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IEEE Guide on Transformers for Application in Distributed Photovoltaic (DPV) Power Generation Systems

IEEE Power and Energy Society

Sponsored by the
Transformers Committee

IEEE
3 Park Avenue
New York, NY 10016-5997
USA

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IEEE Guide on Transformers for Application in Distributed Photovoltaic (DPV) Power Generation Systems

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Transformers Committee
of the
IEEE Power and Energy Society

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Abstract: General and specific recommendations on specification, design, and application of liquid-immersed and dry-type transformers in distributed photovoltaic (DPV) power generation systems for commercial, industrial, and utility systems are provided in this guide.

Keywords: distributed power generation, electrostatic shield, harmonics, IEEE C57.159™, impedance, inverter, photovoltaic, PV, transformer, winding connection diagram

The Institute of Electrical and Electronics Engineers, Inc.
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Introduction

This introduction is not part of IEEE Std C57.159-2016, IEEE Guide on Transformers for Application in Distributed Photovoltaic (DPV) Power Generation Systems.

Transformers addressed in this guide are for the application in distributed photovoltaic (DPV) power generation systems and generally belong to Class I transformers per IEEE Std C57.12.00 and Category I and II transformers per IEEE Std C57.12.00 and IEEE Std C57.12.01. The guide focuses mainly on the inverter transformers of the DPV power generation systems that are connected to the inverters supplying ac voltage and current to the primary (LV) winding of the transformer.

Presently known nominal voltage of these transformers is up to 36 kV and rated power is up to 4000 kVA. Transformers for DPV systems are gradually increasing in their numbers in the field due to the recent increased focus on renewable energy sources. These transformers are primarily used as step-up transformers but can be used as step-down transformers as well. Transformers for DPV systems have a number of specific issues (requirements and constraints) that affect transformer design and application.

This IEEE guide provides information to support specification, design, and application of these transformers by:

— Explaining concerns and differences of DPV system application and providing specific operation and construction techniques to address these concerns and differences.

— Summarizing these considerations for the engineer specifying the transformer.

— Explaining specifics of transformers working with inverters in this application.

— Providing timely state-of-the-art guidance while critical technical details of these power systems are still evolving.

— Increasing awareness of the constraints of this application aiming at increasing reliability of DPV system transformers.

— Having a single document listing all issues related to the application and reference to the relevant existing standards and guides.

— Avoiding pitfalls and failures as has happened in other new distributed power generation systems applications.

— The words “should” and “may” in this document refer to matters that are recommended or permissive but not mandatory.

Describing and addressing the special needs of the DPV power generation systems, the guide will ensure that the transformers for these systems are effective and reliable and will fulfill a need of the solar energy’s growing place in the renewable energy generation systems.

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IEEE Guide on Transformers for Application in Distributed Photovoltaic (DPV) Power Generation Systems

1. Overview

1.1 Scope

This guide provides general and specific recommendations on application of step-up and step-down liquid-immersed and dry-type transformers in distributed photovoltaic (DPV) power generation systems for commercial, industrial, and utility systems.

The guide focuses mainly on the inverter transformers of the DPV power generation systems that are connected to the inverters supplying ac voltage and current to the primary (LV) winding of the transformer. Some specifics attributed to the auxiliary power transformers in these systems are also discussed.

Transformers covered in this guide comply with the relevant requirements defined in the IEEE Std C57.12.00 for liquid-immersed and IEEE Std C57.12.01 for dry-type transformers.[1]

1.2 Purpose

This document supports a harmonized approach to specification, design, and use of the transformers described in the scope of the guide as a component of a DPV power generation system.

[1]Information on references can be found in Clause 2.