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TECHNICAL SPECIFICATION

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Power transformers –
Part 23: DC magnetic bias suppression devices

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POWER TRANSFORMERS –

Part 23: DC magnetic bias suppression devices

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Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 60076-23, which is a technical specification, has been prepared by IEC technical committee 14: Power transformers.

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

Enquiry draft	Report on voting
14/924/DTS	14/943/RVDTS

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

A list of all parts in the IEC 60076, published under the general title *Power transformers*, can be found on the IEC website.

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

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INTRODUCTION

In some cases, abnormal direct current (DC) is introduced into the AC power network and has adverse effects upon neutral grounded power apparatuses such as power transformers.

- Case 1

  Direct current flows into the AC power network through grounded neutral points of transformers when an HVDC transmission system operates in monopole ground return mode or in bipolar unbalanced mode.

- Case 2

  Quasi-DC is induced in the AC power network by geo-magnetically induced current (GIC) during the period of a solar magnetic storm.

- Case 3

  Electric traction locomotives and some large capacity power electronic equipment may cause DC current in AC power network.

DC current flowing through transformer windings may cause DC magnetic bias of the transformers, presenting a safety risk for both the transformers and the power system. The mechanism and harmful effects of DC bias are shown in Annex A and Annex B.

Two techniques for suppressing the transformer DC bias current are presented in this document, respectively to limit or block the transformer bias current produced by the HVDC transmission system.

The two techniques can also be used to suppress transformer DC bias caused by GIC, electric traction locomotives and some large capacity power electronic equipment. However, these issues are not included in this document due to their complexity.

This document defines the technical requirements for the two types of DC current suppression devices that are connected to neutral points of power transformers and converter transformers.

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POWER TRANSFORMERS –

Part 23: DC magnetic bias suppression devices

1 Scope

This document specifies requirements for devices for the suppression of DC magnetic bias of power transformers and convertor transformers. It includes requirements for service conditions, structures, testing, packing, transport and storage.

The devices are connected to neutral points of power transformers and converter transformers to suppress DC bias current in the case an HVDC system is operated in monopole ground return mode or bipolar unbalanced mode. In the case of dedicated metallic return HVDC system, the devices are useful to mitigate DC stray current flowing through power transformers and converter transformers during transient conditions such as DC line fault.

This document applies to DC magnetic bias suppression devices for operation at frequencies of 50 Hz and 60 Hz on power systems having voltages above 110 kV.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60068-3-3, *Environmental testing – Part 3-3: Guidance – Seismic test methods for equipments*

IEC 60076-3, *Power transformers – Part 3: Insulation levels, dielectric tests and external clearances in air*

IEC 60076-5, *Power transformers – Part 5: Ability to withstand short circuit*

IEC 60137, *Insulated bushings for alternating voltages above 1000 V*

IEC 60168, *Tests on indoor and outdoor post insulators of ceramic material of glass for systems with nominal voltages greater than 1000V*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 61071, *Capacitors for power electronics*

IEC 62271-1, *High-voltage switchgear and controlgear – Part 1: Common specifications for alternating current switchgear and controlgear*

3 Terms and definitions

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

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ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
DC magnetic bias suppression device
electric device connected between the transformer neutral point and the earth to limit or to block the DC bias current flowing through the transformer windings

3.2
DC current-limiting device
electric device connected between the transformer neutral point and the earth to limit the DC bias current flowing through the transformer windings

Note 1 to entry: It normally consists of a resistor and a protection gap. For more information, see Annex C.

3.3
DC current- blocking device
electric device connected between the transformer neutral point and the earth to block the DC bias current flowing through the transformer windings

Note 1 to entry: It normally consists of a capacitor, a mechanical bypass switch, a high speed bypass switch, AC and DC sensors, and control devices. For more information, see Annex D.

3.4
mechanical bypass switch
mechanical switch connected in parallel to the capacitor in DC current-blocking device for the purpose of bypassing the capacitor persistently

3.5
high speed bypass switch
high speed switch connected in parallel to the capacitor in DC current-blocking device for the purpose of bypassing the capacitor quickly

3.6
DC bias current
DC current flowing through transformer windings which causes drift of the excitation characteristic curve of transformer

4 Service conditions

4.1 General

This document gives detailed requirements for the DC current-limiting or blocking devices under the following conditions.

a) Altitude

Height above sea-level not exceeding 1 000 m (3 300 ft).

b) Climate conditions

- Maximum ambient temperature: +40 °C.
- Minimum ambient temperature: −25 °C.
- Maximum daily temperature difference: 25 °C.
- Maximum relative outdoor humidity: 90 % at 40 °C.

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