NEWS: focus on renewable energy technologies

Complete monitoring of wind turbines

Combining condition and performance monitoring

Can performance and condition monitoring data be combined to provide a more comprehensive view on the status of wind turbines? Laborelec has taken up the challenge. Our experts are bringing together data from two monitoring tools to benchmark wind turbine performance and detect faults early.

Remotely monitoring every aspect of the condition of wind turbines

Accurately monitoring the condition of a wind turbine requires a number of aspects to be taken into account—vibrations, oil debris, electrical phenomena, blade wear, and so on. Laborelec is testing the use of SmartSignal to remotely monitor all of the various operational aspects affecting the condition of wind turbines. 'SmartSignal enables us to continuously compare operational data with reference values for one wind turbine as well as for an entire wind farm,' explains Sébastien Grégoire. 'The tool generates an alert as soon as a measured parameter differs from the reference data. In this way, we can identify potential faults and wear in advance and recommend the appropriate remedial actions.'

Universal wind turbine performance monitoring tool

Laborelec has developed a monitoring tool that detects a drop in the performance of an entire site or of an individual wind turbine, regardless of brand and technology. 'A large number of key performance indicators (KPIs) are being measured and logged for subsequent analysis,' adds Dries Lemmens. 'These KPIs include wind turbine availability and output. They are linked with information such as wind direction, speed, and relative humidity in order to enable comparisons between expected and actual turbine performance. Based on these data, we can accurately monitor performance evolutions over time and benchmark a wind turbine with other units and farms.'

Generating a complete operational picture

By combining the performance monitoring data with the mechanical and temperature data used for condition monitoring, any drop in performance can be related to a condition problem. This can help highlight where maintenance is needed and provides operators with a broader and more accurate overview of wind turbine status. Laborelec has already started pilot projects to fine-tune this combination of data.

Sébastien Grégoire, Dries Lemmens

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Fostering innovation in renewable energy technology

Tackling the challenges of emerging renewable energy technologies requires multidisciplinary knowledge. Laborelec combines expertise in solar, wind, marine, and biomass energy with in-depth know-how of condition monitoring, vibration mechanisms, and other technical aspects. Our experts complement this multidisciplinary skill set with intense contacts with knowledge centres inside and outside of the GDF SUEZ Group. In this way, we can focus on specific challenges, such as evaluating the potential of concentrated photovoltaics or enhancing the early fault detection of wind turbines. In this edition of Laborelec News, you will read more on these and other projects.

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Laborelec is relating condition and performance data in order to provide a more complete picture of wind turbine status

In short

> Laborelec combines condition and performance monitoring data to provide a more accurate view on the status of a wind turbine
> Using SmartSignal, wind turbine condition can be monitored remotely to detect problems early on
> Performance monitoring tracks the wind turbine KPIs and benchmarks a unit with other wind turbines

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NEWS: focus on renewable energy technologies

Investigating wind turbine cable connection failure

An Italian wind farm was experiencing high rates of medium voltage cable connection failure, so the operator contacted us to identify the root of the problem. Analysis of the cable connections in our laboratories and on site revealed that exposure to excessive temperatures was the primary cause of the failure.

Calculating cable system temperature

Soil type, cable design, load, and distance between cables are key factors in determining the temperature reached by the cable system. Laborelec took these parameters into account during its investigation. 'Our calculations showed that the cables were exposed to temperatures exceeding 100 °C,' states Blandine Hennuy. 'This is well above the acceptable level for this type of cable, with best practices advising a 90 °C maximum.'

Evaluating the technology used for the joints

Another parameter that is vital to ensuring cable system reliability is the technology used for the joints. Given their high loads and heavy load profiles, wind farms are a harsh environment for cable systems. This is particularly true for the joints that experience thermal expansion forces far beyond the forces encountered in a normal distribution network. Additional care must be taken in the choice of the technology used for the connections. A laboratory analysis of the failed joints indicated that the technology used was not the most appropriate one.

The excessive temperatures most probably led to the expansion and warping of the connectors, ultimately resulting in their breakage. A final verification of the root cause still needs to be carried out. Laborelec has already made a number of recommendations regarding cable replacement, installation, and temperature monitoring.

Blandine Hennuy

Laborelec determined that the cable connection failure was probably due to a combination of an improper cable system design and the fact that the technology used was not the most appropriate one.

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Predicting and reducing wake effects in wind farms

A wind farm can be affected by the speed deficits and turbulent intensities generated by the turbines within it. This so-called "wake effect" particularly impacts offshore wind farms. Laborelec is currently benchmarking existing wake models and has consulted several GDF SUEZ companies that are active in this domain, such as Tractebel Engineering.

Under certain atmospheric conditions, the first row of wind turbines in a wind farm can create turbulence, as the photograph illustrates. Measurements from offshore wind farms have shown that the productivity of the rows of wind turbines behind the first one may decrease by as much as 40% due to the speed deficit generated within the wakes. Furthermore, the turbulence caused within the wakes also induces vibrations, thus increasing the risk of mechanical problems.

Wake prediction models not yet mature

'There are already many models that aim to quantify speed deficits and turbulence intensities due to wake effects,' states Marc Van Caillie. 'However, these models are largely based on simplified assumptions and are not accurate enough for large wind farms.'

Close follow-up of European research

Several large-scale European projects involving manufacturers and research centres have been initiated to study wake modelling issues. 'We are closely tracking the status of these projects,' adds Marc Van Caillie. 'Our goal is to continue gathering information and to assess whether to join a research project in the near future.' A first conclusion that can be drawn from these projects is that wake effects can be reduced by ensuring sufficient space between turbines, and by optimizing farm layout and control.

Marc Van Caillie

Wake effects particularly impact wind farms at sea and can reduce their output by as much as 40%.

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Assessing the potential of concentrated photovoltaic units

Concentrated photovoltaics (CPV) is a promising technology for renewable energy generation. Thanks to optics concentrating large amounts of sunlight, CPV units require between 500 and 1,000 times less cell material compared to classic photovoltaic installations. Laborelec is investigating available solutions and following up pilot projects.

Laborelec has started an active technology watch to assess CPV cell performance, optical systems, sun trackers, and cooling systems, among other things. The goal is to establish a detailed comparison of the technologies offered by each supplier and to be able to make valuable recommendations to GDF SUEZ.

Supporting CPV pilot projects

In addition, our experts are involved in several pilots, including a 10 kW CPV project in Italy. Besides the evaluation of CPV technical issues, those pilot projects enable a direct comparison between CPV and classic PV units located at the same place. 'We share findings from our technology watch with our project partners and also receive additional practical input from them that helps us complete our research,' explains Laurent De Vroey.

Laurent De Vroey

Large-scale, centralized solar power generation

Exploring the potential of CSP in Chile

Concentrated Solar Power (CSP) is a promising, innovative technique for large-scale, centralized power generation using solar energy. Laborelec has joined forces with Tractebel Engineering to investigate the potential of CSP technology as a solar booster add-on to a coal-fired power plant in Chile.

Laborelec sees great potential in the CSP Fresnel reflector technology. It is a linear system composed of many thin, flat mirror strips that individually track the sun's movement and concentrate the solar irradiation on a receiver to produce steam. 'The CSP Fresnel collector potentially generates more electricity per unit area of land than photovoltaic panels and the other CSP techniques. This makes the technology particularly interesting. Not only for large-scale, centralized energy generation, but also in combination with conventional generation technologies,' states Stijn Scheerlinck.

Building a pilot plant

GDF SUEZ decided to test this technology as a solar booster add-on to an existing power plant. Laborelec is coordinating the project. 'We chose to integrate a CSP pilot unit into the coal-fired power plant in Mejillones, Chile. The site guarantees the necessary amount of direct sunlight, and the plant's base load operation ensures the constant production required to correctly assess the potential of the CSP unit,' explains Sebastian Falkenberg. 'Our experts will also develop a CSP performance monitoring tool. It will help us learn more about this technology and its integration, and will enable us to recommend adjustments in order to further improve CSP efficiency.'

Stijn Scheerlinck, Sebastian Falkenberg

Supporting marine energy research in Portugal

Laborelec is involved in the Standpoint project, which is part of the European Framework Program 7. Standpoint involves a wave energy converter demonstration project off the Portuguese coast. The project is based on the Wavebob point absorber technology, which transforms the energy from sea waves into electricity. Laborelec is taking part in the project on behalf of DRI (GDF SUEZ), together with a consortium partner and local energy operator GENERG, which is partly owned by GDF SUEZ.

'We are providing support to GENERG with the moorings that attach the unit to the sea bed,' explains Ana Novak Zdravkovic. 'In addition, we are coordinating the commissioning tests, including the revision of all specifications. We also support GENERG in coordinating operation and maintenance activities.'

Ana Novak Zdravkovic

Laborelec is coordinating the development of a CSP pilot unit, integrated into a coal-fired power plant in the Chilean desert.

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Taskforce fosters synergies in biogas research

Biomethane obtained from biogas is becoming a popular source of energy. The GDF SUEZ Group has initiated a taskforce dedicated to studying biogas potential for electricity generation and grid injection, among other things. The taskforce brings together three research centres, including Laborelec, to create research synergies.

Biogas can be produced in large quantities. It is obtained from the anaerobic digestion of a number of biodegradable materials such as agricultural residues and waste streams, sewage sludge, and municipal waste. Biomethane results from the removal of biogas impurities and gas upgrading. The BiogasTaskforce evaluates how this potential can be optimally exploited for electricity generation and/or injection into the gas grid.

Efficiently investigating a wide range of biogas applications

The taskforce gathers three GDF SUEZ research centres: CIRSEE, CRIGEN, and Laborelec. Each centre has distinct competencies in terms of its experimental research. 'CRIGEN primarily focuses on the potential of biomethane for grid distribution. CIRSEE concentrates on the production of biogas from waste/wastewater treatment, as well as on on-site biogas and digestate valorization,' explains Chrystelle Verhoest. 'Our research at Laborelec will focus on exploring the potential of biogas/biomethane for green electricity generation.'

The taskforce will also ensure the internal transfer of accumulated knowledge from one research centre to another—for instance, by sharing databases amongst the three entities—and will coordinate the tracking of regulatory developments concerning the use of biogas.

Chrystelle Verhoest

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Initiative Wood Pellet Buyers (IWPB)
Standardizing industrial wood pellet trading in Europe

The IWPB was launched by GDF SUEZ and unites utility firms that fire large quantities of wood pellets. The goal is to enable the trading of industrial wood pellets among the partnering companies.

The IWPB brings together GDF SUEZ, RWE, E.On, Vattenfall, Fortum, and Dong, as well as certifying companies SGS, Inspectorate, and Control Union. Laborelec participates in this work panel as a technical expert.

Redirecting supplies in the case of plant unavailability

All biomass-fired power plants rely on long-term contracts. When one of them needs to be shut down unexpectedly, it is in the plant's best interests to trade its wood pellet supply. Hence, contract forms and legal conditions must be harmonized to ensure adequate trading conditions. In addition, technical specifications and sustainability requirements for wood pellets need to be standardized. The IWPB does this in complete transparency.

Standardizing quality, fostering sustainability

'Laborelec has considerable experience in assessing the sustainability of biomass throughout the production and supply chain,' explains Yves Ryckmans. 'That is why we are chairing the IWPB sustainability workgroup. The goal is to establish a dedicated verification system for woody biomass.'

Yves Ryckmans

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Renewable Energy Seminar in Bruges was a success

In partnership with Tractebel Engineering, Laborelec hosted the second GDF SUEZ Renewable Energy Seminar. From 21 to 23 September 2011, experts from various GDF SUEZ branches and countries gathered together in Bruges, Belgium. The seminar was the perfect occasion to exchange knowledge and experiences concerning wind power, solar power, biomass/biogas power, and renewable heat. Altogether, the participants learnt how to develop and strengthen their competitive advantages in the rapidly evolving world of renewable energy technologies.

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