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Abstract:

Wind farm (WF) grid codes require wind generators to have low voltage ride through (LVRT) capability, which means that normal power production should be resumed quickly once the nominal grid voltage has been recovered. However, WFs with fixed-speed wind turbines with squirrel cage induction generators (FSWT-SCIGs) have failed to fulfill the LVRT requirement, which has a significant impact on power system stability. On the other hand, variable-speed wind turbines with doubly fed induction generators (VSWT-DFIGs) have sufficient LVRT augmentation capability and can control the active and reactive power delivered to the grid. However, the DFIG is more expensive than the SCIG due to its AC/DC/AC converter. Therefore, the combined use of SCIGs and DFIGs in a WF could be an effective solution. The design of the rotor-side converter (RSC) controller is crucial because the RSC controller contributes to the system stability. The cascaded control strategy based on four conventional PI controllers is widely used to control the RSC of the DFIG, which can inject only a small amount of reactive power during fault conditions. Therefore, the conventional strategy can stabilize the lower rating of the SCIG. In the present paper, a new control strategy based on fuzzy logic is proposed in the RSC controller of the DFIG in order to enhance the LVRT capability of the SCIG in a WF. The proposed fuzzy logic controller (FLC) is used to control the reactive power delivered to the grid during fault conditions. Moreover, reactive power injection can be increased in the proposed control strategy. Extensive simulations executed in the PSCAD/EMTDC environment for both the proposed and conventional PI controllers of the RSC of the DFIG reveal that the proposed control strategy can stabilize the higher rating of the SCIG.

Keywords: squirrel cage induction generator (SCIG); doubly fed induction generator (DFIG); fuzzy logic controller (FLC); PI controller; low voltage ride through (LVRT); power system