Karlsruher Institut für Technologie

Elektrotechnisches Institut

Bachelor/Master thesis

Combined optimization of electrical and thermal energy storage system operations

Topic

Energiespeicher

Focus

- ☒ Theory
- ☒ Literature
- ☒ Simulation
- ☒ Programming
- ☐ Construction
- ☒ Hardware
- ☒ Experiments

Courses of Study

- ☒ Electrical Engineering
- ☒ Mechanical Engineering
- ☒ Mathematics
- ☒ Process Engineering

Starting Date

As soon as possible

Please send your application to:

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Motivation

The BiFlow project at ETI explores an innovative dual use of a vanadium redox flow battery (VFB) as an electrical and thermal storage system. The innovation is made possible by a KIT developed and patented thermal coupling module, which can heat and cool the electrolyte of the VFB when required. The stored heat is later used to support the hot water supply of a student dormitory/stage76, Bruchsal. Such a dual usage of VFB is first of its kind in the whole world.

Thermal coupling module

Vanadium redox flow battery

Although this dual use opens a wide scope for improving the economic aspects of a battery and accelerating the return on investment, it also makes optimal control of the battery a complex task. This is due to the fact that artificial heating and cooling of the VFB directly affects the operational efficiency of the battery as an electrical storage system. Therefore, an innovative optimization solution has to be researched.

Tasks

- Previous student works researched Multi-Integer Linear Programming methods for the optimization of energy storage systems, but only on the electrical perspective. This work aims to extend this work by including the thermal operation in the optimization.
- Several possible optimization techniques available in the literature have to be explored in this work.
- Linear modeling of the VFB as a thermal storage system has to be carried out.
- Real-life testing of the developed algorithm should be performed for validation. The results obtained should be analyzed using different economic metrics.

Strong programming skills in MATLAB/Simulink is a must and good understanding of economic operation of multi-energy systems is recommended. Reliability, an independent way of working, fast comprehension and good German and/or English skills are appreciated.

Required Documents for Application:

- Motivation Letter
- Curriculum Vitae
- Certificates
- Enrollment of study