Department of Industrial Engineering

Field Monitoring of SmartCool™ ESM™

Final Report (Whole Year)

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Executive Summary

This is a field test of the SMARTCOOL™ Energy Savings Module™ (ESM™) in a commercial HVAC application conducted by the University of Miami for Florida Power & Light Company under FPL's Conservation R&D Program. The Smartcool is an electronic control system which collects temperature data versus time when the compressor is on or off in order to calculate the optimal run time for each compressor. Control modules connect to switches located between the thermostat and each compressor.

The goal of the research is to estimate demand reduction of a heating/ ventilation/and air-conditioning (HVAC) control technology from Smartcool Systems, Inc. during Florida Power & Light summer schedule peak hour (4:00 to 5:00 pm), and winter schedule peak hour (7:00 to 8:00 am) specifically during the months of August and January, respectively. Additionally, consumption and reduction of energy (kilowatt-hours) is also of primary importance.

To measure the impact of the SMARTCOOL™, the University of Miami, Department of Industrial Engineering team installed, 21 dedicated data loggers and current transformers (CT), 3 loggers at the service entrance and 3 loggers on each of the A/C roof top units, free-standing, building of a national chain drug store in Miami, Florida.

These loggers were installed to acquire the power consumption at the service entrance and for each of these six units for a full one year. The SMARTCOOL™ was switched ON/OFF every other week to minimize the effect of the weather variation.

This report explains the methodology followed by the University of Miami team, presents the main results obtained, and explains the analysis techniques followed to investigate the performance of the SMARTCOOL™ to determine whether or not the installation of the SMARTCOOL™ on the cooling units will result in a reduction in the power consumption and/or the peak demand. The data collected using the HOBOs were validated by comparing it to a number of the electric bills of that facility. The average absolute percentage difference between the logged kWh and the FPL reported kWh was 3.34% for the 5 billing cycles selected during the winter period, while the average absolute difference between the logged kW demand and the FPL reported kW demand was 2.32%, and for the summer period the average absolute percentage difference between the logged kWh and the FPL reported kWh was 3.34% for the 3 billing cycles selected, while the average absolute difference between the logged kW demand and the FPL reported kW demand was 2.32%.

After validation of the data collection process, the multiple regression technique was the statistical tool used to analyze the data obtained. The kWh consumption data of the cooling units corresponding to an outside temperature that was below the thermostat setting of 70˚F were excluded from the analysis.

Regression equations were developed to describe the relationship between the power consumption of the A/C units (kWh), peak demand recorded at the service entrance (kW) and both the outside temperature and the SMARTCOOL™ were developed.

A t-test was performed on both the indoor relative humidity (RH) and temperature for the summer months. The first hypothesis tested was whether the mean RH with the SMARTCOOL™ “ON” equals the mean RH when it’s “OFF”. The t-test showed that there was no statistical significant difference ($P < .001$) between the mean RH values when the SMARTCOOL™ was “ON” and when it was “OFF”.

The same conclusion was drawn when performing the t-test on the indoor temperature, there was no statistical evidence that turning the SMARTCOOL™ will significantly alter the indoor temperature ($P < .001$).

Based on the regression equation developed, it was concluded that the SMARTCOOL™ managed to reduce the kWh consumption by **8.9%** and to reduce the peak demand by **10.8 %** respectively. Using the test building characteristics and typical average weather for the FPL service territory, the annual energy savings is estimated to be 43,660 kWh with a demand reduction of 6.9 kW at 4-5 PM in August. The greatest energy savings occurred during the summer months (Fig.1). These savings were achieved with no report of change in comfort by the occupants of the test location.

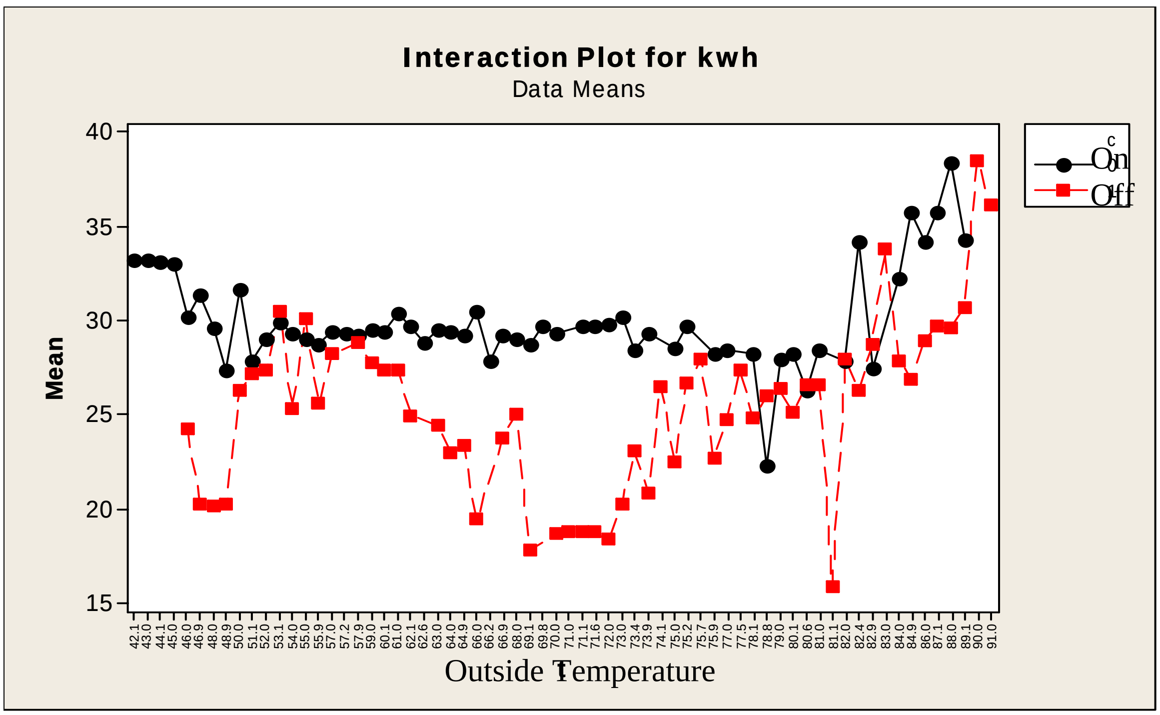

Figure 1. The interaction effect of both the SMARTCOOL™ and outside temperature on the kWh.