USES Shunt Efficiency System Evaluation

For

Energy Systems Group
And
The University of Baltimore
Library Building

by

DWA Energy

www.DWAEnergy.com

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Executive Summary

During February and March 2009, the Energy Systems Group (ESG) purchased and installed an innovative power conditioning system known as the USES® Shunt Efficiency System throughout the University of Baltimore Campus in Baltimore, MD. The USES® System was installed to reduce the overall demand and consumption of real power and improve overall power quality while protecting the electrical circuit against electrical spikes and surges. A total of thirty-eight (38) USES® Model CMES-3D-480 Power Conditioners and one (1) USES® Model CMES-3D-208 Power Conditioners were installed in a total of six buildings on the campus. The buildings include the 1) Law Center, 2) Academic Center, 3) Business Center, 4) Student Center, 5) Library and 6) Family Law Clinic. The following report contains the results of the **Library** evaluation conducted on September 30th, 2009.

In accordance with the final proposal offered to ESG by DWA Energy on December 12, 2008, the USES® System was evaluated to determine the average power conditioning results and real power demand reductions. DWA Energy used Timed Interval Sampling (TIS) methods to determine USES® System performance, and the results of the evaluations are presented herein.

The data tables and graphs presented in this report clearly show the beneficial results provided by the USES® System. All power quality data was averaged to take into account short term load variations and to determine the average levels of power quality when the USES® System was activated and de-activated. The data tables presented in this report are from the On-Peak evaluation conducted on September 30th. We have selected representative graphs for inclusion in this report. Additional data tables and graphs can be found in the compendium Excel Spreadsheet entitled "Lib Analysis, 101609".

A full discussion of the power quality improvements, and their impact on the circuit, are discussed below.

Timed Interval Sampling (TIS) Techniques

Timed Interval Sampling (TIS) is a statistical method of energy measurement with regard to power quality over a relatively short span of time. It is valid in all facilities with electrical loads and is particularly useful in facilities where energy use is a function of manufacturing, environmental loads, and related equipment. TIS techniques are utilized to minimize the effect of numerous variables present when measuring power quality and meets the standards of the International Performance and Measurement Verification Protocol (IPMVP).

During evaluation, the USES® System was alternately energized and de-energized at five-minute intervals to collect comparative samples of energy used by the motors and other electrical loads

under steady state conditions. The energy usage data was recorded and averaged in each respective operating condition (i.e. USES® on or off), in order to demonstrate power quality changes when the USES® System is energized and de-energized.

For the TIS evaluation, an Amprobe DM-II Pro® Power Quality Analyzer and Data Logger was connected to the incoming electric service at a point immediately following the main breaker for the building. The Amprobe meter meets the standards of the National Institute of Standards and Technology. The USES® System is connected to the electrical circuit at each location in parallel through circuit breaker panels or individual breakers. The Power quality parameters measured during TIS testing consisted of voltage (each of three phases, or VAB, VBC and VCA), amperage (each of three phases, or IA, IB and IC), real power demand (Watts), reactive power (volt-amps-reactive, or VAR), apparent power (volt-amps, or VA) and power factor (%). Data on each parameter was collected every one-second during each on/off interval.

On Wednesday, September 30th from 1:08 PM to 1:56 PM, DWA Energy recorded the performance of the USES® System at the Library. The evaluation showed consistent overall power quality improvements and reductions in real power demand. The TIS evaluation was performed by Skip Delclos and Jeff Walsh of DWA Energy.

Evaluation of USES® System performance was made through analysis of the data recorded from the TIS testing. The USES® System was activated and deactivated for intervals of five minutes to measure the changes in overall power quality in each operating condition. A separate test of the cumulative effect of the USES® power conditioners was also conducted to confirm that each of the units was operating properly. Whenever the USES® System was turned on or off, the differences between the conditioned and unconditioned power quality was determined and averaged to demonstrate the overall effect that the USES® System has on the circuit.

All recorded data was evaluated and averaged in the following manner to determine the overall average performance of the USES® System:

- The average power quality for the full five-minute interval was calculated and compared to the next five-minute interval before and after each transition from on to off, and off to on.
- Each instantaneous change in power quality was determined by comparing the last one-second with the USES® System on to the first one-second with the USES® System off, and visa-versa.
- The average power quality was calculated 15-seconds before and after each transition from on to off, and off to on.
- The average power quality was calculated 30-seconds before and after each transition from on to off, and off to on.
- The average power quality was calculated 60-seconds before and after each transition from on to off, and off to on.

- All transitional changes were averaged to derive the overall average performance of the USES® System.

DWA Energy has found that Timed Interval Sampling is the most reliable and verifiable method of comparing power quality while still accounting for all variables present. TIS methods are used to verify that the USES® System is operating as expected in your facility.

Discussion of Power Quality Improvements

The installation of the USES® System at the Library has resulted in measurable and verifiable power quality improvements, as well as other benefits which cannot be measured. A discussion of the power quality improvements resulting from the USES® System is presented below:

Spike and Surge Protection - Inherent in the USES® System, but not measured, is the ability to provide superior spike and surge suppression capabilities. A surge is any voltage increase lasting 3 or more nanoseconds. A spike is any voltage increase lasting less than 3 nanoseconds. The USES® device detects any surges or spikes traveling along one of the active phases and shunts it to the other two phases. From there, the transformer/choke sets within the USES® device attenuate the surge/spike through the action of the "chokes", which use capacitors and inductors to resist the change in voltage and associated change in current, and flatten out the waveform. The surge/spike is recycled as usable power for the circuit. Because no USES® "Wye" units were specified for the University, the USES® System will not protect the circuit against ground fault transients or lightning strikes which can enter the circuit through the neutral conductor.

Reactive Power, Apparent Power and Amperage – The USES® System reduces the reactive power on the circuit through transformer action which produces current which leads voltage on each phase. The USES® System reduces reactive power in a fundamentally different way than power factor correcting capacitors, and does so without creating resonance. Each USES® Model CMES-3D-480 power conditioner reduces reactive power by 21-23 kVAR. A reduction in reactive power results in a corresponding decrease in the apparent power on the circuit. This, in turn, results in a decrease in the amount of amperage on the circuit, which results in a decrease in real power demand as a result of reduced "Copper Losses" on the circuit. Copper losses manifest themselves as heat in motors and conductors and can reduce the useful life of motors, transformers and sensitive electronic equipment. The reduction in reactive power on the circuit also acts to "stiffen" the circuit by reducing overall circuit impedance. A "stiff" circuit will reduce the creation of voltage total harmonic distortion as a result of current harmonics.

Power Factor – Power Factor is the ratio of real power to apparent power. Because the USES System reduces both real power demand and apparent power demand, the power factor is

improved and approaches unity, or 100%. Because the USES System does not create resonance, any leading Power Factor will have no effect on the performance or reliability of the equipment.

Voltage Improvement - By improving voltage across each of the three phases (VAB, VBC, VCA), circuit amperage is further reduced and motors will run cooler and last longer. Increased voltage will also lessen the likelihood of equipment tripping off due to utility voltage sags.

Harmonics – The USES® System reduces the Total Harmonic Distortion (THD) of the amperage and voltage on the circuit to the loads by passing all power generated within the USES® System through 60 Hz Band-Pass Filters. Because the USES System is connected to the electrical circuit in parallel, some THD will continue to pass on to the operational loads. However, because a significant portion of the power supplied to the load is "choked" to 60 Hz, total THD supplied to the load is reduced. This action significantly reduces the THD in the voltage and current provided to the operating motors, thus increasing motor efficiency. Problems associated with circuit harmonics include:

- Excessive Neutral Currents, where voltage harmonics result in additional current on the circuit neutral conductor, resulting in additional heat, possible overloading and the need to install additional neutral conductors.
- Overheated transformers, where harmonics generated on the secondary side of a delta-wye transformer will circulate on the primary side of the transformer. Some types of transformer losses, such as skin losses and eddy currents will increase by the square of the harmonic order.
- Overheated solenoid coils and lighting ballasts.
- Positive, negative and zero sequence voltages on motors and generators, where certain harmonic frequencies will try to rotate the motor forward or backward, or simply heat up the motor.
- Incorrect reading power meters, especially disc type watt-hour meters and averaging type current meters.
- Failure of electronic equipment, including nuisance tripping and overload.
- Nuisance tripping of circuit protection devices including false tripping of relays and failure of UPS devices to properly transfer.
- Blown fuses and overheated power factor correction capacitors due to the effects of harmonics with circuit resonance.

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Summary of Power Quality Improvements

Analysis of the TIS testing results from September 30th, 2009 demonstrate that the USES® System has made substantial improvements in overall power quality. The following power quality improvements are realized by the USES® System. All four units have had the following effect on the electrical circuit:

- Real Power Demand (kW) – **Real Power demand was reduced by 7.4 kW** with all four of the USES® Model CMES-3D-480 Power Conditioners activated. Each USES® unit was individually tested and found to be operational and contributing to the overall power demand reduction.

- Power Factor – Power Factor improved from **92.5% lagging to 98.0% leading** when the USES® System was activated.

- Voltage – Voltage improved by an average of **2.6 volts** across each phase (VAB, VBC, VCA).

- Amperage – Amperage was reduced by **18.5 amps** on all three phases.

- Reactive Power - Reactive Power was reduced by **82.1 kVAR** when the USES® System was activated.

- Apparent Power – Apparent Power was reduced by **16.4 kVA** when USES® System was activated.

Graphs and Data Tables

Through evaluation of the Amprobe DM-II Pro® Power Quality Analyzer and Data Logger recordings collected on September 30th, we have prepared a series of graphs and data tables to demonstrate the performance of the USES® System. The following graphs are presented below, showing all changes to power quality when the USES® System is activated or de-activated:

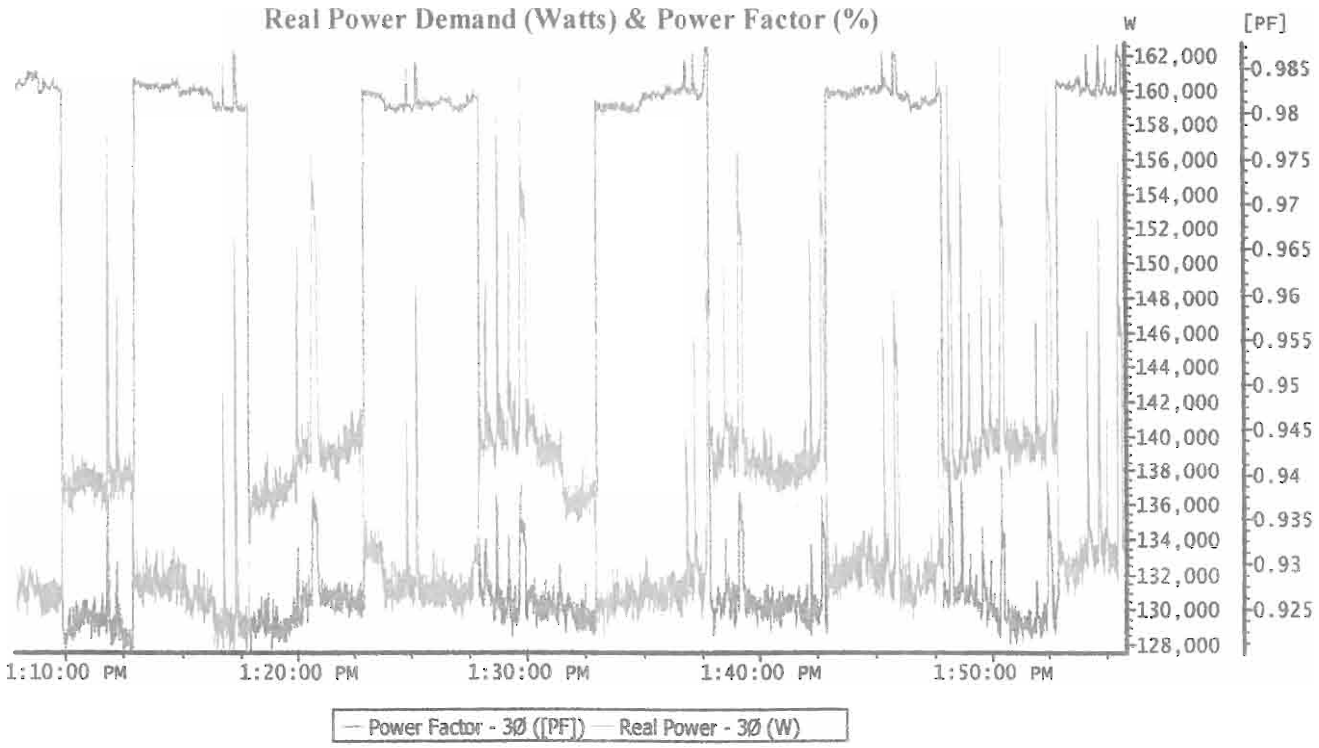
- Graph 1 – Real Power (Watts) and Power Factor (%) – This graph shows real power in watts and power factor in % during the September 30th, 2009 TIS testing.
- Graph 2 – Voltage, 3 Phase from the September 30th, 2009 TIS testing.
- Graph 3 – Amperage, 3 Phase from the September 30th, 2009 TIS testing.
- Graph 4 – Reactive and Apparent Power – This graph shows the effects on reactive and apparent power when the USES® System is turned ON and OFF on September 30th, 2009.

The following data tables are presented to show the average observed performance of the USES® System at the Library. Please note that during the TIS testing, each USES® unit was tested individually to ensure performance and evaluate circuit improvements with one, two, three, and four units cumulatively.

- Table 1 – Real Power (Watts) from September 30th, 2009.
- Table 2 – Power Factor (%) from September 30th, 2009.
- Table 3 – Voltage, 3 Phase Average from September 30th, 2009.
- Table 4 – Amperage, 3 Phase Average from September 30th, 2009.
- Table 5 – Reactive Power (VAR) from September 30th, 2009.
- Table 6 – Apparent Power (VA) from September 30th, 2009.

Note: Graphs and Data Tables are representative of the performance of the USES® System at the Library. All Data Tables and Graphs, together with all raw data are included in the compendium Excel files from September 30th, 2009.

Graph 1



Start: 9/30/2009 1:07:51 PM End: 9/30/2009 1:55:53 PM
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Graph 1 above shows the Real Power Demand in watts and Power Factor on September 30th, 2009 from 1:08 PM to 1:56 PM. With all four USES® Model CMES-3D-480 power conditioning units operating, the real power demand is reduced an average of **7,407 watts**. Overall Power Factor is improved from 92.5% to **98.0%**.

Table 1

Real Power Demand (Watts)

Intervals						Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Difference Off to On	Difference On to Off	Change At Transition	Change Trans.	Change Trans.	Change Trans.	Change Trans.
TIS Testing - Four (4) USES CMES-3D-480 volt units												
1:07:51 PM	1:09:52 PM	4	ON		131,009							
1:09:54 PM	1:12:53 PM	4	OFF	137,898			6,889	6,852	6,041	5,959	6,341	6,501
1:12:54 PM	1:17:53 PM	4	ON		131,038	(4,959)		(5,552)	(6,168)	(6,228)	(6,563)	(6,557)
1:17:54 PM	1:22:53 PM	4	OFF	139,016			7,977	6,676	6,894	6,590	5,180	5,721
1:22:54 PM	1:27:52 PM	4	ON		131,940	(7,076)		(7,680)	(6,634)	(6,696)	(6,648)	(6,700)
1:27:53 PM	1:32:53 PM	4	OFF	139,965			8,026	5,803	6,695	8,608	9,980	10,102
1:32:54 PM	1:37:52 PM	4	ON		131,705	(8,261)		(9,819)	(6,322)	(6,396)	(6,189)	(6,023)
1:37:53 PM	1:42:53 PM	4	OFF	139,674			7,969	(6,645)	(4,490)	1,644	3,475	4,540
1:42:54 PM	1:47:52 PM	4	ON		132,667	(7,007)		(8,105)	(16,425)	(11,664)	(10,419)	(9,405)
1:47:53 PM	1:52:52 PM	4	OFF	141,148			8,481	6,511	4,257	9,613	9,181	9,062
1:52:53 PM	1:55:53 PM	4	ON		134,395	(6,753)		(9,209)	(17,518)	(12,137)	(10,594)	(9,941)
AVERAGE - OFF				139,540								
AVERAGE - USES ON				132,126				ALL TRANSITIONS				
DIFFERENCE				(7,415)								
TRANSITION AVG - OFF to ON						(7,191)	7,868	6,330	5,949	8,270	8,114	8,295
TRANSITION AVG - ON to OFF								(7,584)	(6,658)	(7,839)	(7,499)	(7,275)
AVERAGE - REPRESENTATIVE TRANSITIONS				7,407								

NOTES and INTERPRETATION:

Power consumption trend is steady throughout TIS testing period with distinct load variations
Shaded cells discounted due to significant load variations during averaging period
Performance of USES system = 7,407 Watts Real Power Demand reduction
Average performance per CMES-3D-480 volt USES unit = 1.5 kW per unit

Table 1 above shows analysis of the wattage data collected by the Amprobe DM-II Pro Multi-Meter and Data-Logger during TIS testing on September 30th, 2009. The intervals are generally of approximately 5-minute duration.

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Table 2

Power Factor (%)

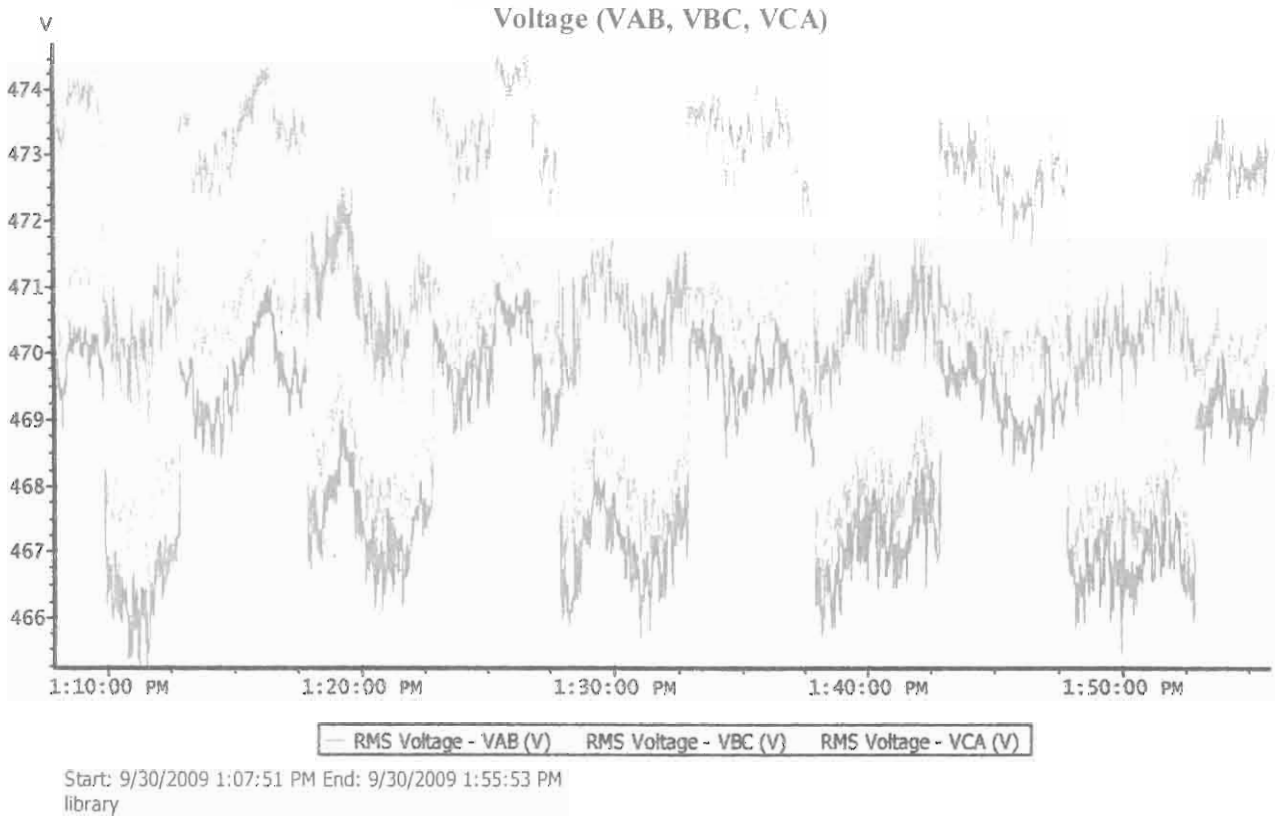
Intervals						Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Difference Off to On	Difference On to Off	Change At Transition	Change Trans.	Change Trans.	Change Trans.	Change Trans.
TIS Testing - Four (4) USES CMES-3D-480 volt units												
1:07:51 PM	1:09:52 PM	4	ON		98.0%							
1:09:54 PM	1:12:53 PM	4	OFF	92.2%								
1:12:54 PM	1:17:53 PM	4	ON		98.0%	5.8%		6.0%	6.0%	6.0%	5.9%	5.9%
1:17:54 PM	1:22:53 PM	4	OFF	92.6%								
1:22:54 PM	1:27:52 PM	4	ON		98.0%	5.4%		5.0%	5.3%	5.2%	5.2%	5.1%
1:27:53 PM	1:32:53 PM	4	OFF	92.6%								
1:32:54 PM	1:37:52 PM	4	ON		98.0%	5.4%		6.0%	6.0%	5.9%	5.9%	5.9%
1:37:53 PM	1:42:53 PM	4	OFF	92.7%								
1:42:54 PM	1:47:52 PM	4	ON		98.0%	5.3%		6.0%	5.1%	5.4%	5.4%	5.4%
1:47:53 PM	1:52:52 PM	4	OFF	92.6%								
1:52:53 PM	1:55:53 PM	4	ON		98.1%	5.5%		5.0%	5.4%	5.3%	5.4%	5.5%
AVERAGE - OFF				92.5%								
AVERAGE - USES ON				98.0%				ALL TRANSITIONS				
DIFFERENCE				5.5%								
TRANSITION AVG - OFF to ON						5.5%	-5.5%	-5.6%	-5.7%	-5.5%	-5.5%	-5.4%
TRANSITION AVG - ON to OFF								5.6%	5.5%	5.5%	5.6%	5.6%
AVERAGE - REPRESENTATIVE TRANSITIONS				5.5%								

NOTES and INTERPRETATION:

- Power consumption trend is variable throughout TIS testing period with significant load variations
- Power factor approaches unity (98.0%) when USES System is activated
- Power Factor changes from 92.5% Lagging to 98.0% Leading when USES System is activated
- Power Factor is graphed together with Real Power Demand

Table 2 above shows the Power Factor changes during TIS testing on September 30th, 2009. The Power Factor is improved to an average of 98.0% by the USES® System when all four Delta units are operational.

Graph 2



Graph 2 above shows three phase voltage on September 30th, 2009. There is approximately a 2.6 volt increase when the USES® System is activated.

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Table 3

Voltage, 3-Phase Average

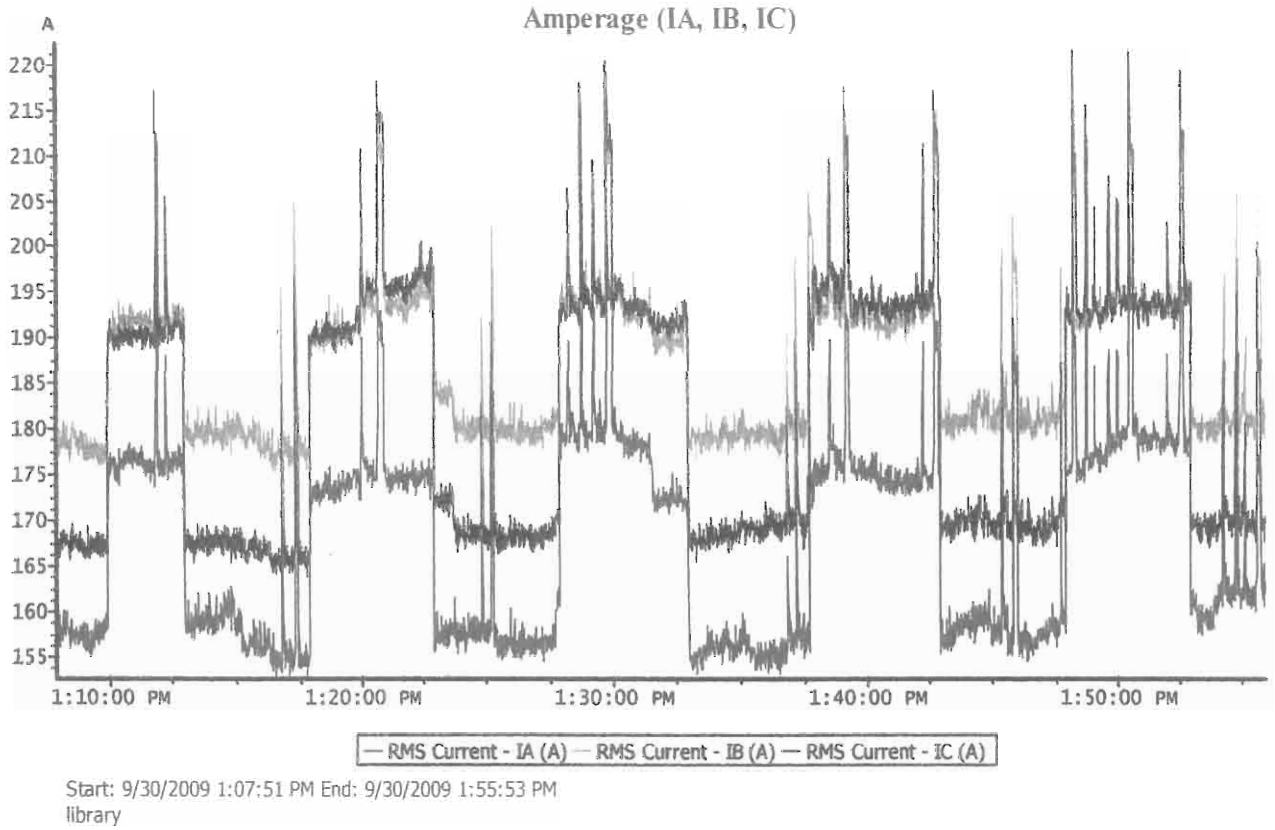
Intervals						Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Difference Off to On	Difference On to Off	Change At Transition	Change Trans.	Change Trans.	Change Trans.	Change Trans.
TIS Testing - Four (4) USES CMES-3D-480 volt units												
6:28:48 PM	6:43:12 AM	4	ON		471.6							
1:26:24 AM	1:55:12 AM	4	OFF	468.2			(3.4)	(2.3)	(3.1)	(3.4)	(3.5)	(3.6)
10:48:00 AM	2:24:00 AM	4	ON		471.2	3.1		2.4	2.5	2.7	2.4	2.3
5:45:36 PM	9:07:12 PM	4	OFF	468.9			(2.3)	(2.3)	(2.3)	(2.2)	(2.1)	(2.0)
5:45:36 PM	2:38:24 PM	4	ON		471.4	2.5		2.0	2.6	2.5	2.2	2.3
9:36:00 AM	10:48:00 PM	4	OFF	468.6			(2.8)	(2.3)	(2.7)	(2.8)	(2.6)	(2.7)
5:31:12 PM	4:04:48 PM	4	ON		471.2	2.6		2.7	2.6	2.6	2.7	2.8
9:07:12 AM	4:04:48 PM	4	OFF	468.5			(2.6)	(2.3)	(2.2)	(2.5)	(2.6)	(2.7)
12:14:24 PM	11:45:36 PM	4	ON		470.8	2.3		2.7	2.7	2.4	2.2	2.1
4:04:48 AM	6:14:24 PM	4	OFF	468.3			(2.6)	(2.8)	(2.4)	(2.8)	(2.9)	(2.9)
2:38:24 PM	2:09:36 AM	4	ON		470.7	2.4		2.8	2.5	2.4	2.3	2.3
AVERAGE - OFF				468.5								
AVERAGE - USES ON				471.1					ALL TRANSITIONS			
DIFFERENCE				2.7								
TRANSITION AVG - OFF to ON						2.6	(2.7)	(2.4)	(2.5)	(2.7)	(2.7)	(2.8)
TRANSITION AVG - ON to OFF								2.5	2.6	2.5	2.4	2.4
AVERAGE - REPRESENTATIVE TRANSITIONS				2.6								

NOTES and INTERPRETATION:

Voltage trend is steady throughout TIS testing period
Voltage is improved due to reduced circuit impedance
Full interval results are consistent with instantaneous, 15, 30, 45 and 60 second analyses.
AVG = 2.6 volt increase.

Table 3 above shows analysis of the data collected for three phase voltage on September 30th, 2009. The increases recorded for the Delta units have a cumulative effect on overall circuit voltage. With four USES® units active, the voltage is improved by about 2.6 volts.

Graph 3



Graph 3 above shows three phase amperage on September 30th, 2009. There is about an 18.5 amp reduction on each phase when the USES® System is activated.

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Table 4

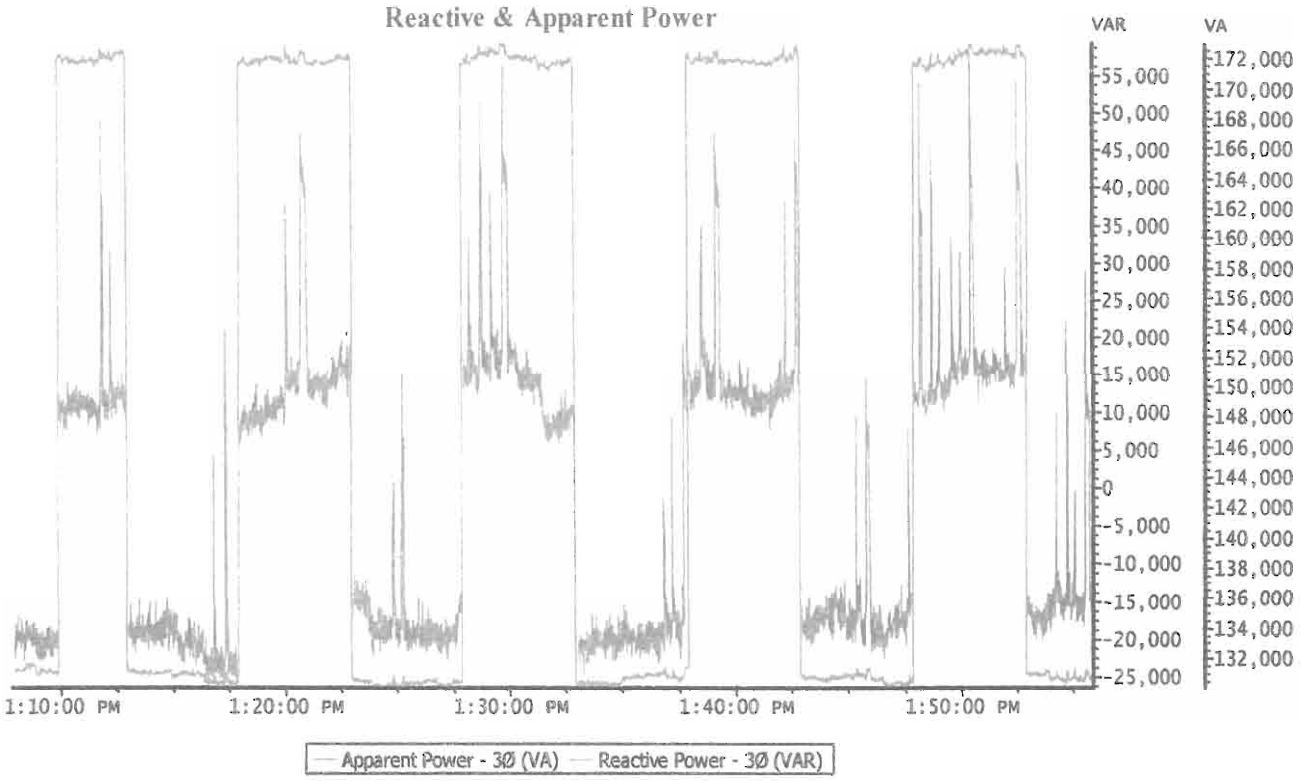
Amperage Average of Phases A, B, C (Amps)												
		Intervals				Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Difference Off to On	Difference On to Off	Change At Transition	Change Trans.	Change Trans.	Change Trans.	Change Trans.
TIS Testing - Four (4) USES CMES-3D-480 volt units												
8:09:36 AM	11:31:12 AM	4	ON		167.7							
3:50:24 PM	4:19:12 AM	4	OFF	186.8			19.0	18.6	17.9	17.9	18.3	18.5
1:26:24 AM	12:28:48 AM	4	ON		168.1	(18.6)		(17.4)	(18.2)	(18.3)	(18.5)	(18.2)
4:48:00 AM	1:55:12 PM	4	OFF	187.7			19.6	17.7	18.0	17.6	15.8	16.4
6:00:00 AM	2:09:36 PM	4	ON		169.4	(18.3)		(19.3)	(18.1)	(18.0)	(17.9)	(18.0)
9:21:36 PM	3:07:12 PM	4	OFF	188.9			19.6	16.3	17.8	20.1	21.8	21.9
6:28:48 PM	6:00:00 PM	4	ON		169.1	(19.8)		(16.4)	(17.6)	(17.5)	(17.3)	(17.1)
9:07:12 AM	5:31:12 AM	4	OFF	188.6			19.6	1.9	4.6	11.9	14.2	15.5
7:40:48 PM	8:09:36 PM	4	ON		170.3	(18.3)		(20.0)	(30.2)	(24.3)	(22.7)	(21.4)
6:00:00 AM	3:50:24 AM	4	OFF	190.5			20.2	17.8	14.6	21.2	20.7	20.5
2:24:00 AM	9:50:24 PM	4	ON		172.3	(18.5)		(21.5)	(19.5)	(25.1)	(25.1)	(22.3)
AVERAGE - OFF				188.5								
AVERAGE - USES ON				169.5				ALL TRANSITIONS				
DIFFERENCE				(19.0)								
TRANSITION AVG - OFF to ON						(18.7)	19.6	14.5	14.6	17.7	18.1	18.6
TRANSITION AVG - ON to OFF								(18.9)	(20.7)	(20.6)	(19.9)	(19.4)
AVERAGE - REPRESENTATIVE TRANSITIONS				(18.5)								

NOTES and INTERPRETATION:

Current is steady throughout TIS testing period
All intervals are included in final average
AVG = 18.5 Amp reduction when USES System activated

Table 4 above shows analysis of the data collected for three phase amperage on September 30th, 2009. There was an average reduction of 18.5 amps as a result of the USES® System.

Graph 4



Graph 4 above shows Reactive Power in VAR and Apparent Power in VA on September 30th, 2009.

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Table 5

Reactive Power (VAR)

Intervals						Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Difference Off to On	Difference On to Off	Change At Transition	Change Trans.	Change Trans.	Change Trans.	Change Trans.
TIS Testing - Four (4) USES CMES-3D-480 volt units												
1:07:51 PM	1:09:52 PM	4	ON		(24,035)							
1:09:54 PM	1:12:53 PM	4	OFF	57,163			81,198	81,670	81,902	81,562	81,326	81,267
1:12:54 PM	1:17:53 PM	4	ON		(24,797)	(82,961)		(82,119)	(82,165)	(82,051)	(81,978)	(81,891)
1:17:54 PM	1:22:53 PM	4	OFF	56,823			81,621	81,874	82,257	82,215	82,151	82,215
1:22:54 PM	1:27:52 PM	4	ON		(25,744)	(82,567)		(82,165)	(82,423)	(82,534)	(82,554)	(82,461)
1:27:53 PM	1:32:53 PM	4	OFF	56,996			82,740	81,748	82,002	82,081	82,565	82,751
1:32:54 PM	1:37:52 PM	4	ON		(25,219)	(82,215)		(82,575)	(82,465)	(82,360)	(82,288)	(82,227)
1:37:53 PM	1:42:53 PM	4	OFF	56,851			82,070	80,688	81,298	81,595	81,652	81,653
1:42:54 PM	1:47:52 PM	4	ON		(25,217)	(82,068)		(81,917)	(83,050)	(82,586)	(82,547)	(82,491)
1:47:53 PM	1:52:52 PM	4	OFF	57,350			82,567	82,473	81,706	82,113	82,047	82,065
1:52:53 PM	1:55:53 PM	4	ON		(24,907)	(82,258)		(81,859)	(82,209)	(82,569)	(82,471)	(82,466)
AVERAGE - OFF				57,037								
AVERAGE - USES ON				(24,987)				ALL TRANSITIONS				
DIFFERENCE				(82,023)								
TRANSITION AVG - OFF to ON						(82,214)	82,039	81,690	81,833	81,913	81,948	81,990
TRANSITION AVG - ON to OFF								(82,129)	(82,463)	(82,420)	(82,368)	(82,306)
AVERAGE - REPRESENTATIVE TRANSITIONS				82,103								

NOTES and INTERPRETATION:

Full interval results are consistent with instantaneous, 15, 30, 45 and 60 second analyses.
Reactive Power decreases from 57 KVAR Lagging to 25 KVAR Leading when the USES System is activated
Average Reactive Power Change = 82.1 KVAR
Reactive & Apparent Power are graphed together

Table 5 above shows analysis of the data collected for Reactive Power on September 30th, 2009. The USES® System reduced reactive power by about 82.1 kVAR when activated. The reactive power on the circuit decreased from about 57 kVAR lagging to about 25 kVAR leading.

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Table 6

Apparent Power (VA)

Intervals						Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Difference Off to On	Difference On to Off	Change At Transition	Change Trans.	Change Trans.	Change Trans.	Change Trans.
TIS Testing - Four (4) USES CMES-3D-480 volt units												
1:07:51 PM	1:09:52 PM	4	ON		133,196							
1:09:54 PM	1:12:53 PM	4	OFF	149,280			16,084	16,021	15,315	15,202	15,497	15,622
1:12:54 PM	1:17:53 PM	4	ON		133,367	(15,913)		(14,983)	(15,683)	(15,672)	(15,918)	(15,677)
1:17:54 PM	1:22:53 PM	4	OFF	150,186			16,819	15,293	15,645	15,343	13,975	14,510
1:22:54 PM	1:27:52 PM	4	ON		134,429	(15,757)		(16,638)	(15,483)	(15,455)	(15,463)	(15,530)
1:27:53 PM	1:32:53 PM	4	OFF	151,130			16,701	14,080	15,234	17,077	18,487	18,623
1:32:54 PM	1:37:52 PM	4	ON		134,102	(17,028)		(14,270)	(15,117)	(15,107)	(14,894)	(14,721)
1:37:53 PM	1:42:53 PM	4	OFF	150,805			16,703	2,683	4,904	10,643	12,409	13,435
1:42:54 PM	1:47:52 PM	4	ON		135,045	(15,760)		(27,122)	(25,057)	(20,452)	(19,248)	(18,264)
1:47:53 PM	1:52:52 PM	4	OFF	152,362			17,317	15,179	12,830	17,917	17,486	17,374
1:52:53 PM	1:55:53 PM	4	ON		136,687	(15,675)		(18,217)	(16,633)	(21,093)	(19,612)	(19,020)
AVERAGE - OFF				150,753								
AVERAGE - USES ON				134,471				ALL TRANSITIONS				
DIFFERENCE				(16,282)								
TRANSITION AVG - OFF to ON						(16,027)	16,725	15,143	14,756	16,385	16,361	16,532
TRANSITION AVG - ON to OFF								(16,246)	(17,595)	(17,556)	(17,027)	(16,642)
AVERAGE - REPRESENTATIVE TRANSITIONS				16,406								

NOTES and INTERPRETATION:

- Apparent Power trend is steady throughout TIS testing period with load variations
- Full interval results are consistent with instantaneous, 15, 30, 45 and 60 second analyses.
- Average Reduction = 16.4 KVA
- Shaded cells discounted due to significant load variations during averaging period
- Apparent Power is graphed together with Reactive Power

Table 6 above shows analysis of the data collected for Apparent Power on September 30th, 2009. There was a reduction in apparent power from 150.7 kVA to 134.5 kVA when the USES® System was activated. This translates to an apparent power reduction of 16.4 kVA on the circuit.

System Savings

Evaluation of the USES® System installed at the Library shows a demand reduction when the USES® System is activated. During the On-Peak TIS testing on September 30th, 2009, the average real power demand reduction was 7,407 watts. The total annual reduction of real power consumed is 7,407 watts x 8760 hours per year = 64,885 kWh per year.

Summary and Conclusions

The installation of a USES® Shunt Efficiency System at the Library has improved power quality and has resulted in a substantial decrease in electrical demand. The USES® System reduced the demand for electricity by about 7.4 kW. The performance of the USES® Shunt Efficiency System at the Library has proven to be consistent with all of the estimated power quality improvements as outlined in DWA Energy's proposal to ESG dated December 12, 2008.

Additional power quality improvements were also realized by the installation of the USES® System. However, the USES® System's ability to provide superior surge & spike protection cannot be measured. The benefits of enhanced surge & spike protection, will translate to additional savings through the avoidance of maintenance costs on motors and sensitive electronic systems within the facility.

The USES® System provides power quality improvements that no other power conditioning system can provide. For any questions or comments on this report, please contact Skip Delclos, Division Manager, DWA Energy at (703) 506-0012, or via email to skip@dwaenergy.com.

USES Shunt Efficiency System Evaluation

Student Center Building

by

DWA Energy

www.DWAEnergy.com

October, 2009

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Executive Summary

During February and March 2009, the purchased and installed an innovative power conditioning system known as the USES® Shunt Efficiency System throughout th The USES® System was installed to reduce the overall demand and consumption of real power and improve overall power quality while protecting the electrical circuit against electrical spikes and surges. A total of thirty-eight (38) USES® Model CMES-3D-480 Power Conditioners and one (1) USES® Model CMES-3D-208 Power Conditioners were installed in a total of six buildings on the campus. The buildings include the 1) Law Center, 2) Academic Center, 3) Business Center, 4) Student Center, 5) Library and 6) Family Law Clinic. The following report contains the results of the **Student Center** evaluation conducted on September 30th, 2009.

In accordance with the final proposal offered on December 12, 2008, the USES® System was evaluated to determine the average power conditioning results and real power demand reductions. DWA Energy used Timed Interval Sampling (TIS) methods to determine USES® System performance, and the results of the evaluations are presented herein.

The data tables and graphs presented in this report clearly show the beneficial results provided by the USES® System. All power quality data was averaged to take into account short term load variations and to determine the average levels of power quality when the USES® System was activated and de-activated. The data tables presented in this report are from the On-Peak evaluation conducted on September 30th. We have selected representative graphs for inclusion in this report. Additional data tables and graphs can be found in the compendium Excel Spreadsheet entitled "stuctr Analysis, 101609".

A full discussion of the power quality improvements, and their impact on the circuit, are discussed below.

Timed Interval Sampling (TIS) Techniques

Timed Interval Sampling (TIS) is a statistical method of energy measurement with regard to power quality over a relatively short span of time. It is valid in all facilities with electrical loads and is particularly useful in facilities where energy use is a function of manufacturing, environmental loads, and related equipment. TIS techniques are utilized to minimize the effect of numerous variables present when measuring power quality and meets the standards of the International Performance and Measurement Verification Protocol (IPMVP).

During evaluation, the USES® System was alternately energized and de-energized at five-minute intervals to collect comparative samples of energy used by the motors and other electrical loads

under steady state conditions. The energy usage data was recorded and averaged in each respective operating condition (i.e. USES® on or off), in order to demonstrate power quality changes when the USES® System is energized and de-energized.

For the TIS evaluation, an Amprobe DM-II Pro® Power Quality Analyzer and Data Logger was connected to the incoming electric service at a point immediately following the main breaker for the building. The Amprobe meter meets the standards of the National Institute of Standards and Technology. The USES® System is connected to the electrical circuit at each location in parallel through circuit breaker panels or individual breakers. The Power quality parameters measured during TIS testing consisted of voltage (each of three phases, or VAB, VBC and VCA), amperage (each of three phases, or IA, IB and IC), real power demand (Watts), reactive power (volt-amps-reactive, or VAR), apparent power (volt-amps, or VA) and power factor (%). Data on each parameter was collected every one-second during each on/off interval.

On Wednesday, September 30th from 11:43 AM to 12:32 PM, DWA Energy recorded the performance of the USES® System at the Student Center. The evaluation showed consistent overall power quality improvements and reductions in real power demand. The TIS evaluation was performed by Skip Delclos and Jeff Walsh of DWA Energy.

Evaluation of USES® System performance was made through analysis of the data recorded from the TIS testing. The USES® System was activated and deactivated for intervals of five minutes to measure the changes in overall power quality in each operating condition. A separate test of the cumulative effect of the USES® power conditioners was also conducted to confirm that each of the units was operating properly. Whenever the USES® System was turned on or off, the differences between the conditioned and unconditioned power quality was determined and averaged to demonstrate the overall effect that the USES® System has on the circuit.

All recorded data was evaluated and averaged in the following manner to determine the overall average performance of the USES® System:

- The average power quality for the full five-minute interval was calculated and compared to the next five-minute interval before and after each transition from on to off, and off to on.
- Each instantaneous change in power quality was determined by comparing the last one-second with the USES® System on to the first one-second with the USES® System off, and visa-versa.
- The average power quality was calculated 15-seconds before and after each transition from on to off, and off to on.
- The average power quality was calculated 30-seconds before and after each transition from on to off, and off to on.
- The average power quality was calculated 60-seconds before and after each transition from on to off, and off to on.

- All transitional changes were averaged to derive the overall average performance of the USES® System.

DWA Energy has found that Timed Interval Sampling is the most reliable and verifiable method of comparing power quality while still accounting for all variables present. TIS methods are used to verify that the USES® System is operating as expected in your facility.

Discussion of Power Quality Improvements

The installation of the USES® System at the Student Center has resulted in measurable and verifiable power quality improvements, as well as other benefits which cannot be measured. A discussion of the power quality improvements resulting from the USES® System is presented below:

Spike and Surge Protection - Inherent in the USES® System, but not measured, is the ability to provide superior spike and surge suppression capabilities. A surge is any voltage increase lasting 3 or more nanoseconds. A spike is any voltage increase lasting less than 3 nanoseconds. The USES® device detects any surges or spikes traveling along one of the active phases and shunts it to the other two phases. From there, the transformer/choke sets within the USES® device attenuate the surge/spike through the action of the "chokes", which use capacitors and inductors to resist the change in voltage and associated change in current, and flatten out the waveform. The surge/spike is recycled as usable power for the circuit. Because no USES® "Wye" units were specified for the University, the USES® System will not protect the circuit against ground fault transients or lightning strikes which can enter the circuit through the neutral conductor.

Reactive Power, Apparent Power and Amperage – The USES® System reduces the reactive power on the circuit through transformer action which produces current which leads voltage on each phase. The USES® System reduces reactive power in a fundamentally different way than power factor correcting capacitors, and does so without creating resonance. Each USES® Model CMES-3D-480 power conditioner reduces reactive power by 21-23 kVAR. A reduction in reactive power results in a corresponding decrease in the apparent power on the circuit. This, in turn, results in a decrease in the amount of amperage on the circuit, which results in a decrease in real power demand as a result of reduced "Copper Losses" on the circuit. Copper losses manifest themselves as heat in motors and conductors and can reduce the useful life of motors, transformers and sensitive electronic equipment. The reduction in reactive power on the circuit also acts to "stiffen" the circuit by reducing overall circuit impedance. A "stiff" circuit will reduce the creation of voltage total harmonic distortion as a result of current harmonics.

Power Factor – Power Factor is the ratio of real power to apparent power. Because the USES System reduces both real power demand and apparent power demand, the power factor is

improved and approaches unity, or 100%. Because the USES System does not create resonance, any leading Power Factor will have no effect on the performance or reliability of the equipment.

Voltage Improvement - By improving voltage across each of the three phases (VAB, VBC, VCA), circuit amperage is further reduced and motors will run cooler and last longer. Increased voltage will also lessen the likelihood of equipment tripping off due to utility voltage sags.

Harmonics – The USES® System reduces the Total Harmonic Distortion (THD) of the amperage and voltage on the circuit to the loads by passing all power generated within the USES® System through 60 Hz Band-Pass Filters. Because the USES System is connected to the electrical circuit in parallel, some THD will continue to pass on to the operational loads. However, because a significant portion of the power supplied to the load is "choked" to 60 Hz, total THD supplied to the load is reduced. This action significantly reduces the THD in the voltage and current provided to the operating motors, thus increasing motor efficiency. Problems associated with circuit harmonics include:

- Excessive Neutral Currents, where voltage harmonics result in additional current on the circuit neutral conductor, resulting in additional heat, possible overloading and the need to install additional neutral conductors.
- Overheated transformers, where harmonics generated on the secondary side of a delta-wye transformer will circulate on the primary side of the transformer. Some types of transformer losses, such as skin losses and eddy currents will increase by the square of the harmonic order.
- Overheated solenoid coils and lighting ballasts.
- Positive, negative and zero sequence voltages on motors and generators, where certain harmonic frequencies will try to rotate the motor forward or backward, or simply heat up the motor.
- Incorrect reading power meters, especially disc type watt-hour meters and averaging type current meters.
- Failure of electronic equipment, including nuisance tripping and overload.
- Nuisance tripping of circuit protection devices including false tripping of relays and failure of UPS devices to properly transfer.
- Blown fuses and overheated power factor correction capacitors due to the effects of harmonics with circuit resonance.

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Summary of Power Quality Improvements

Analysis of the TIS testing results from September 30th, 2009 demonstrate that the USES® System has made substantial improvements in overall power quality. The following power quality improvements are realized by the USES® System. All six units have had the following effect on the electrical circuit:

- Real Power Demand (kW) – **Real Power demand was reduced by 8.2 kW** with all six of the USES® Model CMES-3D-480 Power Conditioners activated. Each USES® unit was individually tested and found to be operational and contributing to the overall power demand reduction.

- Power Factor – Power Factor improved from **86.9.2% to 99.8%** and remained lagging when the USES® System was activated.

- Voltage – Voltage improved by an average of **5.1 volts** across each phase (VAB, VBC, VCA).

- Amperage – Amperage was reduced by **50.5 amps** on all three phases.

- Reactive Power - Reactive Power was reduced by **128.6 kVAR** when the USES® System was activated.

- Apparent Power – Apparent Power was reduced by **44.1 kVA** when USES® System was activated.

Graphs and Data Tables

Through evaluation of the Amprobe DM-II Pro® Power Quality Analyzer and Data Logger recordings collected on September 30th, we have prepared a series of graphs and data tables to demonstrate the performance of the USES® System. The following graphs are presented below, showing all changes to power quality when the USES® System is activated or de-activated:

- Graph 1 – Real Power (Watts) and Power Factor (%) – This graph shows real power in watts and power factor in % during the September 30th, 2009 TIS testing.
- Graph 2 – Voltage, 3 Phase from the September 30th, 2009 TIS testing.
- Graph 3 – Amperage, 3 Phase from the September 30th, 2009 TIS testing.
- Graph 4 – Reactive and Apparent Power – This graph shows the effects on reactive and apparent power when the USES® System is turned ON and OFF on September 30th, 2009.

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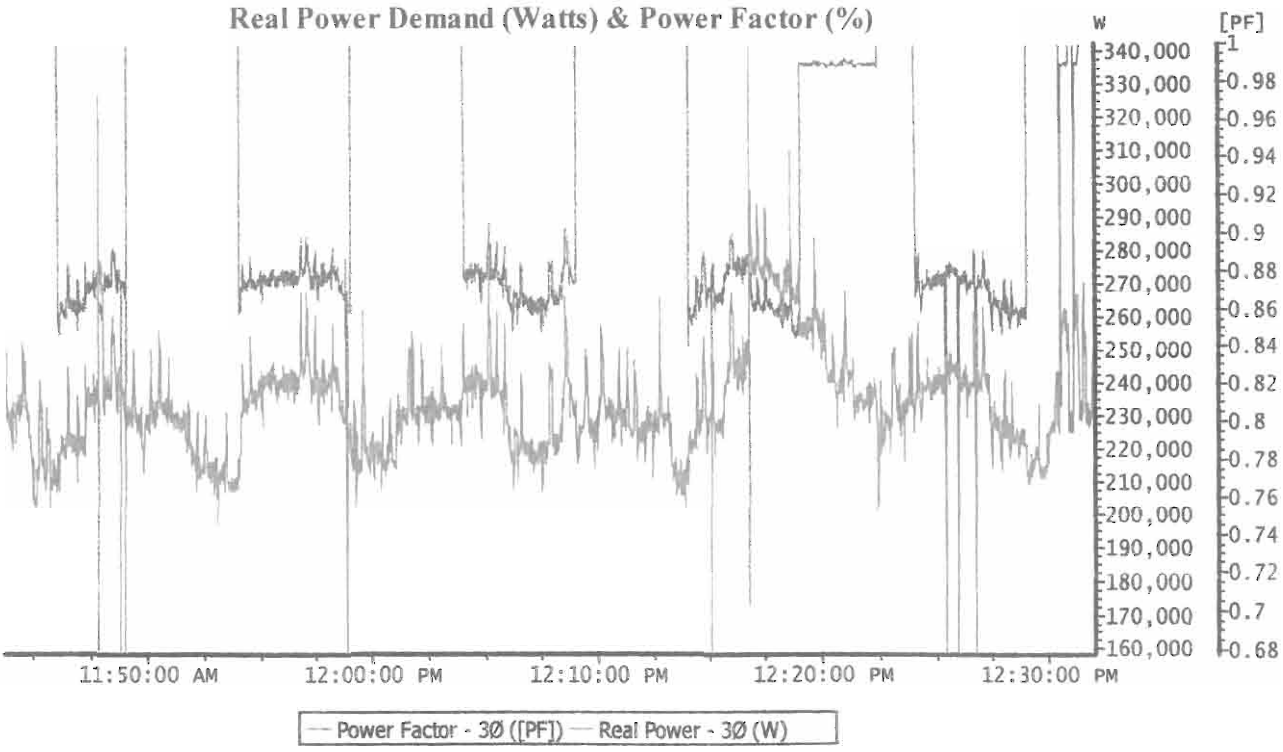
The following data tables are presented to show the average observed performance of the USES® System at the Student Center. Please note that during the TIS testing, each USES® unit was tested individually to ensure performance and evaluate circuit improvements with one, two, three, four, five, and six units cumulatively.

- Table 1 – Real Power (Watts) from September 30th, 2009.
- Table 2 – Power Factor (%) from September 30th, 2009.
- Table 3 – Voltage, 3 Phase Average from September 30th, 2009.
- Table 4 – Amperage, 3 Phase Average from September 30th, 2009.
- Table 5 – Reactive Power (VAR) from September 30th, 2009.
- Table 6 – Apparent Power (VA) from September 30th, 2009.

Note: Graphs and Data Tables are representative of the performance of the USES® System at the Student Center. All Data Tables and Graphs, together with all raw data are included in the compendium Excel files from September 30th, 2009.

Graph 1



Start: 9/30/2009 11:43:25 AM End: 9/30/2009 12:32:03 PM
student center

Graph 1 above shows the Real Power Demand in watts and Power Factor on September 30th, 2009 from 11:43 AM to 12:32 PM. With all six USES® Model CMES-3D-480 power conditioning units operating, the real power demand is reduced an average of **8,247 watts**. Overall Power Factor is improved from 86.9% to **99.8%**.

Table 1

Real Power Demand (Watts)

Intervals						Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
Interval Time Frame		#USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Difference Off to On	Difference On to Off	Change At Transition	Change Trans.	Change Trans.	Change Trans.	Change Trans.
TIS Testing - Six (6) USES CMES-3D-480 volt units												
11:43:25 AM	11:46:02 AM	6	ON		224,571							
11:46:03 AM	11:49:02 AM	6	OFF	233,024			8,454	11,789	5,104	6,925	5,582	6,983
11:49:03 AM	11:54:02 AM	6	ON		222,978	(10,047)		138,796	12,816	3,792	(4,327)	(6,400)
11:54:04 AM	11:59:02 AM	6	OFF	238,873			15,895	6,148	19,658	23,836	22,654	23,404
11:59:03 AM	12:04:01 PM	6	ON		227,653	(11,220)		(7,249)	(2,903)	(7,481)	(9,551)	(13,005)
12:04:02 PM	12:09:02 PM	6	OFF	231,652			3,999	7,356	6,139	7,148	7,369	5,824
12:09:03 PM	12:14:02 PM	6	ON		227,436	(4,216)		(9,752)	(10,708)	(11,131)	(9,902)	(5,566)
12:14:03 PM	12:19:02 PM	6	OFF	252,944			25,508	9,608	10,375	15,119	17,618	13,163
12:19:03 PM	12:24:02 PM	6	ON		241,246	(11,698)		(8,118)	(10,907)	(14,114)	(11,691)	(10,896)
12:24:03 PM	12:29:02 PM	6	OFF	234,208			(7,038)	7,057	1,490	2,639	4,545	2,450
12:29:03 PM	12:32:03 PM	6	ON		233,065	(1,143)		(6,060)	(10,524)	(7,686)	(8,493)	(8,698)
AVERAGE - OFF				238,140								
AVERAGE - USES ON				229,491				ALL TRANSITIONS				
DIFFERENCE				(8,649)								
TRANSITION AVG - OFF to ON						(7,665)	9,363	7,542	5,777	7,958	8,781	7,105
TRANSITION AVG - ON to OFF								(7,795)	(8,760)	(10,103)	(8,795)	(8,913)
AVERAGE - REPRESENTATIVE TRANSITIONS				8,247								

NOTES and INTERPRETATION:

Power consumption trend is variable throughout TIS testing period with significant load variations

Shaded cells discounted due to significant load variations during averaging period

Performance of USES system = 8,247 Watts Real Power Demand reduction

Average performance per CMES-3D-480 volt USES unit = 1.4 kW per unit

Table 1 above shows analysis of the wattage data collected by the Amprobe DM-II Pro Multi-Meter and Data-Logger during TIS testing on September 30th, 2009. The intervals are generally of approximately 5-minute duration.

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Table 2

Power Factor (%)

Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Full Interval Difference Off to On	Full Interval Difference On to Off	Instant Change At Transition	15 Sec Avg Change Trans.	30 Sec Avg Change Trans.	45 Sec Avg Change Trans.	60 Sec Avg Change Trans.
TIS Testing - Six (6) USES CMES-3D-480 volt units												
11:43:25 AM	11:46:02 AM	6	ON		100.0%							
11:46:03 AM	11:49:02 AM	6	OFF	86.4%			13.6%	14.0%	14.4%	13.8%	13.8%	13.8%
11:49:03 AM	11:54:02 AM	6	ON		100.0%	13.6%		42.0%	16.9%	14.6%	13.7%	13.5%
11:54:04 AM	11:59:02 AM	6	OFF	87.5%			12.5%	14.0%	15.1%	12.9%	12.9%	12.8%
11:59:03 AM	12:04:01 PM	6	ON		100.0%	12.5%		14.0%	15.4%	14.1%	13.5%	13.1%
12:04:02 PM	12:09:02 PM	6	OFF	87.3%			12.7%	11.0%	12.1%	12.1%	12.2%	12.2%
12:09:03 PM	12:14:02 PM	6	ON		100.0%	12.7%		13.0%	12.5%	11.7%	12.0%	12.4%
12:14:03 PM	12:19:02 PM	6	OFF	86.6%			13.4%	15.0%	14.4%	13.9%	13.4%	13.3%
12:19:03 PM	12:24:02 PM	6	ON		99.3%	12.7%		14.0%	13.9%	13.5%	13.4%	13.4%
12:24:03 PM	12:29:02 PM	6	OFF	86.6%			12.7%	11.0%	12.8%	13.0%	12.8%	12.8%
12:29:03 PM	12:32:03 PM	6	ON		99.6%	12.9%		15.0%	14.3%	14.4%	14.2%	14.2%
AVERAGE - OFF				86.9%								
AVERAGE - USES ON				99.8%				ALL TRANSITIONS				
DIFFERENCE				12.9%								
TRANSITION AVG - OFF to ON						12.9%	13.0%	-13.3%	-13.4%	-13.2%	-13.1%	-13.0%
TRANSITION AVG - ON to OFF								14.0%	14.0%	13.4%	13.4%	13.3%
AVERAGE - REPRESENTATIVE TRANSITIONS				13.3%								

NOTES and INTERPRETATION:

Power consumption trend is variable throughout TIS testing period with significant load variations

Power factor approaches unity (99.8%) when USES System is activated

Power Factor changes from 86.9% Lagging to 99.8% Lagging when USES System is activated

Power Factor is graphed together with Real Power Demand

Table 2 above shows the Power Factor changes during TIS testing on September 30th, 2009. The Power Factor is improved to an average of 99.8% by the USES® System when all six Delta units are operational.

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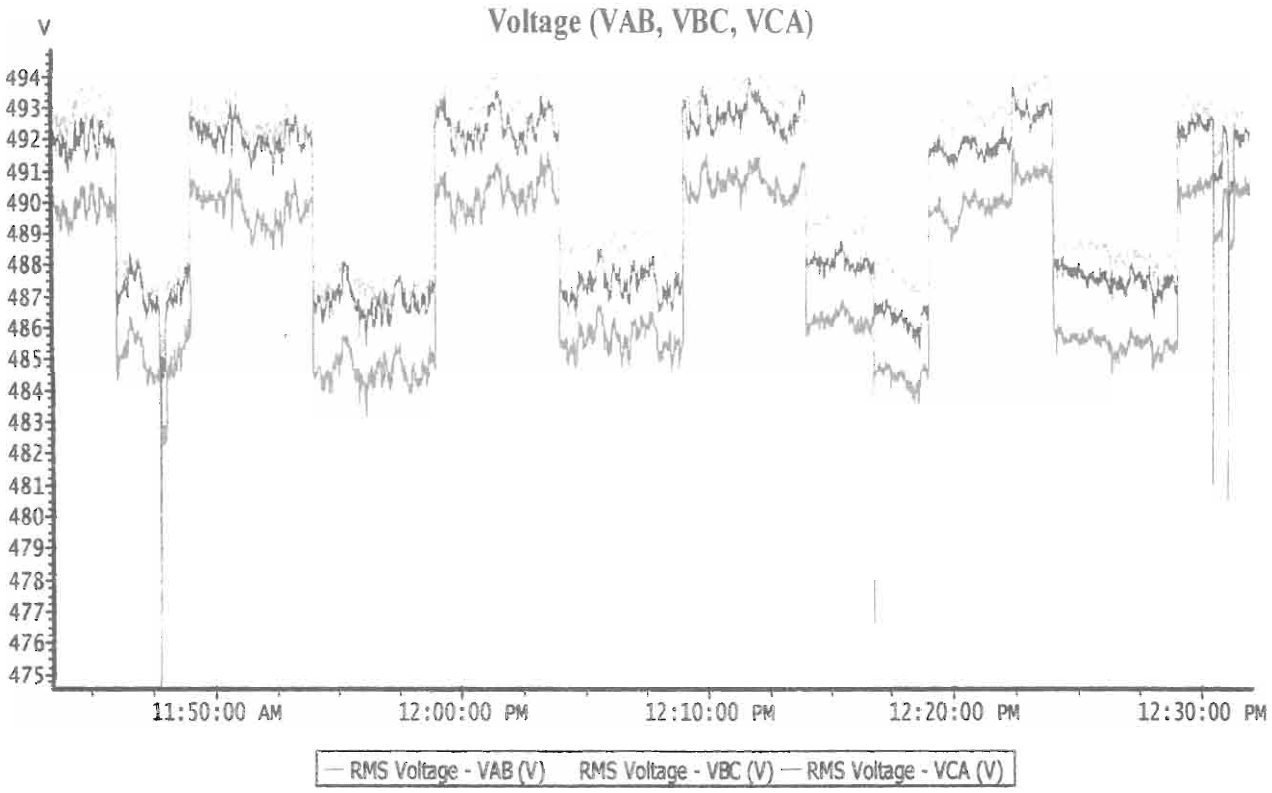
Graph 2



Graph 2 above shows three phase voltage on September 30th, 2009. There is approximately a 5.1 volt increase when the USES® System is activated.

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Table 3

Voltage, 3-Phase Average

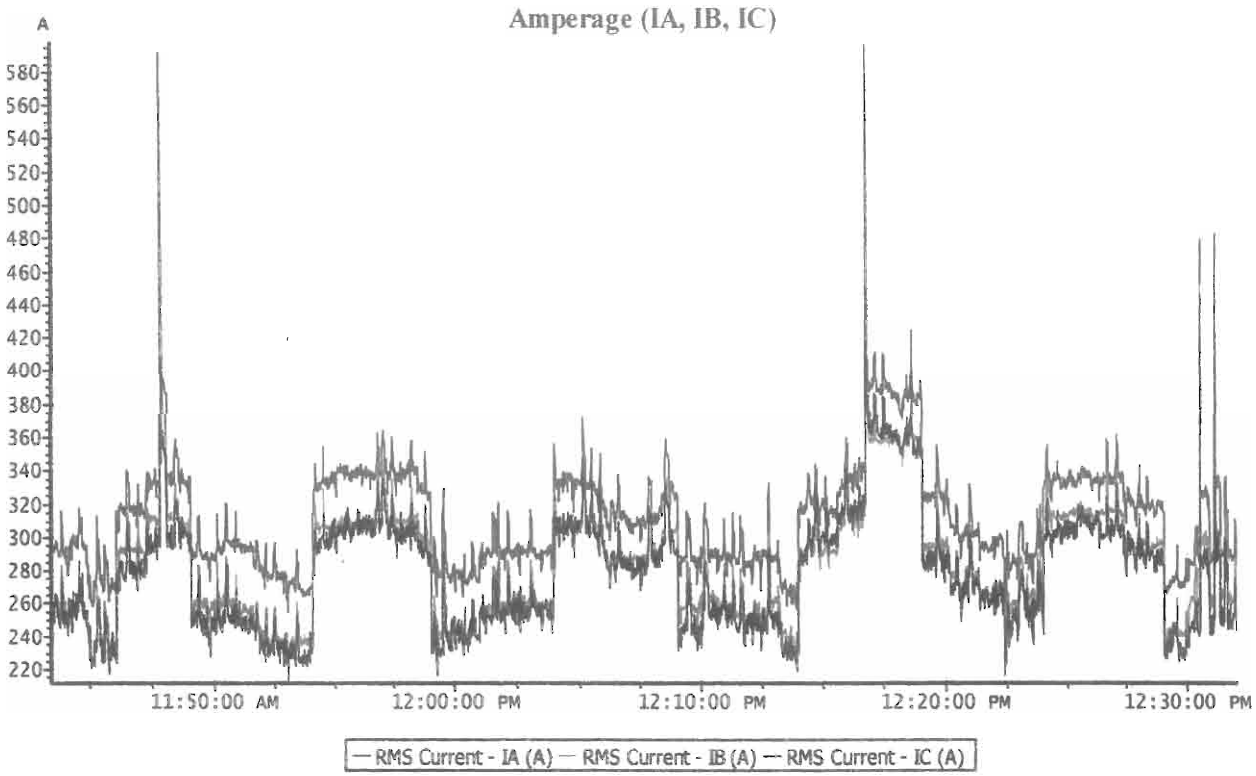
Intervals						Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
				USES OFF	USES ON	Difference	Difference	Change	Change	Change	Change	Change
Interval Time Frame		#USES	Status	AVERAGE	AVERAGE	Off to On	On to Off	At Transition	Trans.	Trans.	Trans.	Trans.
TIS Testing - Six (6) USES CMES-3D-480 volt units												
11:43:25 AM	11:46:02 AM	6	ON		491.5							
11:46:03 AM	11:49:02 AM	6	OFF	486.4			(5.1)	(5.0)	(5.0)	(4.9)	(4.8)	(4.8)
11:49:03 AM	11:54:02 AM	6	ON		491.5	5.0		5.1	4.7	4.9	5.0	5.2
11:54:04 AM	11:59:02 AM	6	OFF	486.3			(5.1)	(5.3)	(5.4)	(5.3)	(5.3)	(5.4)
11:59:03 AM	12:04:01 PM	6	ON		492.0	5.6		5.3	5.5	5.7	5.5	5.5
12:04:02 PM	12:09:02 PM	6	OFF	487.2			(4.8)	(5.0)	(4.9)	(5.5)	(5.5)	(5.4)
12:09:03 PM	12:14:02 PM	6	ON		492.3	5.1		5.2	5.3	5.2	5.2	5.4
12:14:03 PM	12:19:02 PM	6	OFF	487.1			(5.2)	(5.2)	(5.1)	(4.7)	(4.5)	(4.3)
12:19:03 PM	12:24:02 PM	6	ON		491.8	4.7		5.1	5.1	5.4	5.3	5.3
12:24:03 PM	12:29:02 PM	6	OFF	487.2			(4.6)	(5.1)	(5.0)	(5.1)	(5.1)	(5.1)
12:29:03 PM	12:32:03 PM	6	ON		491.5	4.4		5.1	4.9	4.9	5.0	5.1
AVERAGE - OFF				486.8								
AVERAGE - USES ON				491.8				ALL TRANSITIONS				
DIFFERENCE				4.9								
TRANSITION AVG - OFF to ON						5.0	(5.0)	(5.2)	(5.0)	(5.0)	(4.9)	(4.8)
TRANSITION AVG - ON to OFF								5.2	5.2	5.3	5.2	5.3
AVERAGE - REPRESENTATIVE TRANSITIONS				(5.1)								

NOTES and INTERPRETATION:

Voltage trend is steady throughout TIS testing period
Voltage is improved due to reduced circuit impedance
Full interval results are consistent with instantaneous, 15, 30, 45 and 60 second analyses.
AVG = 5.1 volt increase.

Table 3 above shows analysis of the data collected for three phase voltage on September 30th, 2009. The increases recorded for the Delta units have a cumulative effect on overall circuit voltage. With six USES® units active, the voltage is improved by about 5.1 volts.

Graph 3



Graph 3 above shows three phase amperage on September 30th, 2009. There is about a 50.5 amp reduction on each phase when the USES® System is activated.

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Table 4

Amperage Average of Phases A, B, C (Amps)

Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Full Interval Difference Off to On	Full Interval Difference On to Off	Instant Change At Transition	15 Sec Avg Change Trans.	30 Sec Avg Change Trans.	45 Sec Avg Change Trans.	60 Sec Avg Change Trans.
TIS Testing - Six (6) USES CMES-3D-480 volt units												
11:43:25 AM	11:46:02 AM	6	ON		261.3							
11:46:03 AM	11:49:02 AM	6	OFF	313.4			52.1	52.5	46.1	47.4	45.6	47.2
11:49:03 AM	11:54:02 AM	6	ON		259.2	(54.1)		(47.2)	(46.2)	(44.5)	(50.4)	(51.4)
11:54:04 AM	11:59:02 AM	6	OFF	316.4			57.2	47.2	61.5	66.0	64.7	65.6
11:59:03 AM	12:04:01 PM	6	ON		264.5	(51.9)		(46.6)	(54.2)	(53.3)	(53.4)	(56.2)
12:04:02 PM	12:09:02 PM	6	OFF	306.4			41.9	43.6	44.1	45.7	46.0	44.1
12:09:03 PM	12:14:02 PM	6	ON		264.1	(42.2)		(48.4)	(49.3)	(48.5)	(47.6)	(43.1)
12:14:03 PM	12:19:02 PM	6	OFF	338.9			74.7	52.9	53.5	57.9	59.5	54.0
12:19:03 PM	12:24:02 PM	6	ON		282.0	(56.9)		(60.9)	(65.6)	(67.8)	(64.4)	(62.2)
12:24:03 PM	12:29:02 PM	6	OFF	313.3			31.3	48.3	40.4	42.2	44.1	41.5
12:29:03 PM	12:32:03 PM	6	ON		272.8	(40.4)		(49.2)	(53.1)	(50.0)	(50.8)	(51.1)
AVERAGE - OFF				317.7								
AVERAGE - USES ON				267.3				ALL TRANSITIONS				
DIFFERENCE				(50.3)								
TRANSITION AVG - OFF to ON						(45.1)	51.4	48.0	46.0	48.3	48.8	46.7
TRANSITION AVG - ON to OFF								(51.5)	(55.4)	(54.9)	(53.3)	(53.0)
AVERAGE - REPRESENTATIVE TRANSITIONS				50.5								

NOTES and INTERPRETATION:

Current is steady throughout TIS testing period
All intervals are included in final average
AVG = 50.5 Amp reduction when USES System activated

Table 4 above shows analysis of the data collected for three phase amperage on September 30th, 2009. There was an average reduction of 50.5 amps as a result of the USES® System.

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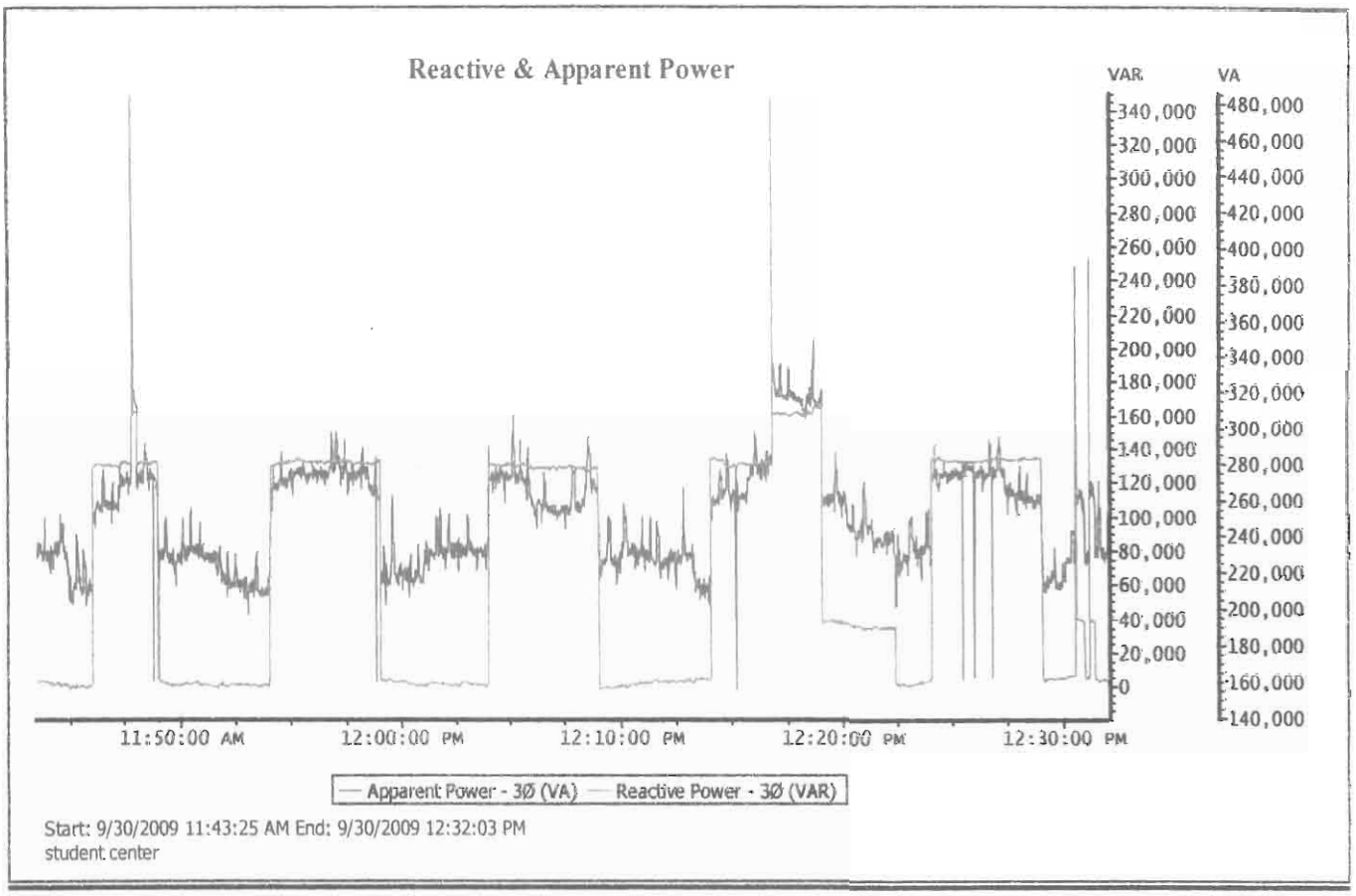
Graph 4



Graph 4 above shows Reactive Power in VAR and Apparent Power in VA on September 30th, 2009.

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Table 5

Reactive Power (VAR)

Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Full Interval Difference Off to On	Full Interval Difference On to Off	Instant Change At Transition	15 Sec Avg Change Trans.	30 Sec Avg Change Trans.	45 Sec Avg Change Trans.	60 Sec Avg Change Trans.
TIS Testing - Six (6) USES CMES-3D-480 volt units												
11:43:25 AM	11:46:02 AM	6	ON		1,578							
11:46:03 AM	11:49:02 AM	6	OFF	134,761			133,183	128,172	129,848	130,096	130,024	130,059
11:49:03 AM	11:54:02 AM	6	ON		1,465	(133,296)		(129,447)	(129,311)	(129,475)	(129,928)	(130,044)
11:54:04 AM	11:59:02 AM	6	OFF	131,836			130,371	129,578	129,315	129,825	130,285	130,263
11:59:03 AM	12:04:01 PM	6	ON		2,043	(129,794)		(128,963)	(128,624)	(127,621)	(127,931)	(127,881)
12:04:02 PM	12:09:02 PM	6	OFF	129,173			127,130	129,553	129,679	129,202	128,980	128,914
12:09:03 PM	12:14:02 PM	6	ON		2,241	(126,932)		(130,026)	(129,486)	(128,595)	(128,545)	(128,509)
12:14:03 PM	12:19:02 PM	6	OFF	145,778			143,537	129,293	129,366	129,010	127,538	127,609
12:19:03 PM	12:24:02 PM	6	ON		25,008	(120,770)		(127,093)	(127,961)	(125,488)	(125,749)	(125,097)
12:24:03 PM	12:29:02 PM	6	OFF	133,330			108,322	129,870	130,141	130,768	130,609	130,935
12:29:03 PM	12:32:03 PM	6	ON		14,259	(119,070)		(129,233)	(129,830)	(129,545)	(129,159)	(129,109)
AVERAGE - OFF				134,975								
AVERAGE - USES ON				7,766				ALL TRANSITIONS				
DIFFERENCE				(127,210)								
TRANSITION AVG - OFF to ON						(125,972)	128,509	129,573	129,758	129,769	129,288	129,379
TRANSITION AVG - ON to OFF								(128,844)	(128,975)	(128,062)	(128,262)	(128,308)
AVERAGE - REPRESENTATIVE TRANSITIONS				128,608								

NOTES and INTERPRETATION:

Full interval results are consistent with instantaneous, 15, 30, 45 and 60 second analyses.

Reactive Power decreases from 135 kVAR Lagging to 7.7 kVAR Lagging when the USES System is activated

Average Reactive Power Change = 128.6 kVAR

Reactive & Apparent Power are graphed together

Table 5 above shows analysis of the data collected for Reactive Power on September 30th, 2009. The USES® System reduced reactive power by about 128.6 kVAR when activated. The reactive power on the circuit decreased from about 135 kVAR to about 7.7 kVAR.

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Table 6

Apparent Power (VA)

Intervals						Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
				USES OFF	USES ON	Difference	Difference	Change	Change	Change	Change	Change
Interval Time Frame		#USES	Status	AVERAGE	AVERAGE	Off to On	On to Off	At Transition	Trans.	Trans.	Trans.	Trans.
TIS Testing - Six (6) USES CMES-3D-480 volt units												
11:43:25 AM	11:46:02 AM	6	ON		224,580							
11:46:03 AM	11:49:02 AM	6	OFF	269,521			44,941	46,983	41,448	42,573	41,166	42,505
11:49:03 AM	11:54:02 AM	6	ON		222,984	(46,537)		70,473	(26,322)	(32,539)	(29,652)	(41,747)
11:54:04 AM	11:59:02 AM	6	OFF	272,920			49,937	42,246	54,104	57,978	56,883	57,612
11:59:03 AM	12:04:01 PM	6	ON		227,665	(45,255)		(47,086)	(40,530)	(43,499)	(44,751)	(47,646)
12:04:02 PM	12:09:02 PM	6	OFF	265,293			37,628	38,484	39,325	40,318	40,575	39,063
12:09:03 PM	12:14:02 PM	6	ON		227,454	(37,839)		(41,057)	(43,729)	(42,979)	(42,127)	(38,446)
12:14:03 PM	12:19:02 PM	6	OFF	292,142			64,687	47,183	47,753	51,728	52,994	48,407
12:19:03 PM	12:24:02 PM	6	ON		243,035	(49,107)		(51,345)	(55,418)	(57,506)	(54,623)	(53,632)
12:24:03 PM	12:29:02 PM	6	OFF	269,701			26,666	42,907	36,202	37,740	39,332	37,176
12:29:03 PM	12:32:03 PM	6	ON		234,525	(35,176)		(43,426)	(47,626)	(44,929)	(45,549)	(45,674)
AVERAGE - OFF				273.916								
AVERAGE - USES ON				230,041				ALL TRANSITIONS				
DIFFERENCE				(43,875)								
TRANSITION AVG - OFF to ON						(42,783)	44,772	42,705	41,182	43,090	43,517	41,788
TRANSITION AVG - ON to OFF								(45,379)	(46,826)	(47,228)	(45,352)	(45,429)
AVERAGE - REPRESENTATIVE TRANSITIONS				44,148								

NOTES and INTERPRETATION:

Apparent Power trend is steady throughout TIS testing period with load variations

Full interval results are consistent with instantaneous 15, 30, 45 and 60 second analyses.

Average Reduction = 44.1 kVA

Apparent Power is graphed together with Reactive Power

Table 6 above shows analysis of the data collected for Apparent Power on September 30th, 2009. There was a reduction in apparent power from 274 kVA to 230 kVA when the USES® System was activated. This translates to an apparent power reduction of 44.1 kVA on the circuit.

System Savings

Evaluation of the USES® System installed at the Student Center shows a demand reduction when the USES® System is activated. During the On-Peak TIS testing on September 30th, 2009, the average real power demand reduction was 8,247 watts. The total annual reduction of real power consumed is 8,247 watts x 8760 hours per year = 72,244 kWh per year.

Summary and Conclusions

The installation of a USES® Shunt Efficiency System at the Student Center has improved power quality and has resulted in a substantial decrease in electrical demand. The USES® System reduced the demand for electricity by about 8.2 kW. The performance of the USES® Shunt Efficiency System at the Student Center has proven to be consistent with all of the estimated power quality improvements as outlined in DWA Energy's proposal dated December 12, 2008.

Additional power quality improvements were also realized by the installation of the USES® System. However, the USES® System's ability to provide superior surge & spike protection cannot be measured. The benefits of enhanced surge & spike protection, will translate to additional savings through the avoidance of maintenance costs on motors and sensitive electronic systems within the facility.

The USES® System provides power quality improvements that no other power conditioning system can provide. For any questions or comments on this report, please contact Skip Delclos, Division Manager, DWA Energy at (703) 506-0012, or via email to skip@dwaenergy.com.

USES Shunt Efficiency System Evaluation

For

Energy Systems Group
And
The University of Baltimore
Family Law Center Building

by

DWA Energy

www.DWAEnergy.com

October, 2009

DWA Energy
www.DWAEnergy.com

Executive Summary

During February and March 2009, the Energy Systems Group (ESG) purchased and installed an innovative power conditioning system known as the USES® Shunt Efficiency System throughout the University of Baltimore Campus in Baltimore, MD. The USES® System was installed to reduce the overall demand and consumption of real power and improve overall power quality while protecting the electrical circuit against electrical spikes and surges. A total of thirty-eight (38) USES® Model CMES-3D-480 Power Conditioners and one (1) USES® Model CMES-3D-208 Power Conditioners were installed in a total of six buildings on the campus. The buildings include the 1) Law Center, 2) Academic Center, 3) Business Center, 4) Student Center, 5) Library and 6) Family Law Clinic. The following report contains the results of the **Family Law Center** evaluation conducted on September 30th, 2009.

In accordance with the final proposal offered to ESG by DWA Energy on December 12, 2008, the USES® System was evaluated to determine the average power conditioning results and real power demand reductions. DWA Energy used Timed Interval Sampling (TIS) methods to determine USES® System performance, and the results of the evaluations are presented herein.

The data tables and graphs presented in this report clearly show the beneficial results provided by the USES® System. All power quality data was averaged to take into account short term load variations and to determine the average levels of power quality when the USES® System was activated and de-activated. The data tables presented in this report are from the On-Peak evaluation conducted on September 30th. We have selected representative graphs for inclusion in this report. Additional data tables and graphs can be found in the compendium Excel Spreadsheet entitled "FamLawCtr Analysis, 101609".

A full discussion of the power quality improvements, and their impact on the circuit, are discussed below.

Timed Interval Sampling (TIS) Techniques

Timed Interval Sampling (TIS) is a statistical method of energy measurement with regard to power quality over a relatively short span of time. It is valid in all facilities with electrical loads and is particularly useful in facilities where energy use is a function of manufacturing, environmental loads, and related equipment. TIS techniques are utilized to minimize the effect of numerous variables present when measuring power quality and meets the standards of the International Performance and Measurement Verification Protocol (IPMVP).

During evaluation, the USES® System was alternately energized and de-energized at five-minute intervals to collect comparative samples of energy used by the motors and other electrical loads

under steady state conditions. The energy usage data was recorded and averaged in each respective operating condition (i.e. USES® on or off), in order to demonstrate power quality changes when the USES® System is energized and de-energized.

For the TIS evaluation, an Amprobe DM-II Pro® Power Quality Analyzer and Data Logger was connected to the incoming electric service at a point immediately following the main breaker for the building. The Amprobe meter meets the standards of the National Institute of Standards and Technology. The USES® System is connected to the electrical circuit at each location in parallel through circuit breaker panels or individual breakers. The Power quality parameters measured during TIS testing consisted of voltage (each of three phases, or VAB, VBC and VCA), amperage (each of three phases, or IA, IB and IC), real power demand (Watts), reactive power (volt-amps-reactive, or VAR), apparent power (volt-amps, or VA) and power factor (%). Data on each parameter was collected every one-second during each on/off interval.

On Wednesday, September 30th from 2:56 PM to 3:34 PM, DWA Energy recorded the performance of the USES® System at the Family Law Center. The evaluation showed consistent overall power quality improvements and reductions in real power demand. The TIS evaluation was performed by Skip Delclos and Jeff Walsh of DWA Energy.

Evaluation of USES® System performance was made through analysis of the data recorded from the TIS testing. The USES® System was activated and deactivated for intervals of five minutes to measure the changes in overall power quality in each operating condition. A separate test of the cumulative effect of the USES® power conditioners was also conducted to confirm that each of the units was operating properly. Whenever the USES® System was turned on or off, the differences between the conditioned and unconditioned power quality was determined and averaged to demonstrate the overall effect that the USES® System has on the circuit.

All recorded data was evaluated and averaged in the following manner to determine the overall average performance of the USES® System:

- The average power quality for the full five-minute interval was calculated and compared to the next five-minute interval before and after each transition from on to off, and off to on.
- Each instantaneous change in power quality was determined by comparing the last one-second with the USES® System on to the first one-second with the USES® System off, and visa-versa.
- The average power quality was calculated 15-seconds before and after each transition from on to off, and off to on.
- The average power quality was calculated 30-seconds before and after each transition from on to off, and off to on.
- The average power quality was calculated 60-seconds before and after each transition from on to off, and off to on.

- All transitional changes were averaged to derive the overall average performance of the USES® System.

DWA Energy has found that Timed Interval Sampling is the most reliable and verifiable method of comparing power quality while still accounting for all variables present. TIS methods are used to verify that the USES® System is operating as expected in your facility.

Discussion of Power Quality Improvements

The installation of the USES® System at the Family Law Center has resulted in measurable and verifiable power quality improvements, as well as other benefits which cannot be measured. A discussion of the power quality improvements resulting from the USES® System is presented below:

Spike and Surge Protection - Inherent in the USES® System, but not measured, is the ability to provide superior spike and surge suppression capabilities. A surge is any voltage increase lasting 3 or more nanoseconds. A spike is any voltage increase lasting less than 3 nanoseconds. The USES® device detects any surges or spikes traveling along one of the active phases and shunts it to the other two phases. From there, the transformer/choke sets within the USES® device attenuate the surge/spike through the action of the "chokes", which use capacitors and inductors to resist the change in voltage and associated change in current, and flatten out the waveform. The surge/spike is recycled as usable power for the circuit. Because no USES® "Wye" units were specified for the University, the USES® System will not protect the circuit against ground fault transients or lightning strikes which can enter the circuit through the neutral conductor.

Reactive Power, Apparent Power and Amperage – The USES® System reduces the reactive power on the circuit through transformer action which produces current which leads voltage on each phase. The USES® System reduces reactive power in a fundamentally different way than power factor correcting capacitors, and does so without creating resonance. Each USES® Model CMES-3D-208 power conditioner reduces reactive power by 7-8 kVAR. A reduction in reactive power results in a corresponding decrease in the apparent power on the circuit. This, in turn, results in a decrease in the amount of amperage on the circuit, which results in a decrease in real power demand as a result of reduced "Copper Losses" on the circuit. Copper losses manifest themselves as heat in motors and conductors and can reduce the useful life of motors, transformers and sensitive electronic equipment. The reduction in reactive power on the circuit also acts to "stiffen" the circuit by reducing overall circuit impedance. A "stiff" circuit will reduce the creation of voltage total harmonic distortion as a result of current harmonics.

Power Factor – Power Factor is the ratio of real power to apparent power. Because the USES System reduces both real power demand and apparent power demand, the power factor is

improved and approaches unity, or 100%. Because the USES System does not create resonance, any leading Power Factor will have no effect on the performance or reliability of the equipment.

Voltage Improvement - By improving voltage across each of the three phases (VAB, VBC, VCA), circuit amperage is further reduced and motors will run cooler and last longer. Increased voltage will also lessen the likelihood of equipment tripping off due to utility voltage sags.

Harmonics – The USES® System reduces the Total Harmonic Distortion (THD) of the amperage and voltage on the circuit to the loads by passing all power generated within the USES® System through 60 Hz Band-Pass Filters. Because the USES System is connected to the electrical circuit in parallel, some THD will continue to pass on to the operational loads. However, because a significant portion of the power supplied to the load is "choked" to 60 Hz, total THD supplied to the load is reduced. This action significantly reduces the THD in the voltage and current provided to the operating motors, thus increasing motor efficiency. Problems associated with circuit harmonics include:

- Excessive Neutral Currents, where voltage harmonics result in additional current on the circuit neutral conductor, resulting in additional heat, possible overloading and the need to install additional neutral conductors.
- Overheated transformers, where harmonics generated on the secondary side of a delta-wye transformer will circulate on the primary side of the transformer. Some types of transformer losses, such as skin losses and eddy currents will increase by the square of the harmonic order.
- Overheated solenoid coils and lighting ballasts.
- Positive, negative and zero sequence voltages on motors and generators, where certain harmonic frequencies will try to rotate the motor forward or backward, or simply heat up the motor.
- Incorrect reading power meters, especially disc type watt-hour meters and averaging type current meters.
- Failure of electronic equipment, including nuisance tripping and overload.
- Nuisance tripping of circuit protection devices including false tripping of relays and failure of UPS devices to properly transfer.
- Blown fuses and overheated power factor correction capacitors due to the effects of harmonics with circuit resonance.

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Summary of Power Quality Improvements

Analysis of the TIS testing results from September 30th, 2009 demonstrate that the USES® System has made substantial improvements in overall power quality. The following power quality improvements are realized by the USES® System. The one unit has had the following effect on the electrical circuit:

- Real Power Demand (kW) – **Real Power demand was reduced by 0.56 kW** with one of the USES® Model CMES-3D-208 Power Conditioners activated. The USES® unit was individually tested and found to be operational and contributing to the overall power demand reduction.

- Power Factor – Power Factor improved from **90.6% to 99.5%** and remained lagging when the USES® System was activated.

- Voltage – Voltage improved by an average of **0.6 volts** across each phase (VAB, VBC, VCA).

- Amperage – Amperage was reduced by **7.6 amps** on all three phases.

- Reactive Power - Reactive Power was reduced by **7.4 kVAR** when the USES® System was activated.

- Apparent Power – Apparent Power was reduced by **3.0 kVA** when USES® System was activated.

Graphs and Data Tables

Through evaluation of the Amprobe DM-II Pro® Power Quality Analyzer and Data Logger recordings collected on September 30th, we have prepared a series of graphs and data tables to demonstrate the performance of the USES® System. The following graphs are presented below, showing all changes to power quality when the USES® System is activated or de-activated:

- Graph 1 – Real Power (Watts) and Power Factor (%) – This graph shows real power in watts and power factor in % during the September 30th, 2009 TIS testing.
- Graph 2 – Voltage, 3 Phase from the September 30th, 2009 TIS testing.
- Graph 3 – Amperage, 3 Phase from the September 30th, 2009 TIS testing.
- Graph 4 – Reactive and Apparent Power – This graph shows the effects on reactive and apparent power when the USES® System is turned ON and OFF on September 30th, 2009.

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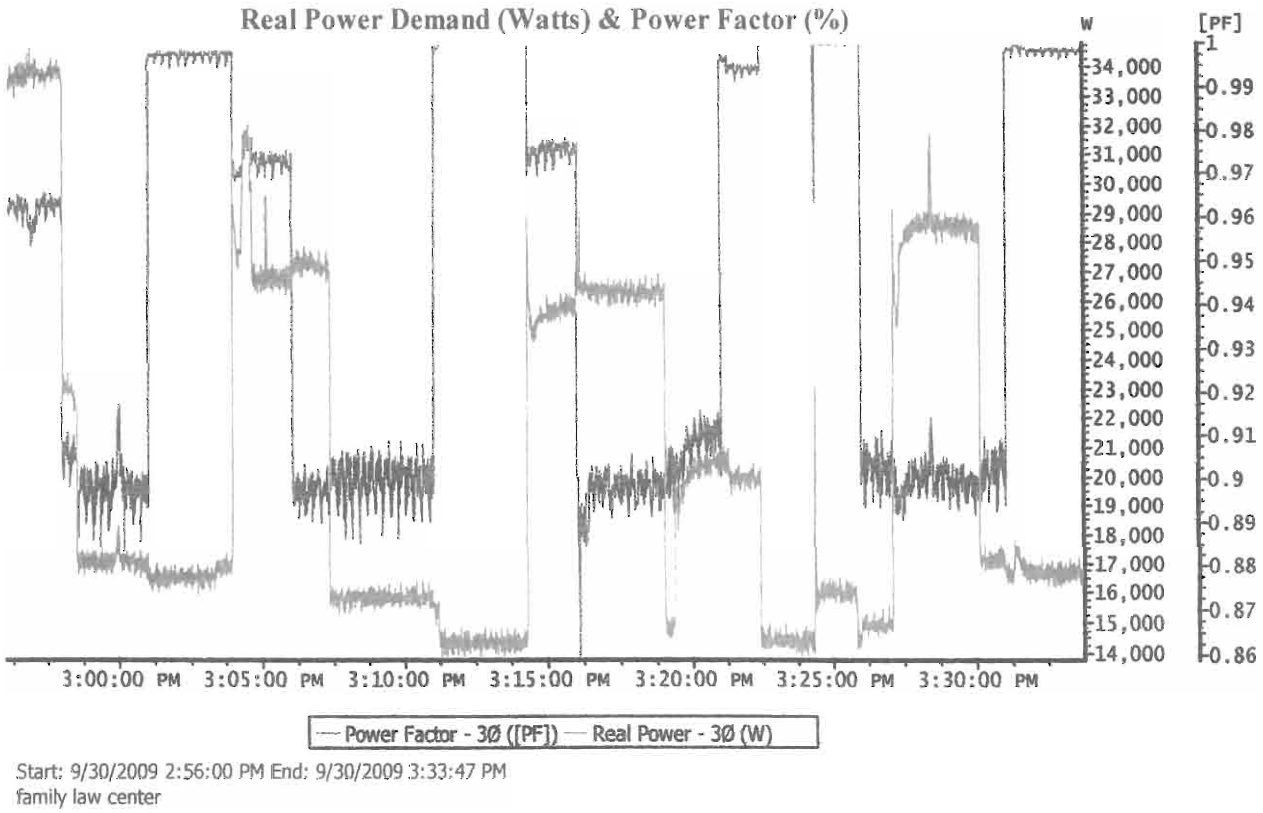
The following data tables are presented to show the average observed performance of the USES® System at the Library. Please note that during the TIS testing, the USES® unit was tested individually to ensure performance and evaluate circuit improvements.

- Table 1 – Real Power (Watts) from September 30th, 2009.
- Table 2 – Power Factor (%) from September 30th, 2009.
- Table 3 – Voltage, 3 Phase Average from September 30th, 2009.
- Table 4 – Amperage, 3 Phase Average from September 30th, 2009.
- Table 5 – Reactive Power (VAR) from September 30th, 2009.
- Table 6 – Apparent Power (VA) from September 30th, 2009.

Note: Graphs and Data Tables are representative of the performance of the USES® System at the Library. All Data Tables and Graphs, together with all raw data are included in the compendium Excel files from September 30th, 2009.

Graph 1



Graph 1 above shows the Real Power Demand in watts and Power Factor on September 30th, 2009 from 2:56 PM to 3:34 PM. With the one USES® Model CMES-3D-208 power conditioning unit operating, the real power demand is reduced an average of **560 watts**. Overall Power Factor is improved from 90.6% to **99.5%**.

Table 1

Real Power Demand (Watts)												
		Intervals				Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
				USES OFF	USES ON	Difference	Difference	Change	Change	Change	Change	Change
Interval Time Frame		# USES	Status	AVERAGE	AVERAGE	Off to On	On to Off	At Transition	Trans.	Trans.	Trans.	Trans.
TIS Testing - One (1) USES CMES-3D-208 volt unit												
2:56:00 PM	3:01:00 PM	1	OFF	24,312								
3:01:01 PM	3:05:59 PM	1	ON		21,262	(3,050)		(658)	(507)	(492)	(506)	(543)
3:06:00 PM	3:11:00 PM	1	OFF	18,878			(2,384)	(56)	508	494	457	289
3:11:01 PM	3:15:59 PM	1	ON		18,183	(695)		(185)	(675)	(1,108)	(1,298)	(1,306)
3:16:00 PM	3:21:00 PM	1	OFF	23,533			5,350	668	859	703	672	693
3:21:01 PM	3:25:59 PM	1	ON		16,493	(7,040)		627	137	(194)	(320)	(309)
3:26:00 PM	3:31:00 PM	1	OFF	23,383			6,890	198	(83)	(620)	(789)	(878)
3:31:01 PM	3:33:47 PM	1	ON		16,740	(6,643)		(364)	(567)	(255)	(306)	(1,803)
AVERAGE - OFF				22,526								
AVERAGE - USES ON				18,169				ALL TRANSITIONS				
DIFFERENCE				(4,357)								
TRANSITION AVG - OFF to ON								433	683	598	565	491
TRANSITION AVG - ON to OFF								(402)	(583)	(512)	(607)	(720)
AVERAGE - REPRESENTATIVE TRANSITIONS				560								
NOTES and INTERPRETATION:												
Power consumption trend is steady throughout TIS testing period with significant load variations												
Shaded cells discounted due to significant load variations during averaging period												
Performance of USES system = 560 Watts Real Power Demand reduction												

Table 1 above shows analysis of the wattage data collected by the Amprobe DM-II Pro Multi-Meter and Data-Logger during TIS testing on September 30th, 2009. The intervals are generally of approximately 5-minute duration.

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Table 2

Power Factor (%)

Intervals						Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Difference Off to On	Difference On to Off	Change At Transition	Change Trans.	Change Trans.	Change Trans.	Change Trans.
TIS Testing - One (1) USES CMES-3D-208 volt unit												
2:56:00 PM	3:01:00 PM	1	OFF	92.4%								
3:01:01 PM	3:05:59 PM	1	ON		98.8%	6.4%		11.0%	10.3%	10.2%	10.2%	10.1%
3:06:00 PM	3:11:00 PM	1	OFF	89.9%			-8.9%	-7.0%	-7.3%	-7.3%	-7.3%	-7.2%
3:11:01 PM	3:15:59 PM	1	ON		99.2%	9.3%		10.0%	10.0%	10.0%	10.0%	10.0%
3:16:00 PM	3:21:00 PM	1	OFF	90.1%			-9.1%	-8.0%	-8.9%	-8.6%	-8.3%	-8.2%
3:21:01 PM	3:25:59 PM	1	ON		99.8%	9.6%		9.0%	9.0%	8.6%	8.4%	8.3%
3:26:00 PM	3:31:00 PM	1	OFF	90.0%			-9.7%	-10.0%	-9.8%	-9.8%	-9.8%	-9.8%
3:31:01 PM	3:33:47 PM	1	ON		100.0%	10.0%		11.0%	9.7%	9.7%	9.8%	9.8%
AVERAGE - OFF				90.6%								
AVERAGE - USES ON				99.5%				ALL TRANSITIONS				
DIFFERENCE				8.8%								
TRANSITION AVG - OFF to ON								-9.0%	-8.1%	-7.9%	-7.8%	-7.7%
TRANSITION AVG - ON to OFF								10.7%	10.0%	9.6%	9.6%	9.5%
AVERAGE - REPRESENTATIVE TRANSITIONS				9.0%								

NOTES and INTERPRETATION:

Power factor approaches unity (99.5%) when USES System is activated
Power Factor changes from 90.6% Lagging to 99.5% Lagging when USES System is activated
Power Factor is graphed together with Real Power Demand

Table 2 above shows the Power Factor changes during TIS testing on September 30th, 2009. The Power Factor is improved to an average of 99.5% by the USES® System when the one Delta unit is operational.

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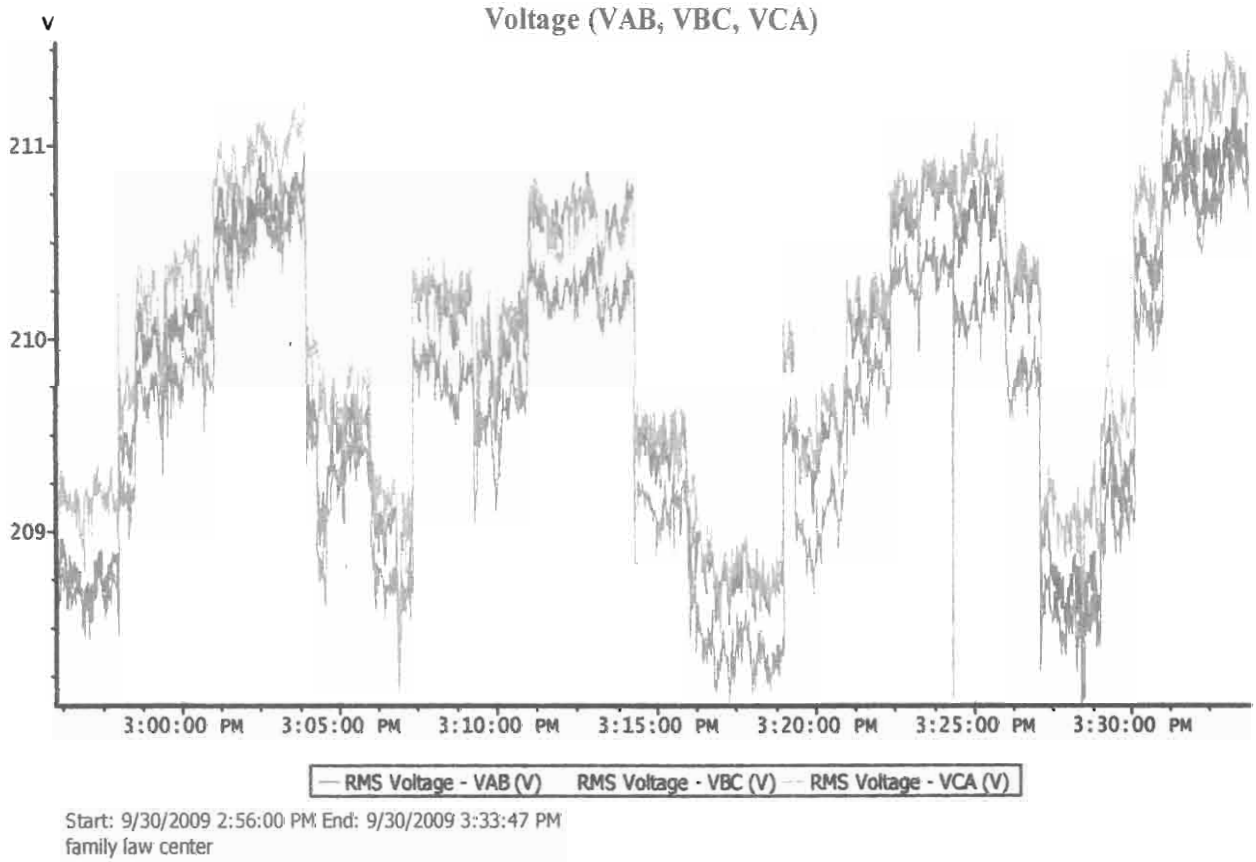
Graph 2



Graph 2 above shows three phase voltage on September 30th, 2009. There is approximately a 0.6 volt increase when the USES® System is activated.

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Table 3

Voltage, 3-Phase Average

Interval Time Frame		Intervals # USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Full Interval Difference Off to On	Full Interval Difference On to Off	Instant Change At Transition	15 Sec Avg Change Trans.	30 Sec Avg Change Trans.	45 Sec Avg Change Trans.	60 Sec Avg Change Trans.
TIS Testing - One (1) USES CMES-3D-208 volt unit												
2:56:00 PM	3:01:00 PM	1	OFF	209.5								
3:01:01 PM	3:05:59 PM	1	ON		210.2	0.7		0.5	0.6	0.6	0.5	0.5
3:06:00 PM	3:11:00 PM	1	OFF	209.7			(0.5)	(0.5)	(0.5)	(0.5)	(0.6)	(0.6)
3:11:01 PM	3:15:59 PM	1	ON		210.1	0.4		0.4	0.6	0.6	0.6	0.6
3:16:00 PM	3:21:00 PM	1	OFF	209.0			(1.1)	(0.5)	(0.5)	(0.5)	(0.6)	(0.6)
3:21:01 PM	3:25:59 PM	1	ON		210.4	1.5		0.4	0.5	0.5	0.5	0.6
3:26:00 PM	3:31:00 PM	1	OFF	209.5			(0.9)	(0.4)	(0.6)	(0.5)	(0.5)	(0.5)
3:31:01 PM	3:33:47 PM	1	ON		211.0	1.5		0.5	0.6	0.6	0.6	0.7
AVERAGE - OFF				209.4								
AVERAGE - USES ON				210.4				ALL TRANSITIONS				
DIFFERENCE				1.0								
TRANSITION AVG - OFF to ON								(0.4)	(0.5)	(0.5)	(0.6)	(0.6)
TRANSITION AVG - ON to OFF								0.4	0.6	0.6	0.6	0.6
AVERAGE - REPRESENTATIVE TRANSITIONS				0.6								

NOTES and INTERPRETATION:

Voltage trend is steady throughout TIS testing period
Voltage is improved due to reduced circuit impedance
Full interval results are consistent with Instantaneous, 15, 30, 45 and 60 second analyses.
AVG = 0.6 volt increase.

Table 3 above shows analysis of the data collected for three phase voltage on September 30th, 2009. The increases recorded for the Delta unit has an effect on overall circuit voltage. With one USES® unit active, the voltage is improved by about 0.6 volts.

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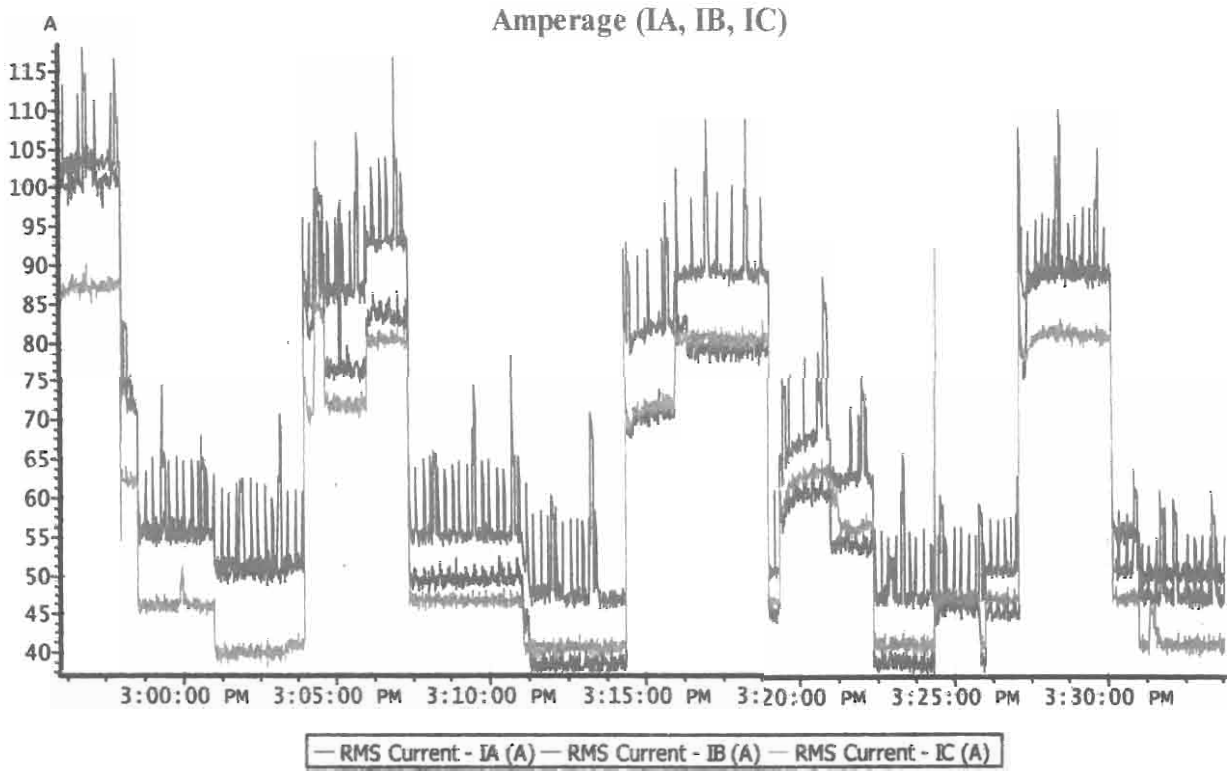
Graph 3



Graph 3 above shows three phase amperage on September 30th, 2009. There is about a 7.6 amp reduction on each phase when the USES® System is activated.

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Table 4

Amperage Average of Phases A, B, C (Amps)

Interval Time Frame		Intervals # USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Full Interval Difference Off to On	Full Interval Difference On to Off	Instant Change At Transition	15 Sec Avg Change Trans.	30 Sec Avg Change Trans.	45 Sec Avg Change Trans.	60 Sec Avg Change Trans.
TIS Testing - One (1) USES CMES-3D-208 volt unit												
2:56:00 PM	3:01:00 PM	1	OFF	72.6								
3:01:01 PM	3:05:59 PM	1	ON		62.1	(10.5)		(5.5)	(5.1)	(5.8)	(5.2)	(5.1)
3:06:00 PM	3:11:00 PM	1	OFF	60.6			(1.4)	6.2	7.4	6.6	6.9	6.8
3:11:01 PM	3:15:59 PM	1	ON		54.0	(6.7)		(4.4)	(5.9)	(7.8)	(8.0)	(7.6)
3:16:00 PM	3:21:00 PM	1	OFF	74.7			20.7	8.1	8.1	7.7	7.8	8.1
3:21:01 PM	3:25:59 PM	1	ON		48.7	(26.0)		(3.9)	(8.0)	(7.8)	(7.3)	(6.8)
3:26:00 PM	3:31:00 PM	1	OFF	71.9			23.2	4.5	2.2	1.4	1.2	1.0
3:31:01 PM	3:33:47 PM	1	ON		47.0	(24.9)		(4.8)	(6.5)	(5.2)	(4.5)	(9.0)
AVERAGE - OFF				69.9								
AVERAGE - USES ON				52.9				ALL TRANSITIONS				
DIFFERENCE				(17.0)								
TRANSITION AVG - OFF to ON								6.3	7.8	7.1	7.4	7.5
TRANSITION AVG - ON to OFF								(4.9)	(5.8)	(6.6)	(6.3)	(6.5)
AVERAGE - REPRESENTATIVE TRANSITIONS				(7.6)								

NOTES and INTERPRETATION:

Current is steady throughout TIS testing period
All intervals are included in final average
AVG = 7.6 Amp reduction when USES System activated

Table 4 above shows analysis of the data collected for three phase amperage on September 30th, 2009. There was an average reduction of 7.6 amps as a result of the USES® System.

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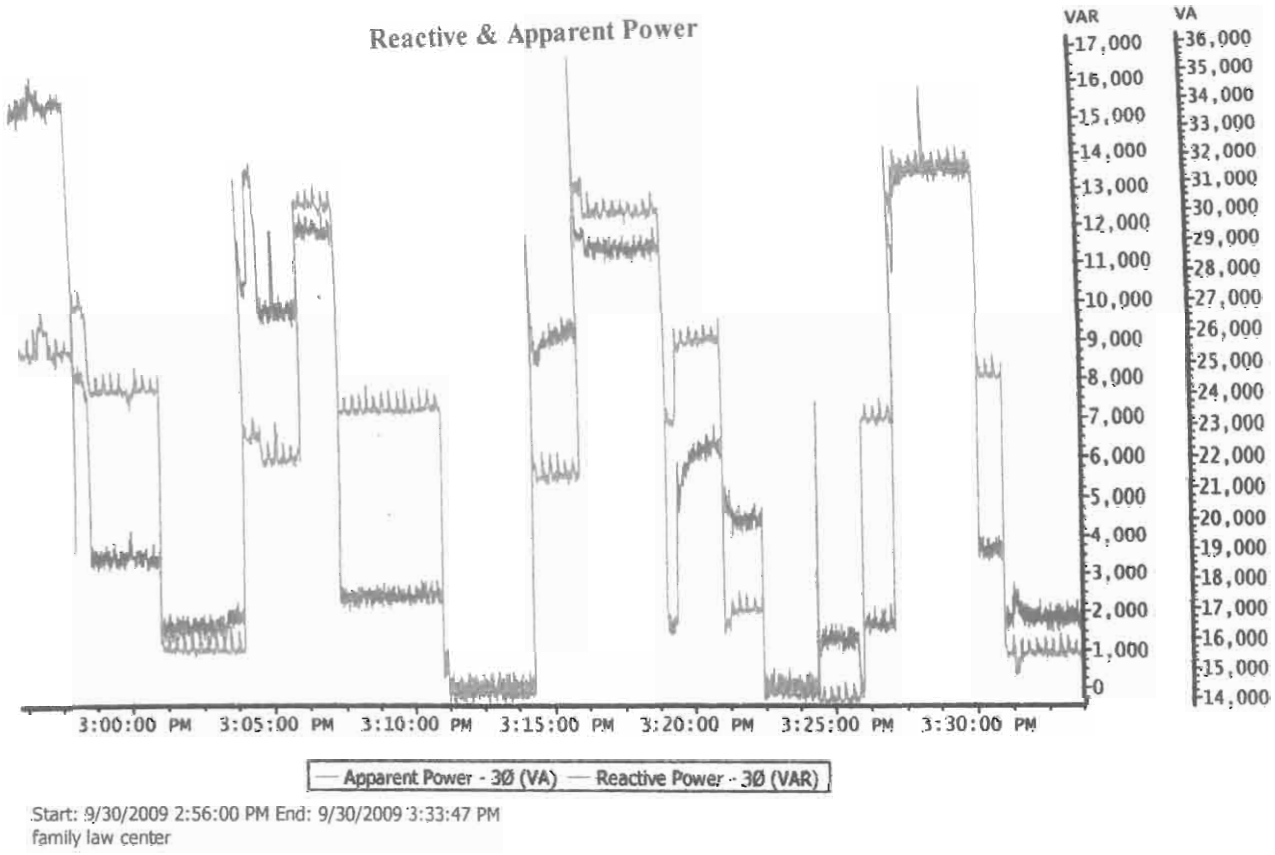
Graph 4



Graph 4 above shows Reactive Power in VAR and Apparent Power in VA on September 30th, 2009.

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Table 5

Reactive Power (VAR)

Intervals						Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Difference Off to On	Difference On to Off	Change At Transition	Change Trans.	Change Trans.	Change Trans.	Change Trans.
TIS Testing - One (1) USES CMES-3D-208 volt unit												
2:56:00 PM	3:01:00 PM	1	OFF	9,062								
3:01:01 PM	3:05:59 PM	1	ON		3,422	(5,640)		(7,380)	(7,169)	(7,189)	(7,173)	(7,176)
3:06:00 PM	3:11:00 PM	1	OFF	9,193			5,771	7,243	7,070	7,079	7,059	7,019
3:11:01 PM	3:15:59 PM	1	ON		1,926	(7,266)		(7,258)	(7,309)	(7,521)	(7,639)	(7,621)
3:16:00 PM	3:21:00 PM	1	OFF	11,355			9,429	7,137	7,380	7,680	7,451	7,400
3:21:01 PM	3:25:59 PM	1	ON		498	(10,857)		(7,571)	(7,573)	(7,398)	(7,281)	(7,259)
3:26:00 PM	3:31:00 PM	1	OFF	11,288			10,790	7,054	7,237	7,279	7,284	7,321
3:31:01 PM	3:33:47 PM	1	ON		938	(10,350)		(7,375)	(7,204)	(7,368)	(7,293)	(8,047)
AVERAGE - OFF				10,224								
AVERAGE - USES ON				1,696					ALL TRANSITIONS			
DIFFERENCE				(8,528)								
TRANSITION AVG - OFF to ON								7,096	7,475	7,380	7,255	7,210
TRANSITION AVG - ON to OFF								(7,338)	(7,227)	(7,369)	(7,346)	(7,352)
AVERAGE - REPRESENTATIVE TRANSITIONS				(7,416)								

NOTES and INTERPRETATION:

Full Interval results are consistent with Instantaneous, 15, 30, 45 and 60 second analyses.
Reactive Power changes from 10.2 KVAR Lagging to 1.7 KVAR Lagging when the USES System is activated
Average Reactive Power Change = 7.4 KVAR
Reactive & Apparent Power are graphed together

Table 5 above shows analysis of the data collected for Reactive Power on September 30th, 2009. The USES® System reduced reactive power by about 7.4 kVAR when activated. The reactive power on the circuit decreased from about 10.2 kVAR to about 1.7 kVAR.

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Table 6

Apparent Power (VA)

Intervals						Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Difference Off to On	Difference On to Off	Change At Transition	Change Trans.	Change Trans.	Change Trans.	Change Trans.
TIS Testing - One (1) USES CMES-3D-208 volt unit												
2:56:00 PM	3:01:00 PM	1	OFF	26,048								
3:01:01 PM	3:05:59 PM	1	ON		21,607	(4,441)		(2,669)	(2,402)	(2,394)	(2,405)	(2,435)
3:06:00 PM	3:11:00 PM	1	OFF	20,998			(609)	2,397	2,894	2,881	2,835	2,662
3:11:01 PM	3:15:59 PM	1	ON		18,399	(2,599)		(1,919)	(2,443)	(2,878)	(3,069)	(3,071)
3:16:00 PM	3:21:00 PM	1	OFF	26,132			7,733	2,982	3,524	3,284	3,154	3,154
3:21:01 PM	3:25:59 PM	1	ON		16,527	(9,605)		(1,376)	(1,804)	(2,125)	(2,237)	(2,224)
3:26:00 PM	3:31:00 PM	1	OFF	25,966			9,439	1,797	1,532	993	822	738
3:31:01 PM	3:33:47 PM	1	ON		16,767	(9,199)		(2,331)	(2,370)	(2,075)	(2,127)	(3,806)
AVERAGE - OFF				24,786								
AVERAGE - USES ON				18,325				ALL TRANSITIONS				
DIFFERENCE				(6,461)								
TRANSITION AVG - OFF to ON								2,389	3,209	3,083	2,995	2,908
TRANSITION AVG - ON to OFF								(2,306)	(2,405)	(2,368)	(2,459)	(2,577)
AVERAGE - REPRESENTATIVE TRANSITIONS				(3,015)								

NOTES and INTERPRETATION:

Apparent Power trend is steady throughout TIS testing period with load variations

Full Interval results are consistent with Instantaneous, 15, 30, 45 and 60 second analyses.

Average Reduction = 3.0 KVA

Apparent Power is graphed together with Reactive Power

Table 6 above shows analysis of the data collected for Apparent Power on September 30th, 2009. There was a reduction in apparent power from 24.8 kVA to 18.3 kVA when the USES® System was activated. This translates to an apparent power reduction of 3.0 kVA on the circuit.

System Savings

Evaluation of the USES® System installed at the Family Law Center shows a demand reduction when the USES® System is activated. During the On-Peak TIS testing on September 30th, 2009, the average real power demand reduction was 560 watts. The total annual reduction of real power consumed is 560 watts x 8760 hours per year = 4,906 kWh per year.

Summary and Conclusions

The installation of a USES® Shunt Efficiency System at the Family Law Center has improved power quality and has resulted in a substantial decrease in electrical demand. The USES® System reduced the demand for electricity by about 0.56 kW. The performance of the USES® Shunt Efficiency System at the Family Law Center has proven to be consistent with all of the estimated power quality improvements as outlined in DWA Energy's proposal to ESG dated December 12, 2008.

Additional power quality improvements were also realized by the installation of the USES® System. However, the USES® System's ability to provide superior surge & spike protection cannot be measured. The benefits of enhanced surge & spike protection, will translate to additional savings through the avoidance of maintenance costs on motors and sensitive electronic systems within the facility.

The USES® System provides power quality improvements that no other power conditioning system can provide. For any questions or comments on this report, please contact Skip Delclos, Division Manager, DWA Energy at (703) 506-0012, or via email to skip@dwaenergy.com.

USES Shunt Efficiency System Evaluation

For

Energy Systems Group
And
The University of Baltimore
Academic Center Building

by

DWA Energy

www.DWAEnergy.com

October, 2009

DWA Energy
www.DWAEnergy.com

Executive Summary

During February and March 2009, the Energy Systems Group (ESG) purchased and installed an innovative power conditioning system known as the USES® Shunt Efficiency System throughout the University of Baltimore Campus in Baltimore, MD. The USES® System was installed to reduce the overall demand and consumption of real power and improve overall power quality while protecting the electrical circuit against electrical spikes and surges. A total of thirty-eight (38) USES® Model CMES-3D-480 Power Conditioners and one (1) USES® Model CMES-3D-208 Power Conditioners were installed in a total of six buildings on the campus. The buildings include the 1) Law Center, 2) Academic Center, 3) Business Center, 4) Student Center, 5) Library and 6) Family Law Clinic. The following report contains the results of the **Academic Center** evaluation conducted on August 14th, 2009.

In accordance with the final proposal offered to ESG by DWA Energy on December 12, 2008, the USES® System was evaluated to determine the average power conditioning results and real power demand reductions. DWA Energy used Timed Interval Sampling (TIS) methods to determine USES® System performance, and the results of the evaluations are presented herein.

The data tables and graphs presented in this report clearly show the beneficial results provided by the USES® System. All power quality data was averaged to take into account short term load variations and to determine the average levels of power quality when the USES® System was activated and de-activated. The data tables presented in this report are from the On-Peak evaluation conducted on August 14th. We have selected representative graphs for inclusion in this report. Additional data tables and graphs can be found in the compendium Excel Spreadsheet entitled "acactr Analysis, 101609".

A full discussion of the power quality improvements, and their impact on the circuit, are discussed below.

Timed Interval Sampling (TIS) Techniques

Timed Interval Sampling (TIS) is a statistical method of energy measurement with regard to power quality over a relatively short span of time. It is valid in all facilities with electrical loads and is particularly useful in facilities where energy use is a function of manufacturing, environmental loads, and related equipment. TIS techniques are utilized to minimize the effect of numerous variables present when measuring power quality and meets the standards of the International Performance and Measurement Verification Protocol (IPMVP).

During evaluation, the USES® System was alternately energized and de-energized at five-minute intervals to collect comparative samples of energy used by the motors and other electrical loads

under steady state conditions. The energy usage data was recorded and averaged in each respective operating condition (i.e. USES® on or off), in order to demonstrate power quality changes when the USES® System is energized and de-energized.

For the TIS evaluation, an Amprobe DM-II Pro® Power Quality Analyzer and Data Logger was connected to the incoming electric service at a point immediately following the main breaker for the building. The Amprobe meter meets the standards of the National Institute of Standards and Technology. The USES® System is connected to the electrical circuit at each location in parallel through circuit breaker panels or individual breakers. The Power quality parameters measured during TIS testing consisted of voltage (each of three phases, or VAB, VBC and VCA), amperage (each of three phases, or IA, IB and IC), real power demand (Watts), reactive power (volt-amps-reactive, or VAR), apparent power (volt-amps, or VA) and power factor (%). Data on each parameter was collected every one-second during each on/off interval.

On Friday, August 14th from 3:33 PM to 4:17 PM, DWA Energy recorded the performance of the USES® System at the Academic Center. The evaluation showed consistent overall power quality improvements and reductions in real power demand. The TIS evaluation was performed by Skip Delclos and Jeff Walsh of DWA Energy.

Evaluation of USES® System performance was made through analysis of the data recorded from the TIS testing. The USES® System was activated and deactivated for intervals of five minutes to measure the changes in overall power quality in each operating condition. A separate test of the cumulative effect of the USES® power conditioners was also conducted to confirm that each of the units was operating properly. Whenever the USES® System was turned on or off, the differences between the conditioned and unconditioned power quality was determined and averaged to demonstrate the overall effect that the USES® System has on the circuit.

All recorded data was evaluated and averaged in the following manner to determine the overall average performance of the USES® System:

- The average power quality for the full five-minute interval was calculated and compared to the next five-minute interval before and after each transition from on to off, and off to on.
- Each instantaneous change in power quality was determined by comparing the last one-second with the USES® System on to the first one-second with the USES® System off, and visa-versa.
- The average power quality was calculated 15-seconds before and after each transition from on to off, and off to on.
- The average power quality was calculated 30-seconds before and after each transition from on to off, and off to on.
- The average power quality was calculated 60-seconds before and after each transition from on to off, and off to on.

- All transitional changes were averaged to derive the overall average performance of the USES® System.

DWA Energy has found that Timed Interval Sampling is the most reliable and verifiable method of comparing power quality while still accounting for all variables present. TIS methods are used to verify that the USES® System is operating as expected in your facility.

Discussion of Power Quality Improvements

The installation of the USES® System at the Academic Center has resulted in measurable and verifiable power quality improvements, as well as other benefits which cannot be measured. A discussion of the power quality improvements resulting from the USES® System is presented below:

Spike and Surge Protection - Inherent in the USES® System, but not measured, is the ability to provide superior spike and surge suppression capabilities. A surge is any voltage increase lasting 3 or more nanoseconds. A spike is any voltage increase lasting less than 3 nanoseconds. The USES® device detects any surges or spikes traveling along one of the active phases and shunts it to the other two phases. From there, the transformer/choke sets within the USES® device attenuate the surge/spike through the action of the "chokes", which use capacitors and inductors to resist the change in voltage and associated change in current, and flatten out the waveform. The surge/spike is recycled as usable power for the circuit. Because no USES® "Wye" units were specified for the University, the USES® System will not protect the circuit against ground fault transients or lightning strikes which can enter the circuit through the neutral conductor.

Reactive Power, Apparent Power and Amperage – The USES® System reduces the reactive power on the circuit through transformer action which produces current which leads voltage on each phase. The USES® System reduces reactive power in a fundamentally different way than power factor correcting capacitors, and does so without creating resonance. Each USES® Model CMES-3D-480 power conditioner reduces reactive power by 21-23 kVAR. A reduction in reactive power results in a corresponding decrease in the apparent power on the circuit. This, in turn, results in a decrease in the amount of amperage on the circuit, which results in a decrease in real power demand as a result of reduced "Copper Losses" on the circuit. Copper losses manifest themselves as heat in motors and conductors and can reduce the useful life of motors, transformers and sensitive electronic equipment. The reduction in reactive power on the circuit also acts to "stiffen" the circuit by reducing overall circuit impedance. A "stiff" circuit will reduce the creation of voltage total harmonic distortion as a result of current harmonics.

Power Factor – Power Factor is the ratio of real power to apparent power. Because the USES System reduces both real power demand and apparent power demand, the power factor is

improved and approaches unity, or 100%. Because the USES System does not create resonance, any leading Power Factor will have no effect on the performance or reliability of the equipment.

Voltage Improvement - By improving voltage across each of the three phases (VAB, VBC, VCA), circuit amperage is further reduced and motors will run cooler and last longer. Increased voltage will also lessen the likelihood of equipment tripping off due to utility voltage sags.

Harmonics – The USES® System reduces the Total Harmonic Distortion (THD) of the amperage and voltage on the circuit to the loads by passing all power generated within the USES® System through 60 Hz Band-Pass Filters. Because the USES System is connected to the electrical circuit in parallel, some THD will continue to pass on to the operational loads. However, because a significant portion of the power supplied to the load is "choked" to 60 Hz, total THD supplied to the load is reduced. This action significantly reduces the THD in the voltage and current provided to the operating motors, thus increasing motor efficiency. Problems associated with circuit harmonics include:

- Excessive Neutral Currents, where voltage harmonics result in additional current on the circuit neutral conductor, resulting in additional heat, possible overloading and the need to install additional neutral conductors.
- Overheated transformers, where harmonics generated on the secondary side of a delta-wye transformer will circulate on the primary side of the transformer. Some types of transformer losses, such as skin losses and eddy currents will increase by the square of the harmonic order.
- Overheated solenoid coils and lighting ballasts.
- Positive, negative and zero sequence voltages on motors and generators, where certain harmonic frequencies will try to rotate the motor forward or backward, or simply heat up the motor.
- Incorrect reading power meters, especially disc type watt-hour meters and averaging type current meters.
- Failure of electronic equipment, including nuisance tripping and overload.
- Nuisance tripping of circuit protection devices including false tripping of relays and failure of UPS devices to properly transfer.
- Blown fuses and overheated power factor correction capacitors due to the effects of harmonics with circuit resonance.

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Summary of Power Quality Improvements

Analysis of the TIS testing results from August 14th, 2009 demonstrate that the USES® System has made substantial improvements in overall power quality. The following power quality improvements are realized by the USES® System. All eight units have had the following effect on the electrical circuit:

- Real Power Demand (kW) – **Real Power demand was reduced by 17.4 kW** with all eight of the USES® Model CMES-3D-480 Power Conditioners activated. Each USES® unit was individually tested and found to be operational and contributing to the overall power demand reduction.

- Power Factor – Power Factor improved from **94.1% to 100.0%** and remained lagging when the USES® System was activated.

- Voltage – Voltage improved by an average of **5.7 volts** across each phase (VAB, VBC, VCA).

- Amperage – Amperage was reduced by **56.9 amps** on all three phases.

- Reactive Power - Reactive Power was reduced by **169.8 kVAR** when the USES® System was activated.

- Apparent Power – Apparent Power was reduced by **46.2 kVA** when USES® System was activated.

Graphs and Data Tables

Through evaluation of the Amprobe DM-II Pro® Power Quality Analyzer and Data Logger recordings collected on August 14th, we have prepared a series of graphs and data tables to demonstrate the performance of the USES® System. The following graphs are presented below, showing all changes to power quality when the USES® System is activated or de-activated:

- Graph 1 – Real Power (Watts) and Power Factor (%) – This graph shows real power in watts and power factor in % during the August 14th, 2009 TIS testing.
- Graph 2 – Voltage, 3 Phase from the August 14th, 2009 TIS testing.
- Graph 3 – Amperage, 3 Phase from the August 14th, 2009 TIS testing.
- Graph 4 – Reactive and Apparent Power – This graph shows the effects on reactive and apparent power when the USES® System is turned ON and OFF on August 14th, 2009.

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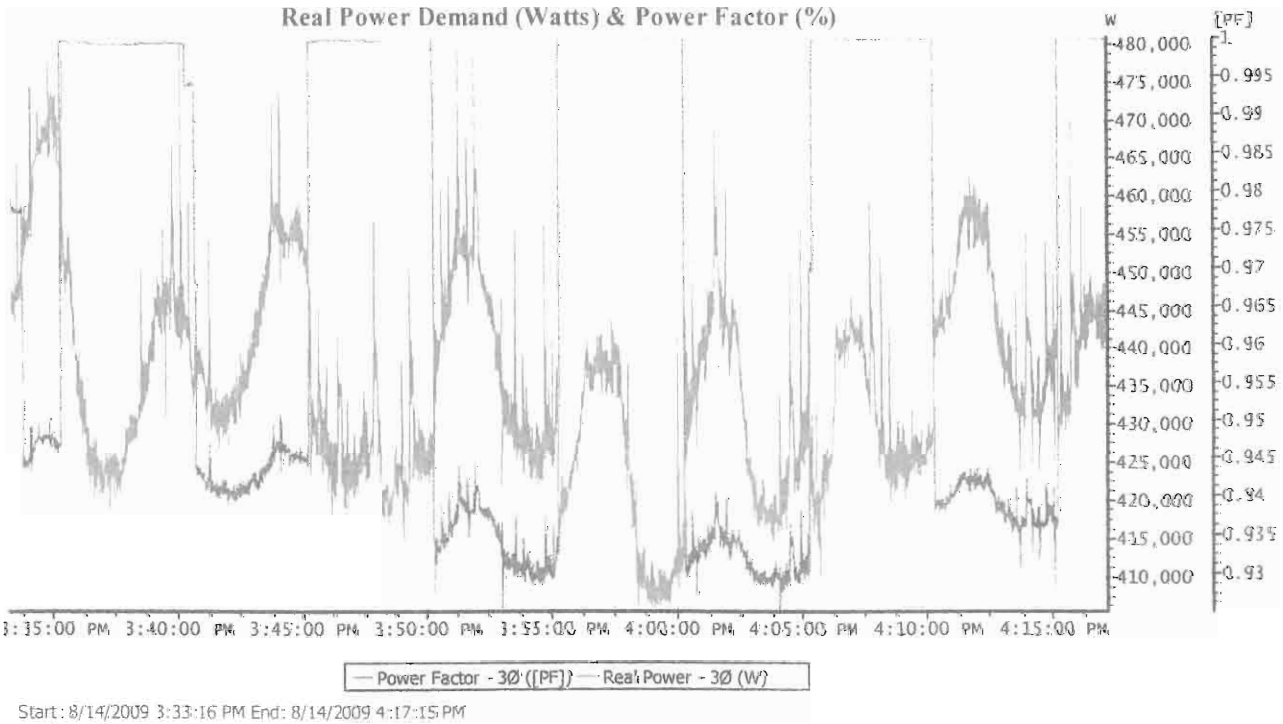
The following data tables are presented to show the average observed performance of the USES® System at the Academic Center. Please note that during the TIS testing, each USES® unit was tested individually to ensure performance and evaluate circuit improvements with one, two, three, four, five, six, seven, and eight units cumulatively.

- Table 1 – Real Power (Watts) from August 14th, 2009.
- Table 2 – Power Factor (%) from August 14th, 2009.
- Table 3 – Voltage, 3 Phase Average from August 14th, 2009.
- Table 4 – Amperage, 3 Phase Average from August 14th, 2009.
- Table 5 – Reactive Power (VAR) from August 14th, 2009.
- Table 6 – Apparent Power (VA) from August 14th, 2009.

Note: Graphs and Data Tables are representative of the performance of the USES® System at the Academic Center. All Data Tables and Graphs, together with all raw data are included in the compendium Excel files from August 14th, 2009.

Graph 1



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Graph 1 above shows the Real Power Demand in watts and Power Factor on August 14th, 2009 from 3:33 PM to 4:17 PM. With all eight USES® Model CMES-3D-480 power conditioning units operating, the real power demand is reduced an average of **17,368 watts**. Overall Power Factor is improved from 94.1% to **100.0%**.

Table 1

Real Power Demand (Watts)

Intervals						Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Difference Off to On	Difference On to Off	Change At Transition	Change Trans.	Change Trans.	Change Trans.	Change Trans.
TIS Testing - Eight (8) USES CMES-3D-480 volt units												
3:33:16 PM	3:35:15 PM	8	OFF	461,283								
3:35:16 PM	3:40:15 PM	8	ON		436,224	(25,059)		(13,393)	(13,745)	(17,348)	(23,241)	(24,031)
3:40:43 PM	3:45:14 PM	8	OFF	443,595			7,372	(5,709)	(10,070)	(12,485)	(12,366)	(12,502)
3:45:16 PM	3:50:14 PM	8	ON		426,671	(16,925)		(14,807)	(19,681)	(22,083)	(24,199)	(24,985)
3:50:17 PM	3:55:14 PM	8	OFF	440,131			13,460	19,915	13,262	16,154	19,069	18,851
3:55:16 PM	4:00:15 PM	8	ON		423,006	(17,125)		(14,654)	(11,587)	(10,341)	(6,765)	(4,647)
4:00:17 PM	4:05:15 PM	8	OFF	431,971			8,965	10,458	17,586	19,353	23,987	25,799
4:05:24 PM	4:10:14 PM	8	ON		430,554	(1,417)		(9,229)	(10,605)	(9,123)	(6,017)	(2,754)
4:10:17 PM	4:15:14 PM	8	OFF	444,238			13,685	14,077	14,894	16,912	18,595	19,698
4:15:16 PM	4:17:15 PM	8	ON		441,175	(3,063)		(13,885)	(6,321)	(6,537)	(24)	1,912
AVERAGE - OFF				444,244								
AVERAGE - USES ON				431,526				ALL TRANSITIONS				
DIFFERENCE				(12,718)								
TRANSITION AVG - OFF to ON						(12,718)	10,870	14,817	15,247	17,473	18,595	19,698
TRANSITION AVG - ON to OFF								(13,193)	(12,388)	(13,087)	(24,199)	(24,985)
AVERAGE - REPRESENTATIVE TRANSITIONS				17,368								

NOTES and INTERPRETATION:

Power consumption trend is highly variable throughout TIS testing period with distinct cycling load variations
Shaded cells discounted due to significant load variations during averaging period
Performance of USES system = 17,368 Watts Real Power Demand reduction
Average performance per CMES-3D-480 volt USES unit = 2.17 kW per unit

Table 1 above shows analysis of the wattage data collected by the Amprobe DM-II Pro Multi-Meter and Data-Logger during TIS testing on August 14th, 2009. The intervals are generally of approximately 5-minute duration.

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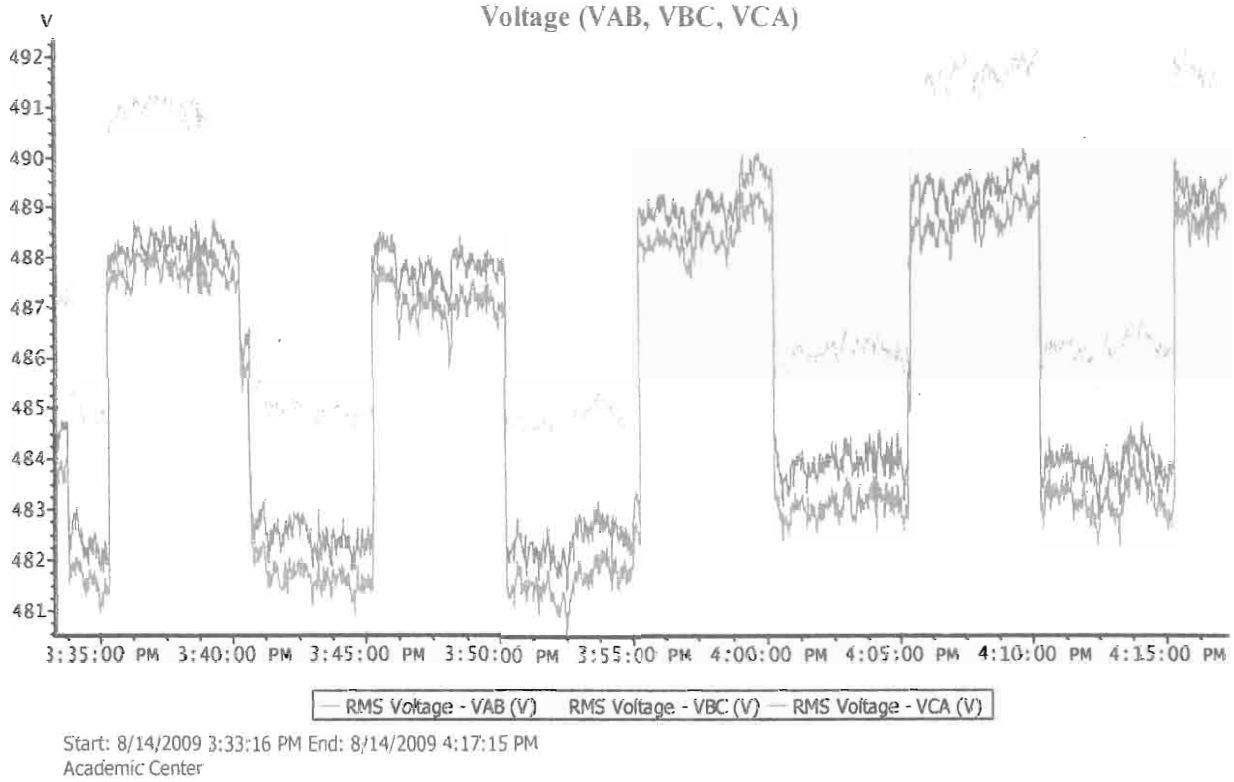
Table 2

Power Factor (%)												
		Intervals				Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Difference Off to On	Difference On to Off	Change At Transition	Change Trans.	Change Trans.	Change Trans.	Change Trans.
TIS Testing - Eight (8) USES CMES-3D-480 volt units												
3:33:16 PM	3:35:15 PM	8	OFF	95.6%								
3:35:16 PM	3:40:15 PM	8	ON		100.0%	4.4%		5.0%	5.0%	5.0%	5.0%	5.0%
3:40:43 PM	3:45:14 PM	8	OFF	94.3%			5.7%	6.0%	6.0%	6.0%	6.0%	6.0%
3:45:16 PM	3:50:14 PM	8	ON		100.0%	5.7%		6.0%	5.9%	5.5%	5.5%	5.4%
3:50:17 PM	3:55:14 PM	8	OFF	93.4%			6.6%	6.0%	6.9%	6.8%	6.6%	6.5%
3:55:16 PM	4:00:15 PM	8	ON		100.0%	6.6%		7.0%	6.9%	7.0%	7.0%	7.0%
4:00:17 PM	4:05:15 PM	8	OFF	93.1%			6.9%	7.0%	6.9%	6.9%	6.9%	6.9%
4:05:24 PM	4:10:14 PM	8	ON		100.0%	6.9%		7.0%	6.9%	6.9%	7.0%	7.0%
4:10:17 PM	4:15:14 PM	8	OFF	94.0%			6.0%	6.0%	6.0%	6.0%	6.0%	6.0%
4:15:16 PM	4:17:15 PM	8	ON		100.0%	6.0%		6.0%	6.1%	6.0%	6.0%	6.0%
AVERAGE - OFF				94.1%								
AVERAGE - USES ON				100.0%				ALL TRANSITIONS				
DIFFERENCE				5.9%								
TRANSITION AVG - OFF to ON						5.9%	-6.3%	-6.3%	-6.6%	-6.6%	-6.0%	-6.0%
TRANSITION AVG - ON to OFF								6.2%	6.2%	6.1%	5.5%	5.4%
AVERAGE - REPRESENTATIVE TRANSITIONS				6.1%								
NOTES and INTERPRETATION:												
Power factor approaches unity (100.0%) when USES System is activated												
Power Factor changes from 94.1% Lagging to 100.0% Unity when USES System is activated												
Power Factor is graphed together with Real Power Demand												

Table 2 above shows the Power Factor changes during TIS testing on August 14th, 2009. The Power Factor is improved to an average of 100.0% by the USES® System when all eight Delta units are operational.

Graph 2



Graph 2 above shows three phase voltage on August 14th, 2009. There is approximately a 5.7 volt increase when the USES® System is activated.

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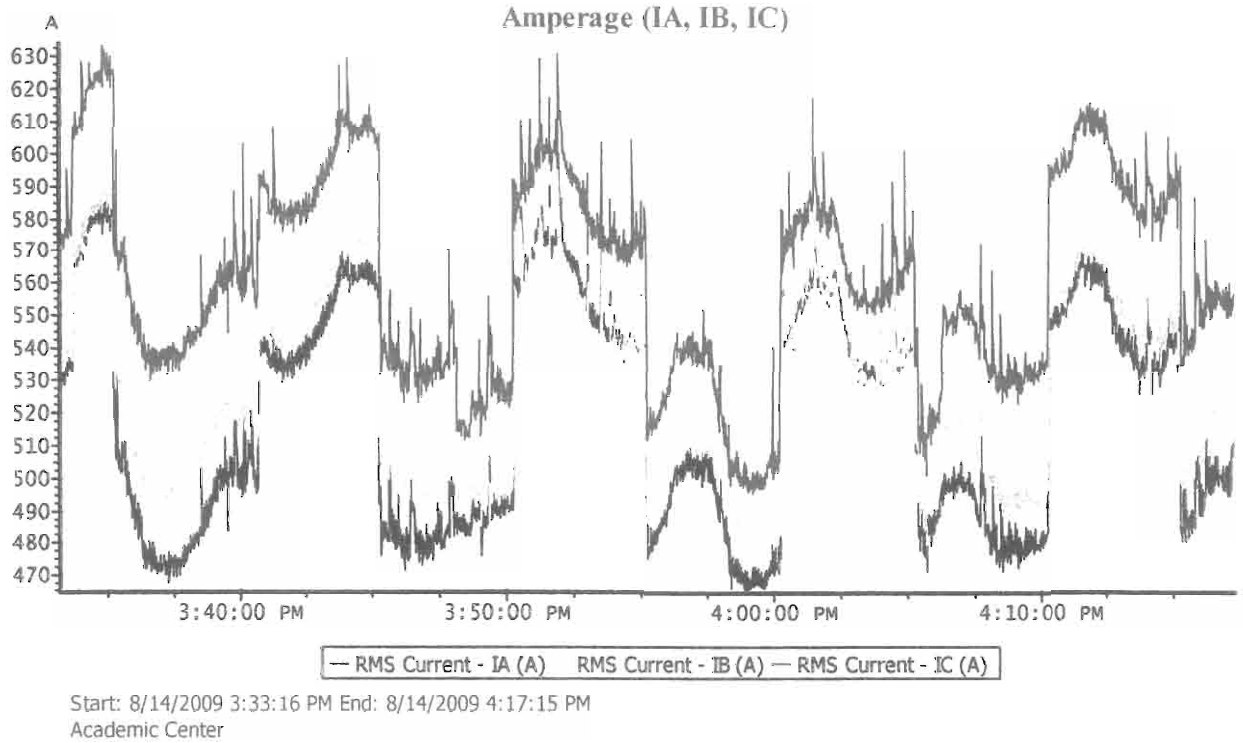
Table 3

Voltage, 3-Phase Average												
		Intervals				Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Difference Off to On	Difference On to Off	Change At Transition	Change Trans.	Change Trans.	Change Trans.	Change Trans.
TIS Testing - Eight (8) USES CMES-3D-480 volt units												
3:33:16 PM	3:35:15 PM	8	OFF	483.5								
3:35:16 PM	3:40:15 PM	8	ON		488.9	5.4		5.7	5.9	6.0	5.9	5.9
3:40:43 PM	3:45:14 PM	8	OFF	483.0			(5.9)	(5.7)	(5.4)	(5.3)	(5.5)	(5.6)
3:45:16 PM	3:50:14 PM	8	ON		488.4	5.4		5.5	5.8	6.0	6.0	6.0
3:50:17 PM	3:55:14 PM	8	OFF	482.9			(5.5	(5.3)	(5.6)	(5.5)	(5.6)	(5.6)
3:55:16 PM	4:00:15 PM	8	ON		489.7	6.8		6.1	5.8	6.2	6.3	6.4
4:00:17 PM	4:05:15 PM	8	OFF	484.4			(5.3	(5.2)	(5.6)	(6.0)	(6.0)	(6.0)
4:05:24 PM	4:10:14 PM	8	ON		489.9	5.6		5.8	5.7	5.5	5.5	5.4
4:10:17 PM	4:15:14 PM	8	OFF	484.4			(5.5	(6.0)	(6.1)	(5.8)	(5.8)	(5.8)
4:15:16 PM	4:17:15 PM	8	ON		490.0	5.5		5.8	5.9	5.9	5.7	5.6
AVERAGE - OFF				483.6								
AVERAGE - USES ON				489.4				ALL TRANSITIONS				
DIFFERENCE				5.7								
TRANSITION AVG - OFF to ON						5.7	(5.6)	(5.5)	(5.7)	(5.6)	(5.7)	(5.8)
TRANSITION AVG - ON to OFF								5.8	5.8	5.9	5.9	5.9
AVERAGE - REPRESENTATIVE TRANSITIONS				(5.7)								
NOTES and INTERPRETATION:												
Voltage trend is steady throughout TIS testing period												
All transitions included in average reactive power calculation												
Average Performance = 5.7 volt improvement												

Table 3 above shows analysis of the data collected for three phase voltage on August 14th, 2009. The increases recorded for the Delta units have a cumulative effect on overall circuit voltage. With eight USES® units active, the voltage is improved by about 5.7 volts.

Graph 3



Graph 3 above shows three phase amperage on August 14th, 2009. There is about a 56.9 amp reduction on each phase when the USES® System is activated.

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Table 4

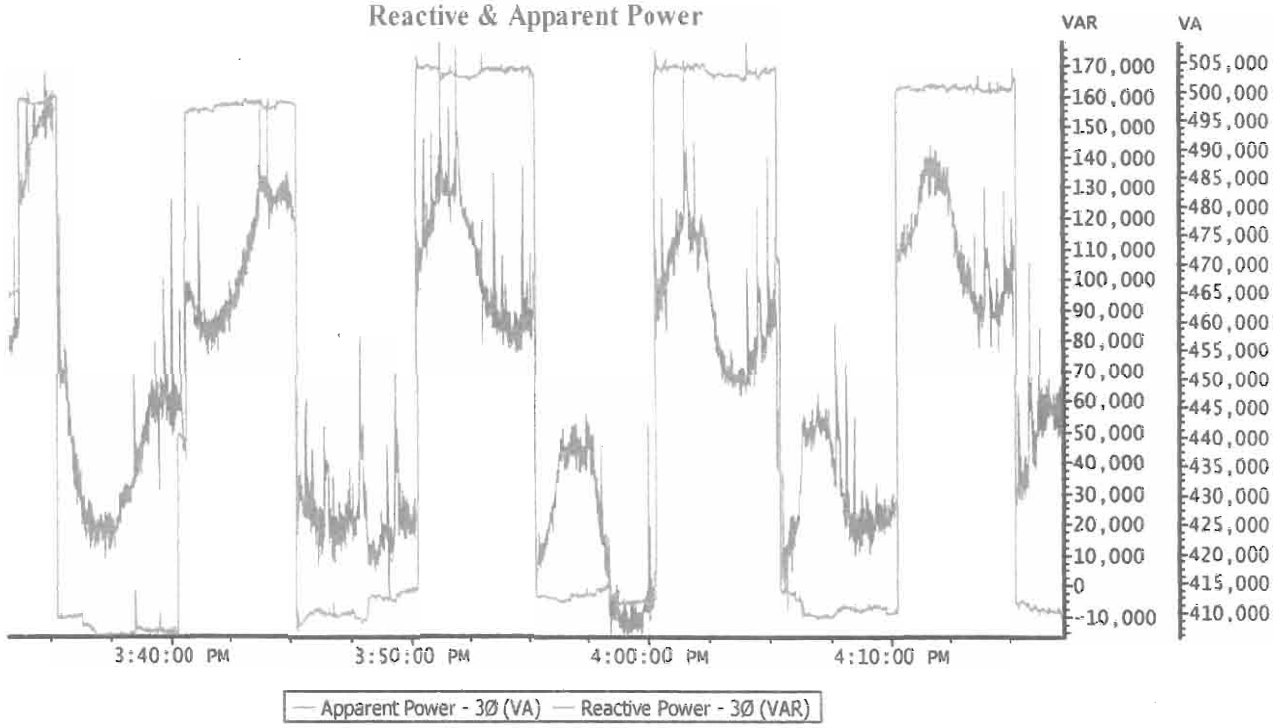
Amperage Average of Phases A, B, C (Amps)												
		Intervals				Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Difference Off to On	Difference On to Off	Change At Transition	Change Trans.	Change Trans.	Change Trans.	Change Trans.
TIS Testing - Eight (8) USES CMES-3D-480 volt units												
3:33:16 PM	3:35:15 PM	8	OFF	581.9								
3:35:16 PM	3:40:15 PM	8	ON		516.6	(65.3)		(57.4)	(57.8)	(61.8)	(68.6)	(69.5)
3:40:43 PM	3:45:14 PM	8	OFF	567.0			50.3	33.6	28.8	26.1	26.5	26.5
3:45:16 PM	3:50:14 PM	8	ON		506.1	(60.9)		(58.6)	(64.7)	(67.7)	(70.3)	(70.9)
3:50:17 PM	3:55:14 PM	8	OFF	565.8			59.7	67.3	60.4	63.5	66.8	66.5
3:55:16 PM	4:00:15 PM	8	ON		500.4	(65.4)		(61.8)	(58.3)	(57.4)	(53.5)	(51.2)
4:00:17 PM	4:05:15 PM	8	OFF	553.9			53.6	56.0	64.9	67.1	72.4	74.5
4:05:24 PM	4:10:14 PM	8	ON		507.8	(46.1)		(56.2)	(57.3)	(55.2)	(51.2)	(47.4)
4:10:17 PM	4:15:14 PM	8	OFF	567.1			59.3	60.4	61.8	63.9	65.7	66.9
4:15:16 PM	4:17:15 PM	8	ON		520.2	(46.9)		(61.3)	(52.4)	(52.0)	(44.0)	(41.5)
AVERAGE - OFF				567.1								
AVERAGE - USES ON				510.2				ALL TRANSITIONS				
DIFFERENCE				(56.9)								
TRANSITION AVG - OFF to ON						(56.9)	55.7	54.3	54.0	55.1	57.8	58.6
TRANSITION AVG - ON to OFF								(59.1)	(58.1)	(58.8)	(57.5)	(56.1)
AVERAGE - REPRESENTATIVE TRANSITIONS				56.9								

NOTES and INTERPRETATION:

Amperage trend is slightly variable throughout TIS testing period due to load variations
All transitions included in average reactive power calculation
Average Performance = 56.9 Amp reduction

Table 4 above shows analysis of the data collected for three phase amperage on August 14th, 2009. There was an average reduction of 56.9 amps as a result of the USES® System.

Graph 4



Start: 8/14/2009 3:33:16 PM End: 8/14/2009 4:17:15 PM
Academic Center

Graph 4 above shows Reactive Power in VAR and Apparent Power in VA on August 14th, 2009.

Table 5

Reactive Power (VAR)												
Intervals						Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Difference Off to On	Difference On to Off	Change At Transition	Change Trans.	Change Trans.	Change Trans.	Change Trans.
TIS Testing - Eight (8) USES CMES-3D-480 volt units												
3:33:16 PM	3:35:15 PM	8	OFF	142,062								
3:35:16 PM	3:40:15 PM	8	ON		(13,762)	(155,825)		(169,956)	(169,721)	(168,878)	(168,327)	(167,934)
3:40:43 PM	3:45:14 PM	8	OFF	156,357			170,119	168,861	169,767	169,981	169,732	169,651
3:45:16 PM	3:50:14 PM	8	ON		(6,664)	(163,021)		(170,543)	(169,162)	(168,374)	(167,135)	(166,571)
3:50:17 PM	3:55:14 PM	8	OFF	167,635			174,299	169,483	170,322	170,368	170,315	170,786
3:55:16 PM	4:00:15 PM	8	ON		(3,658)	(171,294)		(170,137)	(170,601)	(171,082)	(171,579)	(171,774)
4:00:17 PM	4:05:15 PM	8	OFF	167,679			171,337	171,555	172,852	173,096	173,322	173,506
4:05:24 PM	4:10:14 PM	8	ON		(7,093)	(174,772)		(170,682)	(169,835)	(169,711)	(170,193)	(170,750)
4:10:17 PM	4:15:14 PM	8	OFF	162,542			169,634	170,288	170,657	171,120	170,494	170,029
4:15:16 PM	4:17:15 PM	8	ON		(7,220)	(169,762)		(171,058)	(169,556)	(168,535)	(169,030)	(168,935)
AVERAGE - OFF				159,255								
AVERAGE - USES ON				(7,680)				ALL TRANSITIONS				
DIFFERENCE				(166,935)								
TRANSITION AVG - OFF to ON						(166,935)	171,348	170,047	170,900	171,141	170,966	170,993
TRANSITION AVG - ON to OFF								(170,475)	(169,775)	(169,316)	(169,253)	(169,193)
AVERAGE - REPRESENTATIVE TRANSITIONS				169,790								

NOTES and INTERPRETATION:

Reactive Power Demand is steady throughout TIS testing period
All transitions included in average reactive power calculation
Performance of USES system = 170 KVAR Reactive Power Demand reduction
Average performance per CMES-3D-480 volt USES unit = 21.2 KVAR per unit

Table 5 above shows analysis of the data collected for Reactive Power on August 14th, 2009. The USES® System reduced reactive power by about 169.8 kVAR when activated. The reactive power on the circuit decreased from about 159 kVAR lagging to about 7.6 kVAR leading.

Table 6

Apparent Power (VA)												
Intervals						Full Interval		Instant	15 Sec Avg	30 Sec Avg	45 Sec Avg	60 Sec Avg
Interval Time Frame		# USES	Status	USES OFF AVERAGE	USES ON AVERAGE	Difference Off to On	Difference On to Off	Change At Transition	Change Trans.	Change Trans.	Change Trans.	Change Trans.
TIS Testing - Eight (8) USES CMES-3D-480 volt units												
3:33:16 PM	3:35:15 PM	8	OFF	483,281								
3:35:16 PM	3:40:15 PM	8	ON		436,448	(46,833)		(39,772)	(39,990)	(43,318)	(49,118)	(49,847)
3:40:43 PM	3:45:14 PM	8	OFF	470,356			33,908	20,352	16,120	13,925	14,132	14,040
3:45:16 PM	3:50:14 PM	8	ON		426,737	(43,619)		(41,107)	(45,977)	(48,369)	(50,511)	(51,187)
3:50:17 PM	3:55:14 PM	8	OFF	471,000			44,262	50,789	44,808	47,433	50,065	49,708
3:55:16 PM	4:00:15 PM	8	ON		423,024	(47,976)		(45,737)	(42,996)	(41,910)	(38,460)	(36,435)
4:00:17 PM	4:05:15 PM	8	OFF	463,385			40,361	42,028	49,265	50,935	55,424	57,204
4:05:24 PM	4:10:14 PM	8	ON		430,619	(32,766)		(41,302)	(42,359)	(40,826)	(37,569)	(34,331)
4:10:17 PM	4:15:14 PM	8	OFF	473,052			42,433	42,528	43,598	45,661	47,217	48,264
4:15:16 PM	4:17:15 PM	8	ON		441,236	(31,816)		(43,633)	(36,001)	(35,828)	(29,365)	(27,386)
AVERAGE - OFF				472,215								
AVERAGE - USES ON				431,613				ALL TRANSITIONS				
DIFFERENCE				(40,602)								
TRANSITION AVG - OFF to ON						(40,602)	40,241	45,115	45,890	48,010	47,217	48,264
TRANSITION AVG - ON to OFF								(42,300)	(41,465)	(42,050)	(50,511)	(51,187)
AVERAGE - REPRESENTATIVE TRANSITIONS				46,201								

NOTES and INTERPRETATION:

Apparent Power Demand is variable throughout TIS testing period with significant recurring load variations
Shaded cells are not representative of performance due to significant load variations during averaging period
Shaded cells are kept the same as those discounted for Real Power Demand
Performance of USES system = 46.2 KVA Apparent Power Demand reduction
Apparent Power is graphed with Reactive Power

Table 6 above shows analysis of the data collected for Apparent Power on August 14th, 2009. There was a reduction in apparent power from 472 kVA to 431 kVA when the USES® System was activated. This translates to an apparent power reduction of 46.2 kVA on the circuit.

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System Savings

Evaluation of the USES® System installed at the Academic Center shows a demand reduction when the USES® System is activated. During the On-Peak TIS testing on August 14th, 2009, the average real power demand reduction was 17,368 watts. The total annual reduction of real power consumed is 17,368 watts x 8760 hours per year = 152,144 kWh per year.

Summary and Conclusions

The installation of a USES® Shunt Efficiency System at the Academic Center has improved power quality and has resulted in a substantial decrease in electrical demand. The USES® System reduced the demand for electricity by about 17.4 kW. The performance of the USES® Shunt Efficiency System at the Academic Center has proven to be consistent with all of the estimated power quality improvements as outlined in DWA Energy's proposal to ESG dated December 12, 2008.

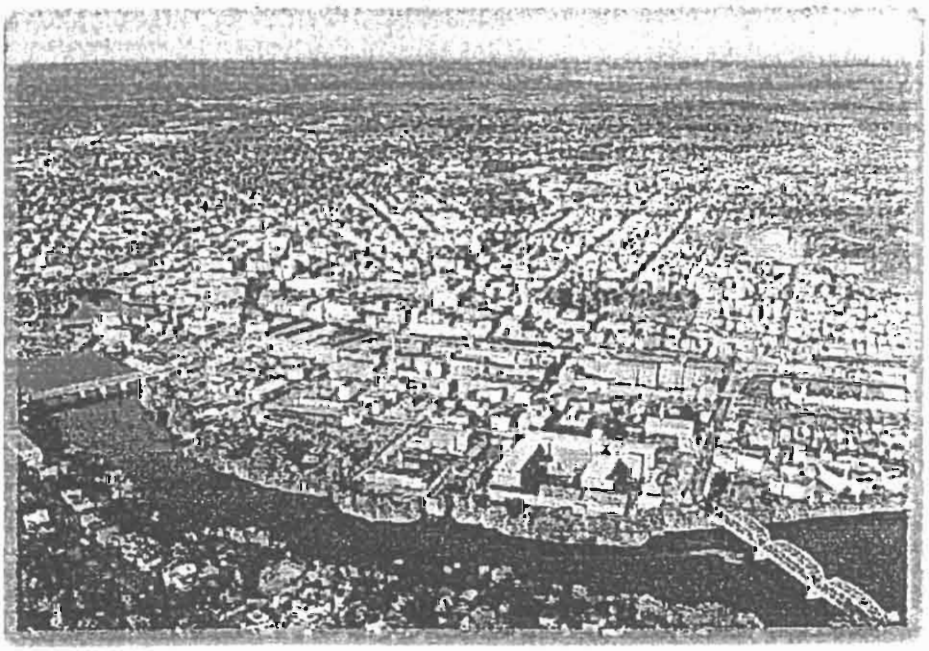
Additional power quality improvements were also realized by the installation of the USES® System. However, the USES® System's ability to provide superior surge & spike protection cannot be measured. The benefits of enhanced surge & spike protection, will translate to additional savings through the avoidance of maintenance costs on motors and sensitive electronic systems within the facility.

The USES® System provides power quality improvements that no other power conditioning system can provide. For any questions or comments on this report, please contact Skip Delclos, Division Manager, DWA Energy at (703) 506-0012, or via email to skip@dwaenergy.com.

POM
Energy Concepts

Energy Savings Evaluation
for
Lewiston-Auburn Water Pollution Control Authority

535 Lincoln Street
Lewiston, ME 04241



February 2004

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Summary

On February 18th and 19th 2004 POM Energy Concepts conducted an evaluation of the USES® Shunt Efficiency System installed at Lewiston-Auburn Pollution Control Facility. The purpose of the USES® System is to reduce energy consumption and demand, improve power factor, and to protect against electrical spikes and surges. The evaluation showed the level of energy savings from the USES® system. The evaluation was performed by Peter Chiaravalle and Stuart Forbes from POM Energy Concepts, and monitored by Mac Richardson and Myron Eames of Lewiston-Auburn WPCA.

The test location for the USES® system was the main switch gear. This allowed monitoring of total electrical energy for the facility. Several parameters were measured including voltage, amperage, kW demand, kWh, and power factor. The results of the energy monitoring are shown on page 3. Graphs from the CMP web site showing electrical usage for the two days are also included.

The USES® system is installed at various panels throughout the facility. Locations are shown in Schedule A. Another parameter not measured but inherent in the USES® product is the spike and surge suppression capabilities. The USES® unit dampens inrush current during motor startup, and clips spikes when equipment is cycled off. The USES® system will buffer spikes and surges and improve power factor and voltage throughout the facility at the panels where these electrical events originate. Additionally, an improved power factor will result in higher voltage and extended equipment life. Greater energy savings will also be realized by reducing electrical line losses.

The results of the evaluation show a **2.0 year simple payback** for the USES® System. The cost per kWh is figured by taking the previous year's total cost and dividing by the total energy used.

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Timed Interval Sampling (TIS) Guidelines

Timed Interval Sampling (TIS) is a statistical method of energy measurement with regard to kWh (kilowatts per hour) over a relatively short span of time. It is valid in all facilities with electrical loads but is particularly useful in facilities where energy use is a function of manufacturing, environmental loads, and related equipment. **TIS** is utilized to minimize the effect of numerous variables present when measuring energy consumption. These variables often include: monthly billing cycle irregularities, weather conditions, facility operations, and man-hour variances.

When the USES® System is being evaluated, it is alternately activated and deactivated at consistent timed intervals such as 15 minutes, 20 minutes, or 30 minutes to collect comparative samples of energy used, in kWh, by the loads in the facility in equal conditions. The energy usage data is recorded and averaged in each respective operating condition (i.e. USES® on or off), in order to demonstrate energy consumed with the USES® System activated and deactivated. Our experience has shown that a few hours to two days of testing is generally sufficient to prove the USES® System is operating at or above its predicted performance guarantee.

The most justifiable way to demonstrate electrical energy reduction is through the utility meter the facility is being billed on. However an Amprobe DM-II Pro energy meter and datalogger is connected in parallel with the facility electric meter to obtain second by second digital measurements. The Amprobe meter meets the standards of the National Institute of Standards and Technology.

POM Energy Concepts has found that Timed Interval Sampling is the most reliable and verifiable method of comparing energy consumption, while still accounting for all variables present. **TIS** will be used to verify that the USES® System is operating as guaranteed in your facility and will provide instantaneous results.

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Lewiston-Auburn WPCA

Lewiston, ME

USES® Installation Schedule

Unit #	Type	Location	Feed From	Amp Rating
1	CMES 3D 480	Main Switch Gear	N/A	2000 amp
2	CMES 3D 480	Main Switch Gear	N/A	2000 amp
3	CMES 3Y 480	Main Switch Gear	N/A	2000 amp
4	CMES 3D 480	Blower Disc	MSG	600 amp
5	CMES 3D 480	Blower Disc	MSG	600 amp
6	CMES 3D 480	Raw Sewage Pump Panel	MSG	N/A
7	CMES 3D 480	Raw Sewage Pump Panel	MSG	N/A
8	CMES 3D 480	Raw Sewage Pump Panel	MSG	N/A
9	CMES 3D 480	Raw Sewage Pump Panel	MSG	N/A
10	CMES 3D 480	Sludge Press Room Panel	MSG	400 amp
11	CMES 3D 480	Sludge Press Control Room Panel	MSG	400 amp

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Lewiston Auburn- Water Pollution Control Authority

Timed Interval Sampling Results

DATE	TIME	kWh Consumed POM Units ON	kWh Consumed POM Units OFF	DELTA	% CHANGE
Wednesday, February 18, 2004	8:30 - 9:00	240			
	9:00 - 9:30		256	16	6.67%
	9:30 - 10:00	248			
	10:00 - 10:30		268	20	8.06%
	10:30 - 11:00	280			
	11:00 - 11:30		340	60	21.43%
	11:30 - 12:00	312			
	12:00 - 12:30		332	20	6.41%
	12:30 - 1:00	308			
	1:00 - 1:30		332	24	7.79%
	1:30 - 2:00	304			
	2:00 - 2:30		308	4	1.32%
	2:30 - 3:00	276			
	3:00 - 3:30		265	-11	-3.99%
	Day totals	**1968**	**2101**	133	**6.76%**
Thursday, February 19, 2004	8:30 - 9:00		300		
	9:00 - 9:30	288		12	4.00%
	9:30 - 10:00		304		
	10:00 - 10:30	292		12	3.95%
	10:30 - 11:00		316		
	11:00 - 11:30	304		12	3.80%
	11:30 - 12:00		328		
	12:00 - 12:30	304		24	7.32%
	12:30 - 1:00		316		
	1:00 - 1:30	256		60	18.99%
	1:30 - 2:00		248		
	2:00 - 2:30	240		8	3.23%
	2:30 - 3:00		260		
	3:00 - 3:30	232		28	10.77%
	Day totals	**1916**	**2072**	**156**	**7.53%**
	2 day totals	**3884**	**4173**	**289**	**7.44%**
	2 day averages	277	298	20.6	

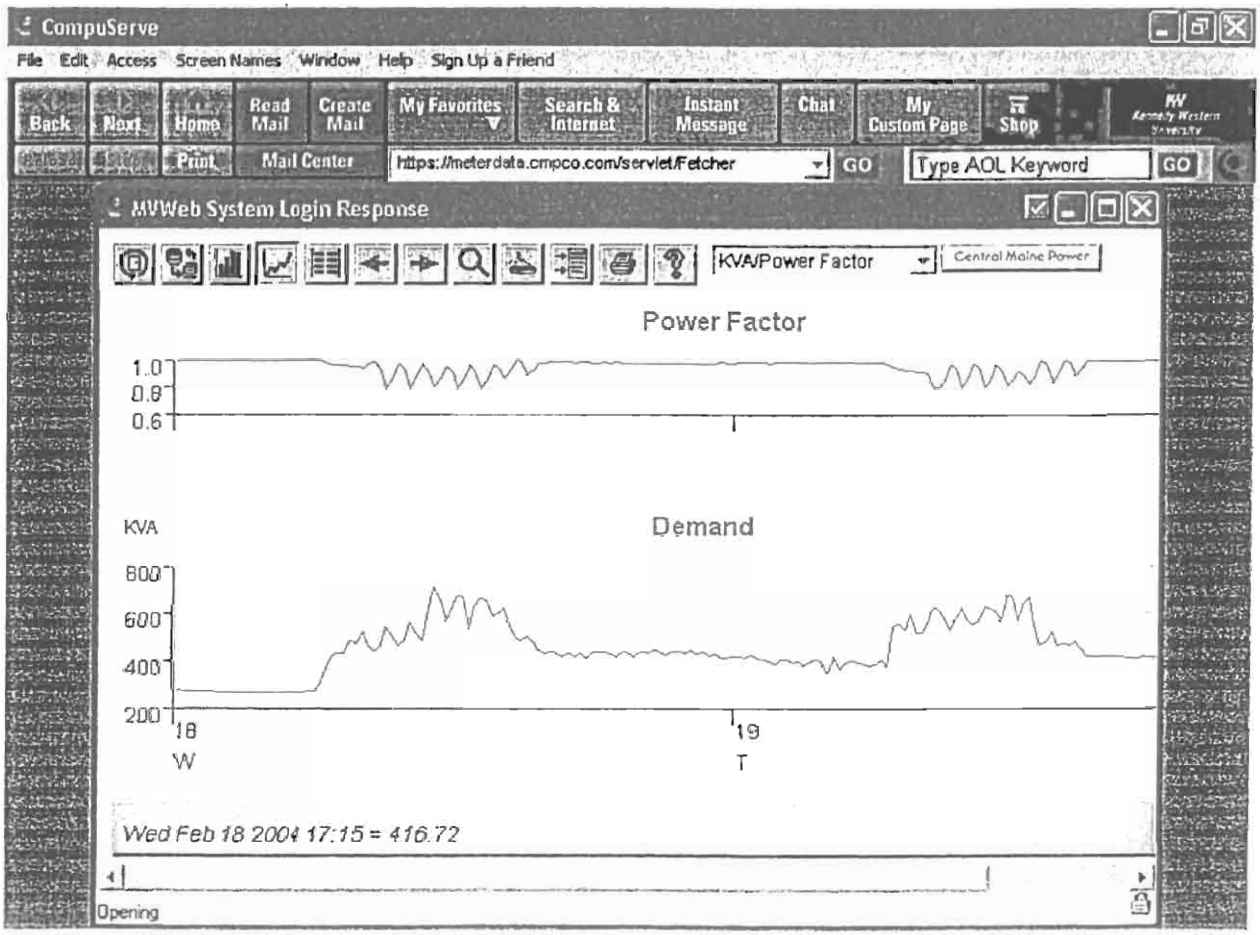
	2 day average difference x 2	41.3 kwh per hour
	kWh per hour x 24 hours	990.9 kWh per day
COP (Cost of Power) 0.095	kWh per day * COP	$94 daily cost of power
	daily COP x 365	$34,358 annual cost of power
		$70,395 total cost of units
		2.0 payback (years)

POM
Energy Concepts

Lewiston-Auburn WPCA

The graph below is from the CMP Website showing meter data for the Lewiston-Auburn Wastewater Treatment Plant for the period of the timed interval sampling on February 18th and 19th. The power factor and demand can be correlated with the time frames that the USES® Shunt Efficiency System was turned on and off.

The power factor can be seen at 1.0 when the system is on. This will preclude any power factor charges if rate structures change to include such charges. A high power factor also helps to extend equipment life. The kVa demand also correlates to the cycling of the USES® System. Although kVa demand is not the same as kW demand, it parallels the same usage patterns. Actual kW demand can be seen in the separate demand graph.



Lewiston-Auburn WPCA

The kW demand graph covers the same time that the Timed Interval Sampling was performed, plus the following day. While the TIS was conducted the saw tooth effect created by the USES System from the ON/Off cycling is seen in the kW Demand. The following day's kW demand is included to show a normal day. The demand profile is consistent with the previous two days but at a higher level and without the pronounced cycling as in the previous two days.