Recent Progress and Results from IECRE Activities

2019 NIST/UL Workshop on Photovoltaic Materials Durability
Gaithersburg, MD
12-13 December 2019

Steve Hogan
George Kelly
Context and Background

• Continued industry growth
  • Demand increasing 20%+ per year – multi GW/yr
  • Significant increase in large commercial plants
  • Transfer of manufacturing base to China

• Concern for quality / bankability
  • Doubts about adequacy of existing standards
  • Need for improved understanding of reliability
  • Validation of product lifetime for investors

• Overall Structure
  • IEC groups generate Standards (TC82)
  • IECRE utilizes Standards to generate Certification OD’s
  • ARESCA coordinates US IECRE activities (through ANSI)
IEC Organization

IEC Central Office Executive Committee

Standardization Management Board (SMB)

Technical Committees (like TC82)
- Technical Advisory Committees
- Strategic Groups

Conformity Assessment Board (CAB)
- CAB Working Groups
- IECEx
- IECQ
- IECRE
IEC Standards Process

• **170** countries represented
  - 83 “member” and 87 “affiliate” countries
  - One vote per country (national committee)

• **203** Technical Committees / Subcommittees
  - Scope and Work Programme for each TC approved by vote of participating national committees
  - National committees appoint experts to participate in each project
  - Minimum 5 participating countries for a new project

• Rules defined under ISO/IEC Directives
Standards Development
Fundamental Principles

• Established by World Trade Organization
  • Common to ISO, IEC, ITU
• IEC procedures are intended to ensure:
  1. Transparency
  2. Openness
  3. Impartiality and consensus
  4. Effectiveness and relevance
  5. Coherence
• And to address the concerns of developing countries
TC 82 Impact

IEC TC 82 standards, implemented in all major markets, have contributed in the last 35 years to:

- High quality and reliability systems
- Cost Reduction
- Innovation
- Transparent markets and trade
- Safety
How the IECRE System Works

• IECRE itself does not certify, but administers the system and provide its framework through a systematic approach that system participants who issue certificates are qualified
• Qualified registered participants are competent to assess RE equipment and projects
• RECBs(RE Certification Bodies)
• REIBs(RE Inspection Bodies)
• RETLs(RE Test Laboratories)
• Competence validation through regular, revolving peer assessment
• Proper IEC and other international standards are referenced insuring appropriate interpretation of standards
• New standards and requirements can be adopted at any time if required by stakeholders (includes policy makers) and if fitting to the system
• Transparency
• Influence for all stakeholders•All stakeholders have a voice (RECBs, REIBs, RETLs, OEMs, end users, policy makers)
• All national member bodies have a vote
• All participating RECBs recognize & accept IECRE certificates
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, and 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
RE Common Elements

IEC-RE System

IEC WT-CAC
Wind Scheme

IEC ME Marine
Energy Scheme

IEC Solar
Energy Scheme

Factory
Type
1) Turbine Design
2) Turbine Testing
3) Mfg. Quality

Type
1) ME Design?
2) ME Test?
3) Mfg. Quality?

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

Project
Field
1) Installation
2) Commissioning
3) Operation

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

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

- **June 2013** CAB approves the creation of a Renewable Energy Conformity Assessment System
  - Oct 2013 Kick-off meeting in Aarhus, Denmark

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

- **September 2014** First Management Committee (REMC) meeting
  - Each industry sector established an Operating Management Committee (OMC) to address their specific needs and define the certification schemes required

- **October 2016** First IECRE Certificates Issued for wind turbines
IEC Conformity Systems

Conformity Assessment Offerings

CAB - Conformity Assessment Board

IECEE
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
PV-OMC Progress

• Approved Rules of Procedure (RoP) April 2016
  – Updated Ed. 2 balloted in Sept 2017

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

• Operational Documents will describe requirements for different certification offerings
  – Multiple aspects of certification tied to lifecycle / events
  – Certificate often required for financial milestones
PV-OMC Member Bodies

- 12 Countries represented by National Committees

Flags of the 12 countries represented by National Committees:
- China
- Germany
- Japan
- Spain
- Egypt
- Hungary
- South Korea
- United Arab Emirates
- Canada
- India
- Netherlands
- United States
Aspects of Certification

• Conformity assessment will be performed and a 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
System Timeline View

- Site Qualification
- PV Plant Design Qualification certificate
- Power Block Design
- Supplier’s Quality System certificate (Module, Inverter, Installation)
- Conditional Project certificate
- Final Project certificate
- Project O&M certificate
- Annual Performance
- PV Plant Asset Transfer
- PV Plant Decommissioning certificate

IECRE certification offerings

NIST/UL Workshop, Gaithersburg, MD, 13-Dec-2019, Steve Hogan - ARESCA
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
## Operational Documents

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<td>PV Inverter Factory QMS certificate</td>
<td>4xx</td>
<td>Future work</td>
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“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
  – 63157 PCE Manufacturing
• 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?

Project Timeline

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

Example considerations:
- NIST/UL Workshop
- Gaithersburg, MD
- 13-Dec-2019
- Steve Hogan - ARESCA
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?
• 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)
Evaluation of OD-401 Commissioning

- ARESCA study funded by NREL
- Three large systems evaluated
- Three inspection bodies used
Findings from Study
Results presented at NREL PV Reliability Conference, February 2019

• Systems were well engineered, and installations were “clean” – conformed to standards
• A massive amount of data being collected – too much??
• Issues found: Cable management; vegetation control; arc flash hazard identification
• Trackers are more common, but standards are not up to speed yet
• CB’s and IB’s need clarification on responsibility
• Some prerequisite certifications are not practical
Challenge to IECRE (PV)

• Establishing value of certification
• Limited participation by IB and CB entities
• Need to establish user groups to promote use
• IEC will continue to support IECRE PV
• World Bank has interest in Rating System
• Existing processes seem to work for traditionally conservative utilities
• How to address smaller systems (cost)
Next Steps

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

• Approve **Participant Applications**
  – Certification Bodies / Inspection Bodies / Test Labs
  – Begin peer assessment process during 2020

• **Market the process and certification benefits**

• Start **Issuing Certificates** in the PV sector
  – Project Completion
  – Power Plant Performance
  – Module Factory QMS
Thank you for your attention

Questions?

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