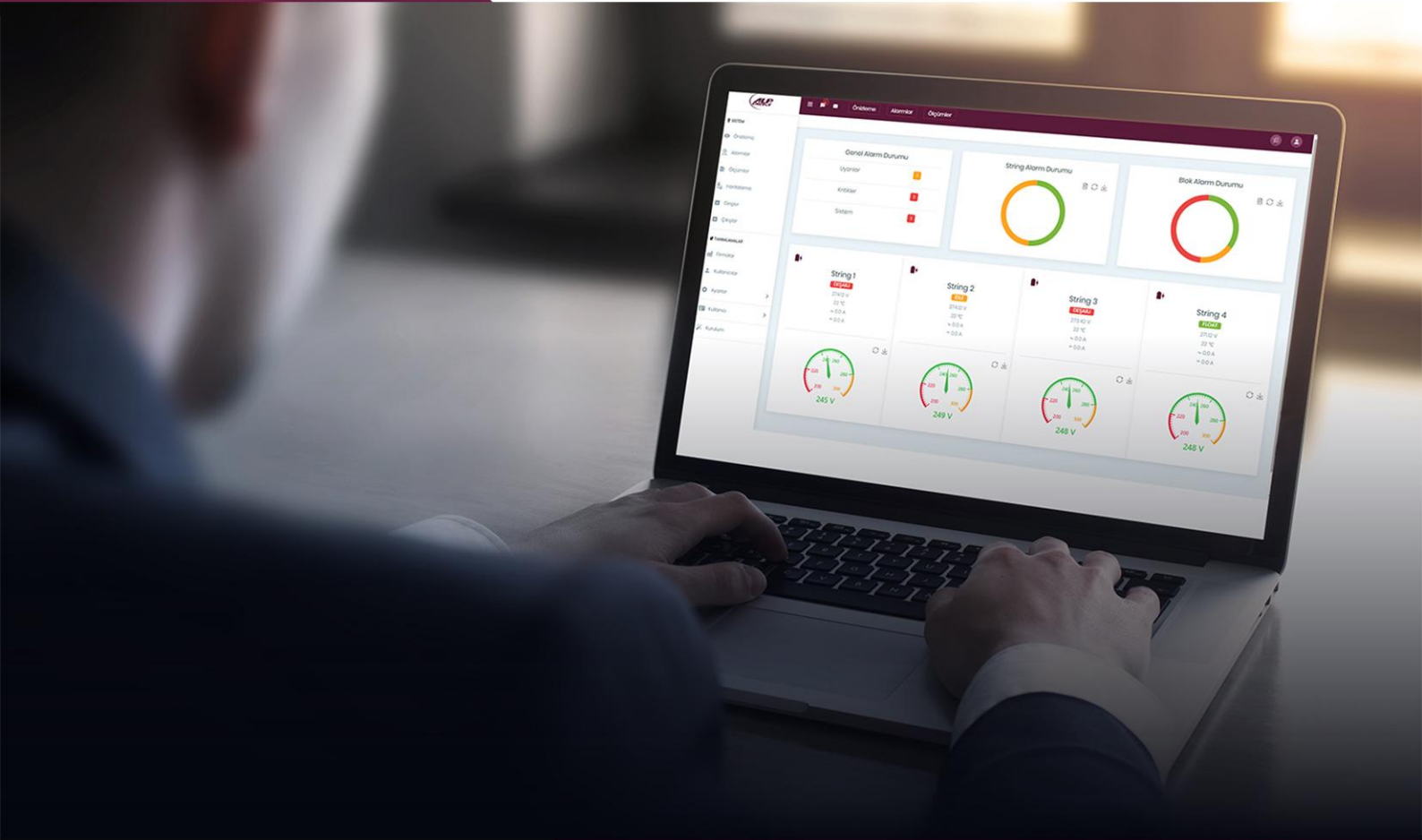


BATTERY FAILURES AND BATTERY MONITORING SYSTEM RELATIONSHIP



INTRODUCTION

“Significant investments were made in critical energy infrastructures. The batteries were checked and maintained according to their maintenance schedules. Everything seems under control. The mains power was out; but it's dark, no machine was be energized. Your backup energy infrastructure, which you defined critically, could not perform its job unexpectedly. Result; financial losses, wasted investments...”

Facing a scenario like given above can be considered as a very low probability but it is more than you think. Batteries, which are the basic elements of the backup power system, can be seen as simple equipment; however, they have an unpredictable structure and can cause unexpected failures.

Because batteries contain not only electrical elements but also chemical elements, they can naturally have unpredictable consequences. For this reason, the majority of catastrophic UPS faults (about 85%) consist of batteries. Even periodic battery maintenance is not enough to eliminate catastrophic risk factors. Ongoing risk factors:

- Lack of attention on transportation and warehousing
- Non-complete controls and maintenances
- Inadequate and bad environmental conditions
- Failure of purchased batteries within the warranty period (approximately 3% new batteries fails in this period)
- The fully maintained battery can actually deteriorate in 2 week timeframe.
- High internal resistance of the batteries as a fabrication error.
- Failure in a single battery affects the entire system

Huge Importance of The Small Actions

When inspired by experienced cases and possible scenarios are evaluated; it is understood that small things that are ignored or not noticed in correct time are issues that need to be given more importance. There can be made no error in the battery room design; however, room conditions can change over time. There may be problems with the air conditioner, the position of the battery racks can be changed and left in a position where it cannot be ventilated and cooled, or the air conditioner may not cool a certain part of the room sufficiently. These temperature increases will affect the long-term health of the battery and will cause some batteries to complete their life much earlier than others in the battery group. For example, a temperature increase of 10 ° C reduces battery life by at least 50%. An increase in battery temperature of 3-4 ° C may appear small, but creates a risk of material loss on a large scale. A minor change in the UPS floating charge settings that is made by the service officer will not be perceived as an alarm by the UPS. During this process, the batteries will no longer charge properly and this will cause aging early.

BATTERY FAILURES

Here are some of the reasons for the battery failures:

- Cracks in battery unit cases, cell dry-out, post seal leaks, stuck valves, plate sulfation, cracked plates or separators and poor plate welds
- Short circuits on battery plates
- Battery interconnections are not made correctly and not screwed at the appropriate torque.
- Environmental factors such as unsuitable ambient temperature and battery temperature rise
- Inappropriate floating charge voltages
- Long periods of time without batteries being charged during the installation and commissioning of the UPS system
- High number of discharge cycle
- Aging
- Fabrication errors (high internal resistance etc.)

Can these reasons, which cause batteries to fail, be eliminated or reduced? Can the risks of breakdown and investment be minimized?

Can periodic maintenance that offered as a solution adequately eliminate risks? Is periodic maintenance sufficient by itself?

When we ask these questions, it is seen that these traditionally applied methods are not enough to eliminate the risks. This situation creates a need for a system that can instantly display the parameters of the batteries, allow for planned battery changes, identify the risk batteries with a high probability of failure, reduce the workforce and increase the efficiency. Battery monitoring systems with different features meet the need in this context and minimize risks.

WHAT IS BATTERY MONITORING SYSTEM ?

The battery monitoring system pre-determines the problems that may occur in each battery, detects battery failures and notifies the user with battery monitoring interface software by monitoring the values of the batteries used in critical area applications. It ensures minimization of battery-driven out-of-service situations, prevention of emergencies and planned battery changes thanks to the data it receives. It is hardware and software system that provides the business continuity. In critical applications such as datacenters, banks, airports, base stations, power generation plants, hospitals, military applications, industrial areas, the installation of a battery monitoring system becomes inevitable day by day.

What Are The Measured Parameters?

As a battery monitoring system, Alpais monitors and reports any value related to faults that may occur in batteries. The table below lists the causes of the breakdown and measured values:

CAUSES OF FAILURE	VALUE MONITORED WITH ALPAIS
Aging	Internal Resistance, Battery Temperature
Internal battery short circuit	Battery Voltage
Inaccurate float charge voltage	Float Charge Voltage
High battery temperature	Battery Temperature
High ambient temperature	Ambient Temperature
Abnormalities in charge/discharge currents	String Current , String Voltage

If You Think I Don't Need A Battery Monitoring System:

- You can say "I have a periodic maintenance agreement with my UPS or Battery service provider".

Your periodic maintenance cannot keep you as safe and secure as you think. Batteries and management of batteries are shown as the cause of nearly 85% of interruptions connected to the uninterruptible power supply. Periodic maintenance has become a traditional method as a result of time. However, there are still interruptions in critical area applications, and these have considerable costs to business owners. Therefore, protecting your backup power system with only periodical maintenance will not reduce the 85% failure rate caused by the battery and will not reduce your risks sufficiently. Batteries, which are unpredictable by nature, can suddenly break down within 2 weeks and cause your system to crash.

- You can say "I already have a monitoring system in the UPS or Rectifier".

All monitoring systems are not the same. Monitoring systems in UPS or Rectifiers monitor batteries as a group and provide only string based monitoring. It monitors at the battery pack as whole, as a block. They usually monitor the group's voltage and charge / discharge states, which cannot provide adequate protection. However, each battery in the battery group has a separate importance; if even one battery in the group fails, the system will not operate or if one battery is unhealthy, this will affect the whole group. In other words, since the monitoring systems in the UPS or Reducer are not able to inspect each battery individually, your system is still at great risk, even when everything seems ok. Whenever you need to ensure that your system will work properly, it is essential to use a system that can monitors each battery separately, examine parameters that may affect its health, and allow you to perform scheduled battery replacement.

- You can say "Instead of installing a Battery Monitoring System, I can reserve some more resources and replace all my batteries".

The backup power system responsible makes this mistake. Installing a new battery system does not eliminate the risk of battery failure. Risks cannot be reduced to zero in any unmonitorable component. The possibility of fabricated problems and the effect of this situation on the total life of the system and the fact that some batteries can be completed by the end of the warranty period (approximately 3%) are among the risk factors that cannot be ignored.

If You Think I Don't Need A Battery Monitoring System:

Even if your batteries are newly purchased, unexpected situations may occur and even your new system that has been relied upon can interrupt your business and cause financial losses. Thanks to the measurements and reports provided by the battery monitoring system, it is possible to identify production-related problems and to submit reports for warranty evaluation.

- You can say "Installing the Battery Monitoring System is a cost for my business".

Contrary to popular belief, the battery monitoring system has many financial benefits. Reduces routine visits or maintenance to battery rooms and reduces the amount of work done, saving you money. It may reduce the frequency of discharge tests that wear batteries; you save time, life of your batteries and cost. Because you can monitor the status of your batteries instantly and be aware of the alarms and warning situations as soon as possible; so you can prevent situations that reduce the life of your batteries individually by detecting and replacing an unhealthy battery and reducing the life of the entire system.

Thus, the life of your battery system is extended, its continuity is ensured and replacement of the whole battery group is postponed. Even result of this situation, the battery monitoring system is a self-paying system.

In addition to the above, the battery monitoring system basically creates benefits by minimizing unexpected power outages, downtime and ensuring business continuity. Financial losses caused by unexpected power outages and downtime are as follows;

- Critical equipment failures
- Data losses
- Lost, existing customers and potential customers
- Opportunity cost

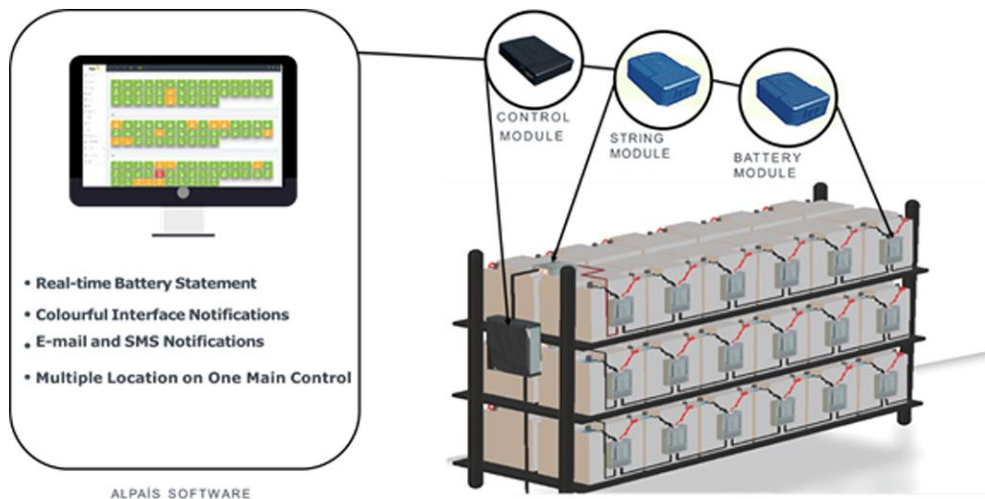
Battery monitoring system minimizes these losses.

Benefits of Battery Monitoring System

In summary, the benefits of the battery monitoring system can be listed as follows:

- It ensures planned battery purchases by preventing emergencies by following the data received from Battery Monitoring System (BMS).
- With BMS, preventive activities are carried out on time and business continuity is aimed to be provided without interruption.
- It provides the opportunity to manage and control your business from anywhere with remote access.
- Reduce Maintenance and replacement costs through effective Protective and Preventive Maintenance.
- Provides maximum benefit with minimum workforce.
- Provides determination and verification of warranty status with recorded data and reporting.
- Provides improvements in business insurance premiums as risks are reduced to minimum.
- Keeping your staff away from battery racks / chambers and vulnerable areas makes sure their safety and activities continue without interruption.

Alpais System Components



Alpais includes three hardware and a software component, consisting of the battery module, string module, control module and battery monitoring software. The table below contains information about the measurements made by the components and their functions:

Battery Module	String Module	Control Module
Battery Voltage	String Current	It is located in the center of the system. It manage the system and provides to record the data received from the string and battery modules.
Battery Temperature	Charge/Discharge States	
Battery Internal Resistance	Ambient Temperature and Humidity	
<p>Battery Monitoring Software:</p> <p>It ensures that the recorded data is presented to users on a web-based platform with a user-friendly interface. Instant battery conditions can be examined, ease of use is provided with colour notifications. Alarms are notified to the user via e-mail and SMS notifications. Retrospective data can be examined. Graphical representations are available. Reports can be made and converted to CSV and PDF format. Battery systems in different locations and cities can be controlled from a single point.</p>		

Conclusion

The subjects of risk factors based on the failure of backup power systems in critical energy infrastructures, the reasons for the failure of the batteries which are the main components of critical energy systems, and the parameters that should be monitored before the failures, are examined. It has been observed that traditional methods do not eliminate or reduce risk factors adequately and it is understood that battery monitoring systems that can monitor each of the batteries instantly and measure the factors that may affect their lifetime should be used in order to minimize the risks.

Each component that cannot be monitored is a threat to business continuity.

Alp Energy Systems