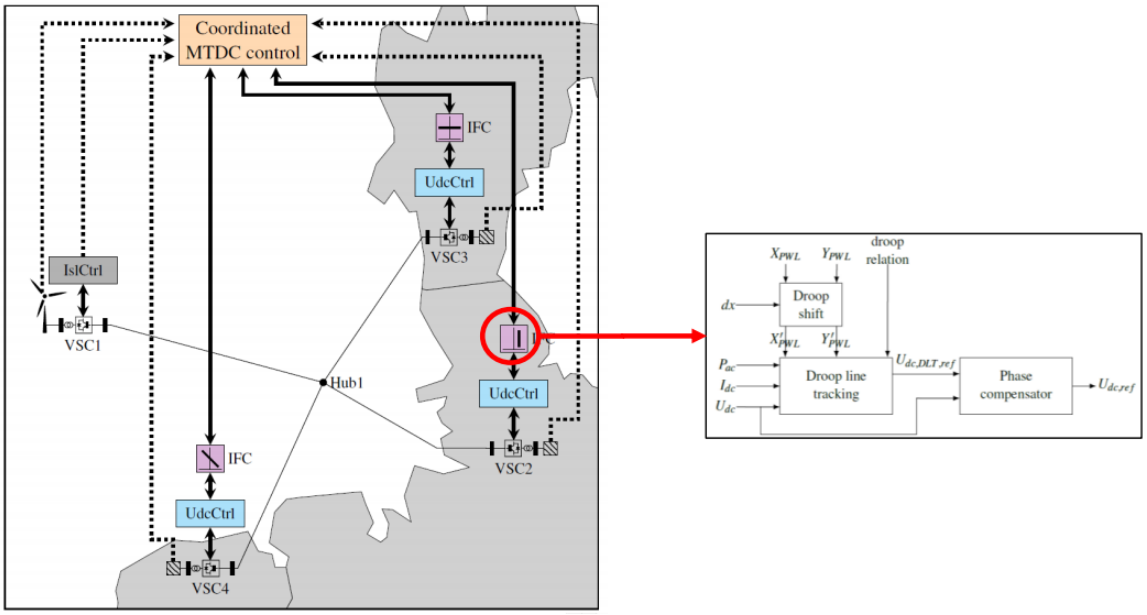
Control Concept for Expandable Multi-Terminal HVDC Transmission Systems



VALUE PROPOSITION

Generally, the conventional DC grid control concept considers a single vendor implementation. However, in reality, different vendors might participate in developing multi-terminal HVDC (MTDC) systems, enabling DC transmission system operators (DC-TSOs) to select the best and most cost optimal solution. This is achieved in the proposed concept, simply by adding an additional control layer (IFC), compared to the conventional DC grid control concept, which is used to interface between the centralized MTDC control and localized converter control. By using the IFC, the only requirements for the converters to be interconnected with each other, are that the DC voltage control (*UdcCtrl*) is available, and that the reference for this control, is adjustable. Hence, the IFC simplifies the interconnection requirements and supports easy realization of multi-vendor MTDC systems.

BUSINESS OPPORTUNITY

In the North Sea region, there are several HVDC links from various vendors already in operation or currently being developed. The offshore wind installations are expected to grow and meet at least 13% of the electricity demand in Europe by 2030. DC grid has been found to be the most suitable way to transport the offshore wind power to the European continent. It is envisioned that in the near future, an MTDC system emerges by interconnecting some of these links or adding a new offshore wind farm converter to an existing link. The converter control system is usually vendor specific and protected by patents. Therefore, with the proposed approach, the DC grid control can be implemented without altering the existing converter control. Hence, lowering the investment cost for realizing the MTDC system for the DC-TSO, and enabling the system suppliers to utilize their current HVDC link concepts, without change in the MTDC system, by utilizing the IFC software as the core part of the solution.

TECHNOLOGY SUMMARY

In principle, the power flow within the DC grid can be controlled by controlling the DC voltage in each terminal of the converter. Furthermore, the DC voltage control is usually available in each of the link. The IFC software produces an appropriate DC voltage reference, such that the converter can be operated to follow a certain characteristic, e.g. to mimic the active power control or DC voltage droop control. The behavior of the existing DC voltage control can be modified by using the phase compensator component within the IFC software. Furthermore, the droop shift part is used to integrate the AC grid control such that the converter can be operated in fully AC-DC grid control.

CURRENT STATE OF DEVELOPMENT

The IFC software has been implemented as an external function in simulation programs like PSCAD and PowerFactory. This means that the IFC software is ready to be used to perform simulations during the feasibility study. With the IFC software, vendor-specific black-box models, which has DC voltage reference input, are sufficient to be used for the simulations to validate whether an HVDC link from a specific vendor can be used as part of an MTDC system, utilizing the IFC software, and thus meet the basic operational requirements from the DC-TSO.

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SEEKING

- Funding/Investors
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PATENT: Software