IEEE STANDARDS ASSOCIATION

IEEE Guide for the Application of Transient Recovery Voltage for AC High-Voltage Circuit Breakers with Rated Maximum Voltage above 1000 V

IEEE Power and Energy Society

Sponsored by the
Switchgear Committee

IEEE
3 Park Avenue
New York, NY 10016-5997
USA

IEEE Std C37.011™-2019
(Revision of IEEE Std C37.011-2011)

IEEE Std C37.011™-2019
(Revision of IEEE Std C37.011-2011)

IEEE Guide for the Application of Transient Recovery Voltage for AC High-Voltage Circuit Breakers with Rated Maximum Voltage above 1000 V

Sponsor

Switchgear Committee
of the
IEEE Power and Energy Society

Approved 8 February 2019

IEEE-SA Standards Board

Abstract: The procedures and calculations necessary to apply the standard transient recovery voltage (TRV) ratings for ac high-voltage circuit breakers rated above 1000 V are covered in this guide. The breaking capability limits of these circuit breakers are determined to a great degree by the TRV. The TRV ratings are compared with typical system TRV duties. Examples of TRV calculation are given with suggested options if the TRV duty exceeds the TRV ratings of the circuit breaker.

Keywords: high-voltage circuit breakers, IEEE C37.011, transient recovery voltage (TRV)

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

PDF: ISBN 978-1-5044-5556-5 STD23554
Print: ISBN 978-1-5044-5557-2 STDPD23554

Important Notices and Disclaimers Concerning IEEE Standards Documents

IEEE documents are made available for use subject to important notices and legal disclaimers. These notices and disclaimers, or a reference to this page, appear in all standards and may be found under the heading "Important Notice" or "Important Notices and Disclaimers Concerning IEEE Standards Documents."

Notice and Disclaimer of Liability Concerning the Use of IEEE Standards Documents

IEEE Standards documents (standards, recommended practices, and guides), both full-use and trial-use, are developed within IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association ("IEEE-SA") Standards Board. IEEE ("the Institute") develops its standards through a consensus development process, approved by the American National Standards Institute ("ANSI"), which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute and participate without compensation from IEEE. While IEEE administers the process and establishes rules to promote fairness in the consensus development process, IEEE does not independently evaluate, test, or verify the accuracy of any of the information or the soundness of any judgments contained in its standards.

IEEE does not warrant or represent the accuracy or content of the material contained in its standards, and expressly disclaims all warranties (express, implied and statutory) not included in this or any other document relating to the standard, including, but not limited to, the warranties of: merchantability; fitness for a particular purpose; non-infringement; and quality, accuracy, effectiveness, currency, or completeness of material. In addition, IEEE disclaims any and all conditions relating to: results; and workmanlike effort. IEEE standards documents are supplied "AS IS" and "WITH ALL FAULTS."

Use of an IEEE standard is wholly voluntary. The existence of an IEEE standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard.

In publishing and making its standards available, IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity nor is IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing any IEEE Standards document, should rely upon his or her own independent judgment in the exercise of reasonable care in any given circumstances or, as appropriate, seek the advice of a competent professional in determining the appropriateness of a given IEEE standard.

IN NO EVENT SHALL IEEE BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO: PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE PUBLICATION, USE OF, OR RELIANCE UPON ANY STANDARD, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND REGARDLESS OF WHETHER SUCH DAMAGE WAS FORESEEABLE.

Translations

The IEEE consensus development process involves the review of documents in English only. In the event that an IEEE standard is translated, only the English version published by IEEE should be considered the approved IEEE standard.

Official statements

A statement, written or oral, that is not processed in accordance with the IEEE-SA Standards Board Operations Manual shall not be considered or inferred to be the official position of IEEE or any of its committees and shall not be considered to be, or be relied upon as, a formal position of IEEE. At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that his or her views should be considered the personal views of that individual rather than the formal position of IEEE.

Comments on standards

Comments for revision of IEEE Standards documents are welcome from any interested party, regardless of membership affiliation with IEEE. However, IEEE does not provide consulting information or advice pertaining to IEEE Standards documents. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Since IEEE standards represent a consensus of concerned interests, it is important that any responses to comments and questions also receive the concurrence of a balance of interests. For this reason, IEEE and the members of its societies and Standards Coordinating Committees are not able to provide an instant response to comments or questions except in those cases where the matter has previously been addressed. For the same reason, IEEE does not respond to interpretation requests. Any person who would like to participate in revisions to an IEEE standard is welcome to join the relevant IEEE working group.

Comments on standards should be submitted to the following address:

Secretary, IEEE-SA Standards Board
445 Hoes Lane
Piscataway, NJ 08854 USA

Laws and regulations

Users of IEEE Standards documents should consult all applicable laws and regulations. Compliance with the provisions of any IEEE Standards document does not imply compliance to any applicable regulatory requirements. Implementers of the standard are responsible for observing or referring to the applicable regulatory requirements. IEEE does not, by the publication of its standards, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

Photocopies

Updating of IEEE Standards documents

Users of IEEE Standards documents should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of amendments, corrigenda, or errata. An official IEEE document at any point in time consists of the current edition of the document together with any amendments, corrigenda, or errata then in effect.

Every IEEE standard is subjected to review at least every 10 years. When a document is more than 10 years old and has not undergone a revision process, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE standard.

In order to determine whether a given document is the current edition and whether it has been amended through the issuance of amendments, corrigenda, or errata, visit the IEEE-SA Website at http://ieeexplore.ieee.org/xpl/standards.jsp or contact IEEE at the address listed previously. For more information about the IEEE-SA or IEEE's standards development process, visit the IEEE-SA Website at http://standards.ieee.org.

Errata

Errata, if any, for all IEEE standards can be accessed on the IEEE-SA Website at the following URL: http://standards.ieee.org/findstds/errata/index.html. Users are encouraged to check this URL for errata periodically.

Patents

Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken by the IEEE with respect to the existence or validity of any patent rights in connection therewith. If a patent holder or patent applicant has filed a statement of assurance via an Accepted Letter of Assurance, then the statement is listed on the IEEE-SA Website at http://standards.ieee.org/about/sasb/patcom/patents.html. Letters of Assurance may indicate whether the Submitter is willing or unwilling to grant licenses under patent rights without compensation or under reasonable rates, with reasonable terms and conditions that are demonstrably free of any unfair discrimination to applicants desiring to obtain such licenses.

Essential Patent Claims may exist for which a Letter of Assurance has not been received. The IEEE is not responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patents Claims, or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from the IEEE Standards Association.

Participants

At the time this IEEE guide was completed, the Revision of C37.011 Working Group had the following membership:

Denis Dufournet, *Chair*
Jingxuan (Joanne) Hu, *Vice Chair*
Carl Schuetz, *Secretary*

Roy Alexander
Mauricio Aristizabal
Anne Bosma
Arben Bufi
Lucas Collette
Helmut Heiermeier
Victor Hermosillo
Roy Neil Hutchins
Amir Khosravi
Jim van de Ligt
Hua Y. Liu
Sushil Shinde
Mike Skidmore
R. Kirkland Smith
Jan Weisker
Xi Zhu

The following members of the individual balloting committee voted on this guide. Balloters may have voted for approval, disapproval, or abstention.

Roy Alexander
Ficheux Arnaud
Roy Ayers
Thomas Barnes
W. J. (Bill) Bergman
Steven Bezner
Frank Blalock
William Bloethe
Anne Bosma
Jeffrey Brogdon
Demetrio Bucaneg Jr.
Arben Bufi
Paul Cardinal
Sean Carr
Stephen Cary
Michael Chirico
Chih Chow
Michael Christian
Lucas Collette
Michael Crawford
Gary Donner
Denis Dufournet
Edgar Dullni
Leslie Falkingham
Sergio Flores
Raymond Frazier III
Dale Fredrickson
Mietek Glinkowski
James Graham
Randall Groves
John Harley
Helmut Heiermeier
Victor Hermosillo
Werner Hoelzl
Jingxuan (Joanne) Hu
Todd Irwin
Richard Jackson
John John
Laszlo Kadar
John Kay
Peter Kelly
Yuri Khersonsky
James Kinney
Boris Kogan
Jim Kulchisky
Benjamin Lanz
John Leach
James van de Ligt
Hua Liu
James McBride
Neil McCord
Steven Meiners
David Mitchell
Charles Morse
Thomas Mulcahy
Jerry Murphy
Arthur Neubauer
Joe Nims
T. W. Olsen
Lorraine Padden
Mirko Palazzo
Shawn Patterson
Christopher Petrola
John Phouminh
Iulian Profir
Reynaldo Ramos
Lakshman Raut
Rosy Raysaha
Samala Santosh Reddy
Anthony Ricciuti
Johannes Rickmann
Charles Rogers
Jesse Rorabaugh
Thomas Rozek
Roderick Sauls
Bartien Sayogo
Carl Schuetz
Nikunj Shah
Devki Sharma
Sushil Shinde
Hyeong Sim
Michael Skidmore
Jerry Smith
Gary Smullin
Donald Steigerwalt
Gary Stoedter
David Tepen
Marcelo Valdes
John Vergis
Mark Waldron
Haifei Wang
John Wang
John Webb
Jan Weisker
Matt Westerdale
Kenneth White
Terry Woodyard
Larry Yonce
Richard York
Wei Zhang
Xi Zhu

When the IEEE-SA Standards Board approved this guide on 8 February 2019, it had the following membership:

Gary Hoffman, *Chair*
Vacant Position, *Vice Chair*
Jean-Philippe Faure, *Past Chair*
Konstantinos Karachalios, *Secretary*

Masayuki Ariyoshi
Ted Burse
Stephen D. Dukes
J. Travis Griffith
Guido Hiertz
Christel Hunter
Thomas Koshy
Joseph L. Koepfinger*
Thomas Koshy
John D. Kulick
David J. Law
Joseph Levy
Howard Li
Xiaohui Liu
Kevin Lu
Daleep Mohla
Andrew Myles
Annette D. Reilly
Dorothy Stanley
Sha Wei
Phil Wennblom
Philip Winston
Howard Wolfman
Feng Wu
Jingyi Zhou

*Member Emeritus

Introduction

This introduction is not part of IEEE Std C37.011™-2019, IEEE Guide for the Application of Transient Recovery Voltage for AC High-Voltage Circuit Breakers with Rated Maximum Voltage above 1000 V.

This application guide has been revised to align the new TRV requirements introduced in IEEE Std C37.04™, IEEE Std C37.09™, and IEEE Std C37.06.1™.

The main changes implemented in this guide concern:

— Revision of 3.2 to develop the part on arc-circuit interaction

— Revision of 3.3 to incorporate information formerly in IEEE Std C37.04b™ but not incorporated in the latest revision of IEEE Std C37.04

— Revision of 3.3.4 to give more detailed explanations on TRV modification during interruption of asymmetrical currents

— Revision of 4.2.3 on short-line faults

— Revision of 4.4.1 to update with IEEE Std C37.06.1 and give guidance

— Addition of 4.5.2 to incorporate TRVs on series capacitor banks

— New Clause 5 to cover testing issues

— New Annex D on guidance for TRV calculation by electromagnetic transients program

— New Annex E on abbreviations

Contents