



Green Hydrogen in the Smart Grid

Power Engineering



Real Experience **Learning**: Intelligent training solutions of the future

Lucas-Nuelle's training systems combine theoretical knowledge with practical experience: Tangible, realistic learning systems with real equipment offer learners the chance to grasp and understand complex relationships. Because only when we experience things, do them ourselves, celebrate small successes and thus experience emotions, does what we have learned enter our long-term memory - and thus become permanently anchored in our minds. Our training systems combine user-friendly e-learning software with the corresponding courses and real tools and systems. In this way, they pave the way for sound practical knowledge.



Thanks to Real Experience Learning with Lucas-Nuelle, learners are immersed in a new world of learning and acquire not only knowledge but also the necessary skills.



Green hydrogen in the Smart Grid

Green hydrogen is considered a key technology in the energy transition: Renewable hydrogen is a crucial element on the way to a low-carbon and sustainable energy supply.

In collaboration with the HAN University of Applied Sciences, we have developed a training system that provides specialists and students with the necessary knowledge on all topics relating to the storage and use of green hydrogen. It complements our teaching systems for photovoltaic and wind power plants and fits perfectly into the smart grid.



What do you learn with our hydrogen storage training system?

Our innovative teaching system provides a sound introduction to the fundamentals and functioning of hydrogen storage systems, which play a central role in the energy transition.

Our teaching system for hydrogen storage comprehensively prepares specialists and students for the challenges and opportunities in the field of green hydrogen.



Learn more!

The training system in the following learning content:

- **Basics and functionality of hydrogen storage systems:** Our hands-on training system with industry-related components provides in-depth knowledge of the various elements of a hydrogen storage system - including electrolyzer, hydrogen storage, fuel cell and battery storage. Specialists and students learn how these components work together to efficiently produce green hydrogen, store it and use it again when needed.
- **Energy management in the smart grid:** One focus of our knowledge transfer is on energy management in the smart grid. Students learn how to integrate hydrogen storage systems into the smart grid in order to ensure a reliable and sustainable energy supply. They are familiarized with the challenges and opportunities associated with energy management in the smart grid and learn how to master them.
- **Energy management with photovoltaic and wind power systems:** We also offer practical insights into energy management with the individual renewable energy sources of photovoltaics and wind power. Students learn how to use these energy sources efficiently and how to build a sustainable energy system in combination with hydrogen storage systems.





The hydrogen storage system has the following features:

Fuel cell

- Type: Proton exchange membrane fuel cell (PEM)
- Energy source: Hydrogen, oxygen (air)
- Nominal power: 1200 W
- Operating pressure: 0 to 15 bar
- Hydrogen consumption at rated output: 15 NL/min

Hydrogen storage tank

- Metal hydride storage
- Max. Pressure: 17.2 bar
- H₂ capacity (at 20°C and 25 bar): 1600 NI

Electrolyzer

- Type: Proton exchange membrane electrolyzer (PEM)
- Nominal pressure: max. 16 bar
- Flow rate: max. 1200 cc/min



Curious?
Then contact us!

NMC Li-Ion battery

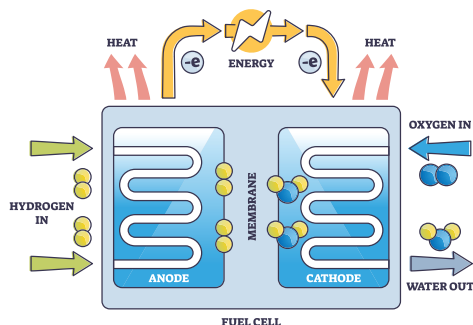
- Battery voltage: 48 V
- Nominal capacity: 50 Ah / 2434 Wh
- Calendar Life @ 80% SOC: 20 years

Multidirectional inverter

- Rated voltage: 3 x 230 V
- Rated power: 9 kVA
- Frequency: 50/60 Hz
- Online UPS

- Touch display
- Interface: Ethernet
- Power meter
- Programmable controller
- Connections: 4 mm
- Safety sockets

HYDROGEN FUEL CELLS



Are you familiar with our other products in the field of hydrogen?



UniTrain – versatile and flexible

Our most identical product is the UniTrain system. The computer-assisted training system for electrical engineering education connects online courses with didactic hardware in your practical classroom with just one interface.

The benefits of UniTrain:

- 100+ courses available on a single single system
- Mobile and deployable anywhere
- Promotes independent learning
- Competence to adequately act through practical assignments
- Safe experimentation thanks to protective extra low voltage
- Online course combines theory and practice
- Advantages of digital learning materials, such as animations, images and questions with immediate feedback



EHY 1 - Check out the website!



EHY1: Fundamentals of fuel cell technology with UniTrain

The UniTrain course Fuel Cell Technology vividly presents the working principle and operation of fuel cells.

Learning content includes:

- The inclusion of characteristics of a fuel cell
- The electrochemical processes of electrolysis (1st and 2nd Faraday's law)
- Faraday and the energy efficiency of a fuel cell
- Series and parallel switching of fuel cells
- Performance analysis of fuel cells
- Working principle and mode of operation of the electrolyser
- Recording of the UI characteristic curve of the electrolyser

The benefits are:

- Interactive practice setup
- Measured values and graphs can be displayed via drag-and-drop into the course saved
- Questions with immediate feedback for furthering the learning process
- Printing option for easy printing of the experiment instructions with answers
- LabSoft course with theory and practice

EHY2: Fuel cell technology for advanced users

The experimental system builds on basic knowledge and allows safe handling of hydrogen and the fuel cell for many interesting investigations. It is suitable for both demonstrations and independent student work. Animated theory, experiments and questions about them are provided by the *Interactive Lab Assistant*.

Make your system flexible

Our modular panel system allows the devices can be assembled particularly flexibly.

- Construction of complex applications in the experiment setup in just few minutes
- Flexible adaptation of the system to the classroom
- Combine systems to build any scenario, from basic module to expert extensions



EHY 2 Advanced fuel cell technology - Check out the website!





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