PD IEC/TR 62001-3:2016

BSI Standards Publication

High-voltage direct current (HVDC) systems — Guidance to the specification and design evaluation of AC filters

Part 3: Modelling

National foreword

This Published Document is the UK implementation of IEC/TR 62001-3:2016. Together with PD IEC/TR 62001-1:2016, PD IEC/TR 62001-2:2016 and PD IEC/TR 62001-4:2016, it supersedes PD IEC/TR 62001:2009, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/22, Power electronics.

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

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TECHNICAL REPORT

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High-voltage direct current (HVDC) systems – Guidance to the specification and design evaluation of AC filters –
Part 3: Modelling

INTERNATIONAL
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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IEC TR 62001-3, which is a Technical Report, has been prepared by subcommittee 22F: Power electronics for electrical transmission and distribution systems, of IEC technical committee 22: Power electronic systems and equipment.

This first edition of IEC TR 62001-3, together with IEC TR 62001-1, IEC TR 62001-2 and IEC TR 62001-4, cancels and replaces IEC TR 62001 published in 2009. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC TR 62001:

a) expanded and supplemented Clause 6;
b) new Clause 4;
c) new Clause 5;
d) new annexes on the location of worst case network impedance;
e) accuracy of network component modelling at harmonic frequencies;
f) further guidance for the measurement of harmonic voltage distortion;
g) project experience of pre-existing harmonic issues;
h) worked examples showing impact of pre-existing distortion;
i) comparison of calculation methods.

The text of this Technical Report is based on the following documents:

Enquiry draft	Report on voting
22F/411/DTR	22F/415/RVC

Full information on the voting for the approval of this document 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 62001 series, published under the general title *High-voltage direct current (HVDC) systems – Guidance to the specification and design evaluation of AC filters*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The IEC TR 62001 series is structured in four parts:

Part 1 – Overview

This part concerns specifications of AC filters for high-voltage direct current (HVDC) systems with line-commutated converters, permissible distortion limits, harmonic generation, filter arrangements, filter performance calculation, filter switching and reactive power management and customer specified parameters and requirements.

Part 2 – Performance

This part deals with current-based interference criteria, design issues and special applications, field measurements and verification.

Part 3 – Modelling

This part addresses the harmonic interaction across converters, pre-existing harmonics, AC network impedance modelling, simulation of AC filter performance.

Part 4 – Equipment

This part concerns steady-state and transient ratings of AC filters and their components, power losses, audible noise, design issues and special applications, filter protection, seismic requirements, equipment design and test parameters.

HIGH-VOLTAGE DIRECT CURRENT (HVDC) SYSTEMS – GUIDANCE TO THE SPECIFICATION AND DESIGN EVALUATION OF AC FILTERS –

Part 3: Modelling

1 Scope

This part of IEC TR 62001, which is a Technical Report, provides guidance on the harmonic interaction across converters, pre-existing harmonics, AC network impedance modelling and simulation of AC filter performance.

The scope of this document covers AC side filtering for the frequency range of interest in terms of harmonic distortion and audible frequency disturbances. It excludes filters designed to be effective in the PLC and radio interference spectra.

This document concerns the "conventional" AC filter technology and line-commutated high-voltage direct current (HVDC) converters.

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 TR 61000-3-6:2008, *Electromagnetic compatibility (EMC) – Part 3-6: Limits – Assessment of emission limits for the connection of distorting installations to MV, HV and EHV power systems*

IEC 61000-4-30, *Electromagnetic compatibility (EMC) – Part 4-30: Testing and measurement techniques – Power quality measurement methods*

3 Harmonic interaction across converters

3.1 General

In order to facilitate the analysis of harmonic generation by an HVDC converter, simplifying assumptions are often made. Typically, the HVDC converter is regarded as a generator of harmonic currents, with an infinite internal impedance. Such an assumption is reasonably valid for practical purposes for most harmonics, and is the basis of the calculation methods described in IEC TR 62001-1.

The customer should be aware, however, that such a simplified approach has limitations, and can lead to incorrect analysis and design in some circumstances. In practice, the converter is a link between the AC and DC side harmonic systems, and the AC side harmonic currents may be strongly influenced by the harmonic impedance and harmonic current flows on the DC side.

This is particularly true for low-order harmonics, and it is strongly recommended that the analysis of third harmonic distortion and filtering requirements should take into account the AC/DC side harmonic interaction. At the 11th and 13th harmonics, the interaction effect can