

R O B O T I N A

S O L U T I O N P R E S E N T A T I O N

B T M S

**B A T T E R Y M O N I T O R I N G
S Y S T E M**

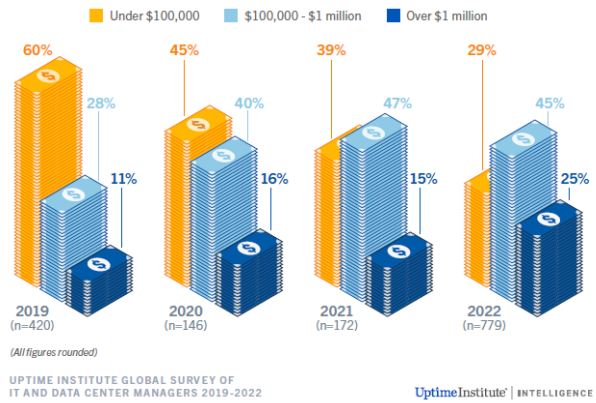
2 0 2 3

HOW BATTERY MONITORING CAN PREVENT THE LOSS OF YOUR DATA AND INFORMATION

The global data center population is growing year after year, owing primarily to the advancement of digitalization and cloud services and applications. In the foreseeable future, the development pace of data centers will increase, as will their electricity usage.



Data center power supply reliability requirements are among the highest among industrial power consumers because uninterrupted power supply is critical to the reliable operation of server hardware. The reliability of power supplies is one of the most important aspects of data center planning.



For many years, the Uptime Institute (2022 Outage Survey) has been tracking the frequency, causes, and consequences of outages in data centers and critical infrastructure. According to the institute's research, the number of outages worldwide is increasing year by year, just as the sector is developing.

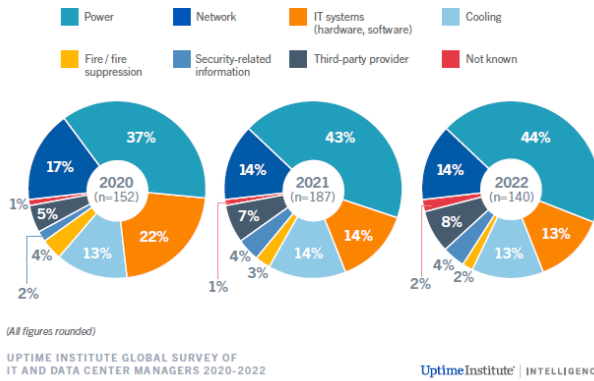
The cost of data center downtime is rising as well. There are various reasons for the cost increase, the most important of which is the rising reliance of companies' economic activity on digital services and data centers. The loss of a crucial IT service frequently has a direct and immediate impact on business disruption and revenue loss.

The primary cause of outages is electricity

Understanding the causes of outages is critical for preventing them and planning future measures and expenditures. This is not always as straightforward as it appears, as most outages have numerous reasons. The results of the annual Uptime 2022 survey, which are consistent with prior years, suggest that power outages are considerably in the lead. All other causes of outages are much rarer.

Power is still main cause of outages

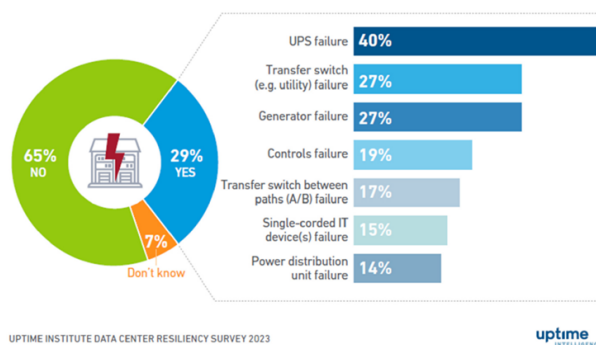
What was the primary cause of your organization's most recent impactful incident or outage?



In-depth analysis in Uptime's separate research further finds that the biggest causes of power-related outages are uninterruptible power supply (UPS) failures, followed less frequently by transfer switch (generator/mains) and generator failures.

Most common causes of major power-related outages

Has your organization experienced a major outage(s) caused by a problem with a power system over the past three years (n=393)? If so, what are their most common causes? Choose no more than three (n=113)?



Engineers at the Uptime Institute explain that UPS fails for several reasons:

- fans often fail because they are generally cheap and in constant use,
- capacitors fail due to wear,
- batteries fail due to prolonged use and insufficient supervision,
- inverters fail less often.

Outages can be avoided

According to the same poll, those who have experienced an outage believe that disruptions can be avoided with improved management, process control, or better configuration.

That is why, for many years, Uptime has recommended improving management, planning, and training as the best and most cost-effective ways to reduce downtime.

Every UPS system contains a set of batteries, and a single battery failure can cause the entire set to fail. Because the batteries in a battery pack are connected in series, if one of them fails, the entire pack fails. This is one of the most common reasons why a UPS fails to execute its intended function during a power outage.

To avoid this, users perform frequent preventive maintenance interventions such as site visits, voltage and internal resistance tests on all batteries, temperature, and so on.

Customers elect to replace specific important batteries based on the examination findings. This form of maintenance is required regardless of whether the UPS was in operation or just in the "standby" position, because batteries are susceptible to self-discharge and lose capacity over time. The unevenness of this procedure exacerbates the situation. Battery life is typically 3-5 years.

BTMS

Battery monitoring system

The Battery Monitoring System (BTMS) gives full real-time visibility into the state of all battery system segments, assuring the continued operation of critical uninterruptible power supply systems.

GDH Abu Dhabi Project

Gulf Data Hub is a data center, which is a centralized system for storing, defining, and delivering data. In that it serves as a central repository for data mining applications, it is a cross between a data lake and a database warehouse.



Reference project, GHD | Abu Dhabi, Implementiran BTMS



In one of the GDH data centers in Abu Dhabi, we successfully implemented:

- 15 rooms with UPSs from 4.2 - 16 MW,
- each room has one GW,
- 7000 batteries, 162 strings, 54 UPS
- display on local touch panels.

What we monitor and control

The battery's internal resistance

Internal resistance rises with running time and is directly proportional to battery life. The lower the resistance, the less constraints the battery encounters in producing the required peak power. Monitoring the impedance trend can reliably indicate the end of life. High impedance readings can be an indication of a problem, such as a faulty terminal connection or a short circuit.

Voltage of the battery

Charging the battery at the proper voltage is essential for battery performance and longevity. Improper charging voltage can significantly reduce battery performance and limit battery life. Furthermore, it might result in the discharge of hazardous gases, corrosion, and even explosion. Measuring cell voltage also aids in the detection of deadly battery failures such as a battery short circuit.

The internal temperature of the battery

The current of charge and discharge raises the temperature of the batteries, which has a direct impact on their life and storage capacity. Overheating can result in excessive gas discharge and, in extreme cases, an explosion. Our technique measures the internal temperature at the negative pole, which is an excellent predictor of the temperature within the battery.

State of Charge(SOC)

SOC (State of Charge) is defined as the proportion of available capacity. Knowing the battery's state of charge is equivalent to knowing the amount of petrol in the tank. The state of charge (SOC) of a battery determines how long it will last before needing to be recharged.

SOH (State of "Health")

The objective of SOH (State of Health) is to monitor the battery's real-time performance or to show how much battery capacity is left before it needs to be replaced. This is essentially a function that monitors long-term changes in the battery and predicts the need for replacement.

Battery pack current (charge and discharge)

We monitor the energy received or emitted by each array by measuring the current of the battery array. This allows us to discover potential charge problems.

String	Cell	From	To	Alarm	Status
21	#01	06/06/2022 15:45:57		Current low (discharging)	active
22	#01	06/06/2022 15:44:02		Current high (charging)	active
24	#01	05/31/2022 15:43:16	06/06/2022 15:43:35	Resistance high	gone
23	#01	05/31/2022 15:43:16	06/06/2022 15:43:35	Voltage low	gone
22	#01	05/31/2022 15:43:16	06/06/2022 15:43:35	Voltage high	gone
21	#01	05/31/2022 12:20:26	06/06/2022 15:43:26	Voltage high	gone
20	#01	05/31/2022 12:20:26	06/06/2022 15:43:26	Voltage low	gone
19	#01	05/31/2022 12:20:22	06/06/2022 15:43:26	Resistance high	gone
18	#01	05/31/2022 12:20:22	06/06/2022 15:43:26	Voltage low	gone
17	#01	05/31/2022 12:20:22	06/06/2022 15:43:26	Voltage high	gone

String tensile strength

We can tell if the batteries are being charged properly by measuring the voltage of the battery arrays.

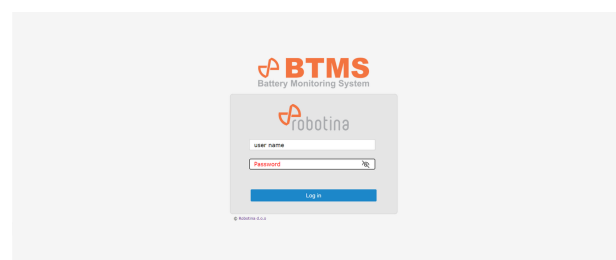
Equalization of voltage (balancing)

Overcharging or undercharging a battery can drastically degrade its performance. The capacity of the complete battery set is determined by the battery with the smallest capacity.

As a result, it is critical that the voltage of all batteries in each set be balanced. We ensure that all batteries in a series have the same voltage by using voltage equalization.

Temperature and humidity in the room

The ideal ambient temperature for lead-acid batteries is between 20 and 25 °C. Battery life can be reduced by 50% if the temperature rises by 8-10 degrees. High humidity can accelerate corrosion, whereas low humidity might induce static electricity and fire.



The BTMS system's essential components

The BM-CS Cell Sensor

Sensor keeps track of each individual battery. It can monitor battery status, voltage, internal resistance, and temperature, as well as calculate SOC and SOH. It is responsible for voltage equalization.



String master BM-SS

It keeps track of what's going on in the array and compiles data on the batteries. It continuously monitors the voltage in the array, the charge and discharge current, and the state of the batteries (impedance, temperature, SOC, SOH) in real time (through CS). Advanced measuring algorithms allow for accurate measurements without raising discharge currents, resulting in no additional losses. It maintains the balance of individual batteries in an optimal state, ensures maximum preparedness, and extends the life of the batteries. The RS 485 protocol is used for communication, and the power supply is turned off. Individual battery sensor addresses are automatically detected. Combine up to 120 BM-CS into a string.

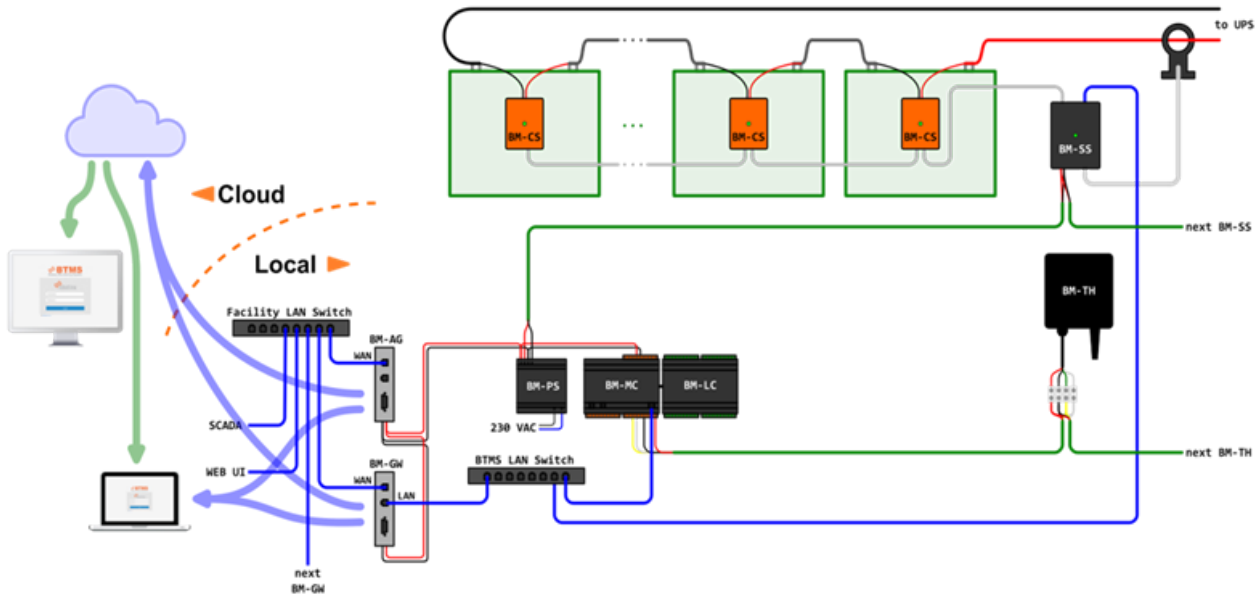


IOT gateway BM-GW

Combine numerous BM-SS into a web-based UPS interface. It allows you to see individual batteries, arrays, and other installed systems on the GW. The data can be monitored both in real time and as processed history (tables, graphs). Alarms can be delivered by SMS or email. Data is saved in a local buffer (there is no data loss). Reliable connectivity of the local system to the BTMS cloud platform (encrypted TLS communication, GDPR compliance). Up to 32 battery packs can be connected.

The remaining complimentary components that constitute an integrated whole (power supplies, temperature and humidity sensors, local displays, expansion modules...) round out the system.





BTMS in action

Robotina has created a battery monitoring device that allows real-time monitoring of all critical factors (mentioned above).

The system has been installed in two GDH data centers in Dubai. These centers' services are used by companies such as Microsoft, Siemens, and many more.

These centers' capabilities are as follows:

- 19 rooms with UPSs ranging from 4.2 to 16 MW,
- Approximately 9000 batteries,
- 200 strings,
- 70 UPSs,
- Local display panels
- Each room has one GW (uninterruptible power supply) for remote internet monitoring and management.

A high level of power supply reliability is crucial to a data center's continuous operation and availability.

This is especially true for vital infrastructure such as telecommunications centers, power distribution, transportation, and the defense sector, where disruptions inflict severe harm.

We prevent downtime and proactively ensure a higher level of operational reliability and data security with an advanced battery monitoring system (BTMS), which with its advanced, fully automatic software solution saves expensive manual checks, limits human errors, and effectively extends the life of all batteries.

