

# IEEE Guide for Switchgear—Unit Substation—Requirements

IEEE Power and Energy Society

Sponsored by the  
Switchgear Committee

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3 Park Avenue  
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USA

**IEEE Std C37.121™-2012**  
(Revision of  
IEEE Std C37.121-1989)

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# **IEEE Guide for Switchgear—Unit Substation—Requirements**

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**IEEE Power and Energy Society**

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**IEEE-SA Standards Board**

**Abstract:** The basis for the coordination of equipment in unit substations by assisting in the selection of components is intended as the use of this guide. A variety of designs for unit substations are possible using various combinations of incoming sections, transformer sections, outgoing sections, and transition sections. It is intended that the incoming, outgoing, transformer, and transition sections included in a unit substation meet the basic requirements of applicable industry standards for those sections. This guide covers three-phase unit substations for step-down operation in the range of 112.5 kVA or greater at primary voltages of 601 V through 38 kV.

**Keywords:** control, dead-front switchboard, distribution, fuse, IEEE C37.121™, metal-clad switchgear, metal-enclosed switchgear, metering, mobile unit substation, molded-case circuit breaker, motor control center, power circuit breaker, primary unit substation, radial substation, rectifier-type substation, secondary selective substation, secondary unit substation, spot-network substation, substation, surge protection, switchgear, transformer, transition section, unit substation

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## Introduction

This introduction is not part of IEEE Std C37.121-2012, IEEE Guide for Switchgear—Unit Substation—Requirements.

C37.121-1989 was originally developed by a working group sponsored by the Power Switchgear Assemblies Technical Committee of the Switchgear Section (8SG) of the National Electrical Manufacturers Association (NEMA/SG/5). The document was transferred from NEMA to the IEEE Power and Energy Society Switchgear Committee, Switchgear Assemblies Subcommittee, in January of 2003. IEEE Std C37.121 was reaffirmed by the IEEE Standards Association Standards Board in 2006.

The Switchgear Assemblies Subcommittee Task Force, created to review this document, determined that this document did not meet the intent of a standard as it references applicable IEEE Standards for all requirements that must be met by each component of a Unit Substation. Based on this review, the Task Force recommended that this document be changed from a Standard to a Guide. The recommendation was accepted by the Switchgear Assemblies Subcommittee.

In the revision of this document from a standard to a guide, the document has been revised to reflect needed technical changes and to update the reference documents to the latest revisions. Other significant changes are as follows:

- Subclauses 1.1 and 1.3 of IEEE Std C37.121-1989 have been combined to form the Scope and subclauses 1.2 and 1.4 have been combined to form the Purpose of the new document.
- Clause 2, Normative references, has been changed to remove dates and all informative standard references have been moved to Annex A.
- Clause 3, Definitions, has been arranged in alphabetical order.
- Table 1 has been redrawn and Table 2 through Table 5 have been combined into a new Table 2—Primary unit substation transformers and Table 3—Secondary unit substation transformers.
- Metal-enclosed bus as described in IEEE Std C37.23 has been added to Clause 6—Incoming section, Clause 7—Outgoing section, 11.2—Unusual service conditions, and 11.5.2—Loading guides.
- All of the existing referenced figures in Clause 6, Clause 7, and Clause 10 have been redrawn, and moved into their respective sections. Figures that had previously shown a fused and unfused figure have now been combined to show a figure with a fuse (when used) designation.
- Clause 8, Ratings, has been updated to reflect the latest rating names and definitions.

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P. Sullivan  
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J. Toney

The following members of the individual balloting committee voted on this guide. Balloters may have voted for approval, disapproval, or abstention.

William Ackerman  
Peter Balma  
Paul Barnhart  
Robert Beavers  
George Becker  
Steven Bezner  
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Iulian Profir  
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Reynaldo Ramos  
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James Smith  
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## 1. Overview

### 1.1 Scope

This guide covers three-phase unit substations for step-down operation in the range of 112.5 kVA or greater at primary voltages of 601 V through 38 kV.

This guide does not cover the following installations:

- a) Substations in which the transformer section includes load-tap-changing equipment.
- b) Substations in which the transformer section is described and defined as “network,” “subway,” “vault,” or “underground” in IEEE Std C57.12.24™ [B14] and IEEE Std C57.12.40™ [B18].
- c) Substations in which the transformer section is described and defined as “pad-mounted” in ANSI C57.12.22 and IEEE Std C57.12.27™ [B16].
- d) Gas-insulated substations as described in IEEE Std C37.122™ [B13].
- e) Rectifier-type substations.
- f) Mobile unit substations.
- g) Installations in ships, watercraft, railway rolling stock, aircraft, or automotive vehicles.
- h) Installations for mines.

- i) Installations of railways for generation, transformation, transmission, or distribution of power used exclusively for operation of rolling stock, or for installations used exclusively for signaling and railway communication purposes.
- j) Installations of communication equipment that is under the exclusive control of communication utilities, located outdoors or in building spaces used exclusively for such installations.
- k) Installations under the exclusive control of electric utilities for the purpose of communication, or metering; or for the generation, control, transformation, transmission, and distribution of electric energy located in buildings used exclusively by utilities for such purposes or located outdoors on property owned or leased by the utility or on public highways, streets, roads, etc; or outdoors by established rights on private property.

## 1.2 Purpose

The guide is intended for use as the basis for the coordination of equipment in unit substations by assisting in the selection of components. A variety of designs for unit substations are possible using various combinations of incoming sections, transformer sections, outgoing sections, and transition sections.

It is intended that the incoming, outgoing, transformer, and transition sections included in a unit substation shall meet the basic requirements of applicable industry standards for those sections. In addition, this guide provides suggested requirements when used as part of a unit substation.

## 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.

ANSI C37.51, American National Standard for Switchgear—Metal-Enclosed Low-Voltage AC Power Circuit Breaker Switchgear Assemblies—Conformance Test Procedures.<sup>1</sup>

ANSI C84.1, American National Standard for Electric Power Systems and Equipment—Voltage Ratings (60 Hz).<sup>2</sup>

ANSI/UL 845, Motor Control Centers.<sup>3</sup>

ANSI/UL 891, Dead-Front Switchboards.

IEEE Std C37.010™, IEEE Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.<sup>4, 5</sup>

IEEE Std C37.20.1™, IEEE Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear.

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