Automation of a hydrogen energy storage solution from Endua

Smart alternative for remote consumption locations

Highlights:

- Endua, an Australian company, specializes in the development of hydrogen-powered energy storage systems
- Endua required a reliable, scalable, and precise control and safety system, so the company teamed up with Phoenix Contact
- With a control solution based on PLCnext Control, including a safety system, Endua can increase its operational efficiency, save costs, and ensure a safe working environment

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>
> Adam Davidson, Control Systems Engineer at Endua

Customer profile:
Endua

The Brisbane, Australia-based start-up Endua focuses on the development of hydrogen-powered energy storage systems (Figure 1). The clean, reliable, and long-term storage solutions are aimed at remote locations, such as mining, communities, and other off-grid energy consumers. Renewable sources supply this energy, even during dark doldrums. With support from the Commonwealth Scientific and Industrial Research Organization (CSIRO), oil producer Ampol, and venture capitalist Main Sequence, Endua's solution focuses on hydrogen for multi-day energy storage – a more sustainable alternative to diesel generators (Figure 2).

Figure 1:
A scalable control and safety system improves the control and information availability of a modular hydrogen energy storage system. (Image source: Endua)

"Endua was established in 2021 to commercialize CSIRO's research into PEM electrolysis technology," said Tim Latimer, Head of Growth and Business Development at Endua.

The Australian start-up's power bank technology is a modular system based on hydrogen electrolysis that uses energy from, at best, renewable sources to split water into hydrogen and oxygen. The hydrogen is stored and used to generate energy when needed by providing electrical energy using fuel cells.

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Figure 2:
Endua focuses on developing clean, reliable, and long-term energy storage for remote industries, communities, and off-grid energy consumers. (Image source: Endua)

The ability to store the hydrogen for several days gives it a clear advantage over typical lithium-ion battery storage systems, which are usually limited to shorter periods of time

Challenge:
Designing a self-sufficient system for storing energy for several days

According to the World Economic Forum[1], 85 percent of hydrogen costs are attributable to utility-scale storage and compression (50 percent) and transportation (35 percent), which is why the economic viability of this technology is sometimes questioned. Large-scale hydrogen production is more feasible when it is located close to the consuming industry.

"The challenges here stem from the costs involved in developing the hydrogen infrastructure," says Latimer. "For smaller hydrogen users, transportation costs are a problem. Therefore, the development of a self-sufficient system is an option, so that the user can produce, store, and use the hydrogen on site. In special applications, hydrogen technology is already proving competitive with lithium-ion batteries and fossil fuels. If the energy is to be stored for days to weeks, the cost per kilowatt hour in a power bank is more competitive than lithium batteries."

The Endua power bank system offers the following advantages:

Modular and scalable design

The flexibility of the storage solution allows the user to scale the energy capacity according to requirements – whether for small remote communities or larger industrial applications.

Reliable off-grid performance

The technology is particularly suitable for industries that currently depend on diesel generators. By switching to hydrogen, they can reduce their carbon footprint without compromising reliability.

Integration with renewable energy

By storing excess renewably generated energy during peak production times, the power bank system provides energy even during dark doldrums.

Long-term storage

Endua's hydrogen technology can store energy for several days, making it ideal for applications where longer power availability is crucial.

Partnership-based implementation of a flexible and adaptable solution

The construction of the first power banks for demonstration and test purposes proved the functionality of the concept. Endua required a reliable, scalable, and precise control and safety system, so they turned to Phoenix Contact. The partnership aimed to develop a flexible and adaptable solution with worldwide support.

Figure 3:
The control cabinet of the power bank systems is equipped with standard and safety controllers, surge protection, cables, terminal blocks, lighting, I/O systems, Ethernet switches, and communication gateways from Phoenix Contact. (Image source: Endua)

Phoenix Contact's international presence ensures that the power banks are manufactured and supported around the globe. "Phoenix Contact has a complete portfolio of electrical and automation products - from surge protection, circuit breakers and power supplies to signal converters, controllers, and safety systems," explains Adam Davidson, Control Systems Engineer at Endua. "By sourcing the entire control system equipment from one supplier, we get a consistent, high-quality solution with low design-in and procurement costs (Figure 3)."

Solution:
Cloud-based monitoring of the power bank components

The first generation of power banks has been equipped with PLCnext Control controllers and PSRmodular safety technology. During software development and commissioning, the Endua team drew on the experience of Phoenix Contact's application engineers to speed up project implementation.

"A good example of this is the development of the safety system, which is used to monitor hydrogen leaks, among other things," reports Davidson. "During commissioning, we encountered problems with the precise readout of the analog signals from the gas detectors in the safety and standard control system. It turned out that there was a wiring error and that the analog input modules and the communication between the safety and standard controllers were not configured correctly. The application engineers from Phoenix Contact identified the errors and rectified them promptly (Figure 4)."

Figure 4:
The Endua and Phoenix Contact sales teams worked closely together to develop the power bank.

The PLCnext Control controllers from Phoenix Contact are designed for programming in the classic IEC 61131-3 languages as well as high-level languages. They can be expanded with standard and function modules from the Axioline and Inline I/O systems. This modular structure allows the PLC to easily adapt to the respective requirements. The configurable PSR safety modules have TÜV-certified software, so the Endua team could create the safety logic with little programming knowledge.

Like any system, Endua power banks require regular maintenance. The user can replace water and air filters, while an approved technician calibrates the gas detection. The stacks of the PEM electrolyzer are designed for on-site replacement.

"Over time, electrolyzers lose efficiency depending on their duty cycle," explains Latimer. "When changing the PEM stacks, the industrial PC (IPC) and communication hardware from Phoenix Contact come into play."

Endua uses the Ignition software platform for Inductive Automation's SCADA systems. This runs on the IPC to monitor the power bank remotely via a cloud-based infrastructure. The industrial PC converts the data from the control system into MQTT and sends it to the cloud server. There, the performance of the power bank components is recorded over their entire service life.

Figure 5:
The industrial PCs convert the data from the control system into the MQTT protocol and send it to a cloud server. This makes it possible to record the performance of the Powerbank components over their entire service life and to plan maintenance in advance. *(Image source: petrmalinak@shutterstock.com; JSparrow@shutterstock.com)*

This makes it possible to predict when maintenance is required – an important aspect when used in remote locations (Figure 5).

Results:

Numerous advantages of the control and safety system

Endua is currently working on a second-generation test system. The PLCnext Control controllers are also being used here. The latest version combines the functions of control, safety, and IPC technology in a single unit. This contributes to even better monitoring and availability of information and reduces the total cost of ownership. The ability to do all programming in the PLCnext Engineer engineering environment and load the code directly onto the controller speeds up the process of programming, testing, and modifying the safety system and provides additional data directly to the control and monitoring system.

"The integrated PLCnext Control solution with functional safety opens up numerous advantages compared to the original power bank configuration," explains Eduardo Aruda, Product Manager at Phoenix Contact Australia. From a system design perspective, the system architecture is significantly simplified. Instead of developing and managing two separate systems for automation and functional safety, the new solution reduces the complexity of the design process and minimizes the potential for errors. Thanks to the uniform programming environment, engineers can create the automation and safety functions on one platform, which ensures consistency and compatibility between the functions, among other things.

Watch a video about the application.

Reference:

1. World Economic Forum 2024, The hidden 85 %: How to make hydrogen cost-effective, *https://www.weforum.org/agenda/2024/05/hydrogen-hidden-costs-energy-transition/*

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