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Technical Specification 12-08

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THE APPLICATION OF FUSE-LINKS TO 11kV/400V AND 6.6kV/400V UNDERGROUND DISTRIBUTION NETWORKS

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PUBLISHING AND COPYRIGHT INFORMATION

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Amendments since publication

Issue	Date	Amendment
Issue 3	January 2014	This Standard has been revised to take account of the publication of BS HD 60269, and BS EN 60282-1.
Issue 2	October 1986	The standard has been revised to take into account the publication of BS88 part 5 and BS2693 part 1. It is extended to incorporate fuse-;inks for 66kV systems. The reference numbering system given in issue 1 has also been changed to cover fuse-links for both 11kV and 6.6kV systems with some for dual voltage application.

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FOREWORD

This Technical Specification (TS) is published by the Energy Networks Association (ENA) and comes into effect from January 2014 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 “ENA TS 12-08”.

This Standard has been revised to take account of the publication of BS HD 60269, and BS EN 60282-1.

The Standard considers the primary requirement of the high voltage Fuse-links to protect a distribution transformer for faults both in the transformer windings and in the low voltage terminal zone. It also takes into account the need for high voltage Fuse-links to discriminate with 400 V fuses protecting distribution circuits on the low voltage side of the transformer.

In this Standard the term 'low voltage' refers to the 400/240V system voltages and the term 'high voltage' to 11kV or 6.6kV.

High voltage Fuse-links are specified for the transformer ratings given in Table 1.

Ratings of 3-phase 11 kV/433V and 6.6kV/433V Transformers kVA to ESI Standard 35-1
200
315
500
800
1000

TABLE 1

Transformers of rating 300kVA and 750kVA are not considered separately in this Standard and Fuse-links, as for transformers of rating 315kVA and 800kVA respectively, may be used with little impairment in performance.

1 SCOPE

This Standard relates to the application of low voltage fuse-links complying with BS HD 60269-2 to the protection of underground distribution systems, and for the protection of distribution transformers it specifies the operational parameters and time/current zones for high voltage fuse-links complying with BS EN 60282-1. High voltage fuse-links form part of a fuse-switch combination and will be provided with striker pins that operate a suitably rated switch that disconnects all three phases.

2 REFERENCES

This Standard makes reference to the following documents:

BS HD 60269-1: Low Voltage Fuses, General Requirement.

BS HD 60269-2: Low Voltage Fuses, Supplementary requirements for fuses for use by authorised persons (fuses mainly for industrial application) – Examples of standardised systems A to J

BS 1361: Cartridge Fuses for ac. Circuits in Domestic and Similar Premises.

BS EN 60282-1: High Voltage Fuses, Part 1 Current-limiting Fuses.

PD IEC/TR 60787: Application guide for the selection of high-voltage current-limiting fuse-links for transformer circuits..

ENA TS 35-1: Distribution Transformers (from 16kVA to 2000kVA).

ENA TS 37-2: Public Electricity Network Distribution Assemblies

ENA TS 41-36: Switchgear for service up to 36kV (cable and overhead conductor connected)

ACE Report 86: Report on HV. Fuse-links for the Protection of Ground Mounted Distribution Transformers.

3 SELECTION OF LOW VOLTAGE FUSE-LINKS

Fuse-links for use in 400V electricity supply networks are specified in BS HD 60269-2. Ratings of fuse-links are chosen to provide, so as far as reasonably practicable, short circuit protection for the cables to which they are connected. Allowance should be made for the permissible cyclic rating of the cable given the conductor size, conductor material, installation conditions and anticipated ground temperatures.

The ratings of Fuse-links suitable for the short-circuit protection of the more common sizes of low voltage cables are given in Appendix A. The Fuse-link ratings which are shown cater for the highest anticipated peak cable loads under winter conditions.

LV fuse-links installed at the substation should, as far as is reasonably practicable, grade with other LV fuse-links connected to the feeder. BS HD 60269-2 shows the standard time/current zones for each rating of Fuse-link and indicates the ratings of major and minor Fuse-links that will discriminate. If a Fuse-link is not to this Standard, the degree of discrimination will have to be determined by reference to its characteristics, allowing ± 10 per cent tolerance on current values if designed to BS HD 60269, and BS EN 60269-3.In order to ensure discrimination between fuses it is necessary to check that the pre-arcing I^2t value of the upstream fuse-link, i.e. that nearer the source of supply. Exceeds the total I^2t value for the downstream fuse-link

4 SPECIFICATION FOR LOW VOLTAGE FUSE-LINKS

Fuse-links for use on the 400V distribution network should comply in all respects with the requirements of BS HD 60269-2.

5 SELECTION OF HIGH VOLTAGE FUSE-LINKS

5.1 Operating Characteristics - General Requirements

A high voltage Fuse-link in a fuse-switch combination protecting a given rating of transformer should:

i. Be capable of carrying continuously the appropriate value of current specified in column 2 of' Table 2, when fitted in the combination.
ii. Withstand periodic transformer overloads as specified in ENA TS 35-1
iii. Withstand transformer magnetising in-rush current. For this purpose a Fuse-link is deemed satisfactory if it withstands, without deterioration, ten times transformer primary full load current for a period of 0.10s.
iv. Operate within 1s for a 3-phase fault in the terminal zone of the transformer secondary winding.
v. Discriminate reliably with low voltage Fuse-links up to the maximum current available for a fault on the low voltage side of the transformer.
vi. Discriminate predictably with up-stream protection.
vii. Be capable of causing the fuse-switch combination to interrupt satisfactorily all values of fault current up to the rated breaking current of the combination.
viii. Not be used on systems where the potential short circuit current exceeds the rated breaking current of the fuse-switch combination.

5.2 Clearance of Faults in the Low Voltage Terminal Zone

The current in a high voltage Fuse-link protecting a transformer when a fault occurs in the low voltage terminal zone, i.e., up to the busbar terminals of the distribution fuses on the low voltage fuse board, will be determined by:

i. The high voltage fault level.
ii. The transformer impedance.
iii. The number of phases involved in the low voltage fault.
iv. The impedance in any low voltage cables.
v. The arc voltage at the point of the fault.

For the purposes of this standard, fault current has been calculated using an overall impedance of 5 per cent based on transformer rating. A factor of 0.6 has then been applied to allow for the effect of arc-voltage, for average source impedance, and, where applicable, for the impedance of low voltage cables and connections between the transformer and the distribution panel. Where high source impedance or a long low voltage cable connection unduly limits the fault currents, due allowance must be made in the rating of the high voltage Fuse-link protecting the distribution transformer. The likely effect of this is to reduce the effective rating of the transformer and to increase the risk of mal-discrimination with LV. fuses.

The decision to consider the 3-phase fault condition as that on which the clearance time of 1s should be based, is reasoned in ACE Report, No.86.

5.3 Discrimination between High Voltage and Low Voltage Fuse-links

Time/Current zones for low voltage Fuse-links are given in Figure.1 of' BS HD 60269-2. Characteristics of high voltage Fuse-links must be such that they will discriminate with Fuse-links on the low voltage side of the transformer for fault conditions resulting in the worst current ratio for high voltage delta/low voltage star transformation and up to the maximum current obtaining on the low voltage side of the transformer. The fault condition representing the lowest LV/HV current ratio is a phase/phase low voltage fault for which the current ratios are 22:1 and 13.2:1 for 11kV/400V and 6.6kV/433V respectively.

Appendix C shows the basic parameters for determining the characteristics of high voltage Fuse-links.

HV fuse-links to this standard will not necessarily discriminate with industrial type LV Fuse-links or circuit-breakers.

5.4 Minimum Breaking Current of Fuse-link

Fuse-links mounted in fuse-switch combinations for the protection of distribution transformers are normally back-up fuses only and have a rated minimum breaking current, below which current must be interrupted by the switch by virtue of the fuse striker operation.

Test shall be carried out on the combination unit to confirm the breaking performance of the mechanical switching device at currents in excess of the minimum breaking current of the Fuse-link.

6 SPECIFICATION FOR 11 kV AND 6.6 kV FUSE-LINKS

6.1 Scope

The following clauses specify the requirements for high voltage Fuse-links for use on electricity board distribution networks in fuse-switch equipment's covered by ENA TS 41-36

6.2 Type and Performance

Two types of Fuse-link are specified: one for use under oil, the other for use in air. All high voltage Fuse-links shall be of the current limiting cartridge type and shall be suitable for use in fuse-switch equipment's to ENA TS 41-36. Oil-immersed Fuse-links shall, in all respects, comply with BS EN 60282-1, except where otherwise specified in this Standard.

Note: Fuses for use in air are not required to comply in all respects with BS EN 60282-1.

6.3 Voltage Rating

The voltage rating of Fuse-links for use on the 11kV and 6.6 kV systems shall be 12kV and 7.2kV respectively.

Note: Fuse-links rated as 12kV may be used on 6.6 kV systems but those rated at 7.2kV must not be used on 11kV systems.

6.4 Normal Current Ratings

Fuse-links shall be marked by the manufacturer with the maximum continuous current rating in amperes (A) in accordance with BS EN 60282-1.

A total of' seven ratings of high voltage Fuse-link are required to cover the range of transformers in Table 1. Table 2 shows the required minimum rated current of each Fuse-link in the combination for each rating of transformer (in the case of dual-voltage Fuse-links it is based on the higher rated current requirement), and the rated current of the highest rating low voltage Fuse-link with which it will discriminate for the conditions described in 5.3.