BLAVIM stands for BLAde VIbration Monitoring and has been developed for the recording, evaluation and monitoring of blade vibrations in LP turbines.

BLAVIM is the first system that enables the measurement of the vibrations of the last two blade rows using the existing shaft vibration sensors.
Why measure and monitor blade vibrations?

In the last few years the requirement specifications of turbines have changed. Base or intermediate load blocks are increasingly being used in the peak load range for secondary regulation. Particularly the end blades of the LP turbines (L-0 and L-1) may then be subjected to additional stress as a result of altered operating parameters.

Due to the large number of possible excitation forms, LP blades in particular tend to be susceptible to strong vibrations. These excitations can be induced by the following conditions, for example:

- Multiples of rotation rate during run-up/run-down
- Holding speeds
- Stochastic impulses due to steam currents
- Change to the condenser pressure
- Bypass operation

In the case of excitations which are close to the resonant frequencies of LP blades, very high amplitudes may occur which result in damage to the blades within a very short time. Once a blade has been damaged, this damage may become worse even with low loads.

It is therefore essential to avoid operation of the blades in the range of their resonant frequencies.
Recording of the vibration signals with MDS 100

Unfavourable values of set process parameters such as the steam current can result in stochastic excitations of the LP blades during operation. The resulting vibrations are transferred to the shaft and measured via the relative shaft vibration sensors attached for operational purposes.

The time-consuming recording of the vibration signals is carried out with a front end (MDS-100 V3), installed in a 19 inch rack which directly processes the raw signal of the shaft vibration sensors at a high resolution. One front end is used for each shaft vibration level. Up to four vibration level units can be inserted into a rack. The BLAVIM concept allows installation even during operation of the machine.

Evaluation and visualisation

All measurement and assessment values can be represented as a function of time.

The vibration evaluations are carried out by means of the vibration spectrogram of the machine, which is part of the system. Thanks to the logarithmic colour scale for the amplitude height of the vibration, both the amplitudes from critical speeds and vibration components with very small amplitudes can be represented in a single diagram.

The high resolution of the temporal sampling rate provides a visible representation of frequency lines in the operational shaft frequency measurement which are related to the natural modes of the LP blades. If a natural mode of the blade is clearly identified, then monitoring during further operation is ensured.

The evaluation is supported by the Campbell diagram, which provides information on the normal vibration behaviour of the LP blades. The Campbell diagram only applies to one blade type and shows the change in the resonant frequencies due to the unwinding of the blades. The determination of the resonant frequencies is carried out in the weight bunker by means of strain gauge strips or inductive sensors. As a rule, a vibration is represented up to its fourth natural mode. As a result it is possible to clearly relate the traces detected in the spectrogram to blade vibrations and their natural modes.
Advantages of BLAde Vibration Monitoring

- Detection and analysis of blade vibrations
- Simple and inexpensive installation through the use of existing shaft vibration sensors
- Detection of unfavourable impact parameters and avoidance of dangerous operating ranges
- Detection of higher natural modes of the blade vibration
- Qualitatively meaningful information about changes of the blade vibrations during operation
- Possibility of analysing the run-down and run-up processes with respect to blade vibrations
- Information support for avoiding more complex monitoring procedures such as TipTiming
- The detection of blade vibrations in LP blading with cover bands is possible in principle
- Extensive support for analysis, diagnosis and evaluation by our Diagnostic Centre

References
BLAVIM is being successfully used in a large number of steam turbine sets of RWE Power AG.