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UPS Battery Failures

Introduction

UPS battery power-related downtime incidents are proven to be the costliest failures in commercial and industrial facilities due to their impact on all connected systems and equipment. This article covers likely causes of failures and UPS selection and design choices to avoid failures and minimize their impact.

Causes of UPS Failure

Like any other battery, UPS batteries have a lifespan and require replacement when they no longer supply 80% of rated amp-hour. However, UPS battery life may be impacted by factors other than time. For instance, extreme temperatures can also affect the capacity of the batteries. High ambient temperature will degrade the batteries, or if temperature drops below a certain degree, they may underperform. Another degrading factor is over-cycling – constant over-cycling causes premature battery end-of-life. If a battery is charged and discharged too frequently, the battery contacts deteriorate, which in turn reduces the battery's capacity.

Failures in UPS batteries can also occur due to poor equipment design or inadequate planning. For example, if a UPS is replaced with a larger capacity UPS and the air conditioning is not upgraded and doesn't produce a sufficient volume of chilled air, the battery will subsequently overheat. To avoid this, air conditioning units must run efficiently during hot summer days and must be serviced regularly to ensure proper and adequate cooling of the UPS system.

Dust build-up on the battery can also cause overheating. The accumulation of statically-charged dust particles coupled with condensation can pass through the UPS's ventilation and deteriorate the battery contacts.

Overheating is one of main culprits of UPS failures. An overloaded UPS continuously operating at 100% or greater output will overheat. Fans are integrated throughout the UPS in specific places to maintain effective component cooling, and a single fan failure can cause overheating. Other causes of failure include overcharging, incorrect float voltage, and being left in storage too long without recharging.

UPS Selection and Design Choices

A single-phase UPS is usually used for smaller loads such as security system control, voiceover IP, distributed services, or any other rack-mounted application. Smaller remote IT stations may rely entirely on a single-phase UPS to keep the infrastructure operational. It is critical to choose the correct battery type for a single-phase UPS, given a failure due to poor equipment design will affect the entire facility or system served. A good option is valve-regulated lead-acid technology. In contrast, inferior or second-rate batteries may shut the whole system down if one cell exceeds a high temperature unless the system employs a strict battery management system (BMS). In data center applications, a large three-phase floor-mounted UPS system is preferable to multiple single-phase UPS units. In addition, three-phase UPS systems shall include a maintenance bypass switch to ensure uninterrupted power during maintenance.

When installing a single-phase UPS, the designer must consider the "form factor." Form factor is a hardware design aspect that defines and prescribes the size, shape, and other physical specifications of electrical and electronic components; different form factors may be appropriate for different contexts. The best practice to install a small UPS is on a DIN rail, a standard metal rail used for mounting electrical control equipment inside an equipment rack, which facilitates equipment cooling. The UPS also needs to comply with *DRM* 7.4.14.2 – Central Uninterruptible Power Supply Systems, which mandates BAS monitoring of UPS for basic status, common alarms, and battery voltage.

Conclusion

Given the criticality of good UPS system design and the potential impact of a failure, it is necessary to ensure that UPS batteries are appropriately managed for reliability and sustainability. This includes evaluating the optimal UPS location, reviewing the mechanical environmental systems (i.e., ventilation, humidity, temperature), developing a comprehensive UPS maintenance program with standardized UPS preventive maintenance services (i.e., routine UPS checks and shakedown), and implementing a Battery Monitoring System through the building's SCADA system. Engineers need to pay special attention to the UPS's degrading factors and work closely with the maintenance team to ensure optimal UPS functionality.

References

1. NIH *Design Requirements Manual*, Section 7.4.14.2 – Central Uninterruptible Power Supply Systems