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IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis

Sponsor

Power Systems Engineering Committee
of the
Industrial and Commercial Power Systems Department
of the
IEEE Industry Applications Society

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Abstract: This Recommended Practice is a reference source for engineers involved in industrial and commercial power systems analysis. It contains a thorough analysis of the power system data required, and the techniques most commonly used in computer-aided analysis, in order to perform specific power system studies of the following: short-circuit, load flow, motor-starting, cable ampacity, stability, harmonic analysis, switching transient, reliability, ground mat, protective coordination, dc auxiliary power system, and power system modeling.
Keywords: cable ampacity, dc power system studies, ground mat studies, harmonic analysis, load flow studies, motor-starting studies, power system analysis, power system modeling, power system studies, protective coordination studies, reliability studies, short-circuit studies, stability studies, switching transient studies.

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Introduction

(This introduction is not a part of IEEE Std 399-1997, IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis.)

This Recommended Practice, commonly known as the “Brown Book,” is intended as a practical, general treatise on power system analysis theory and as an engineer’s reference source on the techniques that are most commonly applied to the computer-aided analysis of electric power systems in industrial plants and commercial buildings. The Brown Book is a useful supplement to several other power system analysis texts that appear in the references and bibliography subclauses of the various chapters of this book. The Brown Book is both complementary and supplementary to the rest of the Color Book series.

One new and important chapter has been added: Chapter 16, entitled “DC auxiliary power system analysis.” All the other chapters in this new edition have been revised and updated—in some cases quite substantially—to reflect current technology.

To many members of the working group who wrote and developed this Recommended Practice, the Brown Book has become a true labor of love. The dedication and support of each individual member is clearly evident in every chapter of the Brown Book. These individuals deserve our many thanks for their excellent contributions.

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IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis

Chapter 1
Overview

1.1 Scope and general information

This Recommended Practice, commonly known as the IEEE Brown Book, is published by the Institute of Electrical and Electronics Engineers, Inc. (IEEE) as a reference source to give plant engineers a better understanding of the purpose for and techniques involved in power system studies. The IEEE Brown Book can also be a helpful reference source for system and data acquisition for engineering consultants performing necessary studies prior to designing a new system or expanding an existing power system. This Recommended Practice will help ensure high standards of power system reliability and maximize the utilization of capital investment.

The IEEE Brown Book emphasizes up-to-date techniques in system studies that are most applicable to industrial and commercial power systems. It complements the other IEEE Color Books, and is intended to be used in conjunction with, not as a replacement for, the many excellent texts available in this field.

The IEEE Brown Book was prepared on a voluntary basis by engineers and designers functioning as a Working Group within the IEEE, under the Industrial and Commercial Power Systems Department of the Industry Applications Society.

1.2 History of power system studies

The planning, design, and operation of a power system requires continual and comprehensive analyses to evaluate current system performance and to establish the effectiveness of alternative plans for system expansion.

The computational work to determine power flows and voltage levels resulting from a single operating condition for even a small network is all but insurmountable if performed by manual methods. The need for computational aids led to the design of a special purpose analog computer (ac network analyzer) as early as 1929. It provided the ability to determine flows and voltages during normal and emergency conditions and to study the transient behavior of the system resulting from fault conditions and switching operations.

The earliest application of digital computers to power system problems dates back to the late 1940s. Most of the early applications were limited in scope because of the small capacity of the punched card calculators in use during that period. Large-scale digital computers became