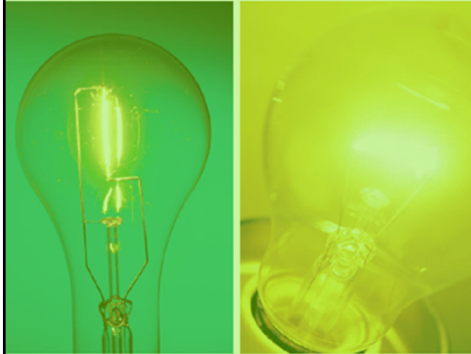


ELECTRICAL UTILITY COST REDUCTION THROUGH PREDICTIVE CONTROL

December 2008



Project Manager: Chris Hayes
Advisor: Paul I-Hai Lin


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BACKGROUND

- Kraft Foods – 35% Reduction of Energy Costs Over The Next 5 Yrs. (2005 Benchmark)
- Kraft Foods Financial Model (Utility Standard) Explained
 - Compressed Air Project (Estimated \$54,000 Annual Savings)
 - T-8 Lighting Project (Estimated \$76,000 Annual Savings)
- Indiana Michigan Power and The Industrial Tariff 322 Charges
 - On-Peak / Off-Peak Demand Charges
 - Energy Charge and Power Factor Correction
 - Fuel Adjustment Charge / Tariff Service Charge
 - Net Savings Merger Rider


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2007 ELECTRICAL CHARGES

	METERED	DEMAND	PF	DEMAND	ENERGY	FUEL	MONTHLY	MERGER	BILL
2007	KWH	KVA	CONSTANT	CHARGE	CHARGE	ADJUSTMENT	TARIFF	SAVINGS	ACTUAL
JAN	1435200	3056.64	0.9541	\$48,934.99	\$15,158.42	\$2,767.40	\$462.70	\$692.88	\$66,630.63
FEB	1780800	3432.00	0.9510	\$55,085.90	\$18,747.50	\$3,422.65	\$462.70	\$872.17	\$76,846.58
MAR	1944000	4126.08	0.9531	\$66,090.27	\$20,510.78	\$3,744.56	\$462.70	\$954.21	\$89,854.10
APR	1641600	4101.12	0.9537	\$65,657.78	\$17,331.13	\$3,164.07	\$462.70	\$806.28	\$85,809.40
MAY	1908000	4104.96	0.9566	\$65,737.87	\$20,204.89	\$3,688.72	\$462.70	\$923.55	\$89,170.63
JUN	1999200	4510.08	0.9604	\$68,156.59	\$21,254.75	\$3,880.38	\$462.70	\$971.54	\$92,782.88
JUL	2270400	4254.72	0.9671	\$72,241.18	\$24,306.44	\$9,560.10	\$462.70	\$1,111.03	\$105,459.39
AUG	2647200	4715.52	0.9701	\$75,508.85	\$28,428.30	\$11,181.29	\$462.70	\$1,353.36	\$114,227.78
SEP	2234400	4383.36	0.9710	\$72,161.09	\$24,017.49	\$9,446.45	\$462.70	\$1,143.38	\$104,944.35
OCT	2299200	4536.96	0.9697	N/A	N/A	\$8,663.97	\$462.70	\$1,174.96	\$105,290.30
NOV	2088000	4128.00	0.9681	N/A	N/A	\$7,855.13	\$462.70	\$1,065.27	\$95,719.65

- Peak Power Charges Contribute to approximately 70% of The Total Bill
- Fuel Costs Have Risen Nearly 100% Since Last Year (From \$0.0020210 Per KWH to \$0.0038860 Per KWH)
- I & M Power is in The Process of Negotiating a 9 to 12% Rate Increase Through The Indiana Utility Commission.³



RECOMMENDATIONS

- Solution Broken Down Into two Stages
 - **Stage 1**
 - o Monitor the Energy Usage and Peak Power on Each of The Three Main Substation Switchgear,
 - o Analyze the Data
 - o Determine The Source of The Highest Peaks (Guilty Party).
 - **Stage 2**
 - o Using Stage 1 Data, Install Addition Metering Equipment on Those Identified Devices In Order To verify and Control The Peak Values.
 - o Analyze the Peak Trending Pattern
 - o Develop A Hypothesis To Limit Peak Power Exposure.
 - o Test and Verify Results

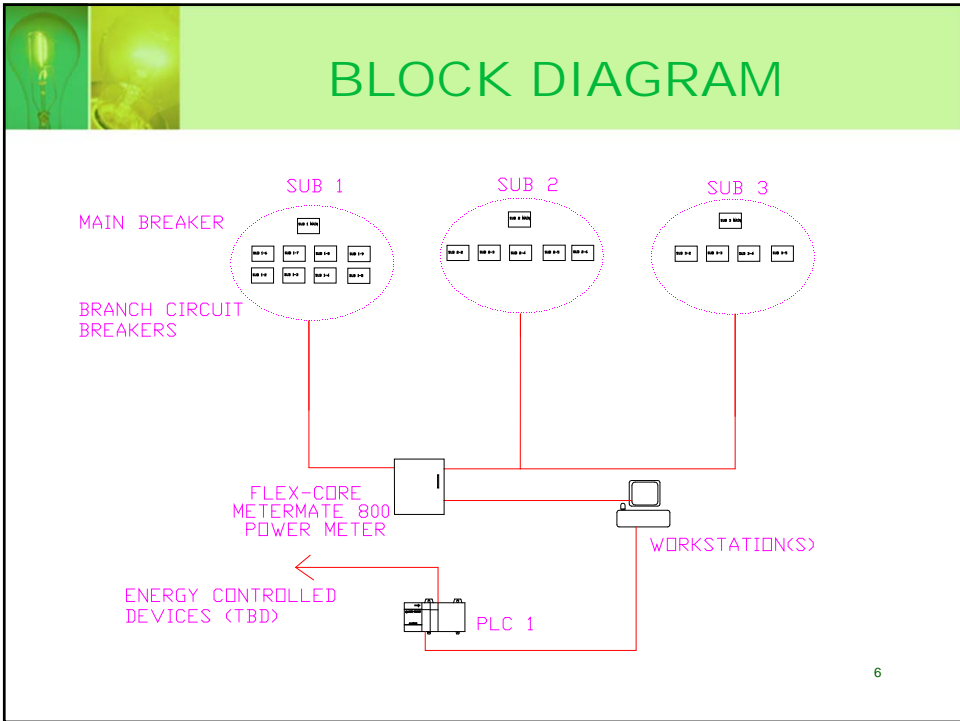
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RECOMMENDATIONS STAGE 1

- **The Use of Idled Existing Equipment**
 - Split Core Current Transformers Current Transformers, 3000/5 current Ratio, 1% Accuracy, Installed 1 Per Phase.
 - Watt/VAR Transducer, 0-5A Current Input, Watt & VAR 0-1mA Output.
 - Signal Converter, Relay Output, 0-1mA Input, 0 to 10,000 Proportional Closure Rate.
 - Metermate 800 Power Monitor, 120VAC, 8 Meter Inputs Derived From Isolated Pulse Contacts, Max Operating Rate of 10 Pulses Per Second Per Input, Asynchronous Serial Transmission RS232C Compatible 300, 1200, 2400, 4800, 9600 Baud
- **Data Analysis**
 - Statistical Process Control
 - Historical Trends
 - MES/OEE Line Usage Historical Data
- **Guilty Party Identification**

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RECOMENDATIONS STAGE 2

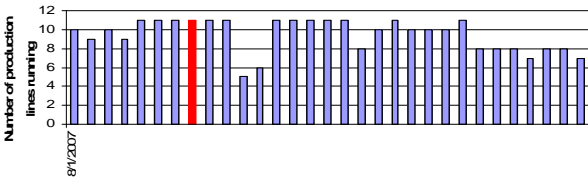
- Install Additional Equipment on Assumed Guilty Party Devices
 - Utilize Upgraded Technology Into Design
 - Veris H8035, H8036 power Meters
 - Single Package Industrial Grade CTs / Power Metering Electronics
 - Split Core Installation
 - RS – 485 Communications (Modbus)
 - Tie in PLC Processor (SLC 500)
 - Programming Concerns
 - If-Then Structured programming,
 - Inputted information Received Form Metering Equipment
 - Compared to Information Gathered From Historical MES/OEE Line Utilization and Peak Electrical Data.
 - Hardware Concerns
 - Identify Method of Tying In (Modbus to Ethernet Conversion)

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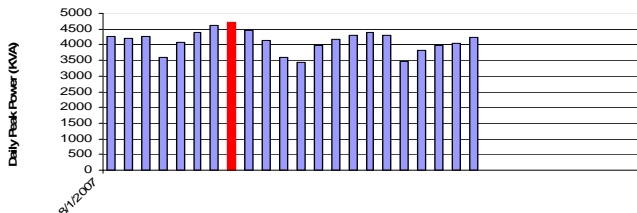
CORRELATION BETWEEN PRODUCTION LINE UTILIZATION AND PEAK KVA POWER

Lines Running - Aug 2007



2007

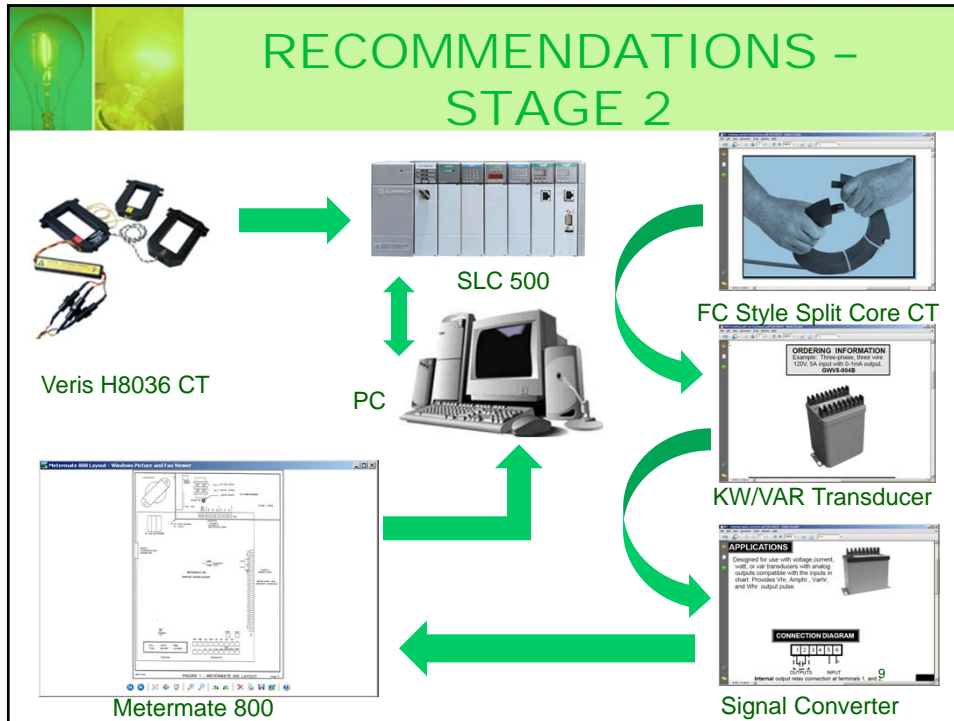
Daily Max KVA Values - August 2007





2007

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- ## DECISION RATIONAL
- **Milestone Schedule Project Completion Dec. 12th, 2008**
 - AR Approval
 - Stage 1 Equipment Procurement
 - Stage 2 Equipment Installation
 - Metermate “Live” Date – Time Allotted For Metermate Programming
 - Data Analysis
 - Stage 2 Equipment Procurement
 - Stage 2 Equipment Installation
 - Programming Complete
 - Preliminary Testing – Top/Down Structure
 - Control Revisions Complete
 - Final Testing
 - Project Completion
 - **Expenses Needed – Anticipated Cost < \$5M**
 - Veris Current Transformers (Quantity TBD)
 - SLC I/O Modules, as Needed
 - Wiring (Belden, 14AWG THNN Control)






ISSUES/RISKS

- (1) I & M Rate Increase
- (2) Tight Control Of Expenses
- (3) Power Outages

SEVERITY OF CONSEQUENCES	IMPOSSIBLE	IMPROBABLE	REMOTE	OCCASIONAL	PROBABLE	FREQUENT
CATASTROPHIC						
CRITICAL				3	1	
MARGINAL		2				
NEGLIGABLE						

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ALTERNATIVE PROJECT BENEFITS

- Power Coordination
 - Comparing Buss Bar Load Values to That of Annual Thermo graphic Study
 - NFPA 70E – Arc Flash Compliance
 - OP Sizing Requirements
- Continuous Improvement Opportunities
 - Monitoring All Utilities (Natural Gas, Waste Water)
 - CTs at the MCC Line-Starter Level – Predictive Maintenance

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