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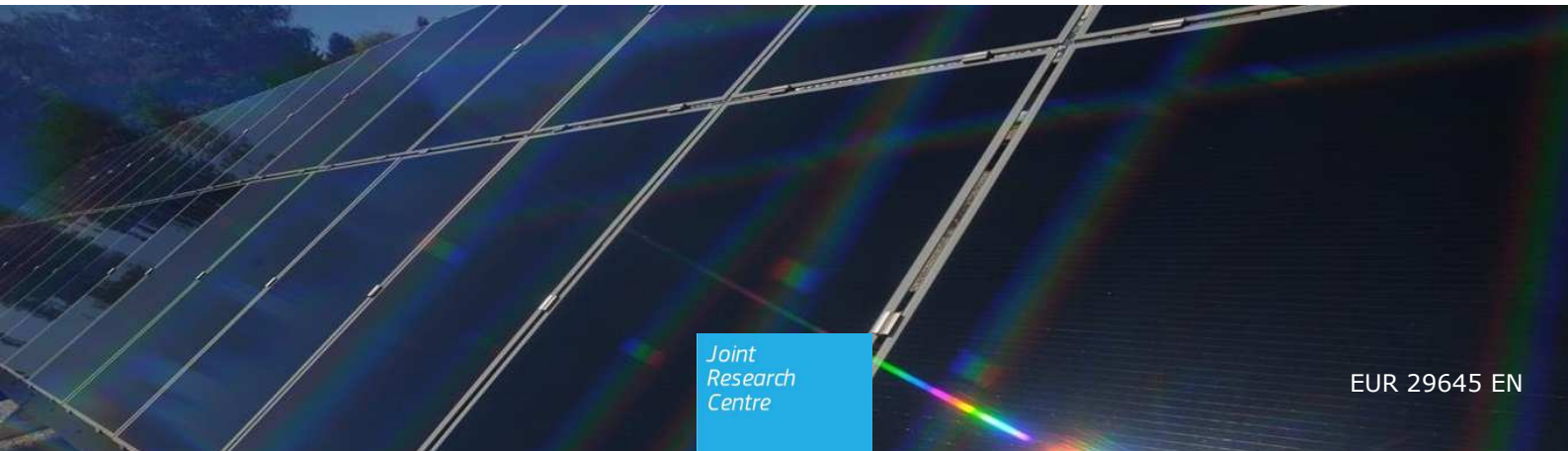
JRC SCIENCE FOR POLICY REPORT

Photovoltaic energy systems: Summary of the JRC's contribution to International and European standards in 2018

SAMPLE T., MUELLEJANS H., HULD T., SALIS E., BARDIZZA G., KENNY R., DUNLOP E., TAYLOR N.

2018



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Contact information
Name: Tony Sample
Address: European Commission, Joint Research Centre, Via Enrico Fermi 2749, I-21027 Ispra (VA) Italy
Email: tony.sample@ec.europa.eu

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Executive summary

Photovoltaics (PV) are expected to make a major contribution to achieving European and global climate change mitigation goals over the coming 35 years. It is the renewable energy technology with the largest scope for cost reduction and efficiency gains, as well as exploiting the largest resource. The rapid technical evolution needs to be matched by standards to ensure product quality, reliability and sustainability, as well as transparent market conditions. The JRC plays a prominent role in both International and European standards committees for photovoltaics. This exploits expertise developed in the European Solar Test Installation (ESTI), a European reference laboratory to validate electrical performance and lifetime of PV devices based on traditional as well as emerging technologies.

Policy context

The European Union has set out plans for a new energy strategy based on a more secure, sustainable and low-carbon economy. It has committed itself to achieve a 32% share of renewables by 2030 ([1]) with the aim of encouraging private investment in infrastructure and low-carbon technologies. The work programmes for European standardisation also target these Energy Union priorities, notably the decarbonisation of the economy and support for green public procurement.

Key conclusions

The continued development of the PV sector as one of the main enablers for decarbonisation and climate change mitigation presents new challenges for the associated standards systems. This relates to innovation in the technology itself, its application and integration, and to sustainability requirements. The JRC has specific expertise to allow it to effectively contribute to achieving these goals.

Main findings

The JRC continues to play a significant role in European and International standardisation activities within the field of Photovoltaic Energy Systems. In particular JRC staff are convenors for working groups in both the relevant International Electrotechnical Commission (IEC) and European Committee for Electrotechnical Standardization (CENELEC) technical committees, and were the project leader of two standards (IEC 61853-3 and IEC 61853-4) which were published by the IEC in 2018. JRC is also the project leader for another 3 standards (IEC 60904-1, IEC 60904-4 and IEC 60904-10) which are progressing through the standardisation process and has made contributions to 24 others (as part of the various project teams).

Related and future JRC work

Photovoltaics are an area of strategic importance for EU policies and initiatives on renewable energy, energy performance of buildings and the circular economy. The JRC work programme for 2019 foresees continued efforts to support the standardisation process in the following specific areas: a) power calibration, b) energy rating, c) reliability and lifetime, d) module electrical safety, e) PV products for buildings and f) energy savings potential for Ecodesign.

The level of commitment it 2019 is expected to be roughly equal to that of 2018, with the support for IEC TC82 WG2 and CENELEC TC82 WG1 being the most significant.

([1]) Council conclusions on "The Governance System of the Energy Union" 14459/15

1 Introduction

1.1 Background

The EU's energy union policy means making energy more secure, affordable and sustainable. A part of this policy framework for energy and climate for 2030 is in place, including a commitment to achieve a 32% share of renewables by 2030 ([2]). Furthermore, the EU's recent reaffirmation of its commitment to achieving a competitive and climate neutral economy by 2050 ([3]) recognises the importance of renewable energy to achieving that aim.

Photovoltaics are expected to make a significant contribution to achieving these goals, being the renewable energy technology with the largest scope for cost reduction and efficiency gains. The sector has been growing rapidly, the worldwide installed capacity increased from around 40 GW in 2010 to more than 400 GW in 2017 with an estimate of over 500 GW in 2018 ([4]). This growth is characterised by rapid technological development, not just scaling up existing systems. In this context, international standards are essential to ensuring market transparency, helping to cut costs and strengthening investor confidence. When correctly designed, they can also play a critical role in accelerating the uptake of innovative solutions ([5]).

The Commission's work programme on standardisation ([6]) acknowledges the role of standardisation in the Energy Union strategy. It specifically notes that "to this end, standardisation has also been identified as an important enabler for market-adoption of low-carbon technologies in the Accelerating Clean Energy Innovation Communication. Specific action should target the interconnection of electricity networks, support diversified gas supply streams and integrate renewable energy into the consumption mix".

The JRC supports this by performing pre-normative R&D on technical areas within its competence and by taking a proactive role on International and European standardisation bodies. Its expertise is based on the work of the European Solar Test Installation (ESTI), which provides a European reference laboratory to validate electrical performance and lifetime of PV devices based on traditional as well as emerging technologies. ESTI also performs pre-normative research to develop and improve traceable, accurate measurement techniques.

In particular, as part of the Commission's liaison with the International Electrotechnical Commission, ESTI staff contributes to International Standards within the Technical Committee 82. Many of the more than 113 publications issued by IEC TC 82 have been either based on original JRC Specifications (such as those on calibration and type approval) or to a larger extent developed from JRC work results. They are in use world-wide and play an essential role for the high quality level PV products maintain, no matter where they are produced or deployed. The International Standards in place allowed the photovoltaic industry a real global reach.

The JRC's contributions to the further development of IEC and CENELEC standards are summarized below in the sections 2 and 3 respectively. Section 4 covers related initiatives likely to impact on future developments. Finally, section 5 summarises priorities for activities in 2019.

([2]) Council conclusions on "The Governance System of the Energy Union" 14459/15

([3]) A Clean Planet for all: a European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy.

([4]) EUR 29463 EN "PV Status Report 2018" Arnulf Jäger-Waldau, ISBN 978-92-79-97466-3 (PDF)

([5]) COM(2016) 358, Standardisation package, European Standards for the 21st Century

([6]) COM(2017) 453 "The annual Union work programme for European standardisation for 2018"

1.2 Relevance to EU Policies

European Union policy on energy shall, under Lisbon Treaty Article 194/1c, "promote energy efficiency and energy saving and the development of new and renewable forms of energy". JRC's activities provide scientific support to the Energy Union policy introduced in 2015, in particular regarding the following aspects;

- The current 2009 RES Directive ([7]) places an obligation on the EU as a whole to reach specific targets by 2020, including 20% renewable energy.
- Buildings resemble the complexity of energy systems. Historically an energy consumer only, they increasingly use renewable resources to provide their own energy (in particular PV and heat-pumps), and to deliver excess electricity to the electricity grid. With Europe's policy of making "Nearly Zero Energy Buildings" a requirement in 3.5 years from now under the Energy Performance of Buildings Directive, PV will have a strongly increasing market. The success of this market will depend also on the availability of building-specific PV modules, regarding their functionality beyond electricity production, like providing roof insulation and water protection, their cost-effective installation within current building technologies and the integration into the overall appearance and style of buildings.
- The 2015 SET-Plan ([8]) communication identifies the need to sustain technological leadership by developing highly performant renewable technologies, as well as recognising the role of standards as "additional enabling conditions".
- The "Clean Energy for all Europeans" package was published in November 2016, comprising a series of measures to achieve the 2030 targets. The revised Renewable Energy Directive was formally adopted by the European Council on 4 December 2016. It sets a new, binding, renewable energy target for the EU for 2030 of at least 32%, including a review clause by 2023 for an upward revision of the EU level target.

The Ecodesign and Energy Labelling legislative framework has the dual purpose of ensuring that more energy-efficient products come to the market (through Ecodesign) while encouraging and empowering consumers to buy the most efficient products based on useful information (through energy labelling). The Ecodesign Working Plan 2016-2019 ([9]) foresees studies on energy savings potentials of PV panels and inverters. In particular, a preparatory study on sustainable product policy instruments for the product group 'solar photovoltaic panels, inverters and systems' was launched in November 2017. The JRC.B5 unit is leading the study under an AA from DG GROW, with a specific contribution regarding standards also from JRC.C.2.

([7]) Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources

([8]) C(2015) 6317 final Towards an Integrated Strategic Energy Technology (SET) Plan: Accelerating the European Energy System Transformation

([9]) COM(2016) 773 COMMUNICATION FROM THE COMMISSION Ecodesign Working Plan 2016-2019

2 IEC TC 82

2.1 IEC Background

The International Electrotechnical Commission (IEC) is the partner organisation of ISO and forms together with the International Telecommunication Union (ITU) the United Nations related, world-wide standardisation process. IEC is entrusted with all standards aspects in the electrotechnical field, and was founded in 1904. Membership is required for all countries which are part of the World Trade Organisation (WTO) as commitment to remove international trade barriers, but open to all other United Nations members.

The Technical Committee (TC) 82 deals with Solar Photovoltaic Energy Systems and was established 1981. Since then it has published more than 113 documents (as of 2018-12-10), which have laid the foundation for the strong increase of trade for PV products.

2018 saw the addition of one new country, Bahrain (participating country) to the list of member states of TC 82. IEC TC 82 currently has 52 member states (41 Participating countries and 11 Observer countries).

Africa: Algeria, Egypt, Kenya, Morocco, Nigeria, South Africa

Americas: Brazil, Canada, Chile, Mexico, United States

Asia/Pacific: Australia, China, India, Indonesia, Japan, South Korea, Malaysia, New Zealand, Singapore, Thailand

EU28: Austria, Belgium, Bulgaria, Czechia, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Romania, Slovenia, Spain, Sweden, United Kingdom (20, all but CY, EE, HR, LV, LT, LU, MT, SK)

Europe: Norway, Russia, Serbia, Switzerland, Turkey, Ukraine

Middle East: Bahrain, Iran, Israel, Oman, Saudi Arabia

TC 82 maintains formally a Type A Liaison with the European Commission, DG GROW. This is the highest possible level of Liaison, and puts the European Commission (and the JRC) on the same level as National Committees, however without voting rights.

TC 82 also has Type A Liaison with The International Energy Agency (IEA) and the International PV Quality Assurance Task Force (PVQAT) established in 2017.

Other technical committees under the Liaison with DG GROW (and thus JRC) are:

- TC 23 Electrical accessories
- SC 45B Radiation protection instrumentation
- TC 59 Performance of household and similar electrical appliances
- TC 100 Audio, video and multimedia systems and equipment
- TC 105 Fuel cell technologies
- ISO/IEC JTC 1 Information technology
- ISO/IEC JTC 1/SC 25 Interconnection of information technology equipment
- ISO/IEC JTC 1/SC 25/WG 3 Customer Premises Cabling

2.2 Technical Committee 82 Solar Photovoltaic Energy Systems

The Secretariat is traditionally provided by the US National Committee, and it makes a secretary and two assistant secretaries available to assist in all Standards processes. A Technical Officer from the IEC Central Office in Geneva assists in all formal aspects (aided by an administrative assistant and editor), as well as serving as the IEC direct contact for the Chairman and the Secretariat.

The current list of TC 82 Officers and IEC Central Office contacts are listed in table 1 and 2 respectively.

Table 1 TC 82 Officers

Chair	Mr Michio Kondo (JP) Term of office : 2022-08
Vice-Chair	Mr Zhengxin Liu (CN) Term of office : 2020-06
Secretary	Mr George Kelly (US)
Assistant Secretary	Mr Howard O Barikmo (US)
Assistant Secretary	Mr Liang Ji (US)

Table 2 IEC Central Office Contacts

Technical Officer	Mr Anson Chiah Mr Charles Jacquemart (retired Sept 2018)
Administrative Assistant	Ms Anouchka Blattler
Editor	Ms Claire Louca

The organisation of TC 82 is arranged into a number of Working Groups, Project Teams and Joint Working Groups, as detailed in table 3 below

Table 3 TC 82 Subcommittee(s) and/or Working Group(s)

Label	**Title**
Working Groups	
WG 1	Glossary
WG 2	Modules, non-concentrating
WG 3	Systems
WG 6	Balance-of-system components
WG 7	Concentrator modules
WG 8	Photovoltaic (PV) cells
Project Teams	
PT 62994-1	Environmental Health and Safety (EH&S) Risk Assessment for the sustainability of PV module manufacturing - Part 1. General principles and definition of terms
PT 63092	Building Integrated Photovoltaics (BIPV)

Joint Working Groups	
JWG 1	Photovoltaic off grid systems, including decentralized rural electrification and hybrid systems
JWG 10	Distributed Energy Resources Interconnection with the Grid Managed by TC 8
JWG 4	Grid code compliance assessment for grid connection of wind and PV power plants Managed by SC 8A
JWG 5	System issues regarding integration of wind and PV generation into bulk electrical grid Managed by SC 8A
JWG 82	TC 21/ TC 82 - Secondary cells and batteries for Renewable Energy Storage Managed by TC 21
JWG 32	Electrical safety of PV system installations Managed by TC 64

A simplified standards development process of a Technical Committee is outlined below

Figure 1. Simplified standards development process

In addition to the development of new standards, technical committees are also responsible for the maintenance of published standards. Each published document has a stability date which lists the time when the technical committee will verify the applicability of the standard. Where appropriate they will then make a revision of the document to take into account progress in the field or, if no revision is necessary, confirm this fact and establish a new stability date. The updating of existing standards through the maintenance cycle requires input from organisations familiar with the existing standards and the current state of the art in the particular field. The ESTI laboratory has a key role in delivering both of these aspects in the case of PV measurement and characterisation. The history of the ESTI laboratory over the last 35 years and its long-term involvement with the development of standards has ensured that

technological developments within the PV industry are reflected within the standards. This is a role also played by other national laboratories around the world; such as

- the National Renewable Energy Laboratory (NREL) USA
- the National Institute of Advanced Industrial Science and Technology (AIST) Japan
- the Physikalisch-Technische Bundesanstalt (PTB) Germany

Table 4 summarises the projects being currently handled by TC 82 (extract of 2018-12-10).

Table 4. IEC TC 82 Projects (shading denotes significant JRC contribution, also see section 2.3)

Project Reference	Title	WG	Forecast Publication Date	Maintenance Cycle
PNW 82-1525	Measurement procedures for materials used in photovoltaic modules – Part 1: Encapsulants – Part 1-1: Polymeric materials used for encapsulants	WG 2	2020-06	
PNW 82-1532	Polymeric materials for photovoltaic (PV) modules – Part 2-1: Safety requirements for polymeric frontsheet and backsheet	WG 2	2019-03	
IEC 60891 ED3	Photovoltaic devices - Procedures for temperature and irradiance corrections to measured I-V characteristics	WG 2	2019-12	Yes
IEC 60904-1 ED3	Photovoltaic devices - Part 1: Measurement of photovoltaic current-voltage characteristics	WG 2	2020-01	Yes
IEC TS 60904-1-2 ED1	Photovoltaic devices - Part 1-2: Measurement of current-voltage characteristics of bifacial photovoltaic (PV) devices	WG 2	2019-03	
IEC 60904-3 ED4	Photovoltaic devices - Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data	WG 2	2018-11	Yes
IEC 60904-4 ED2	Photovoltaic devices - Part 4: Reference solar devices - Procedures for establishing calibration traceability	WG 2	2019-09	Yes
IEC 60904-5/AMD1 ED2	Amendment 1 - Photovoltaic devices - Part 5: Determination of the equivalent cell temperature (ECT) of photovoltaic (PV) devices by the open-circuit voltage method	WG 2	2019-10	Yes
IEC 60904-7 ED4	Photovoltaic devices - Part 7: Computation of the spectral mismatch correction for measurements of photovoltaic devices	WG 2	2019-10	Yes
IEC 60904-8/AMD1 ED3	Amendment 1 - Photovoltaic devices - Part 8: Measurement of spectral responsivity of a photovoltaic (PV) device	WG 2	2019-11	Yes
IEC 60904-9 ED3	Photovoltaic devices - Part 9: Solar simulator performance requirements	WG 2	2020-01	Yes
IEC 60904-9-1 ED1	Photovoltaic devices - Part 9-1: Collimated beam solar simulator performance requirements	WG 7	2020-01	Yes

Project Reference	Title	WG	Forecast Publication Date	Maintenance Cycle
IEC 60904-10 ED3	Photovoltaic devices - Part 10: Methods of linearity measurement	WG 2	2020-01	Yes
IEC 61215-1 ED2	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1: Test requirements	WG 2	2020-01	Yes
IEC 61215-1-1 ED2	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-1: Special requirements for testing of crystalline silicon photovoltaic (PV) modules	WG 2	2020-01	Yes
IEC 61215-1-2 ED2	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-2: Special requirements for testing of thin-film Cadmium Telluride (CdTe) based photovoltaic (PV) modules	WG 2	2020-01	Yes
IEC 61215-1-3 ED2	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-3: Special requirements for testing of thin-film amorphous silicon based photovoltaic (PV) modules	WG 2	2020-01	Yes
IEC 61215-1-4 ED2	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-4: Special requirements for testing of thin-film $Cu(In,GA)(S,Se)_2$ based photovoltaic (PV) modules	WG 2	2020-01	Yes
IEC 61215-2 ED2	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 2: Test procedures	WG 2	2020-01	Yes
IEC 61683 ED2	Photovoltaic systems - Power conditioners - Procedure for measuring efficiency	WG 6	2020-01	Yes
IEC 61701 ED3	Salt mist corrosion testing of photovoltaic (PV) modules	WG 2	2020-02	Yes
IEC 61730-1/AMD1 ED2	Amendment 1 - Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction	WG 2	2020-01	Yes
IEC 61730-2/AMD1 ED2	Amendment 1 - Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing	WG 2	2020-04	Yes
IEC 61853-2/AMD1 ED1	Amendment 1 - Photovoltaic (PV) module performance testing and energy rating - Part 2: Spectral responsivity, incidence angle and module operating temperature measurements	WG 2	2019-12	Yes
IEC 62093 ED2	Power conversion equipment for photovoltaic systems - Design qualification testing	WG 6	2020-01	Yes
IEC 62108 ED3	Concentrator photovoltaic (CPV) modules and assemblies - Design qualification and type approval	WG 7	2020-02	Yes
IEC 62109-1/AMD1 ED1	Amendment 1 - Safety of power converters for use in photovoltaic power systems - Part 1: General requirements	WG 6	2019-12	Yes

Project Reference	Title	WG	Forecast Publication Date	Maintenance Cycle
IEC 62109-2/AMD1 ED1	Amendment 1 - Safety of power converters for use in photovoltaic power systems - Part 2: Particular requirements for inverters	WG 6	2019-12	Yes
IEC 62109-3 ED1	Safety of power converters for use in photovoltaic power systems - Part 3: Particular requirements for electronic devices in combination with photovoltaic elements	WG 6	2020-02	
IEC TS 62257-1 ED4	Recommendations for renewable energy and hybrid systems for rural electrification - Part 1: General introduction to IEC 62257 series and rural electrification	JWG 1	2019-12	Yes
IEC TS 62257-2 ED3	Recommendations for renewable energy and hybrid systems for rural electrification - Part 2: From requirements to a range of electrification systems	JWG 1	2020-05	Yes
IEC TS 62257-3 ED3	Recommendations for renewable energy and hybrid systems for rural electrification - Part 3: Project development and management	JWG 1	2020-05	Yes
IEC TS 62257-4 ED3	Recommendations for renewable energy and hybrid systems for rural electrification - Part 4: System selection and design	JWG 1	2019-11	Yes
IEC TS 62257-5 ED3	Recommendations for renewable energy and hybrid systems for rural electrification - Part 5: Protection against electrical hazards	JWG 1	2019-11	Yes
IEC TS 62257-6 ED3	Recommendations for renewable energy and hybrid systems for rural electrification - Part 6: Acceptance, operation, maintenance and replacement	JWG 1	2019-11	Yes
IEC TS 62257-7-1 ED3	Recommendations for renewable energy and hybrid systems for rural electrification - Part 7-1: Generators - Photovoltaic generators	JWG 1	2019-11	Yes
IEC TS 62257-7-2 ED1	Renewable energy and hybrid systems for rural electrification - Part 7-2: Generators – Wind Turbines	JWG 1	2020-06	
IEC TS 62257-7-4 ED1	Recommendations for renewable energy and hybrid systems for rural electrification - Part 7-4: Generators - Integration of solar with other forms of power generation within hybrid power systems	JWG 1	2019-08	
IEC TS 62257-9-6 ED2	Recommendations for renewable energy and hybrid systems for rural electrification - Part 9-6: Integrated system - Selection of Photovoltaic Individual Electrification Systems (PV-IES)	JWG 1	2019-07	Yes
IEC TS 62257-9-7 ED1	Recommendations for renewable energy and hybrid systems for rural electrification - Part 9-7: Selection of inverters	JWG 1	2019-08	
IEC TS 62257-12-1 ED3	Recommendations for renewable energy and hybrid systems for rural electrification - Part 12-1: Selection of lamps and lighting appliances for	JWG 1	2019-12	Yes

Project Reference	Title	WG	Forecast Publication Date	Maintenance Cycle
	off-grid electricity systems			
IEC TS 62257-13-1 ED1	Recommendations for renewable energy and hybrid systems for rural electrification – Part 13-1: Integrated systems – Quality standards for stand-alone renewable energy products with power ratings less than or equal to 350 W	JWG 1	2019-09	
IEC 62446-2 ED1	Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance - Part 2: Grid connected systems - Maintenance of PV systems	WG 3	2019-08	
IEC 62548 ED2	Photovoltaic (PV) arrays - Design requirements	WG 3	2021-04	Yes
IEC 62759-1 ED2	Photovoltaic (PV) modules - Transportation testing - Part 1: Transportation and shipping of module package units	WG 2	2019-12	Yes
IEC 62787 ED1	Concentrator photovoltaic (CPV) solar cells and cell-on-carrier (COC) assemblies - Reliability qualification	WG 7	2020-01	
IEC 62788-1-4 /AMD1 ED1	Amendment 1 - Measurement procedures for materials used in photovoltaic modules - Part 1-4: Encapsulants - Measurement of optical transmittance and calculation of the solar-weighted photon transmittance, yellowness index, and UV cut-off wavelength	WG 2	2019-11	Yes
IEC 62788-1-6 /AMD1 ED1	Amendment 1 - Measurement procedures for materials used in photovoltaic modules - Part 1-6: Encapsulants - Test methods for determining the degree of cure in Ethylene-Vinyl Acetate	WG 2	2020-01	Yes
IEC 62788-1-7 ED1	Measurement procedures for materials used in photovoltaic modules – Part 1-7: Test procedure for the optical durability of transparent polymeric PV packaging materials	WG 2	2019-07	
IEC 62788-5-1 ED1	Measurement procedures for materials used in photovoltaic modules - Part 5-1: Edge seals - Suggested test methods for use with edge seal materials	WG 2	2019-11	
IEC 62788-5-2 ED1	Measurement procedures for materials used in photovoltaic modules - Part 5-2: Edge seals - Edge-seal durability evaluation guideline	WG 2	2019-12	
IEC 62788-6-2 ED1	Measurement procedures for materials used in photovoltaic modules - Part 6-2: General tests - Moisture permeation testing with polymeric materials	WG 2	2019-11	
IEC TS 62788-6-3 ED1	Measurement procedures for materials used in photovoltaic modules - Part 6-3: Adhesion testing of interfaces within PV modules	WG 2	2019-11	

Project Reference	Title	WG	Forecast Publication Date	Maintenance Cycle
IEC 62788-8-2 ED1	Measurement procedures for materials used in photovoltaic modules - Part 8-2: Materials and coatings for the irradiant incident surface of photovoltaic modules or similar solar devices: Abrasion and environmental testing	WG 2	2020-02	
IEC 62790/AMD1 ED1	Amendment 1 - Junction boxes for photovoltaic modules - Safety requirements and tests	WG 2	2019-08	Yes
IEC TS 62804-1-1 ED1	Photovoltaic (PV) modules - Test methods for the detection of potential-induced degradation - Part 1-1: Crystalline silicon - Delamination	WG 2	2019-11	
IEC TS 62804-2 ED1	Photovoltaic (PV) modules - Test methods for the detection of potential-induced degradation - Part 2: Thin-film	WG 2	2019-11	
IEC 62852/AMD1 ED1	Amendment 1 - Connectors for DC-application in photovoltaic systems - Safety requirements and tests	WG 2	2020-01	Yes
IEC 62891 ED1	Overall efficiency of grid connected photovoltaic inverters	WG 6	2019-07	
IEC 62892 ED1	Extended thermal cycling of PV modules - Test procedure	WG 2	2019-03	
IEC TS 62910 ED2	Utility-interconnected photovoltaic inverters - Test procedure for low voltage ride-through measurements	WG 6	2020-05	Yes
IEC 62938 ED1	Non-uniform snow load testing for photovoltaic (PV) modules	WG 2	2019-07	
IEC 62941 ED1	Terrestrial photovoltaic (PV) modules - Quality system for PV module manufacturing	WG 2	2019-11	Yes
IEC TS 62994 ED1	Environmental health and safety (EH&S) risk assessment of the PV module through the life cycle - General principles and definitions of terms	PT 62994-1	2019-03	
IEC TS 63019 ED1	Information model for availability of photovoltaic (PV) power systems	WG 3	2019-04	
IEC 63027 ED1	DC arc detection and interruption in photovoltaic power systems	WG 6	2020-01	
IEC 63092-1 ED1	Photovoltaics in buildings – Part 1: Building integrated photovoltaic modules	PT 63092	2019-11	
IEC 63092-2 ED1	Photovoltaics in buildings – Part 2: Building integrated photovoltaic systems	PT 63092	2019-11	
IEC 63104 ED1	Solar trackers - Safety requirements	WG 7	2020-03	
IEC TS 63106-1 ED1	Basic requirements for simulator used for testing of photovoltaic power conversion equipment - Part 1: a.c. power simulator	WG 6	2019-12	
IEC TS 63106-2 ED1	Basic requirements for simulator used for testing of photovoltaic power conversion equipment - Part 2: d.c. power simulator	WG 6	2019-12	

Project Reference	Title	WG	Forecast Publication Date	Maintenance Cycle
IEC 63112 ED1	Safety, functionality and classification of Photovoltaic Earth Fault Protection (PV EFP) equipment	WG 6	2020-02	
IEC TS 63126 ED1	Guidelines for qualifying PV modules, components and materials for operation at higher temperatures	WG 2	2019-11	
IEC TS 63140 ED1	Photovoltaic (PV) modules – Partial shade endurance testing for monolithically integrated products	WG 2	2019-11	
IEC TS 63156 ED1	Photovoltaic systems – Power conditioners - Energy evaluation method	WG 6	2019-11	
IEC TS 63157 ED1	Guidelines for effective quality assurance of power conversion equipment for photovoltaic systems	WG 6	2019-11	
IEC 63163 ED1	Terrestrial photovoltaic (PV) modules for consumer products - Design qualification and type approval	WG 2	2020-02	
IEC 63202-1 ED1	Photovoltaic cells - Part 1: Measurement of light-induced degradation of crystalline silicon solar cells	WG 8	2019-07	
IEC TS 63202-2 ED1	Photovoltaic cells - Part 2: Electroluminescence image for crystalline silicon solar cells	WG 8	2019-09	
IEC TS 63209 ED1	Extended-stress testing of photovoltaic modules for risk analysis	WG 2	2020-01	
IEC TR 63217 ED1	Utility-interconnected photovoltaic (PV) inverters – Test procedure of high-voltage ride-through measurements		2019-08	
IEC TR 63225 ED1	Incompatibility of connectors for DC-application in photovoltaic systems		2019-08	
IEC TR 63226 ED1	Managing risk related to photovoltaic (PV) systems on buildings		2019-08	
IEC TR 63227 ED1	Lightning and surge voltage protection for photovoltaic (PV) power supply systems		2019-08	
IEC TR 63228 ED1	Measurement protocols for photovoltaic devices based on organic, dye-sensitized or perovskite materials		2019-08	

2.3 TC 82 Working Group 2 Modules, non-concentrating

WG 2 met twice in 2018. The first was a 4½ day meeting in April in Wilmington, USA and was attended by 96 experts from industry, research and testing organisations.

The second was a 3 day meeting in October held in Busan, Republic of Korea and was attended by around 91 experts from industry, research and testing organisations. The WG2 meeting was held before the 1½ day TC 82 plenary meeting, which was also held in Busan, Republic of Korea.

JRC is convenor of WG 2 (T. Sample) and chaired both meetings of WG 2.

Asian countries provide the largest delegations, confirming their commitment to the international standardisation process which fosters innovation and facilitates global trade in this very dynamic industry. Continuing progress was made on the new set of materials standards that underpin the production supply chain.

Following publication in 2016, amendments/revisions to one of the IEC's TC 82's most widely used document series (IEC 61215 for photovoltaic (PV) module design qualification and type approval) is ongoing together with amendments on the module safety standard (the IEC 61730 photovoltaic (PV) module safety qualification).

The JRC acts as either a project leader for a particular standard or as a technical expert of the project team. The different roles are as follows;

The project leader shall act in a purely international capacity, divesting him- or herself of a national point of view. The project leader should be prepared to act as consultant, when required, regarding technical matters arising at the proposal stage through to the publication stage.

Experts in relevant technical fields for each Technical Committee or Sub Committee are individuals appointed by their National Committees, via Expert Management System, and designated to one or more working group, maintenance team or project team. They will have access (granted by their National Committees) to working documents located on the IEC website. In the case of the JRC, the experts are nominated under a type A liaison between the IEC and the European Commission.

The experts act in a personal capacity and not as the official representative of the organization by which they were appointed. However, it is recommended that they keep close contact with their organization (National Committee or other International Organization in liaison) in order to inform them about the progress of the work. Experts are capable of advising on technical issues in the field of the committee in which they have been appointed.

Those items to which the JRC has provided significant technical input in 2018 include:

- IEC 61853-3, Photovoltaic (PV) module performance testing and energy rating - Part 3: Energy Rating of PV Modules. **(Published August 2018)**. The JRC was the project leader.
- IEC 61853-4, Photovoltaic (PV) module performance testing and energy rating - Part 4: Standard reference climatic profiles. **(Published August 2018)**. The JRC was the project leader.
- IEC 60891 Ed3, Photovoltaic devices - Procedures for temperature and irradiance corrections to measured I-V characteristics. CD submitted. The JRC contributes as experts within the project team.
- IEC 60904-1 Ed3, Photovoltaic devices - Part 1: Measurement of photovoltaic current-voltage characteristics. CD submitted. The JRC is the project leader.
- IEC 60904-1-2, Photovoltaic devices – Part 1-2: Measurement of current-voltage characteristics of bifacial photovoltaic devices. (Being published). The JRC contributes as experts within the project team.
- IEC 60904-3 Ed4, Photovoltaic devices - Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data. (Being published). The JRC contributes as experts within the project team.
- IEC 60904-4 Ed2, Photovoltaic devices - Part 4: Reference solar devices - Procedures for establishing calibration traceability. FDIS submitted. The JRC is the project leader.
- IEC 60904-7 Ed4, Photovoltaic devices - Part 7: Computation of the spectral mismatch correction for measurements of photovoltaic devices. FDIS about to be submitted. The JRC contributes as experts within the project team.

- IEC 60904-9 Ed3, Photovoltaic devices - Part 9: Solar simulator performance requirements. CDV submitted. The JRC contributes as experts within the project team.
- IEC 60904-10 Ed3, Photovoltaic devices - Part 10: Methods of linearity measurement. CDV in preparation. The JRC is the project leader.
- IEC 61215-1 Ed2, Terrestrial Photovoltaic (PV) Modules – Design Qualification and Type Approval Part 1: Test requirements. CDV in preparation. The JRC contributes as experts within the project team.
- IEC 61215-2 Ed2, Terrestrial Photovoltaic (PV) Modules – Design Qualification and Type Approval Part 2: Test procedures. CDV in preparation. The JRC contributes as experts within the project team.
- IEC 61215-1-1 Ed2, Terrestrial Photovoltaic (PV) Modules – Design Qualification and Type Approval Part 1-1: Special requirements for testing of crystalline silicon terrestrial photovoltaic (PV) modules. CDV in preparation. The JRC contributes as experts within the project team.
- IEC 61215-1-2 Ed2, Terrestrial Photovoltaic (PV) Modules – Design Qualification and Type Approval Part 1-2: Special requirements for testing of thin-film Cadmium Telluride (CdTe) based terrestrial photovoltaic (PV) modules. CDV in preparation. The JRC contributes as experts within the project team.
- IEC 61215-1-3 Ed2, Terrestrial Photovoltaic (PV) Modules – Design Qualification and Type Approval Part 1-3: Special requirements for testing of thin-film amorphous silicon based terrestrial photovoltaic (PV) modules. CDV in preparation. The JRC contributes as experts within the project team.
- IEC 61215-1-4 Ed2, Terrestrial Photovoltaic (PV) Modules – Design Qualification and Type Approval Part 1-4: Special requirements for testing of thin-film Cu(In,Ga)(S,Se)2 based terrestrial photovoltaic (PV) modules. CDV in preparation. The JRC contributes as experts within the project team.
- Amendment 1 to IEC 61730-1 Ed. 2: Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction, CD2 in preparation. The JRC contributes as experts within the project team.
- Amendment 1 to IEC 61730-2 Ed. 2: Photovoltaic (PV) module safety qualification - Part 1: Requirements for testing, CD in preparation. The JRC contributes as experts within the project team.
- Amendment 1 to IEC 62790 Ed1, Junction boxes for photovoltaic modules - Safety requirements and tests, FDIS in preparation. The JRC contributes as experts within the project team.
- Amendment 1 to IEC 62852 Ed1, Connectors for DC-application in photovoltaic systems - Safety requirements and tests, CDV in preparation. The JRC contributes as experts within the project team.
- IEC 63092-1 ED1, Photovoltaics in buildings – Part 1: Building integrated photovoltaic modules, CD2 in preparation. The JRC contributes as experts within the project team.
- IEC 63092-2 ED1, Photovoltaics in buildings – Part 1: Building integrated photovoltaic systems, CD2 in preparation. The JRC contributes as experts within the project team.
- IEC TS 63126 Ed1, Guidelines for qualifying PV modules, components and materials for operation at higher temperatures, CD submitted. The JRC contributes as experts within the project team.

- IEC TS 63140 Ed1, Photovoltaic (PV) modules – Partial shade endurance testing for monolithically integrated products, CD submitted. The JRC contributes as experts within the project team.
- IEC TS 63209 Ed1, Extended-stress testing of photovoltaic modules for risk analysis, CD in preparation. The JRC contributes as experts within the project team.
- IEC TR 63228, Measurement protocols for photovoltaic devices based on organic, dye-sensitized or perovskite material; closing date for vote 2018-12-28. The JRC contributes as experts within the project team.

3 CENELEC TC 82

3.1 CENELEC Background

CENELEC is the European Standards Organisation in the electrotechnical field. CEN/CENELEC (+ ETSI) have the European Union's mandate in relation to the "Completion of the Internal Market". The specific mandate for standardisation in the field of solar photovoltaic energy systems and components is M/089 EN.

This is implemented by Technical Committee 82: Solar Photovoltaic Systems. Under the terms of the Frankfurt Agreement between IEC and CENELEC, the latter transforms IEC standards into European standards, usually in a "fast track" procedure of 2 months, keeping the document numbers of IEC. CENELEC together with the European National Committees (EU28+EEA) fosters also the translation into national languages. Under the Frankfurt Agreement there is also the mutual requirement of notification of standards work, and the commitment by either party to not engage in topics if the other party is already doing it.

3.2 CLC TC 82

CENELEC TC 82 is organized in two working groups: WG 1 and WG 2. The scope of the WG1 "WAFERS, CELLS AND MODULES" is to develop international standards for wafers, solar cells and terrestrial photovoltaic modules and for related components. The scope of WG 2 "BOS COMPONENTS AND SYSTEMS" is to develop international standards for balance of systems (BOS) components, interfaces of PV systems and system integration.

JRC is convenor of CLC WG 1 (T. Sample) and chaired the annual meeting of the group held in Brussels in March 2018.

During 2018 the most notable publications were the EN IEC 61730-1 and EN IEC 61730-2, which were adopted as harmonised standards under the Low Voltage Directive (LVD) through the publication in the OJ of the European Union. The JRC contributed as an expert within the project team which prepared the supporting documentation for listing within the OJ of the European Union.

A harmonised standard is a European standard developed by a recognised European Standards Organisation: CEN, CENELEC, or ETSI. It is created following a request from the European Commission to one of these organisations. Manufacturers, other economic operators, or conformity assessment bodies can use harmonised standards to demonstrate that products, services, or processes comply with relevant EU legislation.

The references of harmonised standards must be published in the Official Journal of the European Union. The purpose of this website is to provide access to the latest lists of references of harmonised standards and other European standards published in the Official Journal of the European Union (OJEU).

IEC standards from TC 82 which are circulated for vote are also subjected to a parallel vote by the national committees of CENELEC, via the Frankfurt agreement and if voted positively to be adopted as EN standards.

4 Related Initiatives

4.1 International PV Quality Assurance Task Force (PVQAT, "PV cat")

The first International PV Module Quality Assurance Forum was held in July 2011, in San Francisco, California. The event fostered international participation to develop a rating system that meets the needs of all countries and customers so that PV manufacturers need to complete only a single test. At the Forum, the community expressed strong support for development of international PV QA standards, leading to the formation of The International Photovoltaic Quality Assurance Task Force (PVQAT). PVQAT is a purely voluntary organisation in which each individual participates to further the goals of developing the whole of the PV industry.

The PVQAT leads global efforts to craft quality and reliability standards for solar energy technologies. These standards will allow stakeholders to quickly assess a solar photovoltaic (PV) module's performance and ability to withstand local weather stresses, thereby reducing risk and adding confidence for those developing products, designing incentive programs, and determining private investments. As a result:

- Investors can gain confidence in solar investments.
- PV customers can use standards to choose products that meet their needs.
- Incentive programs can define a minimum durability for module designs.
- Insurance companies can adjust rates according to demonstrated reliability.
- PV module suppliers can optimize module design to minimize cost while still maintaining confidence in reliability for a specific use or application of the modules.
- The entire PV community benefits by reducing installed PV cost when standards are created that establish durability without adding unnecessary cost.

PVQAT strives to provide these benefits by coordinating international development of comprehensive technical standards for verifying PV component and system quality and bankability. To that end, PVQAT has a three-pronged approach that seeks to establish:

- A rating system to ensure durable design of PV modules for the climate and application of interest.
- A guideline for factory inspections and quality assurance (QA) during manufacturing.
- A comprehensive system for certification of PV systems, verifying appropriate design, installation, and operation.

PVQAT now has 13 individual task groups focused on accelerating progress toward implementing these three approaches. Several hundred volunteers from around the world contribute to the various task groups within PVQAT and they have already made significant contributions to the standardisation activities. The JRC contributes to PVQAT activities based on the expertise developed at ESTI during the last decades.

In 2017 PVQAT attained a type A liaison with IEC TC 82 to enable a close co-ordination of its work programme in support to standardisation activities.

The various task groups are undertaking basic research activities, intercomparisons and round-robin tests in a number of areas to define appropriate characterisation and testing methods for many of the basic material and component standards progressing within IEC TC 82.

The JRC has supported the development of the PVQAT from its inception and is represented on the 5-person steering committee by Tony Sample, who also contributes to some of the task groups.

4.2 IECRE

The IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications (IECRE System) aims to facilitate international trade in equipment and services for use in Renewable Energy Sectors while maintaining the required level of safety.

In order to achieve this it:

- operates a single, global certification system
- aims for acceptance by local/national authorities or other bodies requiring and benefiting from certification
- will make use of high quality International Standards and allow for continuous improvement

To be effective and avoid double work of what information must be given when and to whom, the System will include a mechanism to solve disagreements between stakeholders both on the content and its correct application.

Its goal is to offer a harmonised application around the globe, which ensures a uniform:

- implementation and mutual recognition between certification bodies and test labs
- implementation and delivery of information by suppliers, sub-suppliers, end users and others providing documentation for certification
- implementation and clear understanding of all suppliers, sub-suppliers, end users and other applicants for the elements and modules as well as reports, statements and certificates of the certification processes

Renewable Energy (RE) Sectors can be known by different names such as Marine Energy, Solar PV Energy and Wind Energy, and relate to areas characterised by systems which generate electricity from renewable natural sources. They consist of complex arrangements of sub-systems including structures, which are usually installed outside of any protective environment and whose reliability and performance is affected by direct interaction with the natural environment.

These areas may include the equipment and processes to produce energy, as well as the equipment to manufacture, transport and service the energy-producing equipment. Relevant standards exist for specific industry sectors to which the conformity assessment and certification of the IECRE System is done.

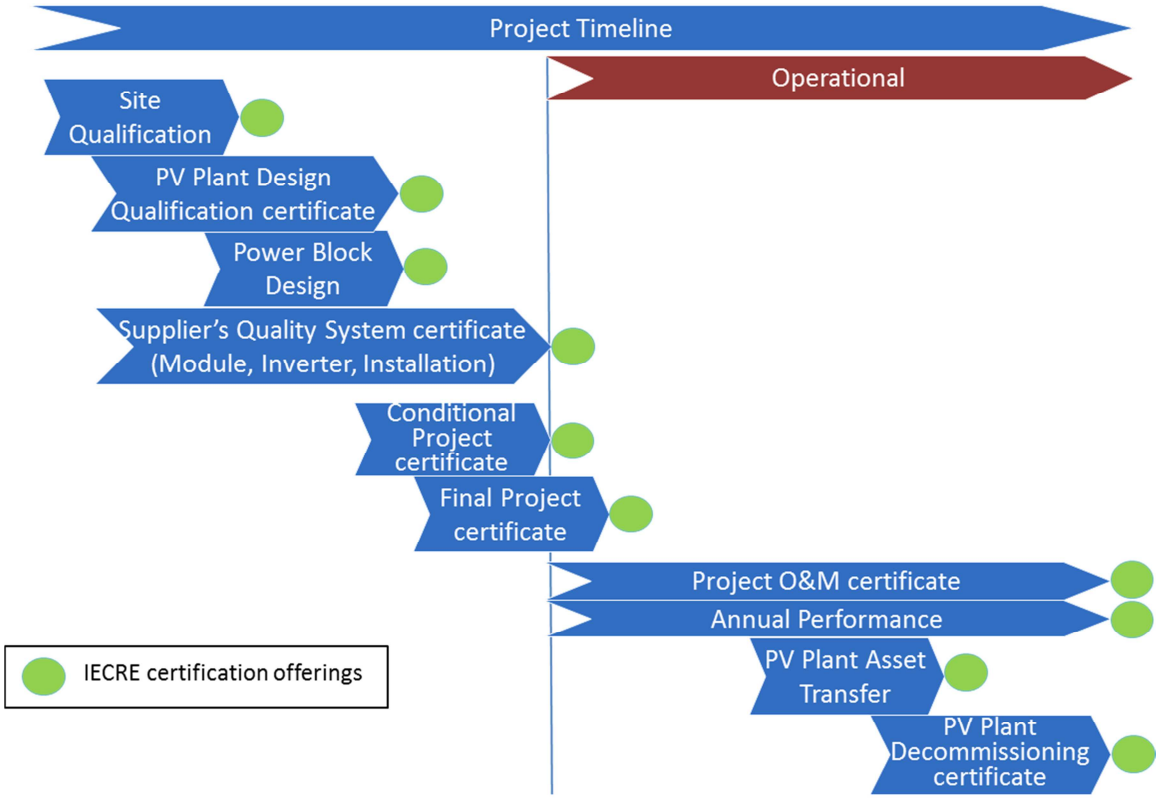
The IECRE was formed in 2014 and currently has 16 member bodies in total, of which 12 are part of the PV-Solar sector. The JRC is not currently involved with the IECRE scheme but we are watching the development of the certification scheme with interest.

Conformity assessment will be performed and certificate issued for an individual PV power plant on a specific site at various stages of its design and implementation (see figure 2).

The Specific Certificate Categories could follow the following:

- PV Site Qualification certificate
- PV Power Block design qualification certificate
- PV Plant Design qualification certificate
- Conditional PV Project certificate (construction complete / commissioning)
- Annual PV Plant Performance certificate
- PV Asset Transfer certificate
- PV Decommissioning certificate

Figure 2. System timeline view



4.3 TC 113 Nanotechnology standardisation for electrical and electronic products and systems

Nano-enabled photovoltaics refers to photovoltaic devices made from the use of nano-sized material elements, involving a combination of organic and inorganic components and hard and soft matter, including liquid electrolytes, usually combined using low-cost preparation methods mainly by low temperature solution processing. In this class a variety of technical solutions and approaches are used to evaluate technologies.

The field has attracted the attention of the TC 113, which has published one technical specification IEC TS 62876-2-1 Nanotechnology - Reliability assessment - Part 2-1: Nano-enabled photovoltaic devices - Stability test (published 2018-08-29). It currently has two PV related items are under consideration (extract of 2018-12-10) and are summarised below:

Table 5. IEC TC 113 Projects related to PV devices

Project Reference	Title	Forecast Publication
PWI 113-78 ED1	IEC 62607-7-1: Nanomanufacturing - Key control characteristics - Part 7-1: Nano-enabled photovoltaics measurement of the electrical performance and spectral response of tandem cells	
IEC TS 62607-7-2 ED1	IEC 62607-7-2: Nanomanufacturing - Key Control Characteristics - Part 7-2: Nano-enabled photovoltaics - Device evaluation method for indoor light	2020-07

The JRC does not take part in IEC TC 113 working groups, but is doing pre-normative research on performance testing of organic (OPV) and dye-sensitised (DSSC) devices, also in the framework of the International Summit on Organic Photovoltaic Stability. It considers that these TC 113 activities should be addressed within TC 82 and encourages those members of TC 113 to participate to TC 82 WG 2.

In this regard TC 82 has prepared an IEC technical report on the characterisation of these slow responding devices (IEC TR 63228, which has been circulated for national committee voting by the 28th December 2018), which may in part cover the area of characterisation under indoor lighting, which is the scope of the PNW 113-389 (Photovoltaic device evaluation method for indoor light).

During 2018 the IEC 62607-7-1 did not progress through the TC 113, this may be due to the publication of the IEC 60904-1-1 and IEC 60904-8-1 (published 2017-05) from TC 82 which covers the same application area.

4.4 Photovoltaics Products for Building Applications

Building integrated PV (BIPV) has long been recognised as an important area, but also one in which the lack of standards is frequently cited as an issue. Given that in Europe the requirements of the Energy Performance in Buildings Directive is expected to push this market segment towards significant growth in the coming years, standards for BIPV products and systems are likely to be a priority area.

The publication of the EN 50583-1 (Photovoltaics in buildings. BIPV modules) and EN 50583-2 (Photovoltaics in buildings. BIPV systems) standards in January 2016 was a major step forward in this complicated area, which covers both building codes and standards as well as those standards aimed at PV devices.

The multifunctional role of PV products in such applications leads to different standards requirements:

- Electrical performance and safety, via CENELEC/IEC standards and the Low Voltage Directive.
- Building energy performance via CEN/ISO standards (as required under the Energy Performance of Buildings Directive)
- Structural performance via Eurocodes. The EN Eurocodes are a series of 10 European Standards, EN 1990 - EN 1999, providing a common approach for the design of buildings and other civil engineering works and construction products. They are the recommended means of giving a presumption of conformity with the basic requirements of the Construction Products Regulation (CPR) for construction works and products that bear the CE Marking, as well as the preferred reference for technical specifications in public contracts.

As part of the Frankfurt agreement both of the above-mentioned EN standards were sent to IEC TC 82 for their consideration for future work. The result of which was to establish a Project Team (PT 63092) to take these two standards forward.

- IEC 63092-1 ED1, Photovoltaics in buildings – Part 1: Building integrated photovoltaic modules, CD2 in preparation. The JRC contributes as experts within the project team.
- IEC 63092-2 ED1, Photovoltaics in buildings – Part 1: Building integrated photovoltaic systems, CD2 in preparation. The JRC contributes as experts within the project team.

5 Planning

Photovoltaics continue to be an area of strategic importance for EU policies and initiatives on renewable energy, energy performance of buildings and eco-industry. As such the JRC work programme for 2019 foresees continued efforts to a) support the standards process, b) to perform relevant pre-normative research and c) to promote harmonisation with international and European partners. This is consistent with the annual Commission work programme for European standardisation for 2018 ([10]), in which energy is one of the main policy areas identified. The level of commitment it 2019 is expected to be roughly equal to that of 2018, with the support for IEC TC82 WG2 and CENELEC TC82 WG1 being the most significant.

JRC-ESTI staff will, via the PV-Energy institutional project, continue to support both IEC TC 82 and CENELEC TC 82. ESTI will prioritise technical input in the following areas:

a) Power calibration

The rated peak-power value remains the key parameter for commerce in PV products, as well as for regulatory purposes. Improving the standards used to define it brings benefits to producers and investors alike. The JRC activities on this topic fall under two themes. Firstly, the improvement of existing procedures for PV products, specific items for 2019 include:

- revision of the IEC standard Photovoltaic devices - Procedures for temperature and irradiance corrections to measured I-V characteristics (IEC 60891 edition 3)
- revision of the IEC standard Photovoltaic devices - Part 1: Measurement of photovoltaic current-voltage characteristics (IEC 60904-1 edition 3)
- revision of the IEC standard Photovoltaic devices - Part 9: Solar simulator performance requirements (IEC 60904-9 edition 3)
- revision of the IEC standard Photovoltaic devices - Part 4: Reference solar devices - Procedures for establishing calibration traceability (IEC 60904-4 edition 2)
- revision of the IEC standard Photovoltaic devices - Part 7: Computation of the spectral mismatch correction for measurements of photovoltaic devices (IEC 60904-7 edition 4)
- revision of the IEC standard Photovoltaic devices - Part 10: Methods of linearity measurement (IEC 60904-10 edition 3)

b) Energy Rating

JRC has been active in promoting the development of an energy rating for PV modules, on the basis that this would provide investors with additional important information on actual electricity generation capability of a product in a representative range of climates. It would also open possibilities for product differentiation, which the peak-power value does not provide. The IEC 61853-1 was published in 2011 and the IEC 61853-2 in 2016, with the IEC 61853-3 and -4 published in 2018.

Although the standard series has just been published, JRC is working towards the incorporation of bifacial module designs, and possibly also BIPV products, within the IEC 61853 standard series. This work will be supported by the results obtained within the PV-Enerate project, which is a EURAMET project under the EMPIR programme, co-financed by the Participating States and by the European Union's Horizon 2020 research and innovation programme. The mission of EURAMET is to develop and disseminate an integrated, cost effective and internationally competitive measurement infrastructure for Europe. The European Metrology Programme for Innovation and Research (EMPIR) coordinates research projects to address grand challenges, while supporting and developing the SI system of measurement units. There is an increased focus within EMPIR on innovation activities to target the needs of industry and accelerate the uptake

([10]) COM(2018) 686, The annual Union work programme for European standardisation for 2019

of research outputs. The programmes capacity-building projects aim to bridge the gap between EU member states with emerging measurement systems and those with more developed capabilities.

c) Reliability and Lifetime

This topic had been partly addressed in 2016 focussing mainly on the revision of the PV type approval standard series IEC 61215, which now combines more stringent requirements with a broader technology scope with technology specific parts for:

- IEC 61215 Part 1-1: Special requirements for testing of crystalline silicon photovoltaic (PV) modules
- IEC 61215 Part 1-2: Special requirements for testing of thin-film Cadmium Telluride (CdTe) based photovoltaic (PV) modules
- IEC 61215 Part 1-3: Special requirements for testing of thin-film amorphous silicon based photovoltaic (PV) modules
- IEC 61215 Part 1-4: Special requirements for testing of thin-film Cu(In,GA)(S,Se)2 based photovoltaic (PV) modules

Although the 2016 editions were a major improvement in consolidating under the IEC 61215 series the type approval testing procedures previously dealt with by separate standards (IEC 61215 and IEC 61646), some issues were not covered at the time. The goals for 2019 are the continued preparation of new editions to the standards to incorporate the specific issues of testing flexible PV modules and bifacial modules. Where appropriate, additional tests will be incorporated into the IEC 61215 standard series to cover specific failure modes (for example PID).

Compliance with the type approval is expected to ensure low failure rates in the PV products entering service. Concerning degradation and useful lifetime, manufacturers are increasingly using long-term degradation rates as a marketing tool, but as yet there are no standard tests to substantiate these claims in reliable and transparent way. This is an issue of key importance to investors, as it impacts directly on the expected financial returns. JRC will continue to support international collaborative efforts to establish appropriate protocols in this area via the International PV Quality Assurance Forum.

In 2017 TC 82 launched an activity (IEC TS 63126 Guidelines for qualifying PV modules, components and materials for operation at higher temperatures), the aim of which is to determine how to modify existing standards to take into account operation at higher temperatures, from high local ambient temperature (desert applications or module integration in buildings) which would lead to module or component temperatures above 90 $^{\circ}$C.

In 2018 TC 82 launched an activity (IEC TS 63209 Extended-stress testing of photovoltaic modules for risk analysis), which is intended to provide a set of data to be used for qualitative reliability risk analysis, highlighting potential failure modes and areas possibly in need of improvement, and for evaluating process changes. It utilises a series of documents describing various testing protocols. It is not intended to be used for service life prediction and, despite the use of quantitative data, is only useful for rank ordering modules and materials for special cases, for very large differences in performance, or with respect to specific understood failure modes and mechanisms. A robust module level rank ordering or service life prediction is beyond the scope of this document.

d) Module Electrical Safety

A range of safety issues, including the use of voltage up to 1500 V, have been incorporated in the revision of the PV module safety standard series (IEC 61730 edition 2), which was published in 2016. Amendments to both IEC 61730-1 and -2 are ongoing to address specific weathering of components and to incorporate Bifacial modules. This is currently being discussed by TC 82 WG2 and should progress through 2019.

e) PV Products for Buildings

The publication of the photovoltaics in buildings standards EN 50583-1 and EN 50583-2 at the beginning of 2016 was a major step forward. Further work on items specific to BIPV in CENELEC TC 82 depends on the feedback on these from users and other stakeholders. As part of the Frankfurt agreement both the EN 50583-1 and EN 50583-2 were transmitted to IEC TC 82 for their consideration for future work. This entailed forming a project team PT 63092 which based much of its work on the existing EN 50583-1 and 50583-2 and consolidated the other BIPV activities within the PT 63092. Experts in the project team are drawn from all of TC 82 and experts from ISO and the IEA. Committee drafts of IEC 63092-1 and IEC 63092-1 were circulated in 2018 and comments were received from the National Committees. The project team is currently answering the comments and preparing modified committee drafts to submit for circulation to the National Committees.

It is noted that several general issues regarding use of PV in the built environment remain open. The Energy Performance of Buildings Directive (EPBD) 2010/31/EC includes standards for assessing the output of energy generating systems. Specifically the calculation of PV energy contribution to the building performance is covered by EN 15316-4-3. However, the application of the method requires location specific data, and that responsibility for reference climatic data is given to the Member States. Overall, while the EPBD requirements establish a framework, many details need to be clearly defined (e.g. system performance factors and degradation effects).

There are specific documents related to safety in building installations like the technical report CLC/TR 50670 "External fire exposure to roofs in combination with photovoltaic (PV) arrays - Test method(s)"

Development on such aspects will be monitored via JRC colleagues working on Eurocodes and other standards relevant to building energy efficiency and structural safety.

f) Ecodesign and Materials Efficiency

As part of the Commission's Circular Economy initiative, the Ecodesign Working Plan 2016-2019 includes studies on the energy-saving potentials of several energy-related products that have not been considered up to now, including solar PV panels and inverters. JRC has competence in several relevant aspects including energy yield assessment, operational lifetime and life cycle analysis and can directly support such studies.

The study has identified a lack of standards regarding durability of PV modules and systems components, as well as for other materials efficiency aspects such as dismantlability of PV modules, disassemblability of PV systems and remanufacturing of PV systems. Such items will require the agreement first of the horizontal standards under mandate M/543 (foreseen to be published in 2019).

List of abbreviations and definitions

AIST	National Institute of Advanced Industrial Science and Technology
AIT	Austrian Institute of Technology
BOS	Balance of Systems
CD	Committee Draft
CDV	Committee Draft for Vote
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CPR	Construction Product Regulation
CPV	Concentrator photovoltaic
DTS	Draft Technical Specification
EEA	European Economic Area
ESTI	European Solar Test Installation
ETSI	European Telecommunications Standards Institute
EU28	European Union 28 member states
EURAMET	The European Association of National Metrology Institutes
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IEC/TS	International Electrotechnical Commission / Technical Specification
IECRE	IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications
ISE	Institut für Solare Energiesysteme
ISO	International Organization for Standardization
ITU	International Telecommunication Union
JRC	Joint Research Centre of the European Commission
JWG	Joint Working Group
LVD	Low Voltage Directive
PV	Photovoltaics
NREL	National Renewable Energy Laboratory
OPV	Organic Photovoltaics
PNW	Proposed New Work
PNW/TS	Proposed New Work/Technical Specification
prEN	project European standard
PTB	Physikalisch-Technische Bundesanstalt
PVQAT	International Photovoltaic Quality Assurance Task Force
RES	Renewable Energy Sources
SET Plan	Strategic Energy Technology Plan
TC	Technical Committee
WG	Working Group
WTO	World Trade Organisation

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