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MICRO HYDRO POWER PLANT FOR SELF GENERATED ELECTRICITY

Syahirah Binti Saidi

Department of Building, Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA
Cawangan Perak, 32610, Seri Iskandar, Perak Darul Ridzuan, Malaysia.

Email: syerahsyah@gmail.com

Abstract:

Malaysia in its efforts to sustain energy which acts as the main pillar of sustainable development. More attention needs to be paid toward the development of renewable energy, green technology and energy conservation in the future. Therefore, renewable power generation has been implemented which is hydro power to support energy efficiency. However, current studies show that the pattern of power generation in Malaysia is only on a large scale project. Thus, a desk study will be conducted by providing a review of relevant research which concentrates on the concept of Micro hydro power plant to fulfill the high demand of electrical energy. It will also identify problems and the impact of non-renewable energy on the environment, and propose its potential for off grid power demand. A new approach of Micro Hydro power plant can support energy efficiency as it provides both an efficient and a reliable form clean source of renewable energy. The Micro Hydro power plant concept requires a little or no reservoir to power the turbine. This small scale alternative electrical power production can meet sustainable energy needs which can be used in a flexible area, location and environment.

Keywords: Sustainable energy; Renewable energy; Energy efficiency; Micro hydro power plant; Small scale.

1.0 INTRODUCTION

Energy is one of the most fundamental elements of our universe. In the last decade, one of the problems related to the energy crisis is meeting the growing demand of electrical energy, leading to the over use of natural resources. Thus, over consuming of natural resources in generating energy may cause the depletion of resource reserves, and consequently hamper independence in energy supply and security. Generally, the major natural resource consumed is the burning of fossil fuel in generating electrical energy (Figure 1). The dependency of this non-renewable energy is now leading to environment degradation and climate change. These problems and issues are continuously increasing, which suggest the need of technological alternatives to provide the solution. Therefore, renewable power generation has been implemented in the form of hydro power to support energy efficiency in Malaysia. However, current studies show that the pattern of power generation in Malaysia is only for a large scale use (Samsuddin, 2016).

One of the technology approaches is Micro hydro power plant with the ability of generating electricity as effective as possible by using renewable resources which is water that contributes less negative effects to the environment and is suitable for small scale use. Micro hydro power plant can be subjected to the small hydro power plant which contributes energy at a range of 5 kW to 100 kW. Micro hydro power plant does not supply the national grid and produces just enough power to provide domestic lighting to a group of houses through charging a battery. On the other hand, Micro hydro power plants are low cost, small-sized and can be installed to serve a small community. These systems are "run-of-river" which does not require an impoundment. Instead, a fraction of the water stream is diverted through a pipe or channel to a small turbine that sits across the stream.

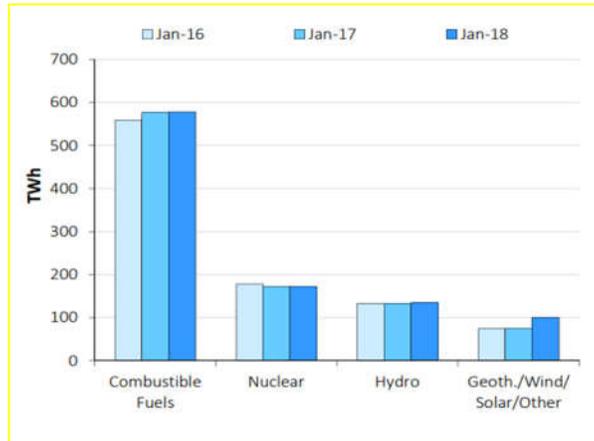


Figure 1: Electric Production by Fuel Type
Source: International Energy Agency, 2018

For instance, the current pattern of power generation cannot be sustained in the near future because of the environmental impacts and depletion of natural resources. Hence, this research focuses on the potential of Micro Hydro power plant for off grid demand and manage the dependency of non renewable sources that act as an alternative of self generation electricity.

2.0 LITERATURE REVIEW

2.1 *Concept of Micro hydro power plant*

Micro hydro power is the application of hydro electric power for smaller communities, single families or small enterprises. The proposed application is an off grid concept which requires a charging source that store the energy into a battery bank. This concept is similar to the off-grid solar or off-grid wind electric system which can be a stand alone and is not fitted with an electricity distribution system (Richard Perez, 2018). Micro hydro power is both an efficient and a reliable form of clean source of renewable energy. The micro hydro power project concept is designated to be a 'run-of-river' type as it required no reservoir to power the turbine with the power generation (Nasir, 2014).

2.2 *Electrical generation capacity*

Micro hydro schemes usually range from 5 kW to 100 kW, do not supply the national grid and produce just enough power to provide domestic lighting to a group of houses through charging a battery (Poindexter, 2018).

2.3 *Problems and Issues*

2.3.1. High demand of electrical energy.

Future energy demand is influenced by population and economic growth, energy prices and adoption of technological advancement leading to the production and consumption of energy (Tan et al., 2013). Thus, a high demand of the electrical energy leads to the over use of non renewable sources and gives side effects to the environment in terms of energy production. Therefore, current needs practice an alternative power generation from renewable resource to ensure the continuity of supply (Samsussin, 2016).

2.3.2 Depletion of natural resources.

Electric power generation in Malaysia significantly depends on three major fossil fuel sources, namely coal, natural gas and fuel-oil. These fossil fuel based power generation causes negative environmental consequences and depletion of fuel reserves (Samsuddin, 2016).

2.3.3. Other renewable energy gives a negative impact to the environment.

Burning of the fossil fuels produces Greenhouse gases (GHGs) and leads to environmental degradation and climate changes (Samsuddin, 2016).

3.0 METHODOLOGY

From the desk study, there are several problems that have been identified such as high demand of electrical energy, consumption of more non-renewable energy than generating electrical energy that has already caused depletion of resources and the burning of fossil fuel which gives a negative impact to the environment. Thus, a critical review on a related research about the concept and potential of the Micro hydro power plant for self generation of electricity has been conducted. The information is then gathered and analyzed to propose a new development of Micro hydro power plant for off grid demand of electric usage.

4.0 ANALYSIS AND FINDINGS

The expected finding for the research is the alternative system which is Micro Hydro Power Plant for self generation of electricity using renewable energy. Micro hydro power plant is a proposed new technology for converting of hydraulic energy to electrical energy. This technology has the ability to fit a small scale area which is suitable for household use.

4.1 The Concept of Micro Hydro Power Plant

Basically, the concept of Micro Hydro Power Plant is an off grid system that is not fitted with an electricity distribution grid system. Thus, it is called a stand alone system or off grid system. This off grid system can be more cost-effective than connecting to the grid in remote locations because only turbine and battery banks are needed as the main equipment to build the system. Other components also are needed and they are shown in Figure 2 below. This off grid system is a combination of techniques and technologies to generate reliable power, reduce costs and minimize inconvenience. Some of these strategies include using fossil fuel or renewable hybrid systems and reducing the amount of electricity required to meet the needs (Tan et al., 2013).

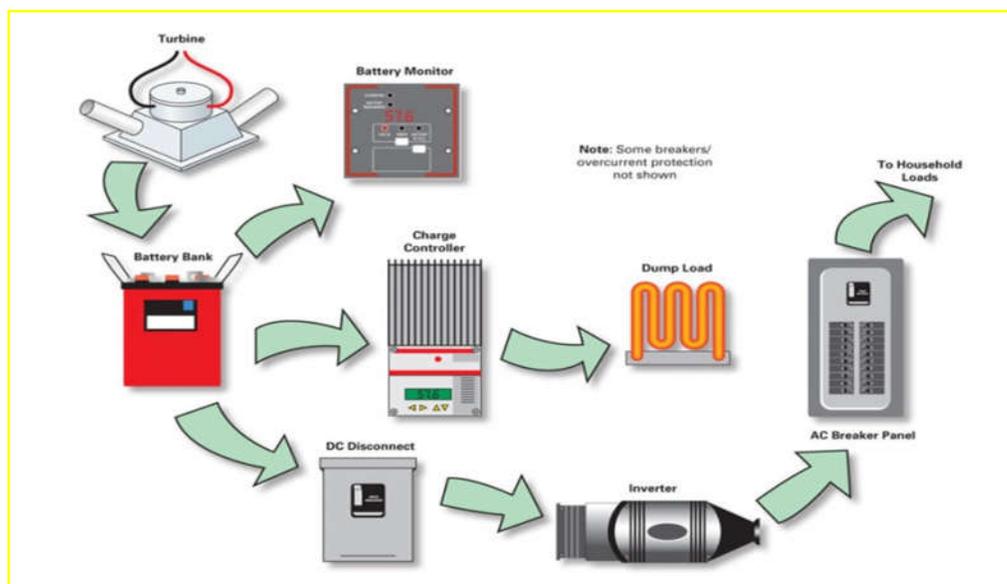


Figure 2: Off-Grid Micro Hydro Electric System Concept
Source: Perez, 2018

4.2 The Application of Micro Hydro Power

The first step in the application of Micro Hydro power system is to evaluate the water resource by measuring the head, which is the vertical drop and flow of the stream. These two measurements are necessary to calculate the energy potential of the stream. A Micro Hydro power system is made up of a number of components, not just the turbine. It may also involve intakes, can be as simple as a screened box submerged in the watercourse, or they can involve a complete damming of the stream. The goal is to divert debris- and air-free water into a pipeline. Another thing is a pipeline itself. Plastic in the form of polyethylene or PVC is the usual choice for home-scale systems. Next is the turbine to convert the energy in the water into electricity. Many types of turbines are available, so it is important to match the machine to the site's conditions of head and flow. For example, impulse turbines, where the water is routed through nozzles that direct the water at some type of runner or wheel.

When energy is supplied, there must be a controller. The function of a charge controller in a micro hydro system is equivalent to turning on a load to absorb excess energy. Battery-based micro hydro systems require charge controllers to prevent overcharging the batteries. A micro hydro system controller does not disconnect the turbine from the batteries thus, this could create voltages that are higher than some components can withstand, or cause the turbine to over speed, which could result in dangerous and damaging over voltages.

Other than that, is the battery bank of micro hydro system is typically the most gentle of the RE systems on the batteries, since they do not often remain in a discharged state. The bank can also be smaller than for a wind or PV system. One or two days of storage are usually sufficient. Deep-cycle lead-acid batteries are typically used in these systems. They are cost effective and do not usually account for a large percentage of the system cost (Perez, 2018).

4.3 The Potential of Micro Hydro Power

The Micro Hydro Power system has been identified as a technology that is reliable and friendly to the environment compared to other sources of energy. It also provides an alternative solution to energy supply where the extension of grid system is not economically and technically feasible for remote and hilly areas. From the details above, it is clear that the Micro Hydro System only involves a simple operation in generating energy. Micro hydro potential is identified by considering three main factors which are the energy demand, accessibility and source of water supply (Nasir, 2014). The application of the Micro Hydro Power system has been implemented in other countries such as in Europe and North America

The Micro Hydro Power System is to assist the consumers to create their own self generation electrical energy by using water as well as can sustain the non renewable energy consumed. Therefore, this self generation concept of Micro Hydro Power is proposed to be adapted for a home-scale system. In addition, it is both an efficient and a reliable form of clean source of renewable energy. The concept is designated to be a 'run-of-river' type as it requires no reservoir to power the turbine which can be operated in housing pipeline systems

5.0 CONCLUSION

In this research, the problems and issues of non-renewable energy used in the production of electrical energy to fulfill the demand that can lead to environmental problems and depletion of natural resource has been discussed. The necessity of exploring energy from alternative sources and the impact of Micro Hydro as an alternative source have been presented. As the Micro Hydro power plant requires terrain and availability of high stream flow rate, therefore, it has a good potential in a home scale use for self generation of electricity. With the ability of power generation of 5 kW to 100 kW of electricity using the natural flow of water, makes it one of the most cost-effective and reliable energy technologies to be considered for providing clean electricity generation. The micro hydropower plant also can be considered as the construction cost is low because it only needs a turbine to transform the flowing water energy into kinetic energy which then produces electrical energy that can be stored in the battery..

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