SESCL investigates modern energy technology systems and new control algorithms in a real network.

Smart Energy System Control Laboratory

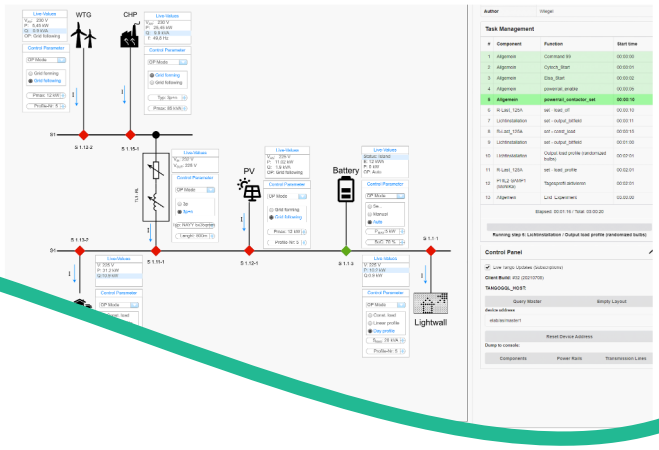
The Lab

The Smart Energy System Control Laboratory focuses on providing infrastructure to develop and test modern but realistic energy system scenarios and new grid control algorithms. The Lab includes a variety of energy technology system components, such as generators, converters, inverters, PV systems, battery storage systems, EV charging stations etc., which can be interconnected in a flexible way while taking into account the physical transmission line characteristics in order to form a Microgrid with variable topology.
The connection flexibility is ensured by a matrix of AC/DC busbars and contactors controlled by a central automation system. This allows easy realization of load shedding or integration of an additional generator, consumer or prosumer at runtime. Furthermore, the automation system monitors and controls both the busbar matrix itself and the individual components as well as the schedule of a planned experiment.

Motivation

The Smart Energy System Control Laboratory combines theory with practice. Many questions of the energy transition can only be answered with extensive simulations and complex models of energy networks, feeders, storage facilities and consumers. Precise models of the plant components are an important prerequisite for this. The physical presence of the plants in the SESCL creates a constant reference to reality and thus facilitates the implementation of the research results in real network environments. Since the experimental field is galvanically isolated from the public power grid, control strategies in borderline areas can be approved and investigated there. In addition, operating points that approach the stability limits can be controlled. Such experiments would not be permitted in the public grid.

Web technologies based SCADA system:
Enables planning, executing, and monitoring of experiments.



Karlsruhe Institute of Technology

ENERGY LAB 2.0

Smart Energy System Control Laboratory

Control room SESCL

Use Cases

- Topology-free automated interconnection and ITC linking of AC/DC systems
- Validation and tuning of real-time energy system models
- Development of novel concepts for energy distribution systems
- Grid stability and new control algorithm
- Software-in-the-Loop (SiL) based Grid Agent and DSM
- Automation and Control of DERs

Facts and Figures

Besides the matrix with 8 AC, 2 DC busbars, 71 connection points and over 400 contactors, various real energy systems mentioned above are part of the lab's equipment. Such a complex electrotechnical system is brought to life by means of an appropriate and comprehensive automation system. It is responsible for the acquisition, display and logging of all experimental, plant-relevant and component-specific measured variables such as current, voltage, network frequency, power, harmonics, etc.
The acquisition of the measured variables is characterized in the AC domain by 20 kHz and in the DC domain by 100 kHz. The experimenter can easily select resources via a graphical interface and integrate the resources into a topology of the planned experiment.
Up to 4 experiments can be run in parallel and can be monitored in real-time by the laboratory management via the process control center. Opal-RT and RTDS real-time simulation systems as well as two Power Amplifiers with up to 8 channels and a total power of 200 kVA complete the hardware equipment of the laboratory.

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