EPE'25 – Call for Tutorials

Power Converters for Electrolyser Systems: State-of-the-Art and Prospects

Name(s) and Affiliation(s) of the Lecturer(s):

Dr Bikash SAH
Bonn-Rhein-Sieg University of Applied Sciences & Fraunhofer Institute for Energy Economics and Energy System Technology IEE
Grantham Allee 20, 53757,
Sankt Augustin, Germany
bikash.sah@h-brs.de
+49 2241 865 9924

Prof. Dr. Marco JUNG
Bonn-Rhein-Sieg University of Applied Sciences & Fraunhofer Institute for Energy Economics and Energy System Technology IEE
Grantham Allee 20, 53757,
Sankt Augustin, Germany
marco.jung@h-brs.de
+ 49 2241 865 316

Tutorial Objectives:

The objective of this tutorial is to provide participants with a comprehensive understanding of hydrogen as a key element for decarbonisation and its large-scale industrial applications. It aims to review the complexities of AC grids, the requirements for GW-scale electrolyser parks, and the different types of electrolyser cells. Additionally, the tutorial will delve into system configurations and power converter topologies, equipping attendees with the knowledge to design efficient electrolyser systems. By the end of the course, participants will have a solid grasp of the technical, operational, and regulatory aspects of integrating electrolysers into modern power grids.

Target Audience:

This tutorial targets participants new to the field of green hydrogen generation using power converters and electrolysis. At the same time, it targets experienced researchers and application engineers who want to closely examine the details and pitfalls of designing power electronics for electrolyser systems. The topics are planned to present the requirements in power electronics, power systems, and electrolysers.

Topical Outline:

Introduction: (Estimated time: 30 minutes)

- Introduction to the course, lecturer, and contents.
- Introduction of hydrogen as a pathway for decarbonisation and large-scale industrialisation.
- Overview of the course structure and key learning objectives.

Topic 1: Review of AC Grid and Electrolysers Requirements (Estimated time: 60 minutes)

- Complexities in electric power grids, including the dominance of power converters, the addition of intermittency, and non-linear loading.
- Network operator requirements for the GW scale electrolyser park- grid codes and requirements.
- Types of electrolyser cells- Alkaline, Proton Exchange Membrane (PEM), and high-temperature electrolysis cells and their electrical requirements.
- Case study to demonstrate real-world examples of current electrolyser installations and their grid interactions.

Topic 2: System Configuration and Power Converter Topologies (Estimated time: 90 minutes)

- Electrolyser park configurations.
- Electrolyser system configurations.
- An overview of topology variants will be presented and discussed in detail
    - Rectifier configurations for state-of-the-art requirements
    - Rectifier configurations and additional system/ancillary service possibilities

Conclusions (Estimated time: 15 minutes)

- Conclusion and summary of key points covered in the tutorial.
- Open discussion, question and answer sessions.
- Evaluation and feedback.

Provisional Schedule of the Tutorial:

Schedule:

09:00 - 10:30: Introduction / Topic 1

10:30 - 11:00: Coffee break

11:00 - 12:45: Topic 2 / Conclusions and feedback

About the Lecturers:

Dr Bikash SAH received the B.Tech. degree in Electrical and Electronics Engineering from the National Institute of Technology Arunachal Pradesh, India, in 2014, and a PhD in Electronics and Electrical Engineering from the Indian Institute of Technology Guwahati, Guwahati, India, in 2021.
He is currently a Group Leader- Power Electronics for E-Mobility and Electrochemical Systems with Bonn-Rhein-Sieg University of Applied Sciences, Sankt Augustin, Germany. He is also working with the Fraunhofer Institute for Energy Economics and Energy System Technology IEE, Kassel, Germany. He has been working for over a decade on projects with industry, academia, and research labs dealing with power electronics and electrochemical systems, focussed on electromobility, battery, electrolysis, and fuel cell systems. His current research interests include

characterising and testing wide bandgap devices for use in electric mobility, electrochemical systems, and renewable energy applications.

Prof. Dr. Marco JUNG Marco Jung (Senior Member, IEEE) completed an apprenticeship for communication electronics in 2003 and continued to study electrical engineering at the TH Mittelhessen University of Applied Sciences, Giessen, Germany, and at the University of Kassel, Kassel, Germany where he received the Diploma and M.Sc. degrees in 2008 and 2010, respectively, and the PhD degree from Leibniz University Hannover, Hannover, Germany, in 2016.

Since 2017, he has been the Head of the Converters and Drive Technology Department at the Fraunhofer Institute for Energy Economics and Energy System Technology IEE, Kassel, Germany. In 2019, he additionally became a Full Professor at Bonn-Rhein-Sieg University of Applied Sciences, Sankt Augustin, Germany. He leads the Power Electronics and Power System Lab (PEPS-Lab) in the Department of Engineering and Communication, where he is responsible for power electronics for renewable energies, electromobility and sector coupling.

Mr. Jung has been the Chairperson of the IEEE Joint IES/IAS/PELS German Chapter since January 1st, 2021 and the Vice-Chairperson Germany of the IEEE PELS R8 since 2024. He is a member of the International Scientific Committee (ISC) of the European Power Electronics and Drives Association (EPE), a member of the European Center for Power Electronics (ECPE), and an advisor board member of the PCIM conference.