IEEE Guide for the Application of Neutral Grounding in Electrical Utility Systems, Part V—Transmission Systems and Subtransmission Systems

IEEE Power & Energy Society

Sponsored by the
Surge Protective Devices Committee

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Abstract: Basic factors and general considerations in selecting the class and means of neutral grounding for a particular ac transmission or subtransmission system are covered. An apparatus to be used to achieve the desired grounding is suggested, and methods for specifying the grounding devices are given. Transformer tertiary systems, equipment-neutral grounding, and the effects of series compensation on grounding are discussed.
Keywords: electrical utility systems, equipment neutral grounding, grounding, neutral grounding, series compensation, subtransmission systems, transformer tertiary systems, transmission systems

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Introduction

This introduction is not part of IEEE Std C62.92.5-2009, IEEE Guide for the Application of Neutral Grounding in Electrical Utility Systems, Part V—Transmission Systems and Subtransmission Systems.

This guide is a part of a series of standards on neutral grounding in electrical utility systems. When the series was first approved and published, it replaced IEEE Std 143™-1954, IEEE Guide for Ground-Fault Neutralizers, Grounding of Synchronous Generator Systems, and Neutral Grounding of Transmission Systems. In this series of documents, individual considerations and practices have been given to the grounding of synchronous generator systems, generator-station auxiliary systems, and distribution systems. IEEE Std 143-1954 is a revision of AIEE No. 954, October 1954, which was a compilation of the following three AIEE Transaction papers:

— AIEE Committee Guide Report, "Application of Ground-Fault Neutralizers," *AIEE Transactions (Power Apparatus and Systems)*, vol. 72, pt. III, pp. 183–190, April 1953.

— AIEE Committee Report, "Application Guide for the Grounding of Synchronous Generator Systems," *AIEE Transactions (Power Apparatus and Systems)*, vol. 72, pt. III, pp. 517–530, June 1953.

— AIEE Committee Report, "Application Guide on Methods of Neutral Grounding of Transmission Systems," *AIEE Transactions (Power Apparatus and Systems)*, vol. 72, pt. III, pp. 663–668, August, 1953.

The contents of Parts I–V of the revision of IEEE Std 143-1954 are based on the foregoing documents but are amplified and updated with new material from the IEEE tutorial course "Surge Protection in Power Systems" (79EH0144-6-PWR) and other sources.

In Part I through Part V of this series, emphasis is on power system grounding practices as contrasted with the grounding, for example, of industrial systems, which is covered in other guides and standards. These guides and standards should be referenced, when appropriate, to gain a full picture of other grounding practices.

It is impossible to give recognition to all those who have contributed to the technology and practices of grounding of power systems, since work involving the preparation of this guide has been in progress for more than 30 years. However, the assistance of members, past and present, of the Neutral Grounding Devices Subcommittee of the Surge-Protective Devices Committee, and other similar groups with comparable purposes, should be acknowledged.

Notice to users

Disclaimer

This guide is specifically written for electrical utility systems and does not recognize the neutral grounding requirements for dispersed storage and generation. These requirements must recognize the restrictions imposed by the specific network to which the dispersed storage or generation is connected. Neutral grounding of dispersed storage and generation needs to be coordinated with the electrical utility system.

This guide is a revision of IEEE Std C62.92.5-1992. The changes include addressing all comments received in the most recent reaffirmation of this guide.

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IEEE Guide for the Application of Neutral Grounding in Electrical Utility Systems, Part V—Transmission Systems and Subtransmission Systems

1. Overview

1.1 Scope

The scope of this document is to give the basic factors and general considerations in selecting the class and means of neutral grounding for a particular ac transmission or subtransmission system, and the suggested method and apparatus to be used to achieve the desired grounding. Definitions of grounding terms used in this part of the guide can be found in IEEE Std C62.92.1™-2000.[1]

1.2 Purpose

The purpose of this document is to provide the user with insight on the basic factors and general considerations in selecting the class and means of neutral grounding for a particular ac transmission or subtransmission system. An apparatus to achieve the desired grounding is suggested, and methods for specifying the grounding devices are given.

[1] Information on references can be found in Clause 2.

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 32™-1972 (Reaff 1997), IEEE Standard Requirements, Terminology, and Test Procedures for Neutral Grounding Devices.[2, 3]

IEEE Std 1313.1™-1996 (Reaff 2002), IEEE Standard for Insulation Coordination—Definitions, Principles, and Rules.

IEEE Std C62.11™-2005, IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits.

IEEE Std C62.22™-2009, IEEE Guide for the Application of Metal-Oxide Surge Arresters for Alternating-Current Systems.

IEEE Std C62.92.1™-2000 (Reaff 2005), IEEE Guide for the Application of Neutral Grounding in Electrical Utility Systems, Part I—Introduction.

3. General considerations

AC transmission and subtransmission systems are generally qualified as those with the following common attributes as compared to generating systems, distribution systems, or auxiliary systems:

a) With some exceptions, transmission and subtransmission systems take energy from or supply energy to other types of systems (i.e., *from* generating systems and *to* distribution systems) rather than supplying this energy at the ultimate utilization point.

b) Transmission and subtransmission systems are three-phase systems.

c) Energy is not supplied directly from generator terminals into these systems; that is, there is an interposing transformer between the generator and the system.

It is sometimes difficult to distinguish between transmission and subtransmission systems. The voltage range in transmission systems is usually taken to be 69 kV to 800 kV or higher, and in subtransmission systems, 115 kV to 34.5 kV or lower. That is, the higher voltages are associated with the term “transmission” and the lower voltages with “subtransmission.”

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