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**Title:** Damping of Frequency Fluctuations of Hybrid Power System by Variable Deloaded Operation of PMSG Based Offshore Wind Farm

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**Author(s) Name:** Effat Jahan, Md. Rifat Hazari, Mohammad Abdul Mannan, Atsushi Umemura, Rion Takahashi, Junji Tamura

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**Contact Email(s):** mdmannan@aiub.edu

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## Abstract:

This paper focuses on a novel variable deloaded operation of variable speed wind turbines with permanent magnet synchronous generators (VSWT-PMSGs) based offshore wind farm (OWF) to maintain primary reserve, which is connected to onshore grid through voltage source converter based high voltage DC (VSC-HVDC) transmission system. A centralized droop controller with dead band is designed for VSWT-PMSGs to utilize this reserve power to suppress the frequency fluctuations of the onshore grid due to the installations of large-scale fixed speed wind turbines with squirrel cage induction generators (FSWT-SCIGs) based wind farm (WF) and photovoltaic (PV) power station. The combination of variable deloaded operation and centralized droop controller can give better frequency regulation and decrease energy loss due to the deloaded operation. The effectiveness of the proposed variable deloaded operation and centralized droop controller is verified through simulation analyses on a modified IEEE nine-bus test system. The simulation results reveal that the variable deloaded operation can decrease the energy loss compared to the fixed deloaded operation as well as suppress the frequency fluctuations in the same level as the fixed deloaded operation.

**Keywords:** PMSG, deloaded operation, frequency control, droop control, hybrid power system