FLORIDA SOLAR ENERGY CENTER®

PROPRIETARY FINAL REPORT

Field Monitoring and Computer Modeling To Determine Energy and Demand Savings from the Melink Intellihood Exhaust and Make-up Air Control System at Two Supermarkets, One Restaurant, and One Fast Food Restaurant

FSEC-CR-1653-06

November 30, 2006

Submitted to:

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FPL PO# 4500292934; C# 4600002848
FSEC Project # 20128103

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Executive Summary

Melink Corporation Intelli-Hood® variable speed exhaust and make-up air fan control systems were installed on four buildings; Miami Publix, Merritt Island Publix, Olive Garden in Melbourne, and Wendy's in Pembroke Pines. Florida Power and Light requested that the Florida Solar Energy Center characterize the energy and demand savings that result from reduced fan power and reduced space conditioning energy use that result from using the Intelli-Hood® control system. This system modulates both exhaust and make-up air (MA) flow rates in response to measurements of "smoke" and temperature in the exhaust hood. The objective of the control system is to reduce exhaust and make-up airflow rates when full exhaust capacity is not required, and to thereby save energy. A combination of monitoring and computer modeling was employed to evaluate those savings.

Dataloggers were installed to monitor the operation of the Intelli-Hood® controlled exhaust and MA fans at these four buildings for a period of at least 11 weeks at each building. The variable drive control signal of the Intelli-Hood® controller was recorded every three minutes. The control signal varies from 0 volts when the fan is OFF up to 10 volts when the fan runs at maximum speed. One-time measurements were taken at each store to characterize the relationship between the Intelli-Hood® control signal (0 – 10 V) and the fan power and fan airflow rates. A database of exhaust and MA flow rates as well as power usage was created from the monitored control signal and the one-time flow and power measurements.

Modeling was used to compare energy use with and without Intelli-Hood® control. The models calculated energy use for the entire year and winter and summer peak demand on the coldest and warmest January and August TMY2 days, respectively. Inputs to the Intelli-Hood® model included the monitored fan operation schedules, monitored fan speeds with the associated power, and hourly TMY2 data. If fans were left on overnight during the Intelli-Hood monitoring, the overnight operation was also modeled. Modeling without the Intelli-Hood® control operated the fans at full speed during business hours, but assumed they were turned OFF at night. To obtain a weighted total for the entire FPL service territory, the modeled results for each building are weighted as follows: Miami (50%), Palm Beach (25%), Fort Meyers (15%), and Daytona Beach (10%). Since no Fort Meyers TMY2 data is available, Tampa weather data was used instead.

At three buildings, the MA was unconditioned and provided to the kitchen space in proximity to the exhaust hood. This is the typical design for exhaust and MA. The MA at Wendy's, however, was provided through a dedicated 100% outdoor air package unit. After being conditioned, the MA was delivered to the return of the main dining room AC unit. The Intelli-Hood® controller reduced the air flow rate of this MA unit as well as the exhaust fans in response to the cooking effluent. Because conditioned MA is fairly unusual, it was decided to model the Wendy's store with both conditioned MA (as found) and with the more traditional unconditioned MA (delivered in proximity to the exhaust hood). Total energy and peak (summer) reduction was found to be considerably less for

Wendy's with unconditioned MA. The energy and demand savings from both reduced fan power and reduced space-conditioning load are shown in Table ES-1.

Table ES-1. Annual whole-building energy and demand savings from Intelli-Hood® control of exhaust and make-up air in four Florida stores, weighted for the FPL service territory.

	Absolute Savings			Percent Savings of Whole Blg.		
Location	Total (MWh)	Winter Peak (kW)	Summer Peak (kW)	Total energy	Winter Peak	Summer Peak
Publix – Miami	13.1	6.3	3.0	0.8	3.6	1.2
Publix – MI	39.3	26.1	4.3	2.5	14.9	1.7
Olive Garden	33.0	1.4	3.6	10.3	5.7	4.1
Wendy's – OA	13.9	-0.7	3.5	5.3	-18.2	7.1
Wendy's – MA	4.9	-0.7	1.0	2.2	-18.2	2.4

Also of interest is the difference between the two Publix stores. The stores and the exhaust and MA flows are similar, but total energy and peak energy reduction was found to be considerably less at the Miami Publix. The reason for the large difference in savings is that the exhaust fans at the Miami store were left ON most nights, while those at the Merritt Island store were turned OFF at night. Since the modeling assumed fans off overnight without control and as monitored overnight operation with control, the Miami supermarket saw diminished savings. Wendy's winter peak negative savings is attributed to the Intelli-Hood® controlled system having been left on during some overnight periods.

Table ES-2 summarizes absolute and relative (percent) savings of weighted fan-only (not whole-building) energy and demand from Intellihood control of exhaust and make-up air in four Florida stores.

Table 17. Summary of weighted fan energy and demand savings from Intellihood control of exhaust and make-up air in four Florida stores.

	Absolute Savings			Percent Savings		
Location	Total (MWh)	Winter Peak (kW)	Summer Peak (kW)	Total energy	Winter Peak	Summer Peak
Publix – Miami	8.6	0.0	1.0	72	0	55
Publix – MI	12.4	1.8	1.7	88	79	74
Olive Garden	8.0	2.4	0.6	37	75	19
Wendy's – OA	4.2	-0.7	0.6	43	-18.2	40
Wendy's – MA	4.2	-0.7	0.6	43	-18.2	40

Other Considerations

Energy savings would be higher if the exhaust and make-up air fans were consistently turned OFF at the Miami Publix and Wendy's restaurants.

- At the Miami Publix store, the exhaust system was typically left ON overnight when controlled by the Intellihood system.
- This was also true, to a large extent, at the Wendy's store. Consequently, energy savings were somewhat less than might otherwise be expected.
- It may be true that the reduced fan noise resulting from the Intellihood control may cause the kitchen staff to fail to realize that the system is still operating at the end of the day. Therefore, training may be needed to provide essential knowledge of how staff should use the Melink air system effectively. One possibility would be to install an occupancy sensor in the food preparation area, so that the fan would be turned OFF if no one is in the kitchen for say 30 minutes.

Airflow balance is also an issue. At three of the four stores, make-up air was only in the range of 20-30% of the total exhaust airflow, much lower than the 80-90% range that is often considered good design. In the fourth store, Wendy's, the make-up air was actually greater than the exhaust air. This was in large part true because the outdoor air for the existing rooftop package AC units had been closed off. Therefore, in this store all of the outdoor ventilation air and all of the make-up air was entering through the one dedicated outdoor air (make-up) air unit. It may be useful for Melink to encourage the customer to increase the make-up air fraction to reduce building energy use and more readily achieve positive building pressure.