

TECHNICAL REPORT



AMENDMENT 2

High-voltage direct current (HVDC) power transmission using voltage sourced converters (VSC)

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High-voltage direct current (HVDC) power transmission using voltage sourced converters (VSC)

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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:

DTR	Report on voting
22F/440/DTR	22F/450/RVDTR

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 website 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- withdrawn,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.

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

2 Normative references

Replace the existing reference "IEC 60633, Terminology for high-voltage direct-current (HVDC) transmission" by the following new reference: "IEC 62747, Terminology for voltage-sourced converters (VSC) for high-voltage direct current (HVDC) systems".

Add the following new references:

IEC 62501, *Voltage sourced converter (VSC) valves for high-voltage direct current (HVDC) power transmission – Electrical testing*

IEC 62751 (all parts), *Power losses in voltage sourced converter (VSC) valves for high voltage direct current (HVDC) systems*

3 Terms and definitions

Replace the existing sentence by the following new sentence:

For the purposes of this document, the terms and definitions given in IEC 62747, IEC 62501 and the following apply.

3.1 General

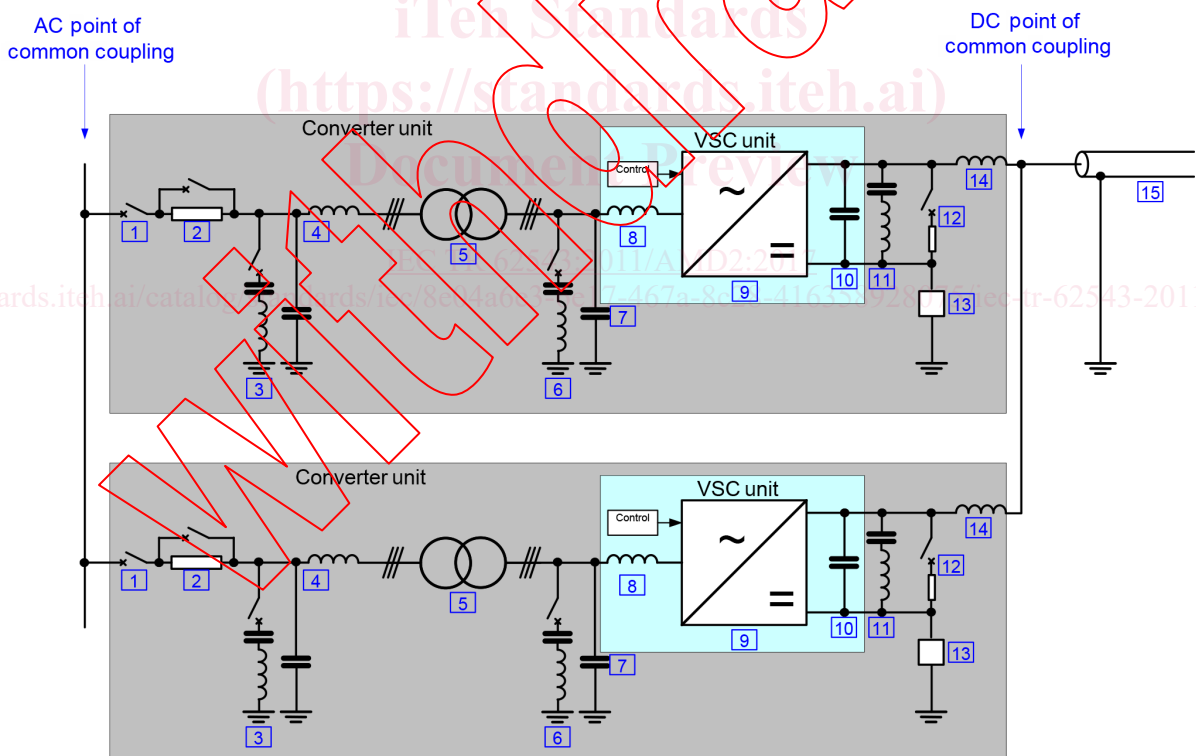
Insert the following text just after the title of 3.1:

Basic terms and definitions for voltage sourced converters used for HVDC transmission are given in IEC 62747. Terminology on electrical testing of VSC valves for HVDC transmission is given in IEC 62501.

Delete the first paragraph of the note. Change the second paragraph of the note into normal paragraph text.

Figure 1 – Major components that may be found in a VSC substation

Replace the existing figure and its footnotes modified by IEC TR 62543:2011/AMD1:2013 by the following new figure and footnotes:



- | | | | |
|-------|--|----|--|
| 1 | circuit breaker | 9 | VSC unit ³⁾ |
| 2 | pre-Insertion Resistor | 10 | VSC d.c. capacitor ⁴⁾ |
| 3 | line side harmonic filter ¹⁾ | 11 | d.c. harmonic filter ¹⁾ |
| 4 | line side high frequency filter ⁶⁾ | 12 | dynamic braking system ⁷⁾ |
| 5 | interface transformer | 13 | neutral point grounding branch ⁵⁾ |
| 6 | converter side harmonic filter ¹⁾ | 14 | d.c. reactor ⁸⁾ |
| 7 + 8 | converter side high frequency filter ²⁾ | 15 | d.c. cable or overhead transmission line |
| 8 | phase reactor ²⁾ | | |

- 1) In some designs of VSC based on "controllable voltage source" valves, the harmonic filters may not be required.
- 2) In some designs of VSC, the phase reactor may fulfill part of the function of the converter-side high frequency filter.
- 3) In some VSC topologies, each valve of the VSC unit may include a "valve reactor", which may be built into the valve or provided as a separate component.
- 4) In some designs of VSC, the VSC d.c. capacitor may be partly or entirely distributed amongst the three phase units of the VSC Unit, where it is referred to as the d.c. submodule capacitors.
- 5) The philosophy and location of the neutral point grounding branch may be different depending on the design of the VSC unit.
- 6) In some designs of VSC, the interface transformer may fulfill part of the function of the line-side high frequency filter.
- 7) Optional.
- 8) Optional, if phase reactors are located on the d.c. side of the converter.

3.3 Power semiconductor terms

Delete the existing sub-clause, modified by IEC TR 62543:2011/AMD1:2013, including its title.

3.4 VSC topologies

Delete the existing sub-clause, modified by IEC TR 62543:2011/AMD1:2013, including its title.

3.5 VSC transmission

Delete items 3.5.1 to 3.5.3, 3.5.5, 3.5.7 and 3.5.9 modified by IEC TR 62543:2011/AMD1:2013.

3.6 Operating states

Delete the existing sub-clause, modified by IEC TR 62543:2011/AMD1:2013, including its title.

3.10 Insulation co-ordination terms

Delete the existing sub-clause, including its title.

4.1.2.1 General

Replace, in the last paragraph, the first sentence by the following new sentence:

The active and reactive power are related to the AC voltages U_L and U_{conv} of the AC system and converter respectively, the reactance X between these voltages and the phase angle δ between them, according to the following:

$$P = \frac{U_L \times U_{conv} \times \sin \delta}{X}$$

$$Q = \frac{U_L \times (U_L - U_{conv} \times \cos \delta)}{X}$$

Move the second and third sentences of the last paragraph on a new line to become a fourth paragraph.

4.1.3 Operating principles of a VSC transmission scheme

Add, at the beginning of the first sentence of the last paragraph, the words "For example,".