Honeywell KVAR Test #1: Executive Summary

A. Overview: The KVAR Power Optimization Capacitors were installed on the chiller and chilled water pump at Apollo Elementary School in Titusville, Florida, on Friday, May 4th, at approximately 12 PM. A data logger was used for brief periods prior and after the installation, in order to measure the effects of the installation on the electrical power system. This report is to document the results of this test.

B. Installation: The chiller utilized for this test is a Carrier #30GT-210, air cooled, packaged unit, manufactured in 1996. It is powered by 480/277V, 3ϕ, wye electrical service. The chiller has seven (7) reciprocating compressors, which cycle on and off to maintain the leaving water temperature setpoint. Weather related load variations cause cycling of the different compressors. Therefore, weather had some effect on the chiller data collected, as electrical load changes likely occurred during trending.

   The pump tested provides primary chilled water for the chiller. There are two 25 HP, base-mounted, end suction pump, operating at constant speed. They are powered by 480/277V, 3ϕ, wye electrical service. Only one pump is operated at a time, with the other use as a backup. Weather related load variations on the chiller will not effect the electrical usage of the pump.

   The measurement tool used in the testing was a clamp-on, power data logger, manufactured by Extech, model #382060. It was installed on the three power feeders between the disconnect switch and load (chiller or pump). It measured real-power (kW) of the 3ϕ service to each load, as well as amps per phase, line-line voltage, kVA and power factor. As savings resulting from the power factor optimization will be realized at the utility meter in kW reduction, this report will focus mainly on those results.

C. Operation: This particular chiller is part of an ice-storage cooling system for the elementary school. It is automatically controlled to perform dual functions throughout the day and night. First, it is operated in the 'ice-building' mode after 10 PM at night, producing 20°F glycol solution to charge the ice storage tanks. After the ice tanks are completely filled, it shuts down, approximately 5 AM each weekday morning. It then operates as a regular chiller between about 6 AM and 12 PM. Finally, it remains off-line until ice-build time, later that night. The primary chilled water pump operates anytime the chiller is running, as well as during the 'ice-burn' mode each day.

D. Baseline data were collected during the morning mode of operation, at around 10 AM. The capacitors were disconnected from both the pump and chiller at this time. After several minutes of data logging, the capacitors were connected and post retrofit data were collected. This process was repeated for both the chiller and the pump.

E. Calculations: The following standard formulas were used to determine the savings from this retrofit:

$$Demand\ Savings = kW_{base} - kW_{post}$$

$$Energy\ Savings = \left(\left[kW_{base} - kW_{post}\right]\ x\ hrs\ per\ year\right)$$

$$Cost\ Savings = \left(Demand\ Savings\ x\ Demand\ Rate\ x\ Months\right) + \left(Energy\ Savings\ x\ Energy\ Rate\right)$$

Assumptions:

1. Chiller operates 40 weeks, 5 days per week, 13 hrs per day, for a total of 2600 hrs per year. Pump operates 40 weeks, 5 days per week, 22 hrs per day, for a total of 4400 hrs per year.
2. Chiller and pump operate over a total of 10 monthly demand periods.
3. Average electrical rates are \$8.65/kW and \$0.0477/kWh.
4. Pump capacitors and installation costs = \$645
5. Chiller capacitors and installation costs = \$3,085

E. Results: The results of the power factor correction can be seen in the charts on the following pages. Actual savings for the retrofit were calculated as follows:

Pump:

$$Demand\ Savings = (12 - 8)\ kW = 4\ kW$$

$$Energy\ Savings = \left(\left[4\ kW\right]\ x\ \frac{4400\ hrs}{yr}\right) = 17{,}600\ kWh$$

$$Cost\ Savings = \left(4\ kW\ x\ \frac{\$8.65}{kW}\ x\ 10\right) + \left(17{,}600\ kWh\ x\ \frac{\$0.0477}{kWh}\right) = \$1{,}185$$

$$Simple\ Payback = \frac{\$645}{\$1{,}185} = 0.5\ yrs$$

Chiller:

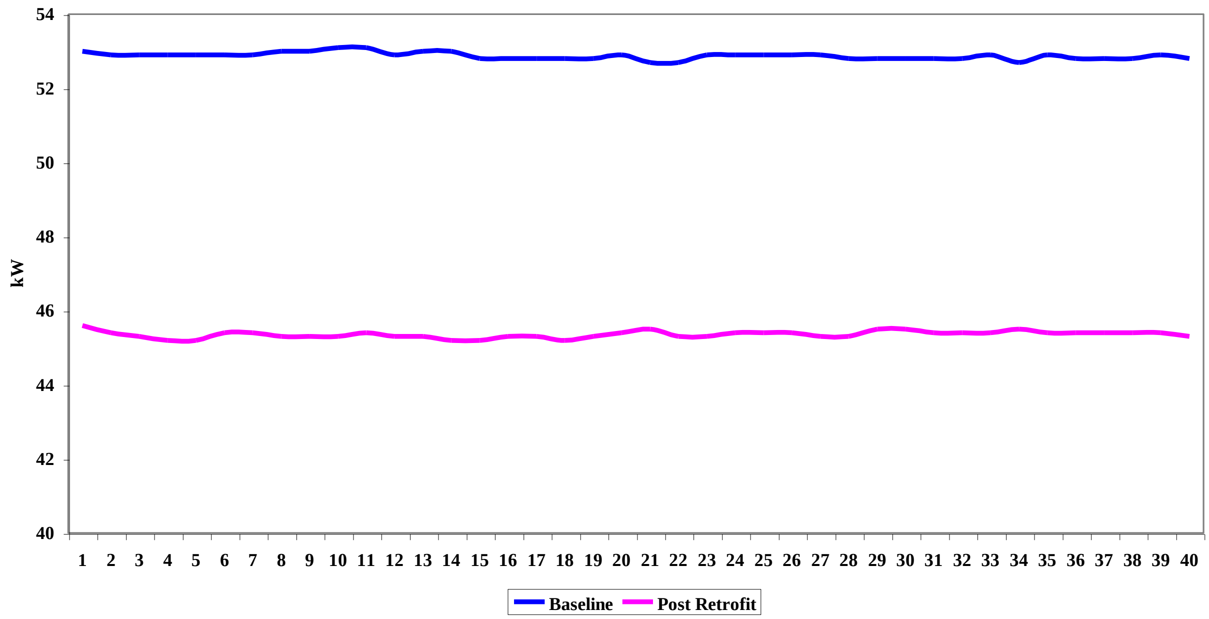
$$Demand\ Savings = (53 - 45)\ kW = 8\ kW$$

$$Energy\ Savings = \left(\left[8\ kW\right]\ x\ \frac{2600\ hrs}{yr}\right) = 20{,}800\ kWh$$

$$Cost\ Savings = \left(8\ kW\ x\ \frac{\$8.65}{kW}\ x\ 10\right) + \left(20{,}800\ kWh\ x\ \frac{\$0.0477}{kWh}\right) = \$1{,}684$$

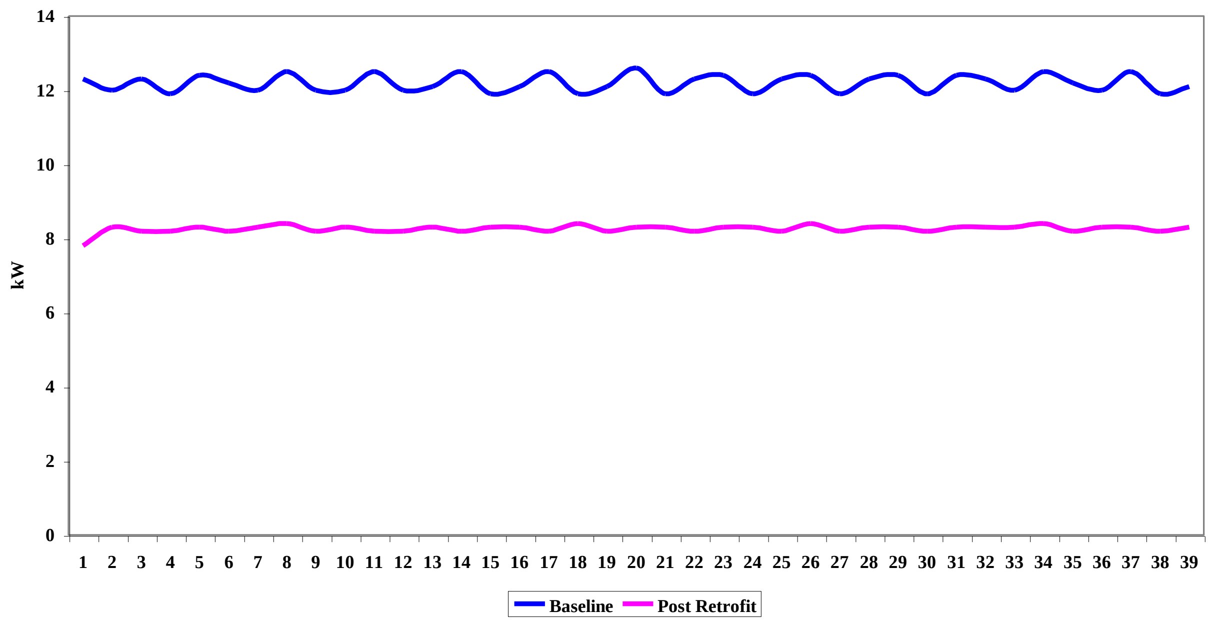
$$Simple\ Payback = \frac{\$3{,}085}{\$1{,}684} = 1.8\ yrs$$

Chiller Electrical Load History



<u>Note:</u> Chart above shows an average chiller power reduction of 8 kW, or 15% of baseline. Weather had some effect on power trending shown.

Pump Electric Load History



<u>Note:</u> Chart above shows an average pump power reduction of 4 kW, or 33% of baseline. Weather had no effect on power trending shown.