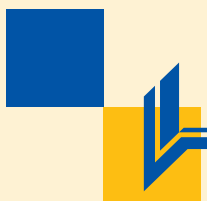


A total solution
for the power
industry



Competences
and
contacts



LABORELEC

The technical Competence Centre
in energy processes and energy use.
From R&D to operational assistance.

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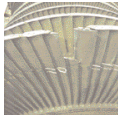
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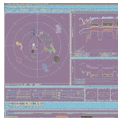
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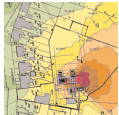
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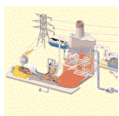
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Assistance for power producers

Whether you are the operator of a 500 MW power plant, or the technical manager responsible for a cogeneration unit on your industrial site, you can call upon Laborelec for every aspect of the power generating process. We have both R&D and operational expertise that enable us to assist you in assessing incidents, giving site-specific advice, solving problems, or optimizing each step of the production process. And we can provide tailor made training courses on each of these aspects as well.

This brochure describes the various services that Laborelec offers and provides you with an overview of useful contacts. It is not intended to be an exhaustive discussion of all of Laborelec's services. If you need more details or have a question about a topic not covered in the following pages, don't hesitate to **contact Gustaaf Boon at gustaaf.boon@laborelec.com or +32 2 382 05 65.** He is the Laborelec Account Manager for Power Generation and will be happy to supply whatever information you need.



More information

For a more complete overview of our products and services, go to www.laborelec.com. There you will find detailed product brochures and leaflets.

To stay informed about our latest realizations and research, subscribe to our monthly newsletter Laborelec News at info@laborelec.com.

Water treatment, conditioning and control

Optimal water circuits – whether waste water, cooling water, or process water - require a thorough knowledge of water chemistry, biology, and control. Laborelec looks at your water network as a whole, optimizes conditioning and treatment techniques, and introduces the best available control processes.



Sustainable and independent advice

Highly specialized techniques make investing in your water systems more cost effective than ever before. Thanks to Laborelec's objective, supplier-independent advice, you can combine high technical performance and care for the environment with constant attention to cost-efficiency. This is our way of helping you find sustainable solutions for your water systems.

The full range of water related activities include:

- Chemistry of the water/steam circuit in fossil fuel fired power stations, combined cycle power plants, and cogeneration units, including conditioning and continuous and off-line monitoring of these circuits
- Follow-up of boiler acid cleaning
- Chemistry of the primary and secondary water circuits of pressurized water nuclear power stations
- Chemistry and biology of open and closed cooling systems
- Pre-treatment and separation techniques applied to water treatment, including ion exchange and membrane techniques, coagulation and flocculation, filtration and precipitation
- Biological and physical/chemical treatment of cooling, process, and waste water related to energy production and other industrial activities
- Management tools including audits, analysis, decision-making software, and modelling

coralie.goffin@laborelec.com

Combustion technology and thermodynamics

Laborelec helps you maximize fuel efficiency, comply with emission regulations, and making optimal use of renewable energy sources. Our combined knowledge of combustion processes and thermodynamics enables power plant operators as well as people in charge of small power production units to optimize each step in the power generating process.

From fuel choice to emission reduction

Laborelec covers a wide variety of activities in the field of combustion technology. Our experts have a thorough knowledge of combustion processes and thermodynamics, specific to power generation. This knowledge is made even more useful because of the practical experience we have built assisting operators of every type of commercial and industrial power plant. This combination gives us the insight to optimize each process step in your power generation, from making a better fuel choice and improving combustion efficiency to minimizing maintenance costs and emissions. In addition, we continuously investigate new opportunities and applications for innovative technologies such as



advanced gas turbines and conscientiously monitor emerging technologies like power generation from hydrogen.

At the cutting edge of technology, including:

- Fuel analysis and selection, ash characterization, and analyses of the influence of a particular fuel on slagging and corrosion
- Characterization of biomass and substitute fuels, advice on how to best take advantage of these fuels and to avoid their specific problems, and gasification
- Burner technology, air distribution, burner adjustments, flame stability, and low NOx burners
- Measurements and analyses of air flows, heat fluxes, temperatures, dew points, and gas composition in boilers
- Dynamic simulations (Computational Fluid Dynamics) of the combustion process to make low cost predictions of temperature distribution and heat fluxes, or the influence of burner configuration and fuel choice on emissions, slagging, and corrosion
- Calibration of monitoring systems, and dust analysis and reduction
- DeNOx and DeSOx process evaluation, advice for procurement, exploitation, and maintenance

johan.vanormelingen@laborelec.com

Integrity assessment and failure analyses

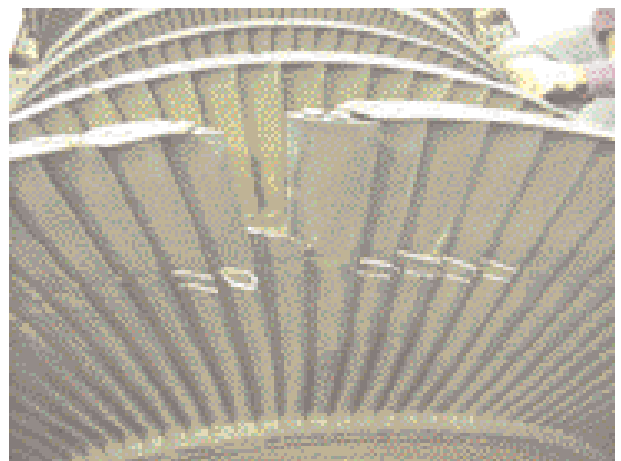
To ensure the safety and reliability of a power generation unit, every component needs to be kept in a good condition. The cause of incidents has to be detected and resolved, and failures have to be repaired in the shortest possible time. On the other hand you need to keep the cost of inspections and maintenance as low as is prudent. We lead you to maximum efficiency with the help of state-of-the-art methods and our extensive knowledge of power generation equipment.

Incident analyses and corrective maintenance

Laborelec uses a number of techniques, ranging from visual inspections to non-destructive and destructive testing, to assess the root cause of a failure in both conventional and nuclear power stations. Our experts collect the necessary data and apply their years of expertise to formulating real-life recommendations with a sound scientific basis. That way, we help you repair possible damage, prevent further damage and avoid similar incidents in the future.

Monitoring installations and devising maintenance plans

- Numerous factors must be monitored to know the exact condition of a machine. Laborelec takes readings or provides permanent monitoring, analyses the results, and based on these, helps you to draw up an optimal maintenance plan, such as:
 - Run to failure
 - Periodic maintenance
 - Preventive maintenance
 - Detective maintenance
 - Predictive maintenance
 - Periodic maintenance



- Predictive maintenance is a maintenance strategy that maximizes reliability with minimal maintenance effort. Laborelec's maintenance experts use specialized techniques including condition monitoring and remaining lifetime calculation to predict the appreciable decline of a machine and the risk that defects will increase significantly. This approach reduces maintenance interventions to only those which are truly essential.

We use a variety of techniques for these maintenance activities, including among others:

- Remaining lifetime calculation
- Analyses of lubricating oil
- Vibration analyses
- Process and cooling water analysis
- Modelling of gas turbine components
- Destructive and non-destructive testing
- Thermography

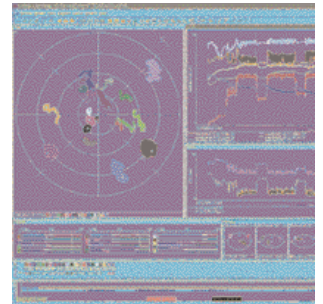
steven.goedseels@laborelec.com

Vibrations

Early detection reduces cost

Monitoring the vibration behaviour of your installations enables you to prevent problematic vibrations and damage, thus reducing maintenance costs and increasing reliability. Laborelec is especially skilled in measurements, monitoring, diagnosing, and solving vibration problems of large, rotating machines. Our experts use specialized instruments that minimize interference with your production processes during measurement. We list the best technical and economic solutions in a clear and concise report. If asked, we can prepare a full predictive maintenance and monitoring plan for your machines.

Laborelec has developed a specialized vibration monitoring system for large turbo groups. The Laborelec Vibration Monitoring System (LVMS) includes remote



monitoring options, allowing a complete service, even from a distance, at minimal cost. LVMS enjoys an outstanding international reputation and received the Suez 'Label of Value Creation' Award.

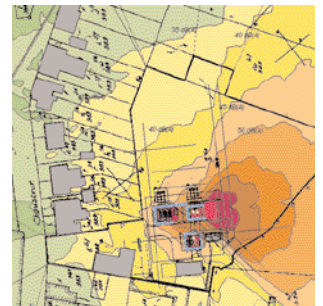
koenraad.debauw@laborelec.com

Noise control

Accurate measurements translated into effective action

When applying for or renewing your operation licence, or when carrying out an environmental impact assessment study, you have to prove that your site meets all noise standards, both inside and outside the building. Laborelec is officially recognized in Belgium to carry out noise measurements. Our experts possess a variety of specialized measuring instruments and software tools, that enables them to record and quantify even the very lowest noise levels on all critical measuring points required by law or regulations. Our method based on frequency analysis filters out the sound of a specific installation

from the background noise. Only a single measurement during operation is needed for highly accurate results. Ingenious simulation software predicts the effect of installing a



new noise source such as a power plant into an environment. It also allows us to simulate the effects of remediation actions. This enables you to direct your investments to the most effective measures, and obtain an installation that meets the standards without exaggerating the safety margin.

didier.tollenaere@laborelec.com

Insulating materials and lubricants



Optimum reliability, lifetime, and safety of your equipment

Oil analyses provide crucial information on the ageing, condition, and quality of the oil itself, and on the condition of the machine. Laborelec provides you with specialized analyses of electrical insulating materials, including transformer oil, and of lubricating oils of turbines, large pumps, motors, and gear boxes. Our experts can advise you on how best to extend the life of these insulating and lubricating materials.

They can also detect latent electrical or mechanical defects in your crucial equipment through oil monitoring or identify an incident's root cause through oil analysis. By keeping the same type of analyses in an extensive database, they can also help you draw up a predictive maintenance plan to optimize your machine uptimes. Our advice may

include modifications in the operating conditions or selecting the best oil treatment for your machine. We let the oil tell us what to do to maximize your equipment's reliability.

Laborelec experts also have years of expertise with solid insulation materials, such as in cables. When investigating incidents caused by defective solid insulation materials, we take mechanical, chemical and electrical aspects into account. We give advice to improve weak points in cable networks and in the purchasing and installation process of medium voltage cables.

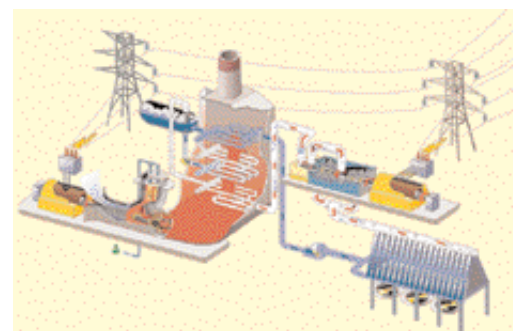
*For insulating fluids and oils:
steve.eeckhoudt@laborelec.com*

*For solid insulating materials:
gerard.platbrood@laborelec.com*

Process control

Energy conversion optimized technically and economically

Close control of energy conversion plants is very complex, often involving non-linear processes. The conception and optimization of these processes' control loop parameters is a highly specialised task. Laborelec can call upon extensive practical knowledge to help you optimize your control processes, from both a technical and an economical point of view. Our experts develop, commission and



optimize control loops, test new control algorithms, optimize the design of an installation and its control structure. After each modification, they test the transient phenomena again. Prior to the construction of a new plant, or the revamping of an existing one, dynamic modelling provides a pro-active check to establish whether the future installation will react appropriately during all transients.

philippe.demlenne@laborelec.com

Power quality and electromagnetic compatibility

Energy that complies with quality standards

The electricity your plant produces must comply with various power quality standards before it is allowed on the public grid. Laborelec experts are accredited to perform specific measurements to assess the quality of the power you produce. We can also install a device for permanent long term monitoring of power quality. If the system discovers a Power Quality problem, you are instantaneously informed by SMS or email.

We also offer a service for troubleshooting. Therefore we can log onto the monitoring system remotely, considerably reducing analyses and reporting time. Our experts identify the cause of a disturbance and give appropriate advice to solve the problem.

One device measures electrical power and speed variations

We offer a new service with an in-house developed device, the data wave recorder (DWR). The DWR allows us to simultaneously measure electronic and mechanic signals. This means we can map the start-up curve of your machines, or for instance load variations.



bernard.dethy@laborelec.com

Preventing electromagnetic influences

Laborelec assists you in avoiding or solving malfunctions caused by electromagnetic sources. Power producers and engineering departments of industrial companies use our expertise to ensure or restore the ability of a device or an installation to function satisfactorily in its electromagnetic environment.

These systems should not introduce in their environment any electromagnetic disturbances that might lead to inefficiencies or malfunctions. Proper earthing, grounding, and shielding are some examples of potential corrective measures. But the best practice is to ensure electromagnetic compatibility right from the beginning. That is why Laborelec offers advice even in the concept phase of your power generation installation. Laborelec also performs measurements to verify that electromagnetic fields comply with the health criteria defined by the European Parliament.



conrad.bottu@laborelec.com

Electrical metrology



Measurements of electrical quantities must be exact. That can only be guaranteed by precisely calibrating electrical quantity measuring equipment and by qualifying metering equipment. In addition to calibration and qualification, Laborelec also provides

consultancy on conducting measurement campaigns and establishing proper protocols. We are an accredited laboratory for electrical metrology, directly affiliated with the Belgian primary laboratory, as well as international labs in Germany and France. We maintain the Belgian standard for the kWh. Power producers can use our services to calibrate their kWh meters; either at their site or in our laboratory. The certificate of calibration that we issue under ISO 17025 accreditation shows the traceability to international units and may be displayed within the framework of an ISO 9000 certification process.

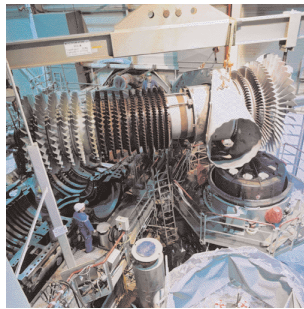
alain.deffrennes@laborelec.com

Laborelec's equipment related competences

The following is a general overview of power plant equipment and processes, the corresponding services Laborelec offers, and the person at Laborelec you can contact for more information.

Gas and steam turbines

- Filtration, compressor fouling, combustion, emissions, and performance monitoring



Contact Johan Vanormelingen at +32 2 382 03 10 or johan.vanormelingen@laborelec.com

- Vanes and blades, materials and coatings, and root cause analysis

Contact Nico Breuls at +32 2 382 05 94 or nico.breuls@laborelec.com for steam turbines

Contact Sigrid Gijbels at +32 2 382 05 25 or sigrid.gijbels@laborelec.com for gas turbines

- General advice on vibrations and mechanical behaviour

Contact Koen De Bauw at +32 2 382 05 75 or koenraad.debauw@laborelec.com

- Lubricating and insulation oils

Contact

Steve Eeckhoudt at +32 2 382 06 04 or steve.eeckhoudt@laborelec.com

Generators

- Electrical expertise and general behaviour

Contact Jeroen Van Cotthem at +32 2 382 03 26 or jeroen.vancotthem@laborelec.com



- Vibrations

Contact Koen De Bauw at +32 2 382 05 75 or koenraad.debauw@laborelec.com

Boilers

- Damage analyses, inspections, calculation of residual life times, and boiler life management

Contact Nico Breuls at +32 2 382 05 94 or nico.breuls@laborelec.com



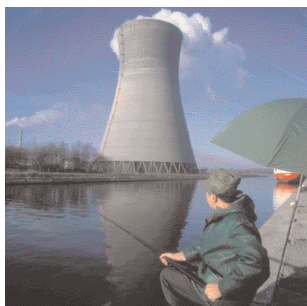
- Chemical cleaning and water conditioning
- Contact Coralie Goffin at +32 2 382 06 62 or coralie.goffin@laborelec.com

- Fuel advice, characterization of ash, combustion optimization, combustion process control, emissions measurement and advice, CFD modelling, and economic modelling for optimal exploitation

Contact Johan Vanormelingen at +32 2 382 03 10 or johan.vanormelingen@laborelec.com

Condensers

- Process water and cooling circuit conditioning
Contact Coralie Goffin at
+32 2 382 06 62 or
coralie.goffin@laborelec.com



- Damage analyses and inspections
Contact Nico Breuls at +32 2 382 05 94 or
nico.breuls@laborelec.com

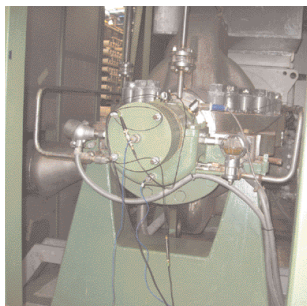
Transformers

- Oil check-up and transformer condition monitoring
Contact Steve Eeckhoudt at
+32 2 382 06 04 or
steve.eeckhoudt@laborelec.com
- Incident expertise
Contact Jeroen Van Cotthem at +32 2 382 03 26
or jeroen.vancotthem@laborelec.com
- Noise measurements and acoustic remediation
Contact Didier Tollenaere at +32 2 382 05 01 or
didier.tollenaere@laborelec.com



Auxiliary equipment

- Pumps and fans
Contact Steven Goedseels at
+32 2 382 04 94 or
steven.goedseels@laborelec.com



Control systems

- Control systems
Contact Theo Verwimp at
+32 2 382 02 24 or
theo.verwimp@laborelec.com
- Troubleshooting - Electro Magnetic Compatibility
Contact Conrad Bottu at +32 2 382 03 60 or
conrad.bottu@laborelec.com



Environment

- Monitoring of the chemical and biological water quality, water conditioning, rational water use, and waste water treatment
Contact Coralie Goffin at +32 2 382 06 62 or
coralie.goffin@laborelec.com
- Emission measurements and combustion advice, and NOx measures
Contact Johan Vanormelingen at +32 2 382 03 10
or johan.vanormelingen@laborelec.com
- Acoustic remediation
Contact Didier Tollenaere at +32 2 382 05 01 or
didier.tollenaere@laborelec.com
- PCB analyses
Contact Steve Eeckhoudt at +32 2 382 06 04 or
steve.eeckhoudt@laborelec.com
- Measuring electromagnetic fields to verify compliance with the health guidelines as defined by the European Parliament in the directive 2004/40/EU on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electric fields)
Contact Conrad Bottu at +32 2 382 03 60
conrad.bottu@laborelec.com





Five reasons for you to choose Laborelec:

- you have one-stop shopping for your energy needs;
- you get access to more than 40 years of experience;
- you get rapid service with reliable solutions;
- you increase the profitability of your installations;
- you benefit from independent and confidential advice.



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