



October 30, 2017

### Review of Power Factor Correction Installation., Millennium Place, Sherwood Park, AB

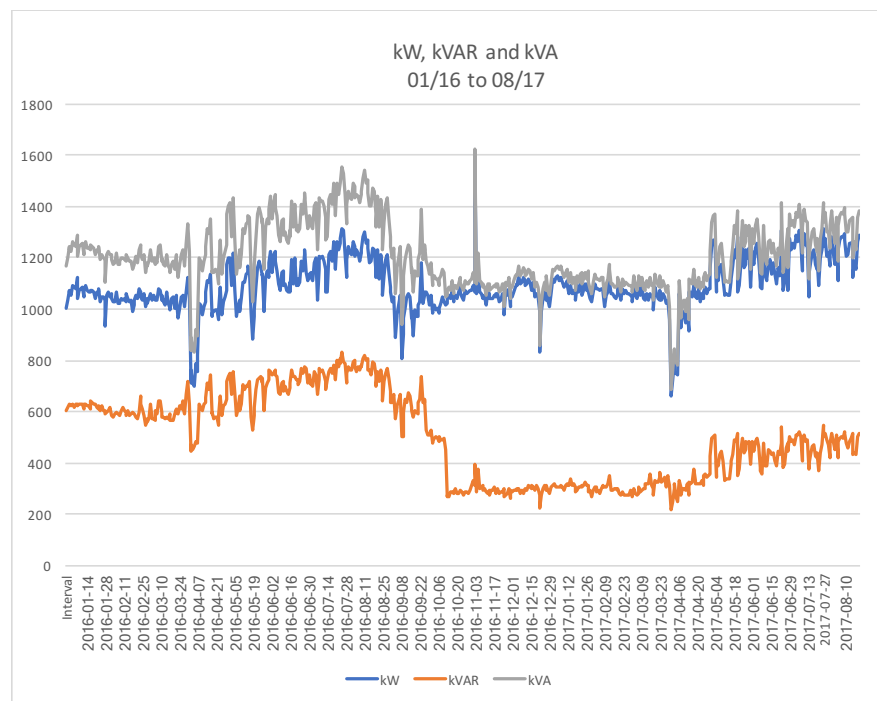
Gray Energy Economics Inc. has reviewed the operational metering data for Millennium Place multi-use sports centre pre and post installation of 4 var compensators for the purpose of power factor correction.

Installation of the var compensators began on Sept. 29, 2016 with one 100 kVAR static unit. This was followed by 125 kVAR and 150 kVAR switchable units energized on October 14, 2016. One additional unit of 150 kVAR switchable capacity was installed in January of 2017, but was not operational due to a programming error in the controller. That unit is now operational.

Data used in the analysis comes from raw Fortis Alberta meter record of kW, kVAR and kVA for the period January 1, 2016 to August 24, 2017.

The effect of power factor correction reducing kVAR demand is clearly shown in this chart.

The step changes in kVAR demand reduce consumption from approximately 700 kVAR to 350 kVAR.



Data for the facility is significantly seasonal, but does appear to repeat on a consistent annual cycle.

Consumption for Jan 1 to August 24 was compared between 2016 and 2017 to isolate the effect of power factor correction on kVAR, kVA and kW.h.

Statistics	kW	kVAR	kVA
2016 Average	822.7	516.2	971.7
Std Dev.	172.0	104.2	199.2
2017 Average	850.1	268.2	892.2
Std Dev.	167.7	80.1	181.6
Difference	27.4	-248.0	-79.4

Both kVAR and kVA have been reduced as expected with installation of power factor correction equipment.

However, average kW demand increased between 2016 and 2017.

A decrease in kW demand should be expected from reduced heating losses in the internal wiring and equipment. As both kVAR and kVA demand are reduced it must be the case that real energy consumption has increased at the facility, either through a change in equipment or a change in equipment operation.

This effect was also analyzed using linear regression with heating and cooling degree days, and dummy variable for pre and post installation and weekend days.

The results were similar with the most robust formulation showing an additional 700 kW.h per day of consumption after installation.

It is not physically possible for VAR compensation to reduce kVAR and kVA demand while increasing kW demand. Therefore, one must conclude that the comparison of pre and post installation consumption data has been affected by a change in load unrelated to the VAR compensation. An estimate for energy savings is not possible under these circumstances.

### **Savings Analysis**

Reducing kVAR demand has had the effect of avoiding penalty billing under the FortisAlberta Rate 61 Large General Service tariff. Penalties are incurred below 90% power factor and power factor at the facility has been corrected to 96 - 98%.

Power factor correction reduces the billing demand for the facility by an average of 69 kW per month. Using the details of the last years billing determinants and adjusting for power factor correction the following savings are expected to be as follows:

Year	Expected Savings
2018	\$12,993
2019	\$14,056
2020	\$14,338
2021	\$15,688
2022	\$15,996
2023	\$16,316
2024	\$16,642
2025	\$16,975
2026	\$17,314
2027	\$17,661