



**Accor Hotels
Novotel London City South**

powerPerfector iQ Voltage Power Optimisation®

Savings Analysis Report – November 2017



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Executive Summary

A 440kVA / 630Amp powerPerfector with a 9% optimisation setting was installed at Novotel London City South in January 2015. Since this original installation powerPerfector technologies have evolved with the introduction of the most advanced electronic voltage control technology available named the 'iQ'.

The iQ is the fastest, most accurate and precise control technology on the market; this new advancement upgrades a standard powerPerfector unit to a 'powerPerfector iQ'. In 2017 the powerPerfector unit at this site was upgraded with an iQ to provide the following benefits:

- **Improved savings:** Existing powerPerfector savings are improved by up to 30%
- **Security of supply:** The site is protected against harmful voltage dips, sags, intervals and swells
- **Improved site efficiency:** Highly stable voltage supply and phase voltage imbalance corrected

The following report analyses electricity consumption data from a Power Quality Analyser and indicates that the average kWh consumption at site is 9% lower.

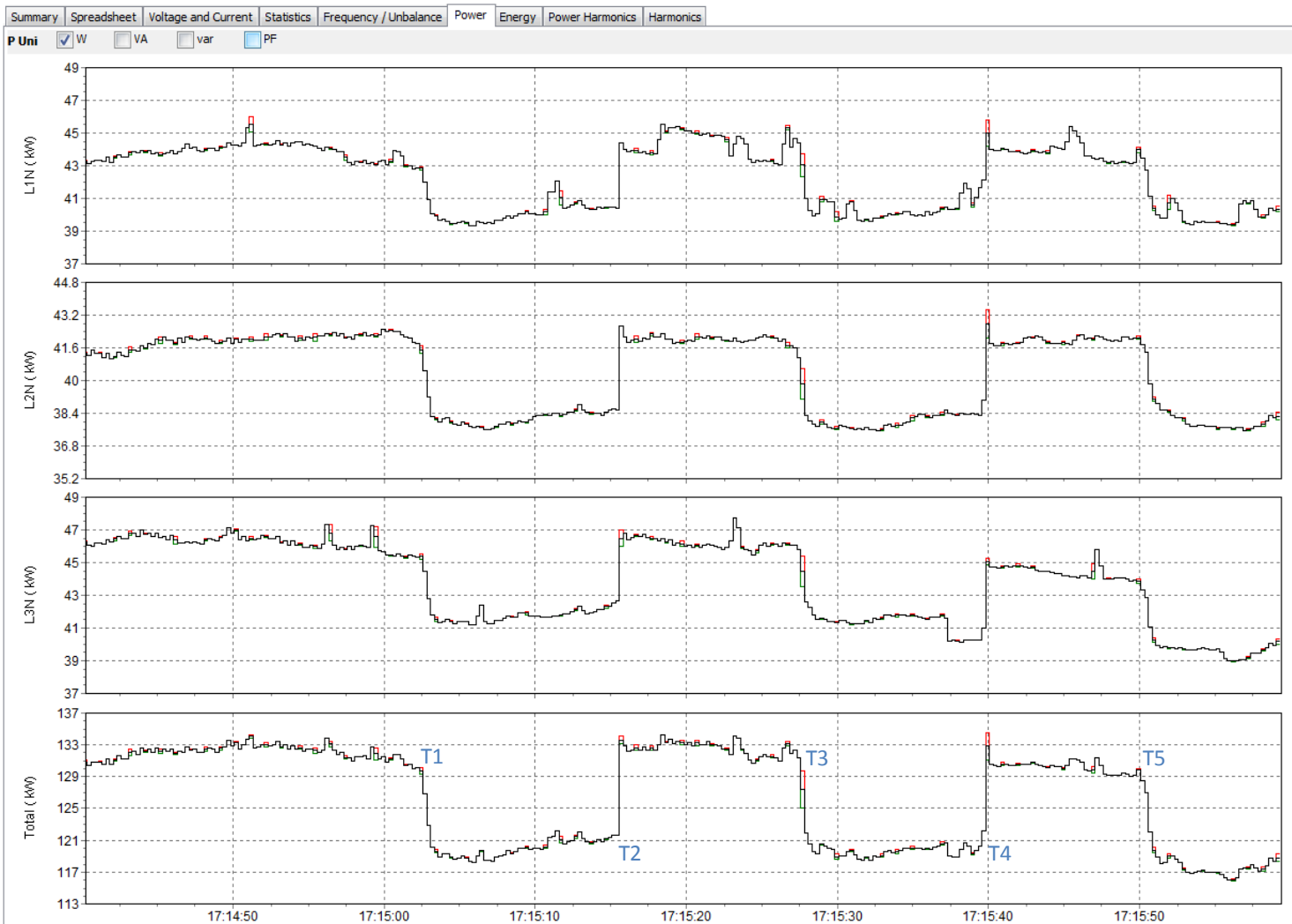
This reduction equates to approximately:

- **62,857** tonnes of carbon dioxide emissions
- **116,058** kWh of energy
- **£12,715** of annual financial savings



Test 1: kW per phase and Total kW

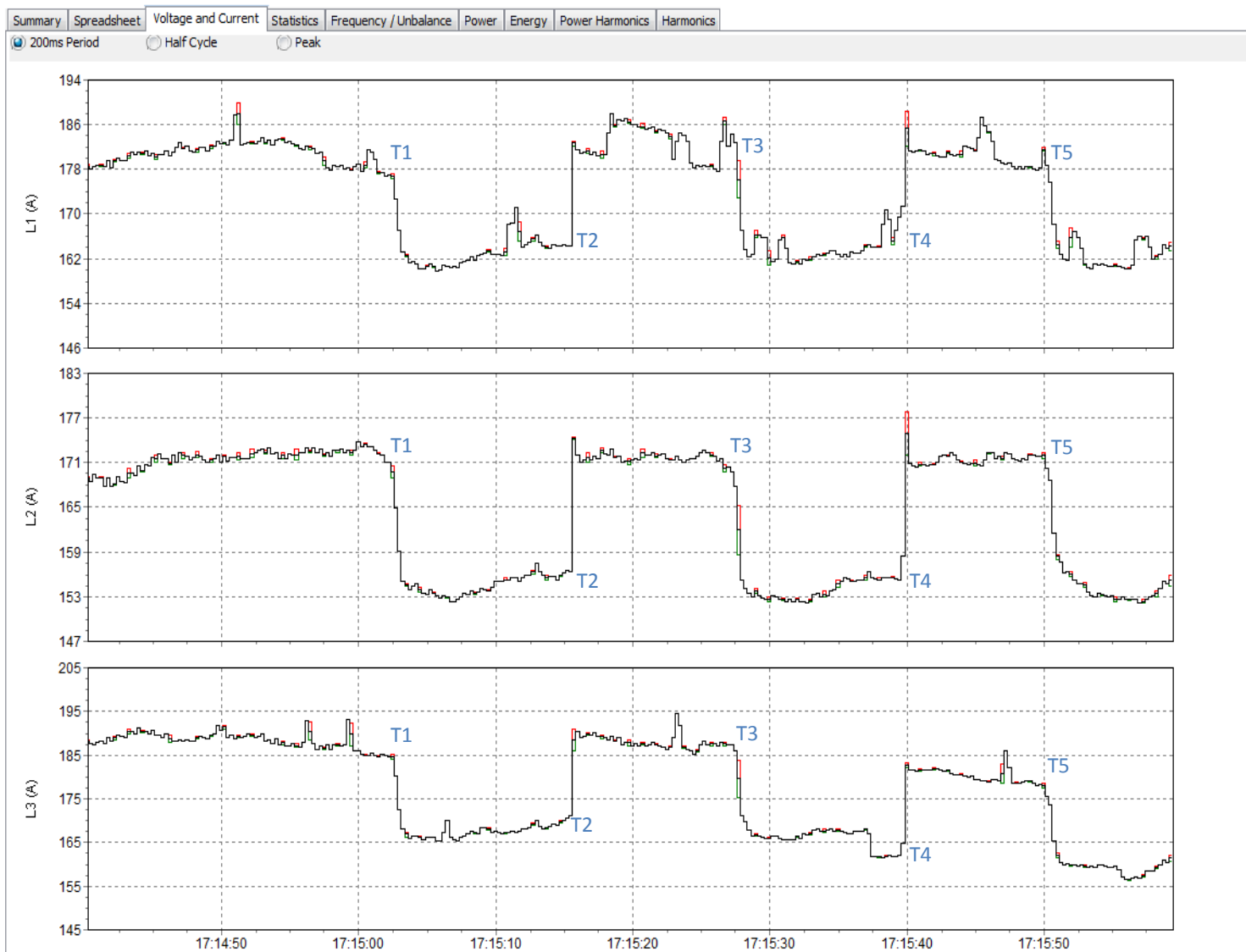
The charts below shows the change in real power kW when the powerPerfector iQ is taken in and out of line i.e. mains to active pPiQ. The step changes in kW can be clearly seen resulting in a definitive saving of 9%.



Test	Total kW change	
T1 = Bypass (mains) to Active pPiQ	130.53	120
	-8.08%	
T2 = Active pPiQ to Bypass (mains)	121.2	133
	+9.74%	
T3 = Bypass (mains) to Active pPiQ	132.33	119.97
	-9.34%	
T4 = Active pPiQ to Bypass (mains)	119.67	130.29
	+8.87%	
T5 = Bypass (mains) to Active pPiQ	129	117
	-9.30%	

Test 2: Current per phase

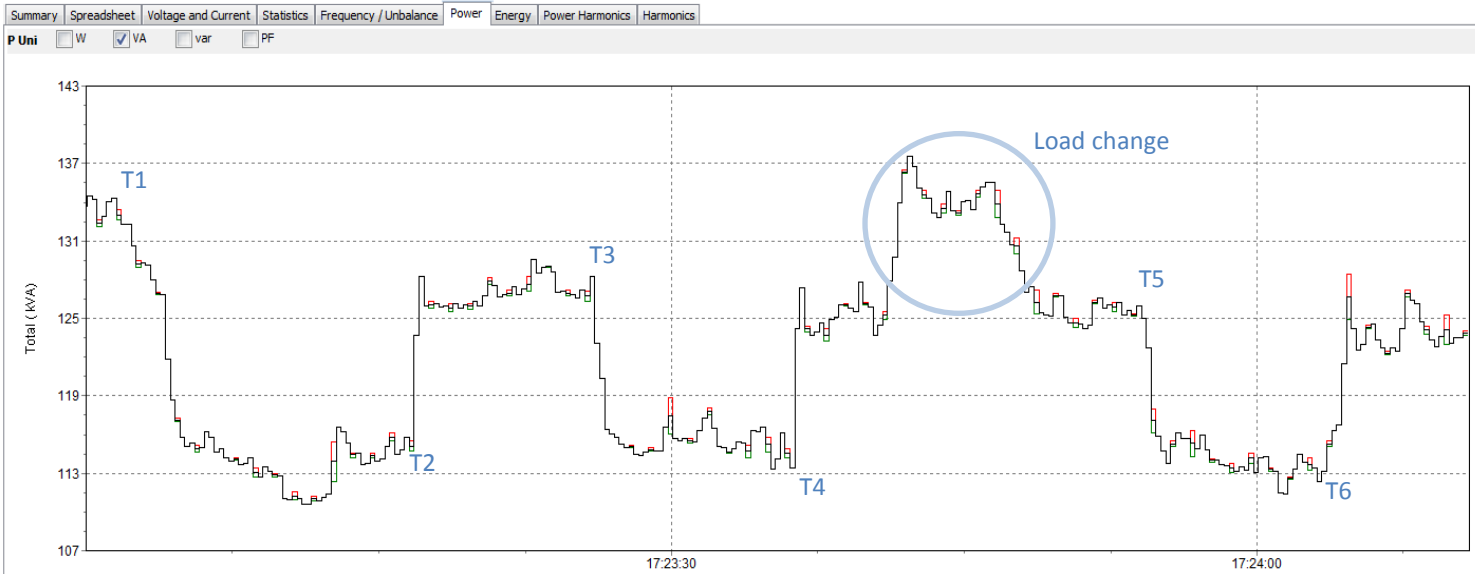
Each phase shows a reduction in current (amps) of approx. 10% as the voltage is reduced via the powerPerfector iQ.



Test	L1 Amps	L2 Amps	L3 Amps	Average change in Amps
T1 = Bypass (mains) to Active pPiQ	178	172.7	185	
	161.3	153.4	166.5	
	-9.38%	-11.17%	-10%	-10.18%
T2 = Active pPiQ to Bypass (mains)	164.3	156.2	168	
	184.6	172.1	187.1	
	+12.35	+10.18	+11.37%	+11.3%
T3 = Bypass (mains) to Active pPiQ	178.6	172.4	187	
	161.3	152.7	166.3	
	-9.69%	-11.43%	-11.07%	-10.73%
T4 = Active pPiQ to Bypass (mains)	169.1	155.7	161.9	
	178.4	172.2	182.1	
	+5.5%	+10.6%	+12.48%	+9.53%
T5 = Bypass (mains) to Active pPiQ	178.4	172.2	182.1	
	162	152.1	157.1	
	-9.19%	-11.67%	-13.73%	-11.53%

Test 3: Total kVA

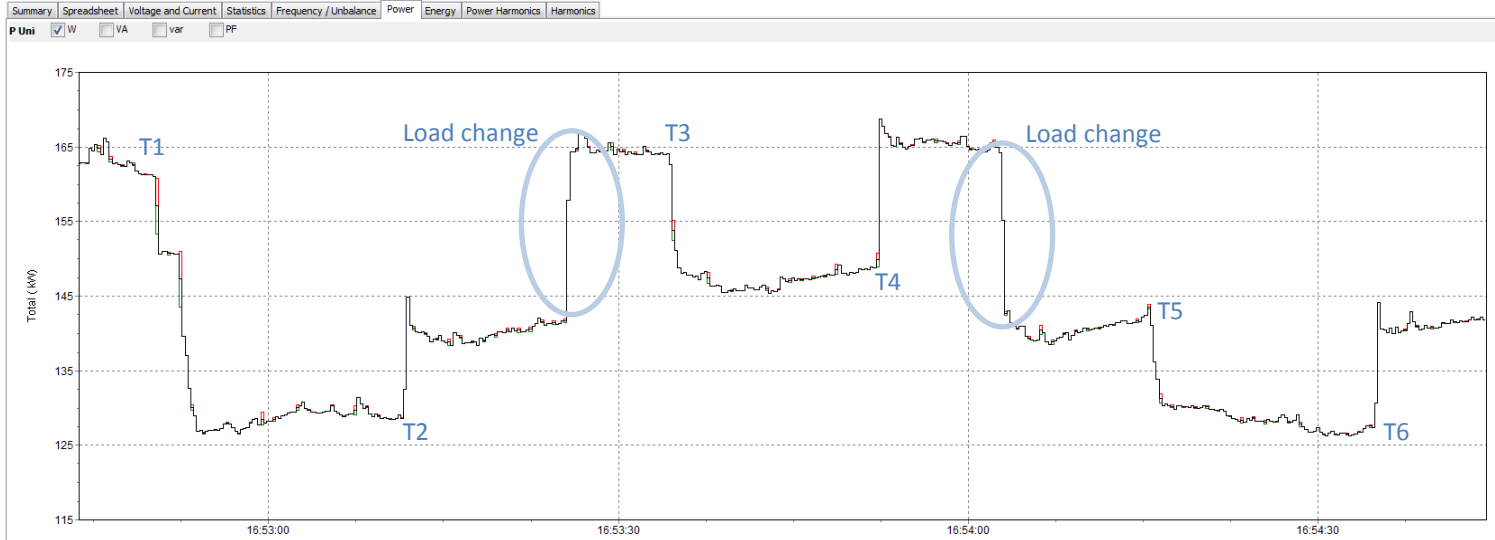
The chart below shows the change in apparent power kVA (real power plus re-active power) as the powerPerfactor iQ is activated. This demonstrates the ability of the unit to reduce maximum demand and reactive power.



Test	Total kVA change	
T1 = Bypass (mains) to Active pPiQ	131	113
	-13.74%	
T2 = Active pPiQ to Bypass (mains)	114	127
	+11.4%	
T3 = Bypass (mains) to Active pPiQ	127	114
	-10.23%	
T4 = Active pPiQ to Bypass (mains)	114	126
	+10.52%	
T5 = Bypass (mains) to Active pPiQ	125	113
	-9.6%	
T6 = Active pPiQ to Bypass (mains)	113	124
	+9.73%	

Test 4: Total kW

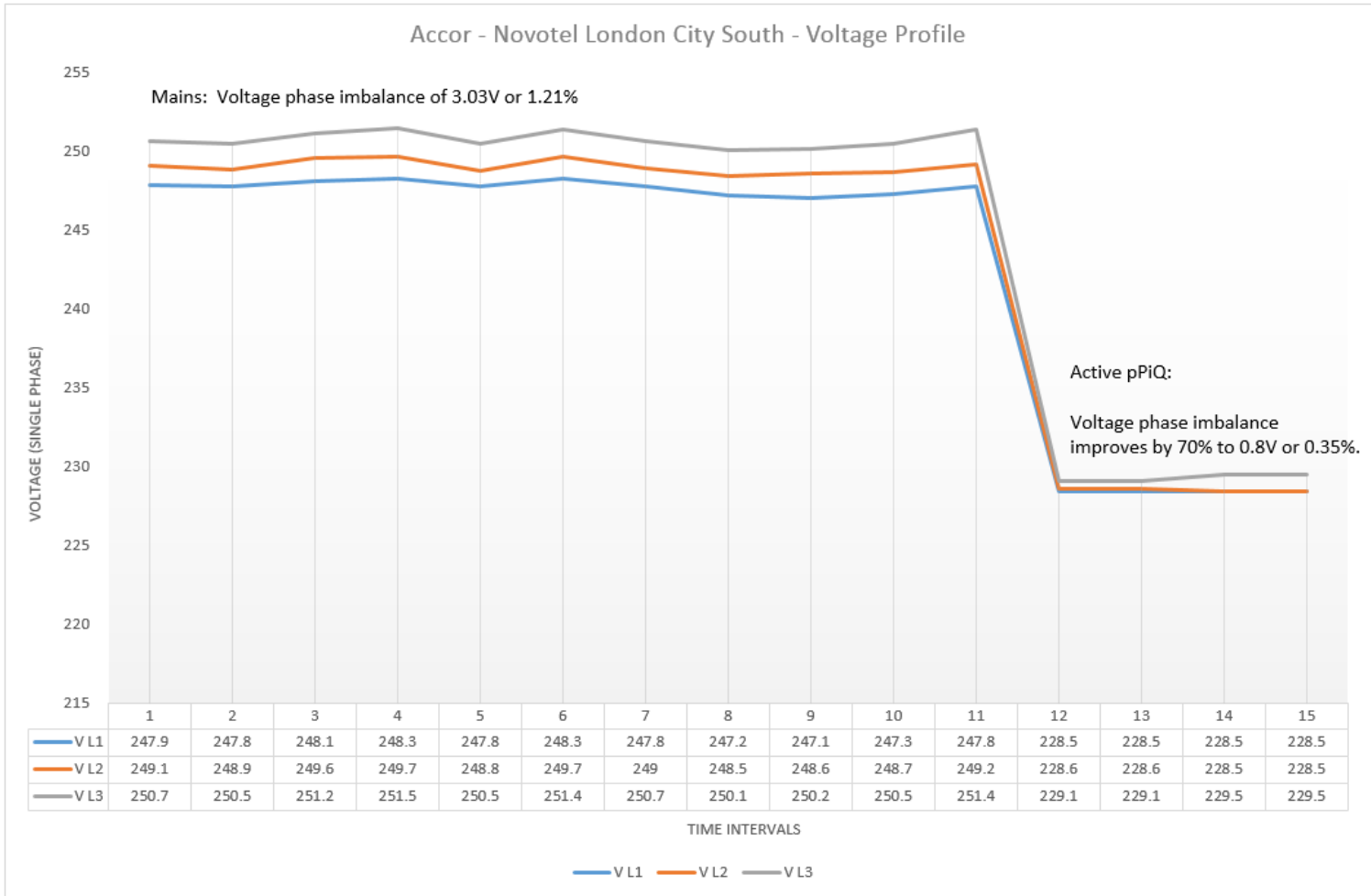
This is a repeat of the total kW test 1 but when the site was under higher loading which has resulted in an increase in the savings level. During the testing significant load changes were noted and highlighted.



Test	Total kW change	
T1 = Bypass (mains) to Active pPiQ	162	128
	-20.73%	
T2 = Active pPiQ to Bypass (mains)	128	139
	+8.59%	
T3 = Bypass (mains) to Active pPiQ	164	146
	-10.79%	
T4 = Active pPiQ to Bypass (mains)	148	165
	+11.49%	
T5 = Bypass (mains) to Active pPiQ	141	126
	-10.64%	
T6 = Active pPiQ to Bypass (mains)	126	141
	+11.9%	

Test 5: Voltage Profile analysis

Single phase voltage readings were recorded on the input and output side of the pPiQ every 10 seconds and plotted to demonstrate the significant improvement in voltage imbalance when the unit is active.



Importance of balanced voltages:

An unbalanced voltage imposed on a motor will result in a current increase and overheating. Moreover, the power consumption will increase and the efficiency, torque, and output of the motor will drop. Then the life of the winding may be shortened and the vibration and noise of the motor may increase because the motor will be partially overheated. Therefore, it is said that the motor should be driven by power with the voltage unbalance ratio suppressed to 2% or below.

If voltage unbalancing occurs, the current will be greatly influenced. It is said that an unbalanced voltage will have the following influence. A voltage unbalance ratio of 1% will result in a current unbalance ratio of approximately 10%.

Source: https://service.daikin.com/newweb/air_conditioner/Members/tech/news/PDF/E-06026.pdf

Conclusion

The report uses data collected from a Power Quality Analyser that was fitted on the grid side of the powerPerfector iQ unit and therefore replicates the DNO half-hourly meter from which the client is billed. The powerPerfector iQ is saving the site 9% of its electrical usage and perhaps more at times of higher load.

This reduction equates to approximately:

- **62,857** tonnes of carbon dioxide emissions
- **116,058** kWh of energy
- **£12,715** of annual financial savings

The iQ upgrade has afforded the site greater functionality including the option to take the unit in and out of line. This has allowed us to demonstrate the improvements to kW, kVA and Amps that optimising the 3 phase voltages creates.

Other benefits include:

- Existing powerPerfector savings are improved by up to 30%
- Voltage instability and fluctuations are eliminated
- Site equipment benefits from a highly stable voltage
- Reacts to supply voltage changes within 250ms
- Equipment efficiency is maximised due to active 3 phase balancing
- The site is protected against harmful voltage dips, sags, intervals and swells
- Precise output voltage control is provided across the whole site
- Wi-Fi remote monitoring & intelligent control