

FINAL VERSION

VERSION FINALE



Thyristor valves for thyristor controlled series capacitors (TCSC) – Electrical testing

Valves à thyristors pour condensateurs série commandés par thyristors (CSCT) – Essai électrique

CONTENTS

FOREWORD	5
1 Scope	7
2 Normative references	7
3 Terms and definitions	7
4 TCSC valve and valve operation in general	10
4.1 TCSC installation and TCSC valve	10
4.2 TCSC valve current and voltage at capacitive boost operation	12
4.2.1 General	12
4.2.2 Waveshapes of valve current and voltage in capacitive boost operation	12
4.2.3 Formulas for TCSC valve current and voltage stresses calculation	13
4.3 Typical operating pattern of TCSC installation	15
5 General requirements	15
5.1 Guidelines for the performance of type tests	15
5.1.1 Evidence in lieu	15
5.1.2 Sequence of tests	16
5.1.3 Ambient temperature for testing	16
5.1.4 Frequency for testing	16
5.1.5 Test reports	16
5.2 Test conditions for dielectric tests	16
5.2.1 General	16
5.2.2 Treatment of redundancy in dielectric tests	16
5.2.3 Atmospheric correction factor	17
5.3 Test conditions for operational tests	17
5.3.1 General	17
5.3.2 Treatment of redundancy in operational tests	17
5.4 Criteria for successful type testing	18
5.4.1 General	18
5.4.2 Criteria applicable to valve levels	18
5.4.3 Criteria applicable to the valve as a whole	19
6 Summary of tests	19
7 Dielectric tests between valve terminals and valve enclosure	20
7.1 Purpose of tests	20
7.2 Test object	21
7.3 Test requirements	21
7.3.1 AC test	21
7.3.2 Lightning impulse test	22
8 Dielectric tests between valve terminals	22
8.1 Purpose of tests	22
8.2 Test object	22
8.3 Test requirements	23
8.3.1 AC test	23
8.3.2 Switching impulse test	23
9 Periodic firing and extinction tests	24
9.1 Purpose of tests	24
9.2 Test object	24

9.3	Test requirements	25
9.3.1	General	25
9.3.2	Maximum continuous capacitive boost test	25
9.3.3	Maximum temporary capacitive boost test	26
9.3.4	Minimum capacitive boost test	26
9.3.5	Operation at bypass	27
10	Fault current tests	29
10.1	Purpose of tests	29
10.2	Test object	29
10.3	Test requirements	29
10.3.1	Fault current without subsequent blocking	29
10.3.2	Fault current with subsequent blocking	29
11	Test for valve insensitivity to electromagnetic disturbance	30
11.1	Purpose of tests	30
11.2	Test object	30
11.3	Test requirements	30
12	Testing of special features	30
12.1	Purpose of tests	30
12.2	Test object	31
12.3	Test requirements	31
13	Routine tests	31
13.1	General	31
13.2	Visual inspection	31
13.3	Connection check	31
13.4	Voltage grading circuit check	31
13.5	Voltage withstand check	31
13.6	Partial discharge tests	31
13.7	Check of auxiliaries	32
13.8	Firing check	32
13.9	Cooling system pre-charge test	32
14	Presentation of type test results	32
Annex A (informative)	TCSC valve operating and rating considerations	33
A.1	Overview	33
A.2	TCSC characteristics	33
A.3	Operating range	34
A.4	Reactive power rating	35
A.5	Power oscillation damping (POD)	35
A.6	SSR mitigation	35
A.7	Harmonics	36
A.8	Control interactions between TCSCs in parallel lines	36
A.9	Operating range, overvoltages and duty cycles	36
A.9.1	Operating range	36
A.9.2	Transient overvoltages	36
A.9.3	Duty cycles	37
Annex B (informative)	Valve component fault tolerance	38
Bibliography		39

Figure 1 – Typical connection and nomenclature of a TCSC..... 11

Figure 2 – TCSC subsegment 11

Figure 3 – TCSC steady state waveforms for control angle α and conduction interval σ 12

Figure 4 – Thyristor valve voltage in a TCSC 13

Figure 5 – Example of operating range diagram for TCSC 15

Figure A.1 – TCSC power frequency steady state apparent reactance characteristics according to Formula (A.1) with $\lambda = 2,5$ 34

Table 1 – Valve level faults permitted during type tests..... 19

Table 2 – List of tests 20

Table A.1 – Peak and RMS voltage relationships 33

Currently in preview, click buy full version

INTERNATIONAL ELECTROTECHNICAL COMMISSION

THYRISTOR VALVES FOR THYRISTOR CONTROLLED SERIES CAPACITORS (TCSC) – ELECTRICAL TESTING

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

DISCLAIMER

This Consolidated version is not an official IEC Standard and has been prepared for user convenience. Only the current versions of the standard and its amendment(s) are to be considered the official documents.

This Consolidated version of IEC 62823 bears the edition number 1.1. It consists of the first edition (2015-08) [documents 22F/342/CDV and 22F/354A/RVC] and its amendment 1 (2019-12) [documents 22F/518/CDV and 22F/532/RVC]. The technical content is identical to the base edition and its amendment.

This Final version does not show where the technical content is modified by amendment 1. A separate Redline version with all changes highlighted is available in this publication.

International Standard IEC 62823 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 publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of the base publication and its amendment 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.

THYRISTOR VALVES FOR THYRISTOR CONTROLLED SERIES CAPACITORS (TCSC) – ELECTRICAL TESTING

1 Scope

This International Standard defines routine and type tests on thyristor valves used in thyristor controlled series capacitor (TCSC) installations for AC power transmission.

The tests specified in this International Standard are based on air insulated valves operating in capacitive boost mode or bypass mode. For other types of valve and for a valve operating in inductive boost mode, the test requirements and acceptance criteria are agreed between purchaser and supplier.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements*

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

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

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

3 Terms and definitions

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

3.1

thyristor valve

electrically and mechanically combined assembly of thyristor levels, complete with all connections, auxiliary components and mechanical structures, which can be connected in series with each phase of the reactor of a TCSC

3.2

valve section

electrical assembly, comprising a number of thyristors and other components, which exhibits the required electrical properties of a complete valve

Note 1 to entry: This term is mainly used to define a test object for valve testing purposes.

3.3

thyristor level

<of a valve> part of a valve comprising an anti-parallel connected pair of thyristors together with their immediate auxiliaries, and reactor, if any