

Guide for Installation of Multi-Function Phasor Measurement Units (MF-PMU)

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Outline

- Multi-function PMUs (MF-PMU)
- Main drives to install MF-PMU
- Background of the guide
- The organization of the guide
- Highlights of the guide
- Status of the guide

Multi-function PMUs

- **Definition:** Multi-function PMUs (MF-PMU) are devices, intended for use in the power system, that can act as PMUs while simultaneously performing one or more other functions. These other functions can include protective relaying, fault recording, revenue metering, and power quality analysis

Main Drivers to Install MF-PMUs

- **Economical and technical benefits**
 - Economy of procurement, engineering design, installation, and maintenance
 - Space savings and leveraging the use of existing equipment
 - There are some other advantages to install MF-PMUs that are specific to the type of the devices selected

The Need for A Guide

- However, there are concerns over
 - Adverse interactions between the PMU function and the various other functions in the device.
 - Use of MF-PMUs may also be constrained by regulatory requirements and company policies
- A subtask team was formed in PRSVTT (previously PSTT) to develop a guide to provide some guidelines and considerations to address these concerns

MF-PMU Subtask Team

- Co-lead: Yi Hu (Quanta Technology) and Jim Hackett (Mehta Tech)
- Members: David Bertagnolli (ISO-New England), Dave Burian (PPL), Bill Dickerson (Arbiter), Bill Flerchinger (SEL), Mital Kanabar (GE), Harold Kirkham (PNNL), Jim Kleitsch (ATC), Jay Murphy (Macrodyne Inc.), Krish Narendra (ERLPHASE), Nuwan Perera (ERLPHASE), Isabella B. Snyder (ORNL), Tony Weekes (Manitoba Hydro), Austin White (OG&E)

The Organization of The Guide

- 1. Overview**
 - 1.1 Scope
 - 1.2 Purpose
- 2. References**
- 3. Definitions**
- 4. Multi-function PMUs**
 - 4.1 Definition of MF-PMU
 - 4.2 Relay-based MF-PMUs
 - 4.3 DFR / DDR based MF-PMUs
 - 4.4 Meter-based MF-PMUs

The Organization of The Guide

- 5. General guidelines for using MF-PMUs**
 - 5.1 Cyber-security considerations**
 - 5.2 Measurement**
 - 5.3 Communication of PMU data**
 - 5.4 Operation, testing, and change management processes and procedures**
 - 5.5 Calibration and maintenance**
 - 5.6 Testing and validation**
- 6. Final comments**

Highlights of The Guide

- Cybersecurity considerations
 - Not different from any other IEDs in substations
 - Evolving scope and requirements
 - Attention should be given to anticipated requirements that may require retroactive changes
 - Ensure compliance to DHS, NIST, NERC, IEEE and other relevant standards (e.g. NERC CIP standards, IEEE Std C37.240 – to be published soon)

Highlights of The Guide

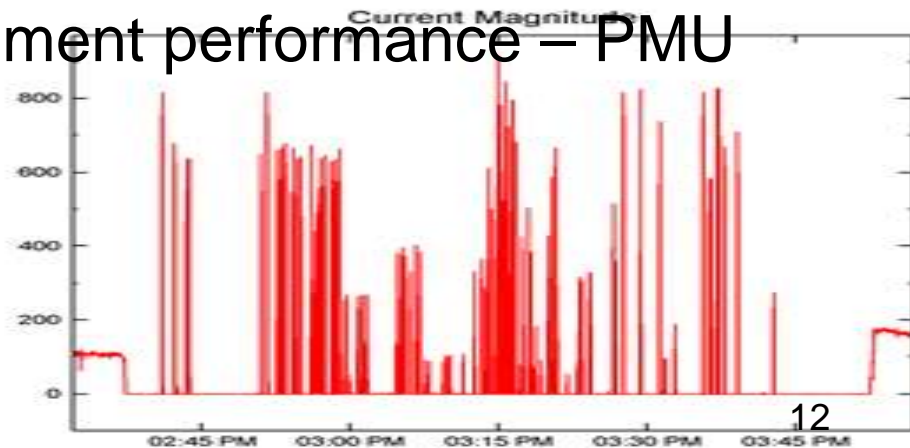
- Measurement
 - manufacturer should clearly state any functions in the IED where settings or configurations are coupled to PMU settings and may impact the communications, signal range, measurement accuracy, filtering, dynamic response, etc.
 - user needs to know which function determines the input circuit settings and the related device configurations
 - MF-PMUs may also have some measurement limitations based on their primary functionality

Highlights of The Guide

- Communication of PMU data
 - Communication of PMU data may be disrupted in a MF-PMU device
 - Any such behavior of a MF-PMU should be clearly stated in the data sheet or instruction manual of the device and include details of how to mitigate such behavior
 - Any testing should be performed under worst case communication loading

Highlights of The Guide

- Operation, testing, and change management processes and procedures
 - User should establish and prioritize proper operation, test, and change management processes
 - Depending on which function takes precedence, other functions are likely to see some impact in operational availability or in measurement performance – PMU data may be impacted



Highlights of The Guide

- Calibration and maintenance
 - A user of a MF-PMU needs to give consideration to calibration and maintenance schedules and procedures
 - Should consider pros and cons of doing PMU and other functions calibration and maintenance either separately or at the same time

Highlights of The Guide

- Testing and validation
 - Important to validate that all functions are performing per the standard requirements and/or device specifications
 - Should consider worst case scenarios to check the MF-PMU device performance under stressful processing conditions

Status of The Guide

- The development work started in 2012 as a PSTT subtask team
- Completed the draft development in early 2014, and circulated within PRSVTT and NASPI leadership team for review and comments
- Finalized the guide in September 2014 after addressed all comments received
- Available on the NASPI web site (<https://www.naspi.org/File.aspx?fileID=1327>)

The background of the slide is a faded, grayscale image of several high-voltage electrical transmission towers and power lines stretching across a landscape. The towers are lattice-structured and support multiple power lines that curve across the sky.

Thank you!

Questions / Suggestions?

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