[NEWS :
Focus on renewable technologies

LIFE CYCLE ASSESSMENT OF POWER GENERATION

Modelling the global environmental impact

Upstream processes are an important element in the environmental impact of a power generating unit. This is an important conclusion of a Life Cycle Assessment (LCA) performed by Laborelec in collaboration with Swiss ESU Services.

LCA calculates the global environmental footprint of a power generating unit in various impact categories, such as climate change, acidification, eco-toxicity, etc. It takes into account all resources used and all emissions linked to the generation of one kWh of electricity, from cradle to grave.

[A model for each power generating technology

Together with ESU Services, a European authority in the field of energy LCA studies, Laborelec has built LCA models for a coal/biomass-fired power plant, a Combined Cycle Gas Turbine (CCGT), a photovoltaic system, and a wind turbine. Jan Mertens: 'The input data are taken from our own field experience as well as from the Ecoinvent database. This database contains detailed information on the resources used and the related emissions for every type of material that goes into the fuel supply chain, the construction, the operation, and the decommissioning of a generation unit.'

[Various simulation opportunities

Each model estimates the environmental impact of a specific power generating technology. 'This estimation is based on a series of assumptions. We, for example, had to make a choice between various environment impact assessment methods. Hence, the model's output may vary to a certain extent,' notes Mertens. 'Taking these nuances into account, it is still safe to say that the upstream processes cannot be neglected.'

The LCA methodology can also be used for scenario analyses. 'We already developed seven scenarios. We can, for instance, calculate the difference in the environmental impact for various coal/biomass mixtures. Scenario analyses can be used during the design phase of new power generating units. It will enable the comparison of the environmental costs and benefits of various design opportunities,' concludes Mertens.

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CONTINUOUS BROADENING OF KNOWLEDGE IN RENEWABLE ENERGIES

The European renewable energy market continues to grow steadily both in installed capacity and in the scope of its applications. Laborelec is continuously evaluating new technologies in solar power, wind power, biomass, and other fields of renewable energy. The growing number of services offered by our experts in these fields range from feasibility studies to performance evaluations and operational assistance, as this edition testifies.

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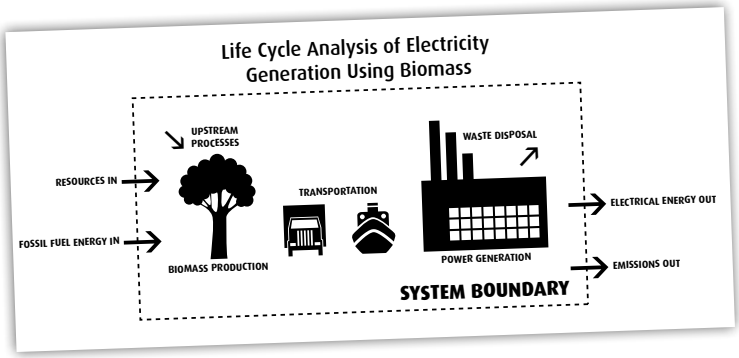
[In short

- Life Cycle Assessment (LCA) calculates the environmental impact of a power generating unit, from cradle to grave
- Laborelec developed LCA models for a coal/biomass-fired power plant, a CCGT, a photovoltaic system, and a wind turbine
- Each model calculates the environmental impact for a specific power generating technology for various impact categories and allows for scenario analyses



Laborelec's LCA model is able to estimate, among other things, the environmental impact of coal/biomass-fired power plants with various fuel mixes.

BUILDING UP KNOWLEDGE OF SOLAR ENERGY

Solar Competence Centre covers growing number of disciplines

Laborelec has established the Solar Competence Centre (SCC) to meet the growing market demand for solar energy applications. The SCC centralizes expertise in this domain and provides a swift answer to market requests.

The purpose of the SCC is to develop and consolidate competence in all aspects of solar energy. It was created within Laborelec to offer customers a broad range of services upon demand and provide assistance in solving solar related issues. It has a complementary role to existing projects. The SCC primarily covers photovoltaics (PV) and concentrated solar power (CSP), but it also meets requests regarding other types of solar technology.

[Diversity of issues addressed on site and in laboratory

'During a recent project,' notes Vasiliki Balafouti, 'a service company asked us to study the electromagnetic compatibility of their PV installations. Little is currently known about the impact of such interference on the behaviour of a PV system, from the module to the grid connection. Through measurements carried out on site and in our EMC laboratory, we were able to answer the customer's question and develop our own knowledge in this area even further.' In another project, Laborelec evaluated the impact of a large PV installation on the voltage quality of the grid. The SCC also worked on the development of a simulation tool used in preliminary studies for establishing CSP power plants.

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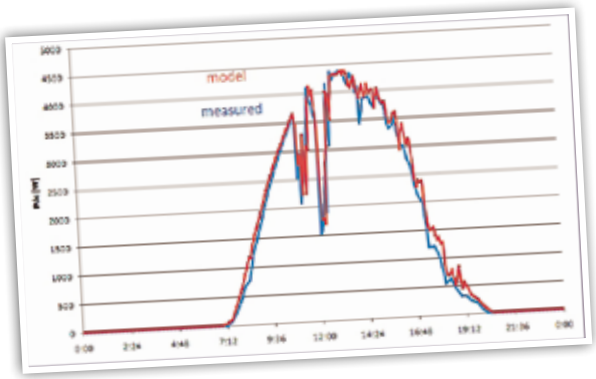
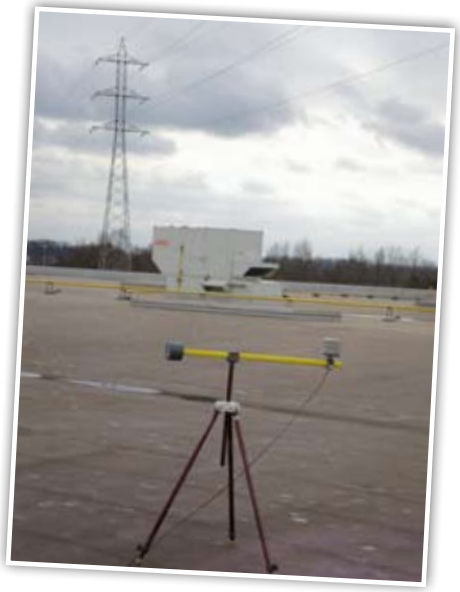


The measured power output is compared with the theoretically expected power.

[In short

- Laborelec's Solar Competence Centre (SCC) centralizes knowledge in the field of solar energy applications
- The SCC covers photovoltaics and concentrated solar power
- Our growing expertise enables us to rapidly address practical issues arising in the field



The Solar Competence Centre addresses all solar related requests from the field.

[Monitoring PV performance

Laborelec continues to improve its monitoring tool for photovoltaic (PV) installations. The software tool is being updated with a calculation function that enables to compare the actual energy production with a theoretically expected value. This is accomplished by measuring the recorded electrical parameters on the one hand, and irradiance and temperature measurement data on the other. The tool detects any sub-performing strings (series of panels) and generates an alarm accordingly. It also allows the monitoring of any deviations in plant performance over time.

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INVESTIGATING WIND TURBINE OPERATION DURING GRID DISTURBANCES

Are wind turbines able to guarantee safe operation during grid disturbances? Laborelec investigated the three most commonly used wind turbine technologies, determined the problems that could occur, and presented possible solutions.

Previously, wind turbines were switched off during grid disturbances. This however, often adds to the risk of serious grid instability; certainly so given the increasing number of wind turbines. For this reason, most European countries have broadened the voltage and frequency range in which wind turbines need to continue operation. But do current technologies allow this? Based on models developed at university, Laborelec studied wind turbine behaviour during grid disturbances. 'Our simulations mainly focused on the electrical behaviour. We identified the electrical parameters that are critical in case of voltage dips and studied how buffer equipment improves the performance of wind turbines with a direct connection to the grid,' states Marc Locht. 'A more detailed mechanical study would be useful, particularly in case of rapid frequency deviation.' Now, Laborelec wants to validate its research in the real world. 'We have already established contacts with French and Portuguese companies within the GDF SUEZ Group that have vast practical experience with wind turbines,' concludes Locht.

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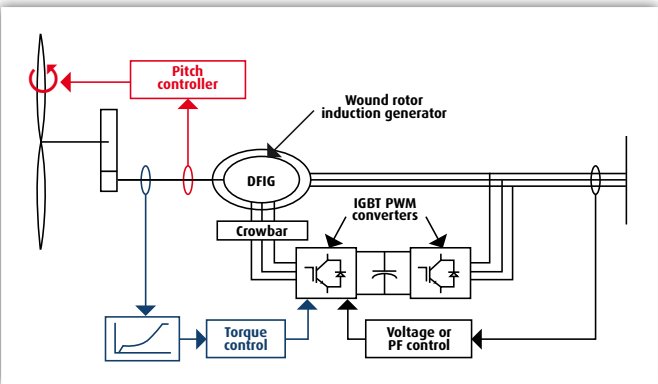

A wind turbine whose stator is directly connected to the grid is very sensitive to voltage dips.

[In short

- New regulations determine the magnitude and duration of grid disturbances during which wind turbines cannot be switched off
- Laborelec studied wind turbine performance during frequency variations and voltage dips

VIBRATION MONITORING ESSENTIAL FOR DYNAMIC WIND TURBINE MAINTENANCE

Laborelec is monitoring vibrations of four wind turbines in Lanaken, Belgium. This experience has confirmed that condition monitoring is essential in developing a dynamic maintenance plan for wind turbines. This is even more crucial for off-shore wind turbines.

The four wind turbines in Lanaken are equipped with sensors that monitor vibrations on the main shaft. The readings are transmitted via GPRS to a server that provides Laborelec with the data via a secured website. 'Through on-line monitoring, we gain insight into the exact state of the most important mechanical components of a wind turbine,' states Olivier le Fevere de ten Hove. 'This information can be used for planning the necessary maintenance work. This is vitally important when support contracts need to be renegotiated with the supplier.'

[On-shore experience useful for off-shore turbines

The need for permanent monitoring will be even more crucial for off-shore wind turbines. 'Off-shore wind turbines are located at remote sites, which are difficult to access. Moreover, they operate in a salty environment and at a higher workload than on-shore installations, making them more vulnerable to degradation,' says Tom Bollaert. 'Permanent monitoring will prove a valuable asset for planning the work meticulously and well in advance.'

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Vibration monitoring is essential for efficient maintenance planning of wind turbines.

[In short

- Continuous vibration monitoring gives valued insight into the exact state of wind turbines
- It is essential for dynamic maintenance planning of on-shore as well as off-shore wind turbines

SWITCHING A POWER PLANT TO FIRING 100% BIOMASS

Accelerated wear proves challenging

Laborelec is assisting Electrabel in converting the Rodenhuize 4 power plant into a unit fired entirely with biomass. This is a challenging project in terms of maximizing catalyst lifetime, boiler availability, and burner reliability.

Originally a 240 MW gas-fired unit, Rodenhuize 4 was adapted in the 1980s to also fire coal. Since 2008, the unit also burns 500,000 tons of wood pellets a year. In the current phase — dubbed 'Max Green' — the unit is being retrofitted to fire only biomass. The expected capacity will be 180 MW.

In view of the Large Combustion Plants (LCP) directive, the plant is now considered new. Consequently, it must comply with more stringent emission limits according to the 'Best Available Technology' approach set out by the authorities. Although no biomass-fired unit of this size has been able to comply with those requirements until now, Laborelec is taking up the challenge.

[Maximizing catalyst service life

'A unique feature of the project is the firing of biomass combined with a $deNO_x$ catalyst placed after the boiler,' says Xavier Henry. 'The problem is that a $deNO_x$ catalyst de-activates much more rapidly when firing wood pellets than with coal. The challenge is to prevent this de-activation from occurring too rapidly to ensure compliance with emission limits, and to minimize additional stoppages and catalyst replacements.'

'Based on our experience, we were able to implement a series of technical solutions that maximize the service life of the catalyst. We are also working closely with suppliers to find ways of extending this service life even further.'

[Simulating burner tube wear

The burner configuration and the burners within the boiler also need to be adapted. 'We established a model to predict boiler behaviour and emissions when firing 100% biomass with different loads,' explains Yves Ryckmans. 'To do this, we relied on our experience with simulation tools for wood and coal, as well as on a newly developed simulation tool.'

In addition, Laborelec took part in drawing up specifications for the parties that will handle the task of adapting the boiler. 'The use of wood pellets accelerates wear in the burner tubes,' notes David Rochaya. 'We are therefore in contact with suppliers to establish what is technically feasible.'

The commissioning of the new unit is planned for the beginning of 2011.

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By 2011, Rodenhuize 4 will be fired entirely with biomass.

[In short

- Electrabel is converting Rodenhuize 4 into a unit fired entirely by biomass
- Laborelec provides assistance in selecting the burners and $deNO_x$ selective catalytic reactor plant
- A key challenge is to ensure compliance with very low emission limits in the framework of the LCP directive, while maximizing equipment service life
- Successfully meeting this challenge would be a world first

[Expert discussions on durability of biomass

Laborelec continuously updates its knowledge of biomass through its own research and by collaborating with external experts. The Scientific Council on Biomass and Sustainable Development is one example of such collaboration. It brings together scientists, university teachers, and GDF SUEZ experts to discuss strategic choices in energy matters concerning the Group. The Council meets several times a year to debate such topics as carbon capture and storage, nuclear energy, and renewable energy. Laborelec is a permanent member of the Council and recently suggested a meeting to discuss the potential of sustainable biomass in generating green energy. A work group meeting was held in Paris and the subsequent report was presented in Saint-Denis to the entire Council. The slides of this presentation are available for consultation.

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