White paper

15 Seconds versus 15 Minutes

Designing for High Availability

OBJECTIVE

This paper will discuss the issue of required ride-through time in a mission critical UPS (uninterruptible power supply) application. The current practice and Uptime Institute tier classification requires 15 minutes or more runtime due to antiquated perceptions. The 15 minutes ride-through is largely driven by the deployment of chemical batteries and does not consider recent and proven technologies such as flywheel technology.

INTRODUCTION

The paradigm of requiring 15 minutes or more of battery backup for mission critical UPS system reliability is an antiquated and flawed perception. When properly integrated and maintained, standby generators can and will reliably support the critical load in 10 seconds or less. This challenges the idea lead-acid batteries and extended backup time are necessary. The growing intolerance to a "graceful shutdown" also renders 15 minutes of backup moot. The UPS system can be designed with much higher reliability and predictability by using more reliable backup energy methods and applying proper design techniques. This paper discusses the issue and methods of implementing a short ride-through system with higher reliability and predictability than with traditional methods.

Figure 1. Standby generator

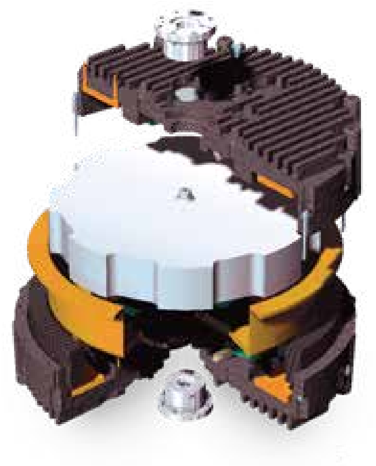

Figure 2. Flywheel assembly

Figure 3. Flooded battery

Figure 4. Valve-Regulated Lead Acid (VRLA) battery

Figure 5. LI-ION Battery

Some engineers and power system designers feel there is a significant difference between typical applications of 25 to 30 seconds of reserve time as with a flywheel UPS system, and 15 minutes as in a conventional static UPS and battery system. There is a reliability difference, but the actual advantage may surprise many.

HIGH AVAILABILITY DESIGN REQUIREMENT

A properly designed high availability critical power system requires, by definition, the diesel generator will start and assume the load when commanded. If it does not, there is no hope to achieve 99.999% or higher availability. This is accomplished by optimizing individual standby generator design, operation and maintenance parameters. Fuel analysis is normally required and redundant starting batteries/circuits or other options. Rigorous maintenance and high-criticality testing procedures are required which are well in excess of those deployed for conventional standby applications. These measures alone increase standby generator start reliability levels by more than an order of magnitude over general duty standby generators. For extreme availability applications, standby generator redundancy is employed. The designer may require N+1, N+2 or even N+N levels of standby generator redundancy, depending upon availability goals.

Again, the base assumption must be the standby generator(s) will start and assume the load, first time, every time. This is in fact what occurs in actual practice barring flaws in design, test or maintenance.

RESERVE TIME REQUIREMENTS

Given the above, a flywheel UPS provides more than enough time to employ standby generators as standby power sources. In fact, sufficient time exists to monitor utility for seconds to minimize unnecessary diesel starts and further reduce standby generator dependency in the availability equation. The additional reserve as provided by 5-minute or 15-minute battery-based systems is superfluous. A 15-minute allowance for "soft shutdown" of computer or other loads is entirely irrelevant since a shutdown after such times is intolerable to most businesses. The standby generator(s) must start, and in fact do over 99.5% of the time according to the IEEE (Institute of Electrical and Electronics Engineers) Gold Book statistics. Arguments that additional time allows for a "second crank" are also without merit because if, in the rarest of circumstances, the generator system described above does not start within the first five or six seconds, then like a car, it will likely not start within the next 15 minutes either.

CONCLUSION

Ironically, high availability UPS designs do not favor battery-based systems regardless of run time, but rather flywheels. This is intrinsic in battery construction. Even if a given battery system starts off with high reliability, it falls off rapidly with time. This is particularly true with VRLA batteries, which show a documented 20% failure rate in just a two to three year age range. If failed VRLA cells are not immediately replaced, even with redundant strings, the probability a complete load loss from open circuit failure is certainly far greater than the possibility of load loss from any failure of the standby generator to start in a flywheel-based system.

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