

# **PMU test and calibration**

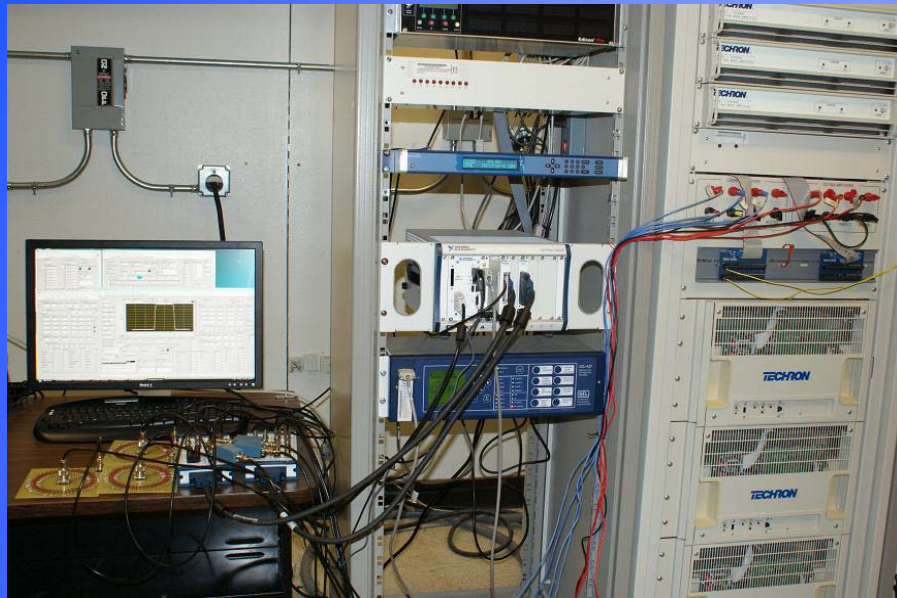
## **Standards, systems, and compliance**

**Allen Goldstein**  
**Technical Project Manager for PMU**  
**Calibration**  
**(contracting to)**  
**Fluke Calibration**

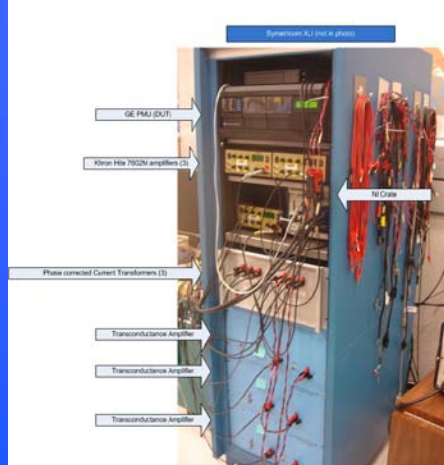
- **Early 1980's: 3 papers report taking direct measurements of phase angle differences on the power system.**
- **Early 1980's: First prototypes of modern PMU (using GPS) developed at Virginia Tech. Deployed at BPA, AEPSC and NYPA.**
- **1991/2: first commercial PMUs produced by Macrodyne.**
- **1991: IEEE 1344 (revised in 1995).**
- **2005: IEEE C37.118 (being revised now).**
- **2006 NIST begins creation of a PMU calibration lab.**

- PMUs which share data need to interoperate.
- PMU users need to know that their data is accurate.
- IEEE sets the standards for compliance.
- Accuracy and interoperability sometimes goes beyond the scope of the standards.
- Test equipment must check both comms. and performance.
- Test gear must be “traceable” to National Metrology Institutes (NMI).
- Results should be repeatable and consistent between test locations.
- Test procedures should be flexible and also check for application specific limits.

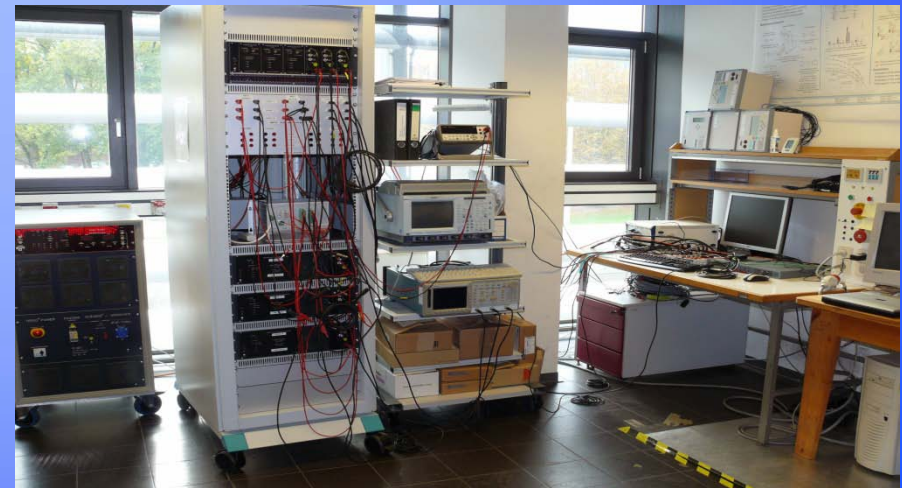
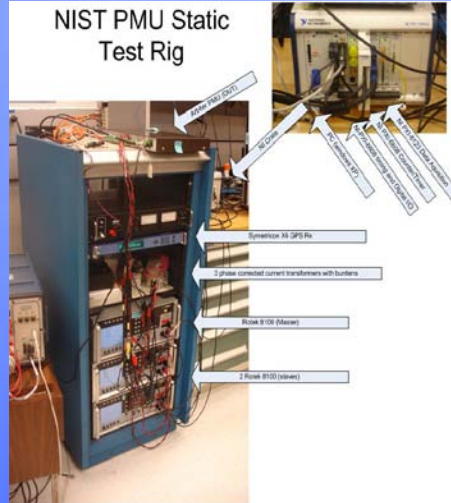
# PMU test systems today (custom designed)



NIST PMU Dynamic Test rig



NIST PMU Static Test Rig



- **2005: Dynamic testing was not specified and dynamic performance was not well understood.**
- **2007: NASPI released the PMU System Test Guide authored by the leading experts on PMU testing.**
- **2009: Different ideas of testing and questions of how stringent were the requirements arose.**
- **2010: Evolving verbiage and impending changes to PMU communications led to splitting C37.118 into .1 and .2 parts.**
- **2011: The NASPI guides are becoming IEEE Guides.**

- **IEEE PC37.118.1 / .2**
- **2005 version being revised (Q1 2011)**
  - Adds compliance under dynamic conditions.
  - Adds compliance for frequency and rate of change of frequency (ROCOF).
  - Adds (informative) PMU reference model which will pass all compliance levels.
- **IEEE PC37.242**
- **An IEEE Guide for ... PMUs**
  - Updates and consolidates 3 NASPI guides into one IEEE guide document.
  - Guides undergoing review and update now.
  - Both expected to be ratified in early 2011.

- **For PMU performance standards:**
  - Please read and review: **IEEE PC37.118.1**
- **For testing procedures**
  - Please read and review **PC PC37.242**
- **If you see gaps:**
  - **PLEASE LET US KNOW**

**Worldwide agreement that calibration is needed, and to provide compliance limits and test methodologies to ensure performance, conformance, and interoperability.**

**To help support compliance to standard, Fluke is working to provide a commercially available, traceable solution to allow end users to demonstrate PMU compliance with precision, accuracy and repeatability.**



**Allen Goldstein**  
**Technical Project**  
**Manager for PMU**  
**Calibration**

**(contracting to)**  
**Fluke Calibration**  
**[allen.goldstein@fluke.com](mailto:allen.goldstein@fluke.com)**

