# Development of a Float Cycling Telecommunication Battery for Emerging Markets in Regions with Unstable Electricity Grids

**Ben Craft**

**Frank A. Fleming**

**NorthStar Battery Company, LLC.**

**Springfield MO, USA**

## 1. History

NorthStar Battery (NSB) has been producing standby Absorbent Glass Mat (AGM) batteries since 2003 for use in outdoor Radio Base Stations (RBS). During 2007 NSB received reports of premature reduction in battery backup times at RBS sites located in the rural areas of Bangladesh. Reports were received as early as 2 months from the initial installation. Several visits were made to these geographic regions by both the RBS manufacturer and NSB technical personnel in order to investigate the shortfall in useful life. Samples were also sent back to NSB for evaluation.

## 2. Introduction

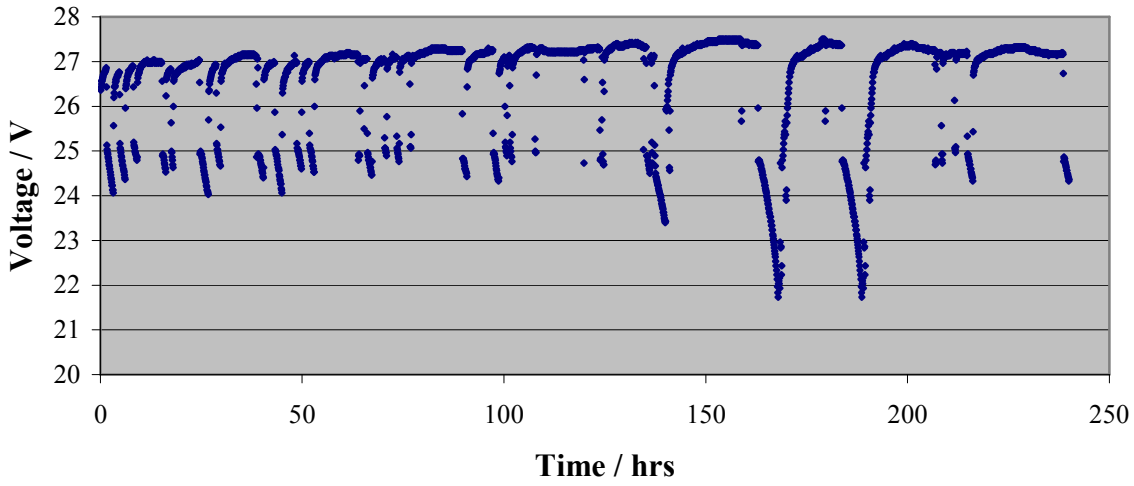
Several factors were considered that can contribute to premature reduction in battery backup time:

a. Temperature
b. Operating Conditions (charge, discharge, duty cycle, power consumption)

Considering the ambient temperatures these batteries were exposed to, we would anticipate a life time of 6 to 7 years. Analysis of battery components showed sulfation of negative electrodes, which is an indication of being undercharged or uncontrolled PSoC cycling.

Using a remote access data logger, current and voltage data was collected from an RBS site in a suburb of Dhaka, Bangladesh. Figure 1 shows the stability of the AC grid recorded over a 10-day period during May and June of 2007.

**Figure 1**




The region suffers from 3 to 7 outages per day with a typical outage lasting 2½ hours followed by a recharge period of approximately 3½ hours. Intermittent deep discharges up to 100% Depth of Discharge (DOD) were also recorded. Over this 10-day period the AC grid was down for a total of 41% of the time. Clearly the batteries were being subjected to regular cycles with less than ideal recharge conditions. These cycling conditions are known as uncontrolled Partial State of Charge (PSoC) cycling.

### 3. Blue Technology

It became clear that the standard AGM product was not suited for locations such as Bangladesh where the power grid is unstable, especially considering the lower power at the RBS. A new electrochemical design was needed to enhance the charge acceptance and PSoC cycling capability of the product. The electrical performances of batteries built with the standard electrochemistry and the newly developed electrochemistry significantly vary. The standard AGM clearly will not withstand PSoC cycling. The new blue technology has the capability to operate in a PSoC, even with low power.

## 4. Lab Experiment

In addition to the field test, in order to demonstrate the performance improvement, a lab experiment was conducted which simulates the operating conditions recorded at the RBS site in Bangladesh.

Both the standard NSB100FT and the NSB100 Blue were tested at 2.27 Volts per Cell (VPC). The standard delivered approximately 250 cycles. To date the NSB100 Blue has delivered 1250 cycles, and continues to operate at the time of this writing.

## 5. Conclusion

At the RBS site mentioned above, NSB170FT batteries had originally been installed. These were replaced with the NSB100 Blue, which reduced the autonomy time to 4 hours. Despite the relative decrease in capacity, the Blue battery has been in operation for 12 months, and has achieved over 330 x 100% Ah turnovers.

When sizing battery backup system for a particular application, several important factors need to be considered. One factor, which most people are aware of, is the required backup autonomy time. Another equally important factor, which most people haven't considered, is the overall stability of the main power grid. In emergent markets, where batteries are required to operate in an uncontrolled PSoC cycling due to low recharge power, Blue Technology by NorthStar Battery can provide a reliable and cost effective solution.