What is Voltage Power Optimisation?

Voltage Optimisation (or Voltage Power Optimisation) is the name given to an electrical energy saving technique, whereby a specialist optimisation device is installed in series with the mains electricity supply to site to give an optimum supply voltage for the site's equipment, and improve power quality by balancing phase voltages, and filtering harmonics and transients from the supply. The type of device used determines whether the power supply is being 'optimised' or merely reduced (voltage reduction can be achieved using a transformer, or by tapping down the HV supply transformer.) Voltage optimisation technology gives the end-user the ability to optimise their supply locally, correcting power quality problems from the grid, and is designed to do so very efficiently. In the UK and Europe, voltage optimisation units fitted have achieved average energy savings of around 13% over the last five years, making this one of the fastest-growing energy saving techniques on the market. Major businesses and Public Sector organisations have adopted Voltage Optimisation as a front-line energy saving measure. Voltage Optimisation is a particularly effective means of saving energy.

Common Power Quality Problems

Overvoltage

Overvoltage refers to voltage higher than the voltage at which equipment is designed to operate most effectively. It causes a reduction in equipment lifetime and increases in energy consumed with no improvement in performance. The 16th edition of the Electricians Guide BS7671 makes the following statements in relation to overvoltage: "A 230V rated lamp used at 240 will achieve only 55% of its rated life" "A 230V linear appliance used on a 240V supply will take 4.3% more current and will consume almost 9% more energy." Various technologies can be used to avoid overvoltage, but it must be done so efficiently so that energy savings resulting from using the correct voltage are not offset by energy wasted in the device used to do so.

Harmonics

Harmonics are current and voltage waveforms at a higher frequency than the fundamental 50Hz main supply and occur at multiples of the fundamental. Harmonics are caused by non-linear loads, which include types of power supply for computer equipment, variable speed drives and many transformers. "Triplen" harmonics (odd multiples of the third harmonic) result when phase voltages are not balanced in a three phase power system and accumulate in the neutral, causing wasteful currents to flow. The possible effects if the level of harmonics, known as total harmonic distortion becomes too high include damage to sensitive electronic equipment and reduction in the efficiency of the HV transformer. The efficiency of electrical loads can be improved by attenuating harmonics at the supply, or by preventing their generation.

Transients

Transients are large, very brief and potentially destructive increases in voltage. Their causes include lightning strikes, switching of large electrical loads such as motors, transformers and electrical drives, and by switching between power generation sources to balance supply and demand. Although they typically only last thousandths or millionths of a second, transients can devastate sensitive electronic systems causing data loss, degrading equipment components and shortening equipment life.

1508 Eastern Tower |Yihai Square Commercial Building | North Chuang Ye Road| Nanshan District | Shenzhen | 518054 | China | **Telephone:+86 755 2664 7764**|
Fax: +86 755 2664 8864 | Registered Office Address: | 803, Futura Plaza, 111 How Ming Street, Kwun Tong, Hong Kong. TEL: (852) 3583 9190. FAX: (852) 2341 1414
|web: www.vanguardspower.com |

Phase voltage imbalance

Most medium to large industrial and commercial sites are supplied with 3-phase electricity, which is transmitted from the national grid in 120º phase intervals. Imbalance between the three phases causes problems somewhat similar to those of harmonics, for example heating in motors and existing wiring leading to wasteful energy consumption.

Power factor and reactive power

The power factor of an electrical supply is the ratio of the real power to the apparent power of the supply. It is the useful power used by the site divided by the total power that is drawn. The latter includes power that is unusable, so a power factor of 1 is desirable. A low power factor would mean that the electricity supplier would effectively supply more energy than the consumer's bill would indicate, and suppliers are allowed to charge for low power factors. Reactive power is the name given to unusable power. It does no work in the electrical system, but is used to charge capacitors or produce a magnetic field around the field of an inductor. Reactive power needs to be generated and distributed through a circuit to provide sufficient real power to enable processes to run. Reactive power increases significantly with increasing voltage as the reactance of equipment increases. Correcting this with voltage optimisation will therefore lead to a reduction in reactive power and improvement in power factor.

Effects on electrical loads

A common misconception as far as voltage power optimisation is concerned is to assume that a reduction in voltage will result in an increase in current and therefore constant power. Whilst this is true for certain fixed-power loads, most sites have a diversity of loads that will benefit to a greater or lesser extent with energy savings aggregating across a site as a whole. The benefit to typical equipment at three phase sites is discussed below.

Three Phase AC Motors

Three phase AC induction motors are probably the most common type of three phase load and are used in a variety of equipment including refrigeration, pumps, air conditioning, conveyer drives as well as their more obvious applications. The de-rating effects of overvoltage and three phase imbalance on AC motors are well known Overvoltage results in saturation of the iron core, wasting energy through eddy currents and increased hysteresis losses. Drawing excessive current results in excess heat output due to copper losses. The additional stress of overvoltage on motors will decrease motor lifetime. Avoiding overvoltage does not affect the motor speed since this is a function of the supply frequency and the number of poles in the motor provided the motor is correctly loaded. Nor does it reduce the efficiency of the motor and so substantial energy savings can be made through reducing iron and copper losses. This is especially apparent if the motor application means that it experiences a variety of loading conditions since the motor efficiency is further reduced with both overvoltage and less than full loading.

1508 Eastern Tower |Yihai Square Commercial Building | North Chuang Ye Road| Nanshan District | Shenzhen | 518054 | China | **Telephone:+86 755 2664 7764**|
Fax: +86 755 2664 8864 | Registered Office Address: | 803, Futura Plaza, 111 How Ming Street, Kwun Tong, Hong Kong. TEL: (852) 3583 9190. FAX: (852) 2341 1414
|web: www.vanguardspower.com |

Lighting

Since lighting loads are in use for a high proportion of the time, energy savings on lighting equipment are extremely valuable. Incandescent lighting is particularly susceptible to wasting energy and decreased lifetimes at high voltages, as the previous extracts from the Electricians Guide illustrate. However, other types of lighting can also benefit from improved power quality, including systems with resistive or reactive ballasts. Fluorescent lighting is more efficient than incandescent lighting and there are also types of electronic voltage optimisation control systems for high-frequency lighting, which would not see an improvement in lifetime or energy consumption on the same level as incandescent lighting. However, lighting controllers and ballasts are responsible for generating high levels of harmonic distortion, which can be filtered with a voltage optimiser, in addition reducing the need for lighting controller. A common concern is that some lighting will fail to strike at lower voltages. However, this should not occur since the aim of voltage optimisation is not simply to reduce the voltage as far as possible, but to bring it to the voltage at which it was designed to operate most efficiently.

Energy and Emissions Savings

The energy savings achieved by voltage optimisation are an aggregation of the improved efficiency of all equipment across a site in response to the improvements in the power quality problems outlined above. It has been and continues to be a key technique for savings in energy consumption and consequently carbon dioxide emissions.

1508 Eastern Tower |Yihai Square Commercial Building | North Chuang Ye Road| Nanshan District | Shenzhen | 518054 | China | **Telephone:+86 755 2664 7764**|
Fax: +86 755 2664 8864 | Registered Office Address: | 803, Futura Plaza, 111 How Ming Street, Kwun Tong, Hong Kong. TEL: (852) 3583 9190. FAX: (852) 2341 1414
|web: www.vanguardspower.com |