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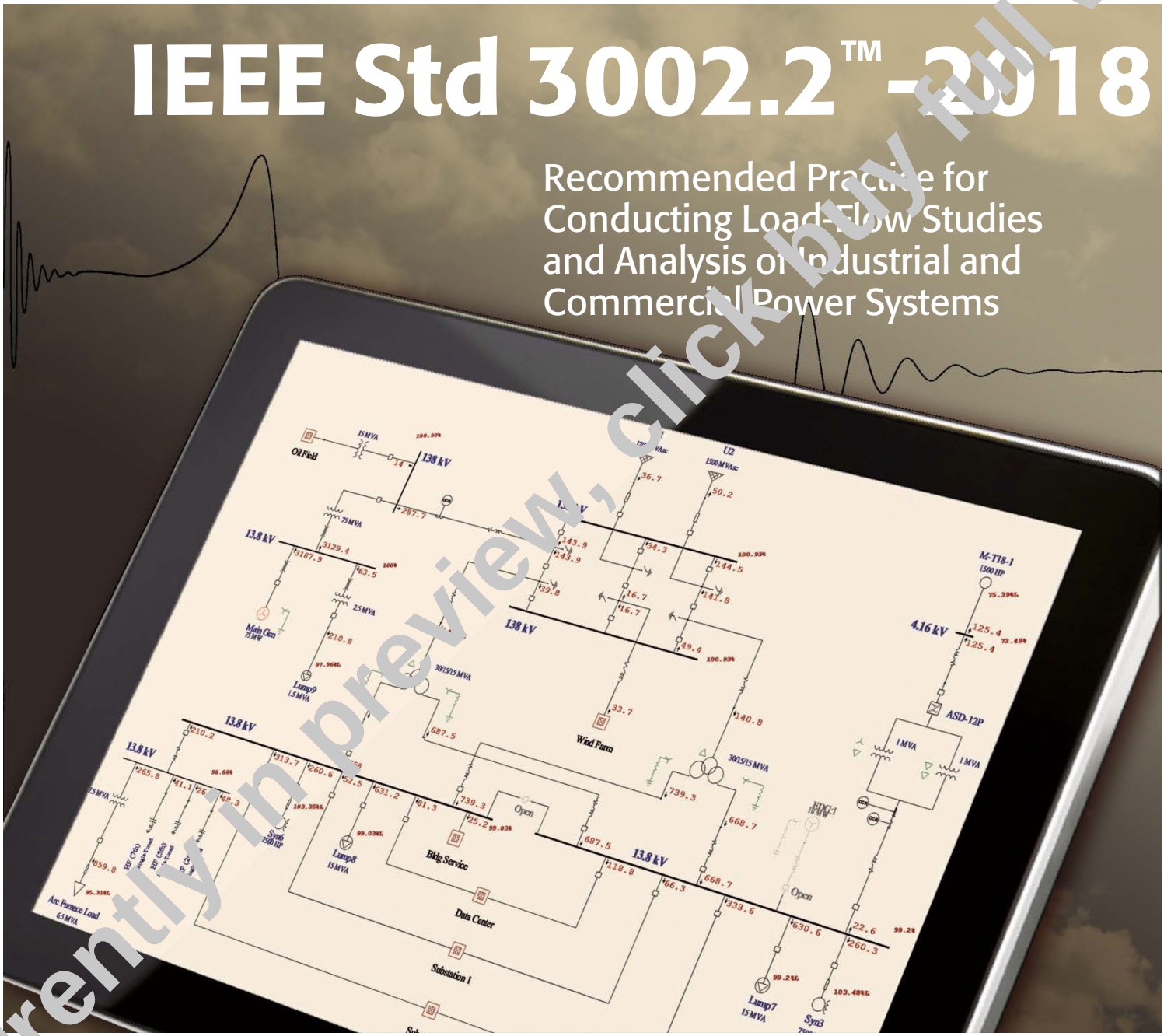
IEEE Std 3002.2™-2018

Recommended Practice for Conducting Load-Flow Studies and Analysis of Industrial and Commercial Power Systems



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IEEE Recommended Practice for Conducting Load-Flow Studies and Analysis of Industrial and Commercial Power Systems

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Abstract: Activities related to load flow analysis, including design considerations for new systems, analytical studies for existing systems, as well as operational and model validation considerations for industrial and commercial power systems are addressed. Load flow analysis includes steady-state power flow and voltage analysis along with considerations for optimal power flow calculations. The use of computer-aided analysis software, with a list of desirable capabilities recommended to conduct a modern load-flow study, is emphasized. Examples of system data requirements and result analysis techniques are presented.

Keywords: cable ampacity, compensation, convergence, demand factor, electrical losses, Gauss-Seidel, generation, IEEE 3002.2, impedance, industrial loads, industrial power system, load flow analysis, load-flow studies, Newton-Raphson, overload, over voltage, power demand, power factor correction, power flow, system validation, under voltage, voltage drop, voltage profile, voltage rise

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Introduction

This introduction is not part of IEEE Std 3002.2-2018, IEEE Recommended Practice for Conducting Load-Flow Studies and Analysis of Industrial and Commercial Power Systems.

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This recommended practice was developed by the Technical Books Coordinating Committee of the Industrial and Commercial Power Systems Department of the Industry Applications Society, as part of a project to repackage the popular IEEE Color Books®. The goal of this project is to speed up the revision process, eliminate duplicate material, and facilitate use of modern publishing and distribution technologies.

When this project is completed, the technical material included in the 13 IEEE Color Books will be included in a series of new standards—the most significant of which will be a new standard, IEEE Std 3000™, IEEE Recommended Practice for the Engineering of Industrial and Commercial Power Systems. The new standard will cover the fundamentals of planning, design, analysis, construction, installation, startup, operation, and maintenance of electrical systems in industrial and commercial facilities. Approximately 60 additional dot standards, organized into the following categories, will provide in-depth treatment of many of the topics introduced by IEEE Std 3000™:

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— Power Systems Analysis (3002 series)

— Power Systems Grounding (3003 series)

— Protection and Coordination (3004 series)

— Emergency, Standby Power, and Energy Management Systems (3005 series)

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In many cases, the material in a dot standard comes from a particular chapter of a particular IEEE Color Book. In other cases, material from several IEEE Color Books has been combined into a new dot standard.

IEEE Std 3002.2™

This recommended practice describes how to conduct load-flow studies and analysis of industrial and commercial power systems. It is likely to be of greatest value to the power-oriented engineer with limited experience in this area. It can also be an aid to all engineers responsible for the analysis of the operation of industrial and commercial power systems.

Contents

IEEE Recommended Practice for Conducting Load-Flow Studies and Analysis of Industrial and Commercial Power Systems

1. Overview

1.1 Scope

This recommended practice describes how to conduct load-flow studies and analysis for industrial and commercial power systems. It will be of greatest value to the power-oriented engineer with limited experience in this area. It can also be an aid to all engineers responsible for the electrical design of industrial and commercial power systems.

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 399™-1997, IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis (*IEEE Brown Book*™).[1,2]

3. Introduction

Load flow is also referred to as *power flow*; these terms may be interchangeably used in this standard. This is the name given to a network solution that predicts steady-state currents, voltages, and real and reactive power flows through every branch and bus in the system. Load-flow studies simulate operating conditions that cannot practically be experienced on the actual system because the system has not yet been built, because of the practical constraints of time, or because it would be unwise to expose the actual physical system to conditions that are potentially damaging. The end objective of the load-flow study is not always to arrive at hard, numerical performance parameters. Often the objective is to gain insight into how the system performs over a range of operating conditions. Power flows are an important part of power system operation and planning.

Because the parameters of the elements such as transmission and distribution lines, cables, and transformers are constant, the power system network impedance is for the most part fixed. However, the power flow problem

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