

Power output increased by wet compression

Gas turbine evaluation at Herdersbrug

SwirlFlash® is a wet compression system that increases the power output of a gas turbine and lowers NO_x emissions. The Herdersbrug power plant has been equipped with this system since 2003. At the request of the operator, Laborelec performed a complete evaluation of the installation. The first results are conclusive.

Spraying water to optimize compression

In a gas turbine, 65% of the generated energy is used to compress the inlet air and is therefore not available for electricity production. Thus, every reduction in the amount of work a turbine must do to compress inlet air improves efficiency and yields an increase in power. One way of applying this idea is to inject a controlled amount of water into the inlet air. This is the principle upon which the SwirlFlash® overspray system is based. The result is a lower level of compression work and an increased fuel flow, resulting in a higher power output. Furthermore, with this technology, the flame temperature in the combustion chamber is reduced. This results in a lower level of thermal NO_x formation.

A complete follow-up

SwirlFlash® is not just an add-on; it is an integral part of the installation. It requires specialized engineering skills to give relevant evaluation of its performances. At the request of the operator, and in order to quantitatively delineate the benefits of the wet compression system, Laborelec performed a complete evaluation of the installation at Herdersbrug. This included the study of thermodynamic and combustion related aspects as well as materials and vibration issues.



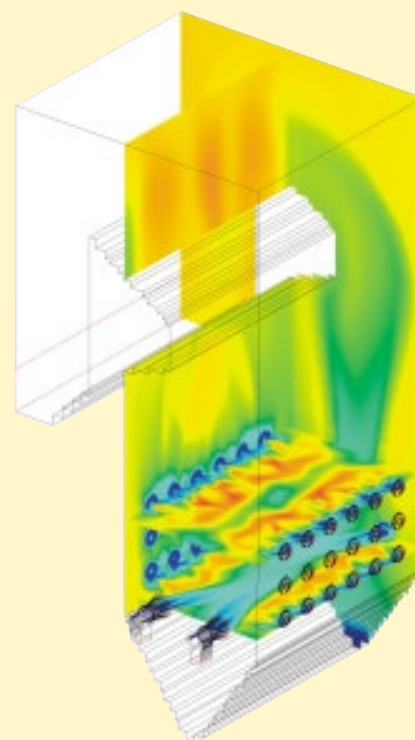
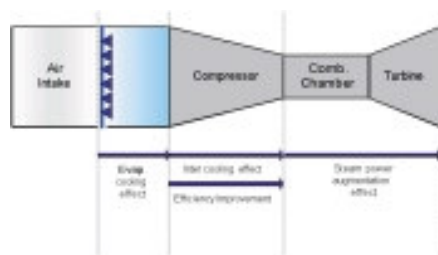
For example, the influence of turbine inlet temperature, gas flow, and compressor

discharge pressure were carefully examined. The materials examination revealed no significant impact traces on the blades or blistering of the coating. No significant change in the vibration behaviour was detected.

Positive results

The study concluded that the SwirlFlash® system constitutes a genuine improvement in the performance of the installation. Furthermore, this experience has produced a broad range of useful information for future use, in particular, for the manufacturer and the insurer. Follow-up of this project will continue in 2004 and include new performance calculations, visual inspections of the IVGs and first compressor stage, and corrosion resistance studies of the first stage turbine blades.

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Combustion optimization

Laborelec is often called upon to optimize combustion processes in various types of boilers. Laborelec can suggest a number of tools to reduce emissions and improve boiler performance.

One tool is air distribution analysis. This technique identifies airflow deviations between burners, and the precise nature and location of any inefficient distributions. By balancing the airflow and the fuel flow between burners, a better heat rate, boiler thermal efficiency, superheater temperature profile, flame stability, and reduction of NO_x emissions can be achieved.

Laborelec also assists power plant operators with burner retrofit projects, in close cooperation with the manufacturer. In this kind of project, Laborelec carefully assesses the installation of improved flame stabilizers, burner geometry, and coal distribution devices. In addition, Laborelec can adopt Computational Fluid Dynamics modelling for the impact study of these changes on the overall boiler performance.

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Vane investigation in Rosen

Independent root cause analysis acknowledged by manufacturer

The Rosen power plant in Italy was confronted with two cracked first stage vanes in one of their gas turbines. This incident was unexpected, since the manufacturer's maintenance requirements and operation specifications were scrupulously observed. The Rosen operator decided to call in Laborelec for an independent root cause analysis.

Variable coating quality

Laborelec was given one of the cracked vanes for a thorough analysis. Our experts performed a visual examination, fluorescent penetration tests, destructive metallurgical tests, and hardness measurements. This investigation revealed several anomalies that all led back to the coating and the refurbishment processes of the vane. The coating adhesion was poor on certain areas of the vane and the thickness was outside specifications on other areas, leading to higher stresses and other non-optimal performance.

Considerable cost avoided

After examining Laborelec's report, the manufacturer acknowledged that the problem lies in the refurbishment process. That means the operator can't be held responsible for the fault. The replacement is thus covered by the guarantee. This result saves the operator several thousands of euros. Rosen is obviously very pleased with this result and has already asked for our expertise on another matter. The power plant has encountered similar problems with a second machine. There, the vanes

are brand new. The root cause analysis will be performed by the original equipment manufacturer (OEM), but Laborelec will follow-up the results with special care.

More quality control

In the mean time, Laborelec's suggestion that an audit be performed at the vane coating company has been followed up. The findings indicated that the coating procedures met the requirements, but that more thorough quality control is needed. This advice is currently being implemented.

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Incoming inspection proves advantageous

For about a year now, Laborelec has been performing inspections of new and refurbished critical components for gas turbines before mounting them into the machines. Some success stories, along with a lot of avoided costs, have proved the usefulness of this type of activities.

Laborelec experts have, for instance, discovered clogged cooling channels on various occasions. But they also reported minor flaws. All of them have been handled positively by the manufacturers. They replaced the vanes

with critical mistakes and confirmed that the minor flaws have no negative consequences for the guarantee conditions for others. All in all, a very beneficial new service for everyone concerned.



SwirlFlash® : prototype clause withdrawn

Ready for general implementation

As reported in Laborelec News N°47 (April 2004), the installation of the SwirlFlash® wet compression system in a gas-fired power plant has a positive influence on the plant's efficiency.

The only aspect keeping the new system from being implemented in other gas turbines was an insurance clause stating that this new system was a prototype. This means that the warranty of a machine with SwirlFlash® is decreased.

Laborelec has defined the criteria that withdraw such prototype clauses. These stipulate among others the procedures necessary for monitoring vane erosion. They also state the conditions for vane replacement, to avoid any risk of decreased reliability. The insurance company was closely involved in the definition of these criteria and has fully accepted them. Now the road is open for general implementation of SwirlFlash®.

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