



Smart, stable grids for a greener Europe

The risks posed by climate change and diminishing traditional energy supplies are challenging conventional methods of electricity generation and distribution. To enable the increased use of renewable energy sources, traditional 'one-directional' electricity transmission grids need to evolve into 'smart grids' capable of managing a complex network of decentralised energy supply and demand.

Europe's National Measurement Institutes working together

The European Metrology Research Programme (EMRP) brings together National Measurement Institutes in 23 countries to address key measurement challenges at a European level. It supports collaborative research to ensure that measurement science meets the future needs of industry and wider society.

Challenge

Smart grids are a key component in the energy infrastructure needed to meet Europe's target of 20% of energy consumption from renewable sources by 2020. But widespread adoption of smart grids is dependent on investor and consumer confidence in their ability to provide a stable high-quality electricity supply. As smart grids are managed by radically different instrumentation and control processes to traditional grids, they require the development of an appropriate measurement infrastructure.

Smart grids have to balance fluctuating energy supply with variable demand in real-time to achieve sufficient power quality and grid stability to prevent blackouts. Phasor measurement units (PMUs) are expected to be the 'life-support monitor' for the smart grids of the future. Installed throughout the grid, PMUs assess and compare the power signals across the network, enabling grid operators to monitor and control these complex systems.

Grid operators need PMUs which perform robustly and reliably at high levels of accuracy to ensure grid stability. However, until recently, Europe lacked the necessary underpinning measurement infrastructure, such as national measurement standards traceable to the SI system of units and access to calibration services to validate the performance of PMUs.

Solution

The EMRP project *Metrology for smart electrical grids* developed calibration equipment, software and processes that enable PMUs to be validated against traceable measurement standards for the first time in Europe. Tests of PMUs in operational grids in Greece and Sweden resulted in best practice guidelines for PMU use, which have been incorporated into a revision of the relevant IEEE Standard used by the industry.

Impact

The project has supported the development of cost-effective calibration services by Fluke Corporation and a commercial PMU by Arbiter Systems, as well as the on-going adoption of effective operational practice via the revised IEEE standard.

Fluke Corporation, a manufacturer of testing and calibration equipment, has introduced a PMU calibrator based partly on the methods developed in the project. This is the first commercially available calibrator, outside of National Measurement Institutes, to provide traceability to national standards and compliance with the IEEE standard for smart grids. PMU calibration is a new market for Fluke and has already been delivered to a number of customers since its launch in 2014. The fully automated calibrator enables operators to demonstrate compliance with the revised IEEE standard, and confidently compare PMU measurements across the grid, safe in the knowledge that all devices produce consistent and robust measurements.

Arbiter Systems, a manufacturer of precision timing and power measurement devices, worked closely with the project team to share technical and market knowledge of the emerging market for PMUs for smart grids. As a result of this collaboration, Arbiter is introducing an improved and cheaper combined PMU and power quality measurement instrument for smart grids. Grid operators will be able to use Arbiter's new device to demonstrate compliance with the revised IEEE standard, and make reliable grid stability measurements at an affordable price. Arbiter is anticipating sales to be in the hundreds of PMUs per year, as

small-scale renewable energy production rapidly expands to meet consumer needs and European targets.

Increased access to cost-effective calibration services and devices, such as those provided by Fluke and Arbiter, will help operators ensure the stability of smart grids and accelerate their adoption in Europe, in turn supporting widespread renewable energy generation and a more stable, low-carbon energy future for Europe.

Metrology for smart electrical grids

The EMRP project *Metrology for smart electrical grids* and its successor projects, *Smart Grids II* and *GridSens*, are developing the measurement infrastructure needed to support successful implementation of smart grids in Europe. This includes the development of analysis and measurement tools for monitoring grid stability and quality of supply, and revenue metering systems for ensuring fair trade.



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