant with EREC G99. Units commissioned before this date may be compliant with EREC G59. If the **Generator** had placed contracts for the additional modules before 17/05/18 they could be connected under EREC G59.	✓	As **Synchronous PGM**s are all separate (because they are synchronous), each should be treated separately.
5	Existing EREC G59 **PPM** site, the **Generator** is adding an additional **PPM** after 27/4/19.	New **PPM** to be compliant with G99.	✓	This is a new investment and cannot sensibly be integrated with the existing module (see figure 6.4 in EREC G99).

	Scenario	DNO position	EREC G99?	Rationale
6	Existing EREC G59 installation – move the **Interface Protection** within the existing site.	The **Generator** does not need to upgrade the equipment. However, if the relay and generation equipment is capable of accepting EREC G99 protection settings, the **DNO** shall ask the **Generator** to upgrade the settings to the latest version of EREC G99 or EREC G59. The **DNO** would witness the moved **Interface Protection** if there have been any wiring or relay changes, and according to the witness thresholds in each license area.	×	This is just a maintenance issue – there is no change to generation characteristics etc. Note that under the Accelerated Loss of Mains Change Programme revised settings will be required anyway.
7	Existing EREC G59 installation – replace **Interface Protection**, no change to **PGM**.	As 6 above.	×	As 6 above.
8	Existing EREC G59 installation – change fuel source (eg gas to bio-fuel, landfill gas to natural gas), with no change to main electrical equipment eg alternator or **Inverter**.	Probably do not need to upgrade to be complaint with EREC G99, provided no significant change to the electrical characteristics.	×	The assumption is that the investment associated with the main plant to make this change is modest and that there is no significant effect on the characteristics of the machine.
9	Existing EREC G59 installation – change prime mover (eg landfill gas site replaces landfill gas engine with a natural gas engine).	Assuming a new engine this is a significant change and the modified installation should comply with EREC G99. Note - a replacement like for like engine would not require EREC G99 compliance	✓	Significant investment in the main plant. The change to the prime mover could have significant effect on some electrical characteristics – eg stability and fault current contribution.
10	Existing EREC G59 installation – replace / upgrade control system (eg AVR, excitation system).	Replacement of components of a **PGM** with modern equivalent components would normally be considered to be maintenance work and therefore does not need to be upgraded to comply with EREC G99, unless this, in exceptional	×	In the main these sorts of changes are not likely to have significant effect on the electrical characteristics of importance to network operators.

	Scenario	DNO position	EREC G99?	Rationale
		cases, results in changes to the fundamental performance characteristics of generation. However any reduction in specific reactive capability specified in the **Connection Agreement** could trigger the need for full compliance with the latest EREC G99. Similarly the control system might influence other technical issues eg system stability which may trigger the need for compliance with EREC G99.		
11	Existing EREC G59 installation – change from Short Term Parallel, or Standby only, to Long Term Parallel operation.	Does not need to upgrade to comply with EREC G99. Does need to comply with the full EREC G59 requirements.	×	The **PGM** is already connected and is not being modified (although there might be protection upgrades needed).
12	Existing **Synchronous PGM** EREC G59 installation – replace alternator with a new non-identical unit.	Significant modification – needs to be compliant with the EREC G99.	✓	Significant investment. Significant electrical characteristics changed.
13	Existing **Synchronous PGM** EREC G59 installation – replace alternator with one of same vintage and identical manufacturers type (eg a reclaimed or spare unit).	Provided identical, does not need to be upgraded.	×	This is just a maintenance issue – there is no change to generation characteristics etc. Covers the case of strategic spares. No change to electrical characteristics.
14	Existing EREC G59 installation – at a **PPM** comprising multiple **Inverters**, replace failed **Inverter**.	Like-for-like replacements do not immediately lead to EREC G99 compliance for the whole module. New **Inverter** does need to be compliant with the latest EREC G99.	×	This is just a maintenance issue – the overall characteristics of the **PPM** are essentially unchanged.
15	EREC G59 installation – replacement of one **Generating Unit** in a **PPM**, eg one wind turbine on a site of several wind turbines.	Like-for-like replacements do not immediately lead to EREC G99 compliance for the whole module.	×	This is just a maintenance issue – there is no change to generation characteristics etc.

	Scenario	DNO position	EREC G99?	Rationale
		New **Inverter** does need to be compliant with the latest EREC G99.		
16	EREC G59 installation – full replacement of a **PGM** (no increase in **Registered Capacity**) with a new module.	EREC G99 20.3.2: New **PGM** must be compliant with EREC G99. 20.3.3: If there are other **PGM**s at the **Generator's Installation** that were installed under EREC G59, these do not need to be upgraded / replaced.	✓	Significant investment in replacing a module with a new module. Significant changes likely to the electrical characteristics at the **Connection Point**.
17	EREC G59 installation – full replacement of a **Type A** or **Type B PGM** with a **PGM** that had been installed elsewhere previously under EREC G59. No increase in **Registered Capacity** at the destination site.	Provided the relocated unit is **Type A** or **Type B** and comes from a EREC G59 compliant site, and the destination site is also EREC G59 compliant, and there is no increase in **Registered Capacity** at the destination site, this is allowable.	×	Modest investment compared to the costs of a new unit. No net change of electrical characteristics at the destination site.
18	EREC G59 installation – addition of a second hand EREC G59 **PGM** but interlocked as a standby set to the existing **PGM** (s)	A variant of scenario 17 if the additional unit was connected under EREC G59 and has been relocated to use as a standby/spare on the site, and is interlocked so it cannot run in parallel with the existing **PGM** (s) such that the effective **Registered Capacity** (and/or export capacity) of the site is unchanged,	×	There is no effective change of the electrical characteristics of the site and no need to comply with EREC G99.
19	EREC G59 installation – full replacement of a **PGM** (increase in **Registered Capacity**).	EREC G99 paragraph 20.3: New **PGM** must be compliant with EREC G99. Other EREC G59 units that are not being replaced do not need to be upgraded.	✓	Significant investment in replacing a module with a new module. Significant changes likely to the electrical characteristics at the **Connection Point**.
20	EREC G59 installation - replace transformer between the **PGM** terminals and the **Connection Point** with similar unit.	Like for like replacement has no effect on electrical characteristics. Does not need to comply with EREC G99	×	This is just a maintenance issue – there is no change to generation characteristics etc.

	Scenario	DNO position	EREC G99?	Rationale
21	EREC G59 installation - replace transformer between the **PGM** terminals and the **Connection Point** with one of significant different impedance.	Will have an effect on fault level contribution and on reactive capability. Any reduction in specific reactive capability specified in the **Connection Agreement** could trigger the need for full compliance with EREC G99 – but otherwise can remain as EREC G59.	×	This is just a maintenance issue – there is no change to generation characteristics etc.

Appendix 2 – Proposed reactive power and voltage control summary table

Type	Reactive range requirement	Voltage range for reactive range	Voltage control requirements
Type A	Capable of operating within the range ±0.95 **Power Factor** (paragraph 11.1.5) at **Registered Capacity**– Control scheme (and specific **Power Factor** for operation) by individual agreement (paragraph 11.1.6).	Nominal voltage only	Typically will be **Power Factor** control with **Generator** choosing the **Power Factor** – but to be agreed bilaterally in all cases (paragraph 11.1.6)
Type B	Must be capable of continuous operation anywhere within the range ±0.95 **Power Factor** (paragraph 12.5.1) **at Registered Capacity**. Must be capable of operating in accordance with **Generator Performance Chart** (paragraph 12.5.2).	Nominal voltage only	Typically will be **Power Factor** control with **Generator** choosing the **Power Factor** – but to be agreed bilaterally in all cases (paragraph 12.4.3.3). Control point is at the **Connection Point**, except for **PGMs** located remote from the **Connection Point** where a different control point can be agreed with the **DNO** (paragraph 12.4.3.2).
Type C and **Type D** - Synchronous	Must be capable of operating anywhere within ±0.92 **Power Factor** (paragraph 13.5.1) at **Registered Capacity**. Must be capable of operating in accordance with **Generator Performance Chart** (paragraph 13.5.2).	±0.05 pu of nominal voltage (paragraph 13.5.1). Maintain reactive performance as far as possible above 1.05 pu and below 0,95 pu within **Generator Performance Chart** (paragraph 13.5.3).	Agreed bilaterally as part of the connection process (paragraph 13.4.5) Control point is at the **Connection Point**, except for **PGMs** embedded within **Generator's Installation** where a different control point can be agreed with the **DNO** (paragraph 13.5.1).
Type C and **Type D** – **PPM** ≤ 33 kV	Lozenge as per paragraph 13.5.5 at **Registered Capacity**. Q/Pmax requirements (paragraph 13.5.6) below **Registered Capacity** unless otherwise specified by the **DNO**.	Lozenge as per paragraph 13.5.5	Agreed bilaterally as part of the connection process (paragraph 13.4.5). Control at the **Connection Point** (paragraph 13.4.4.1) Automatic Voltage Control system requirements as Annex C.5.2, C.5.3 and C.5.4. **Reactive Power** Control (agreed if required) requirements as Annex C.5.6. **Power Factor** Control (agreed if required) requirements as Annex C.5.7.
Type C and **Type D** – **PPM** > 33 kV	Bow tie as per paragraph 13.5.4 at **Registered Capacity**. Q/Pmax requirements (paragraph 13.5.6) below **Registered Capacity** unless otherwise specified by the **DNO**.	Bow tie as per 13.5.4	Agreed bilaterally as part of the connection process (paragraph 13.4.5). Control at the **Connection Point** (paragraph 13.4.4.1). Automatic Voltage Control system requirements as Annex C.5.2, C.5.3 and C.5.4.

			Reactive Power Control (agreed if required) requirements as Annex C.5.6. **Power Factor** Control (agreed if required) requirements as Annex C.5.7.

Draft G99 Amendments – see separate file.