



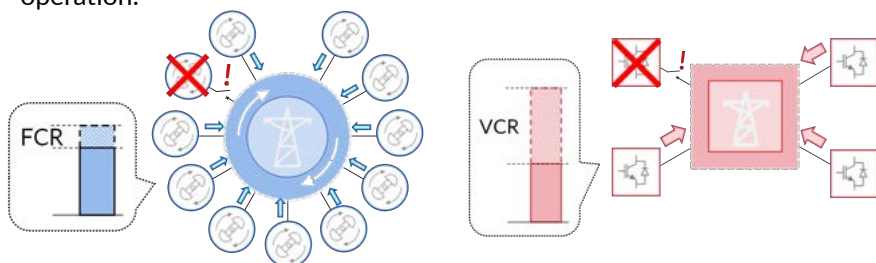
Variable Voltage Droop Control for MTDC

Over & Under Voltage Containment Reserves

Optimal Primary Voltage Control and Voltage Droop Parameter Selection

CONTEXT

Unlike conventional AC systems where hundreds of generators operate synchronously, a particular issue of an MTDC grid, which comprises a relatively small number of converter stations, is the large share of the reserve capacity required of each converter station. An imbalance of the power needs to be shared by a small number of stations. Thus, a burden of power imposed by a sudden loss of a station likely becomes considerably larger than what is normally required of the generators in the AC systems. Ensuring such a large amount of reserve capacity may hinder the economically optimal operation of the entire grid. Therefore, an appropriate allocation of power sharing burdens is necessary not only for secure operation but also for an economically efficient system operation.



TECHNOLOGY DESCRIPTION

This technology proposes a comprehensive methodology for determining the converter droop settings to ensure the voltage security in multi-terminal direct current (MTDC) grid. The novelty lies in the introduction of the concept of over and under voltage containment reserves akin to the frequency containment reserves in AC systems. This not only gives an intuitive understanding of the contribution provided by converters in both rectifying and inverting modes, but also significantly facilitates the procurement of a necessary amount of reserves within their available headroom capacity of power.

Separate procurement of reserves for over-voltage and under-voltage containments. The reserve capacity secured by the converter for the primary voltage control is defined as the Voltage Containment Reserve (VCR) akin to the definition of the FCR in AC system. Regardless of the control mode of the converter, the VCR to be effectuated in case of DC voltage drop is defined as the Under-Voltage Containment Reserve (UVCR). The same principle also applies to the Over-Voltage Containment Reserve (OVCR) for the case where the DC voltage rises.

APPLICATION DOMAIN

Multiterminal DC grids
HVDC, MVDC

ADVANTAGES

- Voltage limit is ensured at any operating point
- No restriction on operating power for securing headroom margin
- Extended operability without compromising security

TRL SCALE



Concept validated in analytical evaluation and EMT simulations

DELIVERABLES

Virtual mock-up (EMT simulation models)
Technical report (1431-vAA-ANR deliverable 1.3.1.4 - Virtual mock-up development - Tests & validation report DC grid stability control)
Patent FR1760889, WO2019/097183

SCIENTIFIC REFERENCE

Journal paper: K.Shinoda et al, « Over & Under Voltage Containment Reserves for Primary Voltage Control and Voltage Droop Parameter Selection » to be submitted

