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Closed Transition Transfer Switch based on Multi-mode Photovoltaic Inverter for Preventing Power Outage

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This paper proposes a closed transition transfer switch (CTTS) based on a photovoltaic inverter which is capable of transition between grid-connected and island modes. The proposed system consists of the CTTS, utility grid and photovoltaic inverter connected to each input, respectively, an active load with power factor correction, and a system controller. According to the grid condition, the system controller manages the closed transition between the two inputs and determines the inverter operation mode.

Unlike the traditional CTTS switching to a diesel generator by a prior notice of outage, the proposed CTTS and inverter have the following two advantages. In case of the normal grid condition, the inverter provides current in the grid-connected mode using a perturb and observe algorithm for maximum power point tracking (MPPT) while the grid supplies voltage, so both of the switches are closed and used for different purposes. Moreover, in case of the unexpected grid failure, they also prevent the power outage through the sudden breaking of grid switch and the simultaneous fast transition to the island mode owing to no start-up delay. When the grid is returned, the voltage source is switched to the grid again after the synchronization of the phase to the grid for the closed transition.

The inverter has an LC filter optimized to both modes and an additional inductor for the safe closed transition. Above all, the current controller predicts current flowing through the filtering capacitor and applies it to the control for the fast transition and stable operation.

The performance was verified by the PSIM simulator. In addition to the closed transition by the prior notice, at the time of the unexpected grid failure, the inverter went into the island mode rapidly in less than 1 ms, so it was verified to prevent any power outage effectively.

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