IEEE Std 1547™-2018
(Revision of IEEE Std 1547-2003)

IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces

Sponsor

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

Approved 15 February 2018

IEEE-SA Standards Board

Abstract: The technical specifications for, and testing of, the interconnection and interoperability between utility electric power systems (EPSs) and distributed energy resources (DERs) are the focus of this standard. It provides requirements relevant to the performance, operation, testing, safety considerations, and maintenance of the interconnection. It also includes general requirements, response to abnormal conditions, power quality, islanding, and test specifications and requirements for design, production, installation evaluation, commissioning, and periodic tests. The stated requirements are universally needed for interconnection of DER, including synchronous machines, induction machines, or power inverters/converters and will be sufficient for most installations. The criteria and requirements are applicable to all DER technologies interconnected to EPSs at typical primary and/or secondary distribution voltages. Installation of DER on radial primary and secondary distribution systems is the main emphasis of this document, although installation of DERs on primary and secondary network distribution systems is considered. This standard is written considering that the DER is a 60 Hz source.

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™, 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, production tests, quality, power, 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

The Institute of Electrical and Electronics Engineers, Inc.
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PDF: ISBN 978-1-5044-4639-6 STD22967
Print: ISBN 978-1-5044-4640-2 STDPD22967

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Acknowledgements

During the writing of this standard, one of our Working Group members, Keith Harley, passed away. Keith had an enthusiasm and passion for his career and for his family. He made a positive impact on those he worked with and made the travel more interesting and fun with his adventurous personality and stories about travel. Keith had a unique ability to articulate very complex technical issues into language that is clear and meaningful. On several occasions, his leadership contributed to establishing some major milestones in this standard and for other IEEE standards development for North America. We are saddened by his loss. His contributions to the industry have been important and will be long-lasting.

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Introduction

This introduction is not part of IEEE Std 1547™-2018, IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces.

IEEE Std 1547 was the first of a series of standards developed by Standards Coordinating Committee 21 on Fuel Cells, Photovoltaics, Dispersed Generation, and Energy Storage (SCC21) concerning distributed resources interconnection. IEEE Std 1547 was amended in 2014 (IEEE Std 1547a™-2014) in response to a widely expressed need to make changes to subclauses related to voltage regulation, voltage response to Area EPS abnormal conditions, and frequency response to Area EPS abnormal conditions in IEEE Std 1547-2003. The additional documents in that series are as follows:

- IEEE Std 1547.1™ [B17] provides conformance test procedures for equipment interconnecting distributed energy resources (DER) with electric power systems (EPS).[1]
- IEEE Std 1547.2™ [B18] is an application guide for IEEE Std 1547.
- IEEE Std 1547.3™ [B19] provides guidance for monitoring, information exchange, and control of DER interconnected with EPS.
- IEEE Std 1547.4™ [B20] provides guidance for design, operation, and integration of distributed resource island systems with EPS.
- IEEE Std 1547.6™ [B21] is a recommended practice for interconnecting DER with electric distribution secondary networks.
- IEEE Std 1547.7™ [B22] provides guidance for conducting distribution impact studies for DER interconnection.

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 (which included IEEE Std 929™-2000 [B14] and IEEE Std 1001™-1988 [B15]).

Traditionally, utility EPSs were not designed to accommodate active generation and storage at the distribution level. The technologies and operational concepts to effectively integrate DERs into existing EPSs continue to be further developed to realize additional benefits and to avoid negative impacts on system reliability and safety.

There is a critical need to have a single document of consensus standard technical requirements for DER interconnection rather than having to conform to numerous local practices and guidelines. This standard addresses that critical need by providing uniform criteria and requirements relevant to the performance, operation, testing, safety considerations, and maintenance of the interconnection.

The intent of this standard is to define the technical requirements in a manner that can be universally adopted. The universality relates not only to the technical aspects, but also to the adoption of this standard as being pertinent across a number of industries and institutions, e.g., hardware manufacturers, utilities, energy service companies, codes and standards organizations, regulators and legislators, and other interested entities.

This standard focuses on the technical specifications for, and testing of, the interconnection itself, and not on the types of the DER technologies. This standard aims to be technology-neutral, although acknowledges that the technical attributes of DER and the types and characteristics of EPSs do have a bearing on the interconnection requirements. The addition of a DER to an EPS will change the system and its response in some manner. Although this standard establishes criteria and requirements for interconnection, this

[1] The numbers in brackets correspond to the numbers of the bibliography in Annex A.

standard is not a design handbook nor is it an application guideline. This standard provides the minimum functional technical requirements that are universally needed to help assure a technically sound interconnection. Any additional local requirements should not be implemented to the detriment of the functional technical objectives of this standard.

This standard recognizes that distributed energy resources need to be integrated into the Area EPS in coordination with the Area EPS operator. The functions specified in this standard may need to be supplemented in coordination with the Area EPS operator for specific situations.

It is beyond the scope of this standard to address the methods used for performing EPS impact studies, mitigating limitations of the Area EPS, or addressing the business or tariff issues associated with interconnection.

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IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces

1. Overview

1.1 General

This standard provides interconnection and interoperability technical and test specifications and requirements for distributed energy resources (DERs). Additionally, several annexes are included in this standard that provide additional material for informative purposes, but are not required to be used in conjunction with this standard.

1.2 Scope

This standard establishes criteria and requirements for interconnection of distributed energy resources with electric power systems (EPSs) and associated interfaces. The stated technical specifications and requirements are universally needed for interconnection and interoperability of distributed energy resources (DERs)[2] and will be sufficient for most installations.[3] The specified performance requirements apply at the time of interconnection and as long as the DER remains in service.

[2]For example, synchronous machines, induction machines, or static power inverters/converters.
[3]Additional technical requirements may be necessary for higher DER penetration situations.