PD IEC TS 60871-3:2015+A1:2023

BSI Standards Publication

Shunt capacitors for AC power systems having a rated voltage above 1 000 V

Part 3: Protection of shunt capacitors and shunt capacitor banks

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National foreword

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The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by A1 A1.

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SHUNT CAPACITORS FOR AC POWER SYSTEMS HAVING A RATED VOLTAGE ABOVE 1 000 V –

Part 3: Protection of shunt capacitors and shunt capacitor banks

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- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- t he subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

International Standard IEC 60871-3, which is a technical specification, has been prepared by IEC technical committee 33: Power capacitors and their applications.

This second edition cancels and replaces the first edition published in 1996. This edition constitutes a technical revision.

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This edition includes the following significant technical changes with respect to the previous edition:

a) Clearer writing of formulas on energy limitation for expulsion fuses;
b) Updated normative references and bibliography;
c) A new clause for synchronized switching has been added.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
33/545/DTS	33/563/RVC

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60871, published under the general title *Shunt capacitors for a.c. power systems having a rated voltage above 1 000 V*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- transformed into an International standard,
- r econfirmed,
- w ithdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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SHUNT CAPACITORS FOR AC POWER SYSTEMS HAVING A RATED VOLTAGE ABOVE 1 000 V –

Part 3: Protection of shunt capacitors and shunt capacitor banks

1 Scope

This part of IEC 60871, which is a technical specification, gives guidance on the protection of shunt capacitors and shunt capacitor banks. it applies to capacitors according to IEC 60871-1.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60549, *High-voltage fuses for the external protection of shunt capacitors*

IEC 60871-1, *Shunt capacitors for a.c. power systems having a rated voltage above 1 000 V –Part 1: General*

IEC 60871-4, *Shunt capacitors for AC power systems having a rated voltage above 1 000 V – Part 4: Internal fuses*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60549, IEC 60871-1 and IEC 60871-4 apply.

4 Internal fuses

4.1 General

Internal fuses for shunt capacitors are selective current-limiting fuses arranged inside a capacitor. As defined in IEC 60871-4, they are designed to isolate faulted capacitor elements or capacitor unit, to allow operation of the remaining parts of that capacitor unit and the bank in which the capacitor unit is connected.

The operation of an internal fuse is initiated by the breakdown of a capacitor element. The affected element is instantaneously disconnected by the operation of the element fuse without interruption in the operation of the capacitor.

The number of externally parallel connected capacitors and the available short-circuit current of the supply system should not affect the current-limiting of internal fuses.

It should be noted that internal fuses do not provide protection against a short circuit between internal connections or a short circuit between active parts and casing, both of which may lead to case rupture.

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4.2 Fuse characteristics

4.2.1 Rated current

There is no definition or test method existing for element fuses.

Element fuses are, in general, designed for much higher currents than the maximum permissible element current. They are meant to disconnect only faulty elements. The faulty elements and their fuses are not intended to be replaced.

4.2.2 Rated discharge capability

IEC 60871-4 and IEC 60871-1 specify that the capacitor be subject to five undamped discharges from a d.c. charge level of 2,5 U_N. For special applications, where inrush currents and/or peak voltages are limited, lower discharge requirements are applicable.

4.2.3 Disconnecting capability

Requirements and test procedures are given in IEC 60871-4. These tests verify that the fuse has a current-limiting action.

4.2.4 Voltage withstand capability after operation

Requirements and test procedures are given in IEC 60871-4.

4.3 Influence of capacitor element configuration on capacitor life

4.3.1 Capacitor with all elements connected in parallel

After the breakdown of an element, the respective fuse will melt in less than a millisecond owing to the discharge current from the parallel connected elements and capacitors and the power frequency current from the supply. The capacitor may, however, continue operating with a correspondingly reduced output.

If the capacitor is operated at a fixed bus voltage, no variation in operating voltage on the remaining healthy elements will occur.

4.3.2 Capacitor with elements connected in series and parallel

After the breakdown of an element, all parallel connected elements discharge their stored energy or part of it into the faulty element. The power frequency current is limited by the remaining healthy elements connected in series.

After the disconnection of the faulty element, the capacitor continues operating with a correspondingly reduced output. The remaining healthy elements of the group are then stressed with a voltage approximately $m \times n / [m (n - 1) + 1]$ times the initial voltage, where n is the number of parallel connected elements per group and m the number of series-connected sections per unit. In certain cases the voltage may be higher, for example due to neutral shift with an ungrounded star configuration.

5 External fuses

5.1 General

External fuses for shunt capacitors are defined in IEC 60549 as intended to clear faults inside a capacitor unit and to permit continued operation of the remaining parts of the bank in which the unit is connected. They will also clear an external capacitor bushing flashover.

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