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In the modern renewable energy system, recent years have seen a rise in the share of power being generated through photovoltaic (PV) plants. In the Danish power system, PV plants are mostly integrated in the medium and low voltage networks which are usually operating under unbalanced conditions. Furthermore, the increasing number of power electronic based equipment affects the grid during faults through their contribution to the fault current. So far studies of PV plants in unbalanced conditions are based on computational simulations, which have limitations in representing reality. Therefore, this study investigated the performance of a three-phase PV inverter under unbalanced operation and fault conditions. The inverter is tested in stable power system operation and during grid support situations through frequency response and reactive power control. All experiments are carried out using an experimental laboratory platform in PowerLabDK. The key outcomes from this study includes the correlation between positive sequence component of voltage and reactive power, active power and current under unbalanced operation, the frequency response dependence on positive sequence voltage, and the fault current contribution from PV inverter during different fault conditions.

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