Understanding how AVEVA™ Predictive Analytics benefits power generation companies

Authored by:

- Mike Reed,
Manager, Artificial Intelligence Center of Excellence (AI CoE), AVEVA

Executive summary:

Power generation companies are facing new challenges, including increased market complexity, disruptive technology, regulatory compliance changes, an ever-increasing need for highly trained and skilled operators. These challenges require them to continuously focus on maintaining operational excellence. AVEVA Predictive Analytics allows power generation personnel to improve the reliability and performance of power generation assets. This paper reviews how these tools can be applied to operations and maintenance.
Introduction

Power generation companies are looking for new ways to address an evolving energy marketplace. The pressures of government regulation, increased competition, and rising consumer demands are driving the need for improved reliability, efficiency, and safety.

The amount of “big data” available today is providing power generation companies with an opportunity to overcome some of these disruptive obstacles. Forward-looking power generation companies are investing in monitoring and predictive analytics tools that help to leverage this data. Navigant research estimates that power generation companies will spend almost $50 billion on asset management and grid monitoring technologies by 2023.\(^1\) Using AVEVA Predictive Analytics software, power generation companies can improve equipment reliability and performance while avoiding potential failures.

Field case: Equipment failure

AVEVA Predictive Analytics provides early warning of equipment failure and abnormal operating conditions that may go unnoticed with traditional maintenance practices. Consider a 110MW steam turbine with seven bearings (including generator bearings): according to the asset maintenance records, this turbine demonstrated sporadic, isolated issues over the course of a year, followed by an escalating condition that ultimately resulted in the unit’s shutdown. The maintenance personnel identified turbine bearing vibrations and took corrective action. Once the maintenance was completed, a similar cycle of sporadic issues began again.

This unit’s raw historical data was then analyzed with AVEVA Predictive Analytics. The results were significant.

Had an AVEVA Predictive Analytics solution been in place, plant personnel would have received early warning that turbine thermal expansion issues were developing and becoming chronic over the year.

Through a modeling exercise, the tool was able to detect the fault patterns with early warnings six months prior to failure. The model showed that the bearing vibrations were a symptom while thermal expansion issues were the primary cause of the problem. Proactive remedial maintenance would have corrected the thermal expansion problem before it led to bearing vibration issues and the shutdown of the unit. The result would have been significant savings in maintenance costs, as well as additional generation sales due to increased unit availability. Estimated savings in this case are in the millions of dollars – a result of 35 days avoided downtime offline and associated repair costs.

Figure 1 illustrates an overall model residual trend (which represents the total predictive model deviation from normal operation of the asset) and confirms that engineers would have identified the problem with this particular turbine. Figure 1 highlights the deviations between the unit’s expected, mode-driven operation profile and its actual performance, providing early warning notification. In this case, the software would have identified the deteriorating conditions that caused a forced outage in April (followed by the subsequent issues the remainder of the year). The operations team would have been able to act on this information and avoid the unplanned unit shutdown and associated costs.

\(^1\)Navigant Research “Utility Spending on Asset Management and Grid Monitoring Technology Will Reach Nearly $50 Billion through 2023” (March 2014)

Figure 1: Predictive Analytics software provides clear indication of a turbine problem prior to failure
Additional benefits

AVEVA Predictive Analytics software enables operations and maintenance personnel to be more proactive in their work. Instead of shutting down a section of the power plant immediately, a problematic situation can be assessed for more optimized outcomes. Loads can be shifted to reduce asset strain, or necessary maintenance can be scheduled during a planned outage. The software tools allow for optimized maintenance scheduling and ordering of replacement parts so impact on operations can be minimized.

AVEVA Predictive Analytics has the ability to forecast the remaining useful life of assets to help provide deep insight into operations and maintenance risk. Once an anomaly in asset performance is detected, the system leverages deep learning to determine the remaining useful life forecast of the asset. Operations and Maintenance teams can leverage this data to understand if the asset can be operated until the next planned maintenance outage or if an urgent shutdown is required. This provides critical input so that plants can schedule maintenance more effectively and assess complex cost versus risk scenarios to maximize efficiency and profitability.

Companies can realize even more savings when avoided costs such as loss of power, replacement equipment, lost productivity, and additional man hours are considered. The power of AVEVA Predictive Analytics is to transform raw data into easy-to-understand, actionable insights that result in improved availability, reliability, and decision-making.

AVEVA Predictive Analytics contextually represents the actual and expected performance of an asset relative to its current ambient conditions, unit loading, and operating mode. It provides operations personnel with clear indication of very subtle changes in an asset’s behavior that would otherwise go unnoticed.

Operations personnel become knowledgeable about where inefficiencies exist and how they affect financial performance. They can gauge the future consequences of the actions and decisions they make in the present. Risk assessment becomes more exact, enabling optimized prioritization of capital and operational expenditures.

Knowledge capture and transfer is another benefit of AVEVA Predictive Analytics. Knowledge capture ensures that maintenance decisions and processes are repeatable. Should experienced personnel leave the company, their years of accumulated knowledge remain available to incoming staff. Knowledge transfer of best practices and standard operating procedures flows naturally between new and experienced operators, which can help to reduce costly maintenance errors.

The reliability and efficiency improvements gained through the use of AVEVA Predictive Analytics software also result in increased customer satisfaction rates. Consumers can experience more reliable service with fewer outages because power generation companies have the insight needed to avoid potential equipment failure and forced outages.
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Reactive maintenance
Reactive maintenance is the most basic maintenance strategy and allows an asset to run until failure. This approach may also be used for assets that have minimal repair or replacement costs and do not warrant an investment in advanced technology.

Preventive maintenance
Preventive maintenance (PM) approaches are designed to ensure that an asset is examined before it reaches the point of failure. The preventive maintenance strategy prescribes maintenance work to be conducted on a fixed time schedule or based on operational statistics and manufacturer / industry recommendations of good maintenance practice without taking into account the actual current condition of the asset.

Condition-based maintenance
Condition-based maintenance (CBM) focuses on the physical condition of equipment and how it is operating. CBM is ideal when a measurable parameter is a good indicator of impending problems. The condition must be definable using rule-based logic, where the rule does not dynamically change depending on loading, ambient or operational conditions.

Predictive and prescriptive maintenance
If a potential asset failure results in significant damage, safety or power outage risk is high. In these cases, a more proactive maintenance approach is required. Predictive maintenance (PdM) relies on the continuous monitoring of asset performance through sensor data and prediction engines to provide advanced warning of equipment problems and failures.

PdM uses artificial intelligence (AI) and machine learning and requires a predictive analytics solution for real-time insights of equipment health.

AVEVA Predictive Analytics solutions are a key part of a comprehensive maintenance program. According to research by ARC Advisory Group, only 18 percent of assets have a failure pattern that increases with use or age. This means that preventive maintenance alone is not enough to avoid failure in the other 82 percent of assets, requiring a more advanced approach. Predictive analytics software compares the historical operational signatures of each asset to real-time operating data to detect subtle changes in equipment behavior. The software can identify changes well before the deviating variables reach operational alarm levels, providing the advanced notice needed for analysis and corrective action prior to asset failure.

Figure 2: Maturity of the maintenance approach is often associated to the level of risk of both stand alone or consolidated assets

1Ralph Rio “Proactive Asset Management with IIoT and Analytics” (January 2015) ARC Advisory Group
Risk-based maintenance

All of the aforementioned maintenance approaches create the foundation for risk-based maintenance. Risk-based maintenance provides a framework to define, measure, and continually improve the asset strategy through the optimized use of reactive, preventive, condition-based, and predictive and prescriptive maintenance approaches to achieve the highest levels of reliability and performance with reduced costs.

Conclusion

AVEVA Predictive Analytics helps power generation companies, systems engineers, controllers, and many other plant personnel take advantage of massive amounts of data and use it to make real-time decisions that have significantly positive effects on reliability and performance. AI and machine learning software helps personnel work more effectively by providing early warning notification and allowing more lead time to plan necessary maintenance, avoiding potential equipment failure and improving performance.

Power generation companies can optimize their maintenance strategies by leveraging PI System data and AVEVA Predictive Analytics solutions to spend less time looking for potential issues and more time taking actions to maximize the return on every single asset. AVEVA Predictive Analytics software tools can allow power generation companies to get closer to achieving operational excellence while delivering 10-20% reduction in OPEX.