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Insulation co-ordination –

Part 5: Procedures for high-voltage direct current (HVDC) converter stations

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Procédures pour les stations de conversion CCHT

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FOREWORD

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- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the 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.

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

IEC 60071-5, which is a technical specification, has been prepared by IEC technical committee 28: Insulation co-ordination.

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

Enquiry draft	Report on voting
28/139/CDV	28/144A/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 3.

This technical specification is published in English only.

Annexes A, B and C are for information only.

The committee has decided that the contents of this publication will remain unchanged until 2008. At this date, the publication will be

- transformed into an International standard
- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

INSULATION CO-ORDINATION –

Part 5: Procedures for high-voltage direct current (HVDC) converter stations

1 General

1.1 Scope

This part of IEC 60071 provides guidance on the procedures for insulation co-ordination of high-voltage direct current (HVDC) converter stations, without prescribing standardized insulation levels.

The guide applies only for HVDC applications in high-voltage a.c. power systems and not for industrial conversion equipment. Principles and guidance given are for insulation co-ordination purposes only. The requirements for human safety are not covered by this application guide.

1.2 Additional background

The use of power electronic thyristor valves in a series and/or parallel arrangement, along with the unique control and protection strategies employed in the conversion process, has ramifications requiring particular consideration of overvoltage protection of equipment in converter stations compared with substations in a.c. systems. This guide outlines the procedures for evaluating the overvoltage stresses on the converter station equipment subjected to combined d.c., a.c. power frequency, harmonic and impulse voltages. The criteria for determining the protective levels of series- and/or parallel combinations of surge arresters used to ensure optimal protection is also presented.

The basic principles and design objectives of insulation co-ordination of converter stations, in so far as they differ from normal a.c. system practice, are described.

Concerning surge arrester protection, this guide deals only with metal-oxide surge arresters, without gaps, which are used in modern HVDC converter stations. The basic arrester characteristics, requirements for these arresters and the process of evaluating the maximum overvoltages to which they may be exposed in service, are presented. Typical arrester protection schemes and stresses of arresters are presented, along with methods to be applied for determining these stresses.

This guide includes insulation co-ordination of equipment connected between the converter a.c. bus (including the a.c. harmonic filters, the converter transformer, the circuit breakers) and the d.c. line side of the smoothing reactor. The line and cable terminations in so far as they influence the insulation co-ordination of converter station equipment are also covered.

Although the main focus of the guide is on conventional HVDC systems where the commutation voltage bus is at the a.c. filter bus, outlines of insulation co-ordination for the capacitor commutated converter (CCC) as well as the controlled series compensated converter (CSCC) and some other special converter configurations are covered in the annexes.

2 Normative references

The following referenced documents 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.

IEC 60060-1:1989, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60071-1:1993, *Insulation co-ordination – Part 1: Definitions, principles and rules*

IEC 60071-2:1996, *Insulation co-ordination – Part 2: Application guide*

IEC 60099-4:1991, *Surge arresters – Part 4: Metal-oxide surge arresters without gaps for a.c. systems*

IEC 60633:1998, *Terminology for high-voltage direct current (HVDC) transmission*

IEC 60700-1:1998,*Thyristor valves for high-voltage direct current (HVDC) power transmission – Part 1: Electrical testing*

IEC 60815:1986, *Guide for the selection of insulators in respect of polluted conditions*