

OVERVIEW ABOUT INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC) STANDARDS APPLIED TO GRID-CONNECTED PHOTOVOLTAIC INVERTERS

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1. Introduction

The objective of this paper is to provide the current information about the documents that have been published by the International Electrotechnical Commission (IEC) Technical Committee (TC82) on Photovoltaic related to grid-connected PV inverters. In addition, documents that have been approved for publication, or are in the review process will be described too. All of them are related with the design qualification of modules, on-site systems measurements, and procedures for various environmental tests, updated to July 2011.

2. International Photovoltaic Standards

Worldwide, grid-connected photovoltaic (PV) power systems are expanding rapidly (IEA PVPS Annual Report). Besides, numerous large-scale projects are currently being commissioned. And prices of both, PV and balance of system components (BOS), are decreasing.

Nowadays there are various PV standards organizations, such as: ANSI, NIST (National Institute of Standards and Technology), ASTM, IEEE, UL, NIST, IEEE, UL, SEMI, SAC, CENELEC and IEC, but the IEC is the most important international body regarding photovoltaic related standardization.

IEC has considerably increased its activity in standards in the renewable systems area through its Technical Committee 82 (TC82). TC82 is responsible for Photovoltaics and also Systems components and Complete Systems. IEC has also formed a joint working group between TC88 (Wind), TC21 (Batteries) and TC82 (Photovoltaics).

The IEC Technical Committee on Photovoltaics (TC82) has been active in the development of international standards for terrestrial photovoltaics since 1982. Currently, it has six working groups: WG1: Glossary Task: To prepare a glossary. WG2: Modules, non-concentrating Task: To develop international standards for non-concentrating, terrestrial photovoltaic modules--crystalline & thin-film. WG3: Systems Task: To give general instructions for the photovoltaic system design, and maintenance. WG6: Balance-of-system components Task: To develop international standards for balance-of-system components for PV systems. WG7: Concentrator modules Task: To develop international standards for photovoltaic concentrators and receivers. JCW 21/TC 82 Batteries Task: To draw up standard requirements for battery storage systems intended for use in photovoltaic systems. JCWG TC 82/TC 88/TC21/SC21A Task: To prepare guidelines for Decentralized Rural Electrification (DRE) projects which are now being implemented in developing countries.

From them, the working groups related to grid-connected PV systems are the WG1, WG2, WG3 and WG6. Then, in this article the most important topics and standards related to grid-connected PV inverters will be taken into consideration. These are related to the type of harmonic emission, immunity of electromagnetic compatibility, standards of security, isolation and control of network.

However, as it can be seen, until now there are some topics that should be treated in the upcoming rules. The topics might be: evaluation of start-up and shut down losses; power factor, performance outside normal operating conditions, DC current injection, MPPT performance under real conditions, overall performance measure (energy rating). In addition, topics related to Electromagnetic Compatibility (EMC) should be taken into account.

3. IEC Standards related to PV grid-connected inverters

The IEC PV standards related to grid-connected inverters are integrated by the WG6, Balance of Systems.

Until now, the following IEC standards has been published:

IEC 61683: 1999 Ed 2, PV systems –Power conditioners –Procedure for measuring efficiency. This standard describes guidelines for measuring the efficiency of power conditioners used in stand-alone and utility-interactive photovoltaic systems, where the output of the power conditioner is a stable a.c. voltage of constant frequency or a stable d.c. voltage. The efficiency is calculated from a direct measurement of input and output power in the factory. An isolation stand-alone and utility-interactive photovoltaic systems, where the output of the power conditioner is a stable a.c. voltage of constant frequency or a stable d.c. voltage. The efficiency is calculated from a direct measurement of input and output power in the factory. An isolation transformer is included where it is applicable.

IEC 62093: 2005 Ed 1, Balance-of-system components for photovoltaic systems -Design qualification natural environments

This International Standard establishes requirements for the design qualification of balance of- system (BOS) components used in terrestrial photovoltaic (PV) systems. This standard is suitable for operation in indoor, conditioned or unconditioned; or outdoor in general open-air climates as defined in IEC 60721-2-1, protected or unprotected. It is written for dedicated solar components such as batteries, inverters, charge controllers, system diode packages, heat sinks, surge protectors, system junction boxes, maximum power point tracking devices and switch gear, but may be applicable to other BOS system components.

IEC 62109-1 Ed. 1.0 Safety of power converters for use in photovoltaic power systems --Part 1. General requirements.

This part of IEC 62109 applies to the power conversion equipment (PCE) for use in Photovoltaic (PV) systems where a uniform technical level with respect to safety is necessary.

This standard defines the minimum requirements for the design and manufacture of PCE for protection against electric shock, energy, fire, mechanical and other hazards.

This standard provides general requirements applicable to all types of PV PCE. There are additional parts of this standard that provide specific requirements for the different types of power converters, such as Part 2 - inverters. Additional parts may be published as new products and technologies are commercialised.

IEC 62109-2 Ed. 1.0 Safety of power converters for use in photovoltaic power systems --Part 2. Particular requirements for inverters. It covers the particular safety requirements relevant to d.c. to a.c. inverter products as well as products that have or perform inverter functions in addition to other functions, where the inverter is intended for use in photovoltaic power systems. Inverters covered by this standard may be grid-interactive, stand-alone, or multiple mode inverters, may be supplied by single or multiple photovoltaic modules grouped in various array configurations, and may be intended for use in conjunction with batteries or other forms of energy storage. This standard must be used jointly with IEC 62109-1

IEC 62116: 2008 Ed 1. Test procedure of islanding prevention measures for utility-interconnected photovoltaic inverters. It describes a guideline for testing the performance of automatic islanding prevention measures installed in or with single or multi-phase utility interactive PV inverters connected to the utility grid. The test procedure and criteria described are minimum requirements that will allow repeatability. Additional requirements or more stringent criteria may be specified if demonstrable risk can be shown. Inverters and other devices meeting the requirements of this standard are considered non-islanding as defined in IEC 61727.

IEC 62446: 2009. It defines the minimal information and documentation required to be handed over to a customer following the installation of a grid connected PV system. Also describes the minimum commissioning tests, inspection criteria and documentation expected to verify the safe installation and correct operation of the system. Is written for grid connected PV systems only.

In addition, there are new projects that are being managed by that committee.

IEC 62109-3 Ed. 1.0 Safety of power converters for use in photovoltaic power systems --Part 3: Controllers.

IEC 62109-4 Ed. 1.0 Safety of power converters for use in photovoltaic power systems - Part 4: Particular requirements for combiner box

IEC/TS 62738 Ed. 1.0 Design guidelines and recommendations for photovoltaic power plants

IEC 62109-3 Ed. 1.0 Safety of power converters for use in photovoltaic power systems - Part 3: Controllers

4. Acknowledgments

Part of this work was supported by the EVADIFOT Project, Code: ENE2009-14771-C02-01, funded by the Innovation and Science Spanish Ministry and by the NUMANCIA-2 Project Code: S2009/ENE-1477 funded by the Regional Government of Madrid (Spain) and by the DIDECON-FV Project Code: CCG10-UC3M/ENE-5395 funded by the Universidad Carlos III de Madrid.

5. References

1. IEA PVPS, Annual Report 2009
2. IEC official web, www.iec.ch