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IEEE Guide for Safety in AC Substation Grounding

Sponsor

Substations Committee
of the
IEEE Power Engineering Society

Approved 30 January 2000

IEEE-SA Standards Board

Abstract: Outdoor ac substations, either conventional or gas-insulated, are covered in this guide. Distribution, transmission, and generating plant substations are also included. With proper caution, the methods described herein are also applicable to indoor portions of such substations, or to substations that are wholly indoors. No attempt is made to cover the grounding problems peculiar to dc substations. A quantitative analysis of the effects of lightning surges is also beyond the scope of this guide.
Keywords: ground grids, grounding, substation design, substation grounding

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Introduction

(This introduction is not part of IEEE Std 80-2000, IEEE Guide for Safety in AC Substation Grounding.)

This fourth edition represents the second major revision of this guide since its first issue in 1961. Major modifications include the further extension of the equations for calculating touch and step voltages to include L-shaped and T-shaped grids; the introduction of curves to help determine current division; modifications to the derating factor curves for surface material; changes in the criteria for selection of conductors and connections; additional information on resistivity measurement interpretation; and the discussion of multilayer soils. Other changes and additions were made in the areas of gas-insulated substations, the equations for the calculation of grid resistance, and the annexes. The fourth edition continues to build on the foundations laid by three earlier working groups: AIEE Working Group 56.1 and IEEE Working Groups 69.1 and 78.1.

The work of preparing this standard was done by Working Group D7 of the Distribution Substations Subcommittee and was sponsored by the Substation Committee of the IEEE Power Engineering Society. At the time this guide was completed, the Substation Grounding Safety Working Group, D7, had the following membership:

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This fourth edition of IEEE Std 80 is dedicated to the memory of J. G. Sverak, who, through his technical knowledge and expertise, developed the touch and step voltage equations and the grid resistance equations used in the 1986 edition of this guide. His leadership, humor, and perseverance as Chair of Working Group 78.1 led to the expansion of substation grounding knowledge in IEEE Std 80-1986.

The following members of the balloting committee voted on this standard:

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IEEE Guide for Safety in AC Substation Grounding

1. Overview

1.1 Scope

This guide is primarily concerned with outdoor ac substations, either conventional or gas-insulated. Distribution, transmission, and generating plant substations are included. With proper caution, the methods described herein are also applicable to indoor portions of such substations, or to substations that are wholly indoors.[1]

No attempt is made to cover the grounding problems peculiar to dc substations. A quantitative analysis of the effects of lightning surges is also beyond the scope of this guide.

1.2 Purpose

The intent of this guide is to provide guidance and information pertinent to safe grounding practices in ac substation design.

The specific purposes of this guide are to

a) Establish, as a basis for design, the safe limits of potential differences that can exist in a substation under fault conditions between points that can be contacted by the human body.
b) Review substation grounding practices with special reference to safety, and develop criteria for a safe design.
c) Provide a procedure for the design of practical grounding systems, based on these criteria.
d) Develop analytical methods as an aid in the understanding and solution of typical gradient problems.

[1]Obviously, the same ground gradient problems that exist in a substation yard should not be present within a building. This will be true provided the floor surface either assures an effective insulation from earth potentials, or else is effectively equivalent to a conductive plate or close mesh grid that is always at substation ground potential, including the building structure and fixtures.

Therefore, even in a wholly indoor substation it may be essential to consider some of the possible hazards from perimeter gradients (at building entrances) and from transferred potentials described in Clause 8. Furthermore, in the case of indoor gas-insulated facilities, the effect of circulating enclosure currents may be of concern, as discussed in Clause 10.