IEEE STANDARDS ASSOCIATION

IEEE Standard for the Electrical Protection of Communication Facilities Serving Electric Supply Locations Through the Use of Isolation Transformers

IEEE Power and Energy Society

Sponsored by the
Power System Communications Committee

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

3 May 2013

IEEE Std 487.5™-2013

IEEE Standard for the Electrical Protection of Communication Facilities Serving Electric Supply Locations Through the Use of Isolation Transformers

Sponsor

Power System Communications Committee
of the
IEEE Power and Energy Society

Approved 6 March 2013

IEEE-SA Standards Board

Abstract: Engineering design procedures for the electrical protection of communication facilities serving electric supply locations through the use of isolation transformers are presented in this standard. These isolation transformers are hard-wired (i.e., have no plug-in units and are not modular).
Keywords: electric supply locations, IEEE 487.5™, isolation, power stations, protection, transformers, wire-line communications

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

PDF: ISBN 978-0-7381-8380-0 STD98209
Print: ISBN 978-0-7381-8381-7 STDPD98209

Notice and Disclaimer of Liability Concerning the Use of IEEE Documents: IEEE Standards documents are developed within the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (IEEE-SA) Standards Board. IEEE develops its standards through a consensus development process, approved by the American National Standards Institute, which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute and serve without compensation. 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.

Use of an IEEE Standard is wholly voluntary. IEEE disclaims liability for any personal injury, property or other damage, of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, or reliance upon any IEEE Standard document.

IEEE does not warrant or represent the accuracy or content of the material contained in its standards, and expressly disclaims any express or implied warranty, including any implied warranty of merchantability or fitness for a specific purpose, or that the use of the material contained in its standards is free from patent infringement. IEEE Standards documents are supplied "**AS IS**."

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. Every IEEE standard is subjected to review at least every ten years. When a document is more than ten 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 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.

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 the official position of IEEE or any of its committees and shall not be considered to be, nor 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 to ensure 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. Any person who would like to participate in evaluating comments or revisions to an IEEE standard is welcome to join the relevant IEEE working group at http://standards.ieee.org/develop/wg/.

Comments on standards should be submitted to the following address:

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

Photocopies: Authorization to photocopy portions of any individual standard for internal or personal use is granted by The Institute of Electrical and Electronics Engineers, Inc., provided that the appropriate fee is paid to Copyright Clearance Center. To arrange for payment of licensing fee, please contact Copyright Clearance Center, Customer Service, 222 Rosewood Drive, Danvers, MA 01923 USA; +1 978 750 8400. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

Notice to users

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

This document is copyrighted by the IEEE. It is made available for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of engineering practices and methods. By making this document available for use and adoption by public authorities and private users, the IEEE does not waive any rights in copyright to this document.

Updating of IEEE 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. 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://standards.ieee.org/index.html or contact the IEEE at the address listed previously. For more information about the IEEE Standards Association or the IEEE standards development process, visit IEEE-SA Website at http://standards.ieee.org/index.html.

Errata

Errata, if any, for this and all other standards can be accessed 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 standard was completed, the Wire-Line Working Group had the following membership:

Percy Pool, *Co-Chair*
Larry Young, *Co-Chair and Secretary*

Ben Bloom
Steve Blume
Joe Boyles
Timothy Conser
Bhimesh Dahal
Jean de Seve
Ernest Duckworth
John Fuller
Ernest Gallo
Dave Hartmann
Dan Jendek
Richard Knight
Randall Mears
Mark Tirio
Thomas Vo
John Wruble

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

William Ackerman
Roger Avery
David Bassett
Ron Baysden
Steven Bezner
Steven Blume
Claude Brisson
Gustavo Brunello
William Byrd
Timothy Conser
Brian Cramer
Ray Davis
Ernest Duckworth
Frank Gerleve
Randall Groves
Yuri Khersonsky
Richard Knight
Joseph L. Koepfinger
Jim Kulchisky
Marc Lacroix
Lawrenc Long
Greg Luri
Michael Maytum
William Mc[illegible]y
Joseph M[illegible]rs
Daleep M[illegible]la
Jer[illegible]urphy
Ha[illegible]erhood
[illegible]ichael S. Newman
Ch[illegible]les Ngethe
Gary Nissen
Lorraine Padden
Donald Parker
Percy Pool
Jesse Rorabaugh
Sergio Santos
Bartien Sayogo
Gil Shultz
Mark Simon
David Singleton
James Smith
Gary Stoedter
William Taylor
Eric Udren
John Vergis
Kenneth White
James Wilson
Larry Young

When the IEEE-SA Standards Board approved this standard on 6 March 2013, it had the following membership:

John Kulick, *Chair*
David J. Law, *Vice Chair*
Richard H. Hulett, *Past Chair*
Konstantinos Karachalios, *Secretary*

Masayuki Ariyoshi
Peter Balma
Farooq Bari
Ted Burse
Wael William Diab
Stephen Dukes
Jean-Philippe Faure
Alexander Gelman
Mark Halpin
Gary Hoffman
Paul Houzé
Jim Hughes
Michael Janezic
Joseph L. Koepfinger*
Oleg Logvinov
Ron Petersen
Gary Robinson
Jon Walter Rosdahl
Adrian Stephens
Peter Sutherland
Yatin Trivedi
Phil Winston
Yu Yuan

*Member Emeritus

Also included are the following nonvoting IEEE-SA Standards Board liaisons:

Richard DeBlasio, *DOE Representative*
Michael Janezic, *NIST Representative*

Michelle Turner
IEEE Standards Program Manager, Document Development

Erin Spiewak
IEEE Standards Program Manager, Technical Program Development

Introduction

This introduction is not part of IEEE Std 487.5-2013, IEEE Standard for the Electrical Protection of Communication Facilities Serving Electric Supply Locations Through the Use of Isolation Transformers.

Wire-line communication facilities serving electric supply locations often require special high-voltage protection against the effects of fault-produced ground potential rise or induced voltages, or both. Some of the telecommunication services are used for control and protective relaying purposes and may be called upon to perform critical operations at times of power system faults. Even when critical services are not involved, special high-voltage protection may be required for both personnel safety and plant protection at times of power system faults.

Effective protection of any wire-line telecommunication circuit requires coordinated protection of all circuits provided over the same telecommunication cable.

This standard presents workable methods for the electrical protection of wire-line communication circuits serving electric supply locations through the use of isolation transformers.

This project is part of a reorganization of IEEE Std 487 in which the main document is broken down into a family of related documents (i.e., dot-series) segregated on the basis of technology.

— IEEE Std 487™

— IEEE Std 487.1™ [Metallic Wire-Line]

— IEEE Std 487.2™ [Optical Fiber Facilities]

— IEEE Std 487.3™ [Hybrid Facilities]

— IEEE Std 487.4™ [Neutralizing Transformers]

— IEEE Std 487.5™ [Isolation Transformers]

Isolation transformers are considered to be a mature technology. Isolation transformers were used extensively and although there are many still in use today, they are usually no longer provided for new installations. For newer technologies refer to IEEE Std 487.1, IEEE Std 487.2, and IEEE Std 487.3.

This standard has been prepared by the Wire-Line Subcommittee of the Power System Communications Committee of the IEEE Power and Energy Society. This standard represents the consensus of both power and communications engineers.

Contents

IEEE Standard for the Electrical Protection of Communication Facilities Serving Electric Supply Locations Through the Use of Isolation Transformers

1. Overview

1.1 Background

Wire-line telecommunication facilities serving electric supply locations often require special high-voltage protection against the effects of fault-produced ground potential rise (GPR) or induced voltages, or both. Some of the telecommunication services are used for control and protective relaying purposes and may be called upon to perform critical operations at times of power system faults. This requirement presents a major challenge in the design and protection of the telecommunication system because power system faults can result in the introduction of interfering voltages and currents into the telecommunication circuit at the very time when the circuit is most urgently required to perform its function. Even when critical services are not involved, special high-voltage protection may be required for both personnel safety and plant protection at times of power system faults. Effective protection of any wire-line telecommunication circuit requires coordinated protection on all circuits provided over the same telecommunication cable.

The isolation transformers covered in this standard are hard-wired (i.e., have no plug-in units) and are not modular.

1.2 Scope

This standard presents engineering design procedures for the electrical protection of communication facilities serving electric supply locations through the use of isolation transformers. Other telecommunication alternatives such as radio and microwave systems are excluded from this document.

1.3 Purpose

This standard presents workable methods that can be used with greater reliability to improve the electrical protection of communication facilities serving electric supply locations through the use of isolation transformers.

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

IEEE Std 367™, IEEE Recommended Practice for Determining the Electric Power Station Ground Potential Rise and Induced Voltage from a Power Fault.[1, 2]

IEEE Std 487™, IEEE Recommended Practice for the Protection of Wire-Line Communication Facilities Serving Electric Supply Locations.

3. Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this document, the following terms and definitions apply. The *IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause.[3]

electric power station: A substation or generating station.

electric supply locations: Any building, separate space, or site in which electric supply equipment is located that may be subjected to the effects of ground potential rise (GPR) from power system fault currents. This definition includes generation, transformation, conversion, switching, and delivery facilities.

ground potential rise (GPR): The maximum electrical potential that a substation grounding grid may attain relative to a distant grounding point assumed to be at the potential of remote earth. This voltage, GPR, is equal to the maximum grid current times the grid resistance.

NOTE—Under normal conditions, the grounded electrical equipment operates at near zero ground potential. That is, the potential of a grounded neutral conductor is nearly identical to the potential of remote earth. During a ground fault the portion of fault current that is conducted by a substation grounding grid into the earth causes the rise of the grid potential with respect to remote earth.[4]

[1] The IEEE standards or products referred to in this clause are trademarks of The Institute of Electrical and Electronics Engineers, Inc.
[2] IEEE publications are available from The Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, NJ 08854.
[3] *IEEE Standards Dictionary Online* subscription is available at:
http://www.ieee.org/portal/innovate/products/standard/standards_dictionary.html.
[4] Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this standard.