Brüel & Kjær Vibro

Application Note

Monitoring strategy – Performance monitoring of pumps

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Scope

The machine monitoring strategy is applicable to all types of horizontal and vertical centrifugal pumps. It is a generic solution, so it can be used for machines in a wide range of industrial processes for all types of fluid applications, including cryogenic (LNG).

Machine Operation and Maintenance Requirements

Pumps are used in many applications, including the petrochemical and power industry. The amount and type of maintenance required for pumps is highly dependent on the type of process they are used in and their operation duty. There is consequently a wide range of different failure modes that can occur. For the wet end portion of the pump, these can include corrosion, erosion, deposits, pressure pulsations, flow recirculation and cavitation. If unchecked, these potential failure modes can consequently result in reduced efficiency, excessive power consumption and reduced Flow capacity.

These and other potential modes can also result in excessive loading, high axial thrust, premature bearing failure, seal leaks, component damage or even a catastrophic failure.

Monitoring Strategy

Performance monitoring is based on thermodynamic parameters that are calculated on input/output process fluid conditions such as pressure, temperature, flow and the fluid properties. As these values are generally already available in the DCS, no extra sensors need to be installed.

The thermodynamic performance parameters are intended to monitor the condition of the wet portion of the pump, the thermodynamic performance of its product output and the process conditions that affects both the performance of the machine and the product quality output. Sub-optimal performance can have a significant impact on the operation life cycle costs of the machine, and provoke premature failure of components.

For more reliable evaluation of the condition of the wet portion of the pump, performance monitoring is most often implemented together with a machine **condition monitoring** strategy in order to correlate vibration and other process parameters to the thermodynamic parameters for earlier fault detection.

Monitoring Configuration and Techniques

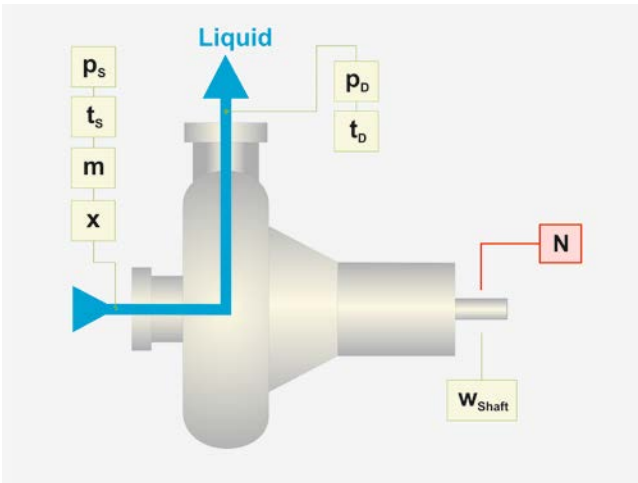

Figure 1. Monitoring inputs.

Symbol	Signal
X	Fluid properties
m	Flow
p_1	Suction pressure
t_1	Suction temperature
p_2	Discharge pressure
t_2	Discharge temperature
N	Shaft speed
w_{Shaft}	Power
Control Signals	Various control signals for power, speed, bypass valve, etc.

Table 1. Input symbols.

Calculations	Plots	Faults that can be detected and diagnosed
Power consumption (actual conditions)	Scalar history, Power vs. flow	Fouling, erosion, corrosion of impellers and diffusers, leaky seals
Head (actual and corrected to inlet reference conditions)	Scalar history, Head vs. flow	
Overall thermal efficiency (actual conditions)	Scalar history, Efficiency vs. flow	
Speed (corrected to inlet reference conditions)	Scalar history	
Volumetric flow (actual conditions and corrected to inlet reference conditions)	Scalar history	
Head deviation	Scalar history	
Efficiency deviation	Scalar history	

Table 2. Monitoring techniques.

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