LABORELEC

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DOSSIER ON ELECTRICAL POWER SYSTEMS AND METROLOGY

Accredited calibration of measurement equipment

Recognized internationally

Laborelec has more than 45 years of experience in calibrating electrical measuring instruments. Our laboratory is internationally renowned and certified by the Belgian Accreditation body (BELAC).

For several decades, Laborelec has been involved in the calibration of energy meters, voltmeters, instrument transformers, and other electrical measurement devices. Laborelec has carried out this task at the request of various network operators, metering companies, and all types of companies with electrical measuring instruments, both in Belgium and abroad.

Power/energy metering

Laborelec is an authority in the field of calibrating power and energy meters. Our lab maintains the Belgian standard in this area for three-phased and single-phased measurement equipment, up to 400 V and 150 A. We also participate in a yearly inter-laboratory comparison. During this initiative, Electricité de France (EDF) invites ten laboratories from France, Germany, Slovenia, Italy, and Belgium to calibrate two reference standards. Laborelec invariably comes out as one of the top labs in terms of accuracy and narrow measurement uncertainty. Our calibration lab is ISO 17025 accredited. The equipment that we use is itself calibrated every two years by the German PTB (Physikalisch-Technische Bundesanstalt), to a point where we can guarantee our customers measurement uncertainty of 10^{-4}.

Instrument transformers

BELAC has also accredited Laborelec for calibrating instrument transformers. Our lab calibrates devices of up to 150 kV and 6 kA. Calibrations are performed in our laboratories in Linkebeek, based on the prevailing international standards. We regularly have PTB calibrate our own reference standards.

Electric and magnetic field measuring instruments

Laborelec has also developed a methodology for calibrating instruments that measure electric fields of up to 35 kV per meter and magnetic fields of up to 0.5 mT. Our experts originally developed this methodology for their colleagues at the Electro-Magnetic Compatibility (EMC) lab. But the methodology is now also BELAC accredited and is currently being used by Elia, VITO, and the University of Liège.

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The technical Competence Centre
in energy processes and energy use.
From innovation to operational assistance.

Laborelec News turns 100!

The end of the year ... what better or more auspicious time to publish our 100th edition of Laborelec News? Over the past many years, our newsletter has been informing you of the achievements of the Laborelec experts. And we will continue to do so in the future, albeit in the new Laborelec house style. But for now, we wish you enjoyable reading about the latest efforts of our EMC lab and our metrology, power quality monitoring, and electrical protection teams.

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Improving power quality views in New-Caledonia

Energie Electrique en Nouvelle-Calédonie (EEC) wants to strengthen its power quality commitments. Laborelec's advice will be used in setting up a reviewed regulatory framework for Nouméa, the capital of New-Caledonia. It will also be applied to elaborate an appropriate power quality monitoring system.

The target is to adopt the European EN 50160 power quality norm. In order to reach that goal, our experts advised EEC on three levels that have the greatest influence on power quality:

- Energy use: (industrial) loads may have a serious impact on power quality. Therefore our experts advised EEC to set up strict rules for customers that want to connect (heavy) loads to the public electricity network
- Transmission network: the power quality that EEC is able to guarantee depends heavily on the power quality at the transmission net's feed-in points. EEC should therefore negotiate planning levels for the feed-in points with ENERCAL, the local transmission network operator
- Distribution network: Laborelec trained local EEC personnel on the subject of power quality and also advised on additional, more specific training

Our expert also provided advice on which type of power quality monitoring equipment is best implemented at fixed locations within the electricity network. He also advised on which mobile devices can be used for investigating specific complaints.
In the future, Laborelec will expand its collaboration with EEC. It is highly probable that Laborelec will get access to EEC's power quality database in order to assist in the reporting of local power quality.

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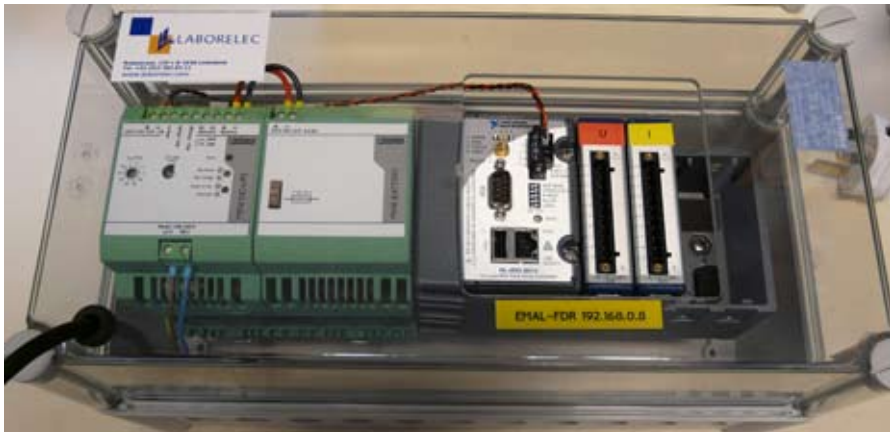
Advanced monitoring to support Dubai transmission system reliability

Developing and deploying a new monitoring device

Tractebel Engineering (TE) is analyzing and reviewing the reliability of Dubai's transmission system. The project especially focuses on voltage security since it is strongly influenced by the behaviour of the air-conditioning (AC) load during the summer period. TE asked Laborelec to conduct measurements and install a dedicated monitoring system to validate the load model used to predict the system's behaviour following major disturbances.



Laborelec developed a monitoring device that record the sine waves of currentd and voltages before and after a variation.

The past years, the Emirate of Dubai experienced a huge load growth in its electricity system. This has required that the grid operator periodically assesses its security margin and the adequacy of its defensive actions. This is necessary in order to achieve high reliability of performances in such a rapidly evolving system.
AC devices take up a large portion of the load of Dubai's electricity system, especially during the summer period. The specific behaviour of these appliances played an important role during recent incidents, including the 2007 blackout. It is important to correctly predict the system's dynamic behaviour following large grid disturbances. Only in this way can it adequately adjust the emergency control and defensive actions such as the automatic load shedding systems.
The main aim of the project is to update and validate the simulation model based, among other things, on data gathered by the monitoring campaign.

A new type of frequency/voltage monitoring

Laborelec experts developed and configured a unique new monitoring device that records abnormal variations in both frequency and voltage. When one of these variations exceeds a pre-defined threshold value, it records the sine waves of the voltages and the currents for a specified amount of time before and after the variation.

Monitoring at the right place at the right time

Together with DEWA and TE, Laborelec identified a set of representative locations. Ten monitoring devices were deployed in five electrical 132/11 kV substations. These included a large shopping mall, a residential area, an industrial site, a district cooling plant, and a mixed industrial/residential area. The monitoring period included August and September when the system is heavily loaded and the AC load proportion is at its maximum.

Examining the results

Thanks to the flexibility of Laborelec's unique monitoring device, TE is able to download and easily process the monitoring results. Each device has already registered several events. The experts are currently examining this data to determine their relevance.

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Testing EMC compliance of invisible conductive coatings in new glass product

Glass specialist AGC – formerly Glaverbel – contacted Laborelec for Electro-Magnetic Compatibility (EMC) tests on its latest Glassiled range of products. AGC's innovation features embedded LEDs that are powered by invisible conductive coatings – a new application domain for Laborelec's EMC laboratory.

The product consists of laminated glass with embedded LEDs that are powered by invisible metallic sheets between layers of glass. The Glassiled technology is complex and involves a minute assembly of the decorative LEDs and the glazing. The innovation has a wide range of potential applications, such as decorated glass for shop windows and home interiors, as well as companies wishing to have their logo incorporated into the glass.

Testing emission and immunity compliance

Because of the innovative power supply system of the LEDs, AGC requested Laborelec to carry out a series of EMC tests. Laborelec tested both the glazing and the external power supply extensively. It assessed emission and immunity compliance with EMC specifications over a wide range of power demands and voltages. Following the tests, Laborelec recommended a number of product improvements to AGC. These improvements have all been implemented by AGC on each of their products. The productive collaboration with AGC is likely to result in further EMC compliance tests in the future.

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EMC laboratory assesses high-tech display monitors

The Belgian railway company NMBS-SNCB asked Laborelec to verify the EMC compliance of its new display monitors. The devices, manufactured by CONRAC, feature complex electronics and built-in intelligence. Laborelec tested whether they met all requested specifications.

CONRAC manufactures display monitors for applications such as arrival and departure screens in airports and railway stations. The company recently received an order from NMBS-SNCB for 3,000 display screens of 32, 40, and 46 inches. The monitors feature TFT screens with a built-in mini-computer and Internet connection. A detection device within each unit confirms that every update is properly received and correctly displayed.

Full range of tests at Laborelec

Before acceptance by NMBS-SNCB, the railway company asked Laborelec to carry out EMC tests on each screen type, as well as climatic and electrical security tests. Because the monitors are to be placed outside, they must resist climatic conditions ranging from -15 to +40 °C. The railway company also asked us to verify whether the products met the requested specifications.
Laborelec tested the entire system for electromagnetic emission and immunity compliance. During the project, there was a productive interaction between Laborelec and CONRAC, with only a few minor adjustments having to be made. Laborelec's knowledge of the CONRAC technology should enable similar acceptance tests to be carried out optimally in the future.

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New EMC equipment extends range of laboratory services

During 2008, Laborelec acquired important new equipment for its Electro-Magnetic Compatibility (EMC) laboratory. The acquisitions were made following numerous requests from customers wishing to go further in standard compliance testing. The new equipment will reduce testing times and enable a wider range of services.

Electrostatic discharge generator

The newly purchased electrostatic discharge generator is capable of establishing voltages of up to 30 kV to test the limits of electrical equipment. Tests with this machine comply with the EN 61000-4-2 EMC standard, which requires that electrostatic air discharge tests be carried out at 8 kV, 15 kV, or higher.

Lightning impulse wave generator

A new lightning impulse wave generator was acquired that can simulate the electric impulse waves occurring in low voltage networks in the event of lightning strikes. Tests comply with the EN 61000-4-5 EMC standard. The machine can produce 1.2/50 µs impulse voltages of 10 kV. This is a considerable improvement over Laborelec's previous lightning impulse wave generator, which was already capable of reaching 6 kV.

High frequency current generator

The EMC laboratory also purchased another high frequency current generator. This device enables the analysis of the same voltage levels much more rapidly than our previous machine. Tests which previously took one hour now only take an average of 15 minutes. The new device produces signals that comply with the EN 61000-4-6 EMC standard.

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Fundamental research in PLC communication

A major toolkit to enable Smart Metering

Previously, in Laborelec News 84, we discussed our involvement in a Smart Metering research project. Our main focus has been on investigating the possibilities of Power Line Carrier (PLC) communication between central units and intelligent meters at residential customers. We have now fine-tuned the tests investigating the performance of PLC communication in a distribution test grid.

In the future, Smart Meters may well replace the electromechanical meters that are presently used in measuring energy consumption in Belgian households. The new type of meters will enable remote reading of consumption data as well as many other services. However, before replacing the old system, it is crucial to understand all of the possible circumstances that might interfere with the accurate transmission of data.
Throughout 2008, our experts have successfully elaborated signal transmission and noise measurement techniques for use at frequencies in the CENELEC A-band (9 – 95 kHz). This essential step has enabled them to carry out numerous measurement campaigns. They have now developed a reliable and appropriate test setup, investigated the necessary data processing techniques, and become highly skilled at correctly interpreting the results.
In 2009, Laborelec will take its research to the next level. Our experts want to validate their testing methodology on new sites in the Belgian grid and characterize them in the PLC frequency range. This will help establish whether online meters at a new location are able to transmit data reliably through PLC communication.

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Can DG units support distribution grids in the event of disruptions?

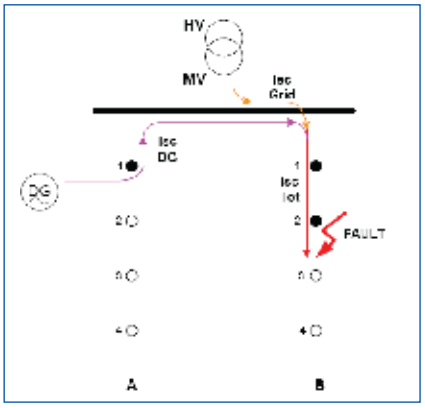
Modifying decoupling protection mechanisms

Whenever frequency or voltage dips arise on a distribution grid, decentralized generation (DG) units are usually decoupled immediately as a precautionary measure. Laborelec is currently assessing whether DG units can temporarily remain connected to the grid when a disruption occurs, and how this impacts network protections and other grid components.

With the growing number of connected DG units, a disruption often entails a series of decouplings. If this is initiated by a frequency drop, for instance, it usually means that production is insufficient. If the DG units are then decoupled, the phenomenon intensifies, thus increasing the impact on the overall network.

Adjusting decoupling relay settings

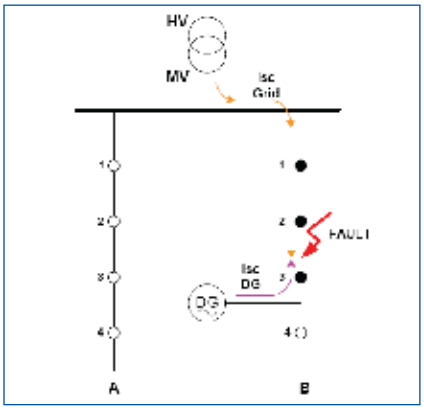
To address this issue, Laborelec is studying whether the decoupling protection parameters on the DG unit side can be modified. Our experts are currently assessing the effects of switching the decoupling relay settings from 49.5 to 47.5 Hz. This would allow the decoupling relays to ride through a frequency dip for a longer period of time.



Risk of false-tripping of protection 1 located on the DG feeder

Assessing impacts on the rest of the grid

The project aims to evaluate how these adapted settings impact grid operation. Is there a need to adjust other adjacent parts of the grid? Are additional or different protection mechanisms necessary? Is there any risk of damage to the DG units? In addition to finding answers to these questions, the project also examines whether the DG units are capable of operating correctly at 47.5 Hz instead of 49.5 Hz.



Risk of blinding of protections 1 and 2 due to the DG contribution in the fault current

Avoiding islanding situations

Another important issue is to determine that no islanding occurs. This is a situation where a DG unit feeds an entire part of the network by itself. Laborelec is assessing whether current islanding detection techniques remain valid with the adapted frequency and voltage requirements, or if the islanding detection techniques need to be updated.
The project is based on theoretical studies and also involves simulations to test protection behaviour. These simulations are currently under way. In a later stage, Laborelec plans to carry out additional tests on its onsite test.

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