

Central Plant Optimization Yields Up to 25% Efficiency Improvement for Pepco Energy Services' Chiller Plant



MTCC Chiller Plant | The chiller plant operates 24 hours per day, 365 days per year, providing essential chilled water via a 42" header to numerous Atlantic City casinos, Pier Shoppes and the Atlantic City Boardwalk Hall and Visitors Center. The 16,200 Ton plant has 4-York 4160v series counter flow chillers and 10-York 480v VSD series counter flow chillers. System pumping capacity is 40,000 GPM.

Pepco Energy Services' (PES) Midtown Thermal Control Center (MTCC) in Atlantic City, New Jersey, sells chilled water and steam to multiple Atlantic City casinos, Boardwalk Hall and Pier Shops. PES is also responsible for stand-alone remote heating and cooling plants for the Atlantic City's major casino's as well as the Atlantic City Convention Center including its 2.4 Mw solar array.

Patrick Towbin, VP of Asset Management for PES, was brought on board to improve the performance of the MTCC plant. It didn't take long for him to see that the 16,200 Ton chiller equipment accounted for a large portion of the MTCC's production costs, and that there were opportunities to improve the efficiency of the operation of this equipment. He hired John Rauch to head the plant's operational management team. The new mandate, under the direction of Towbin and Rauch, was to seek cost effective ways to improve the operations of the MTCC, especially the larger contributors to production costs.

Holistic Approach Needed

Within a short time of his arrival, Rauch, as the new PES Plant Operations Manager, saw that MTCC was relying on the same equipment and processes that were put in place when the plant was built over 15 years ago. "We started our review by asking ourselves how can we produce chilled water

more efficiently so that we can improve our bottom line. With this as our guide, we identified many opportunities for improving efficiency at the plant. Not only in the chilled water production process, but also in measuring and monitoring the output of the production process."

Rauch's investigation showed that the plant was being operated and maintained with a series of independent components and controls, many of which had been modified over the years. From experience, Rauch knew that even the most efficient components fail to meet their promised efficiency over time. He believed it was essential to look beyond component-based efficiency and employ a holistic approach where components work optimally as part of a networked interrelated system.

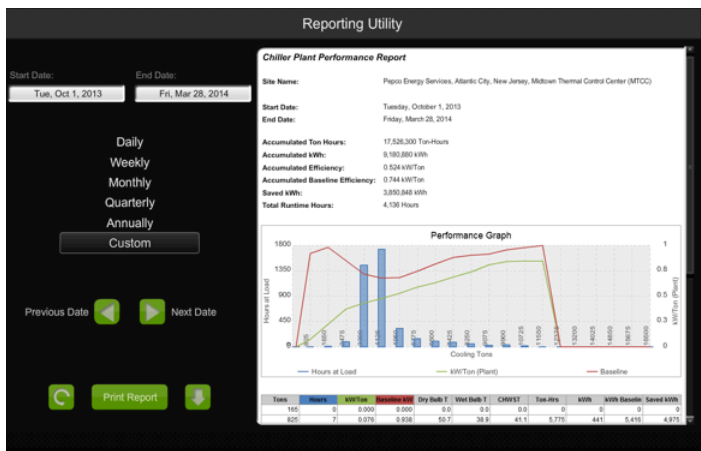
Rauch lost no time in contacting The Tustin Group's Energy Solutions Division, a commercial energy management company headquartered in Norristown, Pennsylvania, to help evaluate the situation and submit a proposal for improvements. Rauch had worked with their team in the past on projects that successfully and significantly reduced energy consumption. What neither party knew at the time was the amount of effort it would take to compile the data necessary to develop a baseline and prepare a proposal for improvements. Once the initial survey and site assessment was complete, it was clear that the largest opportunity for cost effective energy reduction

was in the chilled water production process. However, the opportunity was not simply replacing or adding equipment. It was modifying the controls strategies with which chilled water was produced. TES then reached out to a plant optimization partner to review the opportunity.

Developing a Baseline

“Without good data and a good control system, how do you know if, or what, you need to optimize?” explained Rauch. “For over 10 months in 2012 we worked with TES on the data collection/validation phase in order to understand what we had so that we could very accurately portray what we could gain by implementing a central plant optimization system. We reviewed all prior electric bills and upgraded many flow and temperature transmitters to make sure we got accurate baseline data.”

Rauch understood that improvements in the chilled water production process would be evaluated in competition with other capital expenditure options under consideration by management. Because capital budgets are limited, it was vital that he accurately quantify the benefits to be achieved with the expenditure to gain approval to proceed.



Baseline Performance Data: October 1, 2013 – July 31, 2014
(Total electric savings for the period 5,370,000 kwh)

Once the development and costing process was complete, Towbin spent countless hours reviewing the financial implications of the project. However, before he would submit the proposal to the corporate decision makers in Virginia, he asked to see a working site and to speak to the end users.

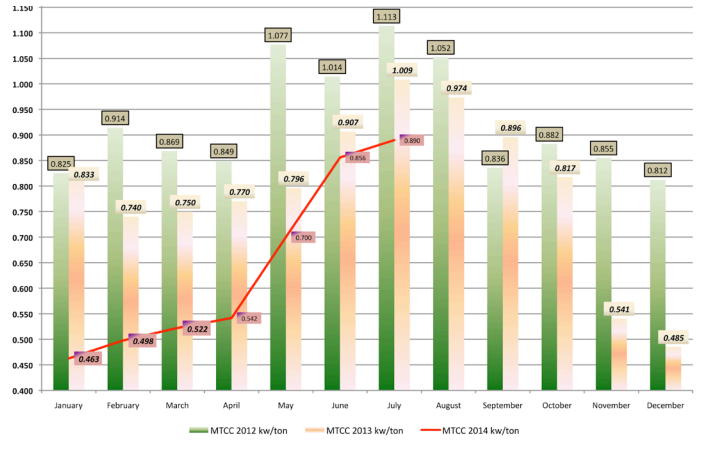
The proposal showed that PES could reduce its chilled water production costs by well over 20% by implementing the proposed chiller optimization changes and other energy efficiency measures. “Over twenty percent is a big number and management was initially skeptical,” said Rauch. “It took almost four months of additional validation to address their questions and to demonstrate that the calculations were accurate.” For Towbin, who had been involved with



“Great projects require great leaders. Pat and John are forward thinking, calculated risk takers — which seemed appropriate for Atlantic City”

*Brad Pappal, General Manager
Tustin Energy Solutions*

Brad Pappal from Tustin Energy Solutions and John Rauch from Pepco Energy Services proudly display the 2014 IDEA Annual Innovation Award at the International District Energy Association Conference (IDEA). The award-winning customized central plant optimization solution resulted in a 25% improvement in operating efficiencies, qualified them for the maximum rebate of a half million dollars from the New Jersey SmartStart Buildings® Program, and now provides real-time and historical performance data 24/7.



MTCC Chiller Plant kw/ton performance January 2012- July 2014

similar projects before, the fast payback was obvious. Towbin relied upon his expertise in analysis, engineering, and asset management to convince his management of the excellent economics associated with the project. The project qualified for a half-million dollar rebate from the New Jersey Office of Clean Energy’s NJ SmartStart Buildings® Program, and also resulted in nearly 25% improvement in operating efficiencies. In the end, and after thorough due diligence on their part, Towbin and Rauch prevailed and the project was approved.

Optimization Measures

“When the plant optimization program is deployed (either in new construction or retrofit) it routinely achieves annual averages of 0.55 kW/ton and lower for the entire chiller plant, (depending on the application), thus translating to significant annual energy and cost savings,” explained Tustin’s General Manager, Brad Pappal. Tustin’s application engineer and programmer worked closely with the optimization partner to customize the system’s software that automatically sequences the operation of the entire chilled water plant.

The optimization software was designed to take advantage of the Plant Control System (PCS) to maximize central plant efficiency. “We were able to interact with the plant’s existing Allen Bradley Rockwell Plant Control System to fully optimize the mechanical systems in the plant,” added Pappal.

The optimization onsite server that is deployed on the backbone of the current PCS, receives data, processes and models the data and provides historical, real-time, and predicted data. The data outputs provide the operational strategies that are automatically implemented by the plant control system. Based upon the energy efficiency measures developed during the initial verification process, Tustin Energy Solutions upgraded various motor starters and system critical instruments required for optimization.

All About the Algorithms

"The optimization platform uses a non-proprietary, open protocol and fully modeled methodology. The approach is model and simulation driven and is customized to PES' plant and operations. At the heart of the software is an algorithm that is computing all possible chiller, pump and cooling tower sequencing permutations, modified flows, set points and load limits. These calculations find the combination of equipment and speeds that result in the lowest kW input. "All of this is recorded, reported and implemented in real time," explained Pappal.

"It's all about the algorithms," explained Rauch. "The system has what's called a Brute Force Optimizer algorithm that constantly calculates the most efficient operation scenario. Algorithms run every 15 minutes, 24/7. They make real-time automatic adjustments to the system based on real-time building loads. The optimization software then simulates that data and directs the PCS for adjustments needed to maximize the system performance. The software has complete knowledge of compressor, tower and pump performance characteristics, which it uses in real time to modulate control levels to all VFDs, pumps and machines."

"If you have the right algorithm and you work with the details that go through it, then it's pretty straightforward," explained Towbin. "The program's successful implementation is largely due to how much patience Rauch and the operators had to make sure the algorithm was programmed correctly."

The program's continuous feedback loops provide detailed, real-time and historical performance data so operators can quickly detect, diagnose and resolve system faults. "They can see the data via easy-to-read graphs and charts that allow for quick diagnosis of faults," said Rauch. "If a chiller goes down for maintenance, the software recalculates, and readjusts, and reassigns the process workload accordingly."

Concern Over Job Security

Plant operators were initially skeptical about a "Hands Off" system taking over completely. "The idea of a plant running relatively 'hands free' in terms of operating efficiency led to a concern about job security," explained Rauch. "However, the way things have worked out, operators are now more available to do maintenance, shutdowns, and system analysis, and can do so without missing critical control changes.

The system's automated demand response, used for balancing supply and demand, allows operators to program the optimization system so it stays under a predetermined plant electrical load. "The optimized control program will now do the adjustments for them," said Rauch. "This is a long way from the days when operators had to stare at a screen and stress over all the things that had to be tweaked, or turned on or off, to meet a demand response number at peak hours. Many of the MTCC's customers are event driven and when there are large events, usage can increase dramatically. We can now better manage these peak usage episodes."

Side Benefit

"In addition to achieving operational efficiencies and savings, this central plant optimization project clearly demonstrated how automated optimization of a complex plant like MTCC can help the owners meet their operational goals by helping them achieve production reliability, as well as enhanced visibility into operations and equipment that enables them to foresee challenges that may impact performance or operations," said Pappal.

One of the things about the Changed plant optimization platform that impressed Towbin was actually finding new opportunities for additional efficiencies. "You start to see things that you never knew were acting as a drag on our production efficiency," he said. "The side benefit is that it helps you optimize your plant and your operations because the system brings to light situations that you had never questioned before. In the end, it was a very deductive way to implement improvements in our plant."



This portion of the display depicts the following:

- Green | Cooling load from customers
- Red | 2011 kW/ton Baseline
- Yellow | Real time kW/ton performance

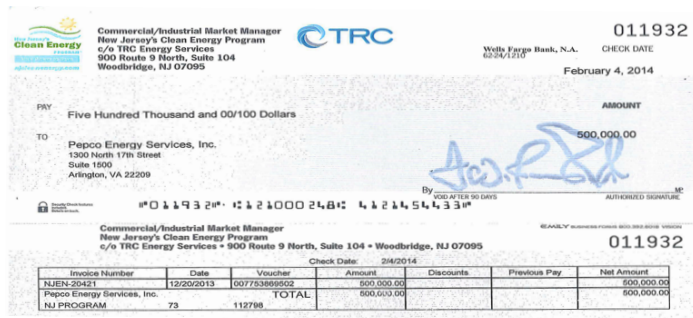
Large left dial indicator portrays the actual, targeted and high alarm performance of the entire chilled water plant. Dial indicators to the right provide more detail for specific chillers, chilled water pumps, condenser water pumps, and tower fan targeted efficiencies.

Annual Savings

The chiller plant optimization was completed in 2013. Since deployment, it has become commonplace to see daily savings of 30% relative to baseline. Going forward, savings are expected to be 20-25% annually. “The Midtown plant operates at near maximum cooling capacity during the summer months and there are limits to the optimization based on weather conditions and customer occupancy,” explained Pappal. “PES benefits most during shoulder and winter months. The demand is much lower and the maximum benefits of optimization are realized. Regardless, the first priority of cooling is always met.” In addition, Towbin added that “now we have people from all over the company coming here to see the efficiencies we have gained.”

Eligible for Rebate

The chiller plant optimization enabled PES to obtain a \$500,000 rebate through the New Jersey SmartStart Buildings® program — the maximum allowable rebate. The NJ program makes financial incentives available for projects that provide significant long-term energy savings.



Pepco Energy Services receives NJ SmartStart project rebate check for \$500,000—the maximum allowable rebate.



Pepco Energy Service Midtown Chiller Plant. A total of 14 chillers are in the plant—16,200T

Additional Services

During the chiller plant optimization, TES repurposed two additional aging proprietary control systems at MTCC and remote mechanical plant for the Atlantic City Convention Center. Along with upgrades and equipment, TES will save PES over \$500,000 annually in energy, repair, and unnecessary services.

Optimizing Total Chilled Water Plant Efficiency

“Plant optimization where components work optimally as part of a networked, interrelated system has allowed us to reach a new level of plant efficiency,” said Rauch. “With the right team, you can make the technology work seamlessly. And that is what we have here, optimization 24/7, helping us save upwards of 25% annually.”

About Tustin Energy Solutions

Tustin Energy Solutions (TES) provides customized, web-based energy management solutions for today’s sustainable buildings. They are experts at making buildings and their processes work together to conserve resources with seamless and optimum efficiency. Building owners and managers look to Tustin Energy Solutions to help reduce energy use and improve their carbon footprint. For more information, contact Tustin Energy Solutions at 2555 Industry Lane, Norristown, PA 19403, call 610.539.8200 or visit the website at www.thetustingroup.com.

About Pepco Energy Services

Pepco Energy Services (PES) delivers a complete range of renewable energy, energy efficiency products and energy efficiency services to a wide variety of clients, including: state, local and federal government; educational; institutional; industrial; and commercial concerns. Pepco Energy Services is a subsidiary of Pepco Holdings, Inc., one of the largest energy delivery companies in the Mid-Atlantic region, serving about 2 million customers in Delaware, the District of Columbia, Maryland and New Jersey. For more information, contact Pepco Energy Services, 1300 North 17th Street, Suite 1500, Arlington, VA 22209, call 703-253-1698, or visit www.pepcoenergy.com.

