nationalgrid

Stage 01: Modification Proposal

Grid Code

GC0118:

Mod Title: Modification to the Grid Code to accommodate the recent Distribution Code modification to Engineering Recommendation P28 –*Voltage fluctuations and the connection of disturbing equipment to transmission systems and distribution networks in the United Kingdom.*

What stage is this document at?

01	Modification Proposal
02	Workgroup Report
03	Code Admin Consultation
04	Draft Final Modification Report
05	Report to the Authority

Purpose of Modification: The purpose of this modification is to ensure the Grid Code implements the proposed changes as set out in the revised Engineering Recommendation P28 Issue 2 (2018) (subsequently referred to as EREC P28 Issue 2).

The Proposer recommends that this modification should be:

- Subject to the normal governance procedures.

This modification was raised **10 July 2018** and will be presented by the Proposer to the Panel on **18 July 2018.** The Panel will consider the Proposer's recommendation and determine the appropriate route.

High Impact: None

Medium Impact: Generators (other than in respect of Small Power Stations) or DC Converter Station owners connected to or seeking connection to a User's System which is located in Great Britain or Offshore. New developers of transmission connected generation installations, and existing users that make changes to existing installations with significant number of transformers that cause rapid voltage changes (RVCs) when energised, who are required to design their installations in accordance with the requirements and planning levels for RVCs in EREC P28 Issue 2.

Low Impact: Any User connected to or seeking connection with the National Electricity Transmission System, The modifications are intended not to unduly impact on or cause interference to existing Users of public electricity systems/networks.
Users that propose to connect disturbing equipment/fluctuating installations to the system, which could result in flicker, who need to carry out assessments and measurements in accordance with EREC P28 Issue 2.

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Any Questions?

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On behalf of the Distribution Network Licensees

Timetable

A timetable will be approved by the Grid Code Panel once the governance route is decided at the Panel meeting on **18 July 2018.**

Workgroup Meeting 1	dd month year
Workgroup Report presented to Panel	dd month year
Code Administration Consultation Report issued to the Industry	dd month year
Draft Final Modification Report presented to Panel	dd month year
Modification Panel decision	dd month year
Final Modification Report issued the Authority	dd month year
Decision implemented in Grid Code	dd month year

1.Summary

Defect

Engineering Recommendation (EREC) P28 Issue 1 was first published in 1989 to provide recommended planning limits for voltage fluctuations for connection of equipment to public electricity supply systems in the UK. EREC P28 Issue 1 was primarily concerned with assessment of voltage fluctuations and associated flicker produced by traditional domestic, commercial and industrial loads.

Since EREC P28 Issue 1 was first published, the factors affecting development of transmission systems and distribution networks, and equipment connected to them have changed significantly. There has been a shift towards connection of distributed/embedded generation equipment powered by renewable energies and other low carbon technology equipment. These types of modern equipment are capable of causing voltage fluctuations.

Significant developments in Electromagnetic Compatibility (EMC) requirements have also taken place, which are captured in the International Electro-technical Commission (IEC) 61000 series of Standards and technical reports. United Kingdom implementation of these Standards is captured in the various parts of BS EN 61000.

Engineering Recommendation P28 is referenced in the Grid Code and Distribution Code. A joint Grid Code and Distribution Code Working Group was established to oversee the revision of Engineering Recommendation P28 Issue 1 and associated modification to requirements for voltage fluctuation in the Distribution Code and the Grid Code and the working group has produced a revised version of Engineering Recommendation P28 i.e. EREC P28 Issue 2 which was submitted to the Authority for approval on 17 May 2018. Unfortunately as Engineering Recommendation P28 is referenced in the Grid Code as simply Engineering Recommendation P28 (no issue number) the Authority was unable to approve the modification without the EREC P28 Issue 2 changes reflected in the Grid Code hence why this Grid Code modification is being proposed.

What

There are a ten specific references relating to Engineering Recommendation P28 in the Grid Code that need to be considered and revised and they are as follows:

- GLOSSARY AND DEFINITIONS
  - Flicker Severity
- PLANNING CODE
  - PC.A.4.7 General Demand Data - PC.A.4.7.1 (f)
  - Appendix C Technical Design Criteria Part 1 PC.C.3 SHETLs Technical Design Criteria (Item4)
  - Appendix E – Offshore Transmission System and OTSDUW Plant and Apparatus Technical Design Criteria – PC.E.2 (Table)
- CONNECTION CONDITIONS
  - CC.6 Technical, Design and Operational Criteria Voltage Fluctuations CC6.1.7
- EUROPEAN CONNECTION CONDITIONS

    - ECC.6 Technical, Design and Operational Criteria
    - Voltage Fluctuations ECC.6.1.7
- OPERATING CODES
    - OC5.5.4 Test And Monitoring Assessment (Test Criteria)

- DATA REGISTRATION CODE
    - Schedule 7 - Load Characteristics at Grid Supply Points

All of the proposed changes bar revision to CC 6.1.7 and ECC 6.1.7 are editorial and relate to modifying the Grid Code so that the Code references EREC P28 Issue 2. Modification to CC 6.1.7 and ECC 6.1.7 is simply deleting duplicate text from the Grid Code that is already included in the new EREC P28 Issue 2.

Why

The changes are required to align the Grid Code and the Distribution Code with the new requirements of EREC P28 Issue 2. In addition it is recommended that text and diagrams in EREC P28 Issue 2 should not be duplicated in the Grid Code and that the Grid Code should only signpost the reader to EREC P28 Issue 2.

How

The solution (draft legal text) proposed is documented in Appendices A and B.

2.Governance

Justification for normal governance procedures

In its decision letter Ofgem (see appendix C) considered that there was not sufficient industry consideration of the impact of DCRP/PC/18/01/FMR (see appendix D) on other industry codes. Specifically, they did not consider that the impact on the Grid Code had been properly considered. Ofgem noted that Engineering Recommendation P28 is referenced multiple times within the Grid Code. The changes proposed under DCRP/PC/18/01/FMR, which have a direct impact on the requirements for parties connecting to the electricity networks, could result in consequential changes to Grid Code requirements that have not been assessed and which may be relevant to inform their decision.

Ofgem therefore expect distribution licensees and the Grid Code Review Panel ('GCRP') to work together and submit any proposed Distribution and Grid Code changes as a package, which should include co-ordinated implementation timetables. Ofgem expects the GCRP to discuss the issues set out in their decision letter and DCRP/MP/18/01 at the next GCRP meeting.

It is therefore recommended that the requirements of CC.6.1.7 and ECC 6.1.7 of the Grid Code are aligned with those in EREC P28 Issue 2 and the references in the Grid Code to Engineering Recommendation P28 is replaced with reference to Engineering Recommendation P28/2 Issue 2 (see appendix E).

A Distribution Code public Consultation which included Grid Code stakeholders was held from the 8th January 2018 to 31st January 2018. Full details of the response are contained in the aforementioned Report to Authority DCRP/PC/18/01/FMR.

Requested Next Steps

This modification should:

- be subject to normal governance procedures.

It is expected that the workgroup should hold no more than one meeting to consider and agree to the recommendations contained in this modification proposal.

The workgroup should then prepare a short report to the Panel. With Panel agreement a final Report to Authority should be submitted in conjunction with the DRCP Report recommending that the modification proposal should be approved.

3.Why Change?

The need for the change and the modification proposal is to align the Grid Code with the new Engineering Recommendation P28. Those changes are set out in section 1 of this report.

If the change is not addressed in the Grid Code then the Authority will not be able to approve the modification to Engineering Recommendation P28 Issue 2. Please note the recent Authority decision letter on DCRP/PC/18/01/RtA (see appendix C).

The following parties will be impacted with regards to complying with the new Engineering Recommendation P28 Issue 2:

- Generators (other than in respect of Small Power Stations) or DC Converter Station owners connected to or seeking connection to a User's System which is located in Great Britain or Offshore;
- New developers of transmission connected generation installations, and existing users that make changes to existing installations with significant number of transformers;
- Any User connected to or seeking connection with the National Electricity Transmission System:
- Users that propose to connect disturbing equipment/fluctuating installations to the system, which could result in flicker.

For additional background and context please also refer to the Distribution Code Final Modification Report DCRP/PC/18/01/FMR (see appendix C) which sets out the recommendation that modifications should be made to the Distribution Code and Engineering Recommendation P28, in relation to voltage fluctuations resulting from the connection of disturbing equipment to transmission systems and distribution networks in the United Kingdom.

ER P28 Issue 2 now:
a) Introduces requirements and planning levels for Rapid Voltage Changes (RVCs).
b) Improves definition and clarity of ‘worst case operating conditions’ to be used in the assessment of voltage fluctuations.
c) Includes an intermediate planning level and associated flicker severity limits for supply systems with nominal voltages of 3.3 kV, 6.6 kV, 11 kV, 20 kV and 33 kV to

improve co-ordination of flicker severity from higher to lower voltage supply systems.
d) Improves the definition of voltage step change.
e) Clarifies information requirements for assessment and responsibilities for provision of information.
f) Includes the application of transfer coefficients for determining voltage fluctuation contributions from different nodes.
g) Assesses voltage fluctuations caused by renewable energy and low carbon technologies.

4.Code Specific Matters

Technical Skillsets

A skill set and understanding in Power Quality standards and the actual application of Engineering Recommendation P28 would be helpful.

Reference Documents

- Grid Code
- Distribution Code
- Security and Quality of Supply Standard
- Engineering Recommendation P28 Issue 2 (2018)

5.Solution

Please refer to appendices A and B

6.Impacts and Other Considerations

The Distribution Code and the Grid Code are both impacted by the proposed modification to Engineering Recommendation P28 Issue 2 but this is mainly editorial, where the Codes signpost users to Engineering Recommendation P28 Issue 2.

The most significant impact is to the requirements for voltage fluctuation in CC.6.1.7 of the Grid Code, in particular Table CC.6.1.7. The limits for RVCs proposed in EREC P28 Issue 2 take into account those in the GC0076 modification to the Grid Code. The key differences between the requirements in EREC P28 Issue 2 and those in the Grid Code are as follows noting that the intention is to align the requirements in the Grid Code with those in EREC P28 Issue 2, so as to provide greater flexibility for customer connections and to be less onerous for customers to comply with.

- Allowable voltage changes are expressed as a percentage of nominal voltage (V_n) in P28 Issue 2 as opposed to a percentage of the initial voltage (V_o) in the Grid Code. The intention being to align with the approach taken in National and International Standards.
- For increases in voltage:

- EREC P28 Issue 2 proposes a limit on the maximum voltage change between two steady state conditions of $\Delta V_{max} \leq 6\%$ for a maximum duration of 0.8 s from the initiation of a voltage change.
- The Grid Code has a limit of $\Delta V_{max} \leq 5\%$ for a maximum duration of 0.5 s.

- For decreases in voltage:
  - EREC P28 Issue 2 proposes a time limit of 100 ms from initiation of a voltage change during which the maximum voltage change permitted (-12% for 'very infrequent events' and -10% for 'infrequent events') can persist.
  - The Grid Code has a time limit of 80 ms from initiation of a voltage change during which the maximum permitted voltage change is -12%.
- For increases and decreases in voltage, EREC P28 Issue 2 permits a greater maximum number of occurrences for Category 3 'very infrequent' events:
  - EREC P28 Issue 2 proposes to permit up to a maximum of 4 RVCs in one day (irrespective of type of operational event causing the RVC) not more frequent than once every 3 months.
  - The Grid Code permits up to a maximum of 4 RVCs in one day (for commissioning, maintenance and fault restoration) typically not planned more than once per year on average over the lifetime of the connection.
- EREC P28 Issue 2 introduces an intermediate category of RVC (Category 2) for 'infrequent events', where up to a maximum of 4 RVCs in one day are permitted not more frequent than 4 times per month providing the $\Delta V_{max} \leq -10\%$ for ≤ 100 ms then reducing to ≤ 6% for up to 2 s after initiation of the event.

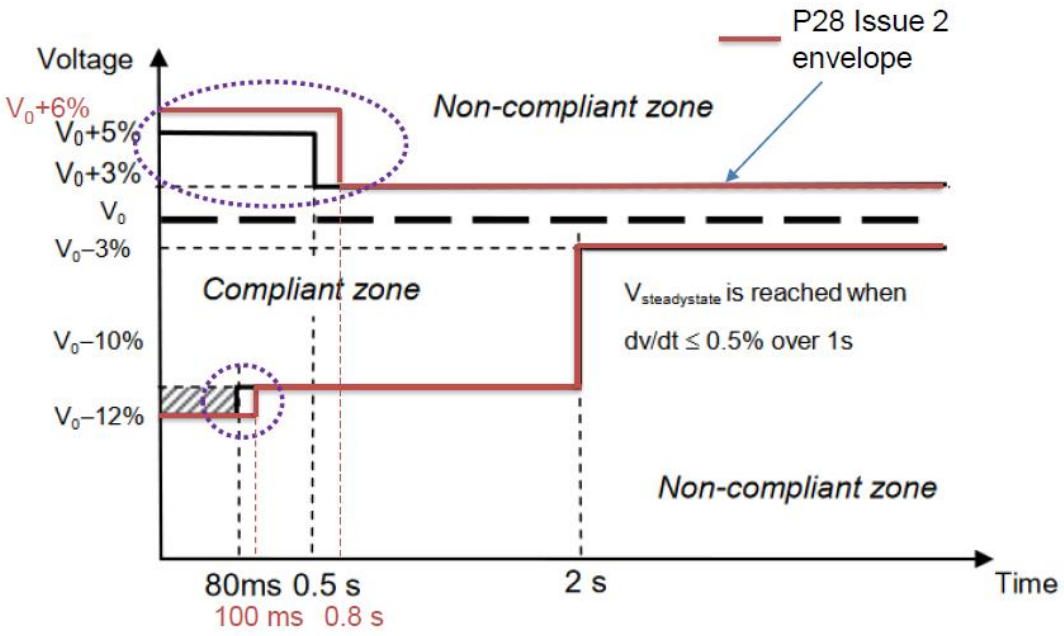

Figure CC.6.1.7 -
Time and magnitude limits for a category 3 Rapid Voltage Change

The difference between the voltage envelope for Rapid Voltage Changes in Figure CC.6.1.7 of the Grid Code and Table 4 of EREC P28/2 Issue 2 for Very Infrequent

RVCs are shown in the above figure. The P28 Working Group has proposed limits for RVC in EREC P28 Issue 2 that:

- generally align with those in Figure CC.6.1.7 for reductions in voltage.
- are absolute and compatible with EREC G59 and grid connected protection as well as TGN 288 for overvoltage.
- are compatible with immunity levels for customer equipment.
- should not result in unacceptable disturbance provided:-
    - events are sufficiently spaced apart.
    - multiple RVCs are completed within a small time window.
    - there is no damage to or tripping of customer equipment.

The impacts of the proposals for RVC limits in EREC P28 Issue 2 can be summarised as follows:

- There could be potentially a greater number of RVCs at any given PCC over a calendar year. The P28 WG believe the potentially greater number of RVCs permitted at a given PCC will not cause unacceptable disturbance to other customers.
- The changes to the RVC limits permit a grater number of transformer to be energised at the same time providing greater flexibility for design of user connections and for operation of the transmission system.
- The proposals will simplify restoring distributed generation following G59 events.
- There is no material impact on ΔV_{max} for decreases in voltage.

The proposed RVC limits in EREC P28 Issue 2 (and associated differences with the requirements in the Grid Code) reflect the:

- further work carried out by the Working Group and the experience of NGET in applying RVC limits since the GC0076 modification was implemented in the Grid Code. NGET's representative on the P28 Working Group oversaw the GC0076 modification the Grid Code and chaired the P28 RVC sub-group.
- limits for RVCs in Category 2 and Category 3 of Table 4 taking into account differences in the perceptibility of RVC compared with flicker associated with continuously fluctuating loads.

Please also note that the Security and Quality of Supply Standard (SQSS) Figure 6.1 references ER P28 (Issue 1) Figure 4. Figure 4 in ER P28 Issue 1 has been replaced by a slightly different Figure B.1.2 in EREC P28 Issue 2. Therefore the GCRP will need to consider a modification to the SQSS also. This will be subject to a separate modification proposal submitted to the SQSS Panel.

There are no practices affected and no systems impacted.

This modification does not impact on any Significant Code Review (SCR) or any other significant industry change project.

There are no consumer impacts as a result of this modification proposal.

7.Relevant Objectives

Impact of the modification on the Relevant Objectives:	
Relevant Objective	**Identified impact**
To permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity	**Positive**
To facilitate competition in the generation and supply of electricity (and without limiting the foregoing, to facilitate the national electricity transmission system being made available to persons authorised to supply or generate electricity on terms which neither prevent nor restrict competition in the supply or generation of electricity)	**Positive**
Subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole	**Positive**
To efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency; and	**Neutral**
To promote efficiency in the implementation and administration of the Grid Code arrangements	**Neutral**

8.Implementation

This modification proposal should be implemented no later than 5 October 2018 or as soon as reasonably practicable to avoid any further delay of the approval of the Distribution Code modification currently awaiting approval of the Authority. There should be no costs attributed to any stakeholder in delivering and implementing this modification.

9.Legal Text

Legal text is included with this modification proposal. Please refer to appendices A and B

10.Recommendations

Panel is asked to:

Agree that this modification proposal should be subject to normal governance procedures and

Agree the Terms of Reference for the Grid Code Workgroup

Appendices

Appendix A - Glossary and Definitions – Draft legal text
Appendix B1- CONNECTION CONDITIONS I5R22 CC.6.1.7 - draft legal text
Appendix B2- EUROPEAN CONNECTION CONDITIONS I5R22 ECC.6.1.7- draft legal text
Appendix C - DCRP/18/01/FMR Decision Letter
Appendix D - DCRP_FMR_EREC P28 Issue 2_v0.4.1_Issued