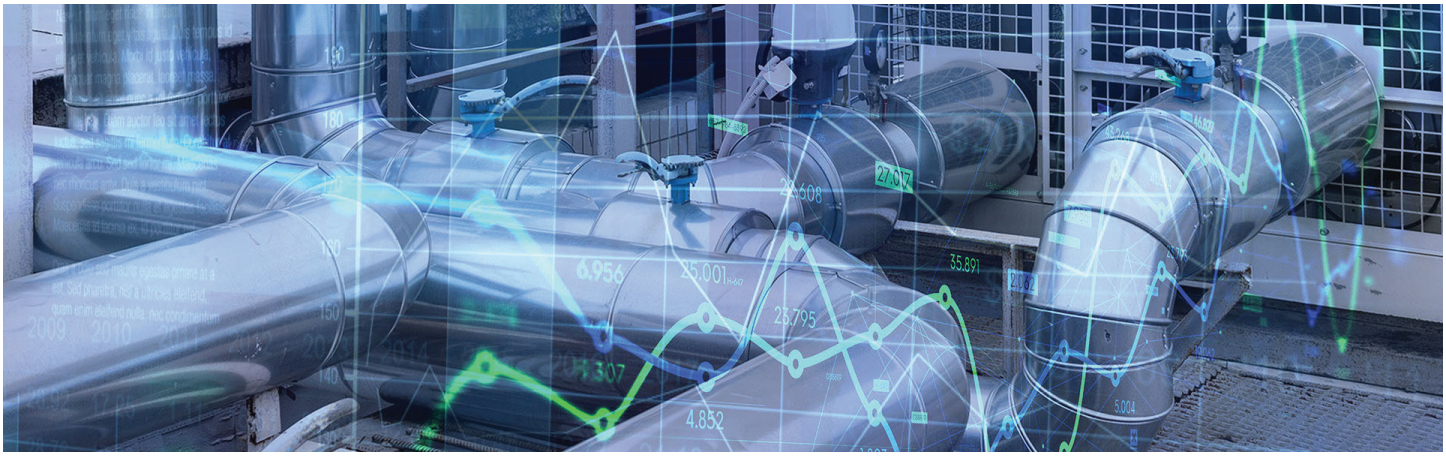
BURNS McDONNELL

CASE STUDY

Fault Detection and Diagnostics Project for Federal Contractor Supports Energy Efficiency Efforts

With federal facilities facing stringent energy efficiency mandates, technology for advanced monitoring and diagnostics can provide much-needed visibility into whether equipment is operating outside of normal ranges — a solution that can help lower energy and operations costs.



Challenge

A major defense systems manufacturer was facing a mandate to bring its complex of facilities up to rigorous new federal energy efficiency standards. Though these facilities were relatively new, they faced a problem that affects all buildings: declining energy efficiency as systems and equipment degrade over time.

Even facilities that meet the highest standards of energy efficiency face this challenge. Mechanical equipment, devices and components all begin to slowly wear out as soon as commissioning agents hand over the keys and occupants move in.

As operator of a federal facility, this manufacturer faced stringent requirements to meet new standards for energy efficiency, greenhouse gas emissions, sustainability and other environmental stipulations under the Energy Act of 2020.

Project Stats

Client
Confidential

Location
Confidential

54
ASSETS ANALYZED

$5K
MONTHLY ENERGY COST SAVINGS*
***SAVINGS IN INITIAL PILOT TEST AREA ONLY**

Solution

The manufacturer engaged Burns & McDonnell for a pilot project to evaluate the feasibility and potential value of an automated fault detection and diagnostics (AFDD) system as a first step toward installing a comprehensive energy management information system (EMIS) for all buildings on the campus. The EMIS would meet a number of requirements of the Energy Act while also complying with codes and standards of the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) as well as other quality process standards.

The pilot project scope was to monitor and analyze performance of selected air handler units along with a make-up air unit, variable air volume units, exhaust air valves, chilled and hot water supplies, and returns on one of the building's penthouses.

With several buildings on this large campus and a planned expansion, the facilities team concluded that the pilot would provide key insights needed to implement AFDD and develop an EMIS. With data providing visibility into how the equipment was performing, it could then be analyzed to identify factors that may be causing equipment to perform less efficiently over time, as well as to establish the economic impact of suboptimal performance. Once those factors were known, the data again would inform development of a plan to improve efficiency.

The monitoring program was designed to capture equipment faults and other anomalies — defined in this instance as equipment that was not performing within optimal standards for efficiency. Equipment operating below optimal standards uses more energy than necessary while also experiencing excessive wear on parts and components, accelerating the frequency of needed parts and component replacements as well as reducing useful life overall.

The AFDD system would become a core element of the campuswide EMIS, enabling a monitoring-based commissioning process that would allow all essential systems and equipment to be continuously monitored for efficiency. Monitoring-based commissioning also exempts the entire campus from mandatory retro-commissioning every four years.

Setting Up the AFDD

This large facility already had a building automation system in place that generated data on the operating profile of various pieces of equipment. Metasys, the automated controls system running the HVAC and other equipment on this campus, was the repository of crucial operational data showing performance trends on all equipment included in the pilot project.

This data was provided on an encrypted storage device and delivered to the project team. It was then uploaded to SkySpark, a monitoring and diagnostic system, to perform the data ingestion and analysis. A version of SkySpark that is licensed to Burns & McDonnell is preprogrammed with unique algorithms that set rules to normalize data from various sources and can be customized with additional algorithms to enhance analytics for a facility.

SkySpark used the data generated by sensors installed on each piece of equipment and captured by the Metasys monitoring system. The SkySpark system then distilled this operational data into an easy-to-digest format, allowing the team to see a consolidated picture of trends and patterns of performance for each piece of equipment included in the pilot. This dashboard format showed, for example, if equipment was experiencing excessive vibration, heat, or any other factor — even showing if filters on the air handling units were becoming clogged faster than normal.

As the pilot got underway, however, the accuracy and quality of the operational and system trend data emerged as a key concern. The team discovered inconsistencies between as-built documentation and documentation of actual installation of certain pieces of equipment. In addition, some of the trend data received was up to six months old, making it problematic for analyzing current performance of some equipment. Other data inconsistencies were found across a range of similar equipment types. Another notable challenge for the testing and evaluation process was access to equipment to gain nameplate information and to verify operation and maintenance in the secure 24/7 environment.

The inconsistencies of data from the Metasys system needed to be reconciled in order to set up the SkySpark system so that its rules were consistent and applied to all the pieces of equipment being monitored. The lack of updated control drawings further complicated the ability to understand equipment characteristics, sequence of operation and proper overall data analysis of the equipment.

Commissioning professionals from Burns & McDonnell were able to resolve these issues. The knowledgeable team had the experience needed to make accepted changes within Metasys to reconcile data inconsistencies. With consistent rules for all equipment, it was then possible to see how each was performing against consistent data benchmarks that could be then set up for the entire campus.

Results

The fault detection and diagnostic pilot served as a first step in developing a program that will give all of the facility operations team a new level of visibility into the performance of all systems and equipment in real time. Operators will be notified of impending issues while also receiving recommendations on necessary corrective steps.

The project also revealed a significant potential for energy cost savings.

For example, three of the eight air handlers investigated in the project were performing so poorly the company could have saved $5,000 in energy costs during a single month, had the proper analytics system been in place.

With those results now documented in a small sample size of operating equipment at this manufacturing campus, an additional phase was recommended to address and resolve issues and challenges impacting a much broader set of equipment.

Preliminary scope items could include:

1. Assess as-built documentation to verify whether current conditions of installation meet specifications, and gather additional data.
2. Review historical maintenance records for equipment managed in the computerized maintenance management system (CMMS) to discover fault signatures and anomaly opportunities for efficiency improvements.
3. Gather additional data sources such as utility meter/sub-meter data and bill histories.
4. Obtain a fully developed dataset that the AFDD solution can effectively ingest and analyze.
5. Develop requirements for an AFDD solution across the entire campus.
6. Develop rules for specialty equipment.
7. Define infrastructure and cybersecurity requirements.
8. Define energy analysis and reporting strategies that comply with the Energy Act.
9. Develop a predictive analytics plan and road map through applied machine learning and artificial intelligence.

Combining a fault detection and diagnostics system with the overall energy management plan is likely to result in significant energy cost savings, plus efficiencies in ongoing maintenance that will drive further cost savings as well as help meet increasingly stringent energy efficiency mandates. A next anticipated phase of the project will help this defense contractor determine if it should procure and license its own version of SkySpark.

About Burns & McDonnell

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