CUSTOMER CASE STUDY

Fingrid Oyj increases innovation with the AVEVA™ PI System™

Fingrid Oyj - www.fingrid.fi/en
Industry - Transmission and distribution

Goals

- Use the PI System for visualization and analysis to replace manual, time-consuming processes

Challenge

- Develop analysis algorithms for efficient use of measurement data to support power system analysis

Result

- Reduced manual analysis, increased use of data, enabled automatic fault processing, and allowed for live-data modeling of new ways to analyze and plan the power system

Solution

- Connect power system measurements to the PI System for visualization and analysis

Fingrid Oyj is the central source of power for Finland's main electrical grid and is interconnected with the inter-Nordic transmission grids of Sweden, Norway and Denmark.

The transmission grid managed by Fingrid Oyj consists of about 14,600 kilometers of transmission lines and nearly 120 substations; about 77% of all electricity in Finland is transmitted through this grid.

As a transmission system operator, Fingrid Oyj generates more than 4 million samples of measurement data daily. But the company was not using this data efficiently to support power system analysis and missed important findings in the system because of its manual, time-consuming analysis processes. "When we had a fault in the system, it took several hours to get the data and create a report," said Antti-Juhani Nikkila, specialist at Fingrid Oyj. "We wanted to automate and shorten this process from hours to minutes."

To address these issues, Fingrid Oyj integrated all of its power system measurements to the PI System for visualization and analysis. The company had installed the initial PI System in 2005, and added to the system in subsequent years:

- 2009 condition monitoring system
- 2010 added separate 1,000 data point system for PMU measurements
- 2018 WebAPI interface
- 2019 IoT Portal Development

The company had used the PI System for years for asset management and system monitoring. By automating its manual processes, Fingrid Oyj significantly increased the use of its data, enabled automatic fault processing, and allowed for new ways to analyze and plan the power system.

Fingrid Oyj utilizes two production PI Systems and a test environment. The first PI System is a 150,000-tag, high availability system for SCADA, power quality, and other data. The second PI System is a 1,000-tag system for phasor measurement unit (PMU) data, which stores 4.3 million samples per day and processes hundreds of signals continuously. The company uses Mathworks MATLAB for custom coding and algorithms for data mining. PI ProcessBook and PI Vision provide visualization. The PI System provides live data and analysis and extends analysis functionalities to other tools such as MATLAB.

Reducing manual processes, increasing measurement data use

With the PI System, Fingrid Oyj reduced manual analysis and significantly increased its use of measurement data analysis to support the power system. In contrast to its infrequent use of PMU data in the past, today the company runs hundreds of thousands of queries continuously on this data 24/7.

"With automated processes enabled by the PI System, we have much more time to actually analyze the results," said Nikkila.

Fingrid Oyj also can analyze long-term trends and changes in the power system because it stores the PMU data for 400 days. Automated analysis processes enable the company to address issues caused by renewable energy sources being integrated into the power system; the PI System provides Fingrid Oyj with access to quality data that helps with forecasting and keeps the system running.

Enabling automatic fault tolerance and anomaly detection

Fingrid Oyj chose the PI System for its test environment because it is a flexible platform that allows the company to test different algorithms with live data and integrate the results from other R&D projects before applying it. The platform's easy-to-use tools for data access and visualization were also important. The company integrated MATLAB with the PI System databases using the PI OPC interface. The combination makes it possible to use the PI System data sources and calculation functionalities together with mathematical analysis performed by MATLAB. It also helps eliminate manual analysis.

One of the test projects developed in-house is a tool that monitors real-time data using the PI System and MATLAB algorithms to detect disturbances and anomalies in the power system.

The tool reads about 50 samples per second of real-time interface or synchro phaser data from the PI System. Custom algorithms analyze changes in frequency on the fly.

> "We have already detected anomalies and errors in the power system performance that we would have missed without the PI System. It's hard to put a price tag on detecting these anomalies, but the consequences of power system disturbances can be quite significant."
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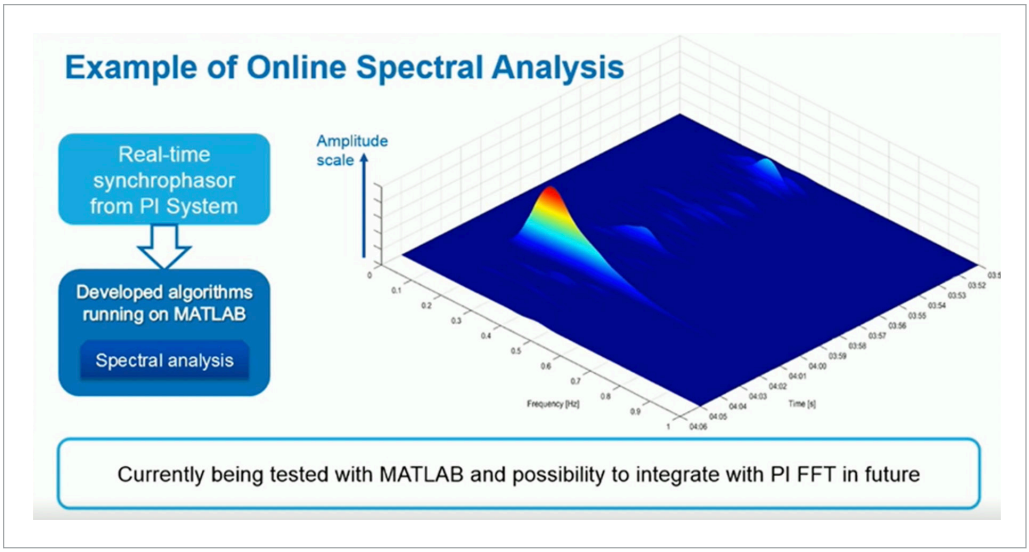
> **Antti-Juhani Nikkila**
> Specialist at Fingrid Oyj



Disturbances or oscillations shown by online spectral analysis help control center operators identify when there are problems in the power system.

When predetermined thresholds are exceeded, the disturbance analysis tool automatically generates a notification and a report that describes what the algorithms discovered. The PI System stores the measurement data, sends it to analysis applications, and provides visualization of the analysis results. Fingrid Oyj also plans to integrate PI Notifications and PI Event Frameworks into the tool in the future.

"With the disturbance analysis tool, we have reduced our fault analysis time from several hours to minutes because we get key results automatically," explained Nikkila. "Automatic fault processing, made possible by the PI System, enables us to locate high-frequency oscillations in the active power system that we would have missed previously using manual analysis. We can now find problems before they cause equipment downtime or a more critical disturbance"

Online spectral analysis is another test project enabled by the PI System and MATLAB. Fingrid Oyj cannot monitor the 150,000 measurement points in the SCADA system at the same time or view time trends from tens or hundreds of measurements due to the volume of data. But with spectral analysis, the company's control center operators can find disturbances or abnormal events that would otherwise be missed using only SCADA measurements. The control center shows oscillations or vibration in the system in the form of a red spike or wave. These indicators tell the operators to examine the SCADA system or other measurements to try to explain what happened.

"During the last 12 months, we have found six or seven incidents using these analyses that would have been missed with traditional SCADA measurements. Online spectral analysis is an example of how the PI System makes it possible to test solutions with live production data. It's a huge advantage."

Fingrid Oyj reports successes with data provided by the PI System include prevention of faults (and repairs made on-site) in the years 2013, 2014 and 2017 in three 400 megavolt amperes (MVA) transformers.

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