Power Quality Improvement and Low Voltage Ride through Capability in Hybrid Wind-PV Farms Grid-Connected Using Dynamic Voltage Restorer

ABSTRACT:
The paper proposes the application of a Dynamic Voltage Restorer (DVR) to enhance the power quality and improve the low voltage ride through (LVRT) capability of a three-phase medium-voltage network connected to a hybrid distribution generation (DG) system. In this system, the photovoltaic (PV) plant and the wind turbine generator (WTG) are connected to the same point of common coupling (PCC) with a sensitive load. The WTG consists of a DFIG generator connected to the network via a step-up transformer. The PV system is connected to the PCC via a two-stage energy conversion (DC-DC converter and DC-AC inverter). This topology allows, first, the extraction of maximum power based on the incremental inductance technique. Second, it allows the connection of the PV system to the public grid through a step-up transformer. In addition, the DVR based on Fuzzy Logic Controller (FLC) is connected to the same PCC. Different fault condition scenarios are tested for improving the efficiency and the quality of the power supply and compliance with the requirements of the LVRT grid code. The results of the LVRT capability, voltage stability, active power, reactive power, injected current, and DC link voltage, speed of turbine and power factor at the PCC are presented with and without the contribution of the DVR system.

KEYWORDS:
1. Active power
2. DC-link voltage
3. DFIG  
4. Dynamic Voltage Restorer  
5. LVRT  
6. Power Factor  
7. Photovoltaic  
8. Voltage Stability  

SOFTWARE: MATLAB/SIMULINK  

BLOCK DIAGRAM:  

![Diagram](image.png)  

Fig. 1. The system configuration of PV/wind hybrid power system.  

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EXPECTED SIMULATION RESULTS:

**FIGURE 2:** Voltage phase magnitude at PCC during faults with typical LVRT and HVRT characteristics requirements of Distributed Generation Code of Germany as an example.

**FIGURE 3:** Voltage phase magnitude at PCC during sag fault.

**FIGURE 4:** Voltage phase magnitude at PCC during short circuit fault

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FIGURE 5: Phase voltage at PCC during sag fault.

FIGURE 6: DVR voltage contribution at PCC during sag fault.

FIGURE 7: Phase voltage at PCC during short circuit fault.
FIGURE 8: Total active power of hybrid system at PCC injected to grid.

FIGURE 9: PV active power at PCC injected to grid.

FIGURE 10: Wind active power at PCC injected to grid.

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FIGURE 11: Total reactive power of hybrid system at PCC injected to grid.

FIGURE 12: PV reactive power at PCC injected to grid.

FIGURE 13: Wind reactive power at PCC injected to grid.

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FIGURE 14: Total PV-WT current injected to grid at PCC.

FIGURE 15: PV current injected at PCC.

FIGURE 16: WT current injected at PCC to grid.

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CONCLUSION:

The simulation study was carried out using MATLAB to demonstrate the effectiveness of the proposed DVR control system to improve the power quality and LVRT capability of the hybrid PV-WT power system. The system has been tested under different fault condition scenarios. The results have shown that the DVR connected to the PV-Wind hybrid system at the medium voltage grid is very effective and is able to mitigate voltage outages and short circuit failure with improved voltage regulation capabilities and flexibility in the correction of the power factor. The results of the simulation also prove that the system designed is secure since the required voltage ranges are respected correctly and the DG generators operate reliably. The main advantage of the proposed design is the rapid recovery of voltage; the power oscillations overshoot reduction, control of rotor speed and preventing the system from having a DC link overvoltage and thus increasing the stability of the power system in accordance with LVRT requirements.

REFERENCES:


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