

TECHNICAL SPECIFICATION



**UHV AC transmission systems –
Part 302: Commissioning**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2021 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC online collection - oc.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

Preview generated by EVS

TECHNICAL SPECIFICATION



**UHV AC transmission systems –
Part 302: Commissioning**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.240.01; 29.240.10

ISBN 978-2-8322-1024-6

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references	8
3 Terms and definitions	8
4 General.....	9
4.1 Requirements	9
4.2 Main purpose	9
4.3 General structure of commissioning	10
4.4 Scope of application	10
4.5 Technical preparation of system commissioning.....	10
5 Pre-commissioning	11
5.1 General.....	11
5.2 Combined test.....	11
5.2.1 General	11
5.2.2 Protection and control system test	11
5.2.3 Instrument transformer test.....	12
5.2.4 Switchgear and transformer test	12
5.2.5 AC and DC power supply system test	13
5.3 Communication system test	13
6 System commissioning	13
6.1 General.....	13
6.2 Test requirements	14
6.2.1 General	14
6.2.2 Energizing test of no-load UHV power transformer.....	14
6.2.3 Energizing test of tertiary connected reactor	14
6.2.4 Energizing test of tertiary connected capacitor.....	15
6.2.5 Energizing test of UHV busbar shunt reactor	16
6.2.6 Energizing test of UHV busbar.....	16
6.2.7 Energizing test of no-load UHV transmission line.....	17
6.2.8 Loop closing (interconnecting)/opening (splitting) test.....	18
7 Measurement in system commissioning	19
7.1 General.....	19
7.2 Measurement requirements.....	19
7.2.1 General	19
7.2.2 Transient voltage and current measurement	19
7.2.3 Electric quantity measurement.....	20
7.2.4 Relay protection measurement	20
7.2.5 Harmonic measurement.....	20
7.2.6 Sound level measurement of power transformer/shunt reactor	20
7.2.7 Vibration measurement.....	21
7.2.8 DGA of power transformer/shunt reactor.....	21
7.2.9 Temperature measurement.....	21
7.2.10 Power frequency electric and magnetic field measurement of substation and transmission line	22
7.2.11 Audible noise measurement of substation and transmission line	22

7.2.12	Radio interference measurement of transmission line	22
7.2.13	Partial discharge monitoring in GIS/power transformer	22
Annex A	(informative) Commissioning experiences in China	23
A.1	General.....	23
A.2	Overview.....	23
A.3	Regulations.....	23
A.4	Pre-commissioning	23
A.5	System commissioning.....	26
A.5.1	General	26
A.5.2	Technical preparations	26
A.5.3	Confirmation on preconditions for on-site commissioning.....	27
A.5.4	System commissioning tests.....	27
A.6	Measurement in system commissioning	35
A.6.1	General	35
A.6.2	Measurement in system commissioning	36
Annex B	(informative) Commissioning experiences in Japan	39
B.1	Overview.....	39
B.2	Regulations.....	39
B.3	Pre-commissioning in Japan	39
B.3.1	General	39
B.3.2	Combined test	40
B.3.3	Communication system test.....	41
B.4	System commissioning in Japan	42
B.4.1	General	42
B.4.2	Energizing test.....	42
B.5	Measurement in system commissioning in Japan	43
B.5.1	General	43
B.5.2	Measurement in system commissioning	44
Annex C	(informative) Commissioning experiences in India	51
C.1	Overview.....	51
C.2	Design, testing, installation, transportation and construction	52
C.3	On-site acceptance tests.....	53
C.3.1	General	53
C.3.2	1 200/400 kV, 333 MVA single phase transformers	53
C.3.3	1 200 kV dead tank spring-spring type SF ₆ circuit-breakers	53
C.3.4	1 200 kV double break centre rotating and knee type disconnector	54
C.3.5	1 200 kV capacitive voltage transformers.....	54
C.3.6	850 kV surge arrestors	54
C.4	Commissioning	54
Bibliography	56
Figure 1	– General structure of on-site acceptance tests and commissioning	10
Figure A.1	– Circuit for test of UHV transformer with current increasing from zero	31
Figure A.2	– Circuit for test of UHV transformer with voltage increasing from zero	32
Figure A.3	– Circuit for loop closing (interconnecting)/opening (splitting) test operated by UHV transmission line circuit breakers	34
Figure B.1	– Circuit for transient voltage and current measurement	44

Figure B.2 – Analysis results of electrostatic induced field in the vicinity of bushing above the ground	47
Figure B.3 – Electrostatic induction field intensity distribution	47
Figure C.1 – Basic set-up at Bina 1 200 kV National Test Station	52
Figure C.2 – Typical variation in voltage over the period of 4 days at Bina 1 200 kV National Test Station	55
Table 1 – Scope of application	10
Table 2 – Recommended test items of pre-commissioning	11
Table 3 – Recommended test items of system commissioning	13
Table 4 – Recommended measurement items of system commissioning	19
Table 5 – DGA of UHV transformer, UHV reactor and neutral point reactor	21
Table A.1 – Test items for pre-commissioning of UHV AC transmission projects	24
Table A.2 – System commissioning tests for UHV AC transmission projects	28
Table A.3 – Measurement items in system commissioning for UHV AC transmission projects	35
Table B.1 – Pre-commissioning items	39
Table B.2 – System commissioning items	42
Table B.3 – Measurement items in system commissioning	44

preview generated by EVS

UHV AC TRANSMISSION SYSTEMS –

Part 302: Commissioning

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 should 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 should 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 should not be held responsible for identifying any or all such patent rights.

IEC TS 63042-302 has been prepared by IEC technical committee 122: UHV AC transmission systems. It is a Technical Specification.

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

DTS	Report on voting
122/115/DTS	122/117/RVDTS

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

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 63042 series, published under the general title *UHV AC transmission systems*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under 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.

IMPORTANT – The "colour inside" logo on the cover page of this document 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

Due to the increase in voltage level and transmission capacity, the reliability and security of high voltage electric equipment and power system are facing new challenges. There is a need to have consensus on a series of technical criteria and requirements for commissioning tests for ultra-high voltage (UHV) AC transmission systems to check the proper and expected performance of substation equipment and transmission lines, to verify the function of the transmission system, to obtain the electromagnetic data and confirm the environmental impacts complying with relevant local regulations. By commissioning, the integrated performance and construction quality of the project before its commercial operation could be confirmed.

This document proposes relevant test items, test preconditions, test methods, and test acceptance criteria for pre-commissioning, system commissioning, and measurement during system commissioning.

UHV AC TRANSMISSION SYSTEMS –

Part 302: Commissioning

1 Scope

This part of IEC 63042 applies to the commissioning of UHV AC transmission systems.

It mainly specifies the test purposes, test items, test preconditions, test methods and test acceptance criteria during pre-commissioning and system commissioning. Also, the measurement requirements for system commissioning are specified.

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 60076-6:2007, *Power transformers – Part 6: Reactors*

IEC 60076-10:2016, *Power transformers – Part 10: Determination of sound levels*
IEC 60076-10:2016/AMD1:2020

IEC 61000-4-13:2002, *Electromagnetic compatibility (EMC) – Part 4-13: Testing and measurement techniques – Harmonics and interharmonics including mains signalling at a.c. power port, low frequency immunity tests*

IEC 61000-4-13:2002/AMD1:2009

IEC 61000-4-13:2002/AMD2:2015

IEC 61786-2:2014, *Measurement of DC magnetic, AC magnetic and AC electric fields from 1 Hz to 100 kHz with regard to exposure of human beings – Part 2: Basic standards for measurements*

IEC TS 63042-301:2018, *UHV AC transmission systems – Part 301: On-site acceptance tests*

CISPR TR 18-2:2017, *Radio interference characteristics of overhead power lines and high-voltage equipment – Part 2: Methods of measurement and procedure for determining limits*

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>