

# NEWS: focus on condition monitoring

## Five years of remote power plant condition monitoring

Detecting faults early on saves money

Over the past five years, Laborelec has installed the SmartSignal condition monitoring tool in a large number of Benelux power plants. Since the tool has now been running in many plants, we felt the time was right to analyze its usefulness.

The SmartSignal tool continuously compares actual data of plant equipment with reference values, providing valuable insight into the equipment's condition. Laborelec has installed the tool in thirteen gas-fired, steam-fired, and nuclear power plants in the Benelux. The tool has already proven its value on multiple occasions.

### Avoiding damage in numerous areas

A key benefit of SmartSignal is that it enables the timely identification of potential faults before they can cause serious damage. Laborelec uses the data generated by the tool to detect abnormalities in a wide variety of components, including condensers, bearings, cooling circuits, valves, boilers, and pumps. In one instance, a valve had remained closed after an offline wash. Using SmartSignal, our experts were able to locate the problem so that it could be investigated in detail and resolved before any damage was caused. The tool also helps detect combustion dynamics issues very early on, thus enabling the power plant to fine-tune the relevant parameters before damage occurs in the combustion chambers.

### Identifying sensor drifts

The analysis also revealed that SmartSignal can detect sensor malfunctions. The tool helps locate sensor drifts by comparing measured values with other process parameters. In one of the plants, for example, a fine rotary filter was often turned on unnecessarily because of an incorrect sensor calibration.

When faults are detected at an early stage, the resulting gains or savings are often difficult to quantify. The benefits of SmartSignal, however, are clear. If these faults had not been detected, there would have been either potential damage or a loss of productivity.

*Sébastien Grégoire*



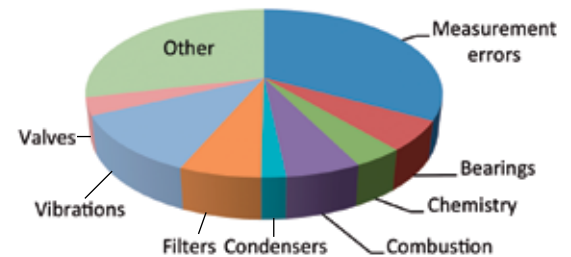
## Helping plant operators preserve the mechanical condition of their equipment

Laborelec covers a wide range of aspects that can potentially affect the condition of key power plant equipment, such as rotating machinery. A previous issue of our newsletter highlighted our expertise in the condition assessment of electrical rotating equipment; this edition focuses on the mechanical aspects of rotating machinery. It highlights some of our interventions in oil analysis, vibration monitoring, and other remote condition monitoring tools for pumps, turbines, and alternators.

### Contact

*sebastien.gregoire@laborelec.com*

## Detected faults - per domain



### In short

- > In the past five years, Laborelec has installed SmartSignal in thirteen Benelux power plants
- > An assessment of the monitoring tool revealed that it has enabled early fault detection in a wide variety of operational domains
- > The tool also detects sensor malfunctions



For more information, contact  
[sebastien.gregoire@laborelec.com](mailto:sebastien.gregoire@laborelec.com)

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## Vibration measurements help solve old bearing problem

Eliminating the operating restrictions of a Brazilian power plant

The Jorge Lacerda Power Plant in Brazil had been having vibration problems with its steam turbines for a long time and called upon Laborelec for assistance. Our vibration measurement experts were able to identify the root cause of the problems. After several mitigation actions, the plant can almost operate at its nominal steam temperature.

The bearings of the medium and low pressure turbines at the Jorge Lacerda Power Plant had been showing abnormally strong vibrations. Over the past few years, several tests had been conducted, but they did not reveal the root cause of the problems. Near the end of 2010, the plant operator contacted Laborelec. Based on the history of the problems, our experts proposed a vibration measurement campaign, including the installation of additional sensors.

### Monitoring indicates abnormal resonance frequencies

After installation of the new sensors, impact tests revealed a resonance frequency close to 60Hz for the low pressure turbine bearing. The actions to stiffen the low pressure turbine bearing did not mitigate the vibrations. Laborelec balanced the turbine rotor to bring vibrations to acceptable levels.

### Consolidating the shaft position changes to identify a deeper cause

The vibration measurement campaign revealed an abnormal evolution of the average shaft position near the medium pressure turbine bearing. The investigation revealed that external forces coming from the steam piping moved the stator vertically upward during the first hours that the turbine is heated. This movement caused rubbing and led to increased vibrations. A temporary solution was found in adjusting the stator downholder bolts. As a result, the plant can resume operation at practically its nominal reheated steam temperature of 540°C, where it had been limited to 480°C in the past. A more complete review of the steam piping fixation will enable a permanent solution for the problem.

Tom Verbruggen



*Adjusting the downholder bolts of the medium pressure turbine stator minimized vibrations, making it possible for the Brazilian power plant to resume operation at practically nominal steam temperature.*



### In short

- > The bearings of the medium and low pressure turbines at the Jorge Lacerda Power Plant in Brazil had been experiencing vibration problems for a long time
- > When Laborelec was called in, our experts observed abnormal resonance frequencies for one of the bearings
- > Further investigation led to the detection of external forces acting on the turbine, a problem that was temporarily solved by adjusting the downholder bolts



For more information, contact  
[koenraad.debauw@laborelec.com](mailto:koenraad.debauw@laborelec.com).

## Vibration measurements reveal lubrication problem

**During the restart of the Roselectra Power Plant in Italy, the temperature of one of the bearings drastically increased. Laborelec's analysis of the vibration data indicated that the bearing was not receiving enough oil. Subsequent inspections identified the root cause of the problem and triggered the appropriate repairs, preventing a longer outage of the unit.**

### Monitoring detects abnormal vibrations

The Roselectra Power Plant asked Laborelec to determine the root cause of the temperature increase of one of its bearings. Our experts analyzed the data from our on-site vibration monitoring system (LVMS), revealing abnormal sub-harmonic vibrations. Our investigation revealed significantly increased sub-harmonic vibrations of 0 to 10 Hz in that specific bearing.

### Advice leads operator to the root cause of the problem

Based on the analysis of the vibration data, Laborelec formulated possible causes for the abnormal vibrations. One of our hypotheses

## Early detection of generator temperature increase at Drogenbos Power Plant

**Laborelec's condition monitoring tool generated an alarm for one of the generators at the gas-fired Drogenbos Power Plant in Belgium. Our Condition Monitoring and Vibration Monitoring departments joined forces to identify the root cause of the problem.**

The online SmartSignal condition monitoring tool continuously monitors the key parameters, such as temperature, vibrations, pressure, and speed, of all critical power plant components. Based on historical reference data, the tool enables Laborelec to rapidly diagnose problems, as demonstrated in the case of the Drogenbos Power Plant.

### Multidisciplinary collaboration identifies root cause

After restarting the Drogenbos Power Plant, the online condition monitoring tool detected an increase in the temperature of one of

was that the bearing did not receive enough oil. The operator decided to inspect the oil pipelines, but this, initially, did not reveal any anomalies. Nevertheless, the bearing temperature remained high after a new restart. Ultrasonic flow measurements of the pipelines revealed that the bearing had a much lower throughput flow than required. The bearing was suffering from oil starvation during normal operation. A more detailed inspection of the pipeline revealed an oil orifice blockage. After repair, the temperature and vibration behaviour returned to normal.

Since the oil starvation could have evolved into a bearing failure, the timely detection of the problem and the fast inspections and repair prevented a longer unplanned unavailability of the unit.

*Kris Matthys*



For more information, contact  
[koenraad.debauw@laborelec.com](mailto:koenraad.debauw@laborelec.com).

the generators' bearings. Our vibration monitoring experts were immediately called in to help identify the root cause of the problem.

Previously, they had observed a similar temperature increase at the other identical gas turbine generator at the Drogenbos Power Plant. This had turned out to be the result of a changed position of one of the bearings. Upon closer examination, our experts found that this second generator was experiencing the same problem, which can seriously damage the bearing in the long term. We consequently advised the operator to closely monitor the situation and inspect it in greater detail during the next scheduled maintenance intervention.

*Willy Vanderelst, Kris Matthys*

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## Vibration analysis training for turbo machines

**Laborelec has developed a training module on vibration analysis for large gas and steam turbines. The goal is to help the power plant's technical staff identify vibration-related anomalies and improve the maintenance strategy for their equipment.**

The training module covers both the theory and practice of lateral vibration analysis of large rotating machinery. It addresses the basics of vibration analysis, the rotor dynamic behaviour of shaft lines, vibration monitoring techniques, relevant ISO standards, and so on. It also includes real-life case studies based on Laborelec's own experiences with more than 100 shaft lines.

## Successful oil monitoring collaboration in Bahrain

**For several years, Laborelec has been monitoring the condition of lubricating and hydraulic oils at a power plant in Bahrain. Our expert advice has enabled the operator to avoid costly maintenance shutdowns. As a result, the plant requested a framework agreement for oil condition monitoring and analysis.**

### Oil monitoring indicates anomalies

Laborelec helped the power plant avoid various shutdowns. For instance, we helped the local operator prevent oil varnishing. The Rotating Pressure Vessel Oxidation Test showed accelerated oxidation of the gas turbine's lubricating oil. However, other oil characteristics were normal. So, our experts advised to regularly top up the oil by 10% to increase the lifespan of the gas turbine.

Together with the local maintenance staff, Laborelec also detected an increasing presence of zinc in the hydraulic oil systems of the gas turbines. Closer investigation revealed that the zinc was coming from the hydraulic pumps.

As a result of our preventive advice, the Bahrain power plant has asked Laborelec to continue its oil monitoring activities as part of a framework agreement.

*Koen Balman*



For more information, contact  
[steve.eeckhoudt@laborelec.com](mailto:steve.eeckhoudt@laborelec.com).

## Training session in Dubai

The first two-day training session in June 2010 was attended by an international audience and was successfully repeated in June 2011. In November 2011, Laborelec organized a four-day training session in Dubai. The training was tailored to the needs of the customer, including a session dedicated to material technology for gas turbine applications.

*Kris Matthys*



For more information, contact  
[koenraad.debauw@laborelec.com](mailto:koenraad.debauw@laborelec.com).



## Laborelec opens Middle East office

**Laborelec wants to be close to its customers. In addition to our headquarters in Brussels and our branch offices in the Netherlands and Germany, we are now extending our customer proximity outside of Europe. Our first realization of this is the opening of an office in Bahrain.**

### Increasing customer proximity

Laborelec has signed a Supply of Services contract with the International Power-GDF SUEZ Dubai Branch. 'As a result of this contract, we will provide power and water plants in the Middle East, Turkey, and Africa (META) with expert advice in water-steam cycle chemistry,' states Jan Vanoudendycke, Head of Operations at International Power – META region.

In order to offer the local plants fast and efficient service, Laborelec has moved its senior expert Marc De Wispelaere to the new office at the Al Dur power and water plant site in Bahrain. He will also help develop Laborelec's services in the Middle East.

*Guy Dreessen*



For more information, contact  
[guy.dreessen@laborelec.com](mailto:guy.dreessen@laborelec.com).