PI SYSTEM

Public Service Electric & Gas deploys OSIsoft's PI System as foundation for CMMS system to minimize costly failures and to enhance customer service

Overview

Country or Region: Newark, New Jersey, U.S.A.

Industry: Transmission and Distribution

Business Situation

The primary goal of using RtPM was to minimize costly failures by shifting from a calendar-based to a condition-based approach for electric transmission and distribution equipment maintenance.

Solution

PSE&G decided to go with OSIsoft because the PI System allows the company to build a repository of operational data, provides client tools to easily analyze the data and is a flexible platform in which to build condition assessment algorithms.

Benefits

- Operational within only eight months

- Saved $300,000 in 2003 maintenance costs

- Better utilization of capital budgets

- Enhanced capacity planning

- Increased reliance of aging equipment and preservation of expertise

"What we wanted to do was create a more formal method that would allow us to make better decisions based on the criticality of the asset, on the failure modes of the asset, the maintenance history and the expected replacement timing. Our aim was to spend our capital dollars more efficiently than we had in the past."

Angela Rothweiler, Principal Engineer, Asset Information and System Policy, PSE&G Delivery, Newark, New Jersey

Public Service Electric & Gas began an implementation of the SAP PM (Plant Maintenance) system in 2000 to enhance the efficiency of their Transmission & Distribution equipment maintenance. While this application did improve maintenance systems, it did not provide the proactive, predictive approach to T&D maintenance the company wanted.

A special project was begun in 2001 to design and implement a computerized maintenance management system (CMMS) that would allow PSE&G to monitor equipment status and handle maintenance procedures using a condition-based approach rather than a calendar based system. The PI System from OSIsoft in San Leandro, California, is the foundation on which PSE&G's engineering and IT staff s created their CMMS solution. The system proposal called for a full ROI by 2005, but the system was launched in early 2002 and began delivering cost savings in its first year. The company reduced its T&D maintenance cost by more than $300,000 in 2003 alone. It also is extending the life of aging equipment through more efficient monitoring of performance.

OSIsoft.

www.osisoft.com

Public Service Electric & Gas Company

Public Service Electric & Gas Company is one of the oldest and largest combined electric and gas companies in the United States, formed in 1903 from the consolidation of more than 400 gas, electric and transportation companies in the state of New Jersey. It currently serves 2 million electric customers and 1.6 million gas customers and spans a 2,600-square-mile diagonal corridor across the state from Bergen to Gloucester counties.

PSE&G has always worked hard to provide uninterrupted electric power to customers in its 2,600 square mile service area. Like any public utility, PSE&G over the years has relied on calendar-based maintenance plans to know when to perform the right maintenance at the right time. The PSE&G Electric Delivery Asset Management department launched a project in 2001 to create a computerized maintenance management system (CMMS) that would utilize a proactive, condition-based maintenance approach to help predict equipment failures before they occurred.

This joint project between the engineering and information technologies (IT) departments used the PI System and software application modules from OSIsoft, an SQL relational database and the Web Intelligence reports platform as the foundation for the new system — including interfaces to the company's SAP enterprise computing systems and the SAP plant maintenance (PM) module. The system was installed in 2002 and PSE&G began to predict failures using a combination of: conditioned assessment algorithm results, experience from internal subject matter experts (SMEs), and OSIsoft's client tools (ProcessBook™ and DataLink™). In 2003, the system is estimated to have saved PSE&G more than $300,000 in maintenance and capital costs.

Achieving perfection isn't easy

As with any other public utility, PSE&G found it difficult to achieve 100% reliability because the mean time between failures (MTBF) of transmission and distribution equipment is difficult to predict. Most utilities follow manufacturer recommendations for preventive maintenance, using a calendar-based approach to repairing or replacing equipment. PSE&G had taken this same approach for years, but felt the need to develop and implement a more intelligent approach that would allow the company to change maintenance practices from reactive to proactive. This resulted in a condition-based maintenance approach.

To operate more cost-efficiently in a deregulated environment, PSE&G engineering and IT groups began a project three years ago to develop a CMMS system that focused on the electrical transmission and distribution (T&D) arm of the delivery organization. The primary assets of concern included transformers, phase angle regulators, high voltage regulators, load tap changers (LTCs) and breakers.

The main objectives of this new system were to:

Change maintenance practices from reactive to proactive

Re-orient corrective maintenance procedures

Redirect capital expenditures more efficiently, based on planned replacement of equipment rather than replacement following a failure

Reduce equipment failures

Better prioritize maintenance orders based on SAP PM applications

Capture and institutionalize the expert system knowledge of PSE&G's more experienced personnel to elevate the level of all technical people

In order to make the most effective use of maintenance resources for electrical inside-plant assets the staff developed completely new equipment condition monitoring applications that would automatically trigger maintenance tasks and provide management indices that would allow the company to measure program effectiveness. The CMMS integrates the existing work management, supervisory control and data acquisition (SCADA) and laboratory information management systems for inside-plant assets. Process data is retained in a time-series database for ease of analysis and transactional data is periodically extracted from the SAP PM module and placed in an SQL Server relational database for reporting and analysis purposes.

PSE&G chose OSIsoft's Platform as the foundation for the CMMS system because it allowed the company to store existing control system data plus additional operational data in one central place and it also provided an interface to the PM module of SAP enterprise systems. A number of OSIsoft modules were used to manage specific tasks for the CMMS, including:

The PI System™ (PI™), for archiving operational data

Module Database,™ for sorting real-time data, aliases, parameters and process ,specs into useful groups for use in programs and displays

ProcessBook, a graphics package for creating dynamic, interactive displays of data

RLINK,™ for interfacing to the SAP PM module for generating work orders and notifications

Manual Logger (PIML) coupled with mobile data terminals (MDTs) for collecting weekly inspection data

Building a condition-based monitoring platform

Using the OSIsoft tools, PSE&G was able to build a condition-based monitoring platform that looked at factors such as counter operations and gas tests from comparative equipment and ranked the equipment according to the sum of the factors. This platform has allowed the company to identify comparative asset performance. Conditional effects algorithms identify the performance parameters of equipment, by class of equipment. SMEs look at the condition assessment results, do further research to verify results then manually create condition-based PM orders in SAP. The field performs the work and reports on the findings. Based on these findings, modifications and adjustments are made to the algorithms to produce results that are more accurate to the operations of the equipment.

Take the 400 Load Tap Changers (LTCs) for example as an equipment class. The algorithms run monthly and take into account the most recent lab tests that determine how much water is in the oil as well as any hot metal gases, methane and ethane. The algorithm also factors in the number of operations, based on inspection data. These raw values are put through case statements and scored accordingly; the sub-scores are then totalized to a final equipment score, which identifies the condition of the equipment (10 being the worst performer and 1 being the best). Differences in characteristics are also factored in among equipment from specific manufacturers, since it's been found that some LTCs can withstand very high hot metal gas levels while others have problems with corrosion.
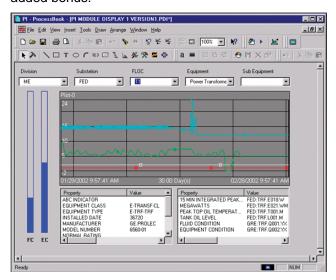
"From all of this analysis we get a detailed breakdown on equipment costs and man/hours to service that give us important business benefits," says Angela Rothweiler, Principal Engineer at PSE&G. "This is information that was not readily accessible before because, without the use of the PI System, it would have taken us several months to gather and analyze the information. We've now developed conditional algorithms for use with 982 transformers, 400 load tap changers and 1,500 breakers."

Up and running in eight months

PSE&G began test usage of the CMMS in 2002 and gradually fine tuned the operations. Condition monitoring goals for 2003 targeted 16 load tap changers (LTCs) for maintenance as a result of wet oil, low dielectric strength and excessive levels of hot metal gases. Of the 16 targeted LTCs, five were found to have impacted contacts and interior components. Overheating and/or failure of internal components of any LTC is a major maintenance item because the cost of switching, tear down and repair is expensive. The estimated savings is over 150,000 dollars in maintenance and capital costs for LTCs alone.

The over-riding goal of condition assessment was to implement preventive maintenance, rather than repair following a breakdown. PSE&G generates preventive and corrective maintenance orders using SAP PM. The company uses PI Manual Logger and mobile data terminals (MDTs) to enter weekly inspection data into PI. There are close to 800 performance equations just to look at LTC operations, cap breaker operations, gas breaker run hours, ATB compressor run hours and gas breaker temperatures. The algorithm looks to see if there's been excessive operations or temperatures over a three-week period and it uses RLINK to automatically generate a notification in SAP. The best part is that PSE&G knows the information is much more accurate and reliable now because there are more people analyzing the data. In the past, operators recorded weekly inspection data on paper; these papers were filed within the division. Identifying which LTC or breakers had excessive operations over time was a time consuming task, but with the new system, the PI servers do the work. The PI Performance Equations (PEs) have identified controls that were out of calibration, leaky blast valves, incorrect CMV settings and defective controls on some of the older LTCs that needed to be replaced.

The SAP corrective maintenance orders were automatically generated through RLINK via PI PE triggers. It is estimated that the system-generated notifications saved the company about $300,000 in 2003. In the original presentations to management for budget approval, the projected ROI was not phased to receive full benefit until 2005 — so early ROI was an added bonus.

The PI Module Database has allowed PSE&G to correlate the company's SAP equipment to operational data, which allows users to easily locate and trend PI data.

Custom reports and data links, too

In addition to the preventive maintenance approach, the new CMMS allowed PSE&G to create custom DataLink reports for the field planners to identify heavily loaded areas. The team also worked with the company's system planners and IT staff in Newark to develop performance equations to calculate substation loads. The system planners need to plan for system growth because when electric loads get to a certain demand point you have to expand capacity or adjust the load.

Originally, when the PI System was set up, encrypted tag names were assigned to 85,000 points. When users were trained on the CMMS, it was difficult to grasp the tag naming convention so a display was created that would allow users to easily locate and trend PI data. This was easily accomplished via ProcessBook displays, a little VBA code and the PI Module Database. A hierarchy structure was set up in the Module Database that mimicked the SAP IPE structure, then the PI operational data was linked to SAP equipment or functional locations via tag attributes, and assigned real names (tag aliases) to all of the points. This display allows the user to navigate the SAP IPE structure in the Module Database and trend the associated operational points. Knowing the tag naming convention isn't required to find a point — users just navigate to the desired station, scroll down to the device and get the information. It's as simple as that. DataLink was also used to create custom reports for users, in particular, the maintenance supervisors. Now, there are reports that monitor transformer nitrogen pressure readings, LTC and breaker operations, and breaker compressor run hours. Reports are easily accessed, there's one click to refresh, and the latest data is there immediately. Readings that fall below or above a predefined limit are highlighted in yellow; maintenance crews investigate these readings and report findings back to the maintenance supervisors.

Currently, there are about 40-50 users accessing PI data, either via ProcessBook displays, DataLink reports or Web Intelligent reports. Sometime next year we plan to implement RtPortal, which, with this highly collaborative environment, PSE&G believes the user base will double.

Bottom line benefits

"One important benefit PSE&G realized from the new system is that the SMEs are aging and will soon be retiring. Our idea was to try to capture as much information as they have and systematize or institutionalize it. They're subject matter experts, so we needed to capture the knowledge they have," says Rothweiler.

"Another benefit has been the ability to do a better job of expending our capital budgets. Previously we used SAP order costs and field knowledge to determine which equipment needed replacement. Today, we combine SAP cost data, field knowledge, lab results, load profiles, location and age to determine equipment replacements. What we wanted to do was create a more formal method that would allow us to make better decisions based on the criticality of the asset, on the failure modes of the asset, the maintenance history and the expected replacement timing. Our aim was to spend our capital dollars more efficiently than we had in the past," says Rothweiler.

"Our new condition-based maintenance system has paid off well. We knew if we had a better way to monitor the data we would have a better chance of preventing a failure before it happened. Our measure of success was to prevent one major transformer failure every two years. Right now, it is too early to claim success but with our 2003 maintenance and capital cost saving we are extremely optimistic. Instead of operating in a "run to failure" mode we've succeeded in capturing system knowledge in intelligent systems that allow us to identify problematic equipment before a failure — and there's no way to calculate the actual return on investment of a predictive maintenance approach like this, simply because you can't really measure failures that never happened," says Rothweiler.