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IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Energy Resources with Electric Power Systems and Associated Interfaces

Developed by the

IEEE Standards Coordinating Committee 21
on
Fuel Cells, Photovoltaics, Dispersed Generation, and Energy Storage

IEEE Std 1547.1™-2020

IEEE

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Abstract: The type, production, commissioning, and periodic tests, and evaluations that shall be performed to confirm that the interconnection and interoperation functions of equipment and systems interconnecting distributed energy resources with the electric power system conform to IEEE Std 1547 are specified in this standard.

Keywords: certification, clearing time, codes, commissioning, communications, dc injection, design, diesel generators, dispersed generation, distributed generation, electric distribution systems, electric power systems, energy resources, energy storage, faults, field, flicker, frequency support, fuel cells, generators, grid, grid support, harmonics, IEEE 1547™, IEEE 1547.1™, induction machines, installation, interconnection requirements and specifications, interoperability, inverters, islanding, microturbines, monitoring and control, networks, paralleling, performance, photovoltaic power systems, point of common coupling, power converters, power quality, production tests, protection functions, public utility commissions, reclosing coordination, regulations, ride through, rule-making, standards, storage, synchronous machines, testing, trip setting, utilities, voltage regulation, wind energy systems

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Introduction

This introduction is not part of IEEE Std 1547.1-2020, IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Energy Resources with Electric Power Systems and Associated Interfaces.

IEEE Std 1547.1 is one of a series of standards developed by Standards Coordinating Committee 21 (SCC21) concerning distributed energy resource (DER) interconnection. IEEE Std 1547.1 and the root standard, IEEE Std 1547, were amended in 2014 and 2015 (IEEE Std 1547a™ and IEEE Std 1547.1a™, respectively) in response to a widely expressed need to make changes to subclauses related to voltage regulation and response to *area EPS* abnormal conditions in IEEE Std 1547-2003 and IEEE Std 1547-2005. A new revision of IEEE Std 1547 was published in 2018 to accommodate additional requirements needed for higher levels of DER. The titles of the additional documents in the series are as follows:

- IEEE Std 1547, IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces.
- IEEE P1547.2™, Draft Application Guide for IEEE Std 1547, Interconnecting Distributed Resources with Electric Power Systems [B9].
- IEEE Std 1547.3™, IEEE Guide for Monitoring, Information Exchange, and Control of Distributed Resources Interconnected with Electric Power Systems [B21].
- IEEE P1547.4™, IEEE Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power Systems [B22].
- IEEE Std 1547.6™, IEEE Recommended Practice for Interconnecting Distributed Resources with Electric Power Systems Distribution Secondary Networks [B24].
- IEEE Std 1547.7™, IEEE Guide for Conducting Distribution Impact Studies for Distributed Resource Interconnection [B25].
- IEEE P1547.9™, Draft Guide to Using IEEE Standard 1547 for Interconnection of Energy Storage Distributed Energy Resources with Electric Power Systems [B10].

The root standard, IEEE Std 1547, defines a set of uniform requirements for the interconnection of DER to the distribution segment of the *electric power system* (EPS). The first publication of IEEE Std 1547 was an outgrowth of the changes in the environment for production and delivery of electricity and built on prior IEEE recommended practices and guidelines developed by SCC21.

IEEE Std 1547 includes requirements relevant to the operation of the interconnection. It generally defines limitations and set points for various parameters that must be satisfied prior to the connection of a DER to the EPS, at the instant of connection, and for the separation of such resources from the EPS for abnormal conditions.

IEEE Std 1547.1 provides conformance test and evaluation procedures to establish and verify compliance with the requirements of IEEE Std 1547. When applied, the IEEE 1547.1 test and evaluation procedures provide a means for manufacturers, utilities, or independent *testing agencies* to confirm the suitability of any given DER for interconnection with the EPS. Such certification can lead to the ready acceptance of confirmed equipment as suitable for use in the intended service by the parties concerned. While this standard defines test and evaluation procedures, it does not specify measurement techniques. Suitable measurement techniques can be found in various technical publications including, but not limited to, IEEE Std 120™ [B17].

It is beyond the scope of IEEE Std 1547.1 to specify the design and performance criteria for DER or components. It is left to the parties concerned to determine that the equipment manufacturer's specifications and confirmed performance satisfy the technical needs of the EPS distribution circuit to which the DER is to be connected and the EPS in general. Similarly, this standard does not address the local electrical power system technical needs nor load requirements for the facility or premises where the *point of DER connection* is made.

Contents

IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Energy Resources with Electric Power Systems and Associated Interfaces

1. Overview

1.1 General

This standard provides tests and procedures for verifying conformance of *distributed energy resources* (DERs) to IEEE Std 1547™.[1] It is recognized that a DER can be a single device providing all required functions or an assembly of components, each having limited functions and capabilities. Components having limited functions and capabilities shall be tested for those functions in accordance with this standard. Conformance may be established through a combination of type, production, and *commissioning tests* as well as DER *design evaluations* and DER *installation evaluations*. Additionally, conformance to IEEE Std 1547 may require periodic tests.

This standard also includes Annex A, which describes normative test signals and ramp functions used in conducting some tests. Information on where to find the test results reporting template (a separate document) is provided in Annex B. Additionally, Annex C through Annex J provide informative content that may be helpful in implementing this standard, but that is not required to implement the procedures defined in this standard.

1.2 Scope

This standard specifies the type, production, commissioning, and periodic tests and evaluations that shall be performed to confirm that the interconnection and interoperation functions of equipment and systems interconnecting *distributed energy resources* (DERs) with the *electric power system* (EPS) conform to IEEE Std 1547, as revised, corrected, or amended.

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