別紙様式５(Attached Form 5)

学位論文要旨 Abstract of Thesis

所属専攻 Field: Computer Science and Electrical Engineering 専攻(Field)
氏　名 Name: Feby Agung Pamuji

Title of Thesis

Maximum Power Point Tracking Control of Multi-input Inverter for connected Hybrid PV/Wind Power System Considering Voltage Limitation In Grid

Abstract（within 1600 words）

The penetration of renewable energy power to the grid system is one of the challenges when the renewable energy connects to the grid system. In the previous research is proposed the approach for limiting the install capacity of distributed generation system (DGS) that connected to grid system in order that the grid system voltage is not increasing, but this approach is not welcomed by DGS manufacturer, because if this approach is applied that will be influenced by their selling product [4]. In this thesis, another approach is developed for limitation power in control of the maximum power point side to make limitation voltage so that the grid system voltage is not increasing.

Y.-M. Chen et al. proposed a novel multi-input inverter for grid-connected hybrid PV and WTG systems to simplify the power system and reduce cost. The proposed multi-input inverter consists of a buck/buck-boost fused multi-input dc-dc converter and a full-bridge dc–ac inverter [2]. The perturbation and observation (P&O) control method is used to introduce the control system of multi-input DC/DC converter, but in this conventional P &

O controller method, P & O method cannot detect the weather condition. In this thesis, the new control method is developed based on a fuzzy logic controller that can detect the weather condition and grid voltage system condition. In this thesis, The FLC uses the weather condition of renewable energy to provide the proper trigger for multi-input DC/DC converter to shift to optimum power with limitation voltage of the grid system.

The proposed method can maximize the output power of hybrid PV/WTG and transfer the power to the grid system without rising voltage and disturbing stability of grid system. Not to raise the voltage of the grid system, the output of the hybrid PV/WTG system is suppressed by setting the suitable voltage of a hybrid PV/WTG system based on "delta voltage". The proposed method shifts the actual voltage to the suitable voltage of a hybrid PV/WTG system by employing fuzzy logic controller (FLC). The FLC controls the multi-input DC/DC converter to shift the voltage output of hybrid PV/WTG until the delta voltage of PV and WTG are close to zero, that is indicated the power of grid is adequate, because the deference voltage between inverter and grid system almost zero at that time, the delta voltage of PV is the difference between actual voltage of PV and previous voltage of PV, the delta voltage of WTG is the difference between actual voltage of WTG and previous voltage of WTG. The FLC stops shifting the output voltage of the hybrid system to prevent raising the voltage of the grid system. The FLC controls the multi-input DC/DC converter to output power as close as the maximum power. This approach can also be achieved by the conventional P & O method, but FLC can control a hybrid system with lower THD of the grid voltage.

The simulation of the hybrid system PV/WTG that connected to grid system in this thesis, the condition of the grid system before power penetration of the hybrid system PV/WTG is stable and the voltage is constant, by using this condition, when there is the

power penetration of hybrid system PV/WTG, we can see that the FLC can control the output power of hybrid system PV/WTG without increasing the voltage of grid system and disturbing the stability of grid system.

In the simulation result, the output voltage of the hybrid system with FLC controller with the limitation of power is constant at 380 V. However, in case of the conventional MPPT controller with the P&O method with the limitation of power, the output voltage of the hybrid system is constant. The output voltage of the hybrid system with FLC without limitation of power, the voltage is increased more than 380 V. The output power of the hybrid system when the irradiation and the wind velocity is fluctuating. At the start of the simulation, the inverter could not produce the desired 380 V, so the power flowed from the grid to the inverter. After 0.05 second, the inverter could produce 380 V, so the power flowed from the inverter to the grid. By using the proposed MPPT method (FLC), the output power of the hybrid system can be maintained constant at almost 8.75 kW under the condition that the grid requires 8.75 kW from the hybrid system. The conventional MPPT controller with the P&O method with limitation power shifts the output power from the hybrid system almost same with an output power of hybrid PV/WTG with FLC with limitation power. By contrast, the output power of hybrid PV/WTG with FLC without limitation of power is more than limitation power; this condition makes the grid voltage is increasing. The reactive power output of the hybrid system, it is around zero with the FLC with limitation power, FLC without limitation power and the P & O method because the controller of inverter is set to transfer only active power to the grid, because in this thesis, I just concern the active power controller to achieve limitation voltage of the grid system in order that the grid voltage is not increasing. In the future work, I want to develop the maximum power point tracking that controls active power and reactive power in wind

turbine double-fed induction generator to provide active power and reactive power to the grid with the limitation of power.

The proposed FLC MPPT controller with the limitation of output power can control the power of a hybrid PV/WTG system effectively without the rise of grid voltage comparing with FLC MPPT controller without the limitation of output power. By the proposed method (FLC), lower total harmonic distortion is achieved by comparing with P & O method with the limitation of output power. Thus, the effectiveness of the proposed method is indicated.

The output voltage of the hybrid system with FLC with power limitation is a sine wave at THD 4.6%. By contrast, the output voltage with FLC without power limitation is a sine wave at THD 6 %. The output voltage with P & O with power limitation is a sine wave at THD 4.9 %. Harmonic on the grid system is caused by renewable energy penetration will give rise to sequence current. The effect of a zero sequence current is the presence of a residual current that will flow at a neutral point (transformer or generator). While the negative currents will cause a back flux in the generator stator and winding field, where the effect will be hazardous to the winding. Therefore, the grid system voltage is expected to have the lowest possible harmonic. Harmonic on the load side result overheated on the equipment. This overheated resulted in the derating of the insulation affecting the equipment being rapidly damaged.