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Recommended Practice for Bus and Switchgear Protection in Industrial and Commercial Power Systems

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IEEE Recommended Practice for Bus and Switchgear Protection in Industrial and Commercial Power Systems

Developed by the

Industrial and Commercial Power Systems Standards Development Committee
of the
IEEE Industry Applications Society

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IEEE SA Standards Board

Abstract: Covered in this recommended practice is the protection of bus and switchgear used in industrial and commercial power systems. Also provided are fault protection and isolation strategies for the substation bus and switchgear, including the bus, circuit breakers, fuses, disconnecting devices, transformers, and the structures on which they are mounted.

Keywords: arc flash, arc flash protection, differential protection, double-ended substation, high impedance bus differential relay, IEEE 3004.11™, percentage differential relay, tie circuit breaker

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Introduction

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When this project is completed, the technical material included in the 13 "color books" will be included in a series of new standards. Approximately 60 "dot" standards, organized into the following categories, will provide in-depth treatment of many of the topics formerly covered in the color books:

— Power Systems Design (3001 series)

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— Power Systems Grounding and Bonding (3003 series)

— Protection and Coordination (3004 series)

— Emergency, Stand-By Power, and Energy Management Systems (3005 series)

— Power Systems Reliability (3006 series)

— Power Systems Maintenance, Operations, and Safety (3007 series)

In many cases, the material in a "dot" standard comes from a particular chapter of a particular color book. In other cases, material from several color books has been combined into a new "dot" standard. The material in this recommended practice replaces Chapter 13 of IEEE Std 242-2001, (*IEEE Buff Book*™).

IEEE Std 3004.11™

This publication provides a recommended practice for the electrical design of commercial and industrial facilities. It is likely to be of greatest value to the power-oriented engineer with limited commercial or industrial plant experience. It can also be an aid to all engineers responsible for the electrical design of commercial and industrial facilities. However, it is not intended as a replacement for the many excellent engineering texts and handbooks commonly in use, nor is it detailed enough to be a design manual. It should be considered a guide and general reference on electrical design for commercial and industrial facilities.

Tables, charts, and other information that have been extracted from codes, standards, and other technical literature are included in this publication. Their inclusion is for illustrative purposes; where technical accuracy is important, the latest version of the referenced document should be consulted to assure use of complete, up-to-date, and accurate information.

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IEEE Recommended Practice for Bus and Switchgear Protection in Industrial and Commercial Power Systems

1. Scope

This recommended practice covers the protection of bus and switchgear used in industrial and commercial power systems. It provides fault protection and isolation strategies for the substation bus and switchgear, including the bus, circuit breakers, fuses, disconnecting devices, transformers, and the structures on which they are mounted.

1.1 General discussion

Switchboards and switchgear are the parts of the power system used to direct the flow of power to various feeders or branches and to isolate apparatus and individual circuits from the power system sources. These parts include the bus bars, circuit breakers, fuses, disconnection devices, current transformers (CTs), voltage transformers (VTs), instrumentation, and the structure on or in which these are mounted. The term bus usually refers to the principal conductive components within an assembly of equipment such as medium-voltage (MV) metal-enclosed switchgear, MV control, low-voltage (LV) switchgear, power switchboards, panelboards, motor control centers (MCCs) and bus duct, a.k.a. busway (see IEEE Std 3001.5™ for information concerning the application of this equipment). Electrically a bus may be defined as any conductor with one or more sources and two or more connected loads with independent switching and protective devices. From the perspective of arc-flash hazard analysis, the line-side bus of a main device is often considered as part of the main equipment bus. To reduce the arc-flash incident energy, protection of line-side conductors must also be considered, even if they are protected by a device on the primary of a transformer.

Several factors have contributed to increasing interest in the improving protection of buses in industrial and commercial power distribution systems. These include:

— Increased short-circuit levels;

— Increased use of in-plant generators and distributed generation increasing the requirement for fast fault clearing, which is needed to maintain generator stability and to allow coordination between generator protection and load-side feeder protection;

— Increased need for reliability;

— Increased use of bus transfer schemes;