Motor Dynamics, Ltd.
WWW.MDLII.COM

Efficiency Evaluation

Re: Empath efficiency testing of facility to focus on Lighting, Air Conditioning and Power Quality!
The cost for dynamic testing of your facility will require at least two days @ $1500 per day.

SCOPE OF WORK

Monitoring of building:

1) Shark revenue grade sub metering, (can identify large consumers and inefficiencies)
2) Nexus Power Quality metering, (if power quality events are captured with the Empath, then a Nexus Power Quality meter may be recommended)
3) Air flow monitoring, (will check existing air handlers for air flow and efficiency)
4) Sub metering of water, (is possible if this is an area of concern)

Empath efficiency testing

1) Periodic testing of major motor loads for integrity and efficiency
2) Empath test to determine where energy is loss and the exact amount of energy loss. Instead of infra-red showing you hot spots which confirms energy loss, but does not tell you how much is loss. Empath gives you both; the hot spot and energy loss in real dollars
3) Chiller testing to monitor efficiency; periodic Empath checks along with refrigerant testing to determine amount of oil entrained in refrigerant.
4) Periodic testing of all air handlers to assure maximum efficiency and proper air flow.

Empath 2000 provides a unique method of measuring the efficiency of electric motors, transformers and whole buildings. The three phase testing done dynamically provides voltage and current imbalance values, (see page included from an Empath test). These values represent actual power consumption usage. For example, when a thermal scan, (infra-red imagining) is performed you will see a colored picture of hot spots around connections which indicate loss. The Empath 2000 measures the exact voltage and current of each connection. With this data you can determine the exact value for the loss and provide an efficiency rating of the load based on these same values. I have also attached a spreadsheet showing motors with hot spots, (voltage and current imbalance) and the effect this has on motor efficiency as well as motor life.

Running Speed = 29.733 Hz / 1784 Rpm

Pole pass frequency = 0.940 Hz

Load = 94.1 %

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Time			
	RMS	Peak	CF
Current 1	72.564	129.950	1.791
Current 2	74.784	139.460	1.865
Current 3	59.102	105.600	1.787
Average	68.816	125.000	1.814
% dev	14.1	15.5	2.8

THDF = **78.0**

Time			
	RMS	Peak	CF
Voltage 1	486.510	709.850	1.459
Voltage 2	480.130	698.690	1.455
Voltage 3	480.000	693.020	1.444
Average	482.210	700.520	1.453
% dev	0.9	1.3	0.6

VDF = **99.2**

			App. Power	Real Power	Reac. Power
	Power factor	Impedance	kVA	kW	kVARS
Phase 1	0.979	6.705	20.354	19.931	4.130
Phase 2	0.999	6.420	20.820	20.801	0.879
Phase 3	0.996	8.122	16.331	16.269	1.423
Avg/Total	0.992	7.082	57.505	57.001	6.432
% dev	1.2	14.7			

Demand Pwr = **76.41 HP [Load:94.1 %, Motor Eff.:92.4 %, Output Pow.:52.7 KW, Imp.Unb.Eff.Reduc.:38.37 %, Output Trq.:207.8 Ft.Lb]**

Summary of Rotor Bar Health				Power line dB diff.		Rotor bar Health index
	Se, fund	Se, harm	Level %	Upper SB	Lower SB	
Measured	0.940	1	-	-62.7	-100.0	0.0146
Severity level	Rotor Condition Assessment			Recommended Corrective Action		
1	Excellent			None		

Harmonic Distortion Results:

Voltage input, from 59.971 Hz harmonics

	THD Odd %	THD Even %	+ve%	-ve %	Zero %	THD All %
Current 1	37.566	0.584	16.705	28.723	17.534	37.570
Current 2	35.529	0.657	11.662	28.292	18.064	35.535
Current 3	43.652	0.684	18.142	37.520	13.002	43.657
Voltage 1	1.793	0.055	1.376	1.100	0.336	1.793
Voltage 2	1.457	0.103	0.919	0.988	0.560	1.461
Voltage 3	1.672	0.059	1.118	1.221	0.240	1.673

The values highlighted in red indicate an imbalance which creates hot spots and energy loss. You will see the efficiency of the motor and the loss of efficiency because of the current imbalance. Once corrected the efficiency of the motor improves and the imbalance, (hot spot) is removed! Also, look at the attached spreadsheet showing the actual dollar value for this imbalance.