CURTISS-WRIGHT

Best Practices in Plant Reliability and Performance

A FAMOS SUCCESS STORY FEATURING EXELON CORPORATION

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— Jeff Marion, thermal performance engineer, Exelon

Exelon®

Organization

Exelon Corporation is an energy company headquartered in Chicago, Illinois that works in every stage of the energy business: power generation, competitive energy sales, transmission, and delivery.

Challenge

Thermal performance engineers primarily used spreadsheet programs to track and troubleshoot plant performance. They did not have a comprehensive way to monitor, analyze, and visualize plant performance data.

Solution

Consolidate the thermal performance engineering team into one central location, then automate plant monitoring, troubleshooting, and what-if analyses with software and services from Curtiss-Wright.

Results

Exelon's thermal performance engineers are better equipped to maximize generation potential by minimizing and preventing plant outages. Fewer engineers are needed.

Exelon, one of the largest competitive power generators in the United States, depends on advanced software technology to enable its thermal performance engineers to monitor its nationwide fleet from one central location.

Previously, Exelon employed one thermal performance engineer and one backup engineer at each of its 13 sites, along with another engineer at corporate headquarters—27 people total. Today, Exelon has centralized its thermal performance group, and automation enables four people to complete the work that was once done by many more.

"We went from 27 engineers down to four, but we needed advanced software technology to make it possible," says Jeff Marion, a thermal performance engineer at Exelon. "Being able to readily access performance data on the status of the plants allows us to do the same amount of work with fewer engineers. We use Curtiss-Wright's FAMOS software to troubleshoot issues, so we can identify where megawatts are being lost and what needs to be done to recapture them."

SIZING UP THE CHALLENGES

Exelon generates more than 32,000 megawatts of nuclear, gas, wind, solar and hydroelectric capacity, making it one of the nation's cleanest and lowest-cost power generation fleets. Like all utilities, the company must continually identify and recover energy losses, which requires data validation and reconciliation (DVR) processes.

In the past, thermal performance engineers primarily used spreadsheet programs to track plant performance. "We were collecting cycle isolation data at most sites, but we didn't have a comprehensive model in place that took that data and converted it to megawatts, and there was no such thing as a what-if model," Marion explains.

Reporting was also a manual process, and generating key performance indicators (KPIs) required approximately one man-week of labor per site. Exelon

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wanted to automate the process of creating KPIs and generating thermal performance reports, especially its Plan of Day (POD) report. To help achieve these efficiencies, the team selected Curtiss-Wright's Fleet Asset Management and Optimization Solutions (FAMOS), a suite of products for analyzing and optimizing plant performance, monitoring and detecting problems, and accessing the data anchoring Exelon's vast, nationwide operation.

Within this integrated suite, Exelon primarily uses FAMOS PMAX, a Thermal Performance Monitoring System (TPMS) for monitoring plant operations and maximizing performance. They also use the FAMOS PEPSE module to generate "what if" studies, modeling plant and equipment performance to test potential efficiency improvements. Finally, FAMOS' Cycle Isolation enables the team to monitor and evaluate valve leakage losses that bypass the generation process.

REDUCING DE-RATES WITH WHAT-IF MODELS

Marion and his team knew that being able to automate report generation activities would yield considerable cost savings, as well as help people obtain critical information more quickly. Previously, each thermal performance engineer had their own spreadsheets that they would update on a periodic basis to troubleshoot issues and make educated recommendations. Each month they would have to collect the last 30 days worth of data and spend time inputting that information. Today, FAMOS makes it much easier to run and update these reports.

"Already fewer people are required to produce the information we need, within the same period of time," confirms Tom Baummer, senior staff engineer, corporate thermal performance. "For example, with the new POD report, you can click a button and it runs itself. It's definitely a big time saver."

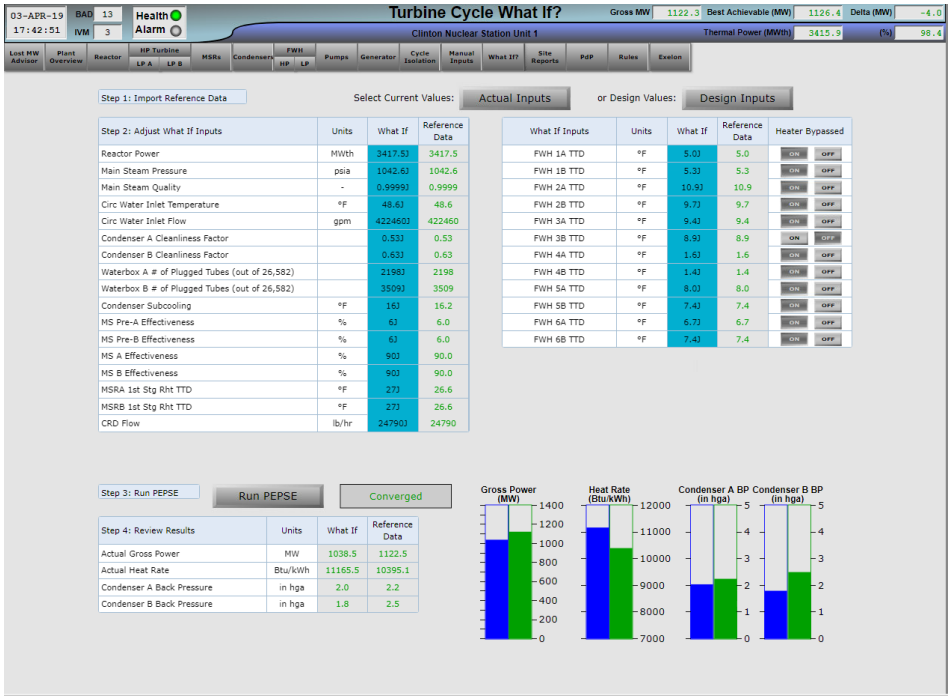
The FAMOS modules work together as part of an integrated suite. For example, PEPSE can be run from PMAX using a "what if" module that enables engineers to visualize up-to-the-minute operating conditions through charts and graphs, which gives them essential data for plant monitoring and optimization.

Having this data at hand helped avert a derate during a feed water heater isolation situation at Exelon's Clinton Power Station, and avoid an estimated 25,000 MWh loss in generation. Procedures from the vendor that supplied the heater advised that the utility reduce power to 30 percent until the problem was fixed. Before proceeding with this power reduction, the engineering team took a closer look at the data supplied by FAMOS. "The model basically said, you're fine right now, there's no need to reduce power, and you can operate safely in this condition—in fact, you can increase power a few megawatts if you'd like until you resolve the issue," Marion recalls.

Soon after, that site was considering a four-day shutdown to fix a tube leak, but the FAMOS analyses revealed that it would be fine to simply reduce power to 65 percent—saving another 11,000 MWh. "We ran various what-if conditions to study the impact of operating under these conditions," Marion adds.

RAPID ANALYSIS DURING EMERGENCIES

FAMOS is also valuable during natural disasters, such as during a recent macro-fouling event at Exelon's Quad Cities Station, when debris from the river was inadvertently allowed to bypass the screens, leading to sudden drop in power of about 20 megawatts. "The site was looking at an emergent issue of possibly shutting down or taking the turbine offline, and going down to a single circulating water pump," Marion recalls. "They were worried about over-pressurizing their water boxes and other issues.



Potential "What-If" Scenarios Generated by FAMOS.

We used the PMAX what-if models and PEPSE models to determine that they did not need to take the turbine offline, and that it would be okay to conduct a tube inspection with one circulating water pump in service, and one out of service. We did recommend some flow reversals, as well as putting the third circulating water pump in service to increase velocity and flush debris out of the water boxes," Marion concluded. Following these recommendations resulted in a 12-megawatt increase in power. Ultimately, the plant returned to normal operations without any need for power reduction.

Having constant insight into plant performance allows Exelon to defer maintenance and repairs until power demands are lower and megawatts aren't as valuable. It also allows the utility to minimize power reductions when maintenance is required.

"The best megawatts saved are the ones you don't lose in the first place," Marion points out. "The Curtiss-Wright tools generate information to prevent a shutdown or minimize power reductions. In this case, given current river temperatures, we were able to tell them that they didn't need to reduce power and they could continue operating at 100 percent."

SPREADING ANALYTICS THROUGHOUT THE ORGANIZATION

In addition to helping corporate central thermal performance engineers with day-to-day performance-management issues, FAMOS allows other Exelon personnel to troubleshoot issues and validate their findings. For example, some of Exelon's chemists use FAMOS to monitor plant condenser performance. The data helps them understand how to impact or change the chemical treatment process. Other employees use FAMOS to gain insight into flow reversals.

Recently, FAMOS delivered valuable data when an extraction line to a Feedwater Water Heater failed in the form of a bellows rupture at Exelon's Clinton Generating Station, resulting in a 7MWe loss. According to a thermal performance engineer at the site, the pressure, TTD, DCA, and dT dropped in the 4A unit. This led to a 5,000 MWh loss due to down power for three weeks, followed by a 256,000 MWh outage to repair the bellows; This situation was obvious in the graphs generated by PMAX.

To validate that Exelon was indeed losing 7MW from the bellows, a thermal performance engineer performed a PEPSE analysis, which showed a 6.3 MWe change due to the ruptured bellows in that location. According to Marion, data from PMAX and PEPSE helped the staff detect the issue, determine the magnitude, and develop an action plan. Shortly after this determination, the plant went into a maintenance outage for the bellows repair. "Of course there are risks associated with operating with a bellows blowout, but we were confident in our assessment," he says.

Thermal performance engineers also

The FAMOS graph showing Exelon's drop in power generation due to bellows rupture.

used PEPSE to model the scenario and narrow down the 7MW loss. The results of this analysis are shown at the bottom of this page, followed by a display that shows the feedwater heater in alarm mode:

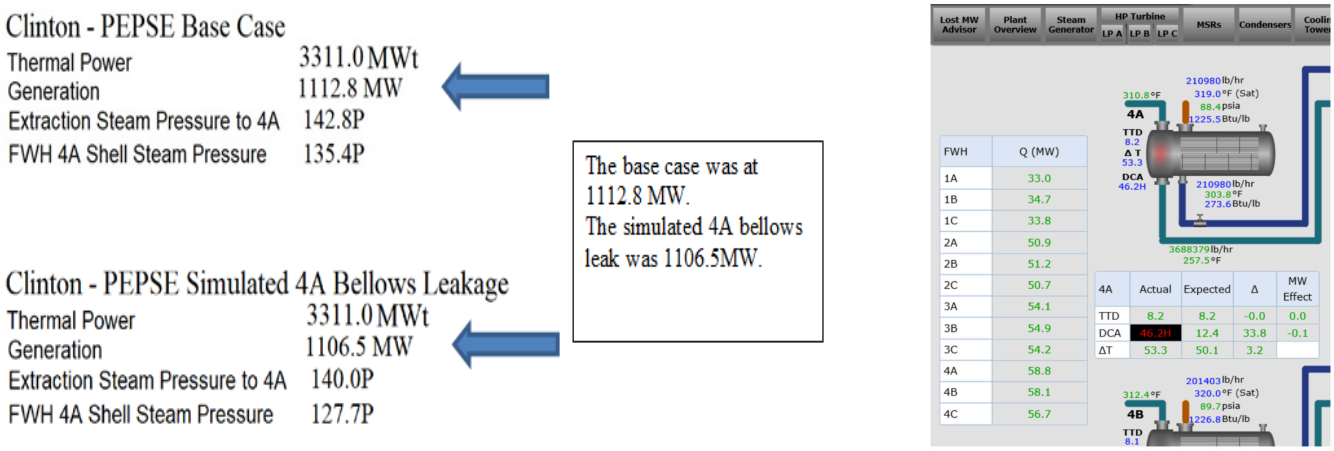
MITIGATING THE IMPACT OF LEAKY VALVES

Leakage through valves is one of the largest and often most overlooked issues in nuclear, fossil, and CCGT power plants. In some cases, leaking steam cycle valves can result in more than 5 MWs of lost power generation. These losses are compounded by the undetected valve leakage continuously damaging the valve, increasing the leak, and leading to additional losses in generation and increased heat rate. Many plants can only make repairs during outages, so it is incumbent upon the thermal performance engineers to identify leaks, quantify those leaks, and prioritize repairs. Working with Curtiss-Wright, Marion and his team have used FAMOS Cycle Isolation to model 2,400 valves in the Exelon fleet. Combining real-time data and web browser displays, this module detects cycle isolation issues and estimates the leakage rate, as well as generation and heat rate impacts for each leaking valve, as shown in the following worksheet.

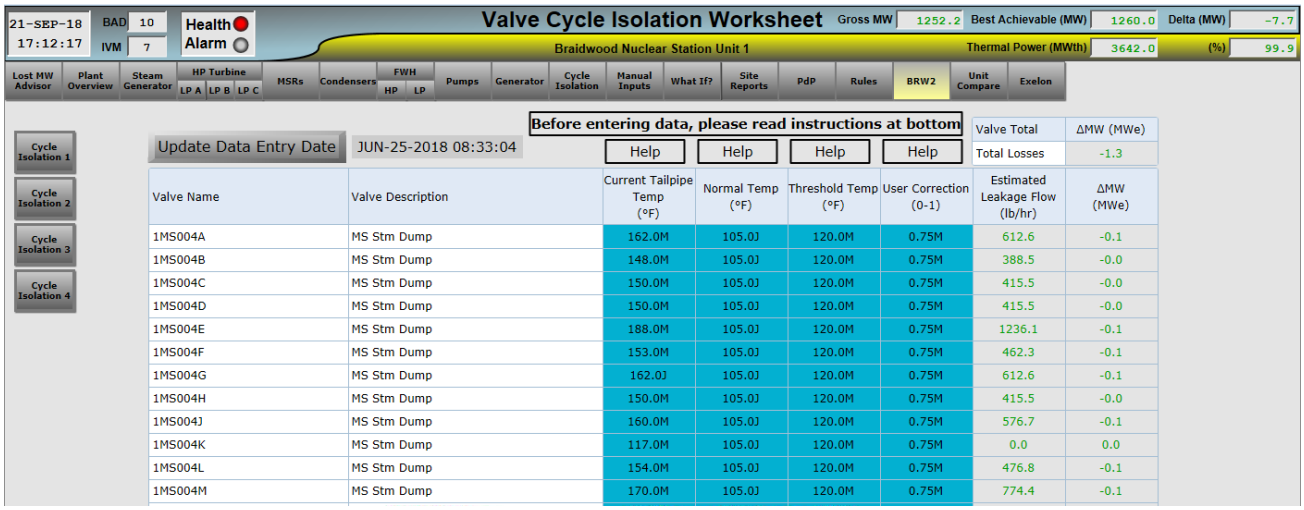
GAINING THE MACRO VIEW

While many plants use the FAMOS tools to monitor individual units, the software also has a totalizer feature that reveals the overall fleet performance. "These statistics keep us apprised of the rated unit power at each site," Marion notes. "We always know exactly what percentage we are operating at, and what our exact gross generation is, moment to moment, for the entire fleet."

This fleet overview also summarizes energy losses. "We know roughly how much we are losing in our condensers, what's associated with not operating at 100 percent power, what's associated with feed water heaters, and what's associated with cycle isolations," Marion adds. "Eventually, if we know a value is a couple degrees higher than the reconciled value, we can introduce a bias based on the data we receive from PMAX."



The MW loss anaylsis and feedwater heater in alarm mode.



The FAMOS graph showing Exelon's drop in power generation due to bellows rupture.

CONCLUSION

Cycle Isolation monitoring and reporting is an integral part of the FAMOS suite. Combining real-time data and web browser displays, FAMOS quickly detects cycle isolation issues and automatically estimates the leakage rate as well as generation and heat rate impacts for each leaking valve. The Cycle Isolation product uses downstream temperature information to generate leakage alerts. Additionally, tools are available to deliver notifications, alarms, and reports to users and recorded in the historian.

In Exelon's case, however, the corporate thermal performance team is constantly monitoring each unit in the fleet to maximize productivity and discover generation losses. FAMOS also helps with corporate sustainability efforts.

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— Jeff Marion, thermal performance engineer, Exelon

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