# SLOVENSKI STANDARD
# SIST EN 62501:2009/A1:2015

**01-maj-2015**

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**Elektronke za pretvornike napetostnih virov (VSC) za enosmerni visokonapetostni prenos električne energije (HVDC) - Električno preskušanje**

Voltage sourced converter (VSC) valves for high-voltage direct curent (HVDC) power transmission - Electrical testing

Spannungsgeführte Stromrichterventile (VSC-Ventile) für die Hochspannungsgleichstromübertragung (HGÜ) - Elektrische Prüfung



Valves à convertisseur de source de tension (VSC) pour le transport d'énergie en courant continu à haute tension (CCHT) - Essais électriques



**Ta slovenski standard je istoveten z:** **EN 62501:2009/A1:2014**

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**ICS:**

| | | |
|---|---|---|
| 29.200 | Usmerniki. Pretvorniki. Stabilizirano električno napajanje | Rectifiers. Convertors. Stabilized power supply |
| 29.240.01 | Omrežja za prenos in distribucijo električne energije na splošno | Power transmission and distribution networks in general |

**SIST EN 62501:2009/A1:2015** **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN 62501:2009/A1

November 2014

ICS 29.200; 29.240

English Version

# Voltage sourced converter (VSC) valves for high-voltage direct current (HVDC) power transmission - Electrical testing (IEC 62501:2009/A1:2014)

Valves à convertisseur de source de tension (VSC) pour le transport d'énergie en courant continu à haute tension (CCHT) - Essais électriques (CEI 62501:2009/A1:2014)

Amendment 1: Ventile von Spannungszwischenkreis-Stromrichtern (VSC) für die Hochspannungsgleichstromübertragung (HGÜ) - Elektrische Prüfung (IEC 62501:2009/A1:2014)

This amendment A1 modifies the European Standard EN 62501:2009; it was approved by CENELEC on 2014-09-16. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this amendment the status of a national standard without any alteration.



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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

**CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels**

## Foreword

The text of document 22F/299/CDV, future IEC 62501:2009/A1, prepared by SC 22F "Power electronics for electrical transmission and distribution systems" of IEC/TC 22 "Power electronic systems and equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62501:2009/A1:2014.

The following dates are fixed:

| | | |
|---|---|---|
| • latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | 2015-06-16 |
| • latest date by which the national standards conflicting with the document have to be withdrawn | (dow) | 2017-09-16 |

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## Endorsement notice



The text of the International Standard IEC 62501:2009/A1:2014 was approved by CENELEC as a European Standard without any modification.

## Annex ZA
(normative)

## Normative references to international publications with their corresponding European publications

***Annex ZA of EN 62501:2009 applies except as follows:***

| Publication | Year | Title | EN/HD | Year |
|---|---|---|---|---|

*In the Annex ZA of EN 62501:2009* ***delete*** *from the existing list the following references:*

| | | | | |
|---|---|---|---|---|
| IEC 60060-1 | 1989 | High-voltage test techniques - Part 1: General definitions and test requirements | HD 588.1 S1 | 1991 |
| IEC 60071-1 | 2006 | Insulation co-ordination - Part 1: Definitions, principles and rules | EN 60071-1 | 2006 |

*In the Annex ZA of EN 62501:2009* ***Add*** *to the existing list the following references:*



| | | | | |
|---|---|---|---|---|
| IEC 60071 | Series | Insulation co-ordination | EN 60071 | Series |
| IEC 60270 | 2000 | High-voltage test techniques - Partial discharge measurements | EN 60270 | 2001 |

# IEC 62501

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# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

colour inside

AMENDMENT 1
AMENDEMENT 1

## Voltage sourced converter (VSC) valves for high-voltage direct current (HVDC) power transmission – Electrical testing



## Valves à convertisseur de source de tension (VSC) pour le transport d'énergie en courant continu à haute tension (CCHT) – Essais électriques



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# FOREWORD

This amendment has been prepared by subcommittee 22F: Power electronics for electrical transmission and distribution systems, of IEC technical committee 22: Power electronic systems and equipment.

The text of this amendment is based on the following documents:

| CDV | Report on voting |
|---|---|
| 22F/299/CDV | 22F/316A/RVC |

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

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the stability date indicated 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.



**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.**

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## CONTENTS

*Replace the annex title as follows:*

Annex A (informative) Overview of VSC converters in HVDC power transmission

*Add the titles of new Subclauses A.5.1 to A.5.4 and new Clause A.7 as follows:*

A.5.1 General
A.5.2 Modular multi-level converter (MMC)
A.5.3 Cascaded two level converter (CTL)
A.5.4 Terminology for valves of the controllable voltage source type
A.7 Hybrid VSC valves

Annex B (informative) Fault tolerance capability

*Replace the annex title as follows:*

Annex B (informative) Valve component fault tolerance

Figure A.9 – One possible implementation of a multi-level “voltage source” VSC valve

*Replace the figure title as follows:*

Figure A.9 - The half-bridge MMC circuit

*Add, in the list of figures, the titles of new Figures A.10 to A.13 as follows:*

Figure A.10 – The full-bridge MMC circuit
Figure A.11 – The half-bridge CTL circuit
Figure A.12 – Construction terms in MMC valves
Figure A.13 – Construction terms in CTL valves



## 1 Scope

*Add, after the first paragraph, the following two paragraphs:*

The scope of this standard includes the electrical type and production tests of dynamic braking valves which may be used in some HVDC schemes for d.c. overvoltage limitation.

This standard can be used as a guide for testing of STATCOM valves.

*Add, at the end of the last sentence of the last paragraph, the words “*between the purchaser and the supplier*” so that the last sentence reads as follows:*

For other types of valves, the test requirements and acceptance criteria should be agreed between the purchaser and the supplier.

## 2 Normative references

*Delete from the existing list, the following references:*

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

IEC 60071-1:2006, *Insulation co-ordination – Part 1: Definitions, principles and rules*

*Add to the list, the following references:*

IEC 60071 (all parts), *Insulation co-ordination*

IEC 60270:2000, *High-voltage test techniques – Partial discharge measurements*

### 3.2 Power semiconductor terms

*Replace the existing introductory text, terms and definitions by the following new terms and definitions:*

**3.2.1**
**turn-off semiconductor device**
controllable semiconductor device which may be turned on and off by a control signal, for example an IGBT

NOTE There are several types of turn-off semiconductor devices which can be used in VSC converters for HVDC. For convenience, the term IGBT is used throughout this standard to refer to the main turn-off semiconductor device. However, the standard is equally applicable to other types of turn-off semiconductor devices.

**3.2.2**
**insulated gate bipolar transistor**
**IGBT**
turn-off semiconductor device with three terminals: a gate terminal (G) and two load terminals emitter (E) and collector (C)



NOTE By applying appropriate gate to emitter voltages, the load current can be controlled, i.e. turned on and turned off.



**3.2.3**
**free-wheeling diode**
FWD
power semiconductor device with diode characteristic

NOTE 1 A FWD has two terminals: an anode (A) and a cathode (K). The current through FWDs is in the opposite direction to the IGBT current.

NOTE 2 FWDs are characterized by the capability to cope with high rates of decrease of current caused by the switching behaviour of the IGBT.

**3.2.4**
**IGBT-diode pair**
arrangement of IGBT and FWD connected in inverse parallel

### 3.3 Operating states

*Replace the existing title, terms and definitions by the following new title, terms and definitions.*

### 3.3 Operating states of converter

**3.3.1**
**blocking state**
condition of the converter, in which a turn-off signal is applied continuously to all IGBTs of the converter

NOTE Typically, the converter is in the blocking state condition after energization.

**3.3.2**
**de-blocked state**
condition of the converter, in which turn-on and turn-off signals are applied repetitively to IGBTs of the converter

**3.3.3**
**valve protective blocking**
means of protecting the valve or converter from excessive electrical stress by the emergency turn-off of all IGBTs in one or more valves

**3.3.4**
**voltage step level**
voltage step caused by switching of a valve or part of a valve during the de-blocked state of the converter

NOTE For valves of the controllable voltage source type, the voltage step level corresponds to the change of voltage caused by switching one submodule or cell. For valves of the switch type, the voltage step level corresponds to the change of voltage caused by switching the complete valve.

### 3.4 VSC construction terms

*Replace the existing terms and definitions by the following new terms and definitions:*

**3.4.1**
**VSC phase unit**
equipment used to connect the two d.c. busbars to one a.c. terminal



**3.4.2**
**switch type VSC valve**
arrangement of IGBT-diode pairs connected in series and arranged to be switched simultaneously as a single function unit



**3.4.3**
**controllable voltage source type VSC valve**
complete controllable voltage source assembly, which is generally connected between one a.c. terminal and one d.c. terminal

**3.4.4**
**diode valve**
semiconductor valve containing only diodes as the main semiconductor devices, which might be used in some VSC topologies

**3.4.5**
**dynamic braking valve**
complete controllable device assembly, which is used to control energy absorption in braking resistor

**3.4.6**
**valve**
VSC valve, dynamic braking valve or diode valve according to the context

**3.4.7**
**submodule**
part of a VSC valve comprising controllable switches and diodes connected to a half bridge or full bridge arrangement, together with their immediate auxiliaries, storage capacitor, if any, where each controllable switch consists of only one switched valve device connected in series