

TECHNICAL NOTE

Effect of Temperature on Run Times of Uninterruptible Power Supply Systems for Signalized Intersections

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Abstract

Traffic signal failures due to power outage can significantly impact the safety and efficiency of intersection traffic operation. Uninterruptible Power Supply (UPS) systems are used to power traffic signals in the event of a power outage. The performance of these UPS systems under different temperature conditions has not been studied. Four different UPS systems were evaluated at sub-zero temperatures, room temperature, and hot temperatures (from -25 °C to +72 °C). All the UPS systems showed longer run times as the temperature increased and drastically shorter run times as the temperature decreased. For +72 °C condition, the percentage change relative to room temperature ranged from +6% to +26%. The percentage change at -25 °C condition ranged from -32% to -80%. The increase in duration of flashing compared to duration of solid operation ranged from 89% to 158%. The increase in combination of solid and flashing duration compared to solid operation duration ranged from 35% to 81%. It is recommended to switch to flashing or a combination of solid and flashing mode of operation in cold temperatures to increase the run time. It was also found that a UPS with a greater battery capacity may not yield greater run times under all temperature conditions.

Keywords – Uninterruptible Power Supply (UPS), Battery Backup Systems (BBS), Run time, signalized intersection, Traffic Signals, Temperature effect on run time.

1. Introduction

An Alternating Current (AC) power failure could cause “black-out” situation and pose serious safety concerns and operational inefficiencies at signalized intersections. If the power outage occurs after dark, the presence of a blacked-out signal may not be obvious to drivers. During the rolling blackouts in California in 2000, one of the major causes of injury and property loss was crashes due to blank traffic signals (Farrell *et al.* 2002). With an Uninterruptible Power Supply (UPS) system installed at an intersection, the traffic signals can continue to operate for some time even when there is an AC power failure. A UPS system can provide a time window for the maintenance personnel to either restore the AC power or provide alternative sources of power. Since, traffic signals equipped with LED modules utilize about 15% of the energy needed for incandescent lamps, using UPS at critical intersections has become a viable tool for improving safety and efficiency of such intersections.

The UPS systems that are used in an outdoor location, such as a traffic controller cabinet, are exposed to a wide range of weather conditions. The temperature at which the battery is discharged