THE DISTRIBUTION CODE OF LICENSED DISTRIBUTION NETWORK OPERATORS OF GREAT BRITAIN

Distribution Code Consultation DCRP/19/01

Title: G98/G99 and G59/G83 Minor Technical Modifications and Editorial Corrections

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: 08 February2019

Deadline for responses: 01 March 2019

Summary:

This Distribution Code public consultation is seeking the views from stakeholders on proposed modifications to ERECs G98 and G99 which have been identified by DNOs and stakeholders in the months since these documents were first consulted on and published.

This is a follow up consultation to the consultation that ran 26 October to 23 November 2018.

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 ERECs G98 and G99.

G98 and G99 were submitted to Ofgem in February 2018. After that date a number of familiarization and implementation workshops and meetings were held with stakeholders. DNOs and stakeholders have become progressively more familiar with the documents over recent months. Through this familiarization, a number of issues have come to light that stakeholders generally would like to see addressed. These were subject to a public consultation between 26 October and 23 November 2018. As a result of the feedback from stakeholders to the consultation, and a small number of other points that the DNOs have themselves raised, a few modifications to the draft text are now proposed and for which stakeholders' view are sought.

Since the previous consultation that closed on 23 November Ofgem have approved the GC0110 modification. This relates to the drafting of the requirements, and their compliance assessment, for the limited frequency sensitive mode – overfrequency requirements (LFMS-O). Ofgem have also approved the modification incorporating the fast track approval process for domestic scale storage. The previous consultation assumed that both of these changes had been approved, so this does not result in any changes to the text of G98 and G99 between the previous and current consultation.

Draft revised versions of G98 and G99 included as part of this consultation have all the proposed housekeeping changes from both consultations marked up. The changes proposed for the 26 October to 23 November consultation are marked up in tracked changes with the author as "ENA" and those additional changes proposed for this consultation are marked with "ENA 2" as the author.

Nine response were received to the first consultation which closed on 23 November. These, along with the DNOs comments on the responses, are all included in Appendix 2.

2 The Defects

Section 2 is split into two main parts. For ease of reference the changes proposed in the 17 October to 23 November consultation are included in Section 2.1, whilst the subsequent changes of this current consultation are described in Section 2.2.

2.1 First Consultation – 17 October to 23 November

This section reproduces the text of the 17 October consultation for ease of reference. Amendments to G98 and G99 associated with the proposals of Section 2.1 are marked up in Appendices 5 and 6 with "ENA" as the author.

2.1.1 Changes with definite implications for some stakeholders

2.1.1.1 Interface Protection testing values

The interface protection requirements for Type A generators are based on the various requirements of G83 and G59, and as a result the minor differences between the historical approaches have been carried forward in G98 and G99. As it possible that type-tested and non-type-tested interface protection will co-exist in future, even possibly in the same installation, it makes sense to align the testing values to avoid confusion. The differences between the values are immaterial.

	G99 Form A2-4 Value (proposed for all Forms)	G99 Form A2-3 and G98 Form B Values (to be replaced)
U/F Stage 1 stability test	47.7 Hz; 30 s 47.2 Hz; 19.5 s	47.7 Hz; 25 s 47.2 Hz; 19.98 s
U/F Stage 2 stability test	46.8 Hz; 0.45 s	46.8 Hz; 0.48 Hz
O/F Stability test	51.8 Hz; 120 s 52.2 Hz; 0.45 s	51.8 Hz; 89.98 s 52.2 Hz; 0.48 s
U/V stability test	188 V; 5.0 s 180 V; 2.45 s	188V; 3.5 s 180V; 2.48 s
O/V Stage 1 stability test	258.2 V; 5.0 s 269.7 V; 0.95 s	258.2 V; 2.0 s 269.7 V; 0.98 s
O/V Stage 2 stability test	277.7 V; 0.45 s	277.7 V; 0.48 s

The values in form A2-4 are also used in forms B2-2 and C2-2, thus all stability tests for all sizes of power generating modules would be identical.

As these changes in value are immaterial to the correct functioning of the interface protection there is no value in causing manufacturers to repeat type tests on existing equipment. To cover this off a new clause 2.14 has been added to G99 to extend the validity of type tests under previous issues of G99. Similarly a new clause has been added as 2.17 in G98.

2.1.1.2 Tests to ensure RoCoF protection correctly discriminates during high RoCoF

During discussions with stakeholders in May 2018 regarding testing and type testing, it was noted that as far as testing RoCoF protection devices in G99 was concerned the existing tests were marginal around the setting values; ie there were no tests that applied a high level of RoCoF to check both for correct operation (ie within the required time window) or restraint (for a high value of RoCoF that did not persist for more than 0.5 s). It was agreed that such tests had merit and should be incorporated and chosen at a value that was easily accomplished with the majority of protection test sets in common use. For simplicity a high RoCoF value of 2.5 Hzs^{-1} can be used for both a tripping accuracy test and a stability test, depending on its duration. These tests have been added to Forms A2-4, B2-2 and C2-2.

2.1.1.3 Importance of FON

A sentence has been added to the end of Section 6.2, and a little clarifying text to 17.4, 18.4 and 19.4 in G99 to underline Generators have no rights operate a Type B, C or D Power Generating Module without a valid Final Operational Notification. The opportunity has also been taken to set a suggested maximum time between commissioning and FON receipt of 28 days. See 2.2.1.1 for details of further modification made for this consultation.

2.1.2 Minor defects in original drafting

2.1.2.1 Phased installations

Although G99 was drafted to allow for some larger installations to be progressively commissioned, the paperwork did not always lend itself to support this easily. Modifications have been made to Form A3-1 Part 2, A3-3 Part 2, Form B3 Part 2 and Form C3 Part 2 to facilitate progressive commissioning.

2.1.2.2 Submission of Compliance Document for Type A

Modifications to G99 Section 16.2, primarily 16.2.2 and 16.2.4, to make the timings of submission clearer.

2.1.2.3 Reconnection Times

The tests in G98 Form C and G99 Forms A.2-1, A.2-3 for reconnection times have a mistake and have a stability test value of 196.1 V instead of the correct 180.0 V. Although manufacturers should correct for this and test using the correct value in future, this is not a material issue. There is no need to repeat type testing to recertify for this, as per the accommodation in 2.1.1.1 above.

2.1.2.4 Missing LMSF-O test steps

Form A2-3 in G99 was missing the final two frequency steps in Section 9 of the form which have been added.

2.1.2.5 Duplication of non-standard voltage settings

The issues of nominal voltage different from the statutory LV voltages is covered twice, in Section 10.6.14 and Appendix A6. Appendix 6 has been deleted.

2.1.2.6 Monitoring of tripping and auxiliary supplies

The longstanding requirement from G59 that tripping etc supplies should be monitored, or lead to lock out on their failure, was correctly included in G99 for Type A PGMs, but was missed for Type B, C and D PGMs. This requirement has now been added to Forms B3 and C3.

2.1.2.7 Published fault levels

In G99 12.3.1.7(c) and 13.3.1.11(c) it is stated that DNOs will publish maximum and minimum fault levels in their Long Term Development Statements. This is incorrect; the specification for the LTDS does not include minimum fault levels and it is not believed that this information is required for the purposes of fault ride through. The word “minimum” is therefore deleted in both locations.

2.1.2.8 Timing of PGMD submission for Type D PGMs

In G99 a few words have been added to 19.2.1 to clarify when Generators should look to first submit the PGMD.

2.1.2.9 Manufacturers' Information

It has been clarified in G99 21.2 that Manufacturers' Information includes both type-tested information, as well as other information that manufacturers might need to provide for any particular installation.

2.1.2.10 Type B simulation studies for reactive power

Section B.4.2 and B.4.3 in Annex B.4 in G99 overspecified the requirements applicable to Type B PGMs (compared to that mandated in the RfG). The overspecified reactive power requirements have been removed.

2.1.2.11 Type B simulation studies for frequency response

Section B.4.5 in Annex B.4 in G99 overspecified the requirements applicable to Type B PGMs (compared to that mandated in the RfG). The overspecified simulation study requirements have been removed.

2.1.2.12 Power Factor Control

Section C.5.7 in G99 contained an erroneous obligation for the DNO to agree aspects of power factor control with National Grid. This has now been removed.

2.1.2.13 Governor/Control specification

G99 13.2.6.1 included a redundant requirement to notify the DNO of the specification of the governor/controller. This has been removed.

2.1.2.14 Replace Minimum Generation with Minimum Stable Operating Level

In the drafting of G99 the older defined term Minimum Generation was used, instead of the equivalent Minimum Stable Operating Level. For consistency with the Grid Code is proposed to use Minimum Stable Operating Level. The specifics of the definition have not changed.

2.1.2.15 Clarification that the PGMD shall be submitted 28 days before synchronization

Minor amendments have been made to Forms B2-1 and C2-1 to clarify that the PGMD should be submitted (albeit not yet fully complete) to the DNO at least 28 days before synchronization is first required, and a reference to Sections 17.2.2 and 18.2.2 is added which specify which parts of the PGMD must be complete at this time.

2.1.2.16 Inclusion of Witnessing and Commissioning paragraph for Type D

The Witnessing and Commissioning paragraphs used for Type B and Type C PGMs had been omitted for Type D. These paragraphs have been included in Section 19.4. The subsequent paragraphs in Section 19 and their cross references have been renumbered.

2.1.2.17 Additional space for insertion of Manufacturers' Information reference numbers

The table cells on Forms A2-2; A2-3 have been enlarged to aid the adding of manufacturers references into these cells.

2.1.2.18 Use of Type Tested in G98

As only Fully Type Tested micro-generators can connect under G98 the use of the defined term "Type Tested" has been reviewed and removed or replaced. "Fully Type Tested" or reference to the "Type Test Verification Report" are used throughout.

2.1.2.19 Voltage Management Units in G98

A paragraph has been added to G98 to clarify that any Micro-generator shall be connected to the Connection Point side of any Voltage Management Unit installed in a Customers' Installation.

2.1.2.20 Multiple Premises Connection Procedure in G98

Clarity has been added to the procedure for multiple premises connection by moving paragraph 8.1.2 to the Section 5 which details connection procedures.

2.1.2.21 Consistency of G59 and G83

Both G59 and G83 do not mention the existence of G98 and G99. A sentence needs to be added to both to make it clear that new installations connected on or after 27 April 2019 need to comply with G98 and G99 as appropriate.

2.1.3 Minor errors, typographical errors etc

2.1.3.1 Labelling of forms

The labelling of all forms in G99 has been standardized as “Form X-M (Annex X.M)”

2.1.3.2 Other minor corrections

- G99 A.7 para 1 corrected reference from Annex 3 to Annex 2.
- In G99 PGF Owner has been replaced, where it occurs, with Generator.
- Two instances of User have been replaced with Generator.
- G98 Annex A2 Power Quality heading should be numbered A2.3
- G98 10.1.2 – Distribution Code is not a defined term, so the bold is removed
- Minor wording changes for clarity in G99: 1.2; 3.4; 9.7.2; 10.2.2; 10.4.1; 10.4.14; 14.4.1(a); 14.5.7; 15.3.3; 16.1.3; 17.1.2; 18.1.2; A.2-1 1; A2-2 1
- Bold for defined terms applied carefully to include the defined term, but not, for example, its plural ‘s’.
- DNO’s system corrected to DNO’s Distribution Network throughout

2.2 This Consultation – 08 February – 01 March 2019

This section explains the additional Amendments to G98 and G99 now proposed, incorporating responses to the previous consultation. The proposed amendments described in this Section 2.2 are marked up in Appendices 5 and 6 with “ENA 2” as the author.

2.2.1 Changes with definite implications for some stakeholders

2.2.1.1 Connection process and Importance of FON

The new words added in 17.2.1, as part of the First Consultation, 17 October, about the connection offer have been clarified.

Concerns were expressed that in some cases generating units can take a significant time to commission and the new text in respect of the FON in 17.4, 18.4 may prevent the PGM from operating once the connection has been demonstrated to be safe. It is noted that a Type D PGM can operate with an ION prior to receiving a FON. The use of EONs and IONs for Type B and C PGMs was discussed amongst stakeholders during the original drafting of G99 in 2017 and there was a clear consensus that such a process was not desirable for Type B and C PGMs. The intention of the additional paragraphs is to expediate the provision of all the necessary compliance documentation prior to the issue of a FON. The clause has been modified to state that the Generator has no *permanent* rights to operate the PGM until the FON is received. The timing of the PGMD submission has been reviewed with stakeholders and is left at 28 days from first synchronisation for Synchronous

PGMs and has been extended to up to 6 months from first synchronisation for PPMs (with the ability to agree otherwise).

The connection process has been reviewed with stakeholders and Paragraphs 17.2.6 – 17.2.10 and 18.2.6- 18.2.10 have been added to assist with clarity. This has resulted in the requirement being removed for the Generator to declare that the PGMD is complete in the Installation and Commissioning form B3 / C3 . The B3 / C3 form will be returned with the B2-2 / C2-2 form as necessary at the time of commissioning with the PGMD being signed and returned once the full compliance process is complete.

Diagrams illustrating the Connection Process for Type B / C and Type D PGMs are given in Appendix 1.

Paragraph 16.4.3 has been added to clarify the rights in respect of a Type A PGM on connection.

2.2.1.2 Regenerative equipment

Paragraph 7.1.2 has been added to clarify requirements in respect of regenerative equipment which may act as a short term source of energy. Because it is unlikely any regenerative equipment would support a power island it is unlikely that G99 would need to be applicable. The DNO can advise if any special considerations such as reverse power protection is required on a case by case basis.

2.2.1.3 Type tested interface protection

There were concerns about the clarity of the modifications which had been proposed to 10.1.4 in respect of type tested interface protection. A new paragraph has been added and the original 10.4.1 redrafted in collaboration with stakeholders to add clarity resulting in modified paragraphs 10.4.1, 10.4.2 and 16.4.4.

2.2.1.4 Tests to ensure RoCoF protection correctly discriminates during high RoCoF

Stakeholders raised several points in respect of the proposed text about RoCoF stability tests. Following discussion with stakeholders the RoCoF stability test ranges, test frequency and test durations have been revised and clarified in the Site compliance and commissioning test forms (A2-4, B2-2 and C2-2).

2.2.1.5 Tests to prove RoCoF withstand

Tests have been added to Form A2-2 and A2-3 for Type A PPMs to demonstrate RoCoF withstand. The frequency test requirements in the Type B PGMD, Form 2-2 have been clarified in respect of RoCoF withstand. Similar frequency test requirements have been added to the Type C PGMD.

2.2.1.6 Reactive capability

Clarification in respect of the interpretation of figure 13.10 for Type B PGMs that are embedded within a generators network has been made in paragraph 13.5.1. Clarification in respect of all Type B PGMs when the voltage is outside ±5% has been made in a new paragraph 13.5.3.

The reactive power and excitation capability tests, in Annex B.5 and B.6, for Type B PGMs have been removed as these are not explicitly required. The references to the tests in the Type B PGMD, Form B2-1, have been removed. Paragraph 17.2.3 (d) has been revised to allow the DNO to agree the requirement for excitation system and reactive capability tests with the Generator for Type B PGMs on a case by case basis.

The reactive power operational requirements in Annex C.5.3.4 have be clarified for PPMs connected at 33 kV or less. The capability requirements given in paragraph 13.5.5 mean that the operating point is indeterminate at 1.05 pu voltage for leading power factor and 0.95 pu voltage for lagging power factor. Hence whilst the capability range is defined by the envelope in figure 13.2, paragraph C.5.3.7 considers the PPM design operating limits and uses figure C.5.2 to illustrate the operation that may be achieved at voltage extremes.

The reactive power simulation studies for Type C PGMs, in Annex C.7.3, have been revised to correctly account for the differences between the required capability of synchronous PGMs and PPMs. This requires the studies to be undertaken at 97% and 103% of nominal voltage for PPMs, rather than 95% and 105% which is the requirement for synchronous PPMs.

2.2.1.7 Voltage control tests

Paragraph 18.1.5 has been added in respect of the initial 20% limit on connection of Type C PPMs until voltage control tests have been completed. This is a duplicate of the intent of paragraph 19.3.9 associated with the ION for Type D PPMs and was erroneously omitted from the original G99 draft.

2.2.2 Minor defects in original drafting

2.2.2.1 Clarification of applicability of version of G99

Paragraph 2.14 has been modified to clarify that the version of G99 current at the time of type testing or ordering plant and / or apparatus is the version that will be applicable to the PGM for the purpose of compliance demonstration.

2.2.2.2 Compliance and Commissioning forms

Several changes have been made to improve the coverage and clarity of the compliance and commissioning forms:

- A check for as installed data added to Type A Installation Document Form A3-1.
- Logic interface port and wiring check anomalies have been corrected in Form A2-2 and A2-4.
- A note has been added to Form A2-2, Voltage fluctuations and flicker to state that measurements can be recorded as in form A2-1.
- A requirement for the Connection Agreement and Site Responsibility Schedule to be complete prior to energisation has been added to the Type B and Type C PGMD (Forms B2 and C2).

2.2.2.3 Modification to Annex A.4.3 in respect of Infrequent Short Term Parallel Operation

Apart from the RfG exclusions the specificity of short term paralleling is dealt with in G99 Section 7.3 (this text is from G59). Hence the exclusion of parts of Section 9 and Section 10 from the infrequent short term paralleling requirements has been determined as being incorrect and has been removed.

2.2.2.4 Clarification of droop for LFSM-O

Figures 11.2 and 12.2 have been modified to show the range of droops that a Generator may choose to implement for LFSM-O.

2.2.2.5 “Must” replaced with “Shall”

To align with other ENA documents, and also with the legal style of international standards and the EU Network Codes, the word “shall” has been used in instances were “must” has been used hitherto.

2.2.2.6 Unnecessary dated references in G59 and G83

In accordance with the good practice established in G98 and G99, unnecessary dated references to IEC and other standards have been removed in G59 and G83. These are shown in Appendices 3 and 4.

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?

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 01 March 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 - **dcode@energynetworks.org**

Appendices

Appendix 1 – Process diagrams

Appendix 2 – Responses to the 26 October Consultation

Appendix 3 – Proposed G59 changes

Appendix 4 – Proposed G83 changes

Appendix 5 - proposed EREC G98

Appendix 6 – Proposed EREC G99

Appendix 1

Connection Process for Type B and C Power Generating Modules

Connection Process for Type D Power Generating Modules

DCRP/18/11/PC: Housekeeping Modifications to G98 and G99

Stakeholders are invited to respond to this consultation, expressing their views or providing any further evidence on any of the matters contained within the consultation document. Stakeholders are invited to supply the rationale for their responses to the set questions.

Please send your responses and comments by **17:00 23 November 2018** to dcode@energynetworks.org and please title your email 'Consultation Response DCRP/18/11/PC '. Please note that any responses received after the deadline may not receive due consideration by the Working Group.

Any queries on the content of the consultation pro-forma should be addressed to DCode Administrator on 020 7706 5174, or to dcode@energynetworks.org

Respondent	Bernard Gospel - Technical Secretary
Company Name	AMPS – Association of Manufacturers of Power Generating Systems
No. of DCode Stakeholders Represented	AMPS is the primary Association for Manufacturers and suppliers of Power Systems (generating sets) and ancillary equipment, with 122 members representing 80% of the UK industry.
Stakeholders represented	*Please see our website http://www.amps.org.uk*
Role of Respondent	UK Generating set manufacturer trade body
We intend to publish the consultation responses on the DCode website. Do you agree to this response being published on the DCode website? [Y/N]	Y

	Questions		DNOs' Response
Q1	Do you agree that all these modifications should be made?	Yes	
Q2	If not, please explain which you think should not be made and the reasons for your view.		
Q3	Would you suggest any alternative wording etc to any of the proposed amendments? And if so, please include the text you suggest.	In Annex A2.4 the additional tripping test at 2.5Hz/s should ideally be at the maximum rate available with the DVS3 test set i.e. 3.0Hz/s to maximise the effectiveness of the test in ensuring immunity to tripping by short lived, high rate events. The frequency range used for this test needs to be wider even if it remains at 2.5Hz/s, for example 48.5 to 51.5Hz. In Annex A2.4 the additional RoCoF stability test that injects 2.5Hz/s for 450ms is unachievable and should be replaced with 1.2Hz/s which is achievable and more consistent with similar tests for the voltage and frequency tests. The range of frequencies used for this test should be specified to ensure consistency. All these RoCoF corrections should be copied to all the following sections as appropriate:	Having had some discussions with AMPS members on this point, DNOs agree with these points and these changes have been made to the next consultation version of G99

		15.4.1 c Should be 0.1Hz/s over the operating point A2-1 section 7 needs updating A2-3 section 7 needs updating Form B2-2 needs updating Form C2-2 needs updating Section 10.1.5 only seems to add to the existing uncertainties over how protection settings should be protected from change: It singles out voltage settings when existing equipment typically has the same mechanism for all settings. It introduces the term “appropriately authorised personnel” without explaining who they are. It introduces the term “additional electronic device” without defining what it is but implying that the status quo of password entry on the module or sealed switches may no longer be sufficient.	
Q4	Are there any other housekeeping or minor corrections you believe should also be made at this time?	Section 7.4 “Switched alternative operation” could be interpreted as meaning that a PGM which is prevented from grid parallel operation by an interlock could still be subject to all the provisions of this standard. Therefore, the scope in section 2.5 should be revised to clarify that only section 7.4 applies to this situation and no other parts of G99.	DNOs agree and have made this change.

DCRP/18/11/PC: Housekeeping Modifications to G98 and G99

Stakeholders are invited to respond to this consultation, expressing their views or providing any further evidence on any of the matters contained within the consultation document. Stakeholders are invited to supply the rationale for their responses to the set questions.

Please send your responses and comments by **17:00 23 November 2018** to dcode@energynetworks.org and please title your email 'Consultation Response DCRP/18/11/PC '. Please note that any responses received after the deadline may not receive due consideration by the Working Group.

Any queries on the content of the consultation pro-forma should be addressed to DCode Administrator on 020 7706 5174, or to dcode@energynetworks.org

Respondent	Awais Lodhi
Company Name	Centrica Plc
No. of DCode Stakeholders Represented	
Stakeholders represented	
Role of Respondent	Supplier Representative (Lead Electrical Engineer)
We intend to publish the consultation responses on the DCode website. Do you agree to this response being published on the DCode website? [Y/N]	No

	Questions		DNOs' response
Q1	Do you agree that all these modifications should be made?	Yes	
Q2	If not, please explain which you think should not be made and the reasons for your view.		
Q3	Would you suggest any alternative wording etc to any of the proposed amendments? And if so, please include the text you suggest.	No	
Q4	Are there any other housekeeping or minor corrections you believe should also be made at this time?	In Form B2-2 few references are not matching to the word. Please review them.	Thank you for spotting these. We have undertaken a review and made some changes.

DCRP/18/11/PC: Housekeeping Modifications to G98 and G99

Stakeholders are invited to respond to this consultation, expressing their views or providing any further evidence on any of the matters contained within the consultation document. Stakeholders are invited to supply the rationale for their responses to the set questions.

Please send your responses and comments by **17:00 23 November 2018** to dcode@energynetworks.org and please title your email 'Consultation Response DCRP/18/11/PC '. Please note that any responses received after the deadline may not receive due consideration by the Working Group.

Any queries on the content of the consultation pro-forma should be addressed to DCode Administrator on 020 7706 5174, or to dcode@energynetworks.org

Respondent	Tobias Gehlhaar
Company Name	Brand name: DNV GL – Energy, Renewables Certification Legal name: Germanischer Lloyd Industrial Services GmbH.
No. of DCode Stakeholders Represented	Difficult to say
Stakeholders represented	*Type B synchronous power generating equipment*
Role of Respondent	Principal Engineer
We intend to publish the consultation responses on the DCode website. Do you agree to this response being published on the DCode website? [Y/N]	Y

	Questions		DNOs' Response
Q1	Do you agree that all these modifications should be made?	Yes	
Q2	If not, please explain which you think should not be made and the reasons for your view.		
Q3	Would you suggest any alternative wording etc to any of the proposed amendments? And if so, please include the text you suggest.	Yes. See attached and below. Annex B, page 270 please clarify if simulation only is requested. If so, please add "Testing is optional." to the sentence: " **Reactive Power capability** Confirm compliance with Section 12.5 by carrying out simulation study in accordance with B.4.2 and by submission of a report. Testing is optional." Annex B, page 294 the test description has been deleted. Please clarify if the test is still required. If yes, please add the old description to B.5.2.1 or update the description. This is the old one: "The open circuit step response of the **Excitation System** will be tested by applying a voltage step change from 90% to 100% of the nominal **Synchronous Power Generating Module** terminal voltage, with the **Synchronous Power Generating Module** on open circuit and at rated speed."	We have reviewed the tests for the Type B PGMs and made the following amendments to the text on G99: Synchronous: • Deleted excitation system tests for Type B in PGMD • Deleted excitation system and voltage tests in B.5 PPMs: • Deleted PGMD req for reactive power test for Type B. • Deleted PGMD req for Voltage control test for Type B • Deleted tests in B.6.2, B.6.3 and B.6.4

Q4	Are there any other housekeeping or minor corrections you believe should also be made at this time?	Yes. See attached and below. Page 110 last lines: deleted double word the. 12.4.3.1**Generating Module** shall be equipped with a permanent automatic **Excitation System** that ~~that~~ has the capability to provide constant terminal voltage (assuming a high enough **Network** source impedance to allow the **Power Generating Module** to achieve this while remaining within its ratings) at a selectable setpoint Annex B, page 269, clarify if DNO will accept tests done once as type tests not to be re-tested or witnessed by DNO. If so, please add: "unless done as type test" and "**DNO** will not request re-testing" forming the following changed sentence: "T - Indicates that the **DNO** would expect to see results of, and/or witness, tests or monitoring which demonstrates compliance unless done as type test TV - Indicates Type Test reports (if **Generator** pursues this compliance option **DNO** will not request re-testing)" Annex B, page 271 add "remotely or" to the sentence: "Confirm the **Active Power** set point can be adjusted remotely or in accordance with instructions issued by the **DNO** "	Noted – thank you. 17.1.2, 18.1.2 and 19.1.2 cover this generally. This should be covered by the Equipment Certificate regime so no change is proposed at present. No change - – there is no requirement to prove it can be done remotely

		Annex B, page 271 please clarify if really no FRT type testing is required. If so, please add "Testing of FRT is not required" to the sentence "**Fault Ride Through** Confirm the compliance with 12.3 by carrying out simulation study in accordance with B.4.4 and by submission of a report. Testing of FRT is not required."	"Testing of Fault Ride Through is not required" has been added to Type B PGM for Synch and PPM
		Annex B, page 271 please clarify if really no hardware testing shall be performed. If so, please add: "A hardware test is not required" to the sentence: "Confirm the compliance with 12.2.4 by carrying out simulation study in accordance with B.4.5 and by submission of a report. A hardware test is not required."	Injection tests are required at a later stage as Annex B5 and B6. No change made.
		Annex B, page 288 please clarify if simulation models should be validated against test results. If so, please add: "Simulation models used shall be validated against corresponding test results." to the sentence: "B.4.4.1 This section applies to **Power Generating Module**s to demonstrate the modules **Fault Ride Through** and **Fast Fault Current** injection capability. Simulation models used shall be validated against corresponding test results."	This is not required for Type B so not included
		Annex B, page 294 please clarify if testing is required or not. If not required, please change the sentence like this (changes are marked in red): "B.5.2.1 The test shall normally be carried out prior to synchronisation or as a type test. **Manufacturers'**	B.5 excitation, voltage control and reactive power tests have been deleted – see above.

		Information may be used where appropriate and may be used if agreed with the **DNO**.” If the test is required, please add a sentence like “testing is mandatory” and keep in mind, that using MI might be understood as testing is optional and manufacturer can confirm compliance without a test.	

DCRP/18/11/PC: Housekeeping Modifications to G98 and G99

Stakeholders are invited to respond to this consultation, expressing their views or providing any further evidence on any of the matters contained within the consultation document. Stakeholders are invited to supply the rationale for their responses to the set questions.

Please send your responses and comments by **17:00 23 November 2018** to dcode@energynetworks.org and please title your email 'Consultation Response DCRP/18/11/PC '. Please note that any responses received after the deadline may not receive due consideration by the Working Group.

Any queries on the content of the consultation pro-forma should be addressed to DCode Administrator on 020 7706 5174, or to dcode@energynetworks.org

Respondent	Alan Creighton
Company Name	Northern Powergrid
No. of DCode Stakeholders Represented	
Stakeholders represented	
Role of Respondent	Senior Smart Grid Development Engineer
We intend to publish the consultation responses on the DCode website. Do you agree to this response being published on the DCode website? [Y/N]	Y

	Questions		DNOs' response
Q1	Do you agree that all these modifications should be made?	Yes, subject to the points identified on the marked up versions G98 and G99 being considered	
Q2	If not, please explain which you think should not be made and the reasons for your view.	N/A	
Q3	Would you suggest any alternative wording etc to any of the proposed amendments? And if so, please include the text you suggest.	Please see the attached marked up versions G98 and G99	Most of these suggestions are very helpful and we have discussed any which are not obvious.
Q4	Are there any other housekeeping or minor corrections you believe should also be made at this time?	Please see the attached marked up versions G98 and G99	

DCRP/18/11/PC: Housekeeping Modifications to G98 and G99

Stakeholders are invited to respond to this consultation, expressing their views or providing any further evidence on any of the matters contained within the consultation document. Stakeholders are invited to supply the rationale for their responses to the set questions.

Please send your responses and comments by **17:00 23 November 2018** to dcode@energynetworks.org and please title your email 'Consultation Response DCRP/18/11/PC '. Please note that any responses received after the deadline may not receive due consideration by the Working Group.

Any queries on the content of the consultation pro-forma should be addressed to DCode Administrator on 020 7706 5174, or to dcode@energynetworks.org

Respondent	Torben Damgaard
Company Name	Orbital A/S Denmark
No. of DCode Stakeholders Represented	0
Stakeholders represented	*1*
Role of Respondent	CTO/Control Engineer M.Sc.
We intend to publish the consultation responses on the DCode website. Do you agree to this response being published on the DCode website? [Y/N]	Y

	Questions		DNOs' Respo;nse
Q1	Do you agree that all these modifications should be made?	-	
Q2	If not, please explain which you think should not be made and the reasons for your view.	-	
Q3	Would you suggest any alternative wording etc to any of the proposed amendments? And if so, please include the text you suggest.	-	
Q4	Are there any other housekeeping or minor corrections you believe should also be made at this time?	Please see below.	Subsequent to Orbital's points below, the ENA has had anemail dialogue with Orbital, culminating thus: Hi Mike and Richard Thanks a lot for the fast reply. I see the difference and that it actually allows to choose either one of the two, I missed that part somehow. We mainly compared it with the requirements in Denmark and Germany where the TSO's has chosen to use the actual output power. From a control perspective I would think that it would be better to have all power plants reducing the output power, but I am no grid expert.

			It is not a big issue for us, but we will have to implement an additional parameter to change the functionality, so I just wanted to make sure that it was intentional. Please disregard the housekeeping comments I sent, and thanks again. Med venlig hilsen/Kind regards **Torben Damgaard** **CTO Orbital Drives**

G99 states that the power reduction should always be from the registered capacity(Pref = Nominal Power), regardless of the actual output power when activating the function.

This is in contrast to the Commission Regulation (EU) 2016/631, which I believe is the background for the G99. This states that the reduction should start from the actual power production when the function is activated (Pref = actual power)

Is this difference an error in G99, or is it purposely different to the EU Regulation and what would the reason be for having a different requirement? Please see pictures below from G99 and EU 2016/631.

I believe that the EU implementation is the correct way to do it, since you would want all producers to reduce power in case of high grid frequencies, not only those already running at maximum power.
Having to implement two different functionalities for G99 and other countries would be an additional and unnecessary cost and complexity factor.

ΔP / P_ref
+0.01
-0.01
-0.02
-0.03
49.9
50.1
50.2
50.3
50.4
50.5
Hz
• P_ref is the Registered Capacity (taking into account any Generating Units not in service)

Figure 1

Active power frequency response capability of power-generating modules in LFSM-O

P_{ref} is the reference active power to which ΔP is related and may be specified differently for synchronous power-generating modules and power park modules. ΔP is the change in active power output from the power-generating module. f_n is the nominal frequency (50 Hz) in the network and Δf is the frequency deviation in the network. At overfrequencies where Δf is above Δf_1, the power-generating module has to provide a negative active power output change according to the droop S_2.

Appendix 2

DCRP/18/11/PC: Housekeeping Modifications to G98 and G99

Stakeholders are invited to respond to this consultation, expressing their views or providing any further evidence on any of the matters contained within the consultation document. Stakeholders are invited to supply the rationale for their responses to the set questions.

Please send your responses and comments by **17:00 23 November 2018** to dcode@energynetworks.org and please title your email 'Consultation Response DCRP/18/11/PC '. Please note that any responses received after the deadline may not receive due consideration by the Working Group.

Any queries on the content of the consultation pro-forma should be addressed to DCode Administrator on 020 7706 5174, or to dcode@energynetworks.org

Respondent	Thorsten Bülo
Company Name	SMA Solar Technology AG
No. of DCode Stakeholders Represented	1
Stakeholders represented	*PV and Storage System Components manufacturer*
Role of Respondent	System Development Engineer
We intend to publish the consultation responses on the DCode website. Do you agree to this response being published on the DCode website? [Y/N]	Yes

	Questions	
Q1	Do you agree that all these modifications should be made?	Yes
Q2	If not, please explain which you think should not be made and the reasons for your view.	
Q3	Would you suggest any alternative wording etc to any of the proposed amendments? And if so, please include the text you suggest.	yes
Q4	Are there any other housekeeping or minor corrections you believe should also be made at this time?	yes

Comments on G98

Page No	Line No	Clause/ Subclause	Paragraph Figure/ Table	Type of comment (General/ Technical/Editorial)	COMMENTS	Proposed change	OBSERVATIONS OF THE SECRETARIAT on each comment submitted
7		2		General	It should be clear, that new Micro Generators replacing old Micro Generators that are compliant with G83 (e.g. due to failure of the inverter) don't need the G83 compliance but may be compliant only with the new G98. This reduces effort on testing and documentation of new inverters.	Add to section 2 (e.g. a new paragraph after 2.6): "2.7 Where an existing Micro-generator commissioned under EREC G83 or a part of it is replaced by a new Micro-generator, the latter may be compliant with EREC G98 instead of EREC G83."	This seems to be stating the obvious – especially since G98 only caters for wholly type tested modules. And G83 similarly doesn't cater for piecemeal replacement. Nor is there any need to be backward compatible with G83. No change proposed.
7		2.1		General	"The requirements set out in this EREC G98 are in addition to those of European standard EN 50438 which should be complied with in full." The EN 50438 will be replaced soon by the EN50549-1. Will then the the 50549-1 be required? Or is this paragraph dispensable at all?	Clarify, if - and if yes - which Cenelec standard's requirements have to be met additionally when the new EN 50549-1 is applicable	G98 is to be reviewed and modified to cater for the withdrawal of 50438 and its replacement with the relevant parts of 50549.

Comments on G99

Page No	Line No	Clause/ Subclause	Paragraph Figure/ Table	Type of comment (General/ Technical/Editorial)	COMMENTS	Proposed change	OBSERVATIONS OF THE SECRETARIAT on each comment submitted
13		2.1		General	It should be clear, that new PGMs replacing old PGMs that are compliant with G59 (e.g. due to failure of the inverter) don't need the G59 compliance but may be compliant only with the new G99. This reduces effort on testing and documentation of new inverters.	Add paragraph to 2.1 after "…in a connection agreement": "Power Generating Modules, that replace PGMs in existing plants (that are compliant to EREC G59) to such an extent that it's Connection Agreement does not have to be substantially revised or replaced, may be compliant with EREC G99 instead of EREC G59."	G59 covers changes in Section 12.6 and similarly this is picked up in G99 Section 20.3. Whilst there is a difference between replacement of a component and complete replacement of the PGM, there is nothing in either G59 or G99 to suggest that inverters type tested to G59 need to be sourced in the future. Any G99 compliant component replaced into a G59 compliant module can be made as there is no conflict or shortfall in G99 performance etc requirements cf those in G59. However if a module is replaced, then it will have to be fully G99 compliant. No change proposed.

DCRP/18/11/PC: Housekeeping Modifications to G98 and G99

Stakeholders are invited to respond to this consultation, expressing their views or providing any further evidence on any of the matters contained within the consultation document. Stakeholders are invited to supply the rationale for their responses to the set questions.

Please send your responses and comments by **17:00 23 November 2018** to dcode@energynetworks.org and please title your email 'Consultation Response DCRP/18/11/PC '. Please note that any responses received after the deadline may not receive due consideration by the Working Group.

Any queries on the content of the consultation pro-forma should be addressed to DCode Administrator on 020 7706 5174, or to dcode@energynetworks.org

Respondent	Isaac Gutierrez
Company Name	Scottish Power Renewables
No. of DCode Stakeholders Represented	1
Stakeholders represented	Scottish Power Renewables
Role of Respondent	Generator
We intend to publish the consultation responses on the DCode website. Do you agree to this response being published on the DCode website? [Y/N]	Y

	Questions		DNOs' response
Q1	Do you agree that all these modifications should be made?	Partially as there is one modification that should be reviewed in conjunction with National Grid. From the list of minor defects published in the consultation paper item" **2.2.14 Replace Minimum Generation with Minimum Stable Operating Level "**requires further review as in some instances this technical term is not applicable.	We agree that these changes to be made to dispel any confusion between these terms. We intend to work with National Grid, as this confusion affects the Grid Code too, and introduce these changes as a further housekeeping mod in due course, ie we will harmonize the changes with those to the Grid Code.
Q2	If not, please explain which you think should not be made and the reasons for your view.	It seems that in some sections term **Minimum Stable Operating level** has been used instead of **Minimum Regulating Level** (formerly known as Design Minimum Operating Level DMOL). I would suggest to contact NGESO as I made this same comment to NGESO and they have acknowledged that this requires housekeeping changes in the UK Grid Code as well	
Q3	Would you suggest any alternative wording etc to any of the proposed amendments? And if so, please include the text you suggest.	SPR would like to suggest the following modification (highlighted in red below) to be included in the legal text of the following clauses: *11.2.4.3 Steady state operation below Minimum Stable Operating Level is not expected but if system operating conditions cause operation below Minimum Stable Operating Level which*	

		give rise to operational difficulties then the Generator shall be able to return the output of the Power Generating Module to an output of not less than the Minimum Stable Operating Level unless the Power Generating Module reaches an operating point below its Minimum Regulating level *12.2.4.2 Steady state operation below Minimum Stable Operating Level is not expected but if system operating conditions cause operation below Minimum Stable Operating Level which give rise to operational difficulties then the Generator shall be able to return the output of the Power Generating Module to an output of not less than the Minimum Stable Operating Level unless the Power Generating Module reaches an operating point below its Minimum Regulating level* *13.2.4.3 Steady state operation below Minimum Stable Operating Level is not expected but if system operating conditions cause operation below Minimum Stable Operating Level which give rise to operational difficulties then the Generator shall be able to return the output of the Power Generating Module to an output of not less than the Minimum Stable Operating Level unless the Power Generating Module reaches an operating point below its Minimum Regulating level* *13.2.6.3 (b) 1.* in the case of overfrequency, the **Active Power Frequency Response** is limited by the **Minimum Regulating Level** **Please also refer to appended pages showing extract from the following sections with suggested new text:** B.6 Compliance testing of Power Park Modules C.8.6.3 Full Frequency Response Testing Schedule Witnessed by the DNO C.8.6.5	

		C.9.5.4 C.9.5.6 C.10.2.3	
Q4	Are there any other housekeeping or minor corrections you believe should also be made at this time?	No	

Appendix 3

PRODUCED BY THE OPERATIONS DIRECTORATE OF ENERGY NETWORKS ASSOCIATION

Engineering Recommendation G59

Issue 3 Amendment 4 5 ~~July 2018~~1 April 2019

RECOMMENDATIONS FOR THE CONNECTION OF GENERATING PLANT TO THE DISTRIBUTION SYSTEMS OF LICENSED DISTRIBUTION NETWORK OPERATORS

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First published, June 1985

Amendments since publication

Issue	Date	Amendment
G59/1	1991	Revised incorporating Amendment 1 (1992) and Amendment 2 (1995)
G59/2	Aug 2010	Revised - replaced two previous Engineering Recommendations, ER G59/1 and its associated Engineering Technical Report ETR 113, and ER G75/1.
G59/2-1	March 2011	Revised Amendment 1 – Appendix A13.1 - Change to DC injection current limits
G59/3	Sept 2011	Major revision to the document to align with G83/2 and to cater for type tested equipment upto 50kW. Other areas revised included: • *Connection application and commissioning procedures* • *Connection and Commissioning Procedure for Power Stations above EREC G83/2 limits but less than 50kW or 17kW per phase using Type Tested Generating Units only* • *Connection and Commissioning Procedure for Power Stations above 50kW which use Type Tested Generating Units only* • *Voltage Unbalance* • *Generation capacity for single and split phase supplies* • *Generating Unit performance requirements for Type Tested Units* • *Over and Under Voltage Stability Tests* • *Frequency Drift and Step Change Stability Test.* • *Protection Settings* • *Revised Forms* • *Simplified application form*

G59/3	Nov 2013	Correction of error. The error relates to the British Standard which is to be used to determine the 'flicker' contribution from small wind turbines. References to this standard are found at 9.6.2.1 and 13.8.5.5 of ER G59/3. The standard that should be referred to is BS EN 61400-12. However, the standard that was referred BS EN 61400-21was incorrect. Therefore, to correct this error, the two references (i.e. at 9.6.2.1 and 13.8.5.5) have been changed and the description of the standard corrected at 3.2 (page 9) of ER G59/3. This will now read: ***BS EN 61400-12-1:2006*** *Wind turbines. Power performance measurements of electricity producing wind turbines.*
G59/3-1	Aug 2014	Revised RoCoF settings in Section 10.5.7
G59/3-2	Sept 2015	Revocation of Section 12.4 (f) – It is no longer a requirement to undertake an additional functional check of the LoM protection by removing one phase of the supply to the Generating Unit. Revision to section 12.3.1 (g) to include the provision of two options to carry out a functional test confirming that the Interface Protection has operated. Testing of RoCoF elements in Appendix 13.3. A discrepancy has been corrected between the wording contained in Section 12.4 and the testing requirements contained in Appendix 13.3 on how to undertake the test . Section 13.8.3.2 is repeated on page 130. Change to 13.8.3.3 and revise subsequent numbering.
G59/3-3	Feb 2018	Modifications to prevent the use of vector shift protection on all new installations from 01/02/2018, and setting out the requirements for RoCoF settings, again for installations commissioned on or after 01/02/2018. Consequential changes to the following clauses. Foreword; 2.10; 10.3.12-14; 10.5.1; 10.5.2; 10.5.7; 10.5.8; 12.4.1; 13.1; 13.3; 13.7.1; 13.7.3; 13.11 (13.11 deleted)
G59/3-4	Jul 2018	Modification to disallow the use of VS protection and to provide new RoCoF requirements for type tested generation. Changes to the following clauses: Foreword; 1.1, 2.10, 9.3.7, 10.3.13, 13.1 Protection (b), 13.8.3.6
G59/3-5	1 April 2019	Note added to the foreword and to 2.11 to make it clear that generation connected on or after 27 April 2019 must comply with G99. Modifications to Section 4 to remove unnecessary dated references

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Foreword

This Engineering Recommendation (EREC) is published by the Energy Networks Association (ENA) and comes into effect from 01 July 2018. It has been prepared and approved for publication under the authority of the Great Britain Distribution Code Review Panel.The approved abbreviated title of this engineering document is “EREC G59”, which replaces the previously used abbreviation “ER G59”.

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.

1 Purpose

1.1 The purpose of this Engineering Recommendation (EREC) is to provide guidance on the connection of **Generating Plant** to the **Distribution Systems** of licensed **Distribution Network Operators (DNOs)**. It is intended to address all aspects of the connection process from standards of functionality to site commissioning, such that **Customers, Manufacturers** and **Generators** are aware of the requirements that will be made by the local **DNO** before the **Generating Plant** will be accepted for connection to the **Distribution System**. This Engineering Recommendation replaces Engineering Recommendations G59/3, G59/3-1, G59/3-2 and G59/3-3.

1.2 The guidance given is designed to facilitate the connection of **Generating Plant** whilst maintaining the integrity of the **Distribution System**, both in terms of safety and supply quality. It applies to all **Generating Plant** within the scope of Section 2, irrespective of the type of electrical machine and equipment used to convert any primary energy source into electrical energy.

1.3 This EREC is intended to provide guidance to **Generator**s and **DNO**s. The mandatory requirements governing the connection of Distributed **Generating Plant** are generally set out in the Distribution Planning and Connection Code 7 (DPC7) of the **Distribution Code** and in the Connection Conditions (CC) of the **Grid Code**. In the event of any conflict with this EREC, the provisions of the **Distribution Code** and **Grid Code** will prevail.

2 Scope

2.1 This EREC provides guidance on the technical requirements for the connection of **Generating Plant** to the **Distribution System**s of licensed **DNO**s. 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.** It is effective from 1 July 2018.

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.

---

[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 Unit**s in a close geographic region with a limit of 16A per phase in each customer installation, under a planned programme of work.

2.3 Specific separate requirements apply to **Generating Plant** comprising **Generating Unit**s less than or equal to 16A per phase and these are covered in EREC G83. However, **Generating Unit**s ≤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 Unit**s 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 Unit**s or offshore **Transmission System**s 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.

2.7 **Medium and Large Power Station**s are, in addition to the general requirements of this EREC, bound by the requirements of the **Grid Code**. In the case of **Large Power Station**s, the **Grid Code** will generally apply in full. For **Medium Power Station**s, 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 G59/3-4 (ie this version of G59) has been updated to remove vector shift as an allowed loss of mains (LoM) technique for type-tested generation. This follows changes to non-type-tested generation which were made with effect from February 2018.

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.

3 Normative references

The following referenced documents, in whole or part, are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

3.1 Statutory Requirements

Health and Safety at Work etc Act (HASWA): 1974

The Health and Safety at Work etc Act 1974 also referred to as HASAW or HSW, is the primary piece of legislation covering occupational health and safety in the United Kingdom. The Health and Safety Executive is responsible for enforcing the Act and a number of other Acts and Statutory Instruments relevant to the working environment.

Electricity Safety, Quality and Continuity Regulations (ESQCR): 2002

The Electricity Safety, Quality and Continuity Regulations 2002 (Amended 2006) - Statutory Instrument Number 2665 -HMSO ISBN 0-11-042920-6 abbreviated to ESQCR in this document.

Electricity at Work Regulations (EaWR): 1989

The Electricity at Work regulations 1989 abbreviated to EaWR in this document.

3.2 Standards publications

BS 7671: ~~2008~~ Requirements for Electrical Installations

IEE Wiring Regulations: Seventeenth Edition.

BS 7430: ~~1999~~

Code of Practice for Earthing.

BS 7354

Code of Practice for Design of Open Terminal Stations.

BS EN 61000 series*

Electromagnetic Compatibility (EMC).

BS EN 61508 series*

Functional safety of electrical/ electronic/ programmable electronic safety-related systems.

BS EN 60255 series*

Measuring relays and protection equipment.

BS EN 61810 series*

Electromechanical Elementary Relays.

BS EN 60947 series*

Low Voltage Switchgear and Controlgear.

BS EN 61869-2:~~BS EN 60044-1: 1999~~

Instrument Transformers. Current Transformers.

BS EN 60034-4:~~2008~~

Methods for determining synchronous machine quantities from tests.

BS EN 61400-12-1:~~2006~~

Wind turbines. Power performance measurements of electricity producing wind turbines.

IEC 60909 series*

Short-circuit currents in three-phase a.c. systems. Calculation of currents.

IEC TS 61000-6-5: ~~2001~~

Electromagnetic Immunity Part 6.5 Generic Standards. Immunity for Power Station and Substation Environments.

IEC 60364-7-712: ~~2002~~

Electrical installations of buildings – Special installations or locations – Solar photovoltaic (PV) power supply systems.

ENA Engineering Recommendation G5

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

ENA Engineering Recommendation G74

Procedure to meet the requirements of IEC 909 for the calculation of short-circuit currents in three-phase AC power systems.

ENA Engineering Recommendation G83

Recommendations for connection of small-scale embedded Generators (up to 16 A per phase) in parallel with public low voltage distribution networks.

ENA Engineering Recommendation P2

Security of Supply.

ENA Engineering Recommendation P18

Complexity of 132kV circuits.

Appendix 4

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Engineering Recommendation G83

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Amendments since publication

Issue	Date	Amendment
Issue 1	September 2003	Revision
Issue 1-1	June 2008	Revision (ammendment1)
Issue 2	December, 2012	Full revision of the previous version G83/1-1 2008 to ensure alignment with the requirements of EREC G59/2
Issue 2-1	01 \July 2018	RoCoF and VS immunity requirements – amendments to; I5.3.1, 5.3.3, Appendix 4
Issue 2-2	1 April 2019	Note added to section 2 to make it clear that generation connected on or after 27 April 2019 must comply with G98. Unnecessary dated references removed from Section 3

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1 Foreword

This Engineering Recommendation (EREC) is published by the Energy Networks Association (ENA) and comes into effect from 1 December 2012[1].

It has been prepared and approved under the authority of the **Great Britain Distribution Code Review Panel.** The approved abbreviated title of this engineering document is "EREC G83", which replaces the previously used abbreviation "ER G83".

The purpose of this Engineering Recommendation is to simplify and standardise the technical requirements for connection of **Small Scale Embedded Generators** (**SSEGs**) for operation in parallel with a public low-voltage **Distribution System,** by addressing all technical aspects of the connection process from standards of functionality to site commissioning.

The procedures described are designed to facilitate the connection of **Type Tested SSEGs** whilst maintaining the integrity of the public low-voltage **Distribution System**, both in terms of safety and supply quality.

This Engineering Recommendation provides sufficient information to allow:

a) **SSEG Manufacturers** to design and market a product that is suitable for connection to the public low-voltage **Distribution System**;

b) **Users**, **Manufacturers** and **Installers** of **SSEGs** to be aware of the requirements that will be made by the **Distribution Network Operator** (**DNO**) before the **SSEG** installation will be accepted for connection to the **DNO's Distribution System.**

Legal Aspects

In accordance with **ESQCR** Regulation 22(2)(c) the **Installer** is to ensure that the **DNO** is made aware of the **SSEG** installation at or before the time of commissioning. The **DNO** may not refuse to accept the connection providing the installation complies with the requirements of **ESQCR** Regulation 22. However under the terms of **ESQCR** Regulation 26 the **DNO** may require a **SSEG** to be disconnected if it is a source of danger or interferes with the quality of supply to other consumers.

In August 2008 an exemption to **ESQCR** Regulation 22(2) (c) was granted by the Health & Safety Executive to the person or persons installing the source of energy from the requirements imposed by **ESQCR** Regulation 22(2)(c) as long as that person or persons installing the source of energy informed the **DNO** of the intention to use that source of energy in parallel with the network no later than 28 days (inclusive of the day of commissioning) after commissioning the source (see Appendix 6)

In addition to the requirements specified in this document which allows connection to the GB electricity Distribution System, the SSEG and all of its components shall comply with all relevant legal requirements including European Directives and CE marking.

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[1] Distribution Code Guidance Note 2/4 - December 2012. - http://www.energynetworks.info/the-distribution-code/

For all Small Scale Embedded Generators (SSEG) of up to 16A per phase, until 1 March 2014 it is permissible to connect to the general requirements of previous versions of G83 provided this is through an Inverter or Controller with a protection/control system that has either been fully type tested in accordance with G83/1-1, G83/2, G83/2-1 or in accordance with G59/2.

After 1 March 2014 it will only be allowable to connect SSEG of up to 16A per phase that complies with G83/2 or G83/2-1 .

2 Scope

This Engineering Recommendation provides guidance on the technical requirements for the connection of **Type Tested Small-Scale Embedded Generators** (**SSEGs**) in parallel with public low-voltage distribution networks. For the purposes of this Engineering Recommendation a **SSEG** is a source of electrical energy rated up to and including 16 Ampere per phase, single or multi- phase, 230/400 V **AC**.
This corresponds to 3.68 kilowatts (kW) on a single-phase supply and 11.04 kW on a three-phase supply. The kW rating shall be based on the nominal voltage (ie 230V) as defined in BS EN 50160 and the Electricity Supply Quality and Continuity Regulations (ESQCR).

SSEGs commissioned on after 27 April 2019 must comply with EREC G98. EREC G83 is not applicable to generation commissioned on or after that date.

Where the **SSEG** includes an **Inverter** its rating is deemed to be the **Inverter's** continuous steady state rating.

There are two connection procedures described in this document.

The first connection procedure covers the connection of one or more **SSEG** systems, either single or multi-phase within a single **Customer's Installation**.
Multiple **SSEG** systems shall be accepted within a single **Customers Installation** provided that the aggregate rated capacity of the systems is not greater than 16A per phase[2].

The second connection procedure covers the connection of multiple **SSEGs** (other than within a single **Customer's Installation**) in a **Close Geographic Region**, under a planned programme of work.

This Engineering Recommendation only specifies the connection requirements applicable to those **SSEG** installations that are designed to normally operate in parallel with a public distribution network. Those installations that operate in parallel with the **DNO's Distribution System** for short periods (ie less than 5 minutes) or as an islanded installation or section of network are considered to be out of scope, on the basis that it is not possible to devise generic rules that will ensure safe operation under all operating conditions.

The generic requirements for all types of **SSEG** systems are defined in the main text of this Engineering Recommendation, whilst the generic and technology specific type testing requirements are defined in the annexes. The generic requirements relate to the connection, installation and network design requirements for connection of a **SSEG** to a public low-voltage **Distribution System**. **SSEGs** that are not **Type Tested** to conform to the requirements of this document can only be connected via the guidelines laid down in Engineering Recommendation G59.

Annexes A and B describe a methodology for testing the particular types of electrical interface between the **SSEG** and the **Distribution System** whilst Annex C describes a methodology for testing technology specific **SSEG** requirements. The purpose of the type tests is to demonstrate compliance with the generic requirements of this Engineering Recommendation. By satisfying the test conditions in the relevant annex the **SSEG** can be considered an approved **SSEG** for

[2] The manufacturer may restrict the rating of the SSEG by applying software settings provided these settings are not accessible to the customer

connection to a public low-voltage **Distribution System**.
In the event that a new type testing annex is required then this should be formally initiated by the **GB Distribution Code Review Panel (DCRP)**.

The Appendices contain pro forma that relate to the connection, commissioning, type testing, and decommissioning of **SSEGs**.

This document does not remove any statutory rights of an individual or organisation; equally it does not remove any statutory obligation on an individual or organisation.

Connection agreements (ie the legal documentation supporting the connection of a **SSEG**), energy trading and metering are considered to be out of scope. These issues are mentioned in this document only in the context of raising the reader's awareness to the fact that these matters might need to be addressed

3 Normative References

The following referenced documents, in whole or part, are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Standards publications

BS 7671: ~~2008~~ Requirements for Electrical Installations
IEE Wiring Regulations Seventeenth (Amendment 1 2011) Edition.

BS EN 50160: ~~2010~~
Voltage characteristics of electricity supplied by public electricity networks.

BS EN 50438: ~~2008~~
Requirements for the connection of micro-generators in parallel with public low-voltage distribution networks.

BS EN 60034-4:~~2008~~
Methods for determining synchronous machine quantities from tests.

BS EN 60255 series*
Measuring relays and protection equipment.

BS EN 60664-1: ~~2007~~
Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests (IEC 60664-1:2007).

BS EN 60947 series*
Low Voltage Switchgear and Controlgear.

BS EN 61000-3-2:~~2006+A2:2009~~
Limits for harmonic current emissions (equipment input current up to and including 16 A per phase).

BS EN 61000-3-3:~~2008~~
Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current < 16A per phase and not subject to conditional connection.

BS EN 61000 series*
Electromagnetic Compatibility (EMC).
BS EN 61508 series*
Functional safety of electrical/ electronic/ programmable electronic safety-related systems.

BS EN 61810 series*
Electromechanical Elementary Relays.

BS EN 62116
Test procedure of islanding prevention measures for utility-interconnected photovoltaic **Inverters**.

IEC 60255-5: 2001
Electrical relays. Insulation coordination for measuring relays and protection equipment. Requirements and tests.

IEC 60725
Considerations or reference impedances for use in determining the disturbance characteristics of household appliances and similar electrical equipment.

IEC 60909-1 ~~(Second Edition): 2002~~
Short circuit calculation in three-phase **AC** systems.

IEC 62282-3-2 ~~ed1.0: 2006~~
Fuel cell technologies - Part 3-2: Stationary fuel cell power systems - Performance test methods.

Where standards have more than one part, the requirements of all such parts shall be satisfied, so far as they are applicable.

Other publications

Health and Safety at Work etc Act (HASWA): 1974
The Health and Safety at Work etc Act 1974 also referred to as HASAW or HSW, is the primary piece of legislation covering occupational health and safety in the United Kingdom. The Health and Safety Executive is responsible for enforcing the Act and a number of other Acts and Statutory Instruments relevant to the working environment.

Electricity Safety, Quality and Continuity Regulations (ESQCR)
The Electricity Safety, Quality and Continuity Regulations 2002 - Statutory Instrument Number 2665 -HMSO ISBN 0-11-042920-6 abbreviated to ESQCR in this document.

Electricity at Work Regulations (EaWR): 1989
The Electricity at Work regulations 1989 abbreviated to EaWR in this document.

Engineering Recommendation G5/4-1 (2005)
Planning levels for harmonic voltage distortion and the connection of non-linear equipment to transmission and distribution networks in the United Kingdom.

Engineering Recommendation G59/2, Amendment 1 (2011)