



Benefits of Lithium-Ion Battery Systems for Three-Phase and Single-Phase UPS

- *Benefits of Li-ion vs VRLA*
- *How VRLA and Li-ion Costs compare over the life of the system*
- *How to justify the budget item to decision makers*

EXECUTIVE SUMMARY:

Review of the benefits of using Lithium-ion battery technology in both 3-Phase and Single-Phase UPS equipment. Demonstrate how Lithium-ion can improve UPS reliability. Discuss the benefits of Li-ion highlighting safety and Total Cost of Ownership.

Lithium-ion UPS batteries have been in use in data centers and other critical applications for several years. The lower total cost of ownership of Li-ion UPS batteries over standard VRLA batteries has been well-documented and repeatedly proven. Yet, for some customers, the higher initial cost is still a significant barrier to entry. Many data center managers are required to justify the higher capital cost of lithium-ion to purchasing decision makers. In this whitepaper, we will discuss the benefits of Li-ion UPS batteries over VRLA and provide some detail proving the lower Total Cost of Ownership (TCO).

Safety used to be a barrier to adoption of Li-ion batteries for UPS however changes in cell chemistry and packaging have made them much safer. Surprisingly, li-ion batteries contain fewer hazardous substances than VRLA batteries.

THE MANY BENEFITS OF LI-ION VERSUS VRLA

The lower costs and enhanced safety features of Lithium-Ion batteries make them a practical choice for some large enterprise 3-Phase UPS applications, as well as for some single-phase UPS units.

Longer Life Expectancy

Industry best practices suggest that VRLA batteries in UPS applications should be replaced every 3-5 years. Lithium-ion batteries, on the other hand, have a 15-year design life in 3-Phase UPS applications. Since most 3-Phase UPS modules have a recommended useful life of 12-15 years, UPS systems configured with Lithium-ion batteries may never require a battery replacement.

Lithium-Ion batteries also offer up to 10X the cycle life of VRLA batteries in UPS applications doubling or tripling the battery service life when compared to VRLA. The longer life expectancy of Lithium-ion batteries in UPS applications means fewer battery failures reducing the risk of downtime or load interruption. Lithium-ion batteries require less maintenance than their VRLA counterparts further reducing the risk of downtime during routine maintenance and service.

Battery Monitoring Systems Included

Standard factory warranties for 3-Phase UPS equipment are typically 1 year. Li-ion batteries come with sophisticated battery monitoring systems (BMS) that provide a clear picture of battery runtime and health. In contrast, remote monitoring systems are available for VRLA batteries but rely on chemistry that makes it hard to accurately predict when they're going to fail. Embedded monitoring in li-ion batteries at the cell, module, and cabinet level provide more predictive reporting allowing potential problems to be addressed long before they occur. The embedded BMS also reduces the frequency of which battery preventive maintenance services need to be completed, once again reducing the risk of inadvertent downtime during routine maintenance and service.

Battery monitoring can be a game changer when staff shortages, remote installations and increasing responsibilities mean that batteries get less

More Power in Less Space

Lithium-ion batteries provide multiple times the energy and power density compared to VRLA. As a result, UPS systems built with Li-ion batteries take up only about one-third the space of a VRLA-based solution that delivers the same power. In general, a lithium-ion battery system for a UPS will take up 50-80% less floor space and weigh 60-80% less than a comparable lead-acid battery system.

As floor space is increasingly in demand, having a smaller battery system allows more footprint for computing power to meet IT demands. In Edge computing or network closet applications that need to maximize the computing power available in small spaces, a lithium-ion battery option can be the perfect solution for high density applications.

Less Weight

The Lithium-ion batteries offer at least a two-thirds reduction in weight. That means facilities have more flexibility in terms of where UPS systems configured with Lithium-Ion batteries can be installed within a building and can often avoid costly building modifications where floor loading is a concern.

More Forgiving in a Wide Range of Temperatures

Li-ion batteries can withstand a wider temperature range than VRLA batteries. The rule of thumb is that VRLA battery life is reduced by half for every 10°C (18°F) increase above 25°C (77°F) ambient temperature. Li-ion batteries are far less sensitive to temperature fluctuations and can accept spikes in temperature with almost no effect on battery life.

This higher temperature tolerance allows for moving the UPS system with Lithium-ion batteries out of the white space making even more room available for revenue generating compute and IT equipment. With the rise of gray space, and rugged applications that require UPS systems to perform in environments that are less controlled, li-ion batteries can handle more fluctuations when compared to most VRLA batteries.

The use of gray space for UPS is on the rise and Li-ion batteries offer wider temperature ranges that may match the environment of your gray space.

Reduced Cooling Requirements and Costs

The smaller footprint and wider temperature range of lithium ion batteries can reduce the space needed in a battery room and increase the optimal operating temperature range. The higher temperatures are good for other IT equipment, which functions more efficiently at more moderate temperatures than VRLA batteries prefer. Li-ion batteries are able to maintain a longer life

at higher temps reducing the demand on cooling and, ultimately reducing energy costs.

HOW LI-ION TECHNOLOGY POSITIVELY IMPACTS THE BOTTOM LINE

Lithium-ion batteries are a good choice to reduce both the total cost of ownership (TCO) and operating expenses (OpEx).

Because Li-ion batteries last far longer without performance degradation than VRLA batteries, they can generally match or exceed the 10-year life expectancy of the UPS itself. As previously discussed, that effectively removes the need for a UPS battery replacement during the life of the UPS and saves OpEx on the cost of both the replacement batteries and the labor to replace them.

Imagine a UPS Battery that matches the life of the UPS. No battery maintenance or changes required.

One contributing factor to the longer life of Li-ion batteries is that they can tolerate higher temperatures than VRLA batteries, up to 40°C (104°F). This allows the UPS systems to operate at a higher temperature and thus reduces cooling costs leading to a lower total cost of ownership.

We have primarily been discussing 3-Phase UPS systems with Lithium-Ion. However, Li-ion batteries in smaller single-phase UPS equipment are becoming increasingly common. For the sake of a real world TCO calculation, let's look at an example from Schneider Electric comparing Li-Ion in their popular Smart-UPS product line.

If you look at a 10-year TCO for an APC Smart-UPS Lithium-ion On-Line UPS vs. a Smart-UPS Lead Acid model, let's assume both have a rated power capacity of 3000VA and an operating temperature of 25°C (77°F).

In this example, the purchase price for the VRLA model is 60% the price for the Li-ion model. But, as you'll see, that's just the beginning of the story.

First, to match the capacity of the Li-ion UPS, the Smart-UPS with the VRLA batteries will need an external battery pack, at an additional cost and RU space. Given the life expectancy of a VRLA battery operating at 25°C is about

4 years, over the course of 10 years, you can expect to replace each battery twice, including the external battery pack. Factoring in the cost of the six batteries and labor, that comes to a higher spend over time.

While, on the Li-ion UPS side, you have a higher initial capital expense. And no battery replacement parts or labor expense because the Li-ion battery's life expectancy is the full 10-year period of our TCO calculation. So, the net result is the VRLA model could typically cost nearly 53% more than the Li-ion model over 10 years, making the Li-ion model a better investment over the longer term.

Additionally, the Lithium-Ion UPS generally comes with a longer factory warranty period (5 years) than the comparable VRLA model (3 years, 2 years for the battery and battery pack) meaning that an annual extended warranty will be required for the VRLA UPS beginning in Year 3 or 4 versus Year 6 for the Li-ion UPS, further adding to the OpEx of the VRLA battery option.

With a full deployment of Li-ion UPS in a network closet or data center, operating expenses will be further reduced since the environment can be warmer and the cooling demand is reduced.

For another case history we look at a facility that compared a 1MW UPS with wet-cell batteries to a 1MW UPS with Lithium-Ion batteries. They found that the Li-ion option was only 10% the footprint and 50% the cost of the wet-cell battery configuration and they were able to save 1,500 square feet of building space for revenue generating IT gear. UPS systems with Li-ion batteries are a great way to reclaim valuable floor space for revenue generating equipment and avoid floor loading concerns.

Summary

The Total Cost of Ownership (TCO) benefits of Lithium-ion batteries in UPS systems continues to be proven with field data as adoption of this more efficient battery chemistry for data center applications continues. While the initial capital cost is still a significant barrier for many users, data center operators that have the flexibility to prioritize the benefits of reduced OpEx

over time versus a higher initial cost should consider Lithium-Ion UPS systems for both single-phase and 3-Phase applications.

The OpEx and TCO benefits go beyond the UPS equipment itself allowing data center operators to maintain a higher temperature environment that is better suited for IT equipment and saves on cooling costs, reducing energy consumption, and contributing to corporate sustainability goals. The reduced risk of downtime during routine service and maintenance eliminates the biggest risk to uptime in a data center - human error. Sophisticated integrated battery monitor systems (BMS) allow operators to take a more “set-it and forget-it” approach to UPS batteries while maintaining equal or better reliability.

Power Solutions can assist with a customized TCO Analysis of Lithium-Ion UPS battery configuration versus VRLA. Contact us for assistance, 800-876-9373 or sales@power-solutions.com

Power Solutions | PO Box 100 | Barrington | RI | 02806