



*The importance of choosing
the right battery for*
**UNINTERRUPTIBLE
POWER SUPPLIES**

Today's data centres depend on uninterruptible power supplies (UPS) to provide clean, continuous power throughout the facility's entire operational life. While the mains supply is available, the UPS protects the data centre's sensitive information and communication technology (ICT) equipment from electrical noise and any other power aberrations that may appear on the incoming power feed. If the supply fails, then the UPS battery must take over instantly and use its stored energy to support the load until either the mains is restored, or a generator can be started, or the data centre systems can be shut down safely.

A UPS battery's ability to store energy reliably and efficiently during normal operation, making it immediately available to the load during a mains failure, is critical to data centre security. Accordingly, in this article, Mark Coughlin, Applications Manager for Reserve Power at EnerSys® reviews the key battery technologies currently available, to inform commercial and technical specifiers responsible for battery selection.

The article starts by looking at how data centre evolution is affecting the demands placed on batteries. It then compares Lead-Acid, the pre-dominant battery chemistry used within data centres, with alternative technologies, in particular Lithium-ion (Li-ion), which has been generated rising interest in recent years. Finally, it examines why data centre operators should consider advanced Thin Plate Pure Lead (TPPL) technology to optimise the performance of their UPS and power systems.

THE EVOLVING DATA CENTRE LANDSCAPE

Data centres today experience a rising incidence of power outages and grid fluctuations caused by increased urbanisation and demand. Meanwhile, their workload is expanding, with a move to multi-user hosting services and larger data storage capacity requirements. These factors increase pressure for 'best in class' technologies and reliable power.

UPS batteries are also directly impacted by reduced autonomy times, now typically between 30 seconds and 5 minutes, compared with historical averages of around 15 minutes. This is because of the shorter times needed to start up generators and switch loads. Fast recharge times are also desirable, allowing batteries to be recharged quickly in order to be able to support further power outages.

Energy efficiency has become an overarching concern for all data centres, not just because of the financial impact of large-scale operation and rising energy costs, but also due to pressure from stakeholders – and legislation – to pursue effective carbon footprint reduction policies.

Concerns about energy costs and grid power availability are driving growing interest in using UPS battery assets for energy storage applications, as a way to generate further revenue. In Firm Frequency Response applications, for example, UK-based data centres could provide battery energy back to the National Grid on demand. Alternatively, the batteries could be used for peak shaving, reducing data centre energy costs by supporting loads when electricity cost is high and then recharge the battery when low-cost electricity supply is available.

Such strategies can bring significant cost savings, and generate money when supplying energy back to the grid. However, they demand longer battery autonomies than the five minutes typically needed for UPS backup. Currently, there are relatively few active sites deploying this strategy. Nevertheless, manufacturers such as EnerSys® have conducted trials with batteries that can support these applications.



BATTERY TECHNOLOGIES AND TRENDS

Battery chemistries currently available for UPS backup include Lead-Acid, Lithium-ion (Li-ion) and Nickel-Cadmium. There are also non-battery technologies like flywheels and Super-Capacitors. However, this article focuses on the two types that currently dominate the data centre industry: Lead-Acid, which represent over 90 per cent of the UPS market share, and Li-ion, which is attracting increasing interest due to its purported performance benefits and high visibility through its use in electric vehicles.

Li-ion is attracting interest through being attributed with performance features superior to traditional Lead-Acid VRLA batteries, which are typically either gel or absorbent glass mat (AGM) designs. Compared to traditional VRLA equivalents, Li-ion offers a high cycle life, together with a significant size and weight reduction. Li-ion batteries also have high charge efficiency, with excellent partial state of charge tolerance – in fact, partial charge is preferred for long cycle life and operation in float conditions at full state of charge is avoided. The self-discharge rate of Li-ion is also low, which results in prolonged shelf life when in storage. Finally, it has good high and low temperature performance, and no gas emissions.

However, Li-ion's comparison with traditional VRLA reveals some challenges along with its benefits. Accordingly, we show how TPPL technology, as an advanced form of Lead-Acid chemistry, offers a number of advantages over traditional VRLA batteries. Despite historical cost reductions, Li-ion pricing remains a barrier for many users. With pricing depending on many factors including purchase volumes and the exact chemistry used, Li-ion is currently significantly more expensive than Lead-Acid. Furthermore, although space-saving may be important within data centres, weight reduction, which Li-ion batteries offer, is seldom critical. Similarly, the high cycling capability of Li-ion isn't a driving factor for selection within UPS applications, where batteries are mostly floating at near full state of charge.

While considered a safe technology, any Li-ion solution, unlike Lead-Acid, must include a battery management system (BMS) to ensure safe charging and discharging. This increases complexity, and requires users to have a thorough understanding of Li-ion technology. However, the BMS provides built-in diagnostics, which identify most problems and allow minimal maintenance.

Additionally, consideration must be given to the MTBF (Mean Time Before Failure) of the electronic components factored into Li-ion calendar lifetime calculations. Lifetimes of 15 years are claimed, but service life is not proven in the field. By comparison, advanced TPPL, with 12+ years design life, provides eight to 10 years' service life, while traditional VRLA 10-year design life batteries typically provide five to six years' service life.

Charging is another important consideration. Firstly, to fast-charge Li-ion, higher charging capacity, with increased cost, may be required. Also, in many cases the charging architecture would need to be replaced or changed to support different Li-ion battery charger voltages, so two different UPS rectifier types would be required across a data centre attempting to deploy both Li-ion and Lead-Acid batteries.

Other factors, while not immediately specific to the data centre environment, should also be considered when selecting a battery technology. During transportation, Li-ion faces legislative shipping restrictions, while Lead-Acid batteries, including AGM and TPPL, is classified as non-hazardous for all transportation modes. Then, at end-of-life, Lead-Acid has an inherent value, and is about 95 per cent recyclable by a very well-established network of smelters; this possibility, however, is not mature for Li-ion.





TPPL: OPTIMISED PERFORMANCE WITHOUT THE DRAWBACKS

Above, we have seen why Li-ion, while attracting increasing attention, has been slow to penetrate to data centre market. On-going development driven by the powerful automotive sector may change this, but advanced TPPL technology offers data centre managers the best of both chemistries.

As a Lead-Acid based battery technology, TPPL is reliable, well-proven, and easy to transport, handle and recycle. Crucially, advanced TPPL technology significantly improves energy efficiency, by providing up to 43 per cent energy reduction compared with traditional VRLA batteries through reducing float current requirements. Further energy savings accrue as it can operate, within warranty, at elevated temperatures, reducing air-conditioning requirements.

Meanwhile, advanced TPPL battery technology reduces data centre vulnerability to multiple mains blackouts, through very short recharge times and time to repeat duty. For example, with 0.4C10 A charging current using fast charge methodology, TPPL can be fully recharged, following a one-minute discharge to 1.6 Vpc, in 2½ hours, and ready to repeat duty in 22 minutes.

Battery replacement costs are also reduced through low internal corrosion rates, yielding a service life 25 per cent longer than for traditional VRLA. Additionally, storage life is increased from six to 24 months due to low self-discharge rates.

Advanced TPPL technology is used today in many demanding critical applications. Data centre users can access TPPL through DataSafe® XE batteries, which are specifically designed for UPS applications. They support autonomies of under five minutes, while offering all the above TPPL features.

WHAT OF THE FUTURE?

Lead-Acid technology is expected to dominate the market for at least the next few years, although enquiries and niche projects suitable for Li-ion will continue to grow. In particular, applications requiring high cycling will be seeking advanced TPPL or Li-ion solutions.

Depending on the application, Li-ion could be the preferred battery type. Nevertheless, before opting for Li-ion as the technology for a particular application, a full consideration of the requirements should be undertaken. The assessment should reflect the Total Cost of Ownership, with the benefits and challenges of Li-ion compared against other available technologies, including TPPL.

Irrespective of the technology chosen, battery monitoring systems will become increasingly popular, due to the battery condition visibility and opportunities for predictive maintenance that they provide. This will also bring UPS applications into the increasingly pervasive Internet of Things (IoT) environment, making them visible as components of the larger data centre infrastructure.

For further information on UPS batteries, specialists can be contacted via the **website**.



Why EnerSys®

EnerSys®, the global leader in stored energy solutions for industrial applications, manufactures and distributes energy system solutions, motive power batteries, battery chargers, power equipment, battery accessories and outdoor equipment enclosure solutions to customers worldwide. Motive power batteries and chargers are utilised in electric forklift trucks and other commercial electric-powered vehicles. Energy Systems provide highly integrated power solutions and services to broadband, telecommunication, utility, uninterruptible power supplies, renewable, medical, aerospace and defence, premium starting, lighting and ignition applications. Outdoor equipment enclosure products are utilised in the telecommunication, cable, utility, transportation industries and by government and defence customers. The company also provides aftermarket and customer support services to its customers in over 100 countries through its sales and manufacturing locations around the world.

Power is crucial to every industry sector and countless industrial applications. In data centres, the operation cannot survive without it – even for a second. This critical demand lies behind the need for stored energy solutions. A demand which EnerSys® – as the world leader in this product sector – is able to meet effectively, efficiently and repeatedly.



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