Vibro-Meter®

Case study: Critical vibration monitoring on cooling tower systems

Essential safety for cooling towers and fans

Cooling towers are critical infrastructure in power generation, oil & gas and petrochemical industry installations. For a mechanical draught cooling tower, a power-driven fan is typically used to force or draw air through the tower. The fan is typically a large diameter, low-speed fan driven by a variable-speed drive (VSD) in order to optimise performance and reduce energy consumption – thereby allowing the cooling tower and fan system to operate at its most efficient and economical levels.

Like all machinery, cooling tower systems are required to meet essential health and safety requirements such as the European union (EU) machinery directive (2006/42/EC), which includes vibration monitoring.

At-a-glance

- Cooling tower and fan systems are critical assets in most power generation, oil & gas and petrochemical industries.
- In Europe, the European union (EU) machinery directive (2006/42/EC) mandates essential health and safety requirements such as inherently safe design and complementary protective measures.
- Correctly implementing a machinery monitoring solution requires machinery monitoring experience, domain knowledge and a thorough analysis of the application.
- Vibration monitoring of cooling tower systems requires reliable low-noise measurements at low rotational speeds (below 1 Hz) and adaptive alarms covering variable-speed operation.
- Meggitt's Vibro-Meter® sensors and VibroSmart® distributed monitoring system enable high-quality, reliable and cost-effective vibration monitoring solutions for lower-channel count systems such as cooling towers.
- SABIC (Saudi Arabia Basic Industries Corporation), ranked among the world's largest petrochemicals manufacturers, are using the solution described in this case study to monitor and protect a cooling tower and fan system in the Netherlands.

  The solution was developed by Istec International BV using Meggitt Vibro-Meter® products in order to achieve the required level of safety, reduce risk and fullfil the mandatory requirements associated with the EU machinery directive.

  In this critical vibration monitoring system, one of the VibroSmart® VSV30x module's dynamic channels is used to monitor the actual fan vibration (providing acceleration and velocity outputs) using an absolute vibration sensor on the fan, while the other dynamic channel is used to monitor the gearbox and detect blade lift using a relative vibration sensor on the gearbox.

Case study: Vibration monitoring on cooling towers

The challenge

Large-diameter cooling towers are subject to strong forces and high-stress factors. Fatigue accumulation is a serious risk as the result of the continuous displacement-induced strain in the materials and components of the cooling tower (construction, foundation and joints) and the fan (blades, gearbox and motor). This is why vibration monitoring is a mandatory requirement as per the European Union (EU) directive 2006/42/EC on the essential health and safety requirements for machinery (commonly referred to as the machinery directive).

European Union (EU) directive 2006/42/EC
According to the EU machinery directive, machinery "manufacturers" must eliminate hazards or reduce risks associated with these hazards by applying safety measures in the following order: 1) inherently safe design; 2) safeguarding and implementation of complementary protective measures; 3) informing users about residual risks.

Accordingly, the safe and efficient operation of a mechanical draught cooling tower with a variable-speed fan requires a vibration monitoring system that can measure vibration and speed down to the low frequencies /speeds at which the fan can operate and support adaptive alarms (dynamic alert and danger levels as a function of operating speed). The adaptive alarms are required because they allow different alarm levels to be used for the different operating speeds of the fan, eliminating the risk of dangerous undetected conditions at lower speeds that are inherent to a system with a single fixed alarm level.

SABIC (Netherlands) has a manufacturing facility in the Netherlands with a cooling tower system whose existing vibration monitoring solution was not meeting their safety requirements, so Istec International BV and Meggitt Vibro-Meter® were contacted to help.

The solution

Following discussions and a thorough analysis conducted with SABIC (Netherlands), it was established that the existing monitoring system was neither compliant with the EU machinery directive nor fit for purpose as the cooling tower and fan were effectively unprotected at lower speeds.

Therefore, in order to increase safety and reduce risk levels, a Meggitt Vibro-Meter® vibration monitoring solution was proposed consisting of:

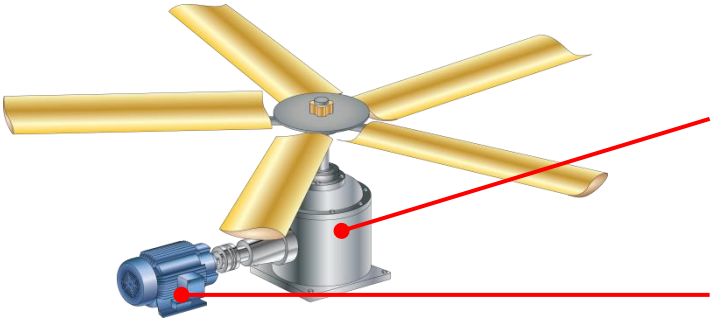
- Measurement chains using a piezoelectric accelerometer for absolute vibration measurements at low-frequencies and TQ4xx proximity sensors for relative vibration and speed measurements.
- A VibroSmart® distributed monitoring system consisting of:
  - A VSV30x monitoring module featuring two dynamic channels and one auxiliary channel (configurable as either a tachometer or DC input), up to 20 processed outputs (extracted data values), adaptive alarms, two relays and two analog outputs (configurable as either 4 to 20 mA or ±5 V).
  - A VSI010 communications interface module, featuring industry standard fieldbuses such as Modbus RTU and TCP, and PROFIBUS DP (including PROFIsafe).

Note: VibroSmart® modules are designed for use in harsh industrial environments and are Ex (ATEX) approved for use in hazardous areas, as required by many variable-speed drive (VSD) applications.

Case study: Vibration monitoring on cooling towers

Vibration monitoring solution for cooling tower and fan system

Cooling tower and fan



Absolute vibration sensor

Relative vibration sensor

Vibration monitoring system

VibroSmart® VSE230 enclosure

+24 V_{DC}

Analog outputs (I or V)

Distributed control system (DCS)

Digital outputs (Relays)

Safety shutdown system (PLC)

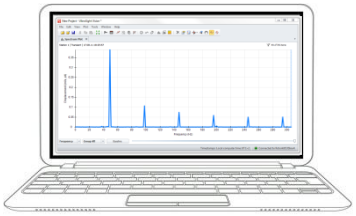
Real-time network

Buffered sensor outputs

Test and measurement equipment

VibroSmart® VSV30x monitoring module

VibroSmart® VSI010 communications module



VibroSight Server for data logging.
VibroSight Vision for data analysis.

Vibro-Meter® product line
Our product competencies and services:
Sensors | Machinery protection | Condition monitoring | Software | Systems

MEGGiTT
smart engineering for extreme environments

201806-CS-SABIC-01-EN

Case study: Vibration monitoring on cooling towers

The benefits

- The piezoelectric accelerometer used to monitor fan vibration is a high sensitivity (500 mV/g), low-frequency sensor with low-noise electronics, making it perfectly suited to this application.
- The second dynamic channel of the VibroSmart® VSV30x module was available to monitor the gearbox and detect blade lift.
- The VibroSmart® VSV30x module's multiple processed outputs (up to 10 extracted data values per dyamic channel) and adaptive alarms allow the configured alarm levels to automatically adapt to the operating speed of the fan so that the levels are always appropriate.
- VibroSmart® is a family of networkable devices developed to implement machinery monitoring and/or protection systems with a low-to-medium measurement channel density, wherever they are required. VibroSmart® modules are powerful and flexible with reduced installation costs. A VibroSmart ® system is easily configured, operated and managed using the VibroSight® software, which allowed SABIC (Netherlands) to cost-effectively implement their required vibration monitoring system functionality.

Here to help

Meggitt Vibro-Meter® designs and manufactures complete high-performance monitoring and protection systems for all rotating machinery, such as gas, steam and hydro turbines, and auxiliary balance of plant (BOP) equipment. Our solutions include sensors and signal conditioners, and monitoring and protection systems (hardware and software), uniquely tailored to customer and market needs, that support critical decision-making. We are trusted by original equipment manufacturers (OEMs) globally and are installed in many of the world's largest power plants.

To find out how our solutions can work for you, call us on +41 26 407 13 00, email us at energy@ch.meggitt, or visit our website at www.meggittsensing.com/energy.

Contact

Meggitt SA
Rte de Moncor 04, 1701 Fribourg, Switzerland
Tel: +41 26 407 11 11 | energy@ch.meggitt.com | www.meggittsensing.com/energy

MEGGITT
smart engineering for extreme environments

201806-CS-SABIC-01-EN