

A Benchmark System for Testing Medium Voltage Direct Current (MVDC-CB) Robustness Utilizing Real Time Digital Simulation and Hardware-In-Loop Theory

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Abstract : The integration of green energy resources is a major focus, and the role of Medium Voltage Direct Current (MVDC) systems is exponentially expanding. However, the protection of MVDC systems against DC faults is a challenge that can have consequences on reliable and safe grid operation. This challenge reveals the need for MVDC circuit breakers (MVDC CB), which are in infancies of their improvement. Therefore will be a lack of MVDC CBs standards, including thresholds for acceptable power losses and operation speed. To establish a baseline for comparison purposes, a benchmark system for testing future MVDC CBs is vital. The literatures just give the timing sequence of each switch and the emphasis is on the topology, without in-depth study on the control algorithm of DCCB, as the circuit breaker control system is not yet systematic. A digital testing benchmark is designed for the Proof-of-concept of simulation studies using software models. It can validate studies based on real-time digital simulators and Transient Network Analyzer (TNA) models. The proposed experimental setup utilizes data accusation from the accurate sensors installed on the tested MVDC CB and through general purpose input/outputs (GPIO) from the microcontroller and PC Prototype studies in the laboratory-based models utilizing Hardware-in-the-Loop (HIL) equipment connected to real-time digital simulators is achieved. The improved control algorithm of the circuit breaker can reduce the peak fault current and avoid arc resignation, helping the coordination of DCCB in relay protection. Moreover, several research gaps are identified regarding case studies and evaluation approaches.

Keywords : DC circuit breaker, hardware-in-the-loop, real time digital simulation, testing benchmark

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