IceCOLD® Performance Test Results

Prepared for: **Siemens Industry, Inc.**

Prepared by: **Greg Christian - President, Huddle LLC**

January 30th, 2010

Document Number: SI 002

Huddle LLC 410 E Highland, Southlake, TX 76092 T 817-903-3939 F 866-258-0766 gchristian@geticecold.colm

Executive Summary:

A performance test was conducted on a 12 ton dual compressor Carrier RTU - [Model Number 48TMD014-A-601] with Serial Number [1507G30911] to validate the performance claims made by **IceCOLD®** technology. The performance test resulted in a 18.4% reduction in Amp*Hrs when comparing the post and pre installation performance periods. **This translates to a direct electricity savings of 18.4%.** This result is consistent with **IceCOLD**'s average savings rate of 23% - as you will see, given the external heat load conditions encountered during the test, this is an exemplary result.

Several additional strategic considerations apply:

I. The catalysts within **IceCOLD** that delivered these results are "dynamic" in nature - in other words, the benefits gained initially by the introduction of **IceCOLD** into the system **are realized for the duration of the system's performance lifetime.** As such, there is no need to retreat units with the technology. In addition, since the investment payback is approximately 12 months, this results in an annualized ROI of +/- 100% for each subsequent year of performance life;

II. The "essence" of **IceCOLD**'s energy reduction lies in enabling systems to run 20% [on average] less while delivering a superior pre-installation performance result. As such, the MTBM [mean time between maintenance] and eventual system replacement costs are deferred by 20% - these soft savings, derived from extended performance life, are not included in the financial considerations contained within this proposal.

Objective:

As previously stated, the study's objective was to substantiate the performance claims made by **IceCOLD**. During cooler weather we look for units with a relatively stable operating environment. The performance test unit selected was based on the following criterion:

- the area serviced included the break room which has a consistent and substantial internal heat load year round;
- the unit was located centrally within the facility as was relatively insulated from external heat load fluctuations;
- as such, we concluded that the outside conditions exerted minimal effect on the room environment for cold air delivery. This, in turn, insured a consistent operating profile necessary for a verifiable test result.

Methodology:

The carrier unit selected was found to be in good working order and operating within the manufacturer's performance guidelines. The performance test was designed and administered by Todd Theisen, Huddle LLC's chief technical officer. The system was inspected by licensed HVAC technician Robert Latchaw. Latchaw also performed the **IceCOLD** installation.

Relevant protocol milestones include:

✦ an Onset Computer Corp HOBO data logger was attached to the system - system runtime data was captured in 90 second increments. Over 17,00 data points were captured during the analysis.

✦ the primary measurement captured was the system's compressor amperage draw. The basic governing equations* are:

amps x volts = power
power x time = billed energy (KwH)

**** energy calculations were accomplished by measuring only the times that the system was running. These events were then multiplied by the sampling rate of 90 seconds to determine the total system runtime. With the sum of Amps multiplied by the total run time we arrive at a single phrase [Amp *Hrs] scale which correlates directly to KwH's.***

Performance Test Schedule

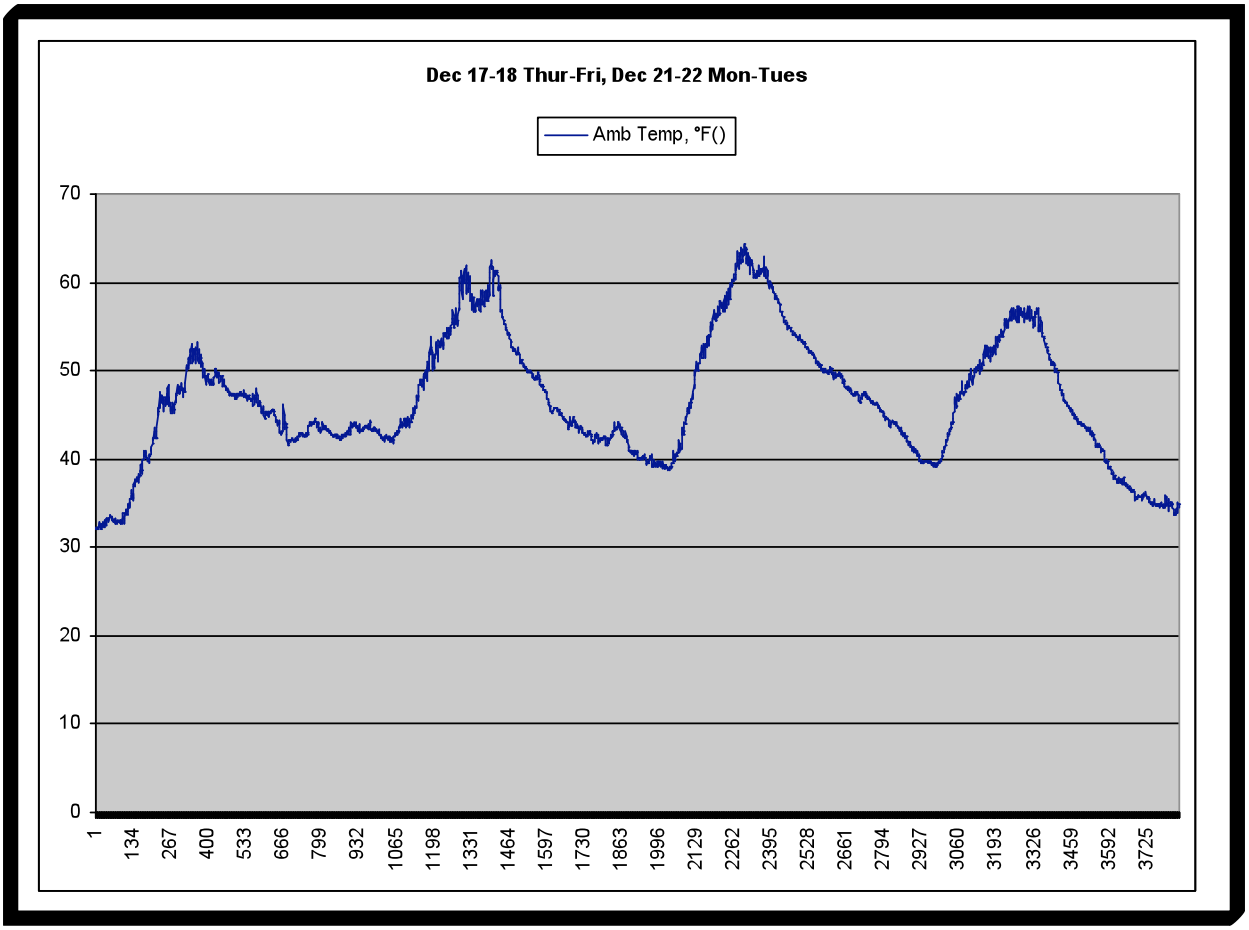
								1-Jan	|	
		Valid Days to compare						2-Jan	|	
		Partial Data						3-Jan	|	
		Weekend/non-standard work day						4-Jan	|	
		Holiday						5-Jan	Solution Time	
		IceCOLD Solution Time						6-Jan	- VERY COLD WEATHER!!!	
								7-Jan	|	
								8-Jan	|	
								9-Jan	|	
								10-Jan	---	
	Partial	16-Dec	W					11-Jan	M	Partial
		17-Dec	TH					12-Jan	T	
		18-Dec	F					13-Jan	W	
		19-Dec	S					14-Jan	TH	
		20-Dec	S					15-Jan	F	
		21-Dec	M					16-Jan	S	
		22-Dec	T					17-Jan	S	
		23-Dec	W					18-Jan	M	MLK - Holiday
	XMAS - Holiday	24-Dec	TH					19-Jan	T	Partial
		25-Dec	F							
		26-Dec	S							
		27-Dec	S							
	Partial	28-Dec	M	<- Installed IceCOLD						
		29-Dec	---							
	Solution Time	30-Dec	|							
		31-Dec	|							

Ambient Temperature Analysis:

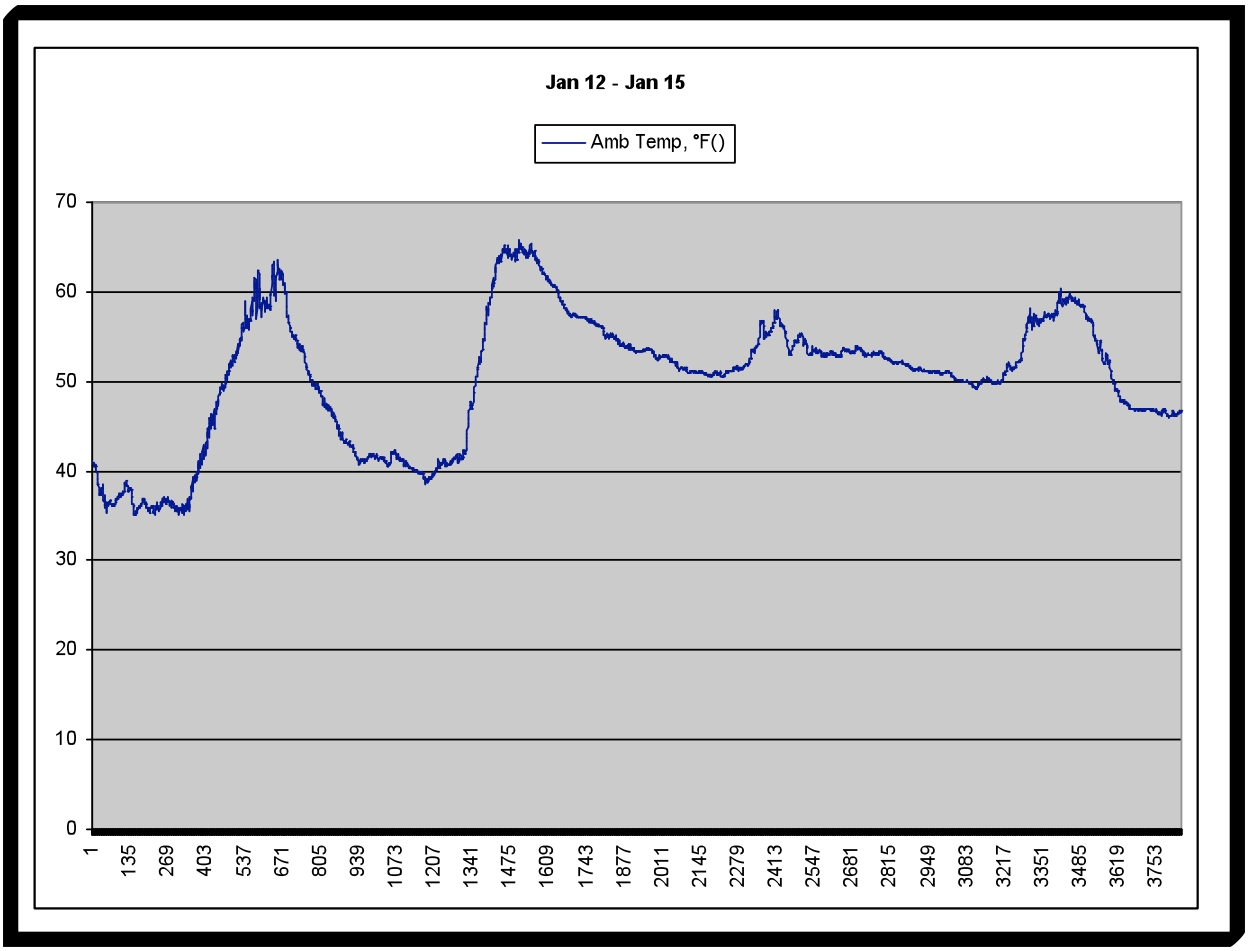
The following graphs and calculations confirm a **nearly identical operating environment** during the pre and post installation periods. Specifically, we measured the **ambient temperature** at a point near the unit but not exposed to any direct sunlight or other sources of heat generation. We also measured the incoming air temperature of the condensing unit.

SIEMENS

Pre-Installation Ambient Temperature Analysis



Post-Installation Ambient Temperature Analysis



Numerically, the period averages were calculated using two methods. The first method calculated the area under the temperature curve. The results:

Ambient Temperature Sum				
Pre	205417.7			
Post	193821.3			
difference	-11596.4	-5.6%		

The second method calculated the average temperature of the incoming condensing air only when the system was running...

Period Average, °F()				
Pre	54.62			
Post	51.57			
dT	-3.05			

System Performance Improvements:

The following system measurements were utilized to identify changes in overall performance and to calculate the savings result of 18.4%. Specifically, we looked at the following performance characteristics:

- condenser air temperature
- compressor output temperature
- system run time
- cumulative Amp*Hrs calculation

With temperature measurements, we look for **a rise in heat levels** where we can see evidence of **improved heat transfer** due to **IceCOLD**.

Condenser Air Temperature:

Condenser Air Temps Average, °F()				
	Supply	**Exhaust**	**dT**	
Pre	54.62	77.90	23.28	
Post	51.57	76.01	24.45	
d-dT	--------	-------->	1.17	

Compressor Output Temperature:

Compressor Average, °F()				
Output	C1	C2		
Pre	135.84	141.20		
Post	139.09	144.64		
dT	3.25	3.44		
Input				
Pre	41.03	x		
Post	50.59	x		
dT	9.56			

Run Time:

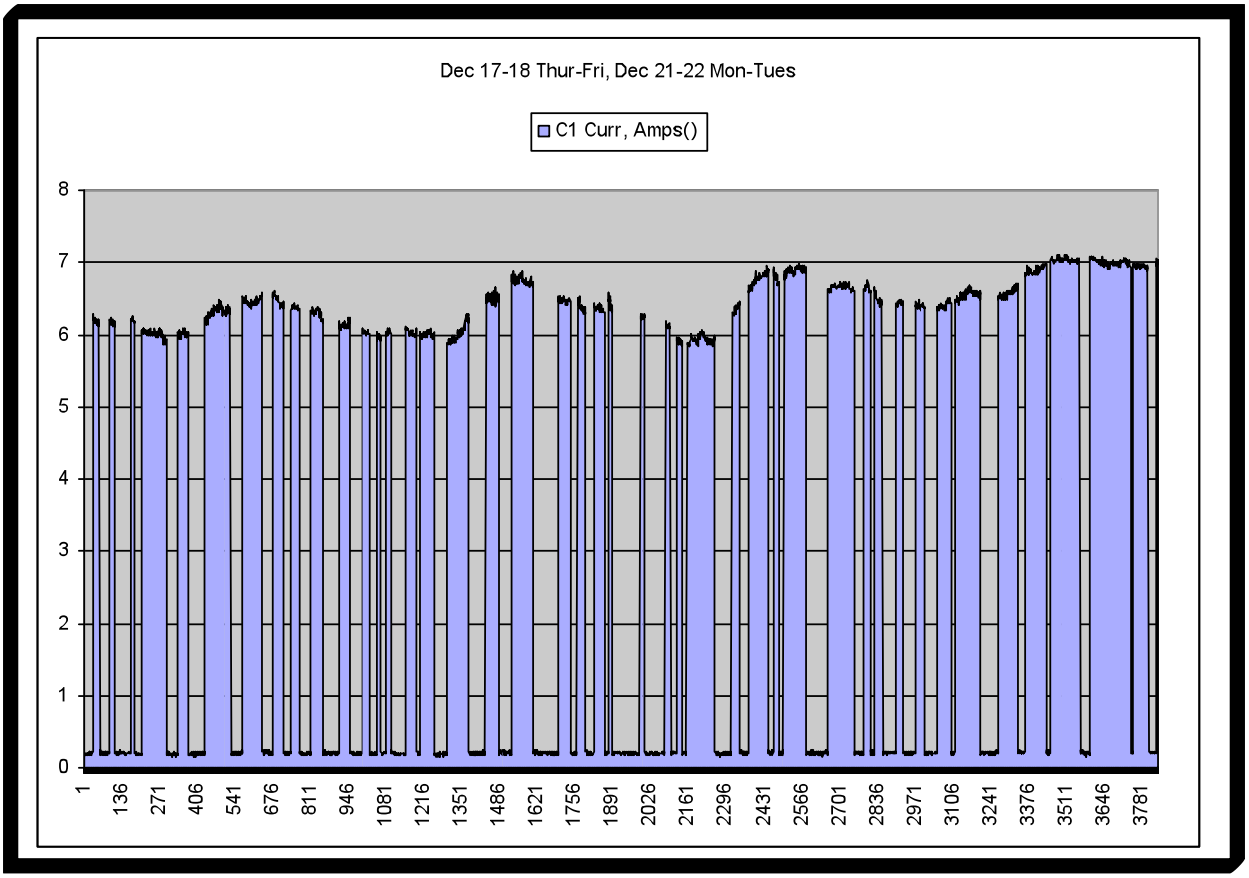
The test unit is configured with two compressors - the run time from both units must be summed to deliver a total system expenditure result. In this case, given the low ambient temperatures, we did not expect to see much reaction from the second compressor. The primary compressor is labels C1 and the secondary compressor is labeled C2. The pre and post period system run times are summarized below:

Run Time				
Pre	2161			
Post	1877			
dT	-284	-13.14%		

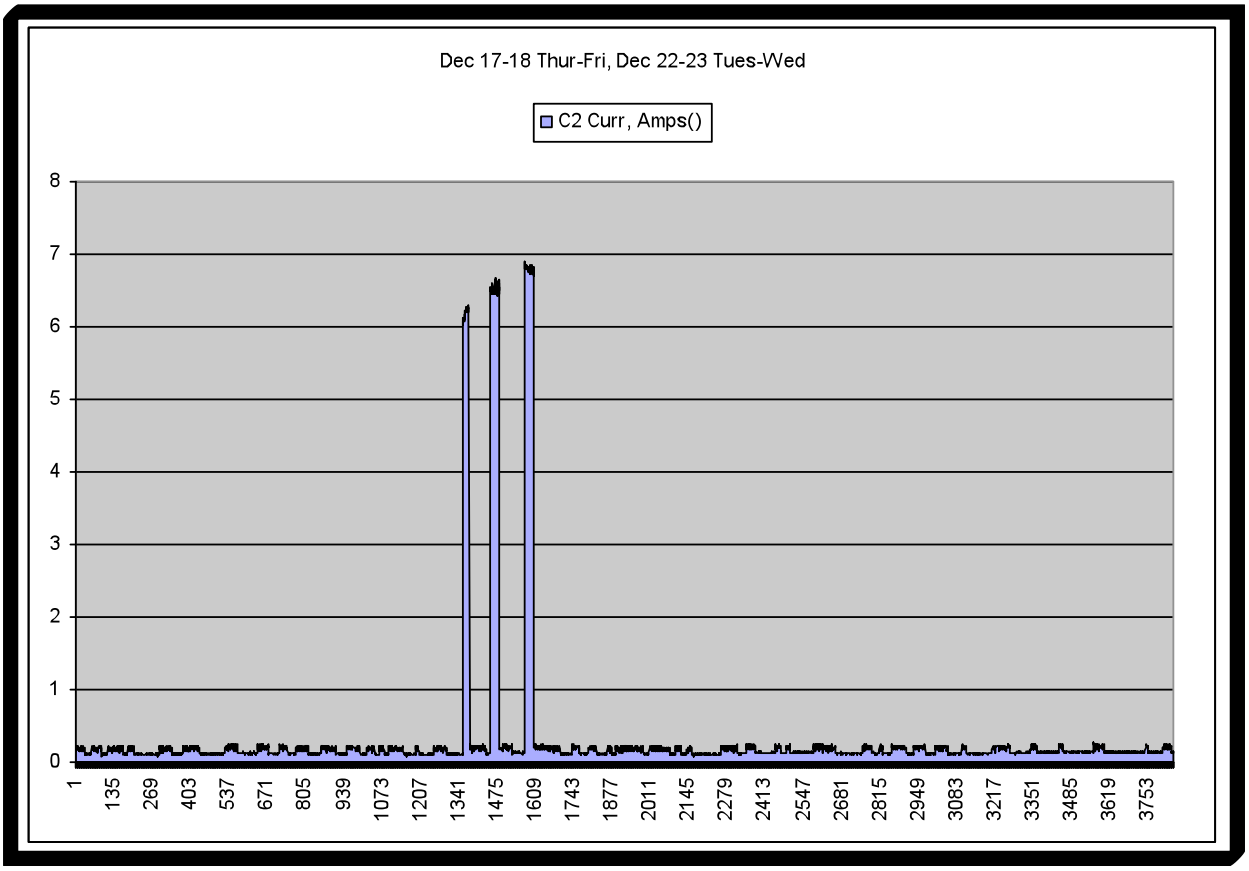
Amp*Hrs Calculation:

Amp*Hrs are measured with a current transformer measuring one leg of the compressor. The sum of the total current measured when the system was running is multiplied by the time interval [90 seconds] to determine the Amp*Hrs result. Amp*Hr is related to KwH by voltage and power factors which are assumed to be constants over the test period and therefore cancel each other out for purposes of calculation. The following graphs depict the energy expenditure by compressor over the entire test period:

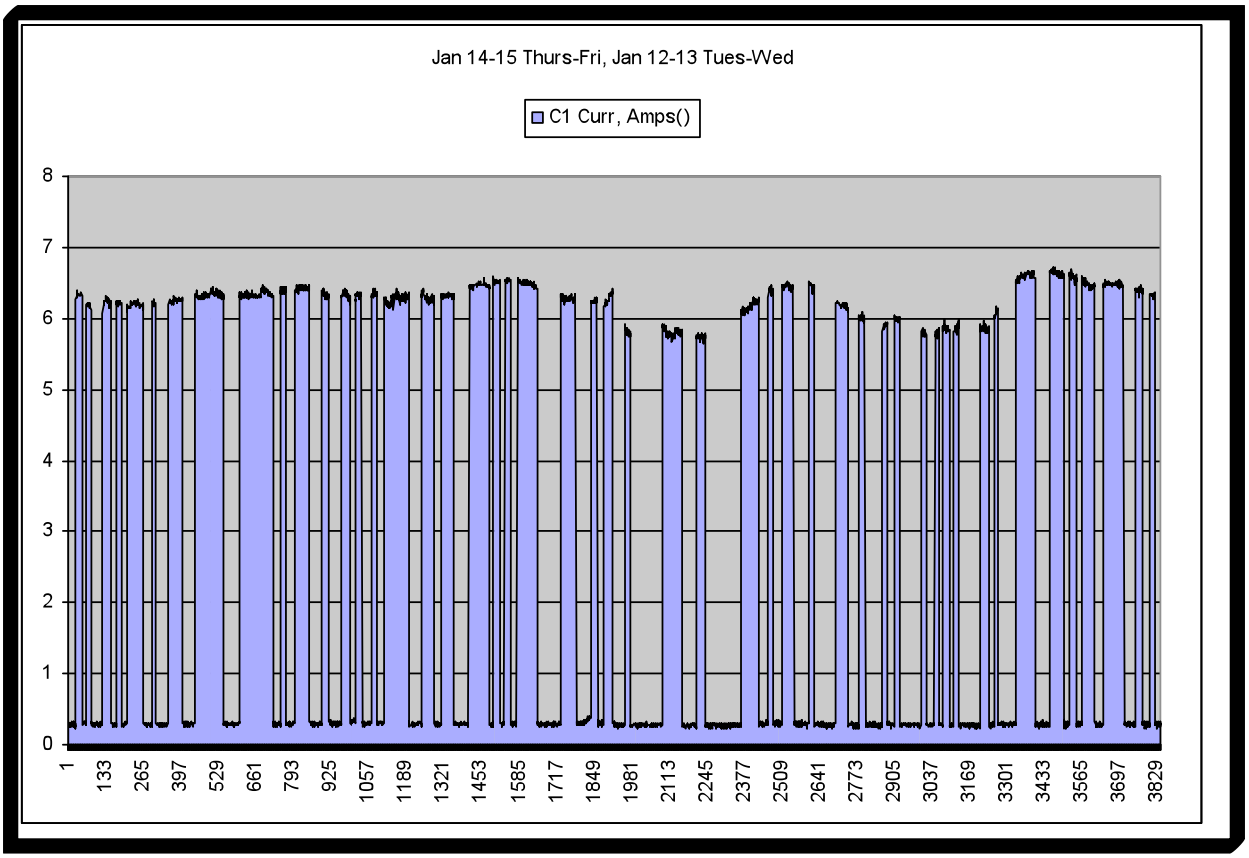
C1 (Primary) Compressor Pre-Installation Runtime



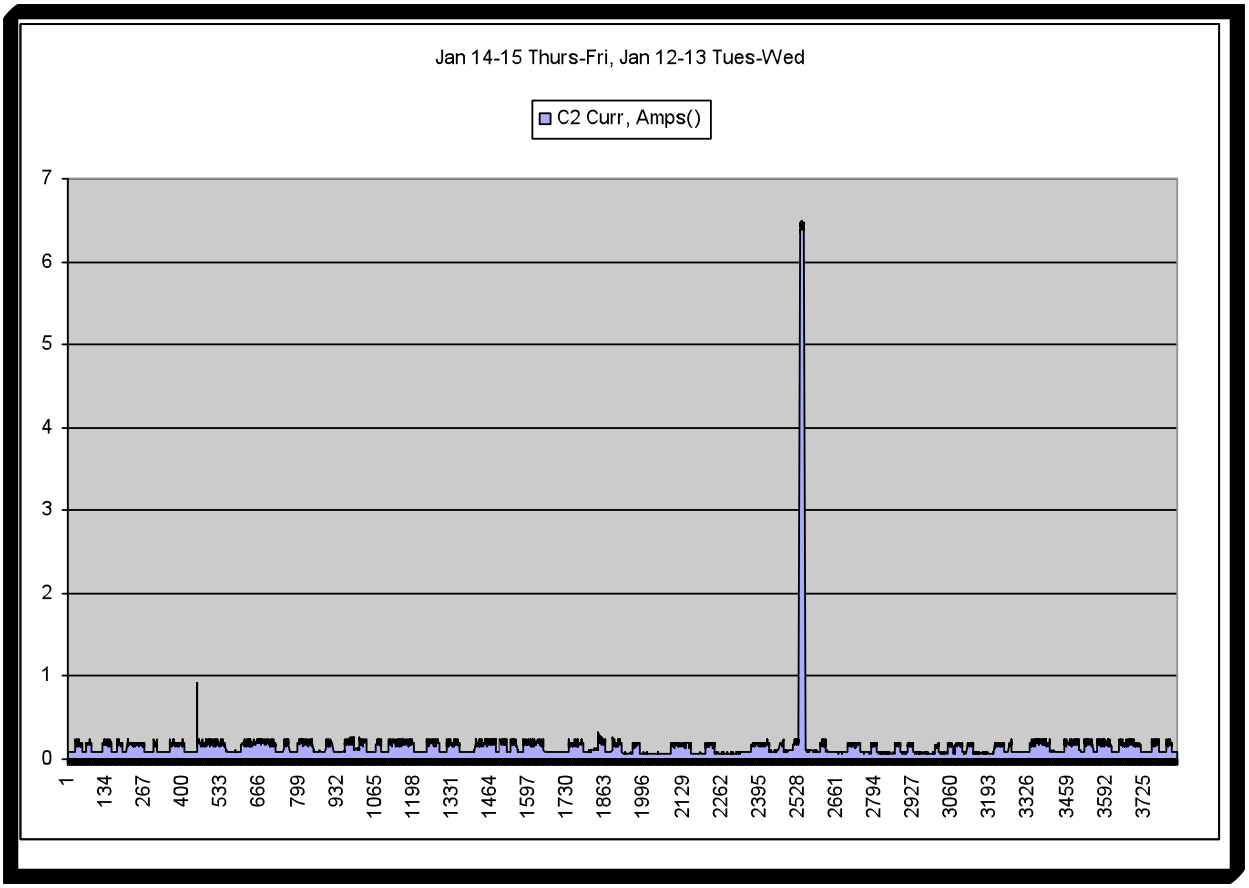
C2 (Secondary) Compressor Pre-Installation Runtime



C1 (Primary) Compressor Post-Installation Runtime



C2 (Secondary) Compressor Post-Installation Runtime



Summary of Key Measurement Results & Observations:

With ambient temperatures relatively equal during the Pre and Post installation periods, we see a **reduced system energy expenditure of 18.4%.** Additionally, the temperature results noted earlier in this analysis lend additional credence to our conclusion that **IceCOLD** resulted in significant improvement to the system's heat transfer capability.

Financial Considerations:

The installation of **IceCOLD** can have a significant impact on Siemens Industry's bottom line profitability. Let's look at several financial drivers:

- assuming a .08 / KwH rate, a customary planning number for A/C related expenditures is $40.00 per ton per month;
- assuming 640 tons of A/C capacity at the Grand Prairie facility, this would equate to a $25,600 per month average expenditure;
- an **18.4% savings** would represent **$4710.40 per month** or **$56,524.80 on an annual basis**;
- the **IceCOLD** investment is only **$90.00 per treated ton of capacity** - in this case a $57,600 one-time expenditure;
- **this represents a payback of 12.22 months** [$57,600 / $4710.40] - it is important to note that **IceCOLD**'s performance is optimized in warm weather conditions where the heat transfer demand is the greatest - ***the reported savings of 18.4% in 50ºF weather is worst case***;

Installation Considerations:

IceCOLD can be installed in minutes directly into the low pressure service port of Siemen's package units - the technology is installed exactly like compressor oil - no additional system hardware or complicated procedures are required:

- to validate our 12 month warranty, a licensed HVAC tech is required to do the installation;

- Huddle LLC has nationwide installation capability - a conservative **per unit installation estimate** for the Grand Prairie location is $150.00;

Conclusion:

We at Huddle sincerely appreciate the opportunity to have conducted a performance test for Siemens Industry. Our test protocol has been designed to eliminate as much subjectivity from the evaluation as possible and to measure conclusively the one metric that everyone is ultimately interested in - electricity savings... Our goal throughout this exercise has been to provide a statistically verifiable model when any improved system performance speaks for itself... Thanks again for your interest and we look forward to discussion of next steps....