



GOOD VIBRATIONS: HOW UNIPER BROUGHT CONTEXT TO VIBRATION DATA USING THE PI SYSTEM

In the world of energy generation, equipment failures are dangerous events that result in unplanned outages and leave customers out in the cold. However, manually detecting performance issues before they become catastrophic is no small feat. Assets such as gas, steam, and wind turbines are massive, complex, and scattered. Keeping these running at optimal levels requires advanced condition monitoring techniques, and condition monitoring starts with vibration.

As turbines spin, vibration monitoring allows to send out signals indicating potential issues. Should a rotor bend even slightly or a small imbalance occur, vibration levels increase, and it's those vibrations that hold the keys to decoding future problems. For Uniper, ensuring that 36 GW of power generation infrastructure across Europe was operating effectively meant tuning into those vibrations. However, vibration data needs context to be truly effective. Together with a proprietary application for anomaly detection, Uniper used the PI System™ to capture and contextualize vibration data. As a result, engineers saw more than just deviations—they understood their cause. Not only did vibration monitoring save money on equipment maintenance, it prevented what could have been a catastrophic outage.

THE TROUBLE OF CONTEXT

Uniper uses Tiresias, a suite of vibration analysis tools as a critical part of the Production Solutions Team's condition monitoring strategies. Vibration boxes scattered across multiple sites gather data and send that data to Uniper's servers, creating a single access point for all vibration data and subsequent analysis. However,

vibration monitoring simply looks at symptoms and immediate cause and vibration data alone is not enough to understand overall asset health. In addition, vibration data is complex because vibrations change with every run, making it difficult to establish clear benchmarks. Faced with patterns that they couldn't understand, the team looked to create context in a way that would fit their immediate and long-term goals.

CHALLENGE

Leverage vibration and other operations data to understand the root cause of issues and overall asset health

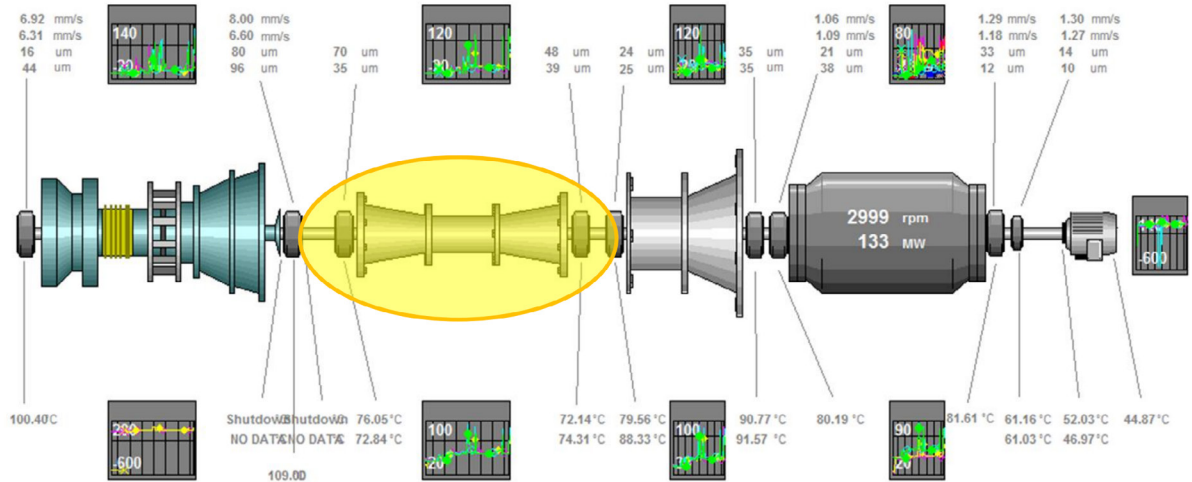
SOLUTION

The PI System and Uniper's SpherICAL anomaly detection system use data to help users identify root causes and make critical decisions

BENEFIT

Early detection of a turbine rotor issue avoided a six-month outage

DYNAMIC OPERATION



As part of Uniper's SpheriCAL solution, the PI System captures and contextualizes vibration data from turbines to detect performance issues and prevent unplanned outages.

Since 2000, Uniper has used the PI System to monitor and analyze operational data in real time. In 2007, the team opted to leverage PI System data to add necessary context to vibration data within Tiresias. They built an anomaly detection algorithm and plugged that into the PI System, enabling them to map PI System data into Tiresias. This algorithm ultimately became SpheriCAL, Uniper's propriety solution that would give the critical context needed.

With the help of SpheriCAL anomaly detection solution, Uniper was able to map things like temperature and pressure valve data out of the PI System and into Tiresias. With SpheriCAL and the PI System, Uniper had created a comprehensive condition monitoring solution that enabled them to understand vibration data in the context of the complete operations dataset within the PI System and to use that data to manage overall asset health. The solution was so successful that Uniper rolled out the PI System and SpheriCAL across all business units, including gas, coal, solar and more.

A MODEL OF COMMUNICATION

Due to variances in equipment and instrumentation, none of these models were identical. To truly understand performance and predict outcomes, the team needed to

determine what was the same within those models, which meant normalizing the data and the surrounding metadata. The models needed to talk to one another. To accomplish this, they built the SpheriCAL VirtualAnalyst system, giving them deep and comprehensive insights into the instrumentation. By normalizing the residual pattern of wind turbine phase voltage data engineers could see when it was moving away from an expected outcome. From there, they could look at a normalized residual pattern and then pinpoint the variation to a specific type of failure.

Not long after deployment, data showed the pitch control failure was building up on a wind turbine. By categorizing data from other wind turbines potentially from the same site and using normalization methods, Uniper identified which data pattern pertained to that pitch problem and isolated the root cause of the issue.

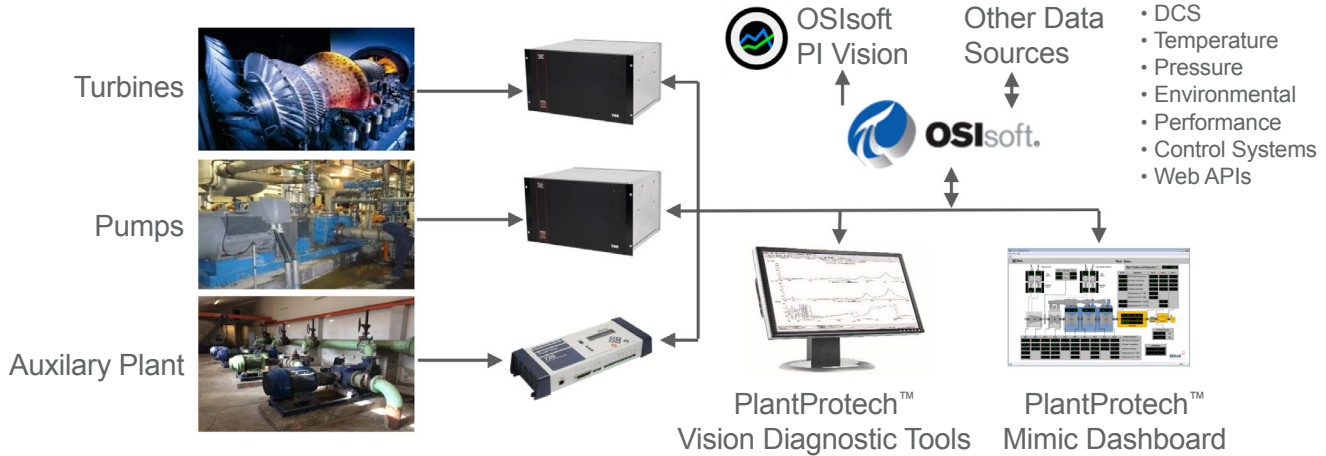
As the number of models continued to grow, the system began to learn and change, making the SpheriCAL VirtualAnalyst artificially intelligent. Now it was a matter of creating the buy-in needed to ensure that users would extract the value Uniper had created. To promote adoption, the team created SpheriCAL Smart Solutions, which would send alerts directly to the users, giving them instant access to necessary information, such as



And we implemented the [PI System with SpheriCAL] everywhere because every time we implemented it, we got immediate value back. So whether that be gas ... coal, biomass, wind of all types, hydro and solar—we tried it on everything and we always were able to show some value."

— Ty Burrige-Oakland, Product Manager, Digital Innovations, Uniper

BERAN PLANTPROTECH™ SYSTEM



Uniper coupled its SpheriCAL solution with Beran, a diagnostic monitoring platform that uses vibration and pressure sensors for turbines.

visualizations in PI Vision, to make a decision. And it was user adoption that helped Uniper avoid a catastrophe. “We built a system that is getting smarter as we are getting smarter,” said Ty Burrige-Oakland, Product Manager of Digital Innovations at Uniper during PI World Barcelona 2018.

A BEND IN THE ROAD

Recently, charged with managing asset risk monitoring, anomaly detection and field balancing processes for all critical rotating assets as well as all process data, Uniper’s Condition Monitoring team coupled its SpheriCAL solution with Beran, a diagnostic monitoring platform that uses vibration and pressure sensors for turbines. Beran is connected to plant protection systems, diagnostics software and the PI System, enabling users to visualize asset data in PI Vision.

In 2017, a single shaft turbine at a thermal plant was vibrating at an abnormally high level during run up, causing the Beran system to indicate that something was out of balance. Upon deeper analysis, it was clear they had a problem: the data indicated the shaft on the rotor was bent. Digging into the PI System data, the team saw a sudden decrease in

temperature, which contributed to the bend while all other parameters were in line.

Operators attempted to address the problem, but after a few hours of trying to straighten the shaft line, they were still seeing a high vibration levels. After additional testing, data suggested that the rotor was beginning to permanently bend, rendering the unit unavailable. Uniper desperately needed this unit’s generation capabilities to deliver energy to customers in the middle of winter. Unfortunately, the original equipment manufacturer had a six month lead time for repairs and replacements.

Based on PI System data and insights from SpheriCAL, the team opted to perform a situ trim balance to get the unit back online and give engineers time to plan an outage and fix the problem. Using a complex system of heavy weights, they managed to get the unit back online—albeit with risk. With the combination of PI System data and SpheriCAL, Uniper was able to detect and mitigate that risk while keeping the unit running during the most critical time of year.

For more about Uniper and the PI System, watch the full presentations here: [SpheriCAL](#) and [Beran](#).

PARTNER:

BERAN



Burrige-Oakland, Ty / Onobhamikour, Omoruyi. “The Data Journey: An Intelligent Path to Machine Learning” and “Combining the PI System and Specialist Vibration Data to Manage Asset Risk”