

IEEE-SA Conformity Assessment Program

Phasor Measurement Unit (PMU) Testing Update

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Conformance is Necessary

PMU's Must Work Together in a Big System

- 21 or more PMU manufacturers
- More than 50 different models of PMU
- PMU functions included in “multifunction devices”:
 - Protective relays
 - Digital fault recorders
 - Power quality meters
- PMUs will be used in almost every power transmission system worldwide.
- Each PMU has 18 or more configurations of nominal frequency (F_0), reporting rate (F_s), and class (M or P)

Documenting The Need for PMU Testing and Certification

- North American Synchrophasor Initiative (NASPI) Report of Task Force on Testing and Certification:

<https://www.naspi.org/File.aspx?fileID=1149>

- *“The scope of synchrophasor technology reaches well beyond phasor measurement units (PMUs), so it would take a long time to cover the process for the entire system. It is recommended that the initial efforts should primarily focus on establishing a testing and certification process solely for PMU (performance IAW IEEE Std. C37.118.1-2011 and future amendments.”*
- *“The guidance defined by the Testing and Certification Committee (TCC) of the Smart Grid Interoperability Panel (SGIP), summarized in this report, is highly recommended for the synchrophasor technology stakeholders to follow.”*

NASPI Executive Summary

- *"It is recognized that **synchrophasor technology is undergoing rapid changes** and that both a PMU standard (IEEE Std. C37.118.1) and products will be undergoing changes in the near future; hence the **testing and certification process is needed** to make sure the new and existing products can be verified against the revised standard requirements."*
- *"The need for testing and certification was revealed by published test results that **existing products do not meet all the requirements specified in the existing standard**. This creates a level of uncertainty as to how such products will perform when used for given applications. The testing and certification process has to provide comprehensive, multi-vendor results to allow users to assess PMU performance impact on applications."*
- *"**IEEE has initiated a PMU certification procedure** for test laboratories. For IEEE to have a successful procedure and process in place, it created a Steering Committee to provide feedback from all the stakeholder groups. IEEE endeavors to adhere to the TCC recommendations for this process to succeed."*

NASPI Recommendations

- *A PMU testing and certification program should be developed and managed by an industry-recognized and -approved body.*
- *PMUs placed into service should be tested by an accredited test organization and the test results be certified by an accredited certifying authority for compliance with the latest PMU standard.*
- *Products successfully completing testing and certification should be placed in an electronic database which references the product and the certification date.*
- *Vendors should strive to meet the latest PMU standards by submitting products with PMU functionality to approved test organizations for test and certification.*
- *Should a product undergo a change or system update that could impact the performance or functionality, the PMU should be retested for compliance.*
- *The initial goal of PMU testing and certification should be expanded to include other components of the synchrophasor system defined by existing standards.*
- *The eventual goal is to develop performance assessment procedures for testing and certifying system solutions used to implement given applications.*
- *The cost of testing and certification should be carefully evaluated by specifying differentiated test and certification requirements for different PMU applications.*

Steps Being Taken

- IEEE-SA Conformance Assessment Program is developing a conformance assessment program for PMUs.
- NIST is developing a portable system to calibrate PMU calibrators that can be used as part of a PMU test laboratory assessment program.
- NIST is conducting a PMU testing inter-laboratory comparison.
- NIST has been assessing the performance of PMUs from multiple vendors (both in production and pre-production models).
 - A NIST Interagency Report is being drafted
 - Early drafts have been given to the members of the joint IEEE/IEC standards working group.
 - NIST is working closely with vendors to re-test new versions of PMU hardware and firmware.
- NASPI, IEEE-SA ICAP, and the Smart Grid Interoperability Panel are working to help build demand among PMU end-users globally to recognize the benefits of deploying PMUs that have been IEEE certified

Standards Used by PMUs

- IEEE Std. C37.118.1-2011 "Synchrophasor measurement"
 - Amended by IEEE C37.118.1a
- IEEE Std. C37.118.2-2011 "Synchrophasor communications"
- IEEE Std. 754-1985 "Standard for Binary Floating Point Arithmetic"
- Various communications standards (Ethernet, TCP, UDP, IEC 61850, etc.)
- Various timing standards (GPS, IRIG Std. 200-04, Universal Time Coordinated (UTC), IEEE Std. 1588, etc.)
- (future) IEEE PC37.240 "Standard for Cyber Security Requirements for Substation Automation, Protection and Control Systems."

**IEEE-SA PMU conformity assessment program is starting with
IEEE C37.118.1-2011 "Synchrophasor measurements"**

PMU Test Types

- Type Testing (IEEE-SA Conformity Assessment)
- Manufacturing test
 - determined by manufacturer
- Commissioning tests
 - determined by utilities
- Periodic calibration
 - recommended by manufacturer

Key Elements of the Synchrophasor Conformity Assessment Program

- Synchrophasor Conformity Assessment Steering Committee (SCASC)
 - Comprised of stakeholders from utilities, vendors, academia and government
- PMU Certification Policy Document
 - Development underway by IEEE-SA Conformity Assessment Program; being reviewed by the SCASC
- Test Suite Specification (TSS)
 - Based on IEEE C37.118.1 and in accordance with the Interoperability Process Reference Manual 2.0 (IPRM)
- Close Ties with Standards Setting Organizations
 - Many SCASC members are also leading members of IEEE PSRC and IEC synchrophasor standards working groups
- Test Laboratories: IEEE Authorized PMU test laboratories to provide testing and evaluation services
- Test Laboratory Authorization
 - ICAP assesses quality and technical competence of laboratories utilizing IEC/ISO 17025
 - NIST is developing a mobile calibration system for PMU calibrators

Synchrophasor Test Suite Specification (TSS)

Purpose /
Scope

PMU
Features

Test
Equipment

Test Signals

Test Result
Calculations

Test Plans
(procedures)

Test
Result
Calculation

Test
Reporting

Test System
Calibration

■ Purpose:

- Procedures and requirements for test laboratories
- In accordance with the IPRM
- Unambiguous test plans
- Sometimes more specific than the standard to resolve ambiguities

■ Scope:

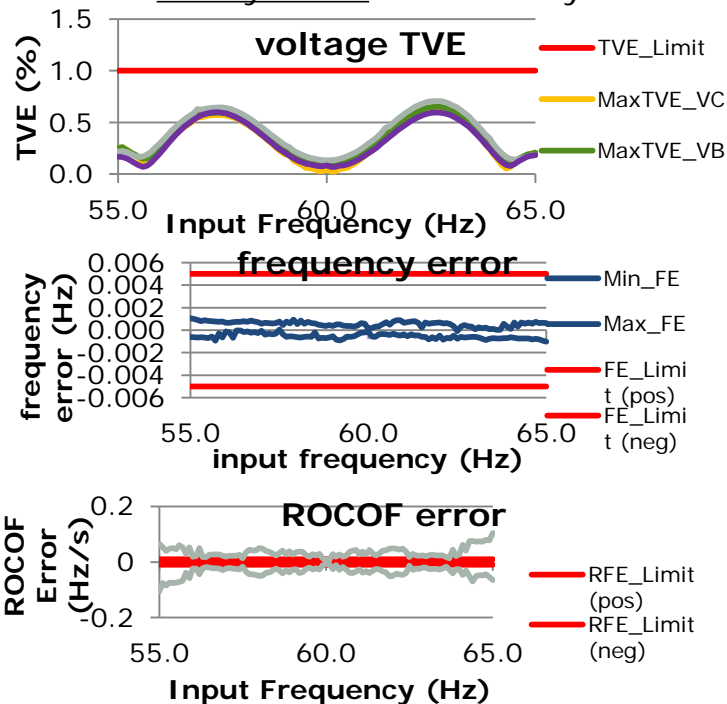
- IEEE Std. C37.118.1-2011 and amendment PC37.118.1a
- PMU Performance ONLY - limit the scope so can be completed within two (2) years
- Data transmission protocol (IEEE C37.118.2) testing MAY be added after performance testing program is under way



Jerry Stenbakken and the first NIST PMU steady-state calibration system



Left: Jerry Stenbakken
Bottom: NIST's first PMU dynamic test system, Right: Fluke Calibration's commercially available, fully automated PMU calibration system.



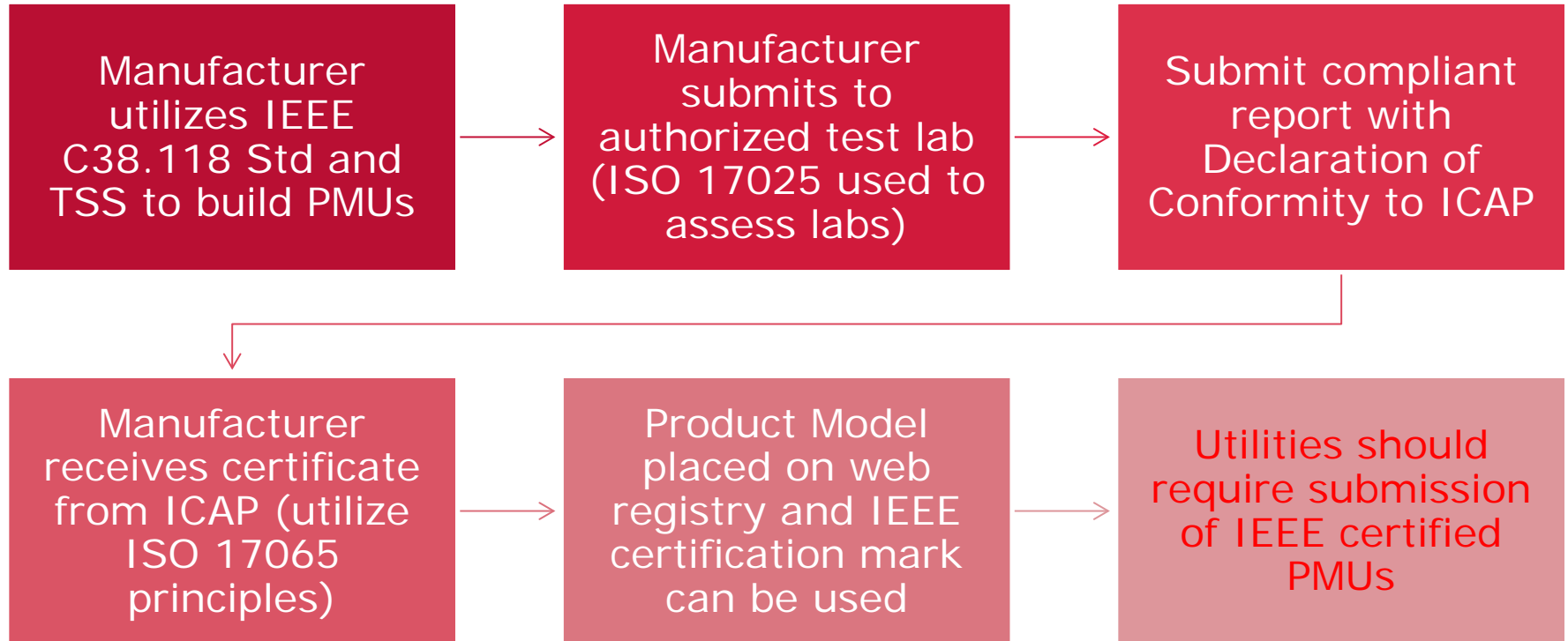
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Conformity Assessment Testing Process

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Simplified Process



Test Laboratory Status

■ Test Laboratory Readiness

- Memorandum of Understanding (MoU) signed with candidate test laboratory – Consumers Energy in Jackson, MI
 - Technical Competencies and Facilities to test to IEEE C37.118-1
 - Have past experience testing for vendors and/or utilities
 - Established Quality System
- Geographic Coverage – Worldwide
 - Evaluating establishment of other labs in Asia and Europe to provide testing and evaluation services

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Scopes
1097.01
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1097.03
1097.04
1097.05

Questions?



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