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Jerome Baddley
Nottingham Energy Partnership
5th Floor Castle Heights
72 Maid Marian Way
Nottingham
NG1 6BJ

2 May 2013

Dear Mr Baddley,

'The case for voltage optimisation in NHS sites' 29 March 2012

We have received a copy of the above report from one of our contacts in the NHS. I would like to begin this letter by saying that we respect the independence with which your report was prepared. Matters raised in the report are of material value and should be highlighted to anyone looking to acquire a voltage optimisation (VO) technology. However, there are certain aspects of the report that we would appreciate the opportunity to speak to you about that may provide further background, detail and colour for you and your audience. Our objective is to confirm specific aspects of the report from an industry perspective and to challenge those matters that we believe may require refinement.

As you know the VO sector of the energy efficiency industry is a comparatively new one and there are no standards that act as an umbrella across the sector in terms of the behaviour of individual firms or their technologies. I can therefore only comment on our own technology, our business and the fashion in which we always seek to interact with our clients. My own background and that of my fellow directors is built on the foundation of trust, professionalism and integrity and I can assure you that the business is and will be managed to my exacting standards and those of my Chairman, Dame Amelia Fawcett.

I see this report as the first pillar of a highly relevant and important piece of work covering our industry sector. I would welcome the opportunity to participate in two further work streams that I believe would be relevant to your audience, namely a paper on where the technology is most suitable employed and should be installed and secondly the standards that must be demanded of any firm involved in the installation of VO technology. In short, what I am proposing is to take this excellent report forward with two further objectives – where should such technology be installed and what service standards should an NHS client expect of any business selling such technology.

I have divided my response into two parts, firstly specific comments on the report itself and secondly details on important background information regarding how we are leading the field in the verification, to scientific standards, of the efficacy of our technology. I will be sharing the detail of that work with you during late summer and would request that you consider whether there are any additional matters that you would like me to cover to further assist your critical appraisal of the technology.

I would like to make the following specific comments in respect of the report:

1. You are correct that the principle reason clients purchase VO technology is to save energy costs through lowering consumption. The knock-on consequence is a carbon saving. To ensure our clients receive what they are promised, we guarantee the return on investment – if nothing else this works to hold us to account and ensures transparency. To enable us to calculate this, we use a measurement and verification expert called EEVS (www.eevs.co.uk) who harness the International Performance Measurement and Verification Protocol (IPMVP) that was developed for the US Department of Energy in the late 1990's. Rather than simply comparing pre and post-installation energy usage, the IPMVP defines how 'avoided energy use' should be calculated. This is crucial for isolating the energy saving from the other factors that affect energy use in a building (temperature, occupancy, etc), and is particularly relevant in an environment where clients are consolidating activities in fewer buildings. In short, energy consumption may rise but not as much as it would have done had the VO technology or other energy efficiency initiative not been installed. Using this standardised methodology, EEVS have evaluated the savings achieved by over one thousand installations of our technology, as well as a number of those provided by other suppliers, which now constitutes a significant body of evidence on the performance of the technology. I would like to highlight that since powerPerfector Ltd was formed we have paid out approximately 1% of revenue in guarantee payments;
2. As you rightly point out the technology may offer secondary benefits. Here I need to be careful as each technology in the market is very different so I am speaking only in respect of our own, the design of which is unique. In short, the technology can 'clean' the power entering a building and this together with the reduced voltage will extend the life of electrical equipment. Let me address those specific benefits individually: a) the technology does defend against transients; b) power factor is increased as a consequence of reducing the voltage – as you know, this is not magic, merely a by-product – reduce voltage to nominal levels and power factor increases; and c) certain harmonics are suppressed (not eliminated) by the tertiary winding of our technology. This is both technology and site specific and depends on multiple factors. Further, it is very difficult to measure. Where a client has a specific harmonic problem we would generally recommend a harmonic specific technology to address the issue;
3. Which sites are appropriate for VO - as you correctly highlight in your report, each site is different and it is essential that any reputable firm undertakes a detailed site survey prior to recommending an installation, for example little benefit will be derived from resistive loads. However, in our experience, hospitals, hotels and office

buildings do generally present an excellent opportunity due to the nature of the electrical loads. I have attached a pie chart illustrating those loads which do and do not benefit from VO;

4. Unintended consequences – you highlight in your report a very important matter indeed, namely the unintended consequences associated with the installation of the technology. Here again it is important to look at the technology being proposed and specifically the credibility of that technology and its supplier. It is essential that voltage is not optimised below the stated operating range of on-site electrical equipment. All electrical equipment sold in the UK must by statute be able to operate within the range of 207v to 253v. In general terms, electrical equipment manufactured for the UK market and even for the wider European market (due to European harmonisation) is designed to operate at peak efficiency at 220 volts, above this level energy is wasted and equipment works harder than is necessary but if set to a level materially below this level you are absolutely correct in the consequences you outline. Any purchaser of VO technology must be very aware of this and to ensure the voltage is set at the correct level at the near point with careful understanding of the on-site volt drop to the far point. To my knowledge, we have never experienced the unintended consequences you outline, indeed for many of our clients – for example supermarkets and car dealerships – lux levels (for example) are critical and very carefully monitored for any deterioration;

5. Lift equipment – it is not unusual that when we undertake a site survey we identify a piece of equipment that may require adjustment to prepare for a modulation of voltage. Although it is not always possible to view the entire site due to access restrictions, we always highlight these types of equipment to our clients during our pre sale process. We see such adjustments as simply business as usual and of no real consequence – provided they are transparent to the client prior to installation. Our installation teams complete a site review post installation generally with our client to ensure the entire site operates appropriately;

6. Motors/pumps speed – the report emphasises the effect of VO on the speed of rotative machines. It is important to clarify that the speed of this type of equipment is directly related with the frequency of the supply and not with the voltage magnitude. VO does not have any effect on supply frequencies. The voltage level will only play a part in the speed of motors/pumps/etc if the voltage is so low that the output torque of the machine cannot overcome the load torque provided on its shaft. As stated in point 4 above, we ensure that far point voltages are as close as possible to nominal levels to avoid under voltage issues. Furthermore, problems related to decreased speeds are very unlikely to happen on the type of equipment described in the report such as air conditioning, central heating, freezes, etc as they tend to have standard and oversized motors fitted for the specific rating of the device itself. Speed issues are only expected on highly loaded rotative machines run on voltages that fall out of scope of the supply band for electricity as defined by BS EN 50160. It is also worth mentioning that electrical infrastructures are designed/ calculated under European voltage levels and therefore running equipment at general nameplate voltages do not have a negative effect on cable sizing and electrical design. We can demonstrate that where savings are seen, these

are monitored at the main meter incoming supply where voltages are untouched, and therefore savings can only be due to decreased on site running currents.

Turning now to our business specifically and our testing plans - over the last ~20 years, a substantial number of VO products have been installed and are in operation worldwide. In the UK, we are the industry leader in the commercial sector and the company has deployed and installed over 4500 units with a range of large customers and with an aggregated rated power of ~1.6GW. As mentioned above, the industry has adopted accepted measurement and verification (M&V) methods (largely statistical in nature) to quantify the energy saving benefits delivered to users of these products at a whole building level, across many individual loads and load types. In addition to this well-established aggregated approach to determining energy benefits, there is also a substantial body of somewhat piecemeal information (both predicted and measured) about the energy usage effects of VO technology on individual loads, commonly found in commercial-scale buildings.

However, despite the material amount of VO products deployed in the field and the substantial body of evidence (both direct and indirect), VO remains a relatively poorly understood, under-analysed and under-recognised technology type which could deliver significant benefits to the built environment and energy systems as a whole. This on-going gap in understanding is not helpful for any stakeholder group and needs addressing promptly with a more comprehensive, objective, independent and scientifically rigorous methodology and associated evidence base.

To help address this important issue, the VO industry (and ourselves in particular) has recently established several high-level strategic relationships with a number of leading wholly independent organisations including: world class universities; publically funded research organisations; and industry-facing trusts that specialise in objective research, analysis, and testing. The various work programmes initiated with these third parties are specifically designed to establish a more scientifically rigorous bottom-up evidence base for the actual energy saving benefits of this important class of technology. This significant initiative is building on solidly grounded scientific fundamentals (including theoretical models) as well as a wealth of primary and secondary data of directly measured characteristics.

With the key outputs from this work destined for public disclosure and/or publication, it will help to inform a range of important stakeholder groups including: policy makers; regulators; standards agencies; building designers; facilities managers; end customers; and equipment makers (and also help stimulate further research in the area).

In brief, the specific work we are doing with a world class academic institution is following a rational top-down framework, using a significant body of bottom-up data sets, with the key steps being followed laid out below – as mentioned – please let us know if there are additional matters you wish us to cover in this scientific review:

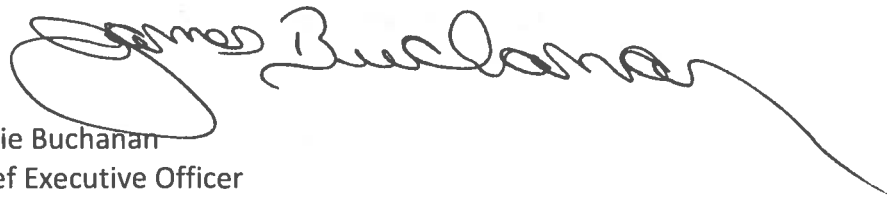
1. Preparation of an overview summary of the scientific fundamentals of the energetics of different types of electrical loads (e.g. inductive and resistive; constant and variable power), in particular as they relate to changing voltage and the resultant energy usage;
2. A categorisation of the range of specific electrical loads commonly found in buildings including the different underlying technologies used within given load types;
3. A scientific description of the energetics of each of the main end-use applications in buildings (i.e. the energy service or functional utility delivered, such as lighting, cooling, heating, pumping, movement);
a. Specifically referencing the underlying machines / equipment / prime movers / enablers of delivering these end-use applications;
b. Providing a clear distinction / differentiation between the energetics of end-uses and the energetics of the enabling components within appliances;
4. Collection and analysis of the available theoretical models, product data sheets, and experimental data sets captured at the level of individual appliances as well as the underlying prime movers / components within those appliances;
5. Preparation of a 'gap analysis' of where further literature and/or further experimentally measured data is required to fill key gaps identified;
6. Addressing any identified gaps by conducting the appropriate literature search and/or further experiments in the appropriately equipped / certified / calibrated labs (e.g. at the electrical and electronic departments of leading universities; electrical specialist test houses; relevant component suppliers to the industry; etc) following appropriate 'test scripts'/protocols as required;
7. Adding together the theoretically expected and/or experimentally validated characteristics of individual load types and building up an expected outcome at a multi-load building-wide level for representative building types;
8. Comparison of the expected building-wide results generated bottom-up with the actual building-wide results measured in the field (e.g. using our master data set and other sources). Areas to be highlighted include where the 'reality on the ground' of the building-level evidence is key to understanding how the real world behaves in relation to the more theoretically predicted outcomes (e.g. based on the actual installed base of a wide range of loads types, of varying technology, age, quality, efficiency);
9. Compilation and publishing of a comprehensive Review Paper incorporating outputs from the above activities to characterise qualitatively and quantitatively the value of VO technology in delivering energy savings (and other benefits) to buildings.

In conclusion, I wish to assure you of our total commitment to ensuring VO technology is only installed where it has best effect. We are keen to support you through empirical independent evidence to enable a high level recommendation as to which building types are most suitable for VO technology. Equally important to the NHS are the standards that should be expected of any organization installing VO in such critical sites as hospitals and medical facilities. It is incumbent on any organization selling to the NHS that they adopt only the highest standards – in short, people's lives are at risk.

powerPerfector Ltd, 1–10 Praed Mews, London, W2 1QY
Registered in England & Wales. Reg # 5106220
Tel: 0845 6014723 fax: 0845 6014724 email: enquiries@ powerPerfector.com
VAT # GB 840679507

We look forward to continuing our dialogue with you and your team and to hearing whether there are any additional matters you wish us to cover in our current research that we expect to conclude by late summer.

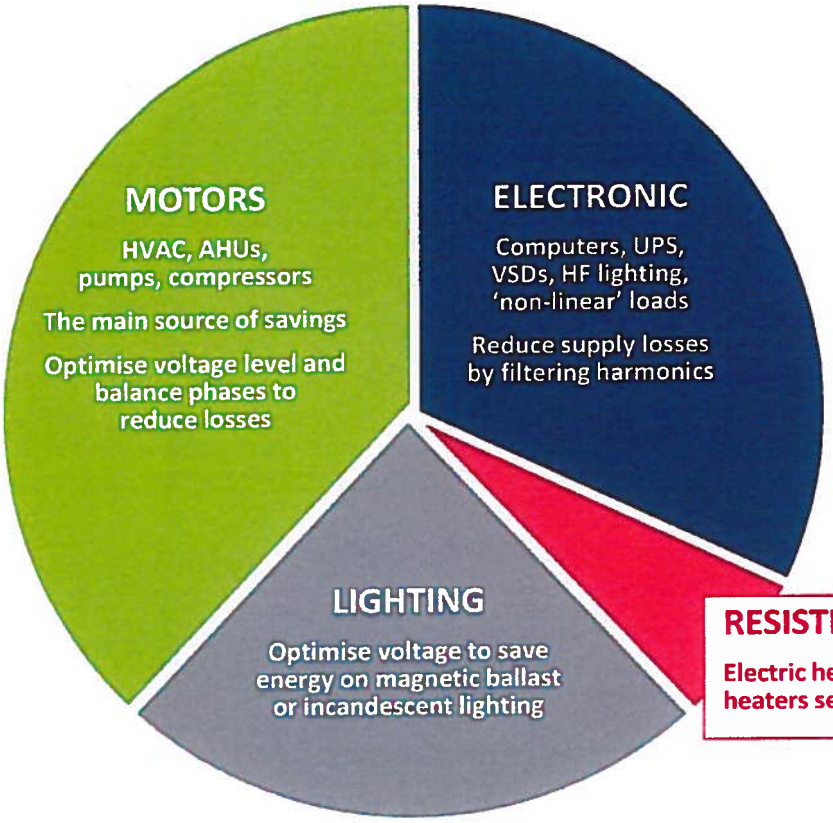
Yours sincerely



Jamie Buchanan
Chief Executive Officer

powerPerfector Ltd, 1–10 Praed Mews, London, W2 1QY
Registered in England & Wales. Reg # 5106220
Tel: 0845 6014723 fax: 0845 6014724 email: enquiries@ powerPerfector.com
VAT # GB 840679507

Load Analysis



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Electric heaters, Thermostatically controlled heaters see no energy saving

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