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colour inside

Voltage sourced converter (VSC) valves for static synchronous compensator (STATCOM) – Electrical testing

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FOREWORD

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International Standard IEC 62927 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 International Standard is based on the following documents:

CDV	Report on voting
22F/412/CDV	22F/431A/RVC

Full information on the voting for the approval of this International Standard 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.

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

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- withdrawn,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

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

The contents of the corrigendum of December 2017 have been included in this copy.

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.

VOLTAGE SOURCED CONVERTER (VSC) VALVES FOR STATIC SYNCHRONOUS COMPENSATOR (STATCOM) – ELECTRICAL TESTING

1 Scope

This document applies to self-commutated valves, for use in voltage sourced converter (VSC) for static synchronous compensator (STATCOM). It is restricted to electrical type and production tests.

The tests specified in this document are based on air insulated valves. For other types of valves, the test requirements and acceptance criteria are agreed between the purchaser and the supplier.

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 (all parts), *High-voltage test techniques*

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

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

IEC 60700-1:2015, *Thyristor valves for high voltage direct current (HVDC) power transmission – Part 1: Electrical testing*

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

3 Terms and definitions

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

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 Insulation co-ordination terms

3.1.1
test withstand voltage
value of a test voltage of standard waveshape at which a new valve, with unimpaired integrity, does not show any disruptive discharge and meets all other acceptance criteria specified for the particular test, when subjected to a specified number of applications or a specified duration of the test voltage, under specified conditions

3.1.2
internal insulation
air external to the components and insulating materials of the valve, but contained within the profile of the valve or multiple valve unit

3.1.3
external insulation
air between the external surface of the valve or multiple valve unit and its surroundings

3.2 Power semiconductor terms

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 1 to entry: There are several types of turn-off semiconductor devices, for example IGBT, IGCT and GTO, which can be used in voltage sourced converters for STATCOM. For convenience, the term IGBT is used throughout this document to refer to the main, controllable turn-off, semiconductor device. However, this document is equally applicable to other types of controllable semiconductor switch device.

3.2.2
gate turn-off thyristor
GTO thyristor
turn-off semiconductor device which can be turned on and off by its gate lead

Note 1 to entry: A GTO thyristor is a special type of thyristor, which is a high-power semiconductor device.

Note 2 to entry: Gate commutated thyristor (GCT) and integrated gate commutated thyristor (IGCT) are special types of GTO thyristor.

3.2.3
insulated gate bipolar transistor
IGBT
transistor provided for power switching having a conduction channel and a PN junction and in which the current flowing through the channel and the junction is controlled by an electric field resulting from a voltage applied between the gate and emitter terminals

3.2.4
free-wheeling diode
FWD
power semiconductor device with diode characteristic connected to an insulated gate bipolar transistor (IGBT) in inverse parallel

Note 1 to entry: An FWD has two terminals: an anode (A) and a cathode (K).

Note 2 to entry: The current through FWDs is in the opposite direction to the IGBT current.

Note 3 to entry: Concepts of "inverse parallel" and "anti-parallel" are identical.

3.2.5
IGBT-diode pair
arrangement of IGBT and FWD connected in inverse parallel

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

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 1 to entry: For a voltage source type valve, one half bridge cell corresponds to one voltage step level and a full bridge cell has two voltage step levels.

3.4 STATCOM construction terms

3.4.1
STATCOM
shunt connected reactive compensation equipment which is capable of generating and/or absorbing reactive power, whose capacitive or inductive output current can be controlled independently of the AC system voltage

Note 1 to entry: Previous alternative terms for the STATCOM have included static var generator (SVG), advanced static var compensator (ASVC) and static synchronous condenser (STATCON).

3.4.2
STATCOM valve
electrically and mechanically combined assembly of IGBT levels, complete with all connections, auxiliary components and mechanical structures, which can be connected in series with each phase of reactor of a STATCOM

Note 1 to entry: Depending on the converter topology, a valve can either have the function to act like a controllable switch or to act like a controllable voltage source. For controllable voltage source type converter, the STATCOM controllable voltage source type valve is a complete controllable voltage source assembly, which is generally connected between two AC phases. For switch type converter, the STATCOM switch type valve is an arrangement of IGBTs connected in series and arranged to be switched simultaneously as a single function unit between one AC phase and one DC terminal of the DC capacitor energy storage.

Note 2 to entry: For convenience, the term "STATCOM valve" is shortened as "valve" in this document.

3.4.3
diode valve
semiconductor valve containing only diodes as the main semiconductor devices, which might be used in some STATCOM topologies

3.4.4
submodule
part of a valve comprising controllable switches and diodes connected in a half bridge or full bridge arrangement, together with their immediate auxiliaries, storage capacitor, if any, where each controllable switch consists of one or more switched valve device(s) connected in series

Note 1 to entry: This definition is only applicable for converters of controllable voltage source type.

3.4.5
switch type valve
arrangement of IGBT-diode pairs connected in series and arranged to be switched simultaneously as a single function unit

3.4.6
controllable voltage source type valve
complete controllable voltage source assembly, which is generally connected between AC phases or between one AC terminal and one DC terminal

3.4.7
modular multi-level converter
MMC
multi-level converter in which each VSC valve (see 3.4.5, 3.4.6) consists of a number of MMC building blocks (see 3.4.9) connected in series

3.4.8
cascaded two-level converter
CTL
modular multi-level converter in which each switch position consists of more than one IGBT-diode pair connected in series

3.4.9
MMC building block
self-contained, two-terminal controllable voltage source together with DC capacitor(s) and immediate auxiliaries, forming part of a MMC

3.4.10
STATCOM valve level
the smallest indivisible functional unit of valve

Note 1 to entry: For any valve in which switch devices are connected in series and operated simultaneously, one valve level is one IGBT including its auxiliaries. For modular multilevel converter (MMC) type without IGBT connected in series, one valve level is one submodule (cell) together with its auxiliaries.

3.4.11
diode valve level
part of a diode valve composed of a diode and associated circuits and components, if any

3.4.12
redundant valve levels
the maximum number of series connected valve levels or diode valve levels in a valve that may be short-circuited externally or internally without affecting the safe operation of the valve as demonstrated by type tests, and which if and when exceeded, would require shutdown of the valve to replace the failed levels or acceptance of increased risk of failures

Note 1 to entry: In valve designs which contain two or more conduction paths within each cell and have series-connected VSC valve levels in each path, redundant levels shall be counted only in one conduction path in each cell.

3.5 Valve structure terms

3.5.1
valve structure
physical structure holding the levels of a valve which is insulated to the appropriate voltage above earth potential

3.5.2
valve support
part of the valve which mechanically supports and electrically insulates the active part of the valve from earth