SMOKE AND MIRRORS: THE TRUTH ABOUT BATTERY SIZING

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ABSTRACT

Upon new battery installations or replacements, end-users have set expectations in terms of runtime and reliability throughout the life of those batteries. Unfortunately, their expectations and the accompanying feeling of security can often be an illusion. This is due to the fact that battery sizing is, in large part, "smoke and mirrors" to the end-user. An anticipated 15 minutes of runtime may really only be a devastating 5 minutes if certain battery sizing factors have not been considered.

This paper addresses these critical sizing factors, including redundancy, design margins, the aging process, and more. The goal is to provide end-users with valuable education on their available options and prompt them to ask the necessary questions, ultimately helping them to better meet their needs. Topics include the importance of:

- Basing UPS sizing parameters on the manufacturer's data, not defaults set by sizing programs
- Recalculating runtime to account for changes in load, due to expansion, downsizing, or more efficient equipment
- Basing a design margin on true application or load profile
- Over-sizing to compensate for the natural corrosion process that leaves end-of-life batteries with only 80% of rated capacity (aging factor)
- Building in redundancy to ensure full load protection
- Keeping batteries healthy with the right maintenance practices

With reliability at stake, there is clearly a need for end-users to become more aware of how batteries are sized and to understand that low price does not necessarily equate a better solution. While this paper features examples from the standpoint of uninterruptible power supply (UPS) systems, the discussion is applicable to all other battery markets and will be presented as such.

INTRODUCTION

Battery sizing has long been a mystery to the end-user. This "smoke and mirrors" aspect of sizing prompts most end-users to go with the lowest bidder with little consideration of the critical systems being supported. However, the fact is that most bids are written primarily to be competitive, rather than to take into account all of the factors that affect battery sizing – and, in turn, affect desired runtime and load protection. Without clearly understanding and planning for these factors, security may be only an illusion and an outage could become an outright tragedy.

Therefore, the goal of this discussion is to educate you and other end-users of the issues that must be addressed upon new battery installations and replacements. Instead of focusing on the question of cost, more critical questions include the following:

- With regard to how long a battery system will support a load, are you referring to the beginning or end of the battery's life?
- Have you taken into consideration any plans to support future loads?
- When replacing an existing system's battery after years of service, are you reviewing the application or simply replacing "like for like"?

- If you are reviewing runtime, are you basing your needs on the data sheet for the system the batteries are supporting? Have you identified your load profile in order to fit your batteries to your needs?

- Are you taking redundancy into account to avoid a single point of failure?

With greater awareness of and attention to these and other sizing issues, you can be confident that battery performance will meet your expectations and the needs of your system and overall company.

RECALCULATING RUNTIME

Any change to your system or other technologies can have a notable influence on battery sizing. Consider the following scenario, which is quite typical. A company purchases a battery string sized to the loads of the original equipment. Over the course of 15 years, the company continues to upgrade its systems with newer, more efficient equipment. By the time the battery needs to be replaced, the load has likely either significantly decreased or increased, or perhaps the company has added a generator. Despite the changes, however, the end-user puts out a Request for Proposal based on the original system. In reality, a less expensive, easier-to-maintain system could and should be utilized.

SIZING PARAMETERS

Your battery-sizing parameters also play a significant role in ensuring the proper protection is in place. The key is to base battery sizing on technical data from the specific system you are supporting. For example, to accurately size batteries for a UPS, you would use the manufacturer's data to determine the unit's power factor and efficiency. Sizing programs may give you a default setting, but that default is often misleading. Having the correct information could be the difference between supporting the critical load for the desired time and allowing a failure to occur.

Table 1: How Power Factor Can Change the kWB Rating in a UPS Application

kVA	Power Factor	Efficiency	kWB
750	90	93	725
750	80	93	645

INCORPORATING AN AGING MARGIN

An aging margin allows you to compensate for the natural corrosion process that reduces the available capacity of your batteries. According to the U.S. industry standard, end-of-life is only 80% of the rated capacity. Therefore, sizing your required runtime for 100% of rated performance could transform an expected 15 minutes of runtime into as little as 5 minutes or less, depending on cell design. This sub-par performance would be difficult to justify to the powers-that-be in event of an outage. The answer lies in over-sizing your batteries with an aging margin, which must be based on true application or load profile.

DESIGNING WITH REDUNDANCY

Creating a truly reliable battery system often requires building in redundancy rather than simply over-sizing your battery string. Single strings leave you with a single point of failure if a cell were to fail. Take, for example, my experiences with a particular customer who claimed he had 24 hours of runtime with his 27-plate flooded battery string. During an unscheduled event, one cell failed and left the entire critical load unsupported. Disturbed by this turn of events, I quickly designed a system with two strings of flooded batteries, giving him one hour of runtime. His system has not been down since.

MAINTENANCE PROCEDURE

Designing the proper system is the initial phase of protection, but sizing a system correctly is futile without follow-through and corrective procedure. Devaluing your maintenance program allows problems to advance unnoticed. That said, the purpose of this section is not to provide maintenance instruction nor dispute maintenance practices, but to highlight the necessity of maintaining a healthy system. There are multiple variations of maintenance programs from the manufacturers and IEEE-recommended practices. Regardless of who performs the service or the instruments used, maintenance often becomes a procedure rather than a means of analysis and corrective action. It is ultimately your responsibility to ensure that maintenance is not just a pass/fail test, but rather a source of empirical data and sound recommendations that will help you make more informed decisions.

CONCLUSION

In conclusion, there truly is no mystery once you know the behind-the-scenes tricks to battery sizing. While there are other factors in battery sizing, such as temperature correction and the need to support varying loads, this discussion has outlined the sizing considerations that affect the vast majority of the market.

In order to ensure reliable protection of your critical load, battery sizing will come into play not only upon installation, but also throughout the natural aging process and the ultimate replacement of the battery plant. Factors such as redundancy and proper maintenance have an added price tag, but that expense is clearly outweighed by the peace of mind associated with the elimination of costly outages.

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