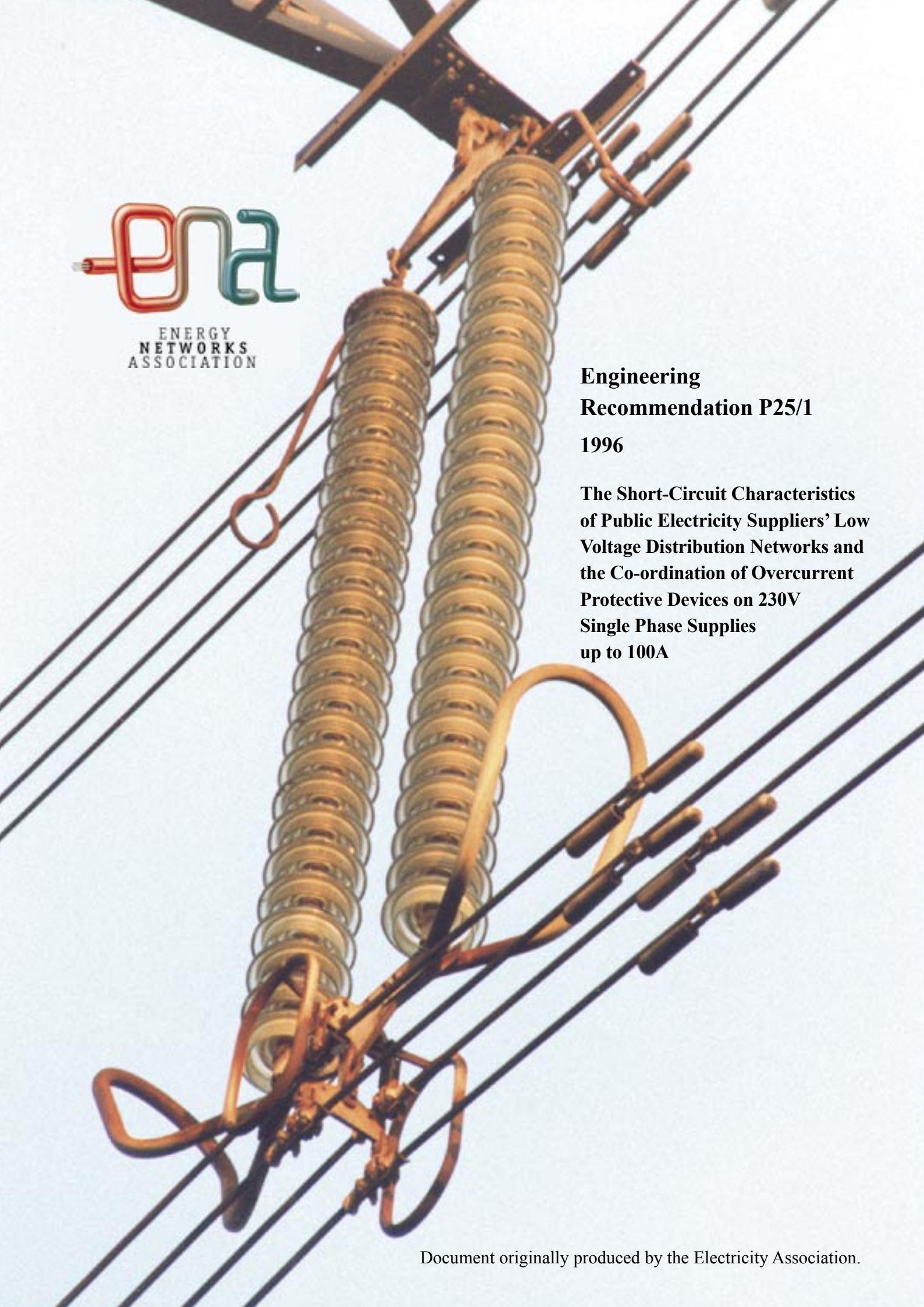

ENERGY NETWORKS ASSOCIATION

Engineering Recommendation P25/1

1996

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

Document originally produced by the Electricity Association.

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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

1 INTRODUCTION

This Engineering Recommendation updates P25. It takes account of the revised structure of the Electricity Industry following the Electricity Act 1989 and makes the necessary amendments to references.

The Electricity Supply Regulations 1988 place a responsibility on the consumer of electricity 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 the Electricity Supply Regulations.

Regulation 313 (Nature of Supply) of BS 7671 requires the designer of an electrical installation to ascertain the characteristics of the supply including the "prospective short circuit current at the origin of the installation". This information may then be used in the selection of equipment in conjunction with appropriate British Standards or manufacturer's information.

The purpose of this Engineering Recommendation is to give guidance as required by the Electricity Supply Regulations 1988 Section 31 (a) on the estimation of maximum prospective short circuit current (PSCC) at the supply terminals of those electrical installations which are to be connected to the Public Electricity Supply Company (PES) low voltage distribution network via a single phase service line of a capacity up to 100A. Advice is also given on the selection of protective devices based on the estimated PSCC.

The related policies and practices of the PES upon which the guidance is based are also explained.

2 THE INCOMING SERVICE ARRANGEMENTS

The PES low voltage distribution main will be overhead or underground and will normally be installed along the public pathway or road either at the front of the property or on the far side of the road. In new open plan housing estate developments the main will normally be located in the public footpath at the front of the house.

The PES incoming service line will also be either overhead or underground. It may be directly connected to the nearest point of the low voltage main or it may be "looped" to an

adjacent service at the service termination point of nearby premises. The service termination will be accommodated within the premises or in an external meter cabinet. The service termination will normally consist of a termination for the service line as an integral part of a cut-out unit. The cut-out will consist of a solidly connected neutral and be fitted with a single pole fuse-link to BS 1361 type II which will be rated tip to 100A according to the policy of the PES.

The PES cut-out fuse-link is installed to meet the requirements of the Electricity Supply Regulations (Section 25) and to provide protection against overcurrent in the zone between the output terminals of the cut-out and the supply terminals. This zone will include the electricity meter(s) and any control devices installed for tariff purposes.

In some cases a double pole isolating switch may be installed between the electricity meter and the consumer unit to provide for ease of isolation of the installation by the customer.

The connections between the PES equipment and the next stage of protection which will be provided by the consumer on the load side of the supply terminals (e.g. in the consumer unit) are the property and responsibility of the consumer. Where reliance is placed upon the PES cut-out fuse-link to provide electrical protection for these connections, the requirements of the PES in respect of the installation of the connections and the protective device must be met. (See BS 7671, Regulation 473-01-04).

If the PES cut-out fuse-link is called upon to clear faults on any part of the consumer's installation the PES cannot accept responsibility for consequent damage to the consumer's installation. The PES has the right to charge the consumer the cost of supplying and fitting a replacement cut-out fuse-link.

3 THE PROSPECTIVE SHORT-CIRCUIT CURRENT ON THE PES MAIN DISTRIBUTOR

The PES is required to meet the demands of all its customers by providing an efficient and adequate supply system. On low voltage distribution systems this means the provision of adequate capacity at all times throughout the system and reinforcing the system to meet any increase of load. The PSCC available at any point of the system, including the consumer's supply terminal, is directly related to the overall system capacity and the distance from the supply source.

Increase in demand may in the course of time require additional capacity to be installed by, for example, building a new hv/lv substation or increasing the capacity of an existing substation. It follows therefore that during the life of any consumer's installation the PSCC may increase. To avoid the need for repeated changes in the protective equipment and the consequent costs, PES normally design their distribution systems to a maximum PSCC and select the equipment for their system accordingly. This equipment includes the PES cut-out and fuse-link.

It is strongly recommended that the designer of an installation should adopt the same approach in selecting equipment particularly where it will be required to operate close up to the supply terminals. Bearing in mind the range of sizes of transformers and mains conductors used in lv-distribution networks, it is considered that an appropriate maximum

design value of the PSCC for single phase 230 volt supplies is 16 kilo Amperes (kA) at the point of connection of the service line to the PES main lv distributor.

Within the London Electricity area special conditions apply and it is recommended that the maximum PSCC for such supplies is taken as 16kA at the supply termination (cut-out) for installations within that area. High load density areas of other major city centres may warrant the same special consideration.

4 ESTIMATION OF THE PROSPECTIVE SHORT-CIRCUIT CURRENT AT THE PES CUT-OUT

The PSCC at the service tee-off point given in Section 3 will be attenuated by the service line and it is possible to allow for this attenuation in estimating the maximum PSCC at the origin of the installation.

Table 1 shows the maximum PSCC and power factor for service line lengths up to 50m, based on 16kA (pf 0.55) at the service tee-off point. Two sets of values are given to cover the range and sizes of cables and overhead lines in use by the PES. The first set represents the minimum attenuation for a single 100A service. The second (right-hand) set represents the minimum attenuation where the service to one Installation is looped out of the cut-out to one or more adjacent properties. Where doubt exists at the design stage as to the size of service line it is recommended that the values in the right hand columns are taken as maxima. The service line length may be measured or estimated from site plans as the shortest distance from the edge of the footpath nearest the installation to the service cut-out. Even if the position of the main distributor is known to be on the far side of the road, this additional length should not be included since it is not uncommon to increase the capacity of the lv distribution system by installing additional main distributors.

NOTE: This procedure is not applicable to installations within the London Electricity area.

5 ESTIMATION OF ATTENUATION IN PROSPECTIVE SHORT-CIRCUIT CURRENT BEYOND THE PES CUT-OUT

For the majority of installations covered by this Engineering Recommendation the consumers switchgear will be positioned within a metre or so of the PES cut-out. Where this is not the case, for example in some forms of multiple-occupancy building, the designer may wish to allow for the additional attenuation in PSCC due to the length of distributor between the cutout and the consumer's switchgear. The designer may find it convenient to add the service line length estimated as in Section 4 above to the length of the distributor within the installation and read the PSCC from Table 1. Alternatively the PSCC estimated in Section 4 may be used as a basis for calculating this additional attenuation.

NOTE: If this procedure is applied to installations within the London Electricity Area, the length of the service line should not be included.

6 SELECTION OF PROTECTIVE DEVICES

The designer will select protective devices for the installation in accordance with the BS 7671 on the basis of such requirements as PSCC, rated breaking capacity, operating characteristics, discrimination, convenience, ease of replacement or re-energisation, cost and reliability. It may be that in the course of selection some compromise between the requirements is necessary.

If the rated breaking capacity of the proposed device is equal to or greater than the maximum PSCC at the service line tee-off point or as estimated in Sections 4 or 5, no further consideration of these two factors is necessary.

When the rated breaking capacity is less than this maximum PSCC it is possible to allow at the design stage for the limitation in fault energy let through by the PES cut-out fuse (see BS 7671 Clause 434-03-01). If this option is used, the designer should assume that the cut-out will contain a 100A fuse-link to BS 1361. The designer should also take into account the requirements in BS 7671 to avoid danger and minimise inconvenience in the event of faults (Regulation 314-01 -01).

In order to assist designers in selecting protective devices in conjunction with the limitation in energy let-through of the PES cut-out fuse-link, the conditional testing procedure has been established by BSI for type testing the devices. In this conditional test, the protective device is tested in series with a cut-out incorporating a 100A fuse-link to BS 1361, single rate credit meter and specified lengths of connecting cable.

Full details are given in Amendment AI : 1994 to BS EN 60439-3 of the procedure adopted. Whenever devices are selected on the basis of the conditional test the designer should ensure that the conditions that pertain within the installation are not more onerous than those required by the BSI procedure.

7 PES RESPONSIBILITY

The advice contained in this Engineering Recommendation is given in good faith based on information available. No guarantee can be given however that the information will not change in the future. The PES cannot be held responsible for costs incurred due to inaccuracies or subsequent changes.

TABLE 1

ESTIMATED MAXIMUM PSCC AT THE PES CUT-OUT BASED ON DECLARED LEVEL OF 16kA (0.55pf) AT THE POINT OF CONNECTION OF THE SERVICE LINE TO THE LV DISTRIBUTING MAIN

Length of Service Line (metres)	Up to 25mm^2 Al or 16 mm^2 Cu Service Cable or Overhead line		35 mm^2 Al or 25 mm^2 Cu Service Cable or Overhead line (Looped Service)	
	PSCC (kA)	pf	PSCC (kA)	pf.
0	16.0	0.55	16.0	0.55
1	14.8	0.63	15.1	0.61
2	13.7	0.69	14.3	0.66
3	12.6	0.74	13.5	0.70
4	11.7	0.78	12.7	0.74
5	10.8	0.82	12.0	0.77
6	10.1	6.84	11.4	0.79
7	9.4	0.86	10.8	0.82
8	8.8	0.88	10.3	0.83
9	8.3	0.89	9.7	0.85
10	7.8	0.91	9.3	0.86
11	7.4	0.92	9.8	0.88
12	7.0	0.92	8.4	0.89
13	6.6	0.93	8.1	0.90
14	6.3	0.94	7.7	0.91
15	6.0	0.94	7.4	0.91
16	5.7	0.95	7.1	0.92
17	5.5	0.95	6.9	0.92
18	5.3	0.96	6.6	0.93
19	5.1	0.96	6.4	0.93
20	4.9	0.96	6.2	0.94
21	4.7	0.96	6.0	0.94
22	4.5	0.97	5.8	0.95
23	4.4	0.97	5.6	0.95
24	4.2	0.97	5.4	0.95
25	4.1	0.97	5. 3	0.95
26	3.9	0.97	5.1	0.96
27	3.8	0.98	5.0	0.96
28	3.7	0.98	4.8	0.96
29	3.6	0.98	4.7	0.96
30	3.5	0.98	4.6	0.96
35	3.1	0.98	4.0	0.97
40	2.7	0.99	3.6	0.98
45	2.5	0.99	3.3	0.98
50	2.2	0.99	3.0	0.98

NOTE: This table should not be used for estimation of attenuation in PSCC due to the service-line for installations within the London Electricity Area.

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APPENDIX A

Al DEFINITIONS

For the purpose of this Engineering Recommendation the following definitions apply:

A1.1 Prospective Short Circuit Current (PSCC)

The current that would flow in a circuit, in the event of a short circuit of negligible impedance, if the overcurrent protective device were replaced by a conductor of negligible impedance; it is measured as the RMS (root mean square) value of the ac component. The actual fault current will therefore be less if the protective device has a current limiting feature or an appreciable impedance.

A1.2 Rated Breaking Capacity

The maximum value of prospective current at which the device is capable of complying with a prescribed test duty cycle at the prescribed voltage and power factor.

A1.3 Supply Terminals

The ends of the electric lines situated upon any consumer's premises at which the supply is delivered and, unless otherwise agreed in writing, where a meter is employed to register the value of the supply and is directly connected to those lines, the terminals of that meter furthest from the installation of the owner of that meter.

A2 REFERENCES

This Recommendation makes reference to and should be read in conjunction with:

BS 1361 : 1986	Specification for cartridge fuses for a.c. circuits in domestic and similar premises.
BS EN 60439-3 : 1991 Amendment A1 : 1994	Specification for low-voltage switchgear and control gear assemblies. Part 3. Particular requirements for Low-voltage switchgear and controlgear assemblies intended to be installed in places where unskilled persons have access to their use. Distribution boards.
BS 7657 : 1993	Specification for fuses (cut-outs), ancillary terminal blocks and interconnecting units up to 100A rating, for power supplies to buildings.

Electricity Supply Regulations, 1988	Statutory Instrument replacing the Electricity Supply Regulations 1937 for Securing the Safety of the Public and for Insuring a Proper and Sufficient Supply of Electrical Energy.
BS 7671	Requirements for electrical installations.