Coordination of International Standards with Implementation of the IECRE Conformity Assessment System

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Abstract

• To address the industry’s need to assure investors of the value of their PV power plants, the International Electrotechnical Commission (IEC) has established a new conformity assessment system for renewable energy (IECRE).

• There is presently important activity devoted to defining the requirements for various types of PV system certificates, and publication of the international standards upon which these certifications will be based.

• This presentation provides a detailed analysis of the progress of these activities and the plan for initiation of IECRE certifications.
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Why was IECRE created?

• While IEC writes technical standards, IEC does not define how these are used
• IECRE was formed in 2014 to define how certificates can be issued at the system level
  – IECRE serves 3 sectors: Wind, PV, and Marine energy
  – Defines requirements for certifying bodies, etc.
  – Identifies the technical documents (within IEC or other standards organizations) for each certificate
  – Initially, a single certificate was envisioned, but now plan for certificates at each stage of development

IEC → Technical standards → IECRE → Certificates for system
Addressing investors’ needs

IECRE ensures that technical due diligence hurdles are cleared.

IECRE sets the height by balancing needs and cost.

IECRE Principles
- Consensus based standards worldwide
- Peer reviewed accreditation
- Consistent/transparent process

How to get a project financed? How to obtain better terms?
IECRE means confidence
Confidence means lower risk
Lower risk means better terms

Confidence elements
- Accreditation
  - Accountability
- Independence
  - Accuracy
- Impartiality
  - Confidentiality
- Competence & Capability
- Consistency/Transparency

Data Security

Trusted DATA

STAKEHOLDERS

Legal Accounting
Investors want zero risk AND low cost: Need balance

Challenges:
We want everything to be perfect, but we also need to minimize cost;
Each customer asks for a different balance and has slightly different goals
Principles for balancing risk and cost

• Benefit from standardization
  – Create and adopt international standards (only one set)
  – Learn from each other (define best standards more quickly)

• Oversight at every stage
  – Design and planning
  – Construction
  – Operation

• Emphasize consistent quality control:
  – Require continuous learning
  – Don’t assume that a single success implies future successes

• Efficient implementation
  – Don’t duplicate inspections
  – Leverage internal quality management actions
International Standards

• Provide **rules, guidelines or characteristics** for activities or their results
• **Consensus** of international experts in an open and **transparent process**
• Made available to the public, for common and repeated use
• Basis for **Conformity Assessment** and for certification of products and systems
Conformity Assessment

• Evaluation against international standards
  – May use national or regional standards if no international standard is available

• Improved quality and performance
  – Assurance that PV plant will operate as designed for its expected lifetime

• Increased confidence for investors
  – Financial return meets expectations
  – Risk is reduced
Benefits of Certification

- **Independent assurance** of conformance with appropriate international standards
- Evaluation by **accredited inspection bodies** in open and transparent process
- **Objective evidence** of best practices for investors and financial institutions
- Common need in Renewable Energy (RE) systems across multiple industry sectors
  - PV Solar, Wind, Marine, others?
Benefits of IEC Systems

• IEC Brand
  – Global recognition – multiple industries
  – International recognition (e.g. WTO + UN)
  – IEC Reports and Certificates used nationally

• Open and Transparent Process
  – Clear Rules in process and results
  – Consistency in processes among participating Certification Bodies & Test Labs

• Industry and market provide direct input
  – CA systems driven by market demand
IEC Global Reach

83 Members  83 Affiliates

IEC Central Office - Geneva
Regional Offices - Brazil, Singapore,
Kenya, US and Australia

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Roles & Responsibilities

- **Standards Management Board (SMB)**
  - Technical Committees => Write the standards
  - Manage nomination of experts and voting by National Committees

- **Conformity Assessment Board (CAB)**
  - Assessment Schemes => Evaluate implementation of standards in specific situations
  - Manage accreditation of Certifying Bodies
Existing CA Systems

- **IECEE**
  - System for conformity testing and certification of *electrotechnical equipment* (specific categories including PV modules)
  - Oversees the Certification Body (CB) Scheme and recognizes CB Testing Laboratories (CBTL)

- **IECEx**
  - Conformity assessment for equipment operating in *explosive atmospheres*

- **IECQ**
  - Quality assessment system for *electronic components* and associated materials
Wind Turbine History

• Wind industry identified need to address “system aspect” of large complex projects

• Not covered by any existing CA scheme at the time

• Formed Wind Turbine Conformity Assessment Committee (WT-CAC) in 2011

• Requirements written into IEC 61400-22 standard
  – Type Certification
  – Project Certification
  – Management of certification system
  – Acceptance of operating bodies
WT-CAC Problem

• IEC structure / policy requires separation of standardization and CA activities
  – TC88 crossed the line, but with strong industry support
  – WT-CAC Parallel infrastructure with CAB was not sustainable

• Concept developed for new CA system (IECRE)
  – Similar requirements exist for Marine Energy projects as well as large PV power plants
  – Specific differences and details apply for each industry
RE Common Elements
IECRE Formation

- June 2013 CAB approves the creation of a Renewable Energy Conformity Assessment System

- Oct 2013 Kick-off meeting in Aarhus, Denmark establishes committee to write rules for new system

- June 2014 CAB approves the Basic Rules for operation of the IECRE system

- Sept 2014 First REMC meeting and approval to establish OMC for each industry sector
REMC First Meeting

Boulder, Colorado, US    Sept-2014    60 delegates/14 countries
IEC Conformity Systems

Conformity Assessment Offerings

CAB - Conformity Assessment Board

IECCEE
System for Conformity Testing and Certification of Electrotechnical Equipment and Components

IECEx
System for Certification to Standards Relating to Equipment for use in Explosive Atmospheres

IECQ
Quality Assessment System for Electronic Components

IEC RE
IEC SYSTEM FOR CERTIFICATION TO STANDARDS RELATING TO EQUIPMENT FOR USE IN RENEWABLE ENERGY APPLICATIONS

IEC Wind Energy Scheme

IEC Solar Energy Scheme

IEC Marine Energy Scheme
IECRE Basic Rules

• Scope
• Governing documents
• Membership
• Organization
• RE Management Committee
• Officers, Executive and administration

• Committees reporting to the MC
• Legal provisions
• Standards
• Voting
• Finance
• Dissolution of the IECRE System

• IECRE System Basic Rules approved by CAB in June 2014
Organizational Structure

IEC CONFORMITY ASSESSMENT BOARD, CAB
Oversees IEC Conformity Assessment policy and Systems, eg IECEx, IECQ, IECFR, IECRE

IECRE Management Committee, REMC
Overall management of the IECRE System

- National Members (Countries)
- Officers + Executive, Scheme Chairs, IEC Gen. Sec
- Expert Working Groups (WGs) – as needed

IECRE Secretariat
Technical Support
Administration

WE OMC
Wind Energy Operational Management Committee
Daily management of WE Scheme
- National Members
- TC 88 + SC Liaison
- SubCommittees + WGs

ME OMC
Marine Energy Operational Management Committee
Daily management of ME Scheme
- National Members
- TC 114 + SC Liaison
- SubCommittees + WGs

PV OMC
PV Solar Operational Management Committee
Daily management of PV Scheme
- National Members
- TC 82 + SC Liaison
- SubCommittees + WGs

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PV-OMC

• Each industry sector established an Operating Management Committee (OMC) to address their specific needs and define the certification schemes required
  — Marine Energy OMC (ME-OMC)
  — Wind Energy OMC (WE-OMC)
  — Solar Photovoltaic OMC (PV-OMC)

• The OMCs each operate at their own pace, as determined by the maturity and needs of the sector

• The PV-OMC is concentrating on determining the most critical issues for stakeholders and how they can be addressed by certification schemes
PV-OMC Member Bodies

• 12 Countries represented by National Committees

Flags of the countries:
- China
- Germany
- Japan
- Spain
- Egypt
- Hungary
- South Korea
- United Kingdom
- Canada
- India
- Netherlands
- United States
PV-OMC Officers

• PV OMC Chairman:
  – Adrian Häring (Germany)

• PV OMC Vice-Chairman:
  – Sewang Yoon (Korea)

• Next meeting planned for October 2016
  – Juno Beach, Florida, US
PV-OMC Progress

• Approved Rules of Procedure (RoP) April 2016
  – Scope
  – Normative references
  – Terms and definitions
  – Acceptance of certification bodies
  – Management of the certification system
  – Extent of certification

• Operational Documents will describe requirements for different certification offerings
  – Multiple aspects of certification tied to lifecycle / events
  – Certificate often required for financial milestones
Aspects of Certification

- Conformity assessment will be performed and certificate issued for an individual PV power plant on a specific site

- **Design Phase**
  - Site evaluation
  - Design evaluation
  - PV equipment evaluation
  - Structural and electrical code compliance

- **Implementation Phase**
  - Installation
  - Output measurement
  - Commissioning surveillance
  - Operation and maintenance surveillance
Different systems

= Different requirements

• **Accuracy** requirements defined in IEC 61724-1*
  – Class A – highest accuracy: (on site POA irradiance measurements required with sensor cleaned periodically)
  – Class B – medium accuracy
  – Class C – lowest accuracy: (OK to use satellite data for irradiance)

• **System operation classes**
  – U1: Utility – *Focus discussion on this today*
  – U2: Residential
  – U3: Commercial
  – U4: Aggregate (collection of small systems)

*Details under discussion
System Certifications

- **Lifecycle Stage**
  - Design
  - Commissioning
  - Operation

- **Operator Class**
  - Utility
  - Commercial
  - Residential
  - Aggregate

- **Location Class**
  - Ground
  - Roof
  - BIPV
Certificate Categories

• 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
PV System Certificates

Project Timeline

- Design Qualification
- Substantial Completion
- Annual Performance
- Asset Transfer

• Need confidence that each step during a project is completed correctly

• For simplicity, today we will discuss four steps:
  – Design qualification (ready to proceed with construction)
  – Substantial completion (ready to operate)
  – Annual performance (final completion, or annual check up)
  – Asset transfer (define health of plant as basis for acquisition)
PV System Certificates

Example considerations

• Local code requirements met
• **Component selection**
  – Qualified for application
  – Quality control during manufacturing
• Safety:
  – Restricted access if appropriate
  – Continuously monitored
  – Overcurrent protection
• Good design
  – Shading considered
  – Trenching
PV System Certificates

Example considerations

• Local code requirements met
• Commissioning completed
• Component quality verified
• Quality management during installation
  – Workers trained with oversight
  – Any design changes reviewed
  – Continuous improvement
• Performance check
  – Does power output match the design?
Based on measured weather and original model, does plant perform as expected?
- **Energy availability** (e.g. if inverters break, the plant could be unavailable)
- **Performance index** (measured performance divided by expected performance based on measured weather)

**O&M costs**
- Relative to planned cost, how much did it cost to keep the plant running?
PV System Certificates

Project Timeline

- Design Qualification
- Substantial Completion
- Annual Performance
- Asset Transfer

Example considerations

- Has plant output been consistent with original model?
- Have O&M costs been consistent with original model?
- Is there evidence of problems to come? (Cracked cells, weeds growing through the modules, hot spots)
PV System Data Collection

Project Timeline

- Design Qualification
- Substantial Completion
- Annual Performance
- Asset Transfer

Data documentation – propose to align with XBRL

- Model assumptions
- **Annual performance**
  - Energy availability
  - Performance index
  - Annual O&M costs
- Many other details (current list includes over 200 items, including information from each certificate, dates of completion, local information, and financial details)
Implementation of IECRE

• Effective implementation requires:
  – Defining **WHAT** will be implemented (*technical details*)
  – Defining **HOW** it will be implemented (who has *authority* to say ‘yes, this meets the requirement’?)

• Consistent implementation in **all countries** is required for an IECRE certificate to have meaning

• Once implemented, **statistics** will help to define the outcomes associated with using this approach
Who can participate?

• First, define who has authority to do PV plant inspections:
  – OD-406: Provides application form to become an IECRE Certification Body or an IECRE Inspection Body
  – Applicants must agree to follow IECRE documents
  – Applicants must agree to peer-review process

• Requirements for inspectors of PV module factories are described in OD-405

• Progress can be tracked at: http://www.iecre.org/documents/refdocs/ (OD-401, OD-402, etc. are PV-specific documents)
“Certifiable” Standards

• **Design**
  – 62548 Array Design (or 62738 Power Plant)
  – 61724-1 Performance Monitoring

• **Commissioning**
  – 62446-1 Documentation, Test & Inspection
  – 61724-2 Capacity Evaluation

• **Operation**
  – 62446-2 System Maintenance
  – 61724-3 Energy Evaluation

• **Quality Management**
  – 62941 PV Module Manufacturing
  – 63049 PV System Installation
Standards Development

• Comprehensive review of existing international and national standards conducted by TC82 experts in 2014

• Determination of which standards would most likely be required to conduct conformity assessments

• Consideration of all IEC standards and others where appropriate (ASTM, UL, VDE, etc.)

• Used to prioritize the work of TC82 and supporting efforts by PVQAT

• Results presented at IEEE PVSC in Denver June 2014
‘PVQAT Effect’ on TC82

Number of New Proposals launched in IEC TC 82

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Remarkable development, demonstrating importance and visibility of IEC standards in the field of solar photovoltaics

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TC82 Productivity

Publication time (months) by Start date

IEC Average = 33 mo.
Closing the Gaps

IEC Solar Energy Scheme

Type
1) Panel + Converter Design
2) Panel + Converter Test
3) Mfg. Quality

Project
1) Installation?
2) Commissioning?
3) Operation?

Module - 61215 / 61730
Inverter - 62109 / 62891
Tracker - 62817
BOS - 62093 + others

Module Manufacturing Quality – 62941
BOS Manufacturing Quality – NWIP

System Design - 62548 / 62738
Installation Quality – 63049
Commissioning – 62446-1
Maintenance – 62446-2
Performance – 61724 series

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Module Quality

- **IEC/TS 62941** Guideline for increased confidence in PV module design qualification and type approval
  - Publication January 2016
  - Collection of *best practices* from across the industry
  - Refers to basic requirements of ISO 9001, plus...

- Focus on **PV-specific** manufacturing processes and procedures to ensure quality and consistency
  - Key metrics and capabilities needed for PV
  - Modules produced this way will be more likely to perform according to warranty (25+ years)

- Preparations underway for first **factory audits** and QMS certificates in Q4 2016
System Design

• IEC 62548 PV Array Design Requirements
  – PV system architectures
  – Mechanical design
  – Selection and erection of electrical equipment
  – Safety issues
  – Marking and documentation
  – Coordination with 61724 series (Performance Monitoring)

• IEC/TS 62738 PV Power Plant Design
  – Specific to utility-scale plants; special techniques allowed
  – CD2 in process; publication in 2017
Installation Quality

- **IEC/TS 63049** Guideline for increased confidence in PV system installation
  - Fast track project in TC82 WG3
  - Describing known best practices for managing quality and avoiding problems
  - Includes many basic requirements of ISO 9001

- Focus on **PV-specific** construction processes and procedures to ensure consistency of installation
  - Key metrics and capabilities needed for PV
  - Systems constructed this way will be more likely to perform according to warranty (25+ years)
Commissioning & Operations

- **IEC 62446-1 Ed. 2**
  - Minimum commissioning tests and inspection criteria
  - Minimum documentation to verify safe installation and correct operation
  - Additions to address different categories of systems
  - Test regimes differentiated as appropriate for the system type, scale, and complexity
  - Coordination with 61829 On-site I-V measurement
  - Grid connected systems only
  - Can also be used for periodic re-testing, re-inspection, maintenance, or modifications

- **System Maintenance 62446-2**
  - At CD stage; publication in 2017
  - Includes preventative and corrective maintenance
  - Both safety-related and performance-related
  - Troubleshooting and documentation of results
Performance Monitoring

- Expanded series of standards
  - 61724-1 System performance monitoring
  - 61724-2 Capacity evaluation method
  - 62724-3 Energy evaluation method

- Future - standardized reporting of performance
  - Information model for system availability (63019)
    - Based on wind turbine document 61400-26
    - Ongoing work in Sandia O&M subteam
  - SunSpec Alliance data protocols
    - Common basis to allow aggregation of data
    - Enables benchmarking and trend identification
Operational Documents

• Published May 2016:
  – OD-401 Conditional PV project certificate
  – OD-402 Annual PV plant performance certificate

• Expected November 2016:
  – OD-405 Quality System Requirements for PV Module Manufacturing
    • 405-1 Requirements for Factory Certification
    • 405-2 Audit Checklist
    • 405-3 Requirements for PV Factory Auditors
Operational Documents

• In process (next 6-9 months):
  – OD-403 PV Plant Design Qualification certificate
  – OD-403-1 PV Site Qualification certificate
  – OD-403-2 PV Power Block Design Qualification certificate
  – OD-401-1 PV Construction Completion certificate
  – OD-404 PV Asset Transfer certificate
  – OD-407 PV Parameters and Definitions
Operational Documents

• Administrative Procedures (Dec 2016):
  – OD-408-1 Procedures for Issuing of IECRE-PV Certificates of Conformity
  – OD-408-2 Procedures for Issuing of IECRE-PV Test Reports
  – OD-408-3 Procedures for Issuing of IECRE-PV Quality Assessment Reports
  – OD-408-4 Procedures for Issuing of IECRE-PV Peer Assessment reports
Standardized database

• Solar Bankability Data to Advance Transactions and Access (SB-DATA)

• “Orange Button” – Funded by US Dept. of Energy
  – Smart Grid Interoperability Panel (SGIP)
    http://www.sgip.org/orange-button/
  – SunSpec Alliance http://sunspec.org/sunspec-osdx/
  – kWh Analytics http://www.kwhanalytics.com/kwh-selected-for-department-of-energys-orange-button-initiative/
  – NREL http://www.orangebuttondata.org/

• Data set for solar asset performance metric
  http://www.xbrl-cet.com/international-electrotechnical-commission.html
Implementation Status

Project Timeline

- Design Qualification
- Substantial Completion
- Annual Performance
- Asset Transfer

Status

- Module selection

- PV plant design guidelines:
  - IEC 62738 – Utility-scale systems guidelines – to be published in 2017

- IECRE OD-405 series – to be published Nov 2016
- IECRE OD-403 series – under development
Implementation Status

**Project Timeline**

- **Design Qualification**
- **Substantial Completion**
- **Annual Performance**
- **Asset Transfer**

**Status**

- **IEC 62446-1** – Commissioning – new edition published
- **IEC 63049** – Quality management for installation process – in development, will be published in 2017
- **IEC 61724-2** – Capacity test – to be published Oct 2016
- **IECRE OD-401** – Published Ed. 2
Implementation Status

Project Timeline

- Design Qualification
- Substantial Completion
- Annual Performance
- Asset Transfer

Status

- IECRE OD-402 – Published Ed. 2
Implementation Status

- Development at concept stage
- Some of the pieces are completed, but not all have been defined yet
Next Steps

• Finalize Rules of Procedure
  – Approval by REMC at meetings in Florida in October

• Develop Operational Documents (ODs)
  – Scope and requirements for each certificate offering

• Accept Participant Applications
  – Certification Bodies / Test Labs / Inspection Bodies
  – Peer assessment process started during 2016

• Start Issuing Certificates by early 2017
Summary

• International standards and conformity assessment are being developed to:
  – Increase confidence in PV plant performance and safety
  – Reduce costs and encourage investment in PV
• First certificates may be issued by end of 2016 – it’s time to start including these requirements in new procurements
• Development will be ongoing, but the foundational pieces should all be available in 2017
• Your suggestions and support in writing/reviewing documents would be welcome!
Thank You

Questions?

Contact george@sunset-technology.com