Abstract 025 – London Offshore Consultants

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Presentation Title: Modelling and Simulation of HVDC Distribution System Suitable for DP Ships

Abstract:

Hybrid electrical distribution systems integrated with solar power, wind energy and storage devices (such as batteries, super capacitors, fly-wheels and fuel cells) seem to be the future for designing ship power systems in order to reduce environmental pollution and the operational costs of assets.

Rectification of AC voltage to DC on DC electrical distribution systems onboard DP ships is currently done using simple six-pulse diode bridges whilst the regulation of DC voltage is achieved by controlling excitation of AC generators feeding diode bridges. Power electronics offer fast current and voltage control and opening of bus tie breakers fast enough to reduce the duration of voltage dips during short circuit like failures in closed bus configuration of switchboards so that voltage dip is not seen by all the consumers fed by affected switchboard and they are able to ride through the voltage dip. However, the maximum output voltage of a single six pulse diode bridge is limited to 1.35 times the source voltage.

Voltage Source Converter (VSC) using IGBTs with PWM algorithm can be used to increase DC voltage up to +/- twice the source voltage. The synchronous generator can be replaced with the permanent magnet synchronous generator as DC bus voltage is controlled independent of excitation of the synchronous generator. Excellent efficiency of the power system can be achieved by de-coupling between direct (d) and quadrature (q) axes to eliminate the cross coupling and controlling dq axes separately using cascade control systems in outer voltage and inner current loops so that zero reactive power is drawn from the generator.

This paper presents modelling and simulation of a DC distribution system in PS-CAD using VSC with State Vector Modulation (SVM). Simulation results will be presented to demonstrate several failure modes and effects, and advantages and disadvantages of proposed model.