Institut für Elektrische Anlagen und Netze

Bachelorthesis

Short-Circuit Current Calculation and Analysis for Grid-Forming Converters

Motivation

With the impending large-scale integration of next-generation grid-forming converters (GFM) into the electrical power grid, understanding their operational characteristics under fault conditions is crucial. These converters are designed to emulate the characteristics of synchronous generators and operate as controlled voltage sources. When encountering grid short-circuit faults, GFMs are limited by the current output capabilities of power semiconductors. Unlike synchronous generators, they cannot exhibit high short-circuit current output due to these limitations.

The solution to this challenge lies in enhancing the overcurrent capability of GFM by installing additional power semiconductors in their hardware design. Determining the necessary overcurrent capacity requires calculating the short-circuit currents in typical grid topologies connected with synchronous generators under various fault conditions. This analysis will inform the required overcurrent capability that GFM should possess to effectively support the grid during faults.

Research questions

This study aims to address the following key questions:

1. Short-Circuit Contributions of Synchronous Generators:

   ○ How do synchronous generators contribute to short-circuit currents in typical grid topologies under different fault conditions?

2. Limitations of Current GFM:

   ○ What are the limitations of current GFM in providing short-circuit currents compared to synchronous generators due to power semiconductor constraints?

3. Determining Overcurrent Requirements for GFM:

   ○ Based on the short-circuit current calculations, what is the minimum overcurrent capability required for GFM to emulate synchronous generator behavior during faults?

Procedure / Methodology / Task

- Selection and Modeling of Typical Grid Topologies
- Identification of Typical Fault Types
- Short-Circuit Current Calculations
- Analysis of GFM Limitations
- Determination of Hardware Overcurrent Requirements

Organizational matters

Start immediately.

Contact person / supervisor

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