NEWS :

Focus on renewable energy technologies

WORLDWIDE SUPPORT FOR CO-FIRING UNITS

Laborelec assists power plants from the design stage

Laborelec supports co-firing projects in a wide variety of areas — from the design stage up to operational optimization. This support includes both new units and retrofits. Below is a sample of interventions we have recently carried out.

Design: handling and safety improvements

'We assisted the power plant at Polaniec (Poland) with the design of two systems to improve biomass handling,' reports Yves Ryckmans. 'We also improved safety by suggesting adaptations to the storage and transfer of biomass. This will further minimize any risk of fire or explosion. The goal was to turn the plant into a textbook example of safety.'

At the same time, GDF SUEZ initiated the design of a 100% biomass-fired unit with an installed power of 190 MW at Polaniec. The brownfield unit will primarily fire 80% of fresh wood chips and 20% of agricultural biomass such as straw, fruit husk, and sunflower residues. Laborelec delivered extensive technical support during the commercial negotiations related to the design of the new unit. The unit will feature an advanced circulating fluidized bed boiler that will provide greater flexibility in burning different types of low-grade biomass.

Assessment: advice based on co-firing potential

Laborelec also provided advice to the GDF SUEZ Energy North America (GSENA) coal-fired power plant in Mount Tom, Massachusetts. 'The plant asked us to assess the feasibility of co-firing coal with wood chips,' explains Xavier Henry. 'We established that the plant is capable of replacing 5 to 10% of the coal with wood chips and also ensure efficient processing of ash and flue gas. This assessment is based on their type of boiler and attrition mill.'

Operational support: promoting best practices

Laborelec initiated a European working panel on the health and safety aspects related to the use of biomass in power plants. The panel tracks incidents and identifies and disseminates best practices. Laborelec regularly invites plant operators and other GDF SUEZ experts to meet for experience exchange sessions.

Yves Ryckmans

SUPPORTING GDF SUEZ RENEWABLE ACTIVITIES IN ALL ITS ASPECTS

More than 18% of the GDF SUEZ power generating capacity is based upon renewable energy sources. This figure positions the Group among the cleanest power producers in Europe. GDF SUEZ can rely on Laborelec's expertise to ensure the reliability and availability of its entire production park. Our support includes maximizing the efficiency of renewable energy-fuelled technologies as well as exploring the potential of emerging concepts. This edition of Laborelec News presents some of the projects in various renewable energy domains in which we are active.

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Laborelec provides extensive advice to new and existing co-firing units.

In short

- Laborelec has advised the Polaniec Power Plant on design and safety improvements
- Our experts have also assessed the co-firing potential of the Mount Tom unit
- Laborelec has initiated a work panel to promote greater safety when handling and firing biomass

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PV TEST BENCH

Laborelec is operating a test bench for photovoltaic (PV) technologies at its Belgian headquarters. The goal is to test the long-term performance of various solar panels, mostly thin-films, under actual conditions and extend our knowledge of PV technologies.

Currently, Laborelec is testing various monocrystalline, polycrystalline, and thin-film PV technologies (see text box). Nevertheless, there is room for more. 'We will expand our test bench with the low-cost CdTe technology,' explains Sebastian Falkenberg.

Testing performance under real-life conditions

The Laborelec test bench is equipped with an electric load and data acquisition system. This enables us to test the yield of a panel in both individual and series connections. 'We are also able to test the variation in performance. For instance, at various temperatures, as well as under direct and diffuse solar radiation,' adds Hélène Grandjean. 'The test bench also enables us to study degradation of the PV module.'

Improving and sharing PV expertise

The PV test bench enables Laborelec to support the GDF SUEZ PV activities. For instance, it makes it possible to test the chosen PV modules before installation. This will certainly help limit the risks of such projects. 'Our test bench is also interesting for the PV manufacturers. Our acquired insights gives them feedback on their panel's performance in real-life conditions,' acknowledges Grandjean.

Hélène Grandjean, Sebastian Falkenberg

Technologies under review at the Laborelec PV test bench

- Monocrystalline silicon (= reference panel)
- Polycrystalline silicon (pyramid glass)
- Amorphous silicon (from two different manufacturers)
- Flexible amorphous silicon
- CIS
- CIGS (from two different manufacturers)
- $CIGS_2$
- Cylindrical CIGS

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FORECASTING WIND TURBINE OUTPUT WITH 13% MORE PRECISION

Trading and Portfolio Management are required to forecast electricity production and inform grid operators of the expected output. Any deviation from this forecast entails financial penalties. Laborelec has developed an algorithm that greatly improves very short term and day ahead forecasting for wind turbines.

Initial results show a 13% improvement in forecasting accuracy compared with the simpler linear methods in day ahead scenarios. The algorithm is based in part on the Numerical Weather Prediction (NWP) models used by weather forecasting agencies. These models predict temperature, wind speed, and atmospheric pressure at different points around the globe.

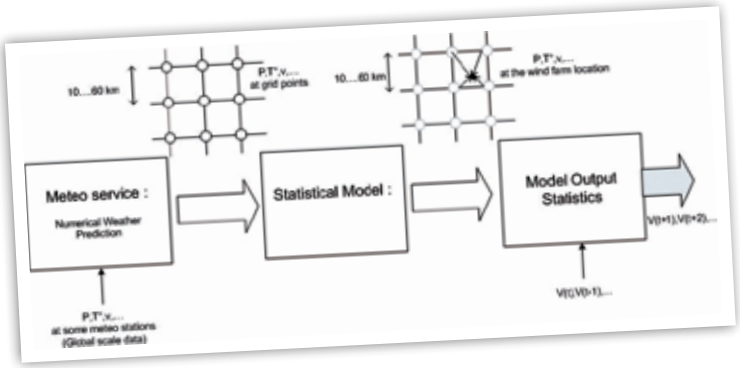
'We interpolate NWP data for the points closest to wind turbines in order to obtain usable values. Similarly, the algorithm interpolates hourly weather forecasts into fifteen minute production forecasts,' explains Thomas Museur. 'We combine these data with archived information on past wind measurements and wind turbine outputs. This enables us to define the output in MW for every known wind pattern.'

Various statistical models

Laborelec relies on a combination of statistical methods. 'The clustering-based model, for instance, integrates optimal linear combinations of the ten to thirteen most typical wind profiles for each wind turbine location,' continues Museur. 'Working with various sources and models substantially reduces the margin of error by combining the advantages of each model.'

The method shows considerable potential for avoiding imbalance penalties and providing accurate data for energy exchange players.

Thomas Museur



The Laborelec forecasting algorithm is based on historical data and weather forecast model outputs.

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MAXIMIZING WIND TURBINE AVAILABILITY

New technologies increase safety

Natural phenomena such as ice build-up, lightning, and sea salt can cause unplanned wind turbine stoppages. The first two also generate potential safety risks for nearby people or buildings. Laborelec is assessing technologies that increase safety around wind turbines while maximizing availability.

Protecting against lightning damage

When struck by lightning, blades can break and fall to the ground. 'We are therefore assessing an alarm system that warns operators of the imminent risk of lightning,' says Monica Burceanu. 'The system detects the electromagnetic fields generated by the lightning channel. Using this system, operators can decide to slow down blade rotation speed or to stop the turbine to reduce the velocity of any broken blade piece that might fall off.'

The structure of the turbine itself must also be protected. 'We are analyzing existing protection systems and recommending adaptations to the turbine structure. In the event of a strike, the lightning current must be guided along a low impedance path into the earth. This way, internal damage is minimized. Since blades are particularly exposed to lightning, their protection against lightning is an important element analyzed during the design stage. A metallic path can, for instance, be incorporated along the blade.'

Avoiding ice build-up on blades

During cold and humid conditions, ice can accumulate on wind turbine blades. If this ice breaks off and falls, it poses a threat for people below and could cause considerable damage to the surroundings. Ice build-up also has economical consequences: the blades become heavier and less aerodynamic, which reduces power output. The structural integrity of the turbine itself can also be affected by unbalance or overloading.

'Security systems exist to stop wind turbines if the risk of ice build-up is too high,' explains Olivier le Fevere de ten Hove. 'New technical developments aim to fight build-up of ice in the first place. These techniques include special blade coatings, electric heating wires, and hot air systems. We are currently assessing available technologies to determine which ones might be worth implementing within the Group.'

Monitoring off-shore turbine condition

On average, off-shore wind turbines are larger in size and exposed to more wind than their counterparts on land. This more intense loading results in accelerated wear. In addition, the salty marine environment is more likely to affect electrical systems, electronic components, and metallic parts. This means that extra maintenance and repair are required. These are also more costly because of difficult accessibility.

'Predictive monitoring therefore takes on an even greater importance,' observes le Fevere de ten Hove. 'We carried out a project evaluating the condition monitoring of off-shore wind turbines in 2009 and made a number of subsequent recommendations to maximize turbine availability. It is essential to install dedicated monitoring tools for vibration, oil, and electronic systems. It is equally important to consolidate all information into a dynamic global maintenance plan.'

Olivier le Fevere de ten Hove, Monica Burceanu

Blades and other turbine components are exposed to lightning strikes and therefore require appropriate protection.

In short

- Laborelec is assessing an alarm system for wind turbines that warns of imminent lightning strikes
- Our experts are also evaluating new technologies designed to fight ice build-up on turbine blades
- For off-shore wind turbines, Laborelec has made recommendations regarding condition monitoring and predictive maintenance

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INVESTIGATING THE FEASIBILITY OF BIOFUELS IN CCGTS

Laborelec investigated the technical and economic feasibility of burning liquid biofuels in combined cycle gas turbines (CCGTs). Under evaluation were the compatibility, combustion behaviour, and sustainability of various biofuels.

Our experts investigated the compatibility of biofuels with component materials used in three types of gas turbines. 'Compatibility depends, in the first place, on the nature of the biofuel. Organic acids, for instance, can damage rubber fittings in piping, whereas biodiesel requires practically no modifications,' explains Hannes Laget. 'In addition, biofuel quality is an important factor. Trace elements can cause serious damage to the gas turbine's hot section.'

The investigation of combustion behaviour revealed that certain biofuels, such as biodiesel, require extensive preheating. Our experts teamed up with the University of Cardiff to run atomization tests and establish the preheating requirements for each type of biofuel.

Our experts also took into account sustainability issues. 'The life cycle analyses of the various biofuels took into account ecological, social, and ethical considerations. In that regard, organic acids pose no problem as they are waste products,' notes Laget.

Our general conclusion is that burning biofuels requires few technical modifications to the gas turbine. However, the difficulty of developing biofuel supply chains, among other things, heavily influences feasibility. Still, it is perfectly possible to build an economically sound business plan based upon biofuels.

Hannes Laget

Laborelec and the University of Cardiff conducted atomization tests and established the preheating requirements for each type of biofuel.

TASK FORCE ASSESSES MICRO-ALGAE POTENTIAL

Micro-algae are increasingly viewed as having considerable potential for the energy sector. Their usefulness is seen both in terms of pollution remediation and energy generation. GDF SUEZ has initiated a Task Force to assess this potential and Laborelec is taking an active part.

The Task Force on Algae brings together CIRSEE, CRIGEN, and Laborelec. Their goal is to unite resources and knowledge in order to identify potential applications for various types of algae within the Group.

Treatment of effluents and fumes

'One area of analysis is whether micro-algae can be used as an alternative means of treating gaseous and liquid effluents from energy production, wastewater treatment plants, or landfills,' says Chrystelle Verhoest. 'Among other applications, micro-algae can contribute to pollution remediation by capturing part of the CO_2 emissions in fumes.'

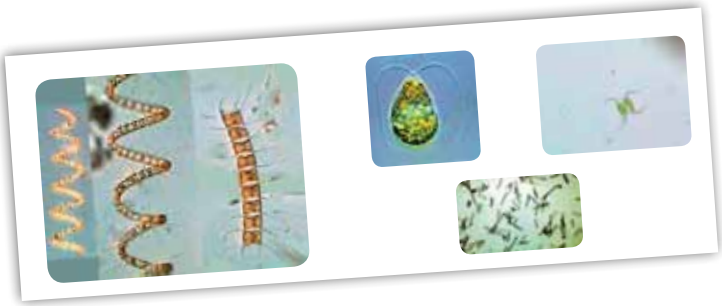
Biofuel for energy generation

'Energy generation is assessed in parallel,' adds Verhoest. 'Because micro-algae cells have a high multiplication rate, they represent an interesting source of biomass for green energy. We are therefore studying which types of micro-algae can best be valorized in the form of biomethane, for example.'

Input from business units

The Task Force's assessment focuses on the added value of algae within the core activities of the Group's business units. 'We have paid much attention to consulting the various business units in order to gather their questions, needs, and concerns,' notes Verhoest. These primarily relate to the feasibility and profitability of micro-algae applications. The first results obtained in 2010 will define the future actions of the Task Force.

Chrystelle Verhoest



Micro-algae exist in numerous forms. The Task Force is assessing which types hold the greatest potential.of possible lubrication oil contaminants.

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