ORNL Testing Phase 1 - Refrigeration

Experimental Evaluation of Abbotly Technologies Compressor Optimization Control Product "ESM System 4000" Two Refrigeration Compressor Rack Systems at the ASDA / Wal-Mart Super Center in Sheffield, UK

- Prepared by: Van D. Baxter under User Agreement UR 04-419 between Abbotly Technologies, Inc. & UT-Battelle, LLC/Oak Ridge National Laboratory

Test Location:	**ASDA / Wal-Mart Super Center in Sheffield, UK**
Compressors Tested:	**Medium Temperature Pack 4, Low Temperature Pack 2** **Each Pack has 8-4 amp scroll compressors and a common suction manifold**
Controller:	**Hussmann Rack Controller**
Test Period:	**Data collected for a 21 day period beginning July 14, 2004.** **ESM On July 14 to July 25 and Off July 27 to Aug 4.**
Data Source:	**Emerson Retail Services and Abbotly kWh meter**
Nature of Test:	**Evaluation based on data archived on a web site by Emerson Electric for ASDA.**

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TEST RESULTS SUMMARY	ornl Oak Ridge National Laboratory	Abbotly
Run Time Reduction: Pack 2	11%	N/A
Run Time Reduction: Pack 4	19%	N/A
kWh Reduction: Total	N/A	72,528/yr
kWh Reduction %: Pack 2	5-6%(1)	15%
kWh Reduction %: Pack 4	6-8%(1)	20%
Cycle Rate Reduction %: Pack 2	38%	N/A
Cycle Rate Reduction %: Pack 4	31%	N/A
Case Temperature Impacts	None	None
COP Increase: Pack 2	11.7%	N/A
COP Increase: Pack 4	13%	N/A

Note (1) : Emerson collected amp data on compressors every 15 min therefore Oak Ridge indirectly estimated kWh reduction using COP calculations. Abbotly, under the supervision of ASDA management, measured actual kWh's using a Seltek Profile Data Logger (kWh meter).

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"**A laboratory test of the ESM** 4000 on an air-conditioning or refrigeration unit would enable relatively tight control of all operating variables (condensing temperature, average system load, etc.). This would allow the impact of the ESM unit to be isolated with a much higher degree of precision. **Such a test is highly recommended.**"

ORNL Testing Phase 2 – Air Conditioning

Experimental Evaluation of Abbotly Technologies Compressor Optimization Control Product "ESM System 4000" as applied to a 21-ton Roof Top Air Conditioner

- Prepared by: Van D. Baxter under User Agreement UR 04-419 between Abbotly Technologies, Inc. & UT-Battelle, LLC/Oak Ridge National Laboratory

Test Location:	**R&D facilities of Lennox Industries, Inc., located in Carrollton, Texas**
Compressors Tested:	**Lennox model LGA248H4B commercial roof top air-conditioner having four scroll compressors of equal size and a total rated capacity of 21 tons cooling (74 kW).**
Controller:	**Novar**
Test Period:	**3 day period April 21 to April 24 2005. ESM Off April 21 & On April 24.**
Data Source:	**Lennox Research Facility, Carrollton, Texas**
Nature of Test:	**Two enclosed chambers(1), one enclosing HVAC unit & one enclosing heaters to simulate load, (i.e. the only variable is whether the ESM was on or off).**

Note (1) : Chamber was approximately 20ft wide * 25 ft long * 10 ft tall ~ 5,000 ft^3

ORNL Testing Phase 2 – Air Conditioning

TEST RESULTS SUMMARY	ornl Oak Ridge National Laboratory
kWh Reduction % Total	7.9% (1)
kWh Reduction % High Load Period	12.1%(1)
Cycle Rate Reduction: Compressors 1 and 2	6%
Cycle Rate Reduction: Compressors 3 and 4	40%
Average Temperature: ESM ON	77.6°F
Average Temperature: ESM OFF	76.8°F
COP Increase: Total Period	6.6%
COP Increase: High Load Period	10%
Peak Demand Reduction: High Load Period	2.2%

Note (1) : This is the kWh reduction on the total HVAC capacity of which the compressors represent approximately 66.5%. Therefore, the reduction of compressor kWh usage is closer to 11.87% for total test period and 18.1% for high load test period. Also, during the ESM On high load period the current to the heaters was turned off for several 2 to 3 minute periods by an improperly set thermostat. Oak Ridge estimates that the maximum load reduction impact would be 6% assuming instantaneous cooling of the heaters with loss of current.

ORNL Testing Phase 2 – Air Conditioning

"In summary, for portions of the Test Program where the cooling load was a large Percentage of the test roof top unit's capacity, the ESM 4000 significantly reduced electricity consumption and provided much more uniform utilization (less severe cycling rates) of the test A/C's four compressors. **A reasonable next step would be to conduct a field evaluation of the ESM 4000 in an actual building application.** One way to conduct such a test would be to install the ESM 4000 on the A/C's of a building and run for several weeks with the ESMs "on" one week and "off" the next while monitoring AC energy use along with indoor and outdoor air temperature and humidity conditions"