Distribution Code Consultation DCRP/21/02/PC

Title: Update of G100 and inclusion in Annex 1 of the Distribution Code

Target Audience: All current and prospective manufacturers, developers, installers, owners and operators of generation (and storage) and controllable demand of any size connecting to distribution networks and where agreed control of the maximum import or export is to be implemented.

Date Published: 8th October 2021

Deadline for responses: 17:00 3rd December 2021

Summary:

This Distribution Code public consultation is seeking the views from stakeholders on proposed modifications to EREC G100, and on its possible inclusion in Annex 1 of the Distribution Code, ie bringing the document under formal Distribution Code governance.

Stakeholders were consulted on the first draft of the revised EREC G100 between 11 June 2021 and 09 July 2021. This resulted in a recognition that some specific and significant changes to the draft were required.

1 Introduction

Engineering Recommendation (EREC) G100 "Technical Requirements for Customer Export Limiting Schemes" was published in July 2016 in response to the growth in generation, and latterly storage, and the need to manage its effects appropriately on the upstream distribution network, without the significant expense of network reinforcements.

The document was broadly accepted by stakeholders and broadly adopted by all DNOs, although it has no formal status.

In the last couple of years a number of shortcomings have been brought to the DNOs' attention, mainly through stakeholder feedback at the Distributed Energy Resources Technical Forum.

It is proposed to revise EREC G100 to address these issues, and to formally include it in the Distribution Code governance.

To this end stakeholders were consulted on a revised draft of EREC G100 between 11 June 2021 and 09 July 2021. Nine formal responses were received which raised points that need to be addressed. The WG and the DNOs have discussed these issues, including in some cases discussions with the respondents, and have produced a revised version. The revised version is believed to strike the right balance between the underlying need for G100 and stakeholders views on its implementation. Their feedback and the resultant changes from the first consultation version are discussed in sections 4 and 5 below.

2 The defects

The following defects were originally identified:

2.1 The criteria used for determining size of generation are opaque

Although EREC G100 does separately refer to the network thermal limits, voltage limits and constraints arising from protection, it is not clear for the thermal and protection limitations what the criteria are that are used by the DNO in assessing G100 installations, or whether these are appropriate.

2.2 The maximum response time as restrictive and arbitrary

An overall maximum response time of 5s is required, for every installation and for every limiting criterion. For most technologies this is not a problem, but is overly challenging for some technologies such as reciprocating gas engine driven generation, or micro hydro installations.

2.3 Confusion over its application to zero export agreements

The drafting of the current published EREC G100 requires tolerances to be applied to settings. If a setting is zero (for zero export) it is confusing to apply a tolerance to this. Additionally, an EREC G100 export limitation scheme might be overkill for zero export, where simple reverse power protection in accordance with the provisions of EREC G99 might be more appropriate.

2.4 Modern communication technologies not accounted for

The only form of non-wired communication allowed in the current EREC G100 is licensed private radio. This is very restrictive and not appropriate for domestic installations – which might become a key EREC G100 application area in the future.

2.5 No coverage of import limits

The current EREC G100 does not include import limits in its scope. Given the rise of new high load devices, such as electric vehicles, batteries and heat pumps for example, the principles of protecting the distribution network from controllable devices should be extended to load as well as generation.

2.6 No guidance on multiple schemes in one installation

The growth of distributed energy technologies means that installations with multiple limitation schemes are already a reality. Guidance is needed on how these should be considered.

2.7 Inconsistent application by DNOs

The current EREC G100 is quite prescriptive of situations it caters for which means that some situations are more open to inconsistent interpretation between DNOs. A move to making the requirements more obvious at the level of principles should reduce the scope for inconsistent application, and possible individual DNO additional requirements.

2.8 No governance of the requirements

As the requirements are those that DNOs wish to agree with customers in relation to the technical requirements for connection to the network, there seems to be no good reason why these currently sit outside the Distribution Code. It also complicates any appeal route that might be needed for disagreements.

3 The proposed amendments to EREC G100

It is proposed to retain the overall general structure of EREC G100. However the document will now cover (CLS) for both export and/or import. The revised document will also formalise an approach that will be built around new concepts of operational states and clear criteria for design limits.

The following sections describe the key aspects of the new draft EREC G100.

3.1 Operation states

To aid clarity of understanding of EREC G100's requirements, the following operational states have been defined:

3.1.1 State 1

This is the normal operating state of the limitation scheme. The limitation scheme operates to keep the current flow (and/or voltage conditions) at the connection point within limits – ie the current flow within the maximum import or export limits and the voltage within statutory limits. Depending on the design of the installation the limitation scheme will be actively controlling sources of generation and/or the controllable demand to avoid breaching the limits. Alternatively the installation will be naturally well balanced with the limitation scheme only reacting as when the equilibrium is sufficiently disturbed.

3.1.2 State 2

The limitation scheme should not normally enter state 2. State 2 caters for unusual circumstances, such as the sudden loss of local demand that would normally be absorbing local generation, for example. In this state, the current flows across the connection point, or the voltage at the connection point exceed those agreed. In state 2 the limitation scheme has to react to return the conditions to those of state 1 within the maximum allowed time associated with whichever technical limit(s) has been breached.

State 2 will define the maximum sizes of generation and/or demand that can be connected with a limitation scheme in place. State 2 allows for excursions outside of normal operating ranges for short periods of time, to allow the limitation scheme to respond. But clearly there are still limits as to how much overstressing of the DNOs network can be tolerated for short times. It is these criteria that set the technical limits for state 2 and which define the maximum generation or demand that can be connected.

Stakeholders responding to the first consultation pointed out that in many cases natural excursions of a very short time, ie 5s or less, would be natural as part of the normal operating cycle of a CLS. Hence the current drafting discounts any excursions into state 2 of less than 5s.

3.1.3 State 3

This is the state where the limitation scheme is in a failed state; either because of some internal failure, or because the excursions into state 2 are too many or have an aggregate duration that signify a fundamental lack of appropriate control. It is proposed that excursions into state 2 are limited and state 3 operation is triggered when:

i. The total time in state 2, neglecting excursion of <5s, in any 24 hours exceeds 8 minutes.
ii. There are more than three excursions (each of >5s but <5 minutes) into state 2 in any 24 hour period.
iii. The time between any two consecutive state 2 excursions is 10 minutes (measured from the time of re-entry into state 1 from state 2 following the first excursion).

In state 3, the behaviour of the loads and generation controlled by the limitation scheme are substantially curtailed or switched off, so that the DNO's network cannot be overstressed.

To return to normal operation from state 3, the fail safe feature needs to be reset as explained in 3.4 below.

3.1.4 State 4

This is simply a recognition that the installation might need to be operated with the limitation scheme out of service. Under these conditions the DNO and the customer should have agreed how the installation can be operated, ie what demand and generation can run and under what limits so that the upstream network and other connected customers are not at risk.

3.2 Technical Limits

3.2.1 Thermal

All upstream network components will have thermal limits but in general the ultimate thermal limits are unlikely to be breached by a single installation. A typical worst case might be that the installation imposes currents that need to be cleared within 5 minutes to avoid damage.

To simplify application, DNOs will initially assume that any current over the agreed maximum that is not greater than the 5 minute thermal limit is acceptable. However, the maximum time that it will be allowed to persist will be 1 minute by default. Exceptionally those technologies which are known to be slow acting in terms of controllability (eg particularly gas reciprocating engines and micro hydro) will be allowed 3 minutes.

3.2.2 Voltage

Excursions outside statutory limits should not occur by design and therefore not in state 1. However recognizing that circumstances will sometimes cause high or low volts, the limits are suggested to be limited to 1 minute for small excursions (within 2 percent) outside statutory limits, to 1 second for larger high voltage excursions, and 2.5 seconds for voltages below 80% of nominal.

The design of the installation will also need to take into account the effect of the limitation scheme on flicker or other voltage phenomena.

Note that if generation is raising the local voltage, that generation will trip when the local voltage reaches 114% of nominal (at LV; 110% for HV).

3.2.3 Protection Coordination

In addition to the thermal limits, high current flows can cause maloperation (or degradation in the case of fuses) of the DNO's protection.

Where fuses are used in the interface between the customer and the DNO, or upstream in the DNO's network, an overload factor of 1.45 will be applied to the fuses' nominal rating.

Where the DNO's protection is provided by relays, then a normal grading exercise will be undertaken to determine the optimum balance of setting versus the current flows imposed in state 2.

3.3 Maximum installation size

As alluded to in 3.1.2 it is the limiting factor from any of the three criteria, thermal, voltage or protection that will fix the maximum installation size. In many cases the planned installation will not reach the state 2 technical limits. But in other cases the lowest of these limits will set an upper limit on the generation and/or loads that can be connected without upstream reinforcement.

3.4 Fail safe

The existing fail safe requirements have been updated to recognize internal failures in the limiting scheme, communication problems between dispersed components of the scheme (or power failures to them) and also inappropriate excursions into state 2 (see 3.1.3).

It is proposed that domestic customers can reset the limitation scheme from state 3 back into state 1 up to three times in 30 days. If there are more than three state 3 operations in 30 days, the customer

will need to seek professional assistance before the limitation scheme can be reset. For non-domestic installations it is proposed that the scheme can be reset without limit; however each reset can only be attempted four hours after entering state 3. This will provide an incentive for the scheme owner to resolve the reason for state 3 operation.

3.5 Communication and cyber security

The requirements have been updated to allow the use of common communication media, such as wifi. In allowing this, it opens up the risks of unauthorised interference such that the basic operation is compromised. Manufacturers and installers of need to recognize this in relation to the risks it poses both to the limitation schemes owner, as well as the DNO.

Although it seems implicit in the existing G100, it is also a requirement of the revised text that the inputs to the transducer(s) are monitored, as well as communication with the transducer(s) itself. This seems very straightforward for voltage inputs, but it probably implies some sort of active monitoring of the current transformer secondary circuit. Respondents to the consultation generally supported the WG's approach, some quite strongly, and the requirements have been restated in the current consultation draft.

The draft includes references to emerging documents which are relevant to this area and with which compliance might be an appropriate requirement. From discussions with stakeholders it seems that the draft EREC G100 quotes the right standards currently, and it is expected that manufacturers will keep up with the appropriate state of the art.

3.6 Access to DNOs' instrument transformers

Because the limitation schemes monitor current and voltage at the connection point the question of access to the DNOs instrument transformers (ie the metering current and voltage transformers and/or the DNOs protection transformers) often arises. A new section of the Distribution Code has been drafted to give guidance on this topic.

3.7 Type Testing

The existing G100 makes provision for manufacturers to provide type test reports and declarations of conformity. The text has been updated to align with the approach used by the ENA for the registration of type tests for ERECs G98 and G99.

3.8 Domestic Installations

It is expected that there might be many more EREC G100 limiting schemes implemented in domestic installations in future, helping to manage the growth of domestic storage, heat pumps and electric vehicles. EREC G100 now includes standard sizes of CLSs related to other technical thresholds applying to the installation of domestic low carbon technologies (eg, domestic generation, storage and EVs).

3.9 Multiple Installations

There is a challenge where a customer wishes to have more than one limiting scheme installed, such as those accompanying electric vehicles and solar generation and battery combination. Such devices are provided by the manufacturers of the main equipment, and are proprietary devices that are generally not compatible. In some cases it might be possible to configure one as the master device and somehow control the others, but this is both complex and cannot be guaranteed.

It is proposed that such arrangements cannot in aggregate have equipment capacity more than the state 2 limits, and also if in aggregate they are of greater capacity than the state 1 limits, for those customers connected at high voltage only, additional fail safe back-up protection should be installed.

3.10 Testing and commissioning

The original EREC G100 section on testing and commissioning has been expanded and rewritten to accommodate full testing of the correct operation of the limitation scheme in states 1, 2 and 3, including recovery from state 3. Proforma test and commissioning sheets have been included as appendices B and C.

4 Feedback from the First Consultation

Nine formal responses were received to the first consultation; 7 from manufacturers, developers or trade associations, and 2 from DNOs.

These are summarised in the table below:

Respondent	A Overall OK?	B State 1 to State 2	C Lockout and customer effects	D Include in D Code?	E Interaction with DSR developments	F Other issues
EO Charging	Y&N	X	X	No	X	2
Myenergi	Partially with substantial caveats	X	neutral	-	X	7
BEAMA	Unstated… tends to "no"	-	-	Not presently*	X	2
Fronius	Yes	X	X	Yes	-	1
Powervault	Unstated… tends to "no"	X	X	Not presently*	-	3
REA	No	X	-	Not presently*	-	3
Caldera	Unstated	X	-	-	-	2
Northern Powergrid	Yes	-	-	Yes	-	3
WPD	Yes	-	-	Yes	-	≈ 8 minor points

In the table above the X indicates that the respondent had particular concerns, and a dash indicates no response on the point.

Column A relates to question 1 from the consultation: "Do you agree with the general intent of the proposed modification? If not, please explain your views".

Column B relates to questions 4, 5 and 7about the operational states and fail safe.

Column C relates to question 6 regarding failures and lockout.

Column D relates to question 2 "Do you agree that the revised EREC G100 should be included in the Distribution Code (as a new requirement by reference in DPC6), be listed in Annex 1 and included under Distribution Code governance in the future?" The three responses marked with an asterisk were concerned that inclusion in D Code governance would make changes hard to make and would limit flexibility of application – certainly until the revised documented had been used in practice and found to be suitable mature.

Column E relates to concerns not specifically addressed in the consultation questions in relation to worries that stakeholders expressed about the interaction of G100 with customer flexibility and demand side services.

Column F reports on a number of other issues raised in the responses.

It is intended that the responses to the first consultation along with response to this consultation would be presented to Ofgem if the DCRP wishes to progress the revised G100 as an Annex 1 Distribution Code Document.

The full responses, and the DNOs' replies, are attached as Appendix 3 to this consultation. The resultant changes to the G100 draft are described in Section º5.

5 Specific Changes to the Drafting Following the First Consultation

5.1 5s grace period introduced before an excursion into state 2 is recognized/counted.

This is the biggest single issue that stakeholders raised, both in their written responses and in discussion. The Working Group realise that this is a valid concern and was not addressed in the consultation version. The solution, broadly agreed in discussion with stakeholders, is to discount any excursion into state 2 from state 1 that is of 5s or less. This will avoid the routine and expected very short excursions, until control actions can take effect, that will follow normal switching of customers' loads etc. triggering lockout. Changes to the text in the draft in 4.3.2 and 4.5.1.3 implement this accommodation.

5.2 Confusion over operation in state 1 or state 2

It became obvious from the points about the interaction of an EREC G100 CLS with other customer demand/generation management schemes was a concern to several stakeholders. In discussions the ENA held with some of these stakeholders, it was found helpful to sketch out the scope of the CLS operation compared to that of contracted or other flexibility that customers intended to use. This sketch has now been turned into an example diagram and included in the introduction to G100.

5.3 Declared and nominal voltage

The draft used the term nominal voltage and declared voltage without any explanation. The drafting now only uses nominal voltage, and includes a note that where non-standard voltages exist, these should be considered appropriately.

5.4 Detection of open circuit in current measurement circuits emphasized

The majority of respondents thought that this was an important point and asked that the requirement was emphasized as a key requirement.

5.5 "Mode" changed to "state"

It was pointed out that "mode" has specific meaning in electric vehicle standards. Therefore to avoid potential confusion when a CLS is used with EV charging, "mode" has been replaced with "state" throughout the new draft.

5.6 Requirement for a master CLS removed

The WG agree that it is not necessary to insist on there being a master CLS where there is more than one independent CLS installed in a customer's installation. The aggregate of the devices controlled by the separate CLS overall must still be less than the state 2 limit for the installation. A note has been added to warn customers that care must be taken to avoid the CLSs hunting or interacting unstably.

5.7 Domestic installations – pre-set cardinal points, or continuously variable settings?

The consultation draft included a requirement that fully type tested CLSs should be set to specific pre-ordained values. Some manufacturers pointed out the logistical etc challenges of this. The revised drafting asks for cardinal settings, but does not proscribe a continuously variable setting range. However the manufacturer needs to consider how incorrect setting can be avoided, and must ensure that settings can only be changed in controlled scenarios (ie not by the customer without overcoming some checks etc). Domestic installations are limited to 100A.

5.8 Challenge to the 125% of fuse rating for state 2 limit

The limit of 125% for state 2 in relation to fuses and their nominal ratings was seen as too limiting for some applications, particularly new domestic demand. This has been raised to 145% of the nominal rating, to align with BS7671 guidance on overload protection.

5.9 Allow manufacturers to reset from state 3 over the internet etc

Manufacturers suggested that they, or their agents, should be able to reset from state 3 remotely, eg via the internet. The working groups view is that provided the appropriate state of the art cyber security applies, this should be allowed.

5.10 Are we specifying too onerous accuracy requirements for current measurements?

One respondent queried if the 2% accuracy requirements for current measurements was too onerous. From discussion with other respondents, and within the working group, it has been decided to retain this requirement unchanged.

5.11 Interaction with storage frequency response requirements

In discussion with one stakeholder the question of interaction between G100 and the new requirements in G99 on falling frequency for storage was raised. The concern is that if on falling frequency batteries in an installation switch from charging to discharging, the frequency response effect might be limited by the CLS if the output was in excess of the state 1 limit. Whilst this is certainly a practical possibility there is nothing in G99, or the underpinning developments in the Grid Code, that would expect any such installation to exceed its maximum export limit. So in these cases it would still be appropriate for the CLS to modulate the battery (and other generation) output to ensure the requirements of EREC G100 are met. No change to the text is proposed because of this.

5.12 Diagrams

Based on the feedback received the working group agreed that it was important that a schematic diagram of the CLS should be available at application and commissioning, but there was limited utility in ensuring this was displayed on site. Conversely where generation exists on the site, ERECs G98 and G99 (and 59 and 83) require a simple operational diagram in any case. The working group believe this is sufficient. The draft text in section 4.2 and Forms B and C has been modified for this.

6 Implementation

It is expected that manufacturers and installers will need some time to implement the new requirements, and therefore a formal implementation date of 01 January 2023 is proposed. However some customers will wish to avail themselves of the new approach before that date. It is therefore proposed to allow the existing issue of G100 to run in parallel until that date, when the existing issue will be withdrawn. Customers will be able to implement export related CLSs to either version of G100 when Issue 2 is published, until the mandatory implementation date of Issue 2, ie 01 January 2023, and Issue 1 is withdrawn.

The foreword and scope sections of Issue 2 explain this.

A new clause (DPC6.8) is proposed to give legal force to G100 Issue 2.

7 Applicable Distribution Code Objectives

The applicable Distribution Code Objectives are to:

(a) permit the development, maintenance, and operation of an efficient, co-ordinated, and economical system for the distribution of electricity; and

(b) facilitate competition in the generation and supply of electricity; and

(c) 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; and

(d) promote efficiency in the implementation and administration of the Distribution Code.

8 Consultation Questions

The original consultation questions are largely still relevant – so please feel free to address the questions in 8.1 below, particular if you did not respond to that consultation, or if you did and you have a point that is outstanding of that failed to have been addressed. The questions in

8.1 First Consultation Questions

These questions are essentially identical to those asked in the first consultation in June/July 2021. Some have been updated slightly to reflect the current draft.

1. Do you agree with the general intent of the proposed modification? If not, please explain your views.

2. Do you agree that the revised EREC G100 should be included in the Distribution Code (as a new requirement by reference in DPC6), be listed in Annex 1 and included under Distribution Code governance in the future?

3. Do you agree that the proposed modifications satisfy the applicable Distribution Code objectives? If not, please explain your concerns.

4. Do you support the formal description of the states of operation and the migration between them?

5. Do you agree with the fail safe approach, and with the excessive state 2 operation criteria? If not, would your propose different criteria?

6. Do you agree with the proposed approach to resetting the limitation scheme and recovering from state 3? In particular do you agree that it is appropriate to distinguish the capability to reset the CLS between domestic and commercial/industrial installations? An alternative would be to make a distinction between fully type tested CLSs and those which are not fully type tested; the WG would be interested in views on this.

7. Do you agree with the revised design limits? Do you support the thresholds now proposed?

8. Do you support the approach to communication media? Do you agree with the suggested approach to cyber security?

9. Do you have any comments on the requirement to monitor the integrity of the secondary circuit of the current transformers used?

10. Do you support the approach proposed for multiple limitation devices installed in a single premise?

11. Do you have any comments on the proposals for domestic installations?
12. Do you have any comments on the proposed type testing regime?
13. Is there the right balance of principle and detail in Section 5 on testing? Do you have any detailed comments on how testing should be prescribed?

8.2 New Consultation Questions

These additional questions relate to the changes between the consultation version of EREC G100 issued in June 2021 and this current consultation version which are not picked up in 8.1 above.

14. Do you agree that the addition Figure 0-1 in the Introduction of EREC G100 aids understanding of the relationship between EREC G100 and flexibility services that the customer might be providing? If not, can you suggest any improvements?
15. Do you agree with requirement in EREC G100 to only provide a schematic diagram, with any operational diagram for generation remaining to be as specified in EREC G99 (or G98, 59 or 83)?
16. Do you agree that the 5s period before an excursion into state 2 is registered is appropriate? If not, please state what you think might be an appropriate approach.
17. Do you agree that is appropriate to allow remote resetting of state 3?
18. Do you agree that fully type tested CLSs should be tested at three current settings, viz maximum, minimum and one intermediate point? If not please suggest.
19. If you have any detailed comments on the proposed drafting, please provide those comments in the proforma provided, or by marking up the consultation draft of G100.

9 Next Steps

Responses to this consultation should be sent to the Distribution Code Review Panel Secretary at dcode@energynetworks.org by 17:00 3rd December 2021 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:

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