



Engineering Recommendation P25

Issue 2 2018

The short-circuit characteristics of single-phase and three-phase low voltage distribution networks.

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Amendments since publication

Issue	Date	Amendment
Issue 2	2018	<p>Major revision of Issue 1 to address the following points.</p> <ul style="list-style-type: none">• Content from P25 Issue 1 and P26 Issue 1 amalgamated in a single document.• References to normative Standards updated.• Update terms in document, for example 'PES' now described as 'DNO'.• Re-calculation of fault levels for range of service lengths. <p>The principal technical changes are described below.</p> <p>Title: Document title changed from '<i>The Short-Circuit Characteristics of Public Electricity Suppliers' Low Voltage Distribution Networks and the Co-ordination of Overcurrent Protective Devices on 230V Single Phase Supplies up to 100A</i>' to '<i>The short-circuit characteristics of single-phase and three-phase low voltage distribution networks</i>' on account of the amalgamation of P25 Issue 1 and P26 Issue 1.</p> <p>Foreword: new clause added to provide publishing information and description of who the document is intended for. Some of the content has been taken from P25 Issue 1 Clause 1 and Clause 7 (Responsibility).</p> <p>Introduction: the content from P25 Issue 1 and P26 Issue 1 has been consolidated and references updated (ESQCR replaces Electricity Supply Regulations 1988). Reference to ER P23 has been included.</p>

		<p>Scope: new clause added to define the supply types which are covered in the document. Some of the wording has been taken from the 'Introduction' in P25 Issue 1 and P26 Issue 1. Wording has been amended to clarify that both 'existing' and 'planned' supplies are covered. A new capacity limit for poly-phase LV supplies is set at 400 A per phase. A paragraph has been inserted to explain that the guidance in the EREC may not be full appropriate for interconnected-LV networks.</p> <p>Clause 2, Normative references: new clause added to capture all normative references. Previous references described in P25 Issue 1 Annex A have been updated and/or removed as appropriate.</p> <p>Clause 3, Terms and definitions: new clause added to capture all terms and definitions used in the document. Previous terms in P25 Issue 1 Annex A have been repeated. A considerable number of new definitions have been inserted which are now used in the document.</p> <p>Clause 4, The incoming service arrangements:</p> <p>New sub-clause 4.1: added to introduce the responsibilities of the customer, DNO and meter operator.</p> <p>Sub-clause 4.2 (P25 Issue 1, Clause 2): description of 'looped' service has been deleted, references and terms updated and description of BS 7671 Regulation 473.1.4 has been deleted and replaced with reference to Clause 7 of the document. A new Figure 1 replaces the description of a typical supply arrangement. A note has been inserted beneath Figure 1 highlighting the differing sizes of cut-out fuse-link which may be in use. The purpose of the cut-out fuse-link has also been clarified.</p> <p>Sub-clause 4.3 (P26 Issue 1, Clause 2): re-written to include a description of typical three-phase connection arrangements, a) and b). A new Figure 2 has been inserted to depict a typical supply arrangement.</p> <p>Clause 5, The PSCC on the DNO's LV distribution network:</p> <p>Sub-clause 5.1 (P25 Issue 1 Clause 3 and P26 Issue 1 Clause 3): common aspects for both single-phase and three-phase are detailed, any duplicated content between the two previous documents has been deleted and editorial amendments completed. An explanation of how network capacity is related to PSCC value has been added.</p> <p>Sub-clause 5.2: new sub-clause inserted to introduce the theory of short-circuit currents and associated terminology. The content has been developed from BS EN 60909-0.</p> <p>Sub-clause 5.3: new sub-clause inserted to describe the parameters used to determine the PSCC values on the DNO's LV network, and the basic formulae to calculate PSCC values.</p> <p>Sub-clause 5.4: the single-phase PSCC value of 16 kA as described in P25 Issue 1 Clause 3 has been changed to 19.6 kA as determined by latest calculation. A paragraph explaining the requirements for interconnected-LV networks has been added.</p> <p>Sub-clause 5.5: the three-phase PSCC value of 25 kA described in P26 Issue 1 Clause 3 has been changed to 25.9 kA. Reference to the previous 18 kA has been deleted. '415 V' has been changed to '400 V' to align with 230 V phase-to-earth. A paragraph explaining the requirements for interconnected-LV networks has been added.</p> <p>Clause 6, Contribution to PSCC from LV generation or motors:</p>
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	<p>New clause and associated sub-clauses inserted to provide background and guidance on LV generation and LV motors which may be found on DNO LV networks.</p> <p>Clause 7, Estimation of the PSCC at the supply terminals:</p> <p>Sub-clause 7.1: new sub-clause inserted to introduce the concept of attenuation. A paragraph describing the significance of power factor has been repeated, previously described in P26 Issue 1, with the exception that 'power factor' has been changed to 'X/R ratio'.</p> <p>Sub-clause 7.2: the content from P25 Issue 1 Clause 4 and Clause 5 has largely been repeated in this sub-clause with the following exceptions: '16 kA (p.f. 0.44)' has been changed to '19.6 kA (X/R = 2.5)' and a new sentence explaining the assumed 'tee-off point' has been added.</p> <p>Table 1: all values previously published in P25 Issue 1 Table 1 have been deleted and replaced with newly calculated values. PSCC values for service line lengths greater than 20 m have been removed.</p> <p>Sub-clause 7.3: the content from P26 Issue 1 Clause 4 and Clause 5 has largely been repeated in this sub-clause with the following exceptions: the previous paragraph relating to '18 kA' and the associated Table 2 from P26 Issue 1 have been deleted, P26 Issue 1 Table 1 values have been deleted and replaced with newly calculated values.</p> <p>Sub-clause 7.4, Estimation of LV generation/motor contribution: new sub-clause inserted to provide guidance on the treatment of generation/motor short-circuit current contribution on LV networks.</p> <p>Clause 8, Selection of protective devices:</p> <p>Sub-clause 8.1: new sub-clause added to clarify general requirements for protection device selection. Previous content in P25 Issue 1 Clause 6 has been updated with new references to BS 7671 and ECA publication – <i>Guide to the Wiring Regulations</i>, and an explanation of the importance of X/R ratio when verifying a device rating has been added.</p> <p>Sub-clause 8.2 (P25 Issue 1 Clause 6): references have been updated as necessary.</p> <p>Bibliography: new clause added to capture information references.</p> <p>Details of all other technical, general and editorial amendments are included in the associated Document Amendment Summary for this Issue (available on request from the Operations Directorate of ENA).</p>
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Foreword

This Engineering Recommendation (EREC) is published by the Energy Networks Association (ENA) and comes into effect from the date of publishing. It has been prepared under the authority of the ENA Engineering Policy and Standards Manager and has been approved for publication by the ENA Electricity Networks and Futures Group (ENFG). The approved abbreviated title of this engineering document is “EREC P25”, which replaces the previously used abbreviation “ER P25”.

Guidance relating to 230 V single-phase supplies and 400 V three-phase supplies, previously provided in ER P25 Issue 1 and ER P26 Issue 1, is now superseded by this Engineering Recommendation (EREC). ER P26 has been withdrawn.

The guidance in this EREC will be of interest to designers of customer low voltage (LV) installations and it is expected that such persons are conversant with the requirements of BS 7671 (IET Wiring Regulations).

This EREC provides guidance on the estimation of maximum prospective short-circuit current (PSCC) on the DNO LV network and at the supply terminals.

This EREC also provides commentary on the selection of protective devices based on the estimated PSCC.

The guidance contained in this EREC is based on information and knowledge available at the time of writing. No guarantee can be given however that the information will not change in the future. The DNO cannot be held responsible for costs incurred due to inaccuracies contained in this document or subsequent changes to the network. Where the reader of this EREC is in doubt regarding the guidance provided, they should consult the relevant DNO.

The term “should” is used in this document to express a recommendation. The term “may” is used to express permission.

NOTE: Commentary, explanation and general informative material is presented in smaller type, and does not constitute a normative element.

Introduction

The Electricity Safety, Quality and Continuity Regulations (ESQCR) 2002 (as amended) [N1] enforces statutory requirements for DNOs. ESQCR Regulation 28 requires the DNO to state the 'maximum prospective short-circuit current at the supply terminals'.

ESQCR [N1] also places a responsibility on the customer to provide and maintain a safe electrical installation. Electrical installations which are designed to the requirements of BS 7671 are deemed to comply with the safety requirements in ESQCR [N1].

BS 7671 requires that the prospective fault current, under both short-circuit and earth fault conditions, be measured, calculated or determined by another method, at the supply terminals. This information may then be used in the selection of equipment in conjunction with appropriate Standards or manufacturer's information.

NOTE: ESQCR Regulation 28 also requires the DNO to state 'the maximum earth loop impedance of the earth fault path outside the installation'. This is covered by ENA ER P23 [N3].

1 Scope

This Engineering Recommendation (EREC) provides guidance on the estimation of maximum prospective short-circuit current (PSCC) at the supply terminals of existing and planned electrical installations which are connected to DNO LV networks via a single-phase service rated up to 100 A or a poly-phase service rated up to 400 A per phase.

For three-phase supplies, where the arrangement consists of more than one separately protected three-phase service, direct from the DNO's LV busbar in the substation, individual guidance should be given on application to the DNO.

The guidance in this EREC may not be fully appropriate for interconnected-LV networks which are prevalent in certain regions of the UK; for example in London, Merseyside, Wirral, and North Wales. Suitable guidance should be obtained direct from DNOs operating in such regions.

2 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 HD 60269-3, BS 88-3, *Low-voltage fuses. Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications). Examples of standardized systems of fuses A to F*

BS EN 60909-0, *Short-circuit currents in three-phase a.c. systems. Calculation of currents*

BS EN 61439-3, *Low-voltage switchgear and controlgear assemblies. Distribution boards intended to be operated by ordinary persons (DBO)*

BS 7671:2008+A3:2015, *Requirements for Electrical Installations. IET Wiring Regulations*

Other publications

[N1] Statutory Instrument 2002 No. 2665, *The Electricity Safety, Quality and Continuity Regulations 2002 (as amended)*¹

[N2] Meter Operator Code of Practice Agreement, www.mocopa.org.uk

[N3] ENA EREC P23, *Guidance on Earth Fault Loop Impedance at Customers' Intake Supply Terminals*

[N4] ENA EREC G81, *Framework for new low voltage housing development installations Parts 1-6*

[N5] ENA TS 35-1 Part 1, *Distribution transformers. Part 1 Common clauses*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply

3.1

customer

person supplied or entitled to be supplied with electricity at any premises

NOTE: Customers will include both domestic and commercial/industrial supplies.

3.2

Distribution Network Operator (DNO)

person or legal entity named in the distribution licence to operate an electricity network

NOTE: Where an independent distribution network operator (IDNO) is present, it should be treated as a DNO for the purposes of this EREC.

3.3

LV

voltage above 50 V a.c. r.m.s. but not exceeding 1 000 V a.c. r.m.s.

3.4

HV

voltage above LV but less than or equal to 20 000 V a.c. r.m.s.

3.5

interconnected-LV network

LV network which operates with distribution substations interconnected via LV circuits

NOTE 1: Interconnected-LV networks generally exhibit higher short-circuit currents in comparison to radial LV networks.

¹ S.I. 2012 No.381, *Electricity Safety, Quality and Continuity Regulations (Northern Ireland) 2012 (as amended)*, applies in Northern Ireland.