Brüel & Kjær Vibro
A member of the NSK Group

Puget Sound Energy's Ferndale Generating Plant | USA

Modernizing Machine Protection and Condition Monitoring

Puget Sound Energy's 270 MW Ferndale generating plant's original machine protection system (MPS) became obsolete in 2014, lacking online condition monitoring and relying on costly, time-consuming ad-hoc diagnostic services. To address these issues, the plant owners sought a modern solution that combined effective machine condition monitoring with cost-efficiency. They evaluated various market options and selected **Brüel & Kjær Vibro's VC-8000/ SETPOINT® solution**. The VC-8000 offered advanced protection and reliable condition monitoring capabilities without necessitating a dedicated condition monitoring system server. This solution not only enhanced the plant's monitoring and diagnostic capabilities but also proved to be more cost-effective compared to upgrading with the legacy MPS supplier.

The Ferndale generating plant is one of six combined cycle-based power plants owned by Puget Sound Energy (PSE).

BACKGROUND

The Ferndale generating plant is one of six combined cycle-based power plants owned by Puget Sound Energy (PSE). Built in 1994 by Tenaska Washington Partners, L.P., and purchased by PSE in 2012, the plant is currently operated under contract by NAES Corp. It is in Whatcom County, approximately 100 miles north of Seattle, WA, USA. PSE incorporates an AVEVA™ PI System™ at the plant as the process historian.

The 270 MW plant is based a 2-2-1 combined cycle; where two dual-fuel General Electric (GE) PG7111EA gas turbine generator (GTG) trains supply heat to two heat recovery steam generator (HRSG) triple pressure units with duct firing capability. This heat in turn powers a single steam turbine generator (STG). The steam turbine is a GE non-reheat controlled extraction, uncontrolled admission condensing unit designed for 1250 psig/925°F throttle conditions. Natural gas for the GTGs and the supplementary firing in the HRSG is delivered to Ferndale via a 20-inch pipeline originating from the Sumas, WA area.

CHALLENGE

The original machine protection system (MPS) for the GTGs and the STG became obsolete in 2014. The legacy supplier no longer supported the MPS. PSE planned to replace it and implement a cost-effective machine condition monitoring strategy.

The original MPS did not have online condition monitoring capabilities, and ad-hoc diagnostic services were performed on the generating units through the legacy MPS supplier. A specialist traveled to Ferndale with a portable data analyzer to diagnose machine vibration whenever in-depth analysis was required.

Onsite visits, followed by post-processing of event data, is costly and time-consuming. Installing a condition monitoring system (CMS) by the legacy MPS supplier is also expensive and requires maintenance and IT infrastructure. Limited IT infrastructure resources and no on-site machinery diagnostic expertise encouraged PSE to consider other alternatives. PSE needed a proven and reliable MPS (the previous system lasted 23 years) and an online condition monitoring capability with no changes to the existing DCS interface. PSE also chose to replace existing transducers with upgraded ones while retaining the original transducer mountings, reuse the field wiring, and fit the new MPS in the same panel cutout as the legacy system.

SOLUTION

PSE explored various machine condition monitoring systems to find a solution that met their needs for advanced capabilities while being cost-effective enough to replace their legacy MPS. Among all the options, Brüel & Kjær Vibro's VC-8000/ SETPOINT® solution was chosen *(monitoring strategy shown in Figure 1 and Figure 2)*. The solution offers modern protection and reliable advanced condition monitoring capabilities, all without requiring a dedicated condition monitoring system server *(see Figure 3)*.

The CMS is based on the AVEVA™ PI System™ data historian used at the Ferndale generating station. VC-8000 eliminated the need for separate, special vibration databases (the AVEVA™ PI System™'s user interface visualizes all vibration data including current values, alarm status, and trends).

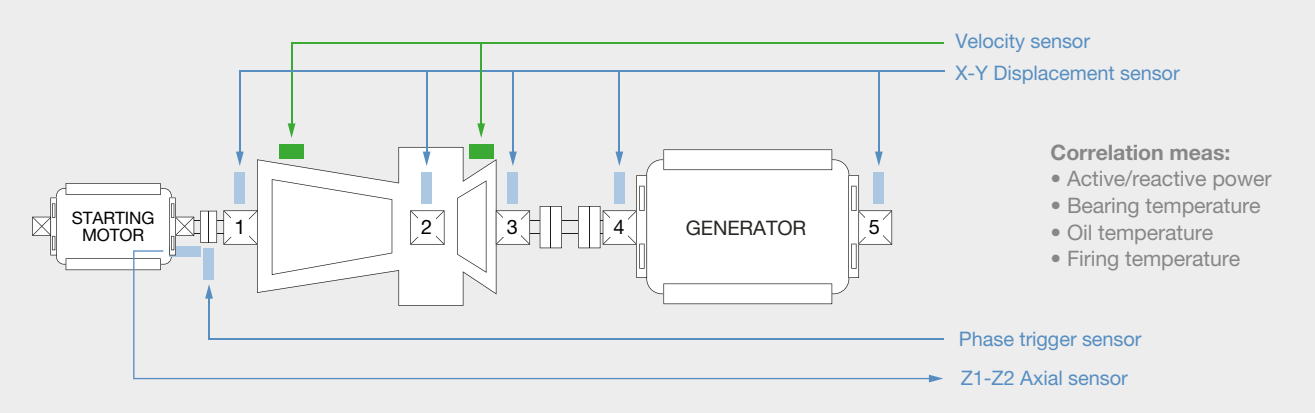

Figure 1 | Monitoring Strategy for the 7EA GTG Train

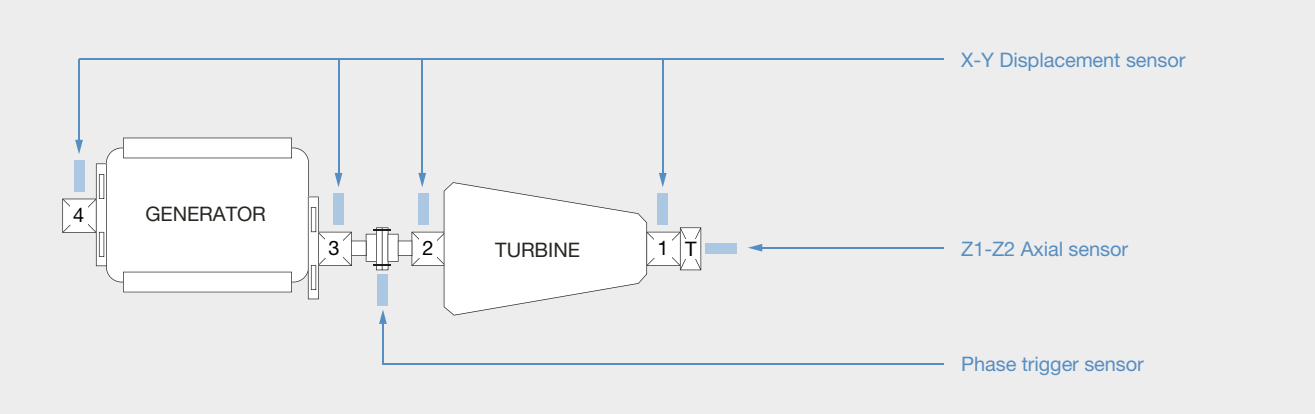

Figure 2 | Monitoring Strategy for the STG Train

Specialized measurements and plots (e.g. time waveforms, orbits, shaft center-line, waterfall, cascade spectrum, etc.) are provided via CMS's visualization tools that augment the AVEVA™ PI System™'s native visualization capabilities. Other third-party products and services such as statistical data analysis, automatic decision support, and thermodynamic performance monitoring of the generating units can be integrated as well.

Another benefit of the VC-8000 MPS is the capability to continuously backup data on the local Secure Digital (SD) card. If PSE's network is down; no data would be lost. Data can be manually retrieved, used, and retroactively stored in the AVEVA™ PI System™. Monitored data can be remotely uploaded by File Transfer Protocol (FTP) or e-mailed to an analyst at any time without a remote connection to the database. This capability benefits PSE by enabling faster decision-making, eliminating the need for complex firewall navigation, and reducing the costs associated with site visits.

RESULTS

The SD function proved to be immediately useful. The AVEVA™ PI System™ connection to the MPS was delayed, but no data was lost due to the lost connectivity.

PSE benefits from correlating process and vibration data – improving the reliability of fault analysis and improving Root-Cause Analysis (RCA) results. Coincidentally, the first diagnostic evaluation performed using VC-8000 occurred during a training session when a machine fault was suddenly detected – an imbalance occurred on bearing #3 of one of the two 7EA gas turbines *(see Figure 4 and Figure 5)*. Personnel were immediately notified of the issue, and it was quickly corrected.

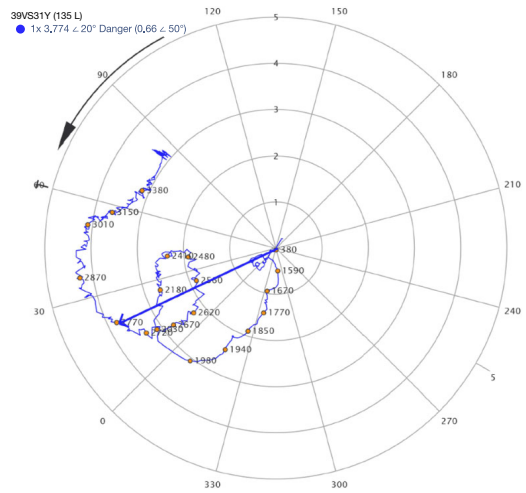

Figure 4 | Polar plot showing high vibration response (over 4 mils, 0.1 mm) due to unbalance on bearing #3 at the second critical speed during a coast down, shortly after commissioning.

CONCLUSION

In conclusion, PSE's search for a machine condition monitoring system that balanced advanced capabilities with cost-effectiveness led them to select the VC-8000/SETPOINT® solution. This solution not only delivered comprehensive condition monitoring features but also proved more economical than upgrading the system with the legacy MPS supplier. The solution successfully met PSE's needs, providing a modern, cost-efficient alternative to their legacy system.

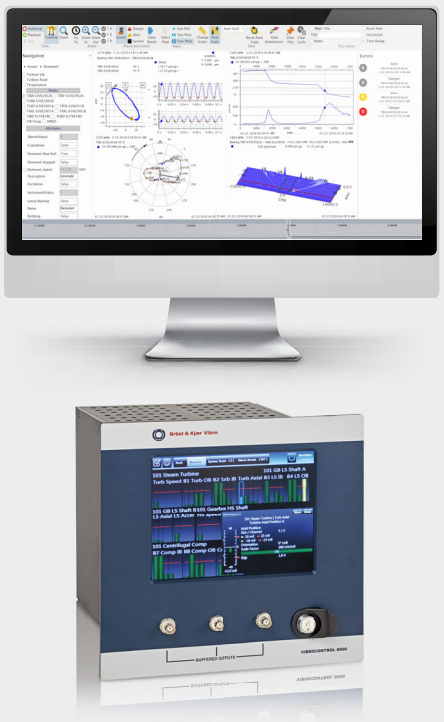

Figure 3 | VC-8000/SETPOINT® solution installed at Ferndale

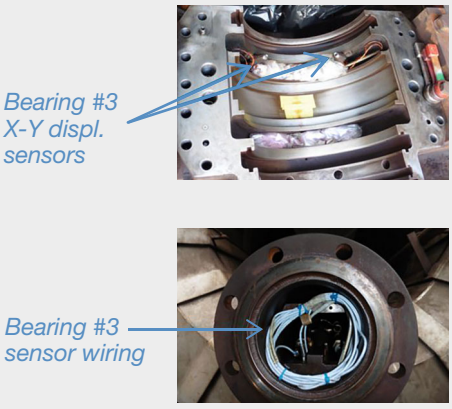

Figure 5 | Displacement sensor installation on bearing #3

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