A sequential MCMC model for reliability evaluation of offshore wind farms considering severe weather conditions

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The offshore wind farms (OWF) are susceptible to the severe weather, which can cause the increase of component failure rate and has significant influence on the maintenance process and the reliability of wind farms.This speech will introduce a new sequential Markov chain Monte Carlo (MCMC) model for reliability evaluation of the OWF considering the impact of severe offshore weather. First, main factors affecting the wind turbine (WT) failure rate are analyzed. Second, a time-varying analytical model for the WT failure rate affected by wind speed and lightning is established. Three types of WT failure rates are considered: the failure rate under normal weather, that under strong wind, and that affected by lightning. Moreover, a time-varying analytical model for the repair time of main components of OWF is established by considering the influence of severe weather on offshore transportation time and maintenance efficiency after component failure. The MCMC model takes into account the temporal correlation of the weather and the repair process of failed component in the reliability evaluation. The model enables simultaneous simulation of the weather intensity and component state. For each system state generated by the MCMC model, a breadth-first search (BFS) method is applied to analyze the connectivity of the WTs and the sink node. Finally, the output of the wind farm is determined based on the wind speed data at this state. The expected energy not supply (*EENS*) and the generation ratio availability (*GRA*) indices of the OWF are evaluated to demonstrate the effectiveness of the new proposed models. Further, the effects of other factors such as the enhanced protection for WT, the use of helicopter, and the weather characteristics of the OWF location on the reliability of OWF are discussed.