

Hydropower plants

On the edge of digitalization

Energy production is a digitalized and automatized industrial sector. Innovative technologies are used in all areas: e.g., production planning, operation and maintenance. During the past decades, digital technologies have driven the development of more intelligent control systems and increased the safety of the power plants.

State-of-the-art monitoring systems are nowadays crucial for operation. Their main role is the early recognition of machinery faults, sending relevant information to the maintenance team with the aim of reducing plant operational and maintenance costs. They rely on precise data acquisition and thresholds that indicate when the plant enters a

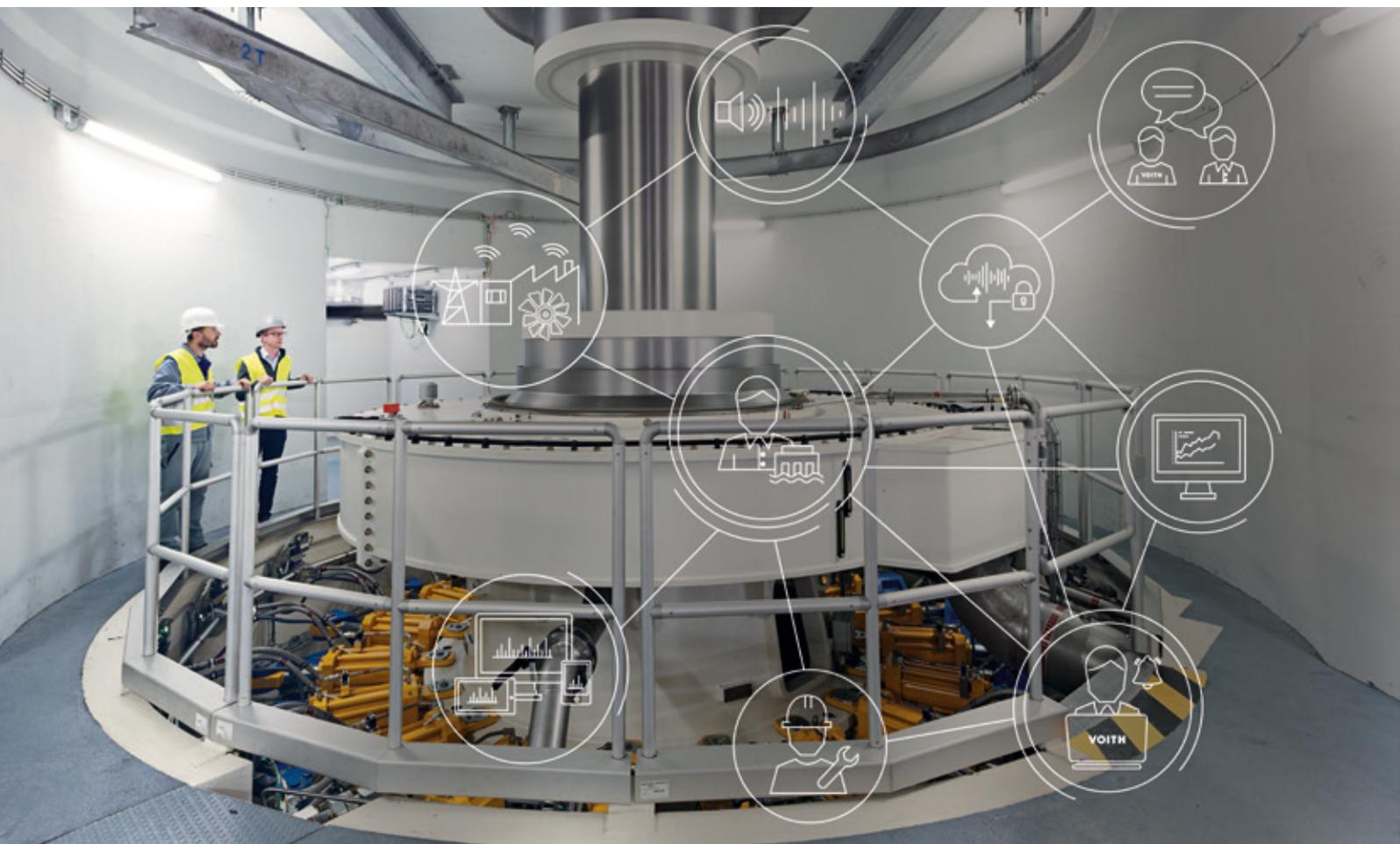
potential dangerous operation zone.

Warnings and alarms, which are triggered by the system, are used in control loops to protect the machine. Moreover, the operation teams use this information for maintenance decisions. Monitoring and automation systems generate large amounts of data, which provides a detailed long-term history of the operation of the machine. Currently the algorithms behind those systems are not designed to learn from history, though historic data could offer new insights in the condition of the machine.

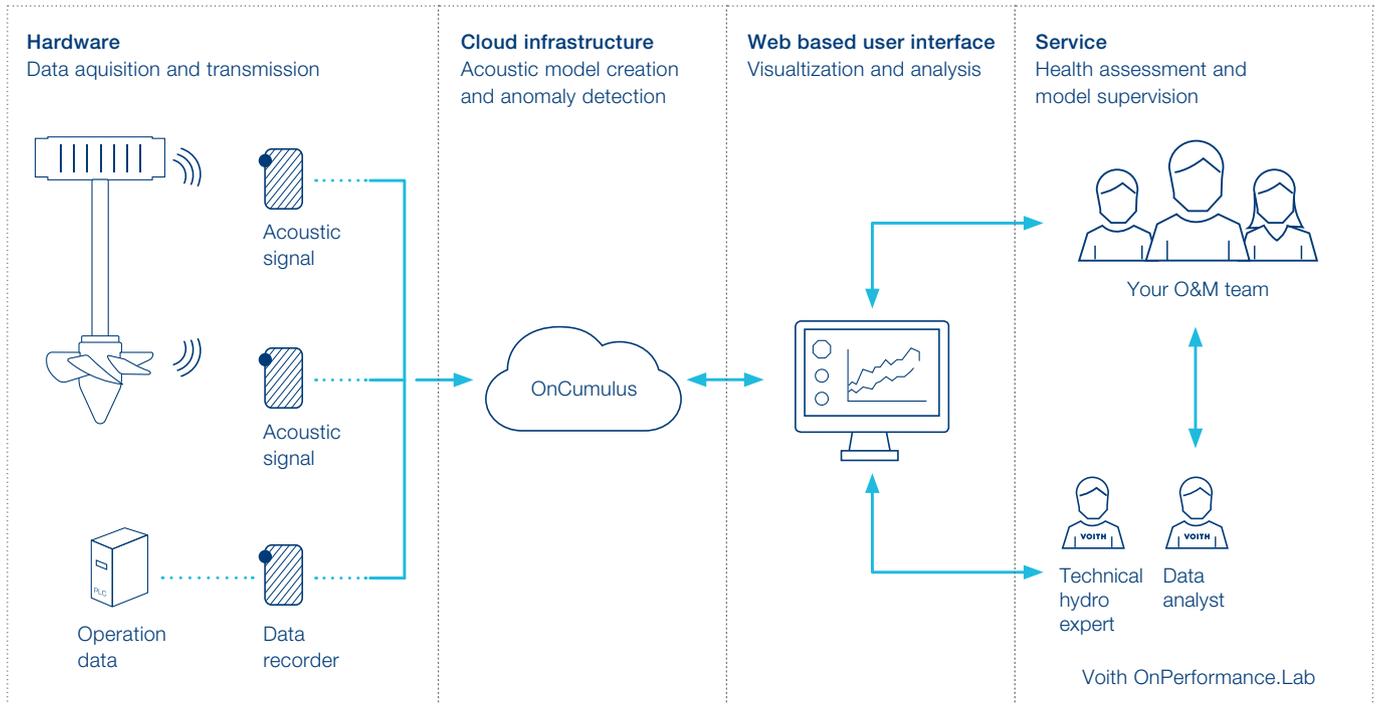
Additionally, hydropower plants nowadays must operate with higher flexibility, since they are used to compensate for

the strong fluctuation of wind and solar energy production. This evolution of the energy market increased the complexity of decision making in operations. Optimal scheduling of maintenance actions becomes more and more difficult. Therefore, energy producers are demanding better tools for maintenance and production planning, and also to avoid unplanned shutdowns.

OnCare.Acoustic addresses these upcoming needs. It provides a step toward predictive maintenance, as acoustics serve as an early indicator for upcoming failures. It uses the stored history of sounds and operation data to assess whether or not the current sounds of the machine are normal.



Integral monitoring system – information flow diagram



OnCare.Acoustic

Our support facilitates the safe supervision of your hydropower plant

OnCare.Acoustic monitors sounds from several machines simultaneously. In addition to the existing CMS (ConditionMonitoring Systems), the overall machine monitoring has taken us another

step into the future. This approach provides new and valuable information to our customers, to ensure the operation of their power plant.



Reduce inspection rounds with acoustic power plant monitoring

It is common for hydropower plants to be situated in difficult to access areas, far away from the congested communities of consumers and providers. Because of this, many hydropower plants are unmanned, relying on regular service cycles and automation systems to discover any occurring anomalies that could lead to dangerous events.

Without advanced analytics and monitoring systems, hydropower plant operators run the risk that possible dangerous conditions – especially with equipment that has no condition monitoring access or is not continuously surveilled – might stay undetected and therefore cause severe damages for equipment, plants and safety.

Recognize



Detect and recognize sound anomalies.

Understand



Identify anomaly source and continue monitoring along with Voith experts.

Optimize



Receive crucial information and find clever solutions to optimize your resources, especially in your service and maintenance processes.

Recognize – Understand – Optimize Modules for individual requirements

The four OnCare.Acoustic performance components:

- 1 OnCare.Acoustic anomaly detection
- 2 OnCare.Acoustic diagnosis services
- 3 OnCare.Acoustic event report
- 4 OnCumulus.Platform connection and data storage



The OnCumulus offering, enables customers to use data from any device from the entire enterprise. With the unique modular OnCumulus.platform, the reliability and performance of the equipment can be monitored, savings

can be achieved and the overall result can be positively influenced. Voith offers value-adding, industry-proven applications for the cloud in connection with the IIoT platform, as well as easy-to-use visualization and analysis applications.

1 OnCare.Acoustic anomaly detection

Hear and recognize

OnCare.Acoustic supports hydropower operators in becoming aware and discovering potential dangerous events by detecting sound anomalies.

Equipped with a sound recorder for acquisition, preprocessing and transmission of sound data, and a data recorder for acquisition, preprocessing and transmission of process data, OnCare.Acoustic is based on the IIoT platform OnCumulus.Platform with specialized visualization and analytics functionalities.

Together with the technological infrastructure, the solution forms the OnCare.Acoustic anomaly detection. It informs about suspicious detected sounds with warnings and alarms. Thus, power plant operators have time to plan and take action before an event occurs.

It also helps by identifying the acoustic patterns of the hydropower plant, forming a visualization of the acoustic fingerprint.



2 OnCare.Acoustic diagnosis services

Understand and learn

With the help of Voith's Hydro experts, plant operators gain further insights into their hydropower plant by means of intelligent and useful data analysis, supported by the Voith OnPerformance.Lab.

The Voith OnPerformance.Lab combines hydro domain know-how with state-of-the-art data analytics.*

By reviewing the sound samples together with these experts, the anomaly is not only identified but narrowed down

to the specific equipment causing this event. Additionally, the OnPerformance.Lab provides continuous monitoring support by Voith experts who further classify warnings and alarms to detect possible dangerous conditions, ahead of other alarms.

Customers can therefore better understand and learn about reoccurring changes, such as seasonal patterns, and track long-term trends and influences.



* Beyond the OnCare.Acoustic offering, the OnPerformance.Lab provides a multitude of hydro data intelligence services, including remote diagnostics as well as value-added software tools to connect hydropower plants to optimize operations with and for Voith customers.

3 OnCare.Acoustic event report

The first step toward visualization and analytics

The OnCare.Acoustic event report provides clients with a summary of all events that occur within the monitoring period. This includes the event time, event description, problem solving and savings for the customer. Additionally, they have access to the OnCare.Acoustic performance analysis, which includes information such as the number of anomalies detected, error messages, and cost savings from OnCare.Acous-

tic. All data can be retrieved from the OnPerformance.Lab Interact platform as an interactive report.

In addition, experts from the OnPerformance.Lab produce a comprehensive annual report (even if no critical events have occurred) based on inspection and maintenance reports, including data on visual inspection, operation and monitoring.



4 OnCumulus.Platform connection and data storage

Prevent, predict and optimize

The IIoT platform OnCumulus.Platform serves as a data hub for data from various sources, e.g., plants, machines and equipment. With the help of this central data platform, customers can control their digitalization projects. The OnCumulus.platform is open source based and meets the highest standards of data protection, security and compliance.



OnPerformance.Lab makes plant operations safer and more efficient

The OnPerformance.Lab combines hydropower domain know-how with state-of-the-art data analytics. We offer remote diagnostics and connect hydropower plants to develop value-added software tools with and for our clients to support optimizing operations.





Voith Cloud



Encrypted





Cloud-based application Further insights with the cloud

As part of the OnCumulus offering, OnCare.Acoustic customers gain new possibilities. Using OnCare.Acoustic and other applications (like OnCare.Health, OnCumulus.Suite or OnCare.Asset) on the same cloud-based technical platform, customers benefit from bridging information and data views cross-site and cross-app.

As a result, customers can leverage untapped correlation possibilities for more advanced insights and transparency. External information sources like energy prices, weather data and connection to smart grids can be easily integrated and correlated with existing operational data.

OnCare.Acoustic Highest security standards

With OnCare.Acoustic, Voith provides an IIoT solution that meets the highest privacy, security and compliance industry standards and best practices, such as CSA, NIST and OWASP.

via an analogue connection and galvanic separators, or optionally a physical data diode, into the secure cloud. Voith cybersecurity experts then ensure end-to-end security at all times.

Although hydropower plants are critical infrastructures, they are not always monitored. If an event occurs, the OnCare.Acoustic software sends information about the anomaly one-directional

Voith supports local control of the data through providing data centers in every region.



Landsvirkjun and Voith establish successful OnCare.Acoustic pilot project in Reykjavík, Iceland

The Budarhals hydropower plant was equipped with an intelligent acoustic monitoring system and extended with digital health assessments. . Voith installed a new remote data analysis service and optimized the operating mode. Hydropower plant operators benefit from intelligent planning of maintenance work.

The National Power Company of Iceland Landsvirkjun and Voith have launched a joint project on intelligent noise analysis in hydropower plants. Voith is installing the acoustic monitoring system OnCare.Acoustic in the Budarhals hydropower plant in Iceland that detects turbine noise deviating from normal conditions to prevent potential shutdowns in good time. In addition, the continuous analysis of machine data is designed to facilitate an optimized mode of operation and the intelligent scheduling of maintenance work.

Identifying turbine damage in good time

“Using artificial intelligence, the system will complement the monitoring of the power plant and preventive maintenance undertaken by personnel and identify potential machine damage in good time,” says Bastian Berg, project manager at Voith Digital Ventures.

To this end, microphones were mounted at specified locations in the power plant and will record all ambient noise to store it in the Voith Bluebox for preprocessing. The final data interpretation will be done on the special Voith platform

OnCumulus. For calibration purposes, the system records all acoustic signals in an initial learning phase. In doing so, it complies with strict data protection guidelines. The data collected is then compared with that of other hydropower plants. Due to the combination with the operating data, OnCare.Acoustic learns which noises correspond to normal machine behavior. In a second learning phase, the system is capable of immediately recognizing deviations from the typical noise pattern. In this case, the system sends out a warning and at the same time notifies one of the power plant operator’s service technicians.

“Voith machines and systems in Budarhals are running really well since commissioning. We trust Voith machines, and thus we really do not expect from OnCare.Acoustic to find problems in your reliable machines. We have very high expectations from OnCare.Acoustic to help us understand and know our machines better.”

Georg Þór Pálsson, Plant Management, Landsvirkjun

Data-based service for optimized operation and maintenance

At the Budarhals hydropower plant in Iceland, Voith implemented this service model for its noise pattern analysis. The system uses a data-based approach and is intended to help power plant operators optimize maintenance and operation.

“In the current learning phase, we are getting several warnings each day, which are analyzed and categorized by our OnPerformance.Lab,” explains Bastian Berg. “The system learns continually and becomes more and more intelligent over time.” To keep the customer’s work to a minimum, Voith is offering a 24/7 diagnosis service for this project, in which the unknown noise is evaluated by Voith’s OnPerformance.Lab very quickly. If the noise suggests a critical or atypical machine status, the customer’s control room is informed immediately.

As the project proceeds, the system works more and more autonomously to identify more noises. In combination with various KPIs, the data collected is then investigated and analyzed for complex correlations by the Voith experts and a team of data analysts.

The results are then provided as a regular report to the power plant operator, allowing operation and maintenance to be optimized. The content of the report is adapted to customer needs on an ongoing basis and the added value verified together with customer.

“In future we will be able to use our noise pattern analysis to tell the operators of hydropower plants the ideal time for replacing mechanical components, for example. Maintenance work and forthcoming repairs can therefore be planned transparently and very efficiently,” says Berg.

About the Budarhals power plant

The Budarhals facility was officially opened in 2014 and has an installed output of 95 MW. It has a capacity of around 585 GW hours per year. Voith has equipped the plant with two modern, environmentally friendly Kaplan turbines with water-filled impellers and cutting-edge generators with specially developed brushless and bluetooth thyristor-controlled excitation systems. Apart from the main components of the electro-mechanical equipment and the control systems, Voith also supplied the crane systems for the plant’s powerhouse. With this current project, Voith is successfully continuing its long tradition of doing business in Iceland. As far back as 1912, the company built the first complete turbine installation in the Fjardarsel power plant. This system has a capacity of 550 kW, is driven by a horizontal Francis turbine and is the oldest power plant in Iceland still in operation.

Voith Group
Voith Hydro Holding GmbH & Co. KG
Alexanderstr. 11
89522 Heidenheim, Germany

Contact:
Phone +49 7321 37-9990
digital-hydro@voith.com
www.voith.com/oncareacoustic



VOITH