A Combined Reliability Model of VSC-HVDC Connected Offshore Wind Farms Considering Wind Speed Correlation

This paper proposes a combined reliability model of voltage source converter-based high voltage direct current (VSC-HVDC) connected offshore wind farms (WFs) using the frequency and duration technique. Firstly, a two-dimensional multi-state WF model is developed considering wind speed variations and WTGs outage. The wind speed correlation between different WFs is included in the two-dimensional multistate WF model by using an improved k-means clustering method. Then, the entire system with two WFs and a three-terminal VSC-HVDC system is modeled as a multi-state generation unit. The proposed model is applied to the Roy Billinton test system (RBTS) for adequacy studies. Both the probability and frequency indices are calculated. The effectiveness and accuracy of the combined model is validated by comparing results with the sequential Monte Carlo simulation (MCS) method. The effects of the outage of VSC-HVDC system and wind speed correlation on the system reliability were analyzed. Sensitivity analyses were conducted to investigate the impact of repair time of the offshore VSC-HVDC system on system reliability.