

Voltage Power Optimisation (VPO)[®]

CASE STUDY Burger King Piccadilly Circus



About Burger King Piccadilly

The Piccadilly Circus store is unique in that as well as the typical electrical loads within a fast food outlet; lighting, refrigeration, air-conditioning etc, the lower level has over 100 PC's in the Easy Internet Café and so power quality as well as the reduction in consumption was closely monitored.

powerPerfector unit details

A 210KVA/300A powerPerfector unit was installed with a 7% Optimisation setting, from which savings of 11.5% are expected. Through installation the following results were achieved:

- **13% reduction in daily average consumption**
- **£8,903 per year**
- **54 tonnes CO2 per year**

Electrical load

The load is varied, with lighting, resistive loads from heating equipment, refrigeration and HVAC, as well as over 100 PCs.

FULL REPORT

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Introduction

powerPerfector optimises the voltage and improves the power quality for a whole site more efficiently than any other technology available. Optimising the supply voltage allows equipment to use only the energy it requires to operate efficiently.

For example, providing a motor with its optimum voltage prevents excess heat and vibration, while delivering the required torque and speed. When these effects are aggregated across a whole site, substantial energy savings are delivered. The Maximum Demand of the site is also reduced — typically by as much as 10% — which will help keep the site within its Agreed Service Capacity and may reduce penalty charges.

Installing a powerPerfector improves power quality on a site considerably. The reactance of some electrical equipment is reduced when voltage is optimised, so there is an overall improvement in power factor. Equipment is protected as the powerPerfector eliminates transients up to 25,000V and harmonics are filtered from the mains, while the balancing of phase voltages maximises the efficiency of three-phase equipment. By optimising the power supply at source, the powerPerfector is able to extend the lifetime of all the electrical equipment on a site, substantially reducing maintenance overheads in addition to the energy savings.

Overview

Following a process of evaluation to confirm the level of Optimisation and suitability of Burger King, Piccadilly for a powerPerfactor unit, a pP210kVA / 300A unit was installed. A scheduled shut down of the site was required.

Following installation all electrical equipment has operated normally and there have been no reports of any problems. With further observation over time, our clients tell us that equipment life can be noticeably extended.

THE SAVINGS REPORT

Savings summary

Reduction in daily average consumption	13%	£24 per day £8,903 per year
Projected annual carbon savings	54 tonnes	
Annual kWh savings	734156kWh	
Harmonic Distortion Reduction	90%	

Overall savings

A 210kVA powerPerfector with a –7% Optimisation setting was installed at Burger King, Piccadilly. As shown in the charts below, the average consumption for the period since the powerPerfector was installed has been reduced by at least **13%** - higher than expected. The method of analysis is outlined in the following report.

Transient Events

Challenge

To prove the elimination of high day to day transient event activity affecting the Burger King's flagship site in Piccadilly with the installation of powerPerfector technology.

Method

A power analyser was used to record transient activity before and after installation.

Benefits

Protection against transients (spikes) that damage computers and other sensitive equipment.

Improved power quality and equipment performance.

Summary

The analyser measured 98 transients over the 28 days prior to the installation of the powerPerfector. A daily average of 3.5 transient events per day.

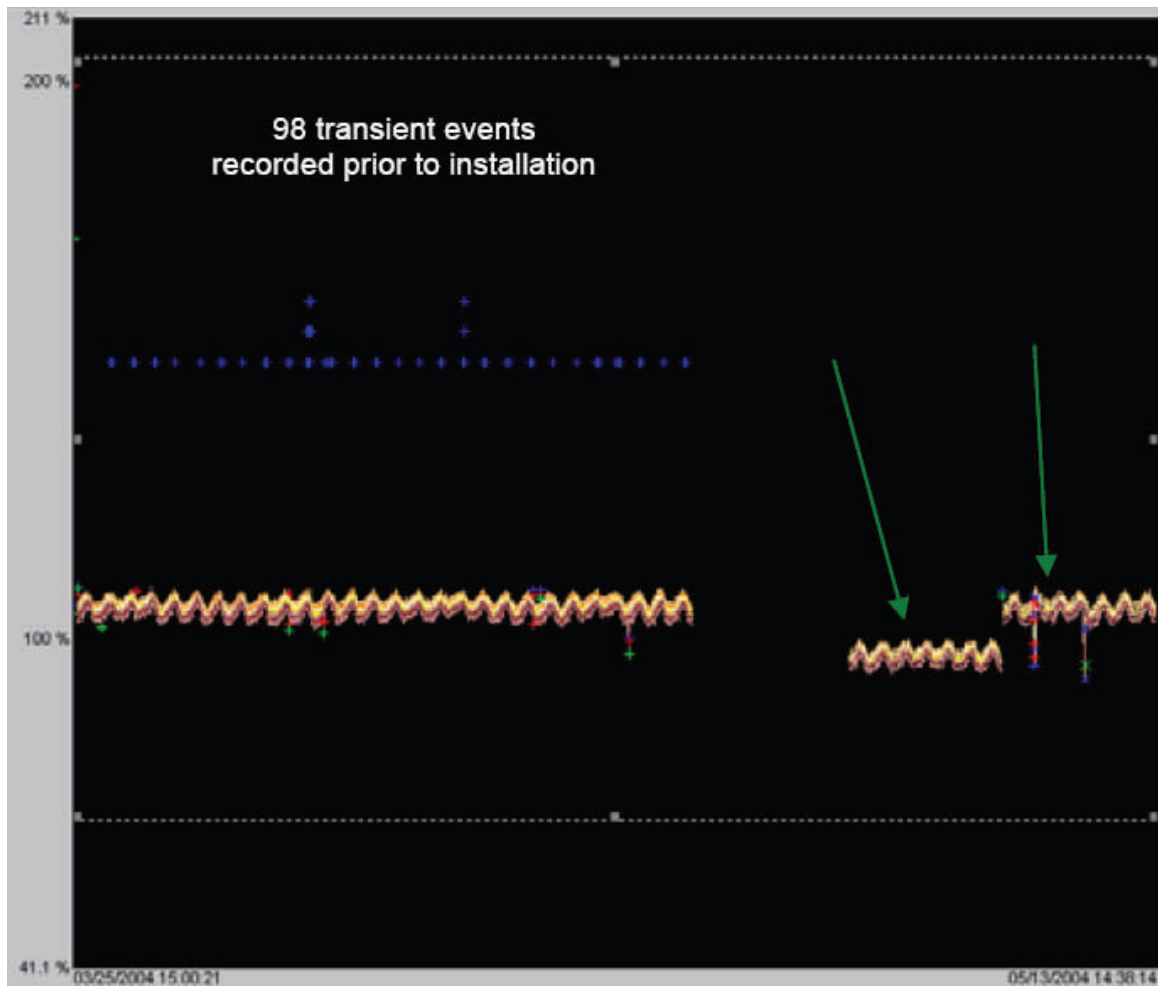
Following the installation of the powerPerfector the number of transient events recorded on the output side of the powerPerfector over a 6 day period was Zero.

After 6 days the analyser was moved to the input side of the powerPerfector to show that transient activity was still continuing.

The entire site's sophisticated electrical equipment is now protected from catastrophic failure due to the increasing level of transients in power supplies.

Figure 1

The transient events at the Burger King outlet, Piccadilly Circus, for a period of 1 month prior to installation of a powerPerfector and for two weeks following installation. It can be seen that following installation the data logger initially monitored the transient events on the output side for a period of one week and was then moved back to monitor the input side for the second week.



Overall Savings

The kWh savings being generated from the installation over 9 months compared to the previous year are **13%**.

High transient activity averaging 10 transients per week prior to installation have now been completely eradicated on the output side of the powerPerfector, so extending the life of the site's sensitive computer equipment and the whole site is now protected from further transients.

Prior to installation harmonics generated by the 100 computers in the internet café in the basement were recorded at a very high level of 426% of fundamentals on the Neutral and 26% on the Phase third harmonics. Both levels have been reduced by over 90% and are now well within the G5/4 guideline levels instituted by the Government in January 2003.

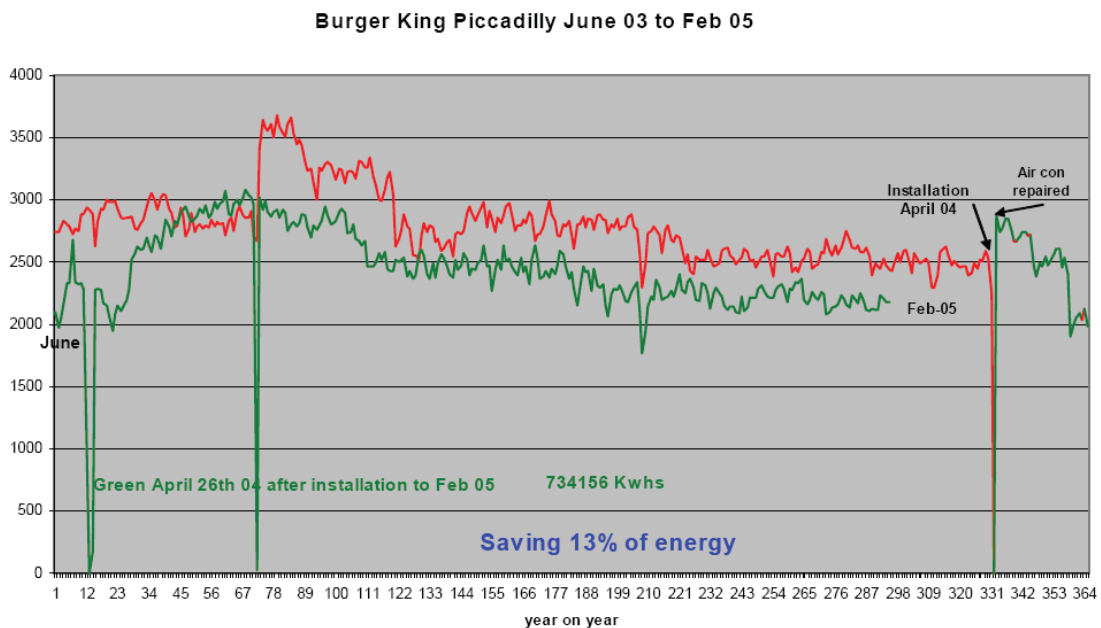


Figure 2 A year-on-year comparison of kWh consumption at Burger King Piccadilly.

Conclusion

In conclusion, analysis of the electricity consumption since the installation of the **powerPerfactor** indicates that savings have exceeded predictions.

Additionally, the site's equipment is being driven more efficiently by the **powerPerfactor's** higher-quality power output, with improved phase balancing, reduced harmonics and optimised voltage. Equipment lifetimes will be extended as a result, giving further savings going forward that are not included in this analysis.

It should be noted that there were no reported problems upon switch over from normal supply to **powerPerfactor** and there is no requirement for ongoing maintenance, beyond the standard 5 yearly electrical checks required for all electrical equipment.

Voltage Power Optimisation Additional Benefits

The ability of VPO[®] technology to reduce energy (kWh) consumption on a site is well documented, but the technology also provides a range of other benefits. These all contribute to creating a more efficient, robust and reliable electrical supply for your site, and provide further financial benefits on top of the reduced energy costs.

Reduced maintenance burden

- Optimising voltage with powerPerfector brings your supply voltage to the “higher efficiency” operating range of your equipment. Without this, the ‘raw’ supply voltage to your site is likely to be at the top end of the range of voltages your electrical equipment can tolerate. As well as reducing energy consumption, this reduces the **strain** on your equipment, and many of our clients tell us that this increases its lifespan.
- For example, a lightly-loaded **induction motor** operating at an optimum 380V instead of a ‘raw’ 415V experiences less heating and vibration, reducing wear on bearings and prolonging its life.
- The life of **incandescent light bulbs** is almost doubled by optimising their supply voltage.
- Most equipment benefits from the lower ‘**pressure**’ when voltages are optimised. Other examples include Variable Speed Drives – which are particularly sensitive to over-voltage – and the capacitor banks in Power Factor Correction systems.
- When these effects are **aggregated**, the benefit to your site of extended equipment lifetimes and reduced replacement costs will be substantial. The exact saving is difficult for powerPerfector to quantify, but we estimate it to give you a 10%+ reduction of your maintenance and capital replacement costs.

Improved power factor

- Optimising supply voltages reduces the **reactance** of electrical equipment, as it prevents over-excitation of magnetic components. The effect of this is to reduce the level of wasteful **reactive power** in the electrical system. Reducing reactive power improves **power factor**, and the powerPerfector typically improves power factor by 3-10%.
- The **maximum demand** of a site is expressed in kVA (incorporating both real and reactive power). So reducing reactive power reduces the maximum demand of a site, which will lead to reduced kVA demand charges, Agreed Service Capacity (ASC), and increase spare capacity for further growth. (8% optimisation = 6%-10% reduction in MD normally)

- Power factor **penalty charges** – which are now uncapped in the UK – can be avoided if your power factor is above 0.95. These may appear on your bill as ‘reactive power charge’, ‘kVAr charge’, ‘use of system charge’ or ‘availability charge’. If your power factor is at around 0.9 at the moment, the powerPerfactor could remove your exposure to these charges.
- In general, the strain on your electrical infrastructure is reduced if power factor is good. If your system is carrying a high proportion of reactive power, impedances and voltage-drop will be excessive, and overall **efficiency** will be low. The powerPerfactor improves the electrical efficiency of your site.
- The powerPerfactor yields many of the same benefits as **Power Factor Correction**, but does not use capacitors, which can be prone to failure. Instead, it helps correct the underlying cause of poor power factor, while saving energy.

Lower harmonic distortion

- The powerPerfactor is able to **filter harmonics** on the mains incomer. Harmonic distortion is on the increase, leading to apparently random failures of electronic equipment.
- As the site is protected from mains-borne harmonics, disruptions to the operation of sensitive **electronic equipment** that could otherwise result from intolerance to harmonic distortion are minimised.
- By preventing harmonics from entering the secondary side of the **HV supply transformer**, the powerPerfactor is able to improve the transformer’s efficiency and increase its effective capacity. Customers whose utility meter is on the HV side of their transformer will see higher savings as a result.
- The threat from damaging **resonance** effects is reduced as harmonic distortion is lower, as is the risk of failure of Power Factor Correction capacitors.
- The **efficiency** of any equipment containing magnetic components is improved – contributing to energy savings – as the heating effect of harmonics is reduced. This in turn extends operating life by postponing the breakdown of insulating materials.

Reduced neutral currents

- As well as providing general harmonic filtration, the powerPerfactor helps to reduce the level of **triplen harmonics** on a site, by balancing the three phase voltages.

- In addition to the benefits listed above, this leads to reduced **neutral currents** and temperatures – even though the neutral cable does not pass through the powerPerfector – as triplen harmonics accumulate on the neutral. Lower neutral currents are always desirable, and with an increasing proportion of non-linear loads generating more harmonics than ever before, undersized neutrals are a potential risk on many sites.

Improved phase voltage balance

- The operation of **three-phase equipment** – particularly induction motors – is much more efficient if the phase voltages are closely balanced. For large industrial sites that are heavily dependent upon such loads, balancing phase voltages at an optimum level with powerPerfector can yield energy savings of over 20% in motors.

Protection

- A powerPerfector makes an electrical supply more robust, and your site better protected. **Transients** – which are very brief surges in voltage from the grid – are eliminated by the powerPerfector, provided they are less than 25,000V.
- This level of protection is able to prevent transients from causing catastrophic damage to equipment, but it also prevents smaller, more common transient events that act to degrade equipment over time. This prolongs the expected life of electronic equipment.

