Coordinated Frequency Regulation from Wind Power Plants Connected through VSC HVDC System

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Abstract

Traditionally, the power system frequency control is provided by conventional synchronous generators. With large scale integration of wind energy leads to a displacement of conventional generation units which in turn leads to the reduction of the power systems inertia leading to faster and larger frequency fluctuations. The goal of this project is to develop, implement, and test control strategies for offshore wind power plants connected through multi terminal HVDC grid to provide ancillary services such as frequency support, voltage control, power oscillation damping, and fault ride through capability.

Objective

- The objectives of the project are focused on the investigation of the technical capabilities and control characteristics of large offshore wind power plants connected to HVDC Grid
- Develop control strategies that will allow the effective delivery of ancillary services from HVDC grid with large amounts of wind power.

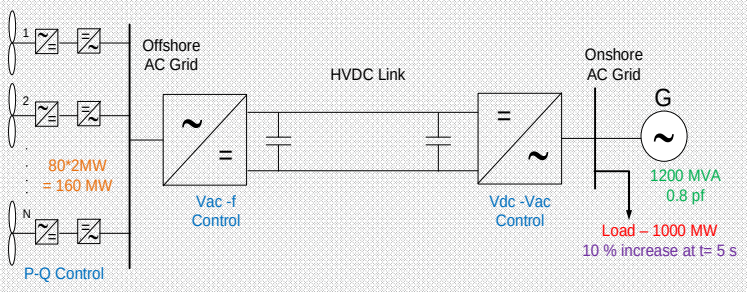

Figure 1: WPP connected to P2P HVDC system

Approach

The proposed approach to meet the objectives are

- System is simulated using DIgSILIENT PowerFactory.
- As a start frequency control of AC Grid from WPP will be studied.
- State of the art of the control strategies of offshore wind power plants for grid frequency support which include inertial, primary, and secondary control will be done.
- The wind power plant with full converter based wind turbines (IEC Type IV) will be modelled. The aggregated model of wind power plant/cluster is integrated to onshore AC grid through a point to point HVDC transmission system as shown in Figure1. The frequency response is simulated for a 10% load change at 5 s.
- A multi terminal HVDC grid composed of at least two offshore wind power plants/clusters and two onshore AC networks as shown in Figure 6 will be used for further study.
- The possible control options for ancillary services support by enabling and disabling the communication between AC and HVDC grids will be evaluated.

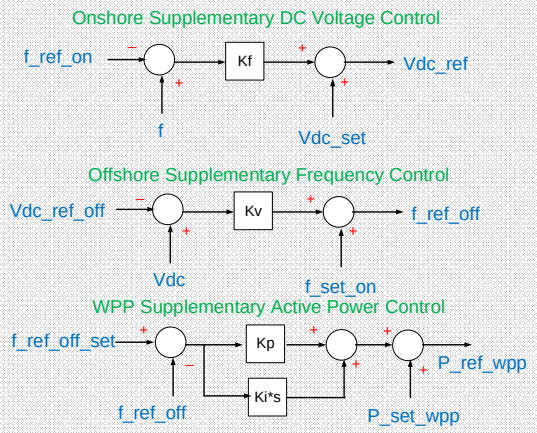

Figure 2: Coordinated frequency control

Contribution of VSC HVDC (P2P) connected WPPs to Grid Frequency Control

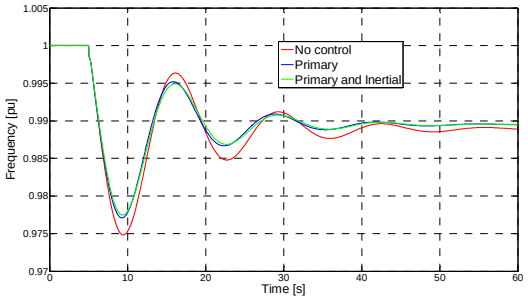

Figure 3: Frequency regulation using HVDC connected WPP communication based control

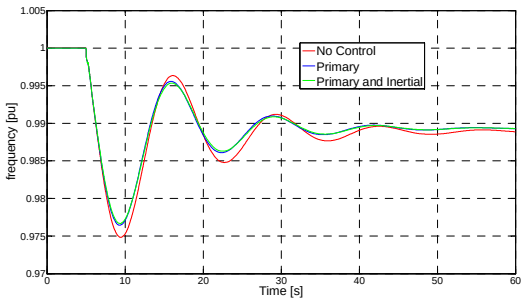

Figure 4: Frequency regulation using HVDC connected WPP coordinated control

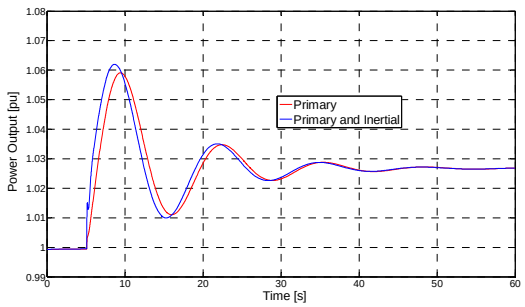

Figure 5: Power output of WPP

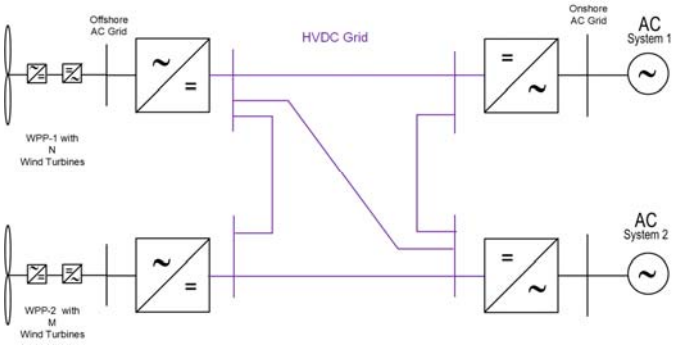

Figure 6: Test Network - WPP connected through MTDC Grid

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MEDOW
MULTI-TERMINAL DC GRID FOR OFFSHORE WIND