

New sensors for the high voltage grid

Conventional electricity grids are being replaced by smart grids which can rapidly respond to changes in electricity flow in real-time and better integrate energy from renewable sources. To monitor these grids a new generation of network sensors, termed 'low-power instrument transformers' are being introduced which must be compliant to international standards. However, the variety of primary sensors, and secondary converters, brings up new challenges for the calibration of such instruments.

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

The increased use of renewables is problematic for electrical networks as these sources of energy can cause harmonics, where the alternating current (AC) is distorted, leading to outages or degraded power quality. To address this, smart grids are being developed which can help stabilise a network by monitoring it in real-time and automatically react to changes in the electricity flow.

A new generation of measuring instruments are being introduced to help implement these grids, including novel, non-conventional voltage and current sensor technologies. These devices measure the continuous analogue output of the voltage and current transformers and convert it to a discrete sequence of digitised samples. These 'sampled values' are then sent over the internet to instrumentation involved in grid control.

International standards are in place regarding such sensors however there is a lack of calibration services covering all the functions of the new instruments. As calibration is a requirement to demonstrate performance and conformity to standards there is a pressing need to ensure measurement services are available to support the introduction of these new technologies.

Solution

The EMRP project *Non-conventional voltage and current sensor for future power grids* examined emerging measurement technologies capable of monitoring the state of electrical networks.

From project results METAS, the National Metrology Institute (NMI) for Switzerland, developed a set-up, along with software architecture based on **code** created at the University of Strathclyde, allowing the calibration of a wide range of measurement instrument types. The new service allows sensors sending sampled values to establish robust traceability to the international standard IEC 61850-9-2. This standard defines the requirements for the communication protocols for intelligent electronic devices to ensure their interoperability. As instrumentation may be geographically separated or produced by different manufactures this is an essential requirement for the introduction of smart grids.

Impact

CONDIS SA, a Swiss manufacturer and technological leader in the area of high and medium voltage capacitors and solutions, employed METAS to calibrate a prototype Electronic Fiber Optic Current Transformer (EFOCT). This sensor developed by PROFOTECH JSC and manufactured in partnership with CONDIS SA presents an alternative to conventional current transformers and can be configured to a range of different applications. The EFOCT is fully compliant to the IEC 61850-9-2 standard with additional features such as a high frequency bandwidth and an oil-free and compact design. Due to its passive sensor design it does not require active liaison to the grid which greatly increases safety for test operators.

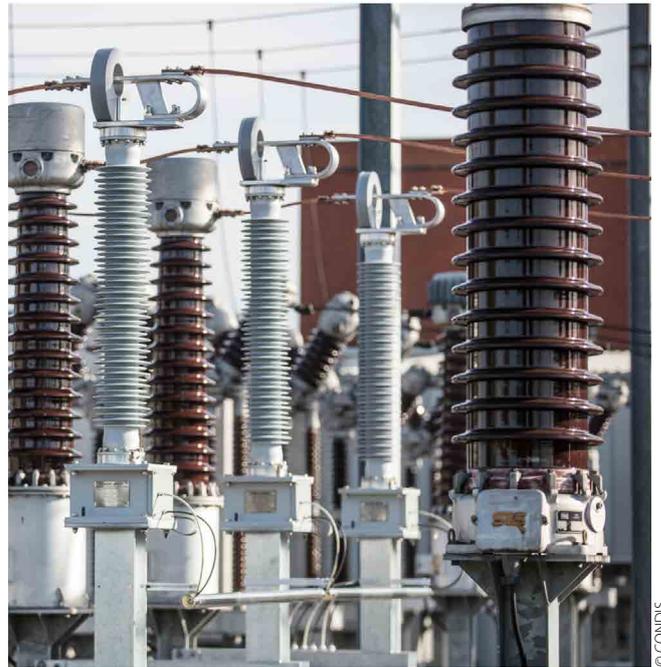
Following METAS' calibration services an independent Swiss laboratory confirmed the high quality of the new device in terms of measurement precision. CONDIS stated that having an official test-report from a renowned measurement institute like METAS will help its entrance into the market for high-voltage instrument transformers that are based on optical measurement technology.

This new calibration service provides traceability to the SI for next-generation network sensors and is a significant step towards ensuring the operational capability of smart grids.

New instrumentation for smart grids

The EMRP project *Non-conventional voltage and current sensor for future power grids* examined the emerging measurement technologies that are required for monitoring the electrical smart grids of the future. It developed novel optical current and voltage sensors with the potential for fault detection in networks over larger distances than conventional instruments. A 100-fold improvement against environmental interference for a current-sensing device, currently used for calibrating voltage transformers, was also demonstrated. Data from the project led to the publishing of two good practice guides on calibrating and installing non-conventional measurement instruments.

The European National Metrology Institutes PTB, METAS, TUBITAK UME and VSL now offer calibration facilities for next generation network sensors, essential for establishing their accuracy and traceability. These services represent a significant step towards ensuring the operational abilities of the power grids of the future.



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