

IEC and ASTM PV Standards and Conformity Assessment



Solar ABCs
Stakeholder Meeting
Sept 17, 2015
Anaheim, CA





George Kelly

- Independent Consultant – PV Reliability
- Past Chairman, ASTM Committee E44 on **Solar, Geothermal and other Alternative Energy Sources**
- Secretary, IEC Technical Committee 82 on **Solar Photovoltaic Energy Systems**
- Chairman, U.S. National Committee for IECRE **Conformity Assessment System for Renewable Energy Applications**

IEC Standards for PV Systems



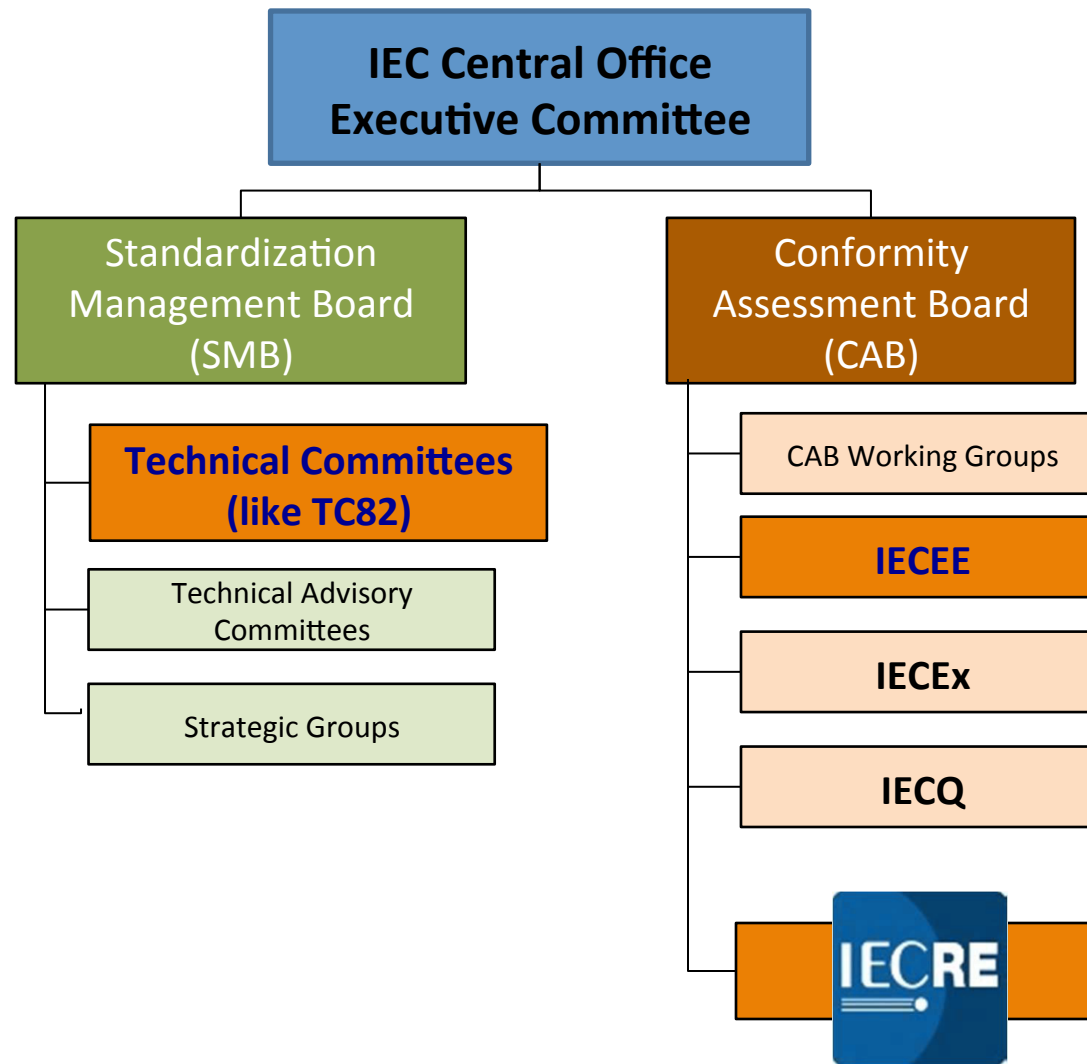
IEC Technical Committee 82 **Solar Photovoltaic Energy Systems**

Roles & Responsibilities



- Standards Management Board (**SMB**)
 - Technical Committees => Write the standards
 - Manage nomination of experts and voting by National Committees (Member Bodies)
- Conformity Assessment Board (**CAB**)
 - Assessment Schemes => Evaluate implementation of standards in specific situations
 - Manage accreditation of Certifying Bodies

Organizational Chart



IEC Standards Process



- **166** countries represented
 - 83 “member” and 83 “affiliate” countries
 - One vote per country (national committee)
- **174** 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

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**

Standards Development Tools



- IEC website: www.iec.ch
 - Current information on all projects
 - Access to all working documents
 - Electronic voting / commenting
 - Templates for drafting standards
 - Web-conferencing
 - Collaboration tools
- Experts Management System (EMS)
 - Administered by national committees
 - Online registration for TC meetings



TC82 Scope



- To prepare international standards for systems of photovoltaic conversion of solar energy into electrical energy and for all the elements in the **entire photovoltaic energy system**.
- In this context, the "photovoltaic energy system" includes the entire field **from light input to** a photovoltaic cell to and including the **interface with the electrical system(s)** to which energy is supplied.

TC82 Structure



- Established **1981**
- **49** countries represented
 - 36 “participating” and 13 “observing” member countries (1 vote each)
 - 350 individual experts
 - 9 active working groups
- TC82 has the **LARGEST** work programme of all IEC committees
 - 72 published standards
 - 80 projects underway (**54 new, 26 revisions**)

TC82 Working Groups



WG 1: Glossary

WG 2: Modules, non-concentrating

WG 3: Systems

WG 6: BOS components

WG 7: Concentrator modules

WG 8: Cells

JWG 1: Decentralized Rural Electrification

JWG 32: Electrical safety of PV system installations (TC 64)

JWG 82: Secondary cells and batteries for Renewable Energy Storage (TC 21)

Modules (WG2) - Technical Areas



- Measurement Principles
- Qualification and Safety Tests
- Power and Energy Ratings
- Specialized Stress Tests
- Module Components
- Module Materials
- PV Module Lifetime Predications

WG2 Highlights



- 61215 Ed.3 Split into Multiple Parts
 - 61215-1 General Requirements (FDIS)
 - 61215-2 Test Methods (FDIS)
 - 61215-1-1 Special Requirements for Testing Crystalline Si (FDIS)
 - 61215-1-2 Special Requirements for Testing CdTe (CDV)
 - 61215-1-3 Special Requirements for Testing a-Si (CDV)
 - 61215-1-4 Special Requirements for Testing CIGS and CIS (CDV)
 - 61215-1-5 Special Requirements for Testing Flexible Modules (NWIP)
- 61730 parts 1 & 2
 - Expect Ed.2 of each early 2016 (FDIS in process)
- 62788 series
 - 10 projects in pipeline; based on PVQAT work

WG3/6 Highlights



- Design
 - 62548 Ed.2 will be IS not TS (CDV in Oct)
 - 62738 for Power Plants (CDV soon)
- 62446 series
 - 1 Commissioning (FDIS in Oct)
 - 2 Maintenance (CD soon)
 - 3 Outdoor IR (NWIP approved)
- 61724 series
 - 1 Monitoring (CDV approved)
 - 2 Capacity test (CDV in process)
 - 3 Energy test (CDV approved)
 - 4 Availability model (CD in process)

Anticipated areas of activity



- **WG2 Modules**
 - Module component specs & tests
 - Reliability & comparative testing
 - Closely tied to PVQA Task Force efforts
- **WG3/6 Systems/BOS**
 - System commissioning and O&M (IECRE related)
 - Safety standards for specific components
- **WG7 Concentrators**
 - Power & energy rating; solar simulator

IEC Certification for PV Systems



IECRE Conformity Assessment System For Renewable Energy Applications

Background



- Industry Growth
 - Demand increasing steadily >20% per year
 - Significant increase in large commercial plants
- Concern for **Quality / Bankability**
 - Doubts about adequacy of existing standards
 - Need for improved understanding of reliability
 - Validation of product lifetime for investors
- Need for **Conformity Assessment**
 - Assurance of security for investments in PV
 - Objective evidence of performance

Conformity Assessment



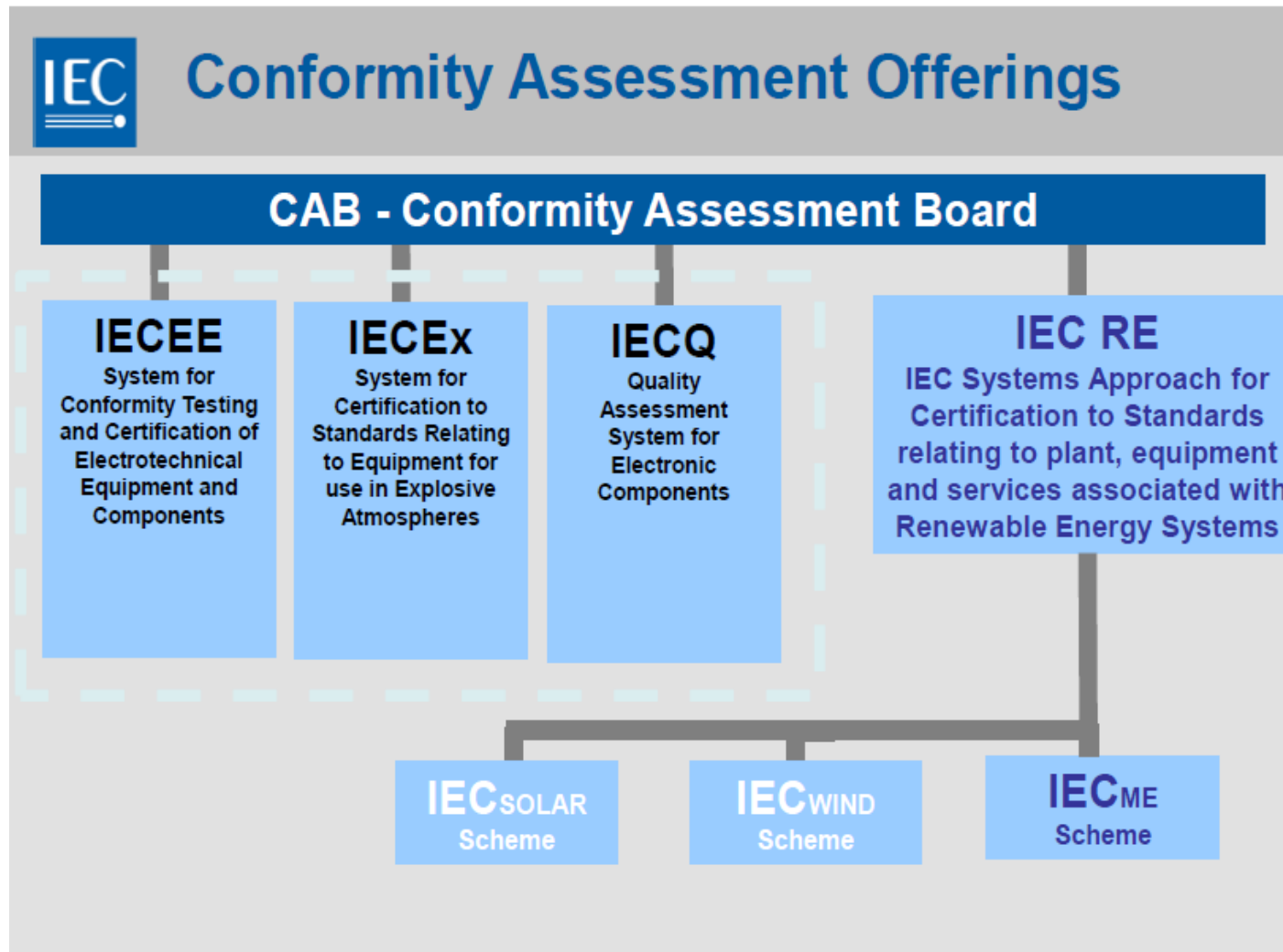
- Evaluation against international standards
 - May use national or regional standards if no international standard is available
- Improved **quality** and **performance**
 - Assurance that power plant will operate as designed for its expected lifetime
- Increased **confidence** for investors
 - Financial return meets expectations
 - Risk is reduced

Benefits of Certification



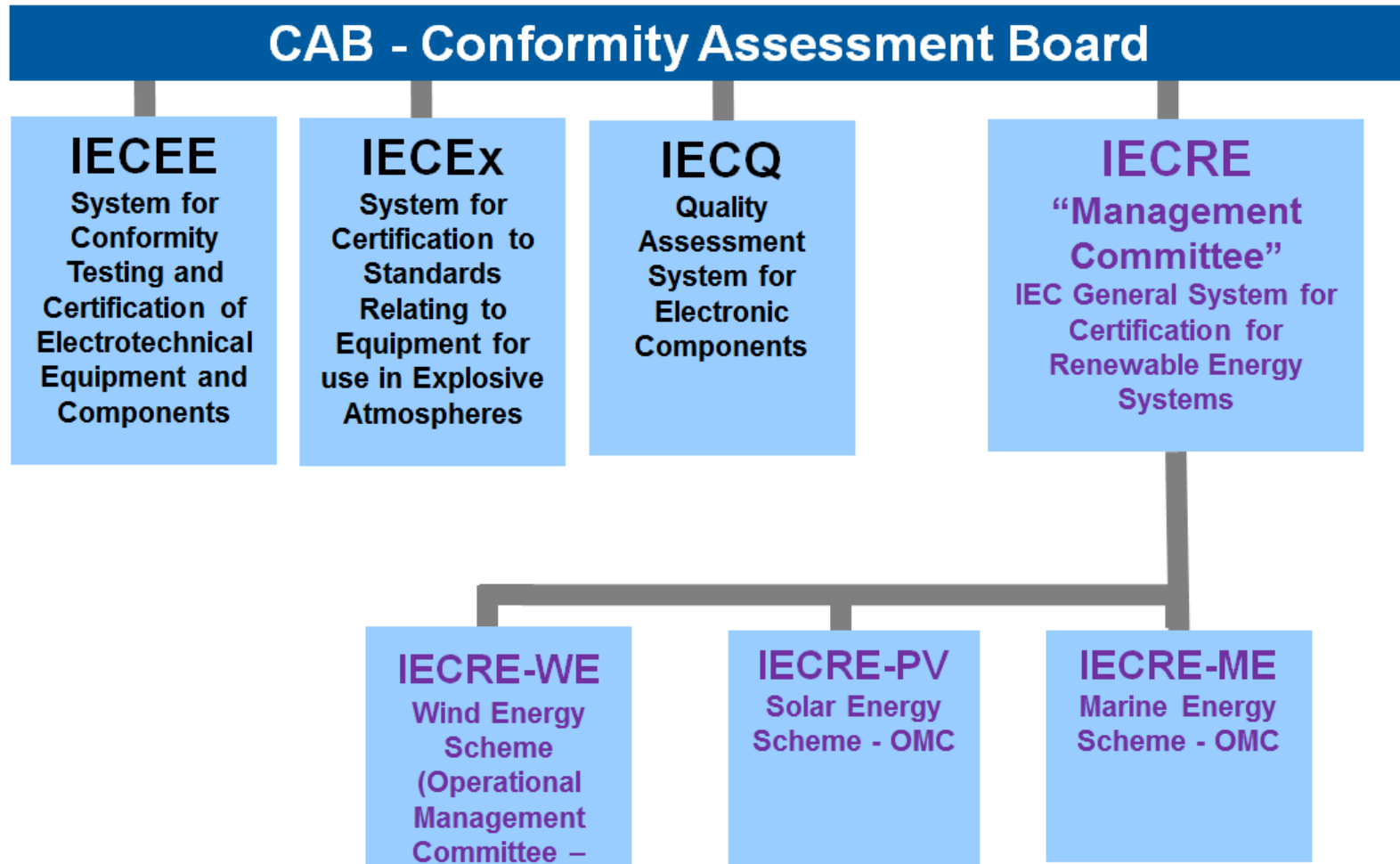
- **Independent assurance** of conformance with appropriate international standards
- Evaluation by accredited inspection bodies in **open and transparent** process
- **Objective evidence** of best practices for investors and financial institutions
- Common need in Renewable Energy (RE) systems across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

IEC CA Systems





IECRE Concept



IECRE Formation



- 2011 Wind industry identifies need to standardize “**system aspects**” of large complex projects
 - Not addressed by any existing CA scheme
 - Common need in other RE industry sectors
- June 2013 CAB approves the creation of a **Renewable Energy** Conformity Assessment 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

IECRE 2015 Meetings



WE-OMC
Austria
2015-Apr



REMC Tokyo
2015-Sep



ME-OMC
Scotland
2015-Apr

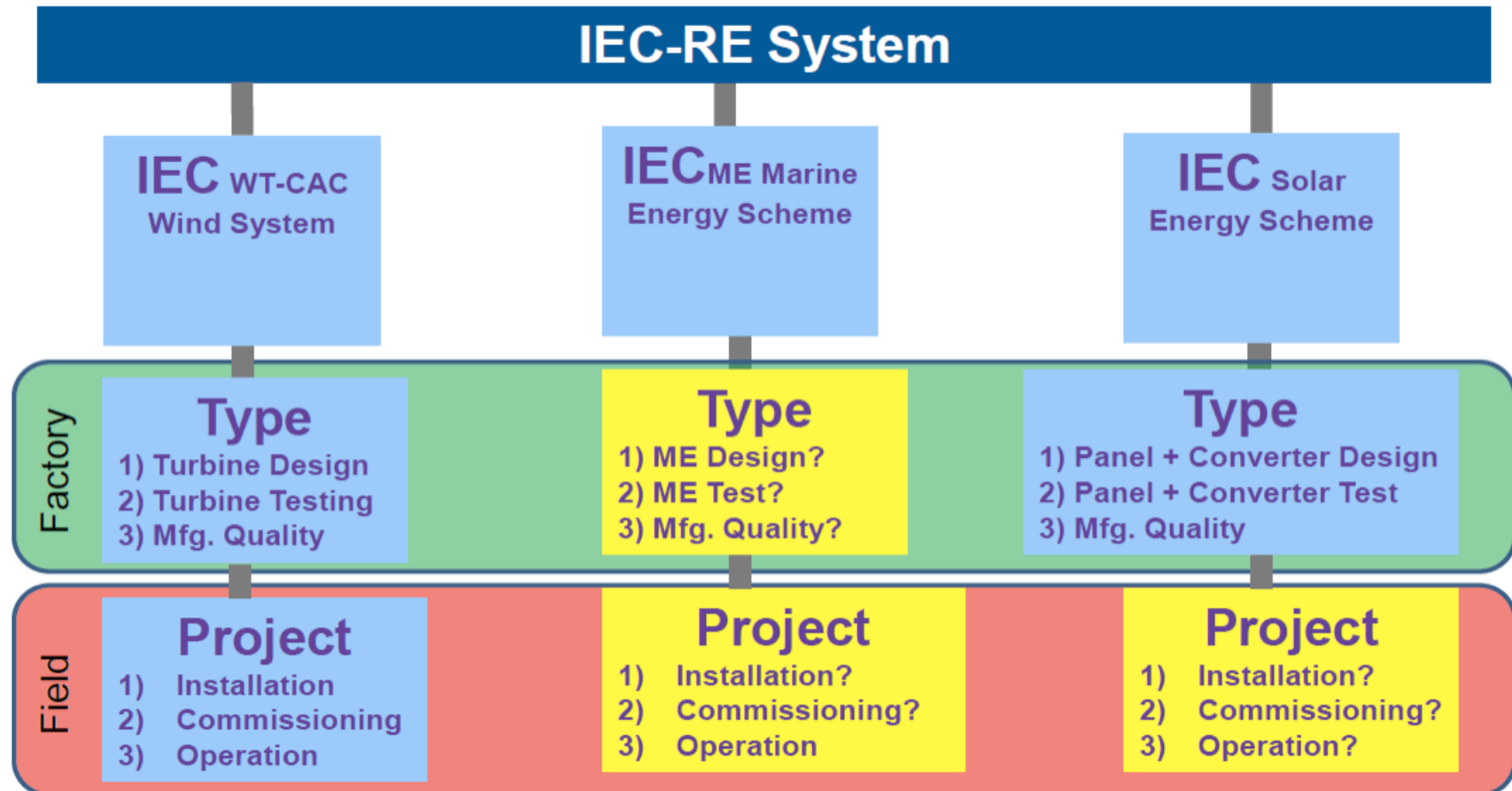
PV-OMC
Germany
2015-May



17 September 2015

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Common Elements



IECRE Rules



- IECRE System **Basic Rules** were approved by CAB in June 2014
 - Scope
 - Membership
 - Organization
 - Officers and administration
 - Legal provisions
 - Voting
 - Finance
 - Etc.
- **Rules of Procedure Ed.2** will be released in early 2016 to clarify definitions
- Aspects of Certification will be covered in **Operational Documents**
- PV **Rules of Procedure** were approved by PV-OMC in Sept 2015
 - Normative references
 - **Terms and definitions**
 - Acceptance of certification bodies
 - Management of the certification system
 - Extent of certification
 - **Aspects of certification**

Aspects of Certification

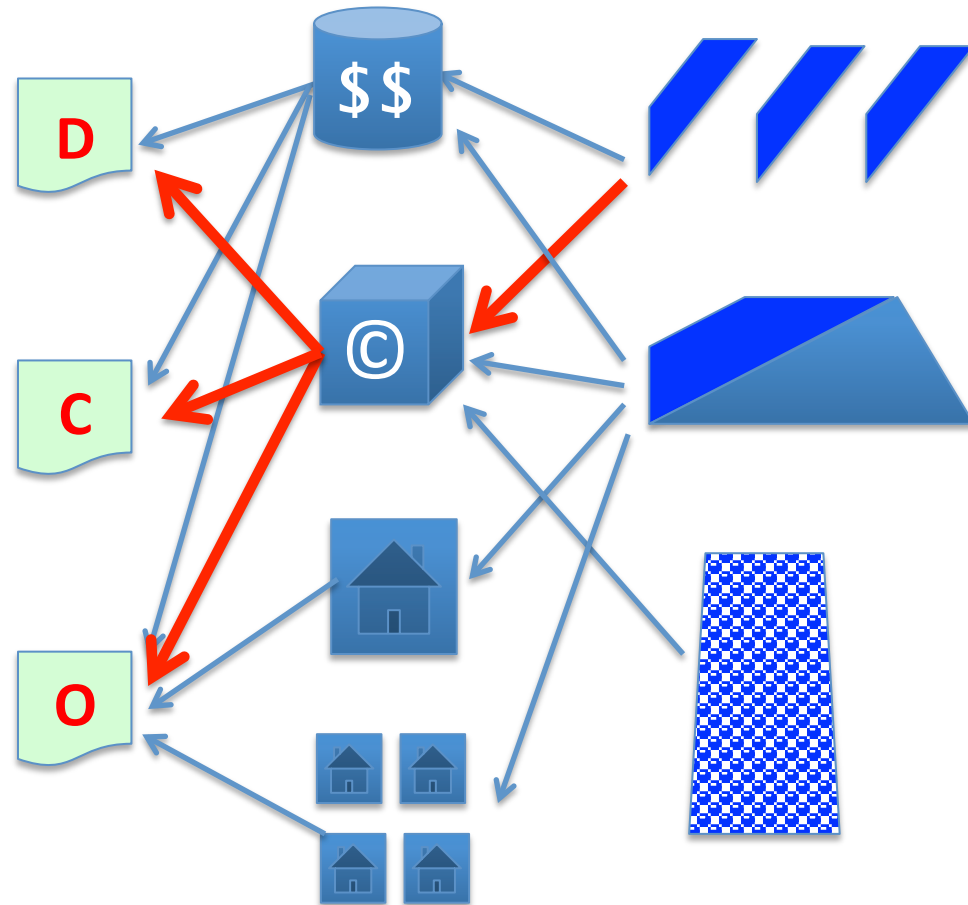


- Conformity assessment will be performed and certificates issued for an individual PV power plant on a specific site at different lifecycle stages
- **Design Phase**
 - General
 - Site conditions evaluation
 - Design evaluation
 - Equipment evaluation
 - Structural and electrical evaluation
- **Implementation Phase**
 - Installation surveillance
 - Output characteristics measurement
 - Commissioning surveillance
 - Operation and maintenance surveillance

System Certification Types



- **Lifecycle Stage**
 - Design
 - Commissioning
 - Operation
- **Operator Class**
 - Utility
 - Commercial
 - Residential
 - Aggregate
- **Location Class**
 - Ground
 - Roof
 - BIPV

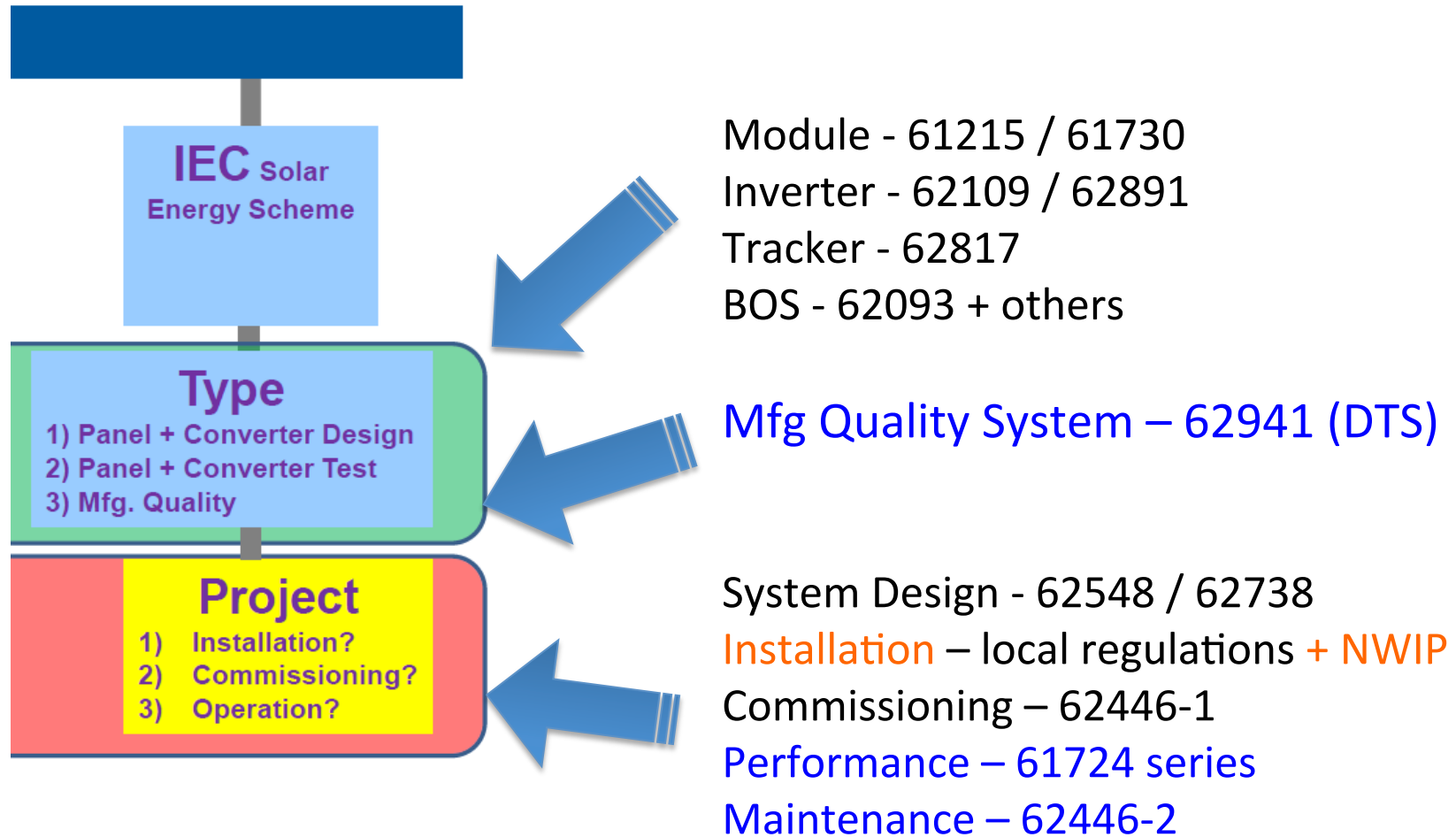




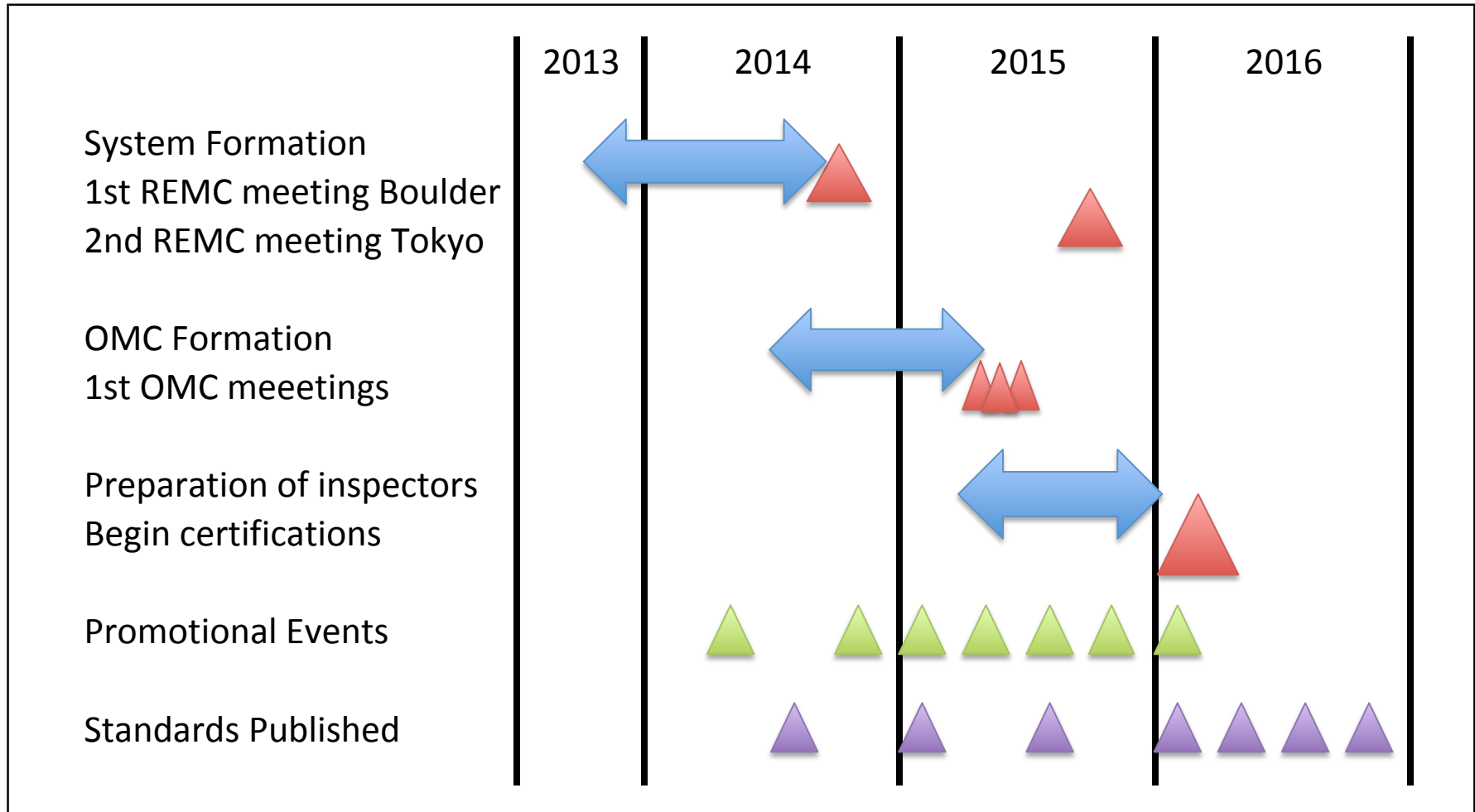
“Certifiable” Standards

- **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

Closing the Gaps



Implementation Schedule



Next Steps



- Update **Rules of Procedure**
 - Approved by PV-OMC last week; Ed.2 by early 2016
- Publish **Operational Documents**
 - First two drafts in progress (**Conditional** and **Final** Certificates)
- Accept **Participant Applications**
 - Certification Bodies / Test Labs / Inspection Bodies
 - Initial list to be approved by PV-OMC in Q4 2015
 - Begin peer assessment process during 2016
- Develop **Test Record Forms** (TRF)
 - Standard checklist of requirements for use by TL/IB
 - Support from PVQAT Task Group 11
- Arrange **“Practice”** Certifications
 - Run through entire process with participating organizations
 - Finalize all requirements to **start issuing certificates in 2016**

ASTM Standards for PV Systems



ASTM Committee E44 **Solar, Geothermal and Other Alternative Energy Sources**

E44 Scope



- The promotion of knowledge, stimulation of research and the development of standard test methods, specifications, guides, practices and terminology concerned with the technology for **conversion of solar and geothermal renewable energy** to directly usable energy forms and the application of such technology for the public benefit.
- The areas of interest shall encompass standards relating to methods and applications of solar and geothermal energy conversion. These methods and applications shall include the following: heating of **domestic hot water**; active and passive **space heating and cooling**; process heating; **thermal conversion** power generation; **photovoltaic generation** of electricity; and advanced energy conversion, including **wind energy**. Consideration shall be given to applicable materials components, subsystems, and systems in each of these methods and applications.

E44 Structure



- Established 1978
- 180 individual experts
 - Categorized by “voting interest”
 - Producer, User, General
- 9 active subcommittees
- 85 experts participating in PV
- 54 published standards
- 6 projects underway (4 new, 2 revisions)

E44 Subcommittees



- E44.01 Terminology and Editorial
- E44.05 Solar Heating and Cooling Systems and Materials
- E44.09 Photovoltaic Electric Power Conversion**
- E44.15 Geothermal Field Development, Utilization and Materials
- E44.20 Optical Materials for Solar Applications**
- E44.25 Heat Metering
- E44.44 Photovoltaic System Fire Safety**
- E44.90 Executive
- E44.93 Government and Industry Liaison

E44 Publications



- E772 Standard Terminology of Solar Energy Conversion
- E903 Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres
- E927 Standard Specification for Solar Simulation for Terrestrial Photovoltaic Testing
- E948 Standard Test Method for Electrical Performance of Photovoltaic Cells Using Reference Cells Under Simulated Sunlight
- E971 Standard Practice for Calculation of Photometric Transmittance and Reflectance of Materials to Solar Radiation
- E973 [Standard Test Method for Determination of the Spectral Mismatch Parameter Between a Photovoltaic Device and a Photovoltaic Reference Cell](#)
- E1021 [Standard Test Method for Spectral Responsivity Measurements of Photovoltaic Devices](#)
- E1036 Standard Test Methods for Electrical Performance of Nonconcentrator Terrestrial Photovoltaic Modules and Arrays Using Reference Cells
- E1038 Standard Test Method for Determining Resistance of Photovoltaic Modules to Hail by Impact with Propelled Ice Balls
- E1040 Standard Specification for Physical Characteristics of Nonconcentrator Terrestrial Photovoltaic Reference Cells

E44 Publications



- E1125 Standard Test Method for Calibration of Primary Non-Concentrator Terrestrial Photovoltaic Reference Cells Using a Tabular Spectrum
- E1143 Standard Test Method for Determining the Linearity of a Photovoltaic Device Parameter with Respect To a Test Parameter
- E1171 Standard Test Methods for Photovoltaic Modules in Cyclic Temperature and Humidity Environments
- E1362 Standard Test Method for Calibration of Non-Concentrator Photovoltaic Secondary Reference Cells
- E1462 Standard Test Methods for Insulation Integrity and Ground Path Continuity of Photovoltaic Modules
- E1597 Standard Test Method for Saltwater Pressure Immersion and Temperature Testing of Photovoltaic Modules for Marine Environments
- E1799 Standard Practice for Visual Inspections of Photovoltaic Modules
- E1802 Standard Test Methods for Wet Insulation Integrity Testing of Photovoltaic Modules
- E1830 Standard Test Methods for Determining Mechanical Integrity of Photovoltaic Modules
- E2047 Standard Test Method for Wet Insulation Integrity Testing of Photovoltaic Arrays

E44 Publications



- E2236 Standard Test Methods for Measurement of Electrical Performance and Spectral Response of Nonconcentrator Multijunction Photovoltaic Cells and Modules
- E2481 Standard Test Method for Hot Spot Protection Testing of Photovoltaic Modules
- E2527 Standard Test Method for Electrical Performance of Concentrator Terrestrial Photovoltaic Modules and Systems Under Natural Sunlight
- E2685 Standard Specification for Steel Blades Used with the Photovoltaic Module Surface Cut Test
- E2766 Standard Practice for Installation of Roof Mounted Photovoltaic Arrays on Steep-Slope Roofs
- E2848 Standard Test Method for Reporting Photovoltaic Non-Concentrator System Performance
- E2908 Standard Guide for Fire Prevention for Photovoltaic Panels, Modules, and Systems
- E2939 Standard Practice for Determining Reporting Conditions and Expected Capacity for Photovoltaic Non-Concentrator Systems
- E3006 Standard Practice for Ultraviolet Conditioning of Photovoltaic Modules or Mini-Modules Using a Fluorescent Ultraviolet (UV) Lamp Apparatus
- E3010 Standard Practice for Installation, Commissioning, Operation, and Maintenance Process (ICOMP) of Photovoltaic Arrays

THANK YOU



Backup Slides



15 June 2015

George Kelly – Sunset Technology

TC82



Measurement Principles

Published Standards

IEC 60891: Temperature and Irradiance Corrections to I-V Curves

[IEC 60904 series](#): Measurement Principles for PV Devices

Active Projects

IEC 60904-1: I-V Curves (CD)

IEC 60904-1-1: I-V Curves for multijunction (CDV)

IEC 60904-8-1: Spectral Response for multijunction (CDV)

IEC 60904-3: Reference spectral irradiance data (FDIS)

IEC 60904-7: Mismatch Calculation (CD)

IEC 60904-9: Solar Simulators (CD)

IEC 60904-12: Infrared (IR) Thermography of Modules (CD)

IEC 60904-13: Electroluminescence (EL) of Modules (CD)

Module Qualification Tests



Published Standards

IEC 61215: 2005 Edition 2 – Crystalline Si Qualification Testing

IEC 61646: 2008 Edition 2 – Thin Film Qualification Testing

Active Projects

Edition 3 of IEC 61215 Split into Multiple Parts

61215-1 General Requirements (FDIS)

61215-2 Test Methods (FDIS)

61215-1-1 Special Requirements for Testing Crystalline Si (FDIS)

61215-1-2 Special Requirements for Testing CdTe (CDV)

61215-1-3 Special Requirements for Testing a-Si (CDV)

61215-1-4 Special Requirements for Testing CIGS and CIS (CDV)

61215-1-5 Special Requirements for Testing Flexible Modules (NWIP)

IEC 62915 TS: Retest Guidelines (DTS)



Module Safety Tests

Published Standards

IEC 61730-1: 2004 Edition 1 – PV Module Safety –
Requirements for Construction

IEC 61730-2: 2004 Edition 1 – PV Module Safety –
Requirements for Testing

Active Projects

IEC 61730-1: Edition 2 (CDV)

IEC 61730-2: Edition 2 (CDV)

Expect next edition of each by Jan 2016

Power and Energy Ratings



Published Standards

IEC 61853-1: Irradiance and temperature performance measurements and power rating

Active Projects

IEC 61853-2: Spectral response, angle of incidence and determination of module temperature (FDIS)

IEC 61853-3: Calculations of module energy rating (CD)

IEC 61853-4: Time periods for calculation of energy rating (CD)

Specialized Stress Tests



Published Standards

IEC 61701: 2012 Edition 2 – Salt mist corrosion testing of PV modules

IEC 62716: 2013 - Ammonia corrosion testing of PV modules

IEC 62804: 2015 - System voltage durability (PID) testing of PV modules

Active Projects

IEC 62759: Transportation testing of PV modules (FDIS)

IEC/TS 62782: Dynamic mechanical load testing of PV modules (DTS)

IEC 62938: Non-uniform snow load (CDV)

Module Components



Published Standards

IEC 62790: Junction boxes for PV modules – Safety requirements and tests

IEC 62852: Connectors for DC applications in PV systems – Safety requirements and tests

Active Projects

IEC/TS 62916: Bypass diode electrostatic discharge (CDV)

IEC 62979: Bypass diode thermal runaway test (CD)

Module Materials



Purpose

- To develop standardized material characterization tests so that module manufacturers can select the materials that meet their **performance** needs
- To determine what material tests should be performed to ensure that PV materials can retain the important parameters required to assure PV module **safety** over their lifetime

Subcommittees Created

- Encapsulants
- Back sheets and front sheets
- Adhesives
- Pottants
- Edge Seals



Module Materials (Cont.)

Active Projects

IEC 62788-1-2: Measurement of encapsulant and backsheet resistivity
(FDIS)

IEC 62788-1-4: Measurement of encapsulant optical transmission
(FDIS)

IEC 62788-1-5: Measurement of encapsulant shrinkage during
processing (FDIS)

IEC 62788-1-6: Measurement of EVA crosslink density (FDIS)

IEC 62805-1: Measurement of haze of TCO glass (CDV)

IEC 62805-2: Measurement of transmittance and reflectance of TCO
glass (CDV)

IEC 62788-2: Frontsheets and Backsheets (CD)

Photovoltaic Systems (WG3)



Published Standards

IEC 61724: Photovoltaic system performance monitoring – Guidelines for measurement, data exchange and analysis

IEC 61725: Analytical expression for daily solar profiles

IEC 61727: Photovoltaic (PV) systems – Characteristics of the utility interface

IEC 61829: Photovoltaic (PV) array – On-site measurement of current voltage (I–V) characteristics

IEC 62253: Photovoltaic pumping systems – Design qualification and performance measurements

IEC 62446: Grid connected photovoltaic systems – Minimum requirements for system documentation, commissioning tests and inspection

IEC/TS 62548: Photovoltaic (PV) arrays – Design requirements

Photovoltaic Systems (WG3)



Active Projects

IEC 61724-1: Photovoltaic system performance monitoring –
Part 1: Monitoring (CDV)

IEC 61724-2: Photovoltaic system performance monitoring –
Part 2: Capacity evaluation method (CD)

IEC/TS 61724-3: Photovoltaic system performance monitoring –
Part 3: Energy evaluation method (CDV)

IEC 61829 Ed. 2: Photovoltaic (PV) array - On-site measurement of
current voltage (I-V) characteristics (FDIS)

IEC/TS 60904-14: Outdoor Infrared (IR) Thermography of Modules
and Systems (CD)

Photovoltaic Systems (WG3)



Active Projects

IEC 62446-1: Grid connected photovoltaic systems – Part 1: Minimum requirements for system documentation, commissioning tests and inspection (FDIS)

IEC 62446-2: Grid connected photovoltaic systems – Part 2: Maintenance of PV systems (CD)

IEC 62548 Ed. 2: Photovoltaic (PV) arrays - Design requirements (CDV)

IEC/TS 62738: Design guidelines and recommendations for photovoltaic power plants (CDV)

IEC/TS 63019: Information model for availability of photovoltaic (PV) power systems (CD)

Balance-of-System Components (WG6)



Published Standards

IEC 61683: Photovoltaic systems - Power conditioners - Procedure for measuring efficiency

IEC 62093: Balance-of-system components for photovoltaic systems - [Design qualification](#) natural environments

IEC 62509: Battery charge controllers for photovoltaic systems - Performance and functioning

IEC 62894: Data sheet and name plate for photovoltaic inverters

IEC 62116: Utility-interconnected photovoltaic inverters - Test procedure of [islanding prevention](#) measures

IEC 62109-1: [Safety](#) of power converters for use in photovoltaic power systems - Part 1: General requirements

IEC 62109-2: [Safety](#) of power converters for use in photovoltaic power systems - Part 2: Particular requirements for inverters

Balance-of-System Components (WG6)



Active Projects

IEC 62093 **Ed. 2**: Balance-of-system components for photovoltaic systems - Design qualification natural environment **(CD)**

IEC 62109-3: Safety of power converters for use in photovoltaic power systems - Part 3: Particular requirements for electronic devices in combination with photovoltaic elements **(CD)**

IEC 62891: Overall efficiency of grid-connected PV inverters **(FDIS)**

IEC/TS 62910: Test procedure of Low Voltage Ride-Through (LVRT) measurement for utility-interconnected PV inverter **(FDIS)**

IEC 62920: EMC requirements and test methods for grid connected power converters applying to photovoltaic power generating systems **(CD)**

IEC 63027: DC arc detection and interruption in photovoltaic power systems **(NWIP)**

Concentrator Modules (WG7)



Published Standards

IEC 62108: Concentrator Photovoltaic (CPV) modules and assemblies
– [Design qualification](#) and type approval

IEC 62108-9: CPV modules and assemblies – Design qualification and
type approval – Part 9: Retest guidelines

IEC 62670-1: Photovoltaic concentrators (CPV) – [Performance](#) testing
- Part 1: Standard conditions

IEC 62670-2: Photovoltaic concentrators (CPV) – [Performance](#) testing
- Part 2: Energy measurement

IEC/TS 62727: Photovoltaic systems – Specifications for [solar trackers](#)

IEC 62817: [Solar trackers](#) for photovoltaic systems – Design
qualification

IEC/TS 62789 Edition 1: Specification of concentrator cell description

Concentrator Modules (WG7)



Active Projects

IEC 62108 **Edition 2**: Concentrator Photovoltaic (CPV) modules and assemblies – Design qualification and type approval **(FDIS)**

IEC 62670-3: Photovoltaic concentrators (CPV) – Performance testing
- Part 3: **Performance measurements** and power rating **(CD)**

IEC 62688: Concentrator photovoltaic (CPV) module and assembly
safety qualification **(CDV)**

IEC 62925: Thermal cycling test for CPV modules to differentiate
increased thermal fatigue durability **(FDIS)**

IEC/TS 62989: Primary Optics for Concentrator Photovoltaic Systems
(CD)



Rural Electrification (JWG1)

IEC/TS [62257 series](#): Recommendations for renewable energy and hybrid systems for rural electrification -

- Part 1: General introduction to IEC 62257 series and rural electrification
- Part 2: From requirements to a range of electrification systems
- Part 3: Project development and management
- Part 4: System selection and design
- Part 5: Protection against electrical hazards
- Part 6: Acceptance, operation, maintenance and replacement
- Part 7: Generators
- Part 7-1: Generators - Photovoltaic generators
- Part 7-3: Generator set - Selection of generator sets for rural electrification systems



Rural Electrification (JWG1)

IEC/TS [62257 series](#): Recommendations for renewable energy and hybrid systems for rural electrification -

- Part 8-1: Selection of batteries and battery management systems for stand-alone electrification systems - Specific case of automotive flooded lead-acid batteries available in developing countries
- Part 9-1: Micropower systems
- Part 9-2: Microgrids
- Part 9-3: Integrated system - User interface
- Part 9-4: Integrated system – User installation
- Part 9-5: Integrated system - Selection of stand-alone lighting kits for rural electrification
- Part 9-6: Integrated system - Selection of Photovoltaic Individual Electrification
- Part 12-1: Selection of self-ballasted lamps (CFL) for rural electrification systems and recommendations for household lighting equipment



Recent Standards Published

Document	Ed.	Date	Title
IEC 62817	1.0	Aug 2014	Photovoltaic systems - Design qualification of solar trackers
IEC 60904-8	3.0	May 2014	Photovoltaic devices - Part 8: Measurement of spectral responsivity of a photovoltaic (PV) device
IEC 62116	2.0	Feb 2014	Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures
IEC 62670-1	1.0	Sep 2013	Photovoltaic concentrators (CPV) - Performance testing - Part 1: Standard conditions
IEC/TS 62548	1.0	Jul 2013	Photovoltaic (PV) arrays - Design requirements
IEC 62716	1.0	Jun 2013	Photovoltaic (PV) modules - Ammonia corrosion testing



Recent Committee Drafts

Document	Working Group	Title
82/892/CD	3	IEC 62738 TS Ed.1: Design guidelines and recommendations for photovoltaic power plants
82/885/DTS	2	IEC 62804 TS Ed.1: Test methods for detection of potential-induced degradation of crystalline silicon photovoltaic (PV) modules
82/884/DTS	6	IEC 62910 TS Ed.1: Test procedure of Low Voltage Ride-Through (LVRT) measurements for utility-interconnected photovoltaic inverter
82/883/CD	7	IEC 62925 Ed.1: Thermal cycling test for CPV modules to differentiate increased thermal fatigue durability
82/875/CD	2	IEC 62941 TS Ed.1: Guideline for increased confidence in PV module design qualification and type approval
82/866/CDV	6	IEC 62891 Ed.1: Overall efficiency of grid connected photovoltaic inverters



Recent New Work Items

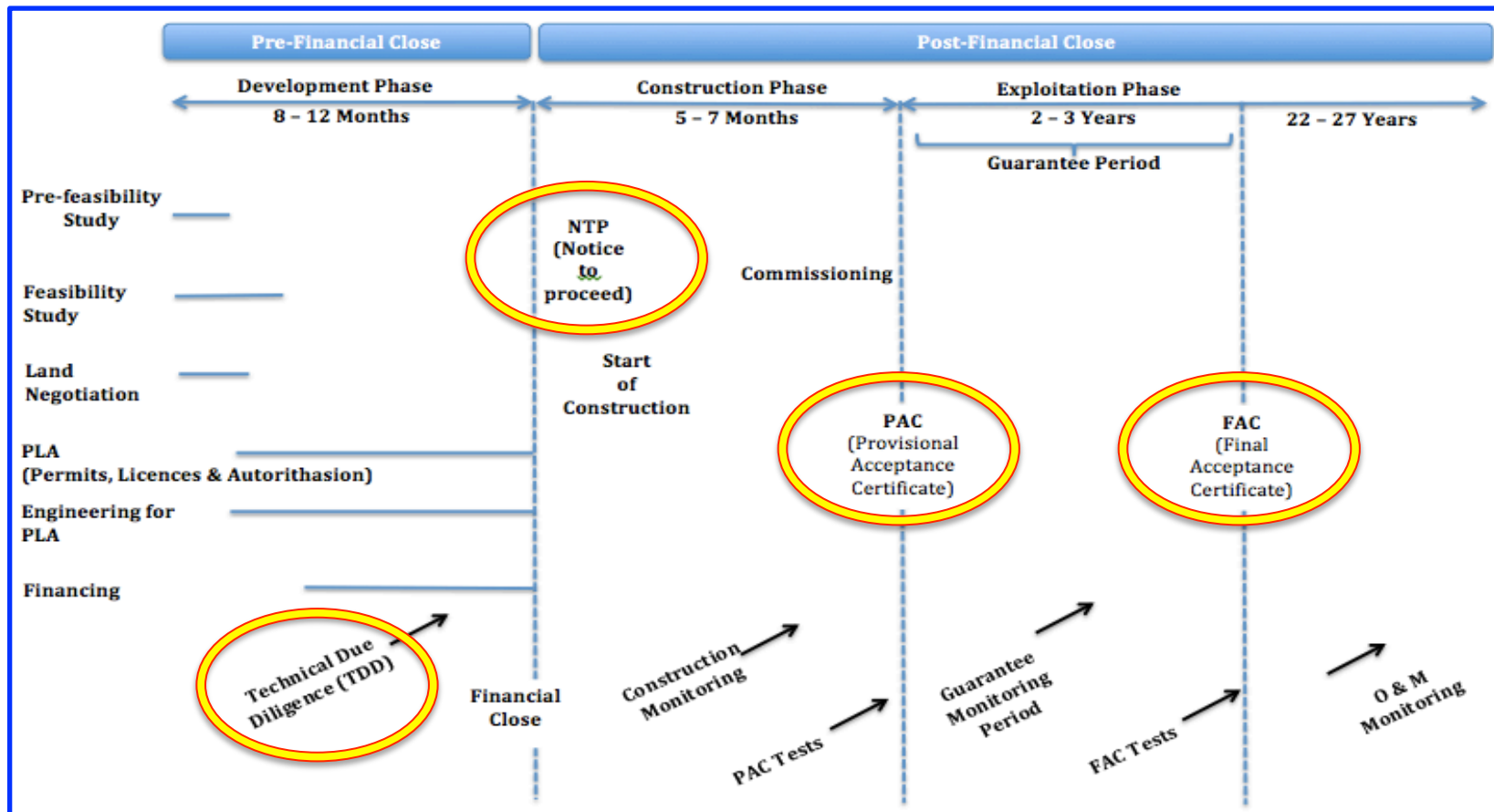
Document	Working Group	Title
82/904/NP	7	Primary Optics for Concentrator Photovoltaic Systems (Future IEC 629XX TS Ed.1)
82/903/NP	2	Measurement procedures for materials used in photovoltaic modules - Part 3-1: Polymeric materials for photovoltaic (PV) modules - Backrail attachment (proposed future IEC 62788-3-1)
82/901/NP	2	Photovoltaic devices - Part 13: Electroluminescence of photovoltaic modules (proposed future IEC TS 60904-13)
82/869/NP	2	Photovoltaic devices - Part 12: Infrared thermography of photovoltaic modules (future IEC 60904-12 TS Ed.1)
82/867/NP	2	Future IEC 62xxx Ed.1: Photovoltaic module bypass diode thermal runaway test
82/826/NP	3	Photovoltaic system energy performance evaluation method

IECRE



PV System Lifecycle

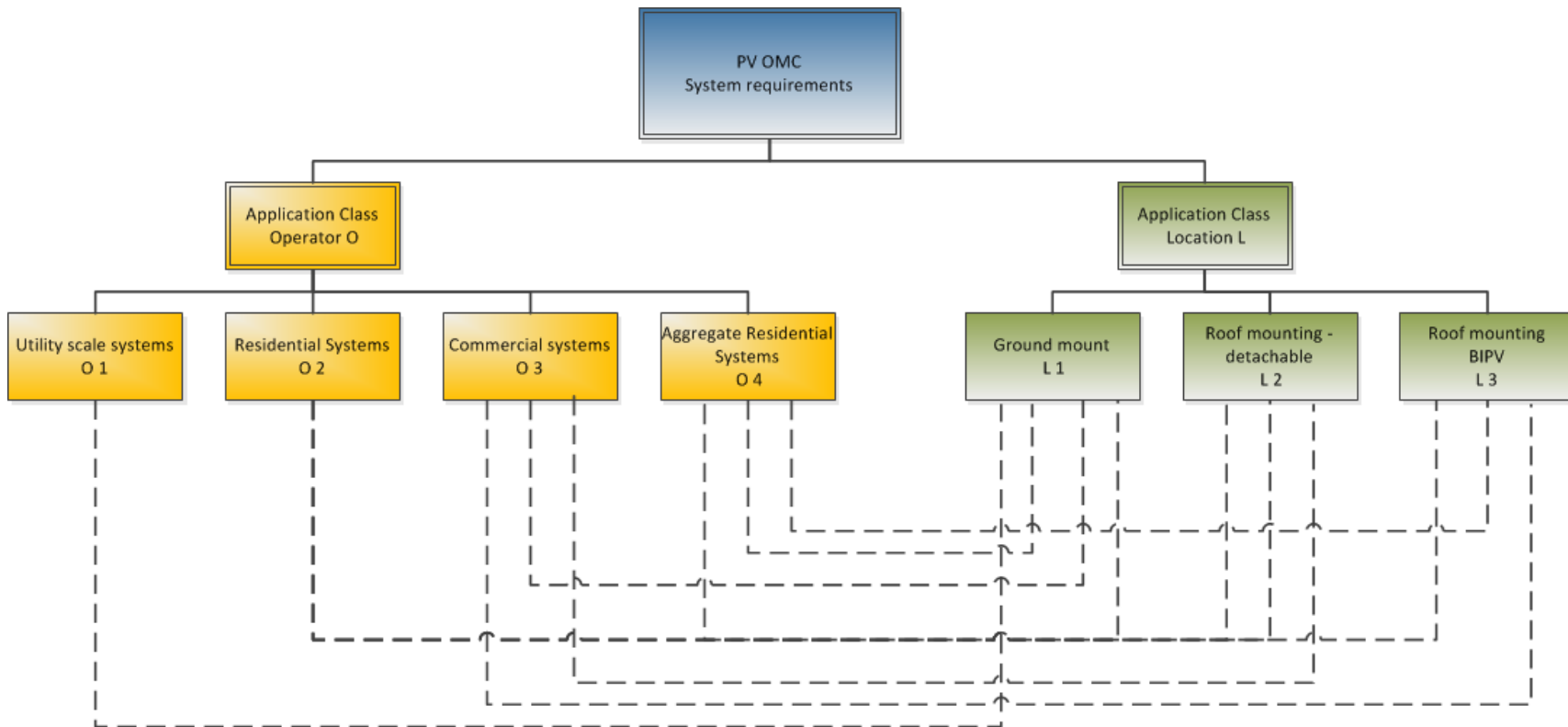
- Different certificates are appropriate at different stages





System Categories

- Requirements may differ by **Operator Class (O)** and **Location Class (L)**



Hardware



- **PV Modules**
 - IEC 61215 Design Qualification
 - IEC 61730 Module Safety
- **PV Inverters**
 - IEC 62891 Inverter Performance
 - IEC 62109 Inverter Safety
- **PV Trackers**
 - IEC 62817 Tracker design qualification
- **BOS Components**
 - IEC 62093 BOS Qualification
 - Multiple IEC, EN & UL standards

QMS Assessment



- **IEC/TS 62941** Guideline for increased confidence in PV module design qualification and type approval
 - At DTS stage in TC82 (expected publication end 2015)
 - 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)

System Design



- IEC/TS **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)
 - CDV to be circulated this month for Ed. 2
- IEC/TS **62738** PV Power Plant Design
 - Specific to utility-scale plants; special techniques allowed
 - CDV in process; publication in 2016

Installation



- No international standard - **local regulatory requirements**
 - NFPA 70 US National Electrical Code
 - IEC 60364 series in Europe
 - Multiple building and fire codes (IBC, IFC, etc.)
- Different documents for different audiences
 - 60364-7-712 = Professional electricians (particularly EU)
 - IEC 62548 = Developing markets or no existing codes
- Special Applications
 - ASTM E2766 for Steep-sloped Roofs
 - IEC 62980 for Curtain Walls

Commissioning



- IEC 62446(-1) Ed. 1
 - Minimum commissioning tests and inspection criteria
 - Minimum documentation to verify safe installation and correct operation
 - 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
- Ed. 2 at FDIS stage; publication in 2015
 - Additions to address different **categories** of systems
 - Test regimes differentiated as appropriate for the system type, scale, and complexity

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 (NWIP)
 - 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

O&M



- Operation
 - ASTM Task Group ([ICOMP](#))
 - Publishing guideline to available standards 2015
 - Future work to focus on power plant operations
 - Collaborating with:
 - Sandia O&M working group
 - Solar Access to Public Capital (SAPC)
 - SunSpec Alliance
- Maintenance
 - [62446-2](#) at CD stage; publication in 2016
 - Includes preventative and corrective maintenance
 - Both safety-related and performance-related
 - Troubleshooting and documentation of results

E44



Standards - *Improving Quality & Efficiency for your Industry*

George Kelly, ASTM E44

What We Will Cover

- **About ASTM International**
- **Standards Development**
- **Global Acceptance and Use**
- **E44 PV Standards**



ASTM International

- **Primary Objective:**

- ...is to be the foremost developer and provider of consensus standards, related technical information, and services having globally recognized quality and market relevance

About ASTM International

- **ASTM International**

- 111 year-old international not-for-profit organization that develops consensus standards – including test methods
- Participation open to all - 30,000 technical experts from across the globe

- **ASTM's Objectives**

- Promote public health and safety
- Contribute to the reliability of materials, products, systems and services
- Facilitate national, regional, and international commerce

- **ASTM Standards**

- Voluntary until referenced in a code, regulation or contract.
- Known for high technical quality and usability.
- Over 12,000 ASTM standards for more than 100 industry sectors
- 6,000 ASTM standards used in regulation or adopted as national standards around the world in at least 80 countries

About ASTM International

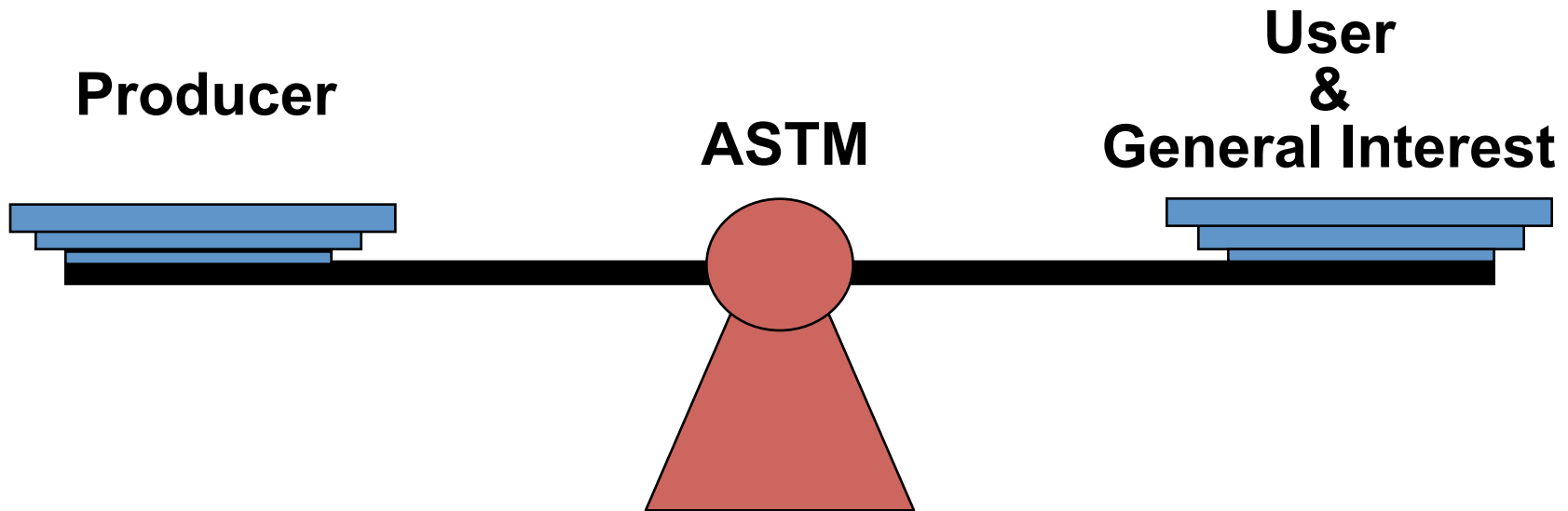
Forum

- ❖ All stakeholders involved
- ❖ Every member has equal say
- ❖ Consensus-based procedures
- ❖ Private and public sector cooperation
- ❖ One vote per organization

Examples:

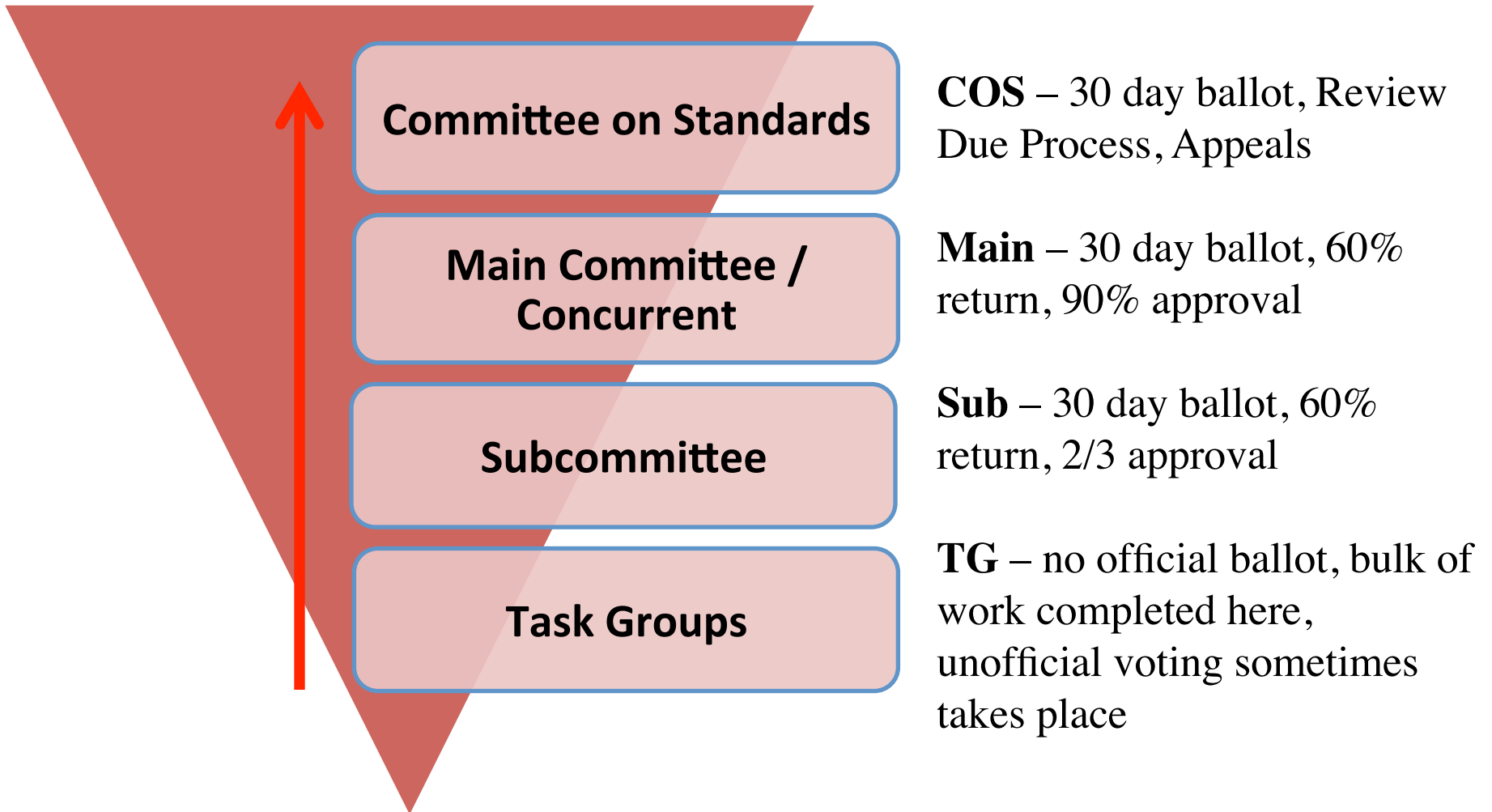
Manufacturers, Regulatory agencies, Associations, Professional societies, Professionals and Consultants, Academia, Research Institutions and laboratories

Balance of Interest

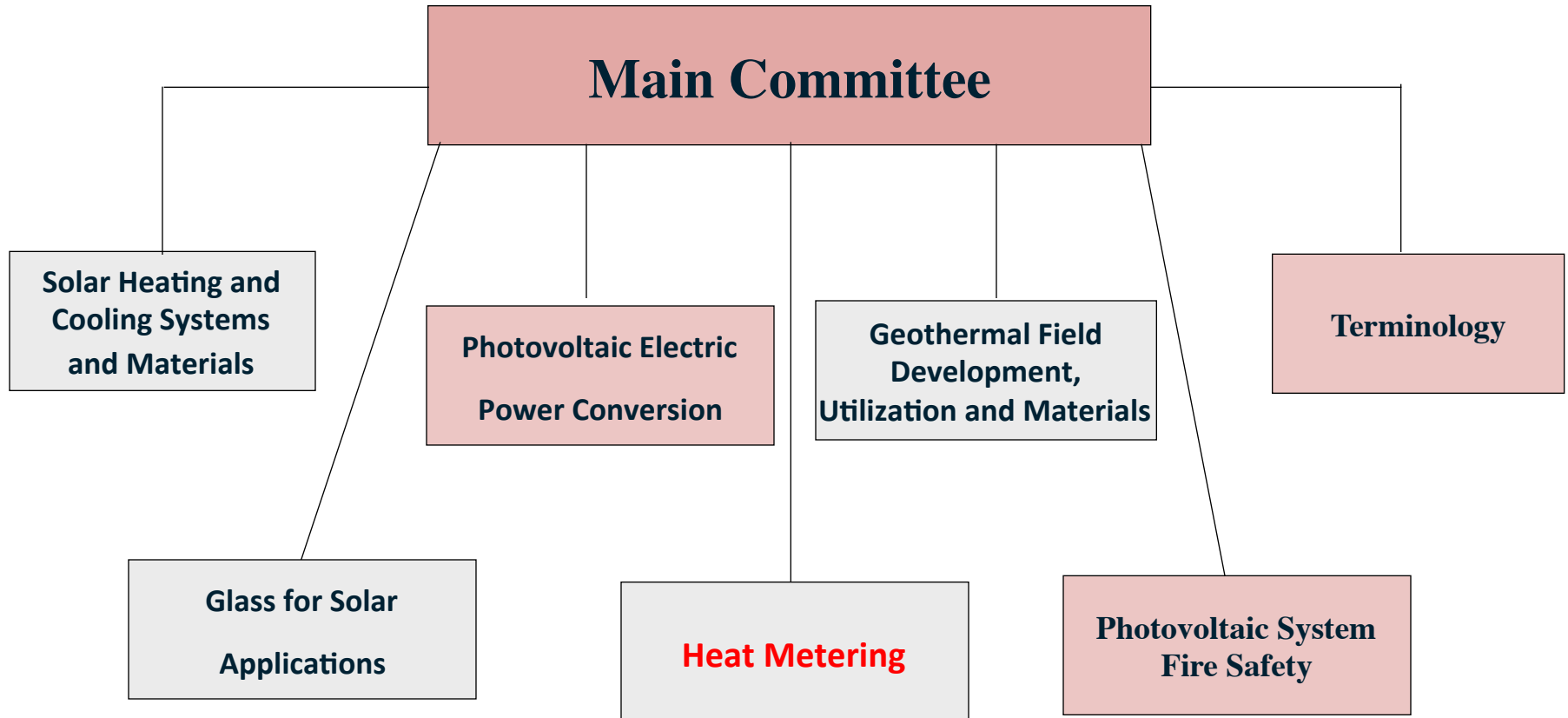


*Technical Committees are balanced.
No excess influence by any interest group.
Ensures market relevance of the content of standards.*

ASTM Balloting Scheme



Creating E44 Standards



Subcommittee E44.09

Photovoltaic Electric Power Conversion

Formed in 1978

- ❖ 24 published standards
- ❖ 100+ members

Scope:

- ❖ Evaluating the design and performance of PV power systems.
- ❖ Include all components necessary for
 - conversion,
 - conditioning,
 - storage,
 - control,
 - distribution of power

E44.09 Primary Standards

Key Standards Covering:

- ❖ E1036 Test Methods for Electrical Performance of Nonconcentrator Terrestrial Photovoltaic Modules and Arrays Using Reference Cells
- ❖ E1125 Test Method for Calibration of Primary Non-Concentrator Terrestrial Photovoltaic Reference Cells Using a Tabular Spectrum
- ❖ E2527 Test Method for Electrical Performance of Concentrator Terrestrial Photovoltaic Modules and Systems Under Natural Sunlight
- ❖ E2766 Practice for Installation of Roof Mounted Photovoltaic Arrays on Steep-Slope Roofs
- ❖ E2848 Test Method for Reporting Photovoltaic Non-Concentrator System Performance
- ❖ E2939 Practice for Determining Expected Capacity and Reporting Conditions for Photovoltaic Non-Concentrating Systems **NEW SEPT 2013**
- ❖ E3010 Practice for Installation Commissioning Operation and Maintenance Process (**ICOMP**)

Other Photovoltaic Standards

E44.44 PV Fire Safety

- ❖ E2908 Guide for Fire Prevention for Photovoltaic Panels, Modules, and Systems

E44.01 Terminology

- ❖ E772 Terminology of Solar Energy Conversion

New Standards Under Development

- ❖ WK38365 Test Methods for Ultraviolet Conditioning of Photovoltaic Modules or Mini-Modules Using a Fluorescent Ultraviolet (UV) Lamp Apparatus

How to Get In the Know?

Become a Member:

- 24 hour online access to ballots, meeting minutes and agenda
- Networking and roster access
- Free copy of the ASTM standards for \$75 annual membership

Notifications:

- Sign up for free email alerts
- Electronic News releases

Task Group Participation:

- Open Meetings
- Online Collaboration Areas

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