APPLICATION NOTE

PU[REC] DATA LOGGER

AND STABL'S IMPLEMENTATION FOR ENHANCED DATA ACQUISITION

STABL x DEWETRON

ABSTRACT

STABL Energy GmbH leads the battery energy storage systems (BESS) industry with high-quality standards and innovative technology. This application note highlights the company's focus on enhancing energy efficiency, safety, and reliability in its BESS solutions, utilizing DEWETRON's PU[REC] for precise measurement and analysis.

A round-trip efficiency rate of approximately 94.1 % showcases the superior engineering of STABL's inverters and commitment to minimizing energy losses. Harmonic distortion analysis confirms the robustness and high power quality of STABL's systems.

Engagement with stringent certification processes like VDE-AR-N 4110 demonstrates STABL Energy's dedication to grid stability and regulatory compliance. DEWETRON's data logging and analysis tools are essential in achieving these standards.

Overall, STABL Energy's advanced measurement integration and rigorous quality protocols solidify its leadership in the BESS market, emphasizing sustainability, safety, and efficiency to meet global energy demands.

INTRODUCTION

STABL Energy specializes in advanced industrial battery storage systems, emphasizing reliability, safety, and efficiency. They are dedicated to optimizing energy management for renewable sources, which ensures their systems are responsive to energy demands and variations. This application note underscores STABLs meticulous approach to enhancing energy efficiency, safety, and reliability across its BESS solutions. By leveraging the advanced capabilities of the PU[REC] data logger, STABL Energy has demonstrated its commitment to precise measurement and comprehensive analysis, crucial for optimizing performance and ensuring regulatory compliance.

PU[REC], short for Pure Recording, is a high-performance data recording system featuring 16 channels capable of capturing and storing data at up to 200 kHz. Integrated with a full-fledged PC, it can perform detailed data calculations and analysis directly on the device.

Fig. 1: Outdoor cabinet & 6 m (20 ft.) container solution from STABL

MEASUREMENTS WITH THE PU[REC] DATA LOGGER

What was the measurement task and what was done?

Round Trip Efficiency Test

This test involves several steps to ensure a comprehensive evaluation of the inverter‘s performance:

- **Energy conversion:** During charging, the inverter converts alternating current (AC) from the grid to direct current (DC) to store energy in the battery. During discharging, it converts DC back to AC to supply energy to the grid or load.
- **Measurement:** The test measures the amount of energy input into the storage system during the charging phase and the amount of energy output during the discharging phase.
- **Calculation:** Round-trip efficiency is calculated by dividing the total energy output by the total energy input and then multiplying by 100 to get a percentage. This value represents the ratio of the energy delivered by the battery to the energy originally stored, accounting for losses during the conversion processes.
  - Total energy input during the charging phase was quantified as 220.99 kWh.
  - Total energy output during the discharging phase was quantified as 208.05 kWh.

  The efficiency of the energy conversion process was calculated using the formula:

$$Round-trip\ efficiency\ (\%) = \left(\frac{Energy\ output}{Energy\ input}\right) \times 100$$

  Substituting the observed values yields:

Round Trip Efficiency = 208.05 kWh/220.99 kWh ≈0.941

This corresponds to a conversion efficiency of approx. 94.1 %.

- **Losses consideration:** Various losses are accounted for, including those due to the inverter‘s internal resistance, heat dissipation, and other inefficiencies in the energy conversion process.

The round-trip efficiency test is crucial because it provides a clear indicator of the overall efficiency of an energy storage system, influencing the system‘s performance, cost-effectiveness, and environmental impact. High round-trip efficiency means more effective use of stored energy, leading to better performance and lower operational costs.

Harmonic Distortion Analysis

This typically involves having the necessary input channels, appropriate voltage and current measurement ranges, and compatibility with harmonic analysis software or modules.

- Connection setup: We connected voltage and current probes for each of the 3 phases to the input channels of the PU[REC]. It has been ensured that the sensors are properly calibrated and securely connected to the electrical circuit or system under test.
- Configuration: Using the OXYGEN software interface, we configured the measurement setup i.e. specify the sampling rate, measurement duration, frequency range of interest. They created a power group in the OXYGEN software and displayed a table of all the harmonics in a dedicated dashboard.
- Harmonic analysis: data acquisition process to capture voltage and current waveforms from the STABL system.
- Data interpretation: Once the data acquisition was complete, we used the OXYGEN software on the logger to analyze the recorded waveforms and calculate harmonic distortion metrics such as Total Harmonic Distortion (THD),

individual harmonic components, harmonic distortion factor, and harmonic distortion factor.

- Visualization and reporting: The loaded software provided visualization tools to display harmonic spectra, waveforms, and other relevant data. OXYGEN further enables the generation of reports and export of data for further analysis or documentation purposes.

Using DEWETRON logger for 4110 measurements

VDE-AR-N 4110 is a grid code certification required to sell systems to customers with medium voltage plants.

While we already have VDE-AR-N 4105 certification for small plants, achieving the 4110 certification involves implementing and testing additional features, including Fault Ride-Through (FRT). FRT is essential for grid stability as it ensures that each large plant contributes to the electrical grid during a fault, preventing a cascade of shutdowns that could lead to a blackout.

To test FRT, we measure the 3-phase current and voltage pairs and utilize the „symmetrical components“ measurements on the PU[REC]. We compare these measurements to our own symmetrical component calculations, implementing math functions to calculate the set-point correction during a fault and comparing it to our system‘s behavior.

We analyze the 4110 features both online using Oxygen dashboards and offline by exporting CSV files and writing custom analysis scripts. The DEWETRON support team provided quick and useful insights, significantly aiding our efforts.

What was the data processing like?

As the data acquisition proceeds, DEWTRON PU[REC] records the acquired data to storage media, such as a hard drive or SSD. The recorded data can be saved in various file formats including .CSV, Excel, MATLAB, depending on user preferences and compatibility with other analysis tools. For round-trip efficiency we used .CSV file and manually analyzed the data due to the small sample size.

DEWETRON’ PU[REC] offers real-time monitoring capabilities, allowing us to visualize acquired data as it is being recorded. This includes viewing waveforms, spectra, and other graphical representations of the acquired signals.

How was it used for a first-time user?

Overall, DEWETRON’s PU[REC] facilitates the entire data processing workflow, from configuration and acquisition to post-processing, analysis, and reporting, providing users with a comprehensive solution for data recording and analysis.

- Referring to the software documentation was very helpful for first-time users.
- Seeking assistance from DEWETRON‘s support resources provided additional guidance and quick setup.
- Numerous video tutorials available online further assisted in understanding and using the software effectively.

SUMMARY

In conclusion, STABL Energy GmbH, through its rigorous adherence to high-quality standards and innovative technological solutions, stands at the forefront of the battery energy storage systems (BESS) industry. This whitepaper underscores the company‘s meticulous approach to enhancing energy efficiency, safety, and reliability across its BESS solutions. By leveraging the advanced capabilities of DEWETRON’s PU[REC], STABL Energy has demonstrated its commitment to precise measurement and comprehensive analysis, crucial for optimizing performance and ensuring regulatory compliance.

The round-trip efficiency test, pivotal in evaluating the overall effectiveness of the energy storage systems, reveals a commendable efficiency rate of approximately 94.1%. This metric not only reflects the superior engineering of STABL's inverters but also highlights the company's dedication to minimizing energy losses and maximizing operational efficiency. The harmonic distortion analysis further emphasizes the robustness of STABL's systems, ensuring high power quality and mitigating potential issues related to harmonic interference.

Moreover, STABL Energy's proactive engagement with stringent certification processes, such as the VDE-AR-N 4110, highlights its commitment to maintaining grid stability and meeting the demanding standards required for medium voltage plants. The use of DEWETRON's state-of-the-art data logging and analysis tools has been instrumental in achieving these benchmarks, providing reliable, real-time data essential for continuous improvement and innovation.

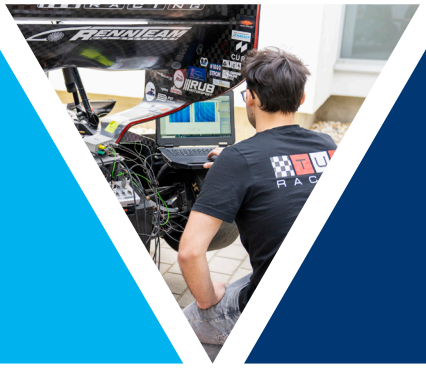
Overall, STABL Energy GmbH's integration of advanced measurement technologies and adherence to rigorous quality protocols underscores its leadership in the BESS market. The company's dedication to environmental sustainability, safety, and efficiency positions it as a trusted provider of advanced energy storage solutions, ready to meet the evolving demands of the global energy landscape.

AUTHORS

Originating from a university project, STABL Energy is now at the forefront of advancing a net-zero energy system. We specialize in advanced industrial battery storage systems, emphasizing reliability, safety, and efficiency. By optimizing energy management for renewable sources, our systems are designed to be responsive to energy demands and variations, contributing significantly to the stability and sustainability of the energy grid.

Our team, comprised of more than 40 passionate and creative individuals from various countries, is dedicated to making a decisive impact in the energy sector.

At STABL, we are committed to driving change in the energy sector with our expertise, innovation, and unwavering dedication to a sustainable future.



About DEWETRON

DEWETRON is a manufacturer of precision test & measurement systems designed to help our customers make the world more predictable, efficient and safe. Our strengths lie in customized solutions that are immediately ready for use while also being quickly adaptable to the changing needs of the test environment and sophisticated technology of the energy, automotive, transportation and aerospace industries.

More than 30 years of experience and innovation have awarded DEWETRON the trust and respect of the global market. There are more than 25,000 DEWETRON measurement systems and over 400,000 measurement channels in use in well-known companies worldwide.

DEWETRON employs over 120 people in 25 countries and is part of the TKH Group, a global corporation, that specializes in the development and supply of innovative solutions worldwide.

DEWETRON's quality is certified in compliance with ISO9001 and ISO14001. The high integrity of the measurement data is guaranteed by our own accredited calibration lab according to ISO17025.

Get to know our
GLOBAL OFFICES

THE MEASURABLE DIFFERENCE.

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