The Model Analysis Photovoltaic with Battery Based Microgrid System

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ABSTRACT

Nowadays, distributed generation technology had gained more popularity by many countries. Recently, there are many problem with power system. One of the problem is high electricity price. The price in power generation rely largely on the type and market price of the fuel used, government subsidies, government and industry regulation, and even local climate patterns. Other than that, usage of fossil fuel needed to be cuts. By using the fossil fuel, it will cause the smog and acid rain. Afterwards that, it will cause the greenhouse emission and earth's climate will shift. To supply a better power system, this thesis introduces a model of photovoltaic (PV) and a battery storage microgrid (MG) system. The PV system will be analysis in grid connected or stand-alone mode.

Keywords – Battery Storage, Photovoltaic and Microgrid

I. INTRODUCTION

The Distributed Energy Sources (DERs) are becoming popular nowadays in the growing trend towards conventional energy resources and in increasing electricity demand. The distributed energy sources consist of distributed generation which act as sources energy to provide uninterrupted power to the connected microgrid for example photovoltaic system. Normally, this PV system is strategically placed at residential area due to the higher usage of electrical energy is used, which can let up on generation, transmission and distribution systems. Therefore, it can lead on delaying the need for new investments, improvement the load curve and voltage profile of the feeder, reducing the level of grid and transformer loadings and reduce electrical losses and avoid pollution [1].

Beside it is also have distributed storage such as battery storage to provide improve stability of the microgrid [2] and can be placed to store excess energy and provide it at times of deficiency [3]. However, while using the distributed generation in energy resources, it has their advantages and disadvantages. It will increase efficiency, reduce rates, improve reliability and diminished emissions. While for the disadvantages, the microgrid becomes more complex and difficult to analyse.

A microgrid can be defined as a separate energy system that consist of distributed energy sources, distributed energy storage and loads capable that parallel with the main power grid. Besides, microgrids provide a varies favourable circumstance for integrating the renewable resources into the distribution system. Microgrid systems operate at low voltage distribution and consist of several distributed energy resources. The microgrid structure consists of Distributed Generation (DG), energy reserves from battery (Distributed Storage/DS) and loads.

Through this research project, there are two types microgrid that had been analysed which are photovoltaic microgrid system and battery storage microgrid system.

II. MODELLING PROCESS

A. Photovoltaic Model

The PV module consists of PV cells that are connected in series and parallel circuits which is for obtaining high power. While, by the combination of
group several modules are called PV array. It can be defined as electrical module that connected in series and parallel to generate the required current and voltage. The building block of PV arrays is the solar cell which is directly converts solar radiation into dc current using photovoltaic effect. It is basically a p-n semiconductor junction.

![Design of Photovoltaic](image1)

**Figure 2.1: Design of Photovoltaic**

The Figure 2.1 demonstrates the design of photovoltaic connected to the load. This design is referred from the previous research and utilize using MATLAB Simulink Software. The photovoltaic model used is Suntech STP270S-24_Vb due to under standard test conditions which is:

a) Irradiance = 1000 W/m²

b) Cell temperature = 25°C

**B. Battery Storage Model**

Batteries can be operated in assorted utility applications which in the areas of generation and customer services. Batteries recently have the largest range of application differentiate to other energy storage technologies. Battery system gives the most advantages for utilities when providing power management support and the response for immediate voltage spike or sags and outages.

Lead acid batteries are the most type of energy storage systems that have been used due to their reduced cost and high durability [6]. In popularity, various of research was performed to identify their properties and behaviour for simulation purposes. Analysing the battery behaviour is essential in designing of the converter. Many battery models were developed that include circuit based models such as [7]. It is important to identify a model for the battery that estimates the state of charge accurately to be able to assess the performance of the power converter operation. The battery model must be compatible with the charging and discharging profiles of typical lead acid batteries. The state of charge must be determined accurately for the purposes of converter control.

![Battery Storage to Microgrid](image2)

**Figure 2.2: Battery Storage to Microgrid**

The photovoltaic and battery are separately connected to grid. Figure 2.2 shows the design of battery storage connect to grid. From the previous research state
that the used battery as storage is lead acid with nominal voltage of 200V.

III. RESULT AND DISCUSSION

A. Photovoltaic microgrid system

From Figure 3.1 until Figure 3.4, show the values that had been taken at grid which are voltage, current, active power and reactive power. Figure 3.1 show that voltage is 415V. While Figure 3.2 state that current is 7A. At last graph for reactive power and active power. From Figure 3.3 show that active power for grid is -4.5kW and the reactive power is 570VAR.

At the photovoltaic side. The value that have been taken are voltage, current and power. Figure 3.5 show the input current is 1.779A and output current is 3.4A. Meanwhile, Figure 3.6 show the value of input voltage is about 88.95V and output voltage is 156.1V. At last, Figure 3.7 show the value of Power is 530W.
B. Battery Storage Microgrid System

At battery storage side, show the values that had been taken at battery which are voltage and current. Figure 3.8 show that output voltage is 600V and output current is 400A as show at Figure 3.9.

From Figure 3.10 until Figure 3.13, show the values that had been taken at grid which are voltage, current, active power and reactive power. Figure 3.10 show that voltage is 415V. While Figure 3.11 state that current is 40A. At last graph for reactive power and active power. From Figure 3.12 show that active power for grid is -533kW and the reactive power is -85kVAR.

IV. CONCLUSION

In conclusion, the first objectives which is the concept of photovoltaic connects to microgrid are studied from the previous research. There are theory and basic principle need to know before constructing the PV and battery storage microgrid. Next, the objectives have been achieved by designing the photovoltaic system to
microgrid using MATLAB Simulink software. The 3rd objective also achieve in modelling the battery storage system to microgrid by using MATLAB Simulink software. The output result from the simulation had been done is recorded in chapter 4.

REFERENCES


