*Power**CET*** Corporation
3350 Scott Blvd., Bldg. 55. Unit 1
Santa Clara, CA 95054 USA
Voice: 408/988-1346 | Fax: 408/988-4869
E-mail: consulting@powercet.com
URL: http://www.powercet.com

Sample Report

Consulting Report
Electrical Service Monitoring
Silicon Services

Somewhere Valley, CA

Introduction

PowerCET Corporation was contracted by Joe Tron of Techie Engineering 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 July 22nd and ending July 29th. 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 readings. 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-minuite-demand interval. The average (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 20% of its rated 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 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 0.8 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 20% less than the corresponding kVA values. A review of the PG&E utility bill does not indicate any power factor rate adjustment so the only economic incentive for implementing a power factor correction program would be a slight savings in energy costs from IR losses in the system and to recover distribution system capacity if loading becomes critical.

Table 1 – Min/Max/Median – Summary Report

	Channel A		Channel A
Min V	264.5 on 07/24/2003 at 05:39:59	Min I	273.9 on 07/27/2003 at 16:20:00
Max V	280.3 on 07/28/2003 at 22:30:00	Max I	717.2 on 07/25/2003 at 22:40:00
Med V	274.2	**Med I**	**408.6**
	Channel B		**Channel B**
Min V	259.2 on 07/24/2003 at 13:10:00	Min I	287.6 on 07/26/2003 at 16:30:00
Max V	280.5 on 07/28/2003 at 22:30:00	Max I	723.2 on 07/25/2003 at 22:40:00
Med V	274.6	**Med I**	**420.2**
	Channel C		**Channel C**
Min V	257.5 on 07/24/2003 at 13:10:00	Min I	206.2 on 07/29/2003 at 10:20:00
Max V	280.4 on 07/28/2003 at 22:30:00	Max I	742.0 on 07/25/2003 at 22:40:00
Med V	274.2	**Med I**	**437.2**

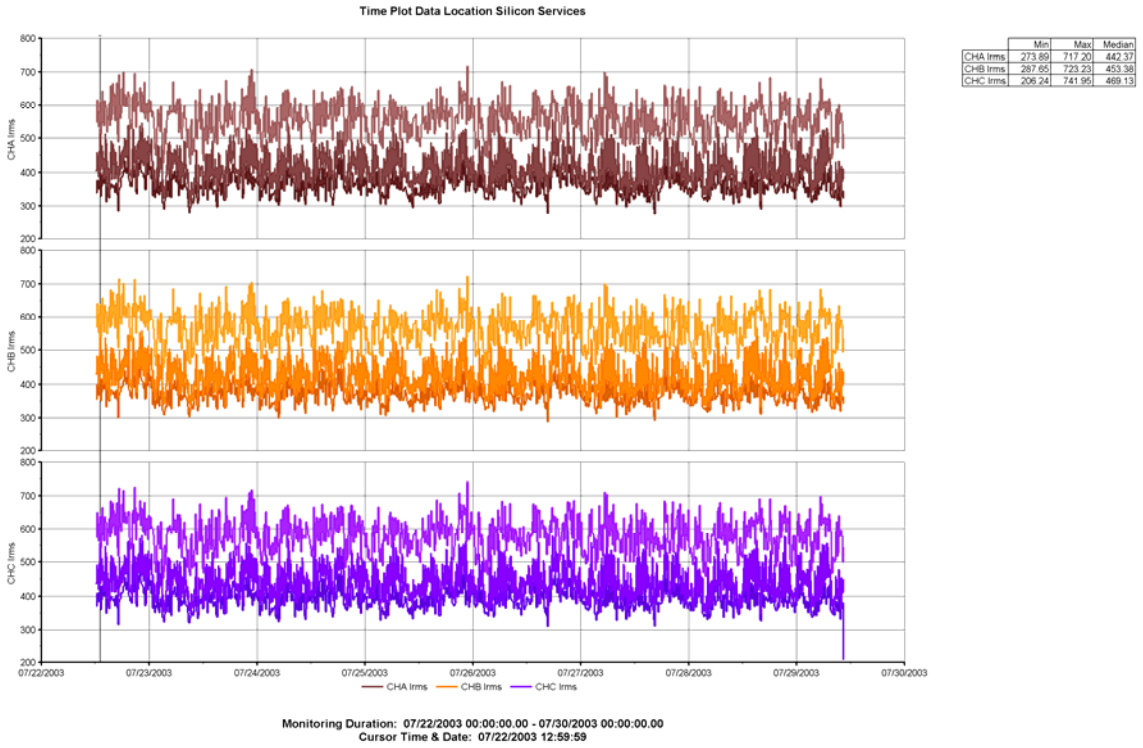
Table 2 – Min/Max/Median Power Report

	A	B	C	ABC	
Min kW	83.7	88.7	94.6	266.2	on 07/23/2003 at 01:30:00
Max kW	138.2	143.7	149.1	431.0	on 07/25/2003 at 23:00:00
Avg kW	**110.2**	**116.4**	**121.4**	**347.4**	
Min kVA	106.0	108.2	113.3	327.5*	on 07/22/2003 at 12:15:00
Max kVA	176.2	179.5	185.4	541.1*	on 07/22/2003 at 12:15:00
Avg kVA	**143.4**	**147.1**	**151.1**	**441.6***	
Min kVAR	65.3	62.3	63.8	190.4	on 07/23/2003 at 01:30:00
Max kVAR	113.2	112.9	113.5	336.9	on 07/23/2003 at 22:30:00
Avg kVAR	93.1	91.1	91.4	275.7	
Min PF	0.757	0.795	0.808		
Max PF	0.861	0.877	0.893		
Avg PF	**0.809**	**0.830**	**0.842**		
Cumulative Energy	14887.54	15840.15	16728.37	47457.07 (kWh)	

* kVA ABC total represents sum of individual phases.

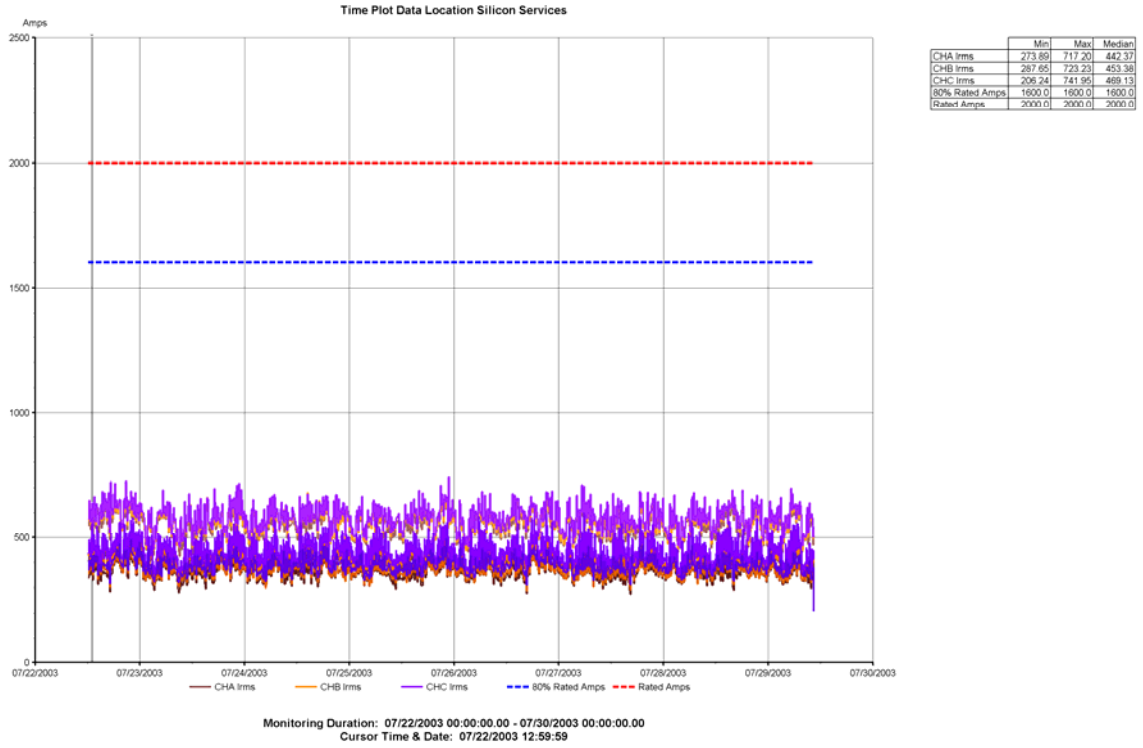
Figure 1 is the time plot record for the current associated with each phase during the monitoring period. Each phase time plot includes a minimum, maximum and median values—the table to the right of the graphic provides a numerical summarization of the graphical information. The maximum (top) trace for each phase is reflective of the inrush current during equipment turn-on.

Figure 2 is a comparison of the current time plots, existing loading, with the rated capacity limits.



	Min	Max	Median
CHA Irms	273.89	717.20	442.37
CHB Irms	287.65	723.23	453.38
CHC Irms	206.24	741.95	469.13

Figure 1 - Current time plots -- min/max/median.



	Min	Max	Median
CHA Irms	273.89	717.20	442.37
CHB Irms	287.65	723.23	453.38
CHC Irms	206.24	741.95	469.13
80% Rated Amps	1600.0	1600.0	1600.0
Rated Amps	2000.0	2000.0	2000.0

Figure 2 - Current time plots versus electrical system capacity.

The existing loads are dominantly sinusoidal as evidenced by the waveform graphic in Figure 3.

The phasor diagram, Figure 3, also graphically demonstrates the displacement power factor, 0.8 from Table 2. Power factor correction capacitors could be installed to improve the existing power factor and recover system capacity

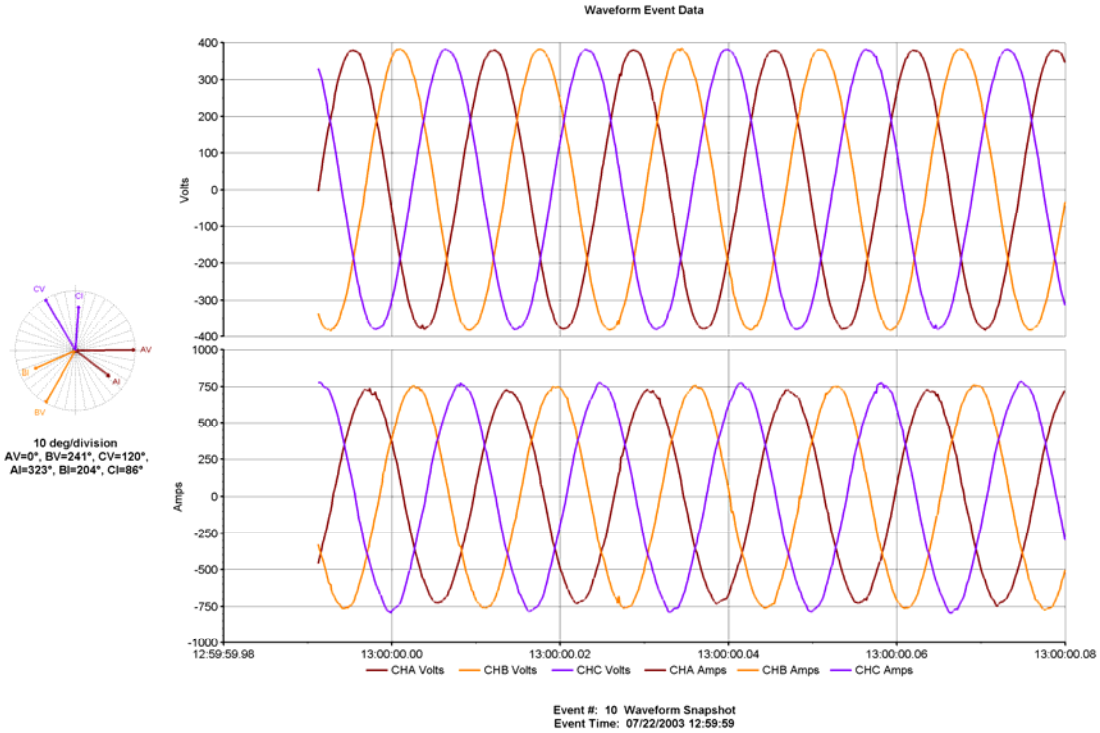


Figure 3 - Representative voltage and current waveform with phasor diagram.

RECOMMENDATION: Power factor correction capacitors could be installed to recover electrical system capacity. However, the electrical charactertics 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.

2. Quality of Supply

The following collection of graphics, Figure 4A-E, documents the general overall quality of the electrical supply for the Silicon Services facility. . [Note: The interpretation of the Quality of Supply Summary Graphs (Figure 4) 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, ABC Current THD, Voltage Unbalance and Frequency.]

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.

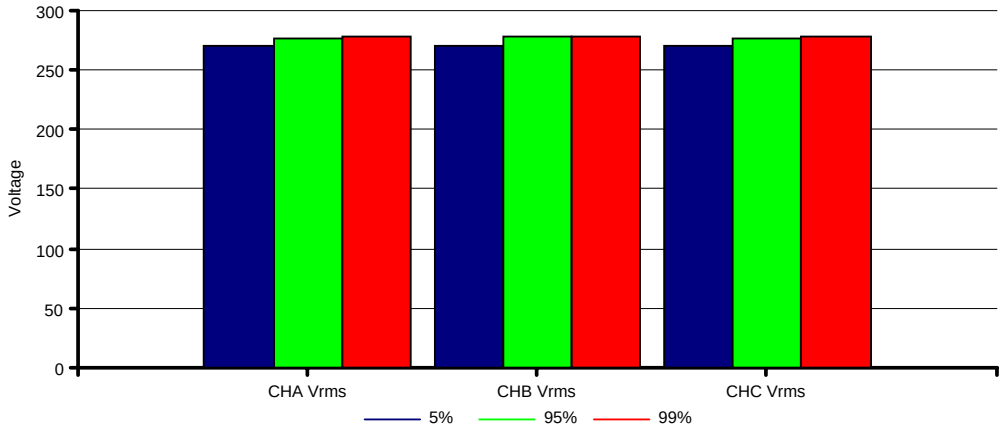


Figure 4A - Voltage Quality.

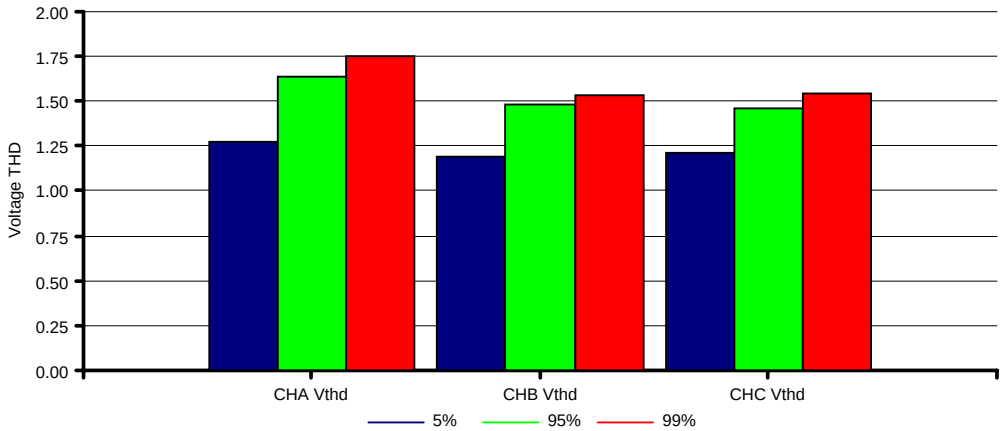


Figure 4B – Voltage Total Harmonic Distortion (Vthd).

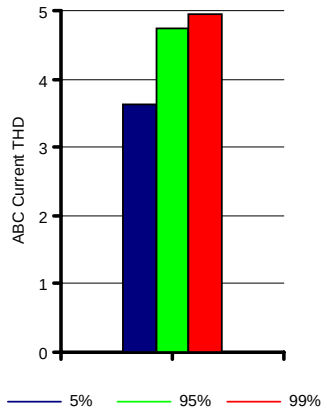


Figure 4C – ABC Current THD

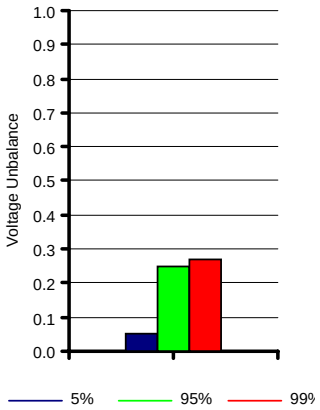


Figure 4D – Voltage Unbalance

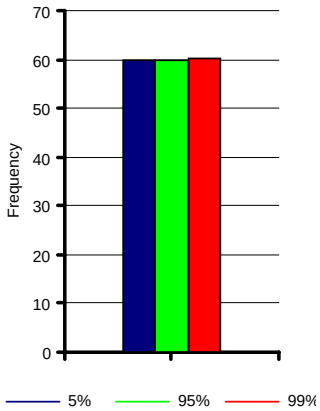


Figure 4E - Frequency

Figure 5 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 3% is very good and indicates a well-balanced installation.

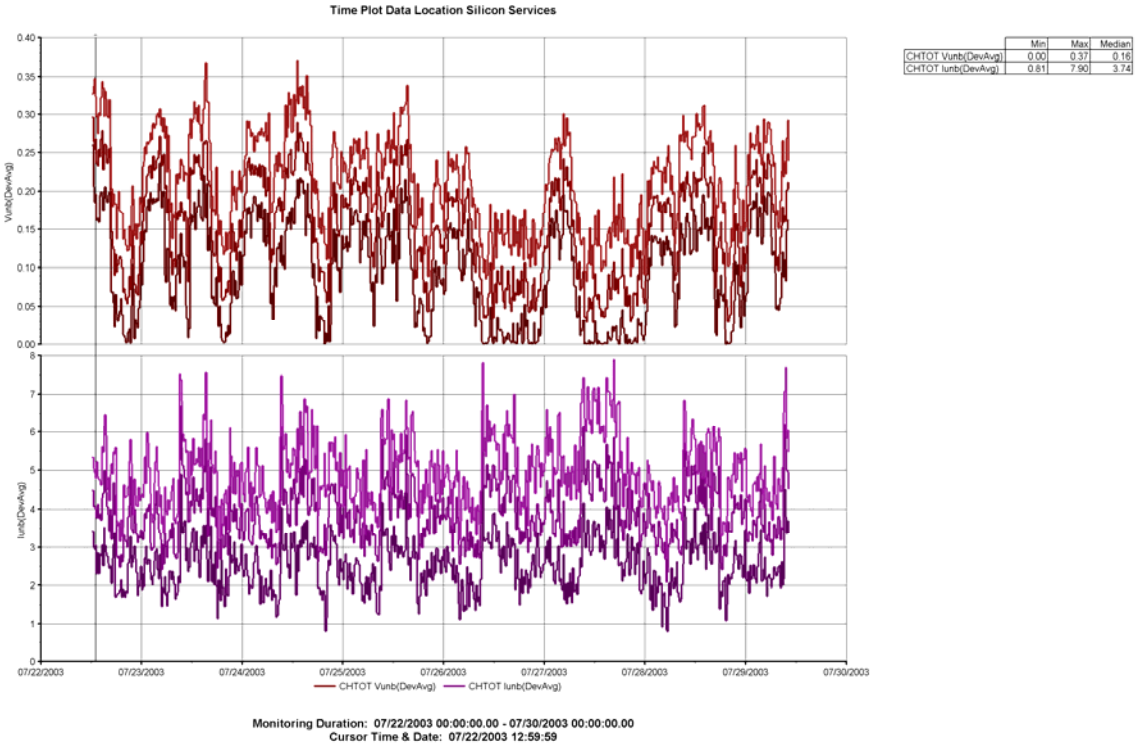


Figure 5 - Voltage and current unbalance time plots.

3. Electric Utility Bill Review

The PG&E electrical service for Silicon Services is under the A6 Small General Time-of-Use Service rate. The main features of the A6-rate are that it does not have a demand charge or power factor adjustment. It does have variable energy charges associated with time-of-use (TOU) and seasonal variations—Summer/Winter.

Table 3 – PG&E Rate A6

Season	TOU	Total Energy Charge $/per kWh
Summer	On Peak	0.34322
	Part Peak	0.15839
	Off Peak	0.10169
Winter	Part Peak	0.17113
	Off Peak	0.11720

The various TOU periods are defined as follows:

SUMMER (Service from May 1 through October 31):

- Peak: 12:00 noon to 6:00 p.m. Monday through Friday (except holidays)
- Partial-peak: 8:30 a.m. to 12:00 noon AND 6:00 p.m. to 9:30 p.m. Monday through Friday (except holidays)
- Off-peak: 9:30 p.m. to 8:30 a.m. Monday through Friday
  All day Saturday, Sunday, and holidays

WINTER (Service from November 1 through April 30):

- Partial-Peak: 8:30 a.m. to 9:30 p.m. Monday through Friday (except holidays)
- Off-Peak: 9:30 p.m. to 8:30 a.m. Monday through Friday (except holidays)
  All day Saturday, Sunday, and holidays

Holidays: "Holidays" for the purposes of this rate schedule are New Year's Day, President's Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, and Christmas Day. The dates will be those on which the holidays are legally observed.

There is probably little incentive to implement a power factor correction (capacitor installation) program at the facility unless there is a need to recover distribution system capacity, as there currently is no fee associated with low power factor. It is likely that PG&E, and other utilities, will be implementing some type of power factor surcharge for levels below 0.95 in the future. Electric utility billing should be reviewed (tracked) on a periodic basis with respect usage and costs.

RECOMMENDATION: The energy costs difference of peak ($0.34) versus off-peak ($0.10) should be taken into consideration when scheduling and planning production so far as practical. Equipment maintenance should be scheduled for peak hours and attempt to maximize high-energy load usage for off-peak periods.

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 lightly loaded, approximately 25% of capacity. The installation of an additional 1200 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.

