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IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

Sponsor
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Foreword

(This Foreword is not a part of IEEE Std 81-1983, IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.)

In order to increase its practical usefulness, this guide has been divided into two parts. Part I, *Normal Measurements*, covers the majority of field measurements which do not require special high-precision equipment and measuring techniques, and which do not encounter unusual difficulties such as may be found with extensive grounding systems, abnormally high stray ac or de currents, etc. Part I has been extensively revised and updated. Part II, *Special Measurements*, is to be completed in the future. This part is intended to describe the methods of measurements applicable when unusual difficulties make normal measurements either impractical or inaccurate. Very large power station ground grids and counterpoises of transmission lines are examples of such grounding systems.

This guide was prepared by the Earth Resistivity, Ground Impedance, and Earth Surface Potential ,Measurement Working Group of the RLC Subcommittee, Power System Instrumentation and Measurements Committee. The working group's members at the time the guide was prepared were:

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IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surfact Potentials of a Ground System

Part I Normal Measurements

1. Purpose

1.1

It is the purpose of this guide to describe and discuss the present state of the technique of measuring ground resistance and impedance, earth resistivity, potential gradients from currents in the earth, and the prediction of the magnitudes of ground resistance and potential gradients from scale model tests. Factors influencing the choice of instruments and the techniques for various types of measurements are covered. These include the purpose of the measurement, the accuracy required, the type of instruments available, possible sources of error, and the nature of the ground or grounding system under test.

1.2

The guide is intended to assist the engineer or technician in obtaining and interpreting accurate, reliable data. It describes test procedures which promote the safety of personnel and property, and prevent interference with the operation of neighboring facilities.

2. Scope

2.1

The testing methods covered in this guide include:

1) The measurement of the resistance and impedance to earth of electrodes varying from small rods and plates to large grounding systems of stations.
2) Ground. potential surveys, including the measurement of step and touch voltages, and potential contour surveys.
3) Scale-model tests for laboratory determination of the ground resistance and potential gradients for an idealized design.
4) The measurement of earth resistivity.

2.2

The methods covered herein are limited to those using direct current, periodically reversed direct current, alternating sinusoidal current and impulse currents (for measuring transient impedances). This guide does not propose to cover all possible test signals and test methods.

2.3

Extreme precision is not always possible because of the many variables encountered; therefore, the measurements should be carefully made by the most suitable method available, with a thorough understanding of the possible sources of error.

3. Objectives of Tests

3.1

Measurements of ground resistance or impedance and potential gradients on the surface of the earth due to ground currents are necessary to:

1) Verify the adequacy of a new grounding system
2) Detect changes in an existing grounding system
3) Determine hazardous step and touch voltages
4) Determine ground potential rise (GPR) in order to design protection for power and communication circuits.

3.2

Scale-model tests are useful in studying or developing new designs for grounding systems which cannot be adequately studied by analytical methods (complex shape or complex soil structure).

3.3

Earth resistivity measurements are useful for:

1) Estimating the ground resistance of a proposed substation or transmission tower
2) Estimating potential gradients including step and touch voltages
3) Computing the inductive coupling between neighboring power and communication circuits