

Early detection of system anomalies with Power Quality Analytics

All values within permissible limits – but is really everything ok?

At a glance

Power quality is a fundamental aspect of a reliable supply of connected loads and equipment. Very often, disturbances cannot be evaluated because in most cases, they only occur for a very short time. Power Quality Analytics, a service of Siemens PTI, addresses this challenge by:

- Permanent monitoring and analysis of the power quality to prevent faults
- Consulting services and mitigation measures to avoid disturbances and outages to finally reduce outage costs and to improve reliability of supply

In the context of a Power Quality Analytics service at a chemical company, the PQA expert system detected an anomaly in the total harmonic distortion (THD) within permissible values. An in-depth analysis of the recurring event revealed that this was caused by a filter disturbance. By taking mitigation measures, damage to the system and related outage costs could be prevented.

Initial situation

Siemens PTI is running a PQA service for a chemical company to monitor the voltage quality in the 11-kV-feed of the plant. Due to the high reactive power consumption, capacitors and filters are used. As part of the PQA service, the trigger settings of the SICAM Q200 were optimized. As the sensitivity of the anomaly detection within the PQA expert system adapts automatically, the measuring system has reached an optimal level between sensitivity and robustness.

Event

After running the monitoring service for about eight months, the PQA system recognized an outlier in the THD following a switching event.

The timeline in figure 1 describes the course of events for selected measurement channels and channel combinations: Points mark significant transient events and anomalies.

The operational characteristics of the channels are classified using a cluster analysis. Similar operating states are marked by the same color. A color change therefore indicates a significant change in status.

As can be seen in figure 1, there is a clear time correlation between the THD channel and two transient trigger event points.

A clearly increasing distortion in the current is associated with the switching event, but no permanent change in the active power had been observed.

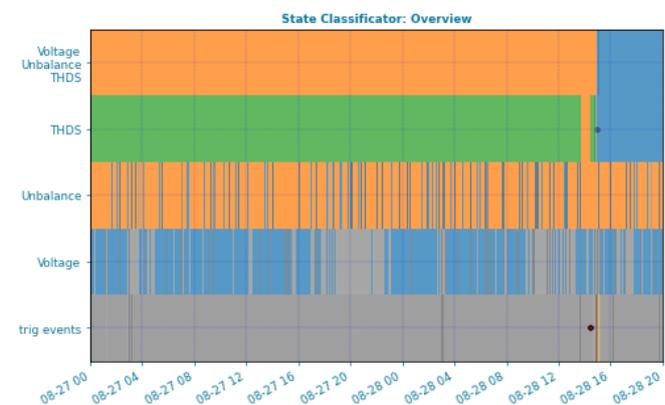


Figure 1: Timeline

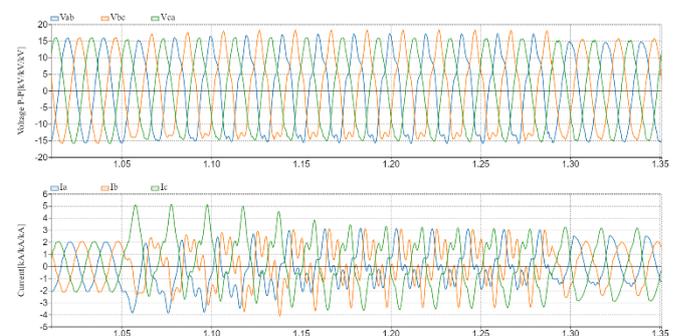


Figure 2: Switching event at transformer and compensation feeder

“Thanks to this warning we could see that we had a problem with a capacitor battery and a 5th harmonic filter. The warning has been very important to us.”

The heat map clearly showed that there was a permanent change in the harmonic distortion in current and voltage towards higher values.

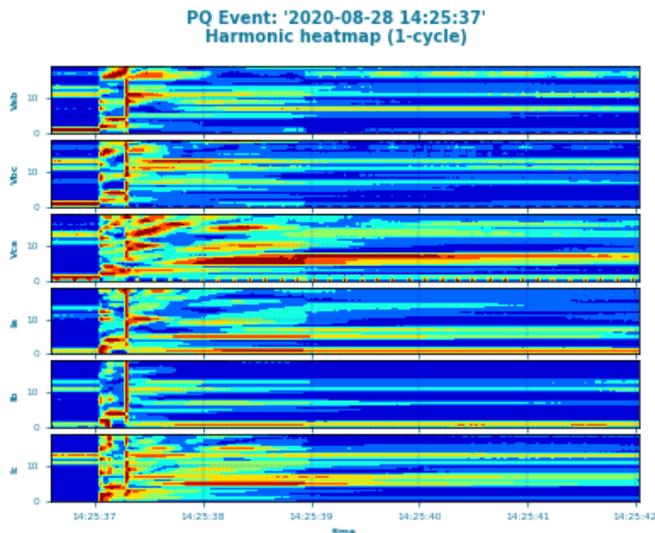


Figure 3: Dynamic heatmap

In contrast to reactive power, the active power (figure 4) does not change permanently. The consumption of reactive power increased significantly, although compensation systems should actually counteract this. At the same time, the voltage distortion increased to a value that was permissible, but unusual for the plant (figure 5).



Figure 4: Power diagrams

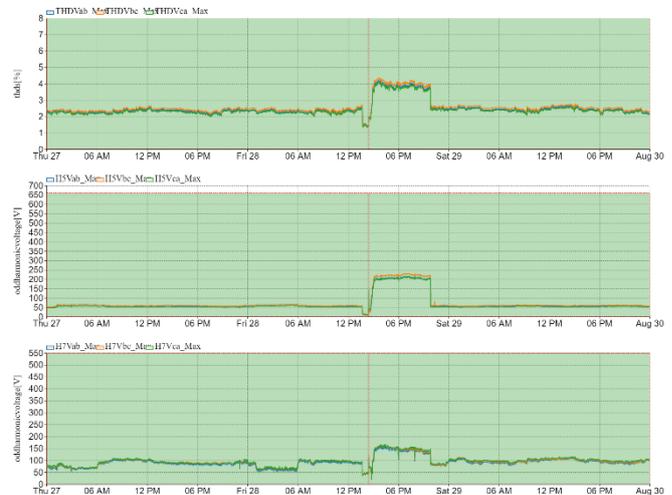


Figure 5: Harmonic distortion

Analysis and warning

All aspects together gave the Siemens PTI expert a clear indication that there could be a malfunction in the compensation system. He instantly sent an alert to the customer. The excellent ergonomics of the PQA workbench allowed the Siemens PTI specialist to carry out a convenient and, above all, fast analysis, which made a significant contribution to the fast response time.

Conclusion

The alert system and fast reaction of the Siemens PTI expert allowed for an early detection of a malfunction. Damage to the equipment and high down-time costs could be avoided.

In close collaboration with Siemens PTI, the client is now investigating how such incidents can be avoided in the future; for instance, with the help of suitable energizing strategies, but also by improving the protection concept of the capacitor bank.

This case clearly shows that it is mandatory for fault prevention to also examine the supposedly “green” area, i.e. the area in which limit values have not been exceeded, for anomalies. This can be largely facilitated by applying AI-supported pattern recognition methods, such as provided by Power Quality Analytics.