

# **Proposed Changes to Engineering Recommendation P28**

Voltage Fluctuations and the Connection of  
Disturbing Equipment to Transmission Systems and  
Distribution Networks in the United Kingdom

Consultation Paper



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## EXECUTIVE SUMMARY

NIE Networks periodically reviews the Distribution System Security and Planning Standards and when necessary proposes to make changes to better align the Standards with the equivalent standards that apply in Great Britain (GB).

NIE Networks proposes changing the following Distribution System Security and Planning Standard:

- EREC P28 (the Planning Limits for Voltage Fluctuations standard) to be superseded by EREC P28 Issue 2.

A copy of EREC P28 Issue 2 is included on the NIE Networks website<sup>1</sup>. The main technical modifications in EREC P28 Issue 2 include:

- The introduction of requirements and planning levels for Rapid Voltage Changes (RVCs).
- Improved definition and clarity of worst case operating conditions to be used in the assessment of voltage fluctuations.
- 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.
- Improved definition of voltage step change.
- Improved clarity concerning information requirements for assessment and responsibilities for provision of information.
- Concept of transfer coefficients for determining voltage fluctuation contributions from different nodes.
- Additional recommendations for assessing voltage fluctuations caused by renewable energy and low carbon technologies.

Stakeholders are invited to express a view on the proposed changes in EREC P28 and any other aspect of this paper. Responses should be received in writing by NIE Networks by 17:00 on 15th May 2020 and should be addressed to:

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<sup>1</sup> <https://www.nienetworks.co.uk/about-us/distribution-code/open-consultations>

## 1. INTRODUCTION

Under Condition 19 of its electricity Distribution Licence (the Licence), NIE Networks is required to plan, develop, maintain and operate the distribution system in accordance with:

- The Distribution System Security and Planning Standards (the Standards); and/or
- Such other planning and operational standards adopted by NIE Networks from time to time with the approval of the Utility Regulator (the Regulator).

Moreover, the Licence requires NIE Networks to periodically review the Standards in consultation with parties liable to be materially affected.

NIE Networks now propose to adopt the changes made to Engineering Recommendation (EREC) P28 in Great Britain to ensure equivalent Standard alignment.

The purpose of this consultation is to set out the proposed changes to EREC P28 and seek feedback from stakeholders. Note that all Tables and Figures in this consultation are titled and numbered according to P28 Issue 2.

## 2. LATEST INDUSTRY STANDARDS

The existing Distribution System Security and Planning Standards adopted by NIE Networks can be seen in the table below and can be downloaded from the NIE Networks website<sup>2</sup>.

<u>Title</u>	<u>NIE Networks Standard</u>
Security of Supply	EREC P2/6
<b>Planning Limits for Voltage Fluctuations</b>	<b>EREC P28</b>
EHV or HV Supplies to Induction Furnaces	EREC P16
Planning Limits for Voltage Unbalance	EREC P29
Limits for Harmonics	EREC G5/4-1
Application of Protective Multiple Earthing to Low Voltage Networks	EREC G12/4

### CURRENT STANDARDS ADOPTED BY NIE NETWORKS

NIE Networks periodically reviews the Standards and considers each standard in turn with the aim of identifying:

- If an updated equivalent industry standard has been adopted by GB distribution network operators (DNOs) and referenced in the GB Distribution Code;
- If such latest industry standard is relevant to the Northern Ireland distribution network and can therefore be adopted by NIE Networks;
- The implications for stakeholders of changing the NIE Networks standard.

<sup>2</sup> <https://www.nienetworks.co.uk/distribution-code>.

System Security and Planning Standards are reviewed under the auspices of the Energy Networks Association (ENA), the membership of which includes NIE Networks and GB DNOs.

EREC P28 has been revised by the ENA and P28 Issue 2 was adopted by GB DNOs in 2019 following a public consultation. Consequently, NIE Networks proposes to also move from EREC P28 to EREC P28 Issue 2.

### 3. DETAILED ASSESSMENT OF PROPOSED CHANGES

#### 3.1 General

NIE Networks is now seeking comments from wider industry stakeholders on the proposals highlighted in this consultation paper.

EREC P28 was first issued in 1989. It is the current standard for planning limits for voltage fluctuations applied to the Northern Ireland distribution network. The standard is also referenced in the NIE Networks Distribution Code and can be downloaded from NIE Networks' website.

It is to be used by those who propose to connect disturbing equipment with the potential for voltage fluctuation, being flicker and/or RVC, to public electricity supply systems. The document should also be used by those who carry out assessments concerning the suitability of connecting such equipment to these systems.

There has been a shift towards connection of distributed/embedded generation equipment powered by renewable energies and other low carbon technology equipment. The impact of connecting this modern equipment has been reviewed and EREC P28 has been updated accordingly. The sections below describe the main changes between EREC P28 Issue 2 and the existing EREC P28.

#### 3.2 Rapid Voltage Changes (RVCs)

EREC P28 has been amended to assess the acceptability of voltage fluctuations, including RVCs, and includes three different envelopes that prescribe the maximum allowable magnitude and duration of voltage fluctuations depending upon the maximum number of occurrences permitted in a given time period (see Clause 5.3.2 of EREC P28 Issue 2). These envelopes encompass limits for voltage step changes.

The proposed envelopes in EREC P28 Issue 2 are replicated below (see Figure 5, Figure 6 and Figure 7).

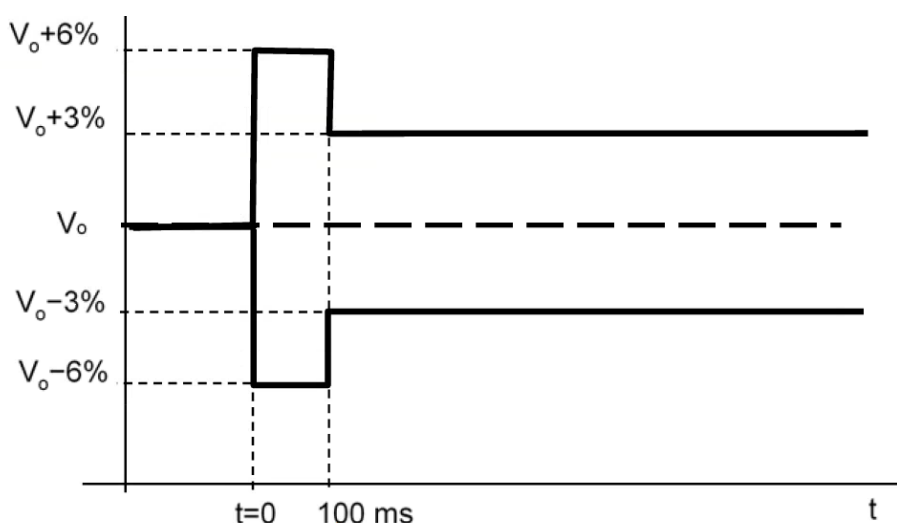
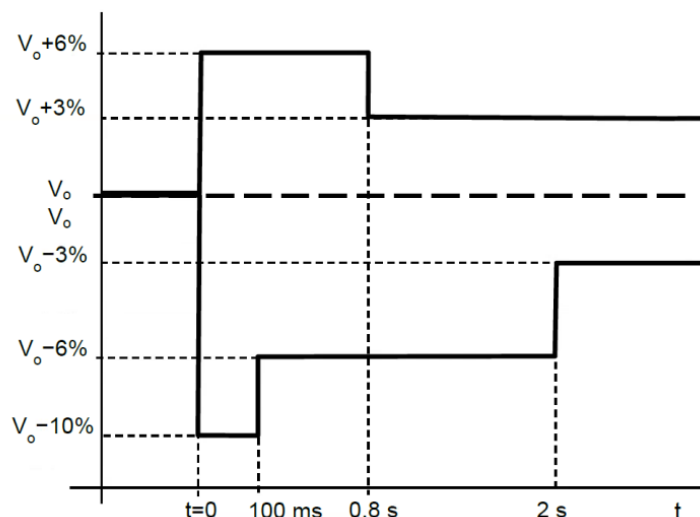


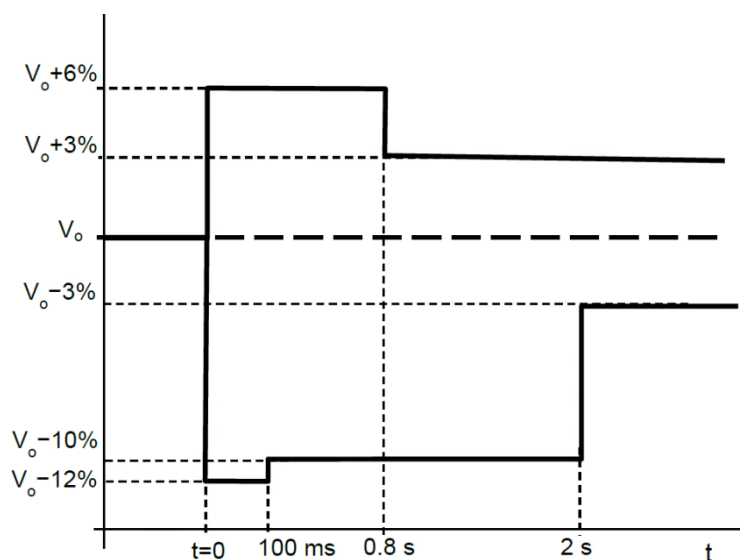
FIGURE 5 – VOLTAGE CHARACTERISTIC FOR FREQUENT EVENTS (CATEGORY 1)

The minimum interval between frequent events fitting within the envelope in Figure 5 is determined by conformance to flicker severity ( $P_{st}$ ) limits in EREC P28.



**FIGURE 6 – VOLTAGE CHARACTERISTIC FOR INFREQUENT EVENTS (CATEGORY 2)**

Up to 4 RVC events per calendar month are permitted for voltage fluctuations fitting within the envelope in Figure 6.



**FIGURE 7 – VOLTAGE CHARACTERISTIC FOR VERY INFREQUENT EVENTS (CATEGORY 3)**

One RVC event not more frequent than once in 3 calendar months is permitted for voltage fluctuations fitting within the envelope in Figure 7.

In practice these changes will permit greater numbers of transformers to be energised at the same time and simplify restoring distribution generation after de-energisation. Table 2, is replicated from EREC P28 Issue 2, which summarises the proposed categories, maximum number of occurrences within a defined time period, limits and examples of applicability for RVCs.

Category	Title	Maximum number of occurrence	Limits $\% \Delta V_{\max}$ & $\% \Delta V_{\text{steadystate}}$	Example Applicability
1	Frequent events	(see NOTE 1)	As per Figure 5	Any single or repetitive RVC that falls inside Figure 5
2	Infrequent events	4 events in 1 calendar month (see NOTE 2)	As per Figure 6 $ \% \Delta V_{\text{steadystate}}  \leq 3\%$ For decrease in voltage: $ \% \Delta V_{\max}  \leq 10\%$ (see NOTE 3) For increase in voltage: $ \% \Delta V_{\max}  \leq 6\%$ (see NOTE 4)	Infrequent motor starting, transformer energisation, G59 re-energisation (see NOTE 7)
3	Very infrequent events	1 event in 3 calendar months (see NOTE 2)	As per Figure 7 $ \% \Delta V_{\text{steadystate}}  \leq 3\%$ For decrease in voltage: $ \% \Delta V_{\max}  \leq 12\%$ (see NOTE 5) For increase in voltage: $ \% \Delta V_{\max}  \leq 6\%$ (see NOTE 6)	Commissioning, maintenance & post fault switching (see NOTE 7)
NOTE 1	±6% is permissible for 100 ms reduced to ±3% thereafter as per Figure 5. If the profile of repetitive voltage change(s) falls within the envelope given in Figure 5, the assessment of such voltage change(s) shall be undertaken according to the recommendations for assessment of flicker and shall conform to the planning levels provided for flicker. If any part of the voltage change(s) falls outside the envelope given in Figure 5, the assessment of such voltage changes, repetitive or not, shall be done according to the guidance and limits for RVC.			
NOTE 2	No more than 1 event is permitted per day, consisting of up to 4 RVCs, each separated by at least 10 minutes with all switching completed within a two-hour window.			
NOTE 3	-10% is permissible for 100 ms reduced to -6% until 2 s then reduced to -3% thereafter as per Figure 6.			
NOTE 4	+6% is permissible for 0.8 s from the instant the event begins then reduced to +3% thereafter as per Figure 6.			
NOTE 5	-12% is permissible for 100 ms reduced to -10% until 2 s then reduced to -3% thereafter as per Figure 7.			
NOTE 6	+6% is permissible for 0.8 s from the instant the event begins then reduced to +3% thereafter as per Figure 7.			
NOTE 7	These are examples only. Customers may opt to conform to the limits of another category providing the frequency of occurrence does not exceed the 'Maximum frequency of occurrence' for the chosen category.			

**TABLE 4 – PLANNING LEVELS FOR RVC**

### 3.3 Applicability to Operating Conditions and Fault Outages

EREC P28 Issue 2 has been amended to provide improved clarity for the assessment of voltage fluctuations under worst case normal operating conditions (see Clause 6.1.6 of EREC P28 Issue 2).

Worst case normal operating conditions as defined in EREC P28 Issue 2 include credible outages conditions for which the public electricity supply system is designed to operate within acceptable/statutory limits. These conditions include planned outages and fault outages consistent with securing demand as required by relevant security of supply standards.

Notwithstanding, the limits in EREC P28 Issue 2 are not intended to apply to transient voltage fluctuations between fault initiation and fault clearance or during any reconfiguration of the public electricity supply system immediately following a fault to secure supplies.

This proposal is intended to provide a more consistent understanding and application of the network conditions by customers and system/network operators for EREC P28 type assessments as the present EREC P28 is not particularly clear in this respect and is open to interpretation.

### 3.4 Planning Levels for Flicker

The planning levels for flicker severity at any point of the supply system currently are stated in Table 1 of Engineering Recommendation P28 Issue 1.

Supply system Nominal voltage	Planning level	
	$P_{st}$	$P_{lt}$
132 kV and below	1.0	0.8
Above 132 kV	0.8	0.6

TABLE 1 OF ER P28 ISSUE 1

Table 2 of EREC P28 Issue 2 proposes 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 as follows:

Supply system Nominal voltage	Planning level	
	$P_{st}$	$P_{lt}$
LV	1.0	0.8
3.3 kV, 6.6 kV, 11 kV, 20 kV, 33 kV	0.9	0.7
66 kV, 110 kV, 132 kV, 150 kV, 200 kV, 220 kV, 275 kV, 400 kV	0.8	0.6

TABLE 2 OF ER P28 ISSUE 2

This proposal is intended to improve the co-ordination of flicker transfer from higher voltage to lower voltage supply systems. This will reduce the possibility of background flicker severity levels exceeding compatibility limits at low voltage (LV) from the transfer of voltage fluctuations down through the supply system.



### 3.5 Voltage Step Changes

The general limit on the magnitude of voltage step changes of  $\pm 3\%$  remains the same in EREC P28 Issue 2. However, EREC P28 Issue 2 now clarifies that the  $\pm 3\%$  general limit relates to the voltage change between steady state conditions, referred to as  $V_{\text{steadystate}}$ , (see Clause 4.7 of EREC P28 Issue 2).

Although EREC P28 Issue 2 does not place a limit on the time for transient decay, it requires that voltage changes must be within  $\pm 3\%$  after 2 s from event initiation.

NOTE: Limits for voltage fluctuations in between steady state conditions (referred to as  $V_{\text{max}}$ ) can be greater than  $\pm 3\%$  for infrequent events and very infrequent events and fall under requirements for Rapid Voltage Changes in EREC P28 Issue 2.

The intention of this proposal is to allow a clear distinction between distinct different voltage change events.

## 4. CONSULTATION QUESTIONS

- 4.1. Do you agree with the proposed requirements and planning levels for RVCs in EREC P28 Issue 2 (as provided in Figure 5, Figure 6, Figure 7 and Table 4)?
- 4.2. Do you agree with the proposal for providing improved clarity of what constitutes 'worst case normal operating conditions' for the assessment of voltage fluctuations under EREC P28?
- 4.3. Do you agree with the proposals for an intermediate planning level to assist with co-ordination of the transfer of flicker severity from higher voltage to lower voltage supply systems?
- 4.4. Do you have any objections to the proposal for NIE Networks to move from EREC P28 to EREC P28 Issue 2?
- 4.5. Do you have any other comments to make on the proposed changes?

## 5. NEXT STEPS

Stakeholders are invited to express a view on the proposed changes in EREC P28 and any other aspect of this paper. Responses should be received in writing by NIE Networks by 17:00 on 15th May 2020 and should be addressed to:

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During the consultation period, should any stakeholder have any specific queries on any aspect of this document, or on the proposed changes to the standards, they should contact Josh Watson at the address set out above.

NIE Networks intends to collate all responses received to this consultation as part of its report to the Utility Regulator. Following the end of this consultation period NIE Networks will, in accordance with its Distribution Licence send a report on the outcome of its review to the Regulator detailing;

- The proposed revisions to the Distribution System Security and Planning Standards which NIE Networks proposes to make; and
- Any written representations or objections from any electricity undertakings (including any proposals for revisions to the document that were not accepted in the course of the review) arising during the consultation process and subsequently maintained.

Following the end of the consultation period and the discussions to be held with the Regulator, revisions to EREC P28 will be finalised and published on the NIE Networks website once approval has been received by the Regulator.