T&D europe

The European Association of the Electricity Transmission and Distribution Equipment and Services Industry

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Grid Forming Control in HVDC systems

Europe's Grid Technology Providers

T&D EUROPE is the European association of the **electricity transmission and distribution** equipment and services industry

Our scope includes the **complete range of products and services** necessary to transport and distribute electricity in high and medium voltage

T&D Europe is working towards **future-proofing the electricity networks** in Europe by means of policy, technology and investments

The companies represented by T&D Europe account for a production worth over €25 billion, and employ over 200.000 people in Europe

12 National trade association members

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Introduction

Ancillary services provided today by (VSC) HVDC

- Frequency Control
- Fast Frequency Control

Where is Grid Forming Control used in HVDC?

- Island operation for Offshore Wind Connections
- Black Start
- Extremely weak grids

Addressing the system needs with (VSC) HVDC

1. Create system voltage
2. Contribute to fault level / fault current contribution
3. System survival to allow effective operation of LFDD
4. Sink for harmonics
5. Sink for unbalances
6. Prevent adverse control interaction
7. Contribution to inertia

Minor/no cost implications for hardware or software

AC fault response options for VSC HVDC converters

Grid-Following

matches AC grid voltage and frequency

provides reactive current equal to the steady state rated current during AC faults

Grid-Forming

regulates both instantaneous AC frequency and AC voltage

provides reactive current equal to the steady-state rated current during AC faults

Synchronous Grid-Forming

Grid-Forming converter able to operate in parallel with other AC frequency regulating equipment and converters

Virtual Synchronous Machine

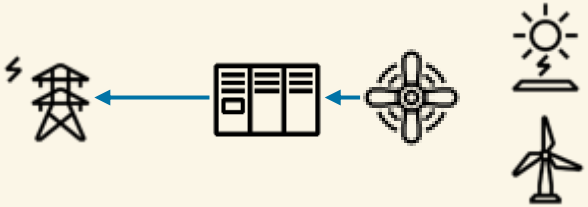
(Synchronous) Grid-Forming converter with energy storage

delivers extra energy for short time

provides more than steady-state rated current during a fault

Differences between VSC HVDC and generation in GFC

Generation plant



Primary source is limited

Single-terminal system: only grid-side would need to run in GFC

Low DC voltage, easier integration of storage

HVDC

Primary source is „unlimited“

Double-terminal system: one or both converters to run in GFC?

High DC voltage, challenging for integration of storage

Potential of (VSC) HVDC for future system needs

- HVDC is a transmission asset
- It does not subsitute synchronous generation, neither reduces system strength
- Some functionalities come without cost, or only marginal cost, others can be fulfiled in a limited way without increasing cost
- Main benefit of HVDC is to provide fast frequency control by connecting synchronous areas
- In the future, there will be no „infinite grid“ at the sending end, generation/storage will have to provide the power needed at the remote end

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