technische universität
dortmund

Fakultät für Elektrotechnik
und Informationstechnik

Institut für Energiesysteme,
Energieeffizienz und
Energiewirtschaft

Master's thesis 12.02.2026

System Stability Analysis under Regulatory Adjustments of Frequency Control in Future Low-Inertia Power System

The ongoing energy transition is driving profound changes in the electrical power system. Among other aspects, generation technologies are being transformed, which directly affect system inertia and frequency control. To regulate these ancillary services, both European and national frameworks exist that need to be continuously adapted to technical requirements and enable remuneration through ancillary service markets. At the same time, the nature of fault events is evolving. These events must remain controllable under existing and future regulatory frameworks to ensure system stability. The interplay between regulatory frameworks and technical developments related to system inertia raises questions about how future power systems can ensure technically and economically efficient disturbance management.

The aim of this thesis is to develop a dynamic simulation model representing a synchronous area with relevant generation technologies and control systems. The model should feature modularity, proper parameterization, and well-founded assumptions to ensure applicability for subsequent studies. Furthermore, it should allow for the implementation of prospective disturbance scenarios and regulatory frameworks in order to investigate their impact on system stability. Using this model, simulations will be conducted to assess whether frequency control measures need to be regulated differently in future low-inertia systems or if various frequency control strategies could substitute one another. A suitable simulation environment available at ie³ for this work is, for example, DIgSILENT PowerFactory.

Work plan:

- Literature review: Studies on future frequency stability within the EU, Future fault scenarios
- Familiarization with suitable simulation software and models
- Development of a modular and parameterizable system model
- Simulation with defined scenarios
- Discussion with respect to the research question

Betreuung:

- Simon Uhlenbrock (simon.uhlenbrock@tu-dortmund.de)
- Mandy Wältermann (mandy.waeltermann@tu-dortmund.de)