

Project Facts:

Retrofit

First smart grid commercial building in downtown Philadelphia

22-story high-rise commercial space

270,000 square ft.

Saves \$40k on energy costs during warmer months

Additional demand response savings of \$10k per year

2 year pay back period

CALMAC

1500 Walnut Street

HVAC system transforms building into 'virtual power plant' and prepares it for smart grid

Overview

Built in 1929, 1500 Walnut Street is a 22-story, 270,000 square foot high-rise commercial building located in Philadelphia, Pennsylvania. The current owner of the building had purchased the 1500 Walnut property in 2005. He was faced with a failing HVAC system that meant keeping temperatures comfortable for tenants, particularly in the summertime, was an expensive and inefficient process.

Challenge

The owner sought a new HVAC system which offered the best net present value, lowered energy expenses, fit inside the building's mechanical room, and was not difficult to operate. The owner also wanted to perform the retrofit without ceasing building operations or affecting tenant satisfaction.

"We had a number of tenants that wanted to leave. We had a failing HVAC system," said Gene O'Donnell, the building manager at 1500 Walnut. "The system we had in place was an energy hog that was affecting bottom-line revenue for the owner. There was no question we needed a new system, but we also couldn't burden the tenants while we installed it."



Solution

The building owner at 1500 Walnut Street solicited bids in 2007 to replace the building's outdated 500 and 600-ton chillers. Challenged with evaluating different systems, the building owner retained Tozour Energy Services to perform a life-cycle cost analysis. The solution included CALMAC thermal energy storage tanks and two 300-ton chillers, which were installed at the same cost as the existing system.

Kevin Keenan, Manager of Energy Project Development at Tozour Energy Services, said CALMAC's system offered a superior design.

"The circular design with the tube sheets rolled gets a lot more burn out of each cubic foot of CALMAC's energy storage tanks, significantly reducing the cost and size of each tank."

Results

The installation of CALMAC's system went smoothly, performing the retrofit while the building was still in operation without impacting tenant satisfaction. The energy storage tanks fit easily into the building's mechanical room, where the chillers were also located on elevated pads for easy access.

CALMAC MANUFACTURING CORPORATION





Operators were trained and became experts at optimizing the system, alleviating concerns that the system would be overly-complicated down the line.

The CALMAC system provided just a 2 year payback. It was operated to take advantage of less expensive night-time energy. The IceBank energy storage tanks made ice at night, when power was less expensive, and used it to cool the building the following day when power was most expensive. However, following energy deregulation in the electricity market, it became difficult to predict power prices and most beneficial to use ice to cool the building when the locational marginalized price – the variable cost of power by hour – was high. First, changes and upgrades were made to the controls and building automation systems which reduced the energy use from 1.6 million kWh to 1.1 million kWh per year. Then using VPower software from Viridity Energy, CALMAC's system changed to a demand response system. The load optimization process of the VPower software determined the duration and rate of use of charging and discharging the IceBank energy storage. 1500 Walnut Street could call on the stored energy to substantially reduce its mechanical cooling load for demand response without any effect on the tenants, unlike alternative demand response methods such as changing the thermostat and shutting off lights during energy emergencies.

Virtual Power Plant

Viridity Energy software enabled the building to forecast power prices and utilize its HVAC system to generate revenue, essentially becoming a "virtual power plant" in the eyes of the utility.

"Viridity Energy can forecast where prices due to congestion will be for the next day on an hour by hour basis and provide a schedule to the building operator through the building automation system, which the ice system is tied into to make ice or burn ice," said H.G. Chissell of Viridity Energy. "When they are using ice they are not using their chillers and their load drops. We can



then make sure that the grid operator knows that this load is dropping during these hours and they don't have to go to a power plant. The grid operator diverts the income or the money to the building."

"Power companies have said, 'if we need one megawatt of power to satisfy the Grid, we can go to a power plant and see how much that would cost. Alternatively, we can pay you, the building owner, the same thing we would have paid the power plant for that megawatt," added Keenan. "So you're actually getting a revenue stream by freeing up more power for the power plant to use."

With CALMAC's IceBank energy storage, an HVAC system upgrade and Viridity Energy software, 1500 Walnut Street is saving nearly \$40,000 a month on energy costs during warmer months, when more cooling is required to keep tenants comfortable. The ice storage operates as a demand response system, generating an additional \$10,000 of revenue per year by responding to market-based pricing and demand response programs.

"This is found money," O'Donnell said. "We don't need one square foot of space in this building to make this money, and the tenants in this building see no change at all. We're as happy as pigs in mud. The system works."

Summary

Overall, the new chillers and thermal energy storage tanks provided 1500 Walnut Street with a system that not only offered the best net present value and significantly cut energy costs but also helped the building prepare for future changes in energy. After deregulation, 1500 Walnut has used software from Viridity Energy to take its ice storage system to the next level, ultimately becoming the first building in downtown Philadelphia to integrate with the Smart Grid and use its HVAC system to earn revenue. The end results are reduced congestion on the utility grid, optimized energy storage to in turn generate revenue, reduced costs and increased reliability.