

Smart Grid Testing and Certification

July 28, 2017

1:00-3:00 PM



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2017 Technical Program

Smart Grid Testing and Certification Committee (SGTCC)



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Agenda

SGTCC Overview

- Recent Accomplishments
- Future Work Plan

Overview of the IEEE's Conformity Assessment Program (ICAP)

Electromagnetic Interoperability Issues (EMIIWG) Working Group Introduction

Smart Grid Testing and Certification Committee Overview, Accomplishments, and Future Directions

Cuong Nguyen, NIST



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SGTCC Overview



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- Smart Grid Testing and Certification Committee (SGTCC) is a working group within SEPA
- SGTCC high level goals are
 - ✓ To establish and maintain a framework for smart grid testing and certification programs
 - ✓ To accelerate the development of test programs in support of smart grid standards
 - ✓ To support existing and emerging test programs in their implementation of the SGTCC framework
 - ✓ To build awareness and encourage adoption of test programs that help to enable interoperability

Recent Accomplishments



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- Testing Prioritization Project
 - Identify, prioritize and address testing needs, gaps and opportunities for Smart Grid standards
- Outreach Initiative
 - Engage with Smart Grid industry stakeholders to communicate the value and importance of testing
- PAP 23 focused on requirements for Distribution Feeder Measurements and fed into the UCAIug IEC 61850 Test Program

Recent Accomplishments (Cont.)



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- Provide Catalog of Standards informational reviews assessing testing related attributes
- Support test programs in their IPRM implementation and recognize their success
- Catalog of Test Programs (CoTP)
 - CoTP Attributes Form
 - ITCA Attributes Worksheet
- Interoperability Process Reference Manual (IPRM) Standard

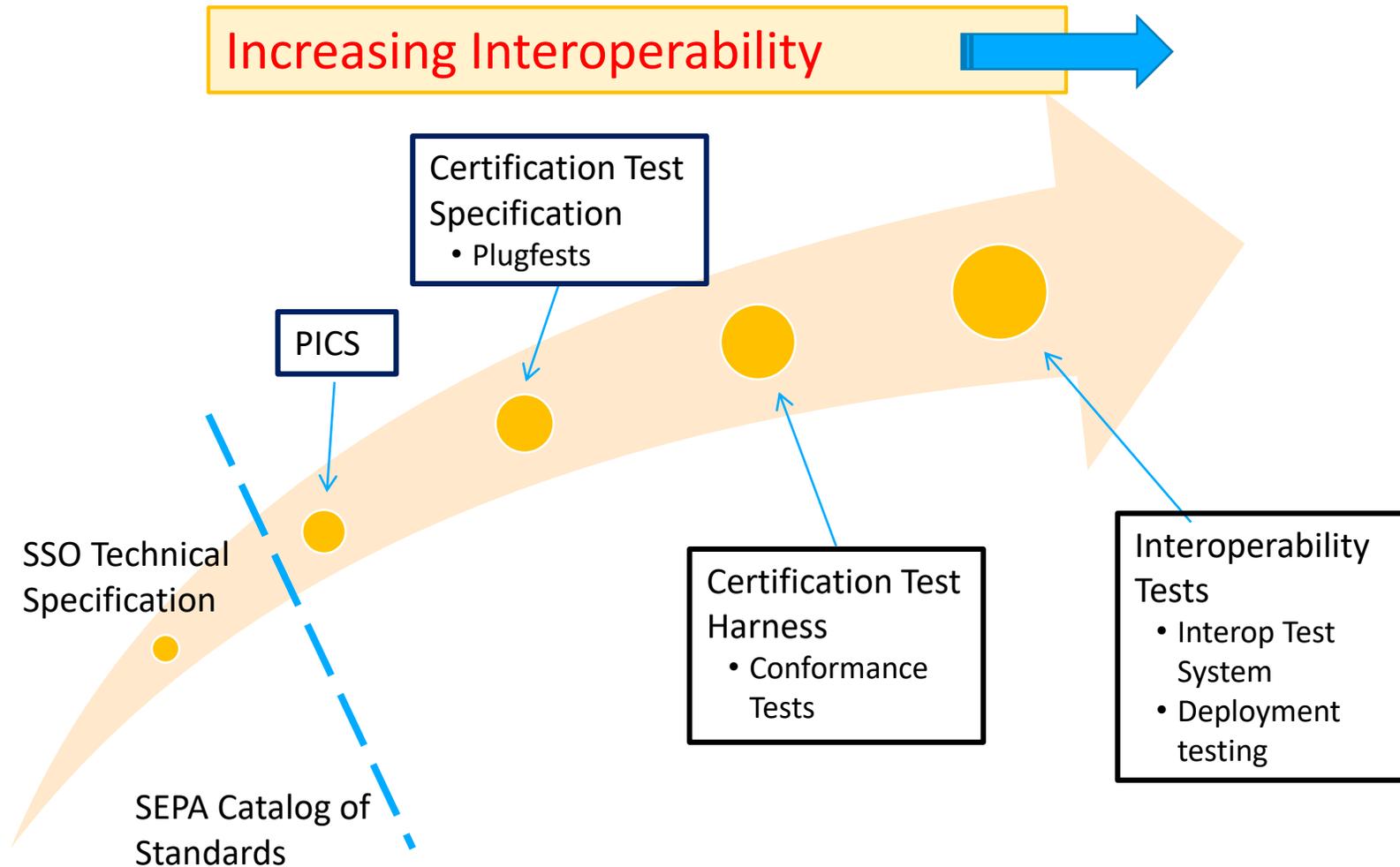
SGTCC's Testing and Certification Framework

- SGTCC conducted a landscape analysis of available smart grid test programs
- The study found a limited number of existing smart grid test programs
- As a result, the SGTCC embarked on the creation of an operational framework to spur the development of test programs to support the smart grid industry
- The Interoperability Process Reference Manual (IPRM) is the primary document defining the framework for Smart Grid testing and certification

Conformance and Interoperability

- Conformance testing – product conforms to specification
- Interoperability testing – products from different vendors interoperate
- ***Conformance testing DOES NOT guarantee interoperability BUT greatly improves its probability***
- Both are necessary

Smart Grid Testing and Certification



Evolution of the IPRM



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- In November 2010, SGTCC published version 1 of the IPRM that was informational
- Version 2, published in January 2012, was expanded to enhance the usability of the document
- By the time Version 3 was published in 2015, NIST and SGTCC leadership recognized that the IPRM had matured through revisions
- It had already been adopted by several new test programs including the Green Button, OpenADR, and IEEE Phasor Measurement Unit test programs
- In January 2015, SGIP and National Electrical Manufacturers Association (NEMA) entered into an agreement to transition the IPRM into an ANSI/NEMA standard

ANSI/NEMA SG-IPRM 1-2016 Standard



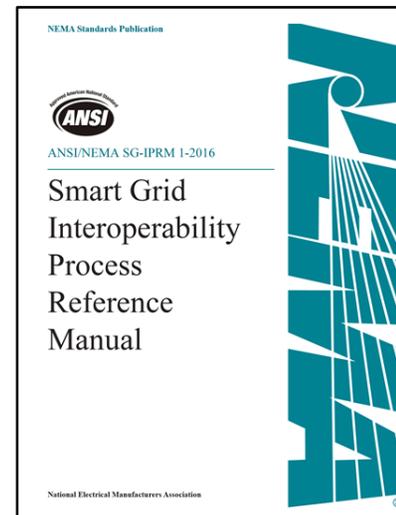
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- The IPRM standardization effort is completed
- NEMA published the new standard, Smart Grid Interoperability Process Reference Manual, ANSI/NEMA SG-IPRM 1-2016 (IPRM), in May 2016
- The standard codifies the IPRM that SGTCC has developed and refined over the past six years and it retains much of the technical material from all three versions of the IPRM



<http://www.nema.org/Standards/Pages/Smart-Grid-Interoperability-Process-Reference-Manual.aspx>

IPRM Overview



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The major goals of the IPRM are

- to increase buyers' confidence that the certified smart grid-related products they purchase will be interoperable with existing systems
- to enhance the testing and certification processes, through a set of best practices, across multiple standards
- to reduce costs and shorten the implementation cycle time of certified products

Key IPRM topics include

- Best Practices for Interoperability Test Construction
- Criteria for certification body processes
- Criteria for test laboratory best practices
- Best Practices for Cybersecurity Test Construction
- Interoperability Testing and Certification Authority (ITCA) implementation of the IPRM recommendations

Key IPRM Concepts



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- All certification bodies and test labs operating programs associated with Smart Grid standards accredited in accordance with globally recognized ISO/IEC standards
 - Certification Bodies – ISO/IEC 17065 accreditation
 - Test Laboratories – ISO/IEC 17025 accreditation
- The IPRM introduces the concept of an “Interoperability Testing and Certification Authority (ITCA),” an entity that designs and manages the end-to-end processes associated with interoperability testing and certification with appropriate supportive infrastructure

ITCA Roles and Responsibilities

Interoperability Testing and Certification Authority (ITCA) supports standards implementation by

- Designing, developing and managing a testing and certification program
- Monitoring and enforcing testing and certification policies and procedures
- Managing relationships between various actors and stakeholders
- Managing conformance and interoperability assessments in the course of standard creation

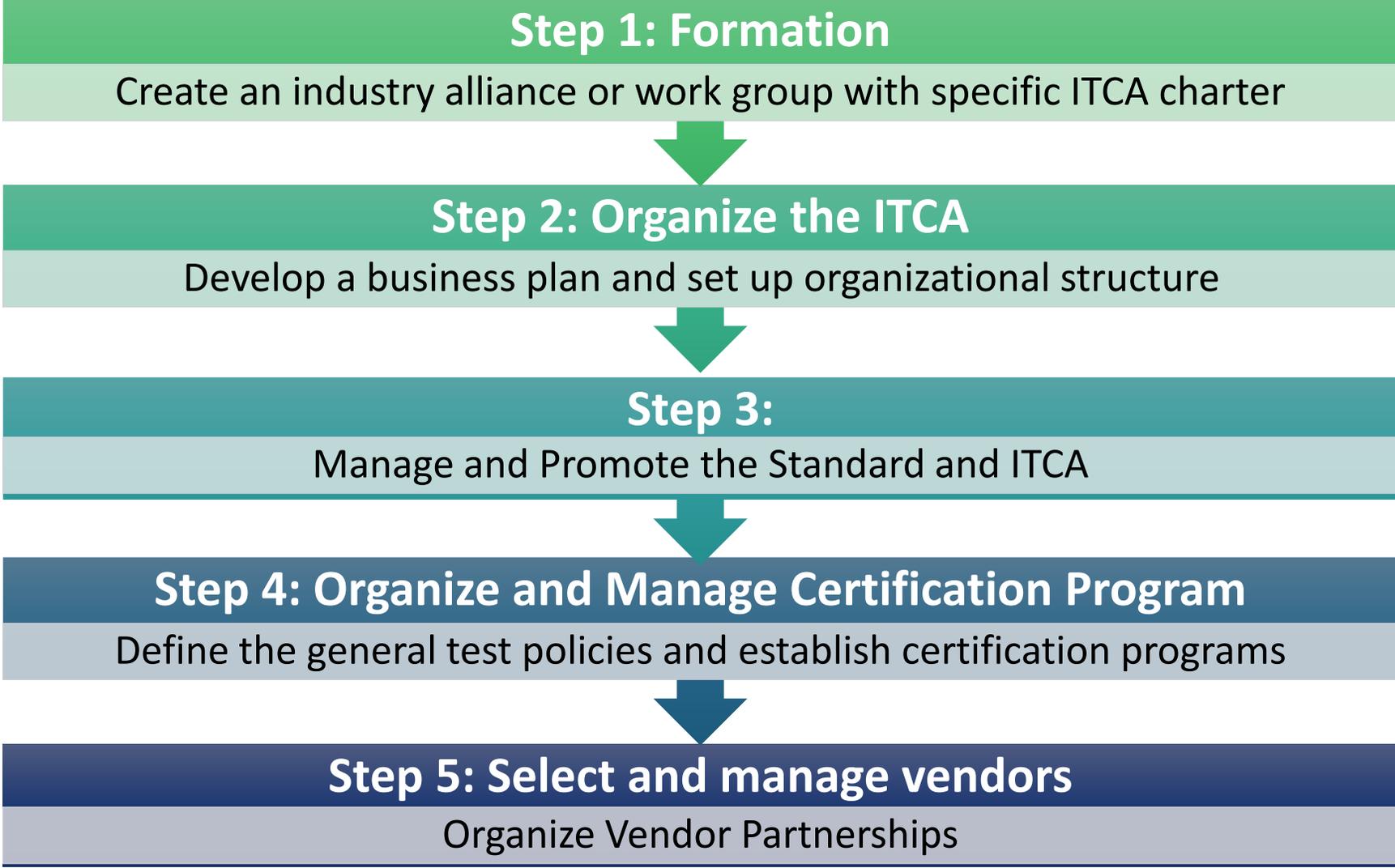
Implementing an ITCA



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Additional IPRM Recommendations

- Interoperability and Conformance Test Program Construction
 - General Test Policies
 - Test Suite Specification
 - Attributes of a Test Profile in lieu of Complete TSS
 - ITCA Technical Program Design
- Interoperability Certification Body and Test Laboratory Requirements
 - Certification Bodies and Test Laboratories
 - Governance
 - Laboratory Qualification
- Additional Issues Impacting Interoperability
 - Cybersecurity
 - Electromagnetic Compatibility Considerations

IPRM Users' Guide



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- The User's Guide contain:
 - A high-level overview of the IPRM and its history
 - An IPRM implementation approach
 - Includes tasks with details on recommended steps and processes
 - Additional business recommendations for ITCAs
 - Special considerations for assessing cybersecurity and electromagnetic immunity
 - Business recommendations

IPRM Users' Guide Team



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- Cuong Nguyen, Lead, NIST
- Don Heirman, American Council of Independent Laboratories
- Rolf Bienert, OpenADR Alliance
- Kosta Tolios, DTE Energy
- Khaled Masri, NEMA
- Brent Cain, Itron
- Brian Marchionini, NEMA

IPRM Users' Guide Status



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- Final draft completed and is being reviewed by SEPA and NEMA
- Publication planned for September 2017
- Webinar launch

Catalog of Test Programs



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- Identified basic information to collect for each test program
- In discussion with SEPA staff for web support
 - Information layout
 - Collection form and process
- Recruiting test programs for initial data entry

Future Directions



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- Publish IPRM Users' Guide
 - A webinar launch
- Continue to support OpenFMB on testing needs
- Engage with Smart Grid industry stakeholders to communicate the value and importance of testing
- Conduct Smart Grid testing needs analysis based on evolving architecture
 - Update prioritization document
- Catalog of Test Programs
 - Launch website and populate data
- Contribute to model procurement language on testing and certification
- Support the NIST Smart Grid Interoperability Framework Version 4.0 Update

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IEEE-SA Conformity Assessment Program

Presented by: Jason Allnutt, ICAP Specialist
Friday, July 28th, 2017



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ICAP Completes the IEEE-SA Business/Standards Lifecycle



ICAP is a
Program of
IEEE-SA

IEEE – Conformity Assessment Program (ICAP)

Mission: ICAP develops and implements programs that couple standards development activities with conformity assessment activities, which help to accelerate market adoption of IEEE Standards while reducing implementation costs.

ICAP Power Portfolio:

- Phasor Measurement Unit (PMU) – IEEE C37.118
- PTP Power Profile – IEEE C37.238
- COMTRADE - IEEE C37.118
- Distributed Energy Interconnects – IEEE 1547/1547.1
- IEEE Nuclear Equipment Standards – IEEE P60780 – 323
- EV Charging – IEEE 2030.1.1

ICAP Webpage [Link](#)

ICAP Phasor Measurement Unit (PMU) Conformity Assessment Program



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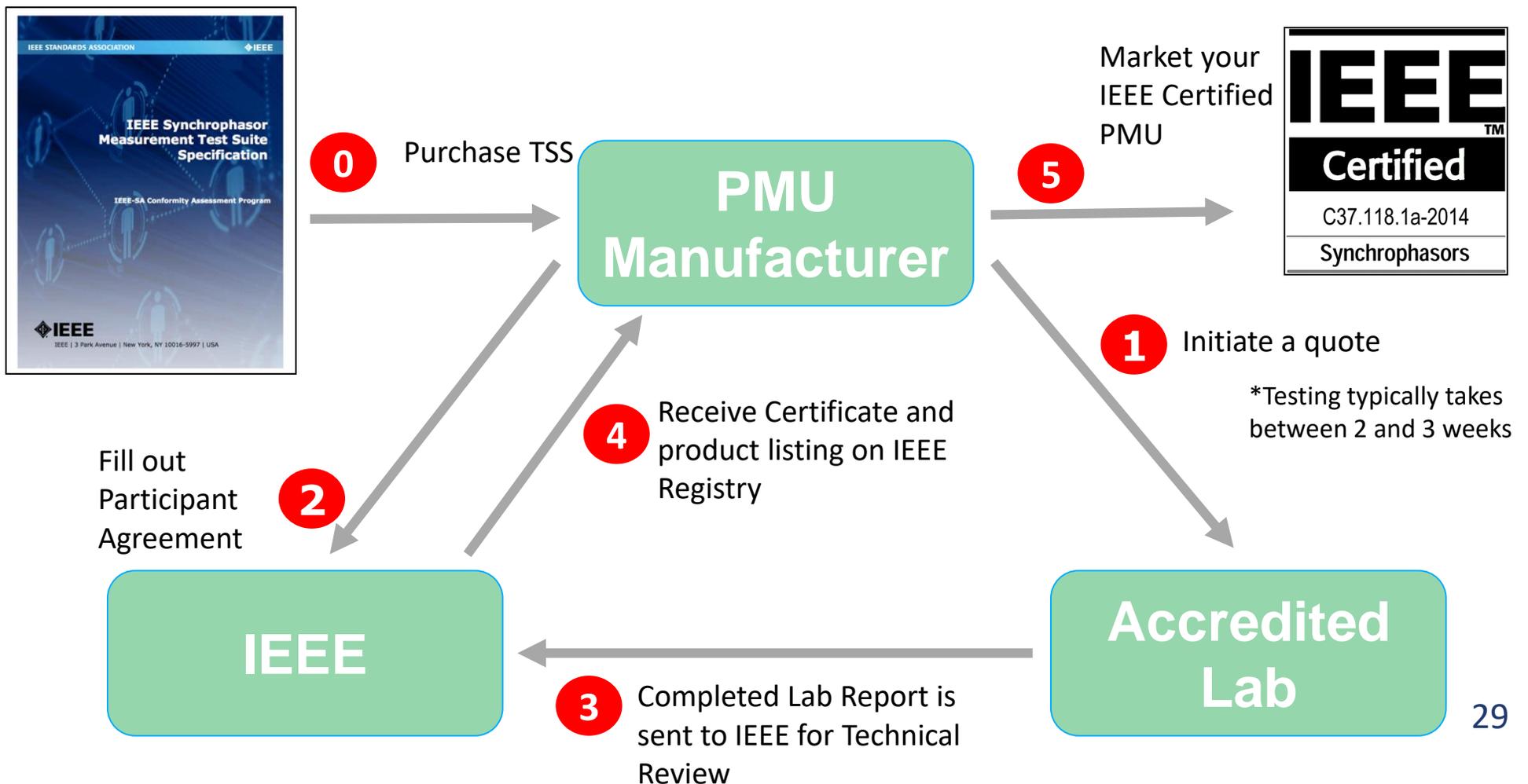
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- Purpose of the program is to enable PMU Manufacturers to demonstrate conformance to IEEE C37.118.1a – 2014
- The Steering Committee (SC), which consists of volunteer Subject Matter Experts in the power and energy field, has worked since 2012 to develop and approve the main requirements of the program.
- In addition to the program details the SC has also created the *IEEE Synchrophasor Measurement Test Suite Specification (TSS)* available for purchase through IEEE
- Consumers Energy (Jackson, MI) was the first ICAP Accredited Lab and offers complete testing capabilities to the TSS
 - First certified PMU in early 2016
 - More Info on Consumers Energy at www.laboratoryservices.com

IEEE Phasor Measurement Unit (PMU) Certification Program

- Purpose of the program is to enable PMU Manufacturers to demonstrate conformance to IEEE C37.118.1a – 2014



ICAP 1588 Power Profile Certification



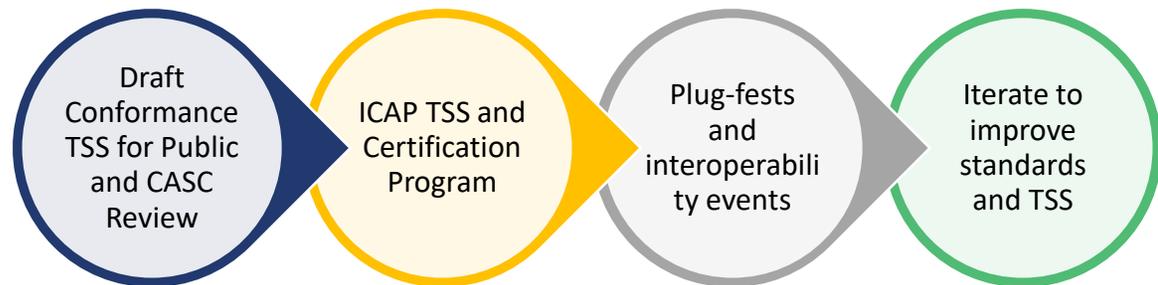
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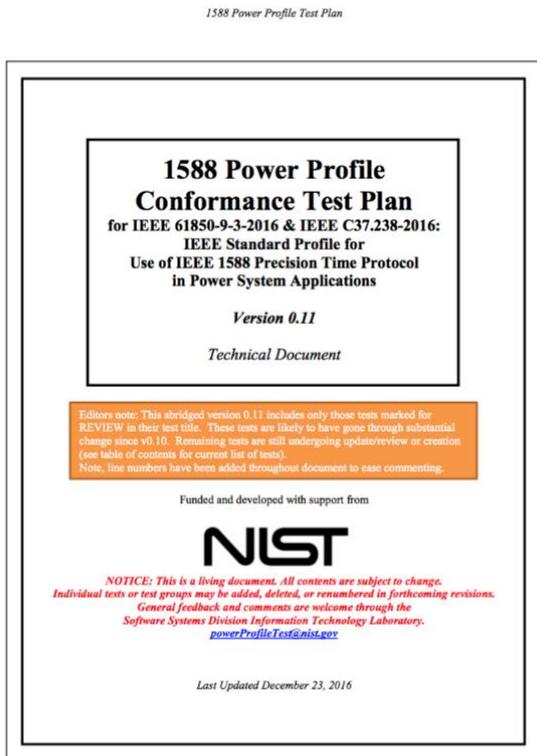
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Provide assurance of conformance, interoperability, and integrity of IEEE 1588 Power Profile Devices



- Steering Committee comprised of industry stakeholders from manufacturers, utilities and standards developers are leading the effort.
- IEEE 1588 CASC is developing a comprehensive TSS in collaboration with UNH-IOL on behalf of NIST grant.
- Interoperability tests and event are an expectation for certifying PTP Power Profile devices.
- Pilot testing for CA should commence by the end of 2017.



Application Drivers for 1588 Power Profile

Grid application	Timing requirements	Relative or absolute time count
Sequence of events recorder	50 μ s to 2 ms time accuracy	absolute
Differential fault recorder	50 μ s to 1 ms time accuracy	typically relative
Protection relays	10 to 20 μ s time accuracy	relative
Synchrophasor	Better than 1 μ s time accuracy 30 to 120 Hz reporting rate	absolute
Traveling wave fault recorder	100 to 500 ns time accuracy	absolute
Micro-PMUs (sample at 512 samples/cycle)	Better than 1 μ s time accuracy	absolute
Communications protocols		
Substation local area network communication protocols (IEC 61850 GOOSE)	100 μ s to 1 ms synchronization accuracy	absolute
Substation local area networks (IEC 61850 Sample Values, 4800 frames/s)	1 μ s	absolute

Source: Marc Weiss, Alison Silverstein, Francis Tuffner, and Ya-Shian Li-Baboud. "The use and challenges of precise time in electric power synchrophasor systems," *ION ITM and PTTI Meetings*, Feb. 2017.

COMTRADE C37.111 CA Program



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- PSRC WG H26 published a COMTRADE 2013 Conformity Test Plan in May of 2015
- COMTRADE is adopted and cited in NERC PRC-002-2
 - *11.4 - FR and DDR data will be provided in electronic files that are formatted in conformance with C37.111, (IEEE Standard for Common Format for Transient Data Exchange (COMTRADE), revision C37.111-1999 or later.*
- Develop methodology for evaluating tools that would test for conformance to IEEE C37.111 COMTRADE/IEC 60255-24 Ed 2.0
 - Current effort to focus on 1991,1999 & 2013 versions
- Evaluate current tools submitted to IEEE for approval
 - Elektek Concepts, Inc.
 - Softstuf

IEEE 1547 Conformity Assessment Program

- The IEEE 1547 Conformity Assessment Steering Committee (CASC) has developed a universal commissioning template to verify IEEE 1547 Conformity
- Conformity is assessed by an IEEE authorized commissioning company with input from the DER project developer and utility
- Commissioning template contains the following scope
 - DER Operational Description
 - Diagram of system interconnection
 - Relevant DER system details
 - Confirmation drawings match physical system
 - Visual inspection of DER settings related to utility 1547 requirements
 - Testing of site specific functions as required by the utility
- The program is currently connecting utilities, vendors, and test labs for pilot demonstrations of conforming DER interconnections to 1547 in the US and abroad.



1547.1 CASCADE Pilot Demonstration



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FREEDM evaluates conformance testing for IEEE 1547.1



FILED UNDER
> Industry and Partners

TAGS
> Green Energy Hub
> IEEE
> Testing

[VIEW THE ARCHIVE →](#)

FREEDM Center publication on IEEE 1547.1 Commissioning Pilot [Link](#)

IEEE 2030.5 – Smart Energy Profile 2.0

- ZigBee Smart Energy Profile 2 initiated in 2008
 - Requirements defined by utilities
 - Designed to use widely-adopted technologies
- Consortium for SEP 2 Interoperability (CSEP) formed in 2012
 - Founded by HomePlug, Wi-Fi and ZigBee
 - Completed V1.0 PICS and Test Spec in December 2013
- Standard completed and adopted as IEEE 2030.5 in 2013 (IEEE 2030.5-2013)
- Added to SGIP Catalog of Standards in 2013
- First Test Harness available in February 2015
- Selected as the “default protocol” for California Rule 21 in 2016

Benefits of IEEE Certification



- Helps differentiate between compliant and non-compliant PMUs.
- Addition to the IEEE Registry for certified products, allowing purchasers an easy and quick resource to find compliant devices.
- Intrinsic connection with IEEE-SA working groups and supporting staff
- Turnkey Certification Management program, including Conformance, Interoperability, Inspection, Accreditation
- Legal and operational umbrella for testing & conformity assessment programs
- Reduces the vendor's cost / need for re-tests for different end-users

Contact Information Page

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Thank you!



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ElectroMagnetic Interoperability Issues Working Group (EMIIWG) Overview, Accomplishments, and Future Directions

Cuong Nguyen, NIST



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SEPA EM Interoperability Issues Working Group (EMIWG) Charter



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- This WG investigates enhancing the immunity of Smart Grid devices and systems to the detrimental effects of natural and man-made electromagnetic interference, both radiated and conducted.
- The focus is to address these electromagnetic compatibility (EMC) issues and to develop recommendations for the application of standards and testing criteria to ensure EMC for the Smart Grid, with a particular focus on issues directly related to interoperability of Smart Grid devices and systems.
- These issues include, but are not limited to: impacts, avoidance, generation and mitigation of and immunity to electromagnetic disturbances, which can cause interference.
- The Working Group effort generally does not encompass a review of general electromagnetics and electric power related issues, such as power quality.
- These topics are being addressed in different standards development groups outside the SEPA, such as by the technical committees in the IEC and the IEEE.

EMIIWG Approach



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- Work with power industry utilities, manufactures of Smart Grid devices, EMC experts, standards development organizations (SDOs), and other stakeholders.
- This is in addition to the SEPA Priority Action Plans (PAPs) and WGs, in order to identify, evaluate, and/or initiate development of the appropriate EMC standards and testing criteria to improve the interoperability of the various Smart Grid devices, their communications protocols, and installed systems.

Major Recent Activity



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- Wrote EMC section and appendix in the Smart Grid Testing and Certification Committee (SGTCC) Interoperability Process Reference Manual (IPRM)
- This identifies the importance of considering EMC into Smart Grid test and certification programs and raises EMC awareness for test program managers
- The IPRM is now an ANSI/NEMA standard SG-IPRM 1-2016: “Smart Grid Interoperability Process Reference Manual (IPRM)”

EMIWG Charter Work Topics



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- * Evaluate EM phenomena issues on SG reliability—**extent and severity**
- * Specific EMC SG device **test setups** with SG data being transferred
- * Review existing state of EMC of Power Grid—current and future enhancements
- * Evaluate impact of high power EM threats such as HEMP (High Altitude Electromagnetic Pulse), IEMI (Intentional EM Interference), Geomagnetic storms

2016-2017 report and webinar



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Evaluation of the Electromagnetic Phenomena Issues on Smart Grid Reliability

http://www.sqip.org/wp-content/uploads/SGIP_WP_Evaluation_of_the_Electromagnetic_Phenomena_Issues_on_Smart_Grid_Reliability_FINAL_2-21-2017.pdf

Open webinar 17 January 2017 rolling out the above white paper

<https://attendee.gotowebinar.com/recording/7622528566870386947>

Enter info requested and then click on “Register”

EMIIWG Activity for 2017



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- **Started second major charter activity**
 - Provide specific EMC SG device **test setups** with that has an active communication channel active with data being transferred
 - Test labs and equipment manufacturers are the targeted audience
 - Referencing key immunity test standards accepted worldwide
 - Output will be white paper and explanatory webinar

Summary



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- Electromagnetic Interoperability Issues Working Group
 - Continues to raise awareness for the need to incorporate EMC guidance and standards into the design of the Smart Grid
 - Working to include EMC into the testing and certifications process for Smart Grid systems.
- If interested in the WG activity you are encouraged to join the WG as we work on the next white paper focusing on the extent and severity of the electromagnetic environment on SG devices and the SG system.
 - Contact Don Heirman about the work of the EMIIWG at d.heirman@ieee.org

Thank you!



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