



Consulting Report Electrical Service Monitoring Silicon Services Somewhere Valley, CA 94804

Introduction

PowerCET Corporation was contracted by Kevin Robinson of EDMCI to conduct a 7-day study of the electrical service associated with the Silicon Services facility in Somewhere Valley, California. The purpose of the study is to document the existing energy usage prior to expanding the production capability of the facility.

Methodology

A Dranetz-BMI PP4300 equipped with a Multi-DAQ TASKCard was installed at the main switchgear inside the facility for a 7-day period beginning Monday, November 28th and ending Monday, December 5th, 2005. The monitor was programmed to accumulate energy data every 15-minutes which includes the minimum, maximum and average values for voltage and current during the interval. All other parameters are calculated based on these recorded measurements. In addition the PP4300 was set to capture timed event waveforms, which provide a capability of post processing a detailed harmonic study if necessary.

The minimum and maximum values listed in this report reflect the single cycle min/max value during the 15-minute-demand interval. The average (and median) value is the average accumulated over the 15-minute demand interval.

Key Findings / Recommendations

1. Electrical Service Loading

The following summarizes the specific rated capacity for the existing electrical service:

- 2000 Ampere per phase
- 480/277Vac 3-phase 4-wire
- 554 kVA per phase (443.2 kVA at 80% of rating)
- 1662 kVA total (1329.6 kVA total at 80% of rating)

The monitoring indicates that the service is loaded to approximately 50% of its rated capacity and 62% of the maximum allowable continuous load. Chart 1 provides a visual representation of the present loading and service capacity.

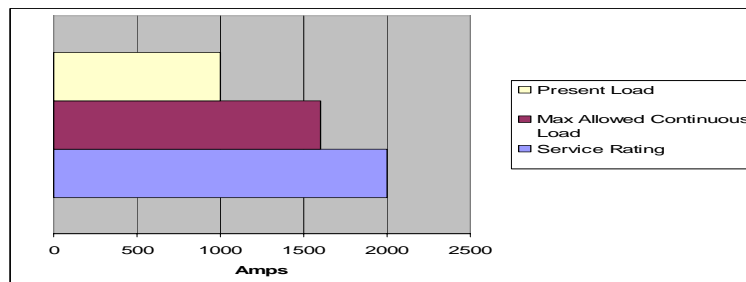


Chart 1 – Visual representation of present loading and electrical service capacity.



Table 1 summarizes the min/max/median readings for both voltage and current during the monitoring period. The maximum current levels are most likely the result of inrush associated with equipment turn-on and are not indicative of a long-term condition.

Table 1 -- Min/Max/Median Voltage & Current – Summary Report

VOLTAGE	
	Channel A
Min Volts	227.502 on 12/01/2005 07:30:00.0
Max Volts	279.750 on 12/04/2005 02:45:00.0
Median Volts	267.374
Average Volts	267.436
	Channel B
Min Volts	228.627 on 12/01/2005 07:30:00.0
Max Volts	279.875 on 12/04/2005 02:45:00.0
Median Volts	267.747
Average Volts	267.795
	Channel C
Min Volts	229.871 on 12/01/2005 07:30:00.0
Max Volts	280.625 on 12/04/2005 02:45:00.0
Median Volts	269.123
Average Volts	269.251
CURRENT	
	Channel A
Min Amps	187.55 on 12/04/2005 02:45:00.0
Max Amps	2189.00 on 12/01/2005 07:30:00.0
Median Amps	740.30
Average Amps	730.30
	Channel B
Min Amps	183.69 on 12/04/2005 02:45:00.0
Max Amps	2209.35 on 12/01/2005 07:30:00.0
Median Amps	760.09
Average Amps	755.42
	Channel C
Min Amps	205.14 on 12/04/2005 02:45:00.0
Max Amps	2280.30 on 12/05/2005 09:00:00.0
Median Amps	796.94
Average Amps	787.15

Table 2 shows the min/max/median readings associated with the power parameters. As with the current readings in Table 1, the average values, highlighted in red, are probably most representative of the steady state conditions in the facility.

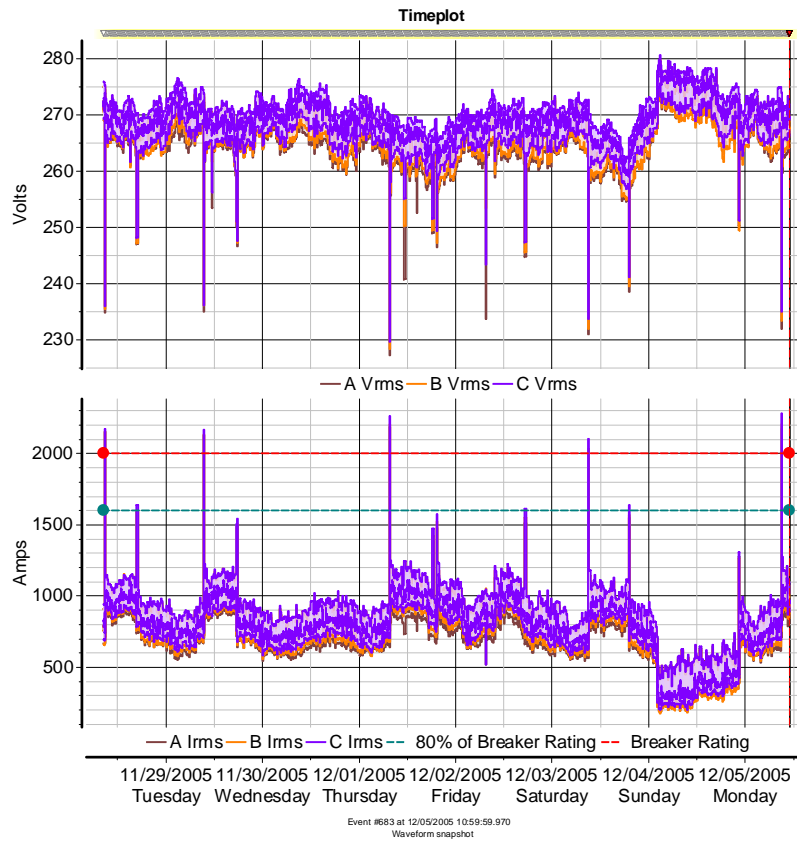
The power factor of 0.85 indicates that do to the inductive characteristics of the facility loads the electrical system is not operating at optimum efficiency—the KW readings are approximately 15% less than the corresponding kVA values. The power factor has improved since the previous monitoring at which time the power factor average approximately 0.80.

Table 2 -- Min/Max/Median Power Report

ACTIVE POWER, P (W)				
Phase	A	B	C	TOTAL
Min kW	44.756	45.053	52.946	142.77 on 12/04/2005 03:00:00.0
Max kW	267.51	291.17	291.12	848.39 on 12/01/2005 07:45:00.4
Median kW	165.00	176.62	182.17	522.96
Average kW	163.87	176.00	180.67	520.55
APPARENT POWER, S (VA)				
Phase	A	B	C	TOTAL
Min kVA	52.823	51.770	57.790	162.37 on 12/04/2005 03:00:00.0
Max kVA	495.18	503.77	525.71	1524.67 on 12/05/2005
Median kVA	197.63	203.65	214.76	615.09
Average kVA	194.92	201.91	211.54	608.39
REACTIVE POWER Q, AT FUND. FREQ. (VAR)				
Phase	A	B	C	TOTAL
Min kVAR	27.492	25.009	22.867	75.99 on 12/04/2005 03:00:00.0
Max kVAR	424.30	414.52	436.87	1266.24 on 12/05/2005
Median kVAR	108.28	100.72	113.60	322.46
Average	105.20	98.571	109.68	313.47
POWER FACTOR, PF				
Phase	A	B	C	TOTAL
Min	0.454	0.502	0.497	0.488 on 12/03/2005 09:15:00.5
Max	0.884	0.908	0.925	0.903 on 12/04/2005 10:45:00.3
Median	0.839	0.870	0.854	0.855
Average	0.839	0.870	0.855	0.855

Figure 1 is the time plot record for the voltage and current associated with each phase during the monitoring period. Each phase time plot includes a minimum, maximum and median values—the table to the right of the graphic provides a numerical summarization of the graphical information—the same information as contained in Table 1.

The maximum current levels where there is a corresponding voltage sag (decrease) represent inrush current from equipment turn-on—Table 3 summarizes the peak inrush and corresponding times and may be useful in identification of the loads with the high inrush current..



GRACE	Min	Max	Med	Avg
AVrms	227.5	279.8	267.4	267.4
BVrms	228.6	279.9	267.7	267.8
CVrms	229.9	280.6	269.1	269.3
AIrms	187.5	2189	740.3	730.3
BIrms	183.7	2209	760.1	755.4
CIrms	205.1	2280	796.9	787.1
80% of Breaker Rating	1600	1600	1600	1600
Breaker Rating	2000	2000	2000	2000

Figure 1 – Voltage and current time plots with limit lines for current.

Table 3

Date	Time	Observation	Peak Amps
11/28/2005	8:45	turn-on	2200
	16:45	shut-down	1650
11/29/2005	9:15	turn-on	2200
	11:15	util sag	
12/1/2005	17:45	shut-down	1550
	7:30	turn-on	2350
12/2/2005	11:15	util sag	
	18:15	turn-on	1450
12/3/2005	19:15	turn-on	1600
	7:30	util sag	
12/4/2005	17:15	turn-on	1600
	9:00	turn-on	2100
12/5/2005	19:00	turn-on	1650
	9:00	turn-on	2300

Figure 2 is a representative sample of the voltage and current waveforms during bakery operations along with the corresponding phasor diagram. Loads are dominantly sinusoidal and the phasor diagram shows the 0.85 lagging displacement power factor (Cosine of 30-degrees). Should electrical system capacity or utility power factor rate charges become an issue capacitors could be installed on the larger inductive loads to correct the power factor condition.

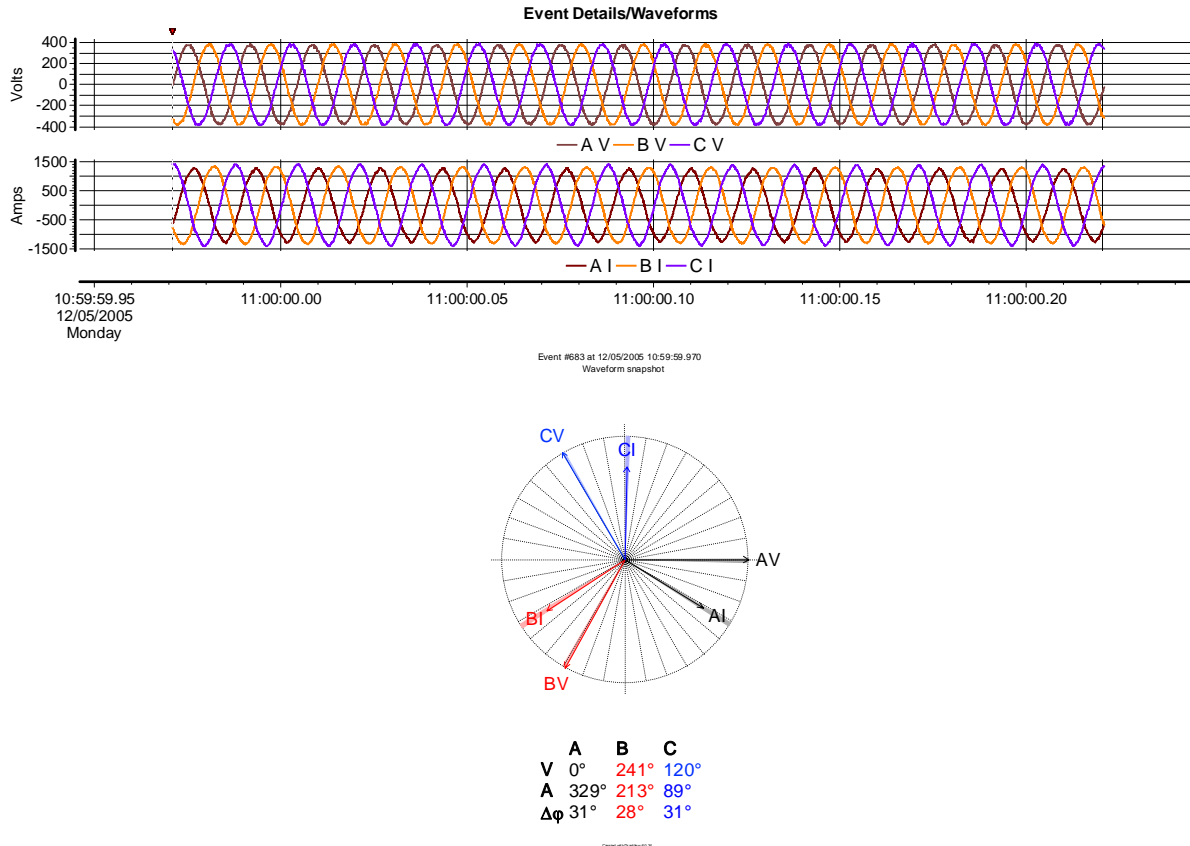


Figure 2 – Voltage and current waveforms along with phasor diagram.

RECOMMENDATION: Power factor correction capacitors could be installed to recover electrical system capacity. However, the electrical characteristics of the new equipment should be reviewed (considered) prior to any implementation of capacitors. The concern is that the new loads may introduce some power frequency harmonics into the existing environment and would need to be taken into consideration before addition of capacitors in the distribution system. The inductive nature of the existing loads may, in fact, help in mitigating any harmonic issues introduced by the new loads. This appears to have been the case with the previous equipment addition as the power factor has improved from 0.80 to 0.85 when compared with the previous monitoring.

2. Quality of Supply

The following collection of graphics, Charts 2-6, documents the general overall quality of the electrical supply for the Silicon Services facility. Voltage levels for the monitoring period were well within normal industry standards and should not pose operational issues for electrical equipment or systems. The harmonic distortion levels for both voltage and current are very low and reflect the sinusoidal nature of the existing electrical loads.

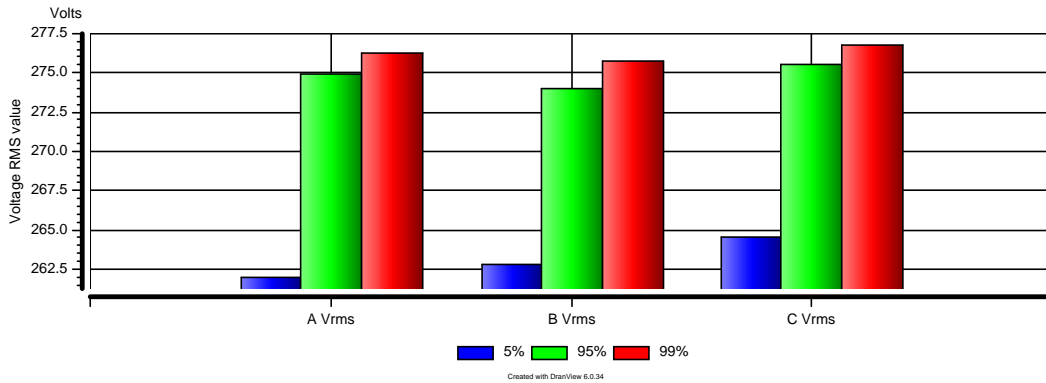


Chart 2

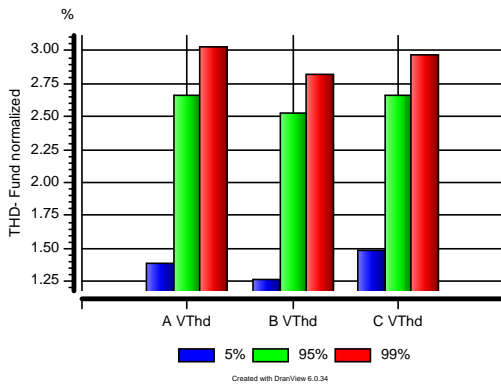


Chart 3

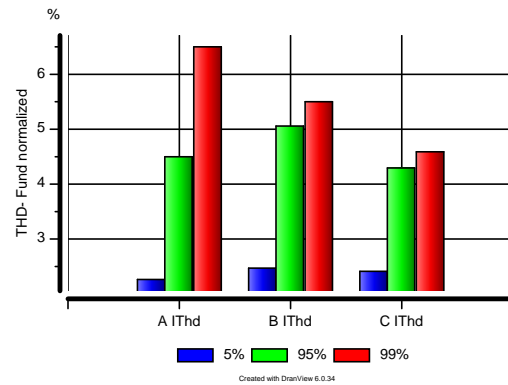


Chart 4

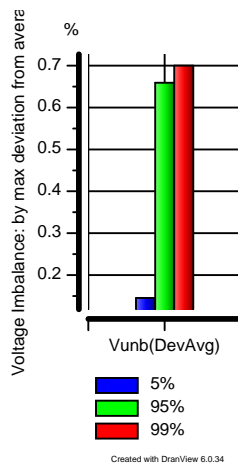


Chart 5

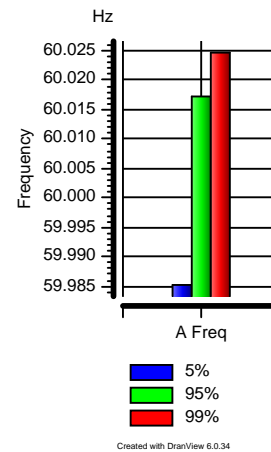


Chart 6

[Note: The interpretation of the Quality of Supply Summary Graphs is sometimes confusing. It is best to think of the result as: for N% of the time the values are less than or equal to the N% value, for the remainder of the time it is greater (where N is 5, 95 or 99). Graphs are provided for Vrms, Vthd, Ithd, Vunb and Frequency.]

Figure 7 shows the voltage and current percent (%) unbalance compared to the deviation from the average. In the case of the voltage unbalance the objective is to maintain a percent unbalance of less than 2% and less than 20% for the current. The average current unbalance of 4% to 4.5% is very good and indicates a well-balanced installation.

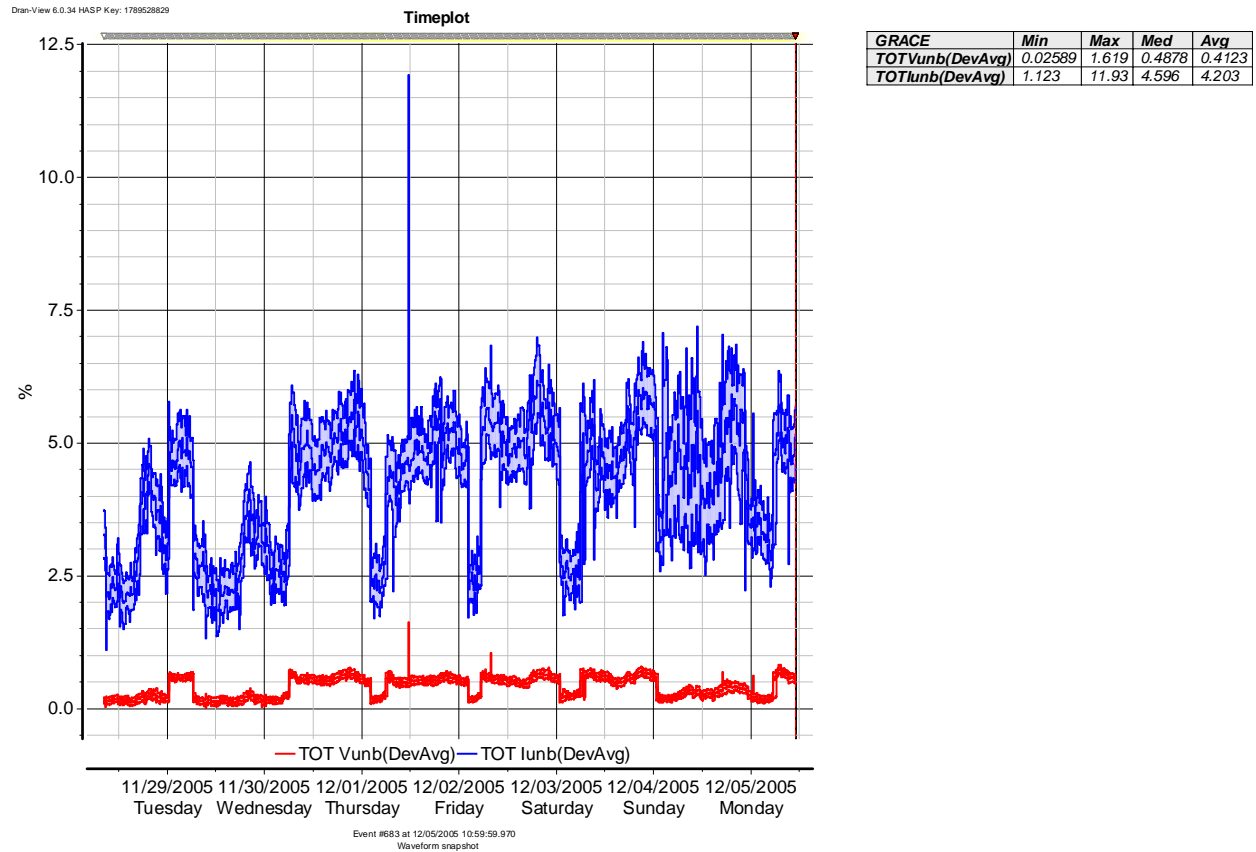


Figure 3 - Voltage and current unbalance time plots.

RECOMMENDATION: Install permanent monitoring on the electrical service to provide facilities with the ability to evaluate the quality of the electrical supply and energy usage on an ongoing basis. Typical installations of this type run approximately \$4000.

Summary

The general quality of the electrical supply is quite good for the facility. The monitoring data indicates that the electrical service is currently moderately loaded, approximately 50% of rated capacity and at approximately 62% of maximum allowed continuous load—80% of rated capacity. The installation of an additional 600 Amps of load will put the service at capacity and will probably necessitate addressing the low power factor issue.

The numeric data from the power monitoring activity can be made available in a comma delimited format for import to various worksheet and plotting programs if required.

Report prepared by:
 Bruce Lonie
 President, PowerCET Corporation



Disclaimer

The information contained in this document is provided for educational purposes only as an example on how to incorporate power monitoring data and other observations into a report format. It is not intended to provide consulting advice for any specific problem or situation. This is a copyrighted document and intended for individual use and should not be reproduced or distributed in any form without specific written permission from PowerCET Corporation.