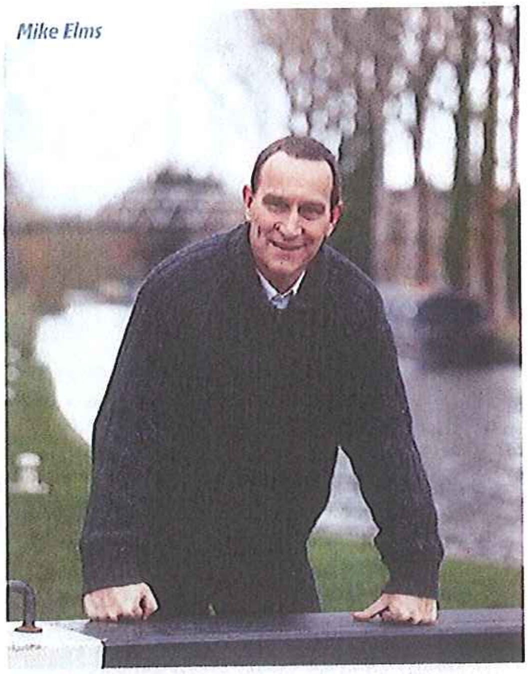
UNINTERRUPTIBLE POWER SUPPLIES UK SALES MANAGER, MIKE ELMS, EXPLAINS HOW MODULAR UPS SYSTEMS CAN HELP CUT YOUR ENERGY BILLS

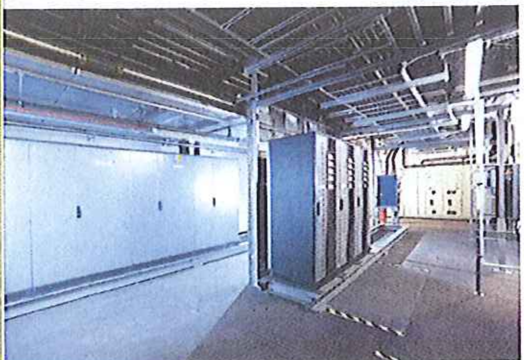
Are UPS systems key to the CRC?

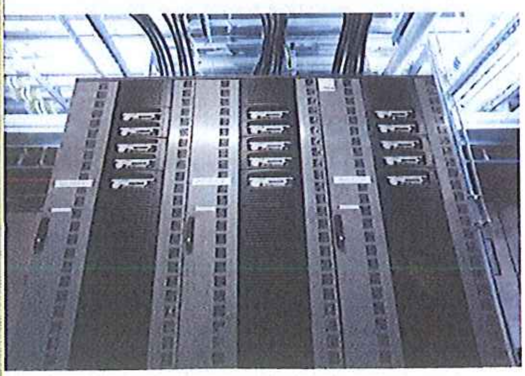
Mike Elms



THE NEED FOR qualifying organisations to reduce their energy usage is highlighted by the Government's Carbon Reduction Commitment Energy Efficiency Scheme, or 'CRC', which came into effect on 1 April this year. With the scheme rewarding qualifying participants who perform well, while penalising those who do badly, in both financial and publicity terms, it's clear simply finding ways of reducing energy use is not enough; it's essential that these improvements have long term sustainability. Developments in uninterruptible power supply (UPS) technology offer one way of achieving sustainable energy savings.

Maintaining continuous supply power from uninterruptible power supplies (UPS systems) is now considered essential by organisations running financial, healthcare or industrial processes that depend on vulnerable ICT equipment. As UPS units are installed in the critical supply path, any improvement to their efficiency will make an appreciable contribution to their operators' energy management strategies.





Such efficiency improvements are possible, through selection of suitable UPS topology and by carefully sizing the UPS system to match its critical load. One increasingly popular approach is to use systems based on advanced modular topology, which allows UPS capacity to be closely matched, or 'right sized', to the critical load size. Modular UPS capacity can easily be incremented or decremented to efficiently match changing load requirements throughout the life of the installation – a sustainable efficiency solution.

As well as saving energy and helping to meet CRC targets, modular technology allows significantly smaller, lighter UPS installations with increased power availability. By looking at what modular technology is, we can better understand its benefits and their practical application.

On-line, static double conversion UPS systems first appeared in the seventies and are still in use today. Their principle of operation is to rectify incoming AC mains into DC, which charges a battery before being inverted back to AC to drive the UPS critical load. In the event of AC mains failure, the battery can take over the role of supplying DC to feed the inverter until the incoming AC mains is restored. In early designs the inverter was followed by an output transformer, necessary to restore the output AC voltage to the same level as the mains input. However advances in power semiconductor technology and the introduction of the Insulated Gate Bipolar Transistor (IGBT) have allowed changes to the UPS design which permit elimination of the output transformer. This yields a number of advantages, the most important of which relate to improved efficiency, reduced size, and weight.

Energy efficiency is improved for a number of reasons. With no transformer core to heat there are no iron losses; with no windings there are no copper losses. Both factors contribute to energy savings. Transformerless designs also exhibit lower input current harmonic distortion (THDi) and an improved input power factor, which both reduce energy. Eliminating wasted energy also reduces heating effects, and therefore cooling costs. Further energy savings arise from modular technology which, as we shall see, is made possible by transformerless design.

Eliminating the transformer reduces the UPS's size and weight by something like 66%. This is a large reduction which has had a profound effect on the way UPSs are seen and used. Uninterruptible Power Supplies Ltd (UPSL) realised that a 3-phase UPS rated up to 50 kVA could be implemented as a rackmounting module rather than a large standalone unit. And implementing a UPS as a set of modules in a rack rather than a single standalone unit gives great flexibility as well as space savings. This flexibility allows right sizing, with a UPS solution that's closely matched to its load. The result is less capital and space wasted on unnecessary capacity together with maximised operating efficiency. An example shows the efficiency savings possible:

Let's imagine a site with a load of 96 kW and a power factor of 0.8, which demands a 120 kVA supply. We'll also assume that, for security, N+1 redundancy is required. That is, N UPS units have sufficient capacity to completely support the load, so in an N+1 configuration, one unit's failure would still leave sufficient UPS capacity to support the load. This would typically be implemented in a standalone system using two 120 kVA units, each of which would only be 50% loaded during normal operation. Efficiency with legacy transformer based design would be 90%. By contrast, a modular system could be implemented using four 40 kVA modules, where each module is now 75% loaded. As well as being smaller, lighter and more easily expandable, its efficiency would be 96%, which more than halves the cost due to losses per year. The annual cooling costs are also more than halved. At 7.84 p/kWh, total annual savings would amount to over £5000pa.

If our site load remains at 96 kW throughout its operation life, the annual £5000 savings will continue with no further action needed. In real life however, the load is not only likely to change, but the extent of its change can defy prediction. In a typical scenario a data centre may be expected to be initially loaded to 35% of its capacity, with this load growing steadily to 90% of capacity over a period of 10 years. With a standalone UPS, the response is typically to install a system sized for 90% data centre capacity from the outset, to avoid the difficulties of upgrading or replacing it later. These include finding more floorspace in a crowded data centre, disrupting business operation with building work and installation, and laying or repositioning cabling. However, such an oversized system would spend its operational life greatly under loaded, adding reduced efficiency to unnecessary capital costs and space requirements. This would be exacerbated if the load does not grow to the expected 90%. While the UPS's conservative rating should ensure that the load would always be supported, it's not unknown for the actual load to exceed projections so that new UPS capacity must be supplied after all.

These difficulties can be avoided by using a modular system. Its flexibility means it can easily be expanded or reduced after being initially rightsized to its load. There is no need to oversize it initially because modules can be added without disruption as and when they are needed. This flexible property of modular UPS topology is known as its scalability, and it's a scalability that has two dimensions – vertical scalability and horizontal scalability.

The example above has four 40 kVA modules totalling160 kVA capacity, or 120 kVA with N+1 redundancy. These modules could populate four out of five slots in a single server-style floorstanding rack. Vertical scalability is a reference to the fifth slot, which can be populated to increment capacity at any time. Additionally, a second rack could be provided for an incremental increase in floorspace and cost. The ability to add further racks in parallel is known as horizontal scalability. This adds up to enormous flexibility, with UPS configurations over 1 MVA being possible.

The task of efficiently maintaining right sizing to the critical load, however unpredictably the load grows, becomes simple. The modular approach allows the maximum possible energy efficiency as well as minimising capital and space costs throughout the life of the installation.