TECHNOLOGY TRANSFER AWARD

SUCCESS STORY

Chevron and Vistra Deploy EPRI's Digital Twin Technologies to Gas Turbine Maintenance and Dispatch

Two members successfully deployed EPRI digital twin (DT) technologies in their gas turbine (GT) fleet, Chevron for managing regular maintenance activities, and Vistra for enhancing GT dispatch. Both members were able to achieve measurable monetary improvements through the deployment of these tools, improving their daily plant operations and marketing options.

ENSURING GT RELIABILITY AND PERFORMANCE

Gas Turbines are an important yet complex and aging generating asset within utility fleets. Ensuring peak operational reliability and performance will maximize output to ever more critical grids.

A digital twin is a virtual model of a real-world process or asset that can be used for simulation, testing and performance optimization. The blending of the virtual and physical worlds allows data analysis and system monitoring to identify problems early, prevent downtime, and investigate the impacts of potential hardware or software changes by simulations. Digital twin technology enables operators and engineers to monitor and analyze the real-time data and performance of a GT, and then use this information to simulate and predict its future performance. The technology can help improve the efficiency, reliability, and safety of gas turbines, and can reduce maintenance costs and downtime by identifying potential issues before they occur.

In theory, a digital twin allows companies to have a complete digital trajectory throughout the lifecycle of an asset, ranging from design and development to maintenance and service phases. Through the continuous analysis of physical data of an asset, a digital twin can help to identify failures by detecting precursors earlier than most other systems. The physics-based approach allows the digital twin to adapt to new operation modes easily.

DIGITAL TWIN RESEARCH

Over the past seven years EPRI has been developing digital twin replicas of simple and combined cycle GTs to provide owners and operators with improved capabilities that typically reside in the domains of original equipment manufacturers and third-party service providers.

APPLICATION ON GT FLEETS

Chevron deployed digital twin (DT) technology for portions of their 7EA, LM2500, and 6B gas turbine fleet to better detect anomalous behavior and monitor when to perform regular maintenance activities. The P216/P217 Gas Turbine Digital Twin tool was developed for these gas turbines using Chevron's assistance and data. Chevron successfully used the technology to detect instrumentation issues and isolate the performance impact of compressor washes. This improved reliability and availability, which is key to operations. Chevron implemented the technology through integration with their historian and through a standalone desktop entitled "Wash Calculator," which implements the DT in an Excel file that they can run themselves. Using the DT to identify compressor washes on a condition-based basis reduces cycles on the GT and prevents needless wash events. The ability to output missing parameters, such as DWATT (for mechanical drive units) and FQG (fuel flow, where it is suspected to be

incorrect or not measured) enables them to focus on facility optimization and carbon reduction where they otherwise might not have a line of sight.

Luminant utilized the learnings from Chevron's DT work to develop, test, and deploy EPRI's Optora Dispatch Optimization Software, which leverages artificial intelligence (AI) and DT to give engineers an easy-to-use performance characterization tool, and is now in production as the Gas Turbine Digital Twin Self-Calibration Tool. The software was tested using Luminant's gas turbine fleet which was part of the early EPRI work on fleet level Digital Twins.

Luminant assisted in thoroughly testing the DT tools and has compared them to their in-house approaches for time and accuracy. Luminant also deployed the DT for fault detection in their historian and was able to identify a post-outage performance loss and compressor fouling events. These two activities can improve dispatch decisions for better grid response and maintain reliability of GT assets.

BENEFITS

Digital twins allow for greater precision in unit performance, which adds significant value. Overall, including the digital twins in their processes has helped Chevron and Luminant develop their commercial strategy for the fleet. Both members were able to achieve measurable monetary improvements through the deployment of these tools, improving their daily plant operations and marketing options—where both of these impact areas can realize tens of thousands of dollars in savings for operations and hundreds of thousands or more in gains from market effects. These tools will help the industry to operate the assets more efficiently and optimize the available assets towards defined goals such as reliability and fuel efficiency. This will help to optimize the operation of current and future asset mixes and further the understanding of asset capabilities.

RELATED EPRI PRODUCTS

REPORT TITLE	PRODUCT ID
Digital Twin Implementation: Applications for Fleet Tracking and Increased Virtual Sensing	3002018031
Digital Twin Implementation: Applications for Fault Signature and Virtual Sensor Development for Enhanced Monitoring	3002016248
Digital Twin Self Calibration Tool: Guideline for Gas Turbines v1.0	3002022197
Gas Turbine Digital Twin Autocalibration Tool (DTACT) v1.2.0	3002024128
The EPRI Gas Turbine Digital Twin – a Platform for Operator Focused Integrated Diagnostics and Performance Forecasting	3002023071

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