Fidelity : Jurnal Teknik Elektro
Vol. 6, No. 1, January 2024, pp. 21-25
p-ISSN: 2686-3650 | e-ISSN: 2686-3642, DOI: 10.52005/fidelity.v6i1.158

Study on the Design of a Micro Hydro Power Plant in Curug Muncar, Kaliwungu Village, Bruno District, Purworejo Regency, Central Java Province

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ABSTRACT

The activities and needs of humans in their daily life cannot be separated from the presence of electricity. Indonesia is a country that has many potential sources of renewable energy which until now have not been used optimally. Most of the renewable energy potential that has been utilized is in the form of rivers whose water tends to be wasted into the sea. Whereas every kilometer of the river can be used as a source of energy to drive power plants, micro hydro power plants (PLTMH) are an alternative to using renewable energy. Utilization of renewable energy can be optimized, especially in tourism locations, one of the tourism objects with the potential for PLTMH is Curug Muncar, Kaliwungu Village, Bruno District, Purworejo Regency. From the analysis results of the 15Kwp Micro Hydro Power Plant Design Study with a capacity in Muncar Waterfall, Kaliwunggu Village, Bruno District, Purworejo Regency, Central Java Province, it can be concluded as follows: The estimation results of 34.68 Kwh per day in Curug Muncar in the chapter that is in accordance with the needs of electrical energy. To simulate the design with the PLTMH application at Curug Muncar, Kaliwungu Village with digsilent. The water source for the MHP comes from the fountain river with a measured discharge at that time of 120 l/s

Article Info

Article history:

Received June 06, 2023
Revised October 21, 2023
Accepted December 31, 2023

Keywords:

Micro Hydro
Power Plant
Digsilent

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1. INTRODUCTION

Human activities and needs in their daily lives are inseparable from electricity. Indonesia is a country that has a lot of potential renewable energy sources which until now have not been used optimally. Most of the potential for renewable energy that has been utilized is in the form of rivers whose water tends to be wasted into the sea[1].

Even though every kilometer of the river can be used as a source of energy to drive power plants, micro-hydro power plants (PLTMH) are an alternative to the use of renewable energy[2].

Utilization of this renewable energy can be optimized especially in tourism locations, one of the tourism objects with the potential for PLTMH is Curug Muncar, Kaliwungu Village, Bruno District, Purworejo Regency[4].

This micro hydro potential can be used as a power plant for eco-friendly tourism areas, it can also be used as an educational tour for visitors who want to make the Curug Muncar PLTMH a role model for other renewable energy developments[5,6].

The construction of the Curug Muncar PLTMH assists the government in the field of utilization of new and renewable energy sources in accordance with the mandate of Government Regulation No. 79 of 2014 concerning the National Energy Policy (KEN) which is expected that by 2025 some 23.1% of national electricity needs will be supplied from new and renewable energy sources (alternative energy) both from water, wind, sunlight, geothermal, bioenergy, and others[7,8.9].

To increase the use of new and renewable energy, the Energy and Mineral Resources Office of Central Java Province through the 2020 APBD Fund will carry out the preparation of the DED (detailed engineering design) for the PLTMH in Kaliwungu Village, Bruno District, Purworejo Regency, to obtain information and technical analysis as well as the cost of constructing the PLTMH in the intended location[10,11,12].

The preparation of this DED requires guidelines and standards in applicable technical planning, with the aim of achieving planning efficiency and uniformity specifically by involving planning consultants[13].

2. METHOD

2.1 Research Method

This research was conducted at Curug Muncar which is one of the tourist attractions in Purowrejo which is still natural and certainly beautiful. The waterfall is located in the mountains with an altitude of 900 meters above sea level. The address for Curug Mucar is in Kalibang Hamlet, Kaliwungu Village, Bruno District, Purworejo Regency. The distance from the center of Purworejo City is about 45 kilometers to the northwest of Purworejo district. The Curug Muncar Tourism Area is currently not served by electricity from PLN, while to support tourism development, one of which is the availability of electricity for lighting and for other purposes that require electric current, therefore other sources of electrical energy are needed.

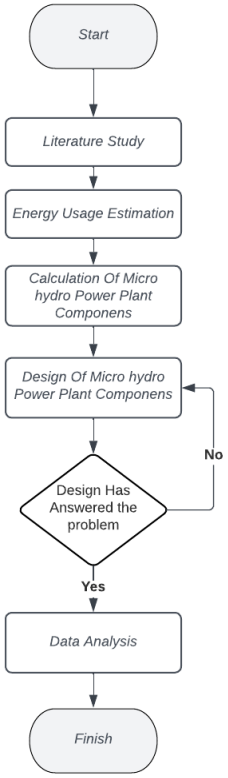

Figure 1. Research FlowChart

2.2 Electrical Energy Needs in Curug Muncar, Kaliwungu Village

Because the utilization is only in the form of tourist facilities in the form of street lighting along 400 meters as well as buildings such as mosques, food shops, and bescam. Table 1

Table 1. Energy Needed

Equipment Type	Amount	Power(Watt)		Operations per day(Hours)	
		Day	Night	Day	Night
Public Street Lighting	10	0	20	0	10
Public facilities	14	180	120	5	6
House	10	70	130	5	5
Total		250	270	10	21

From the table above it can be seen that the use of electrical energy is around 250 watts per day during the day for 10 hours while at night for 21 hours is 270 watts.

3. RESULTS AND DISCUSSION

This chapter discusses the results and systems that have been designed and created. It is designed to determine whether the system meets the author's desired standards.

3.1. Estimated Daily Use of Electricity in Curuk Muncar

The first step in planning the MHP system in Kaliwunngu village, Bruno sub-district, Purworejo district, Central Java province is to determine the estimated daily usage required. The total daily requirement is the amount of energy required by the electric appliance to operate.

Table 2. Estimated Daily Electricity Usage

Equipment Type	Amount	Power(Watt)		Operations per day(Hours)		Load Energy Requirements	
		Day	Night	Day	Night	Day	Night
Public Street Lighting	10	0	20	0	10	0	200
Public facilities	14	180	120	5	6	900	720
House	10	70	130	5	5	330	650
Total		250	270	10	21	1250	1570

Based on the load usage data table for the Kaliwunngu village installation, Bruno sub-district, Purworejo regency, Central Java province, the average daily energy consumption can reach 34.68 kWh/day

3.2. PLTHM ELC (Electronic Load Controller) Wiring Circuit

The electric load controller is a control tool used in PLTMH so that the power generated by the generator is always of the same value as the power consumed by the consumer's load. In the ELC system using a thyristor is used to divert power that is not used by consumer loads to the ballast load. For Adjusting the amount of power that is diverted to the ballast load can be adjusted through the alpha controller which is used to adjust the size of the firing angle on a scale of 0° to 180°. The following figure 2 explains the flow chart of the research methodology.

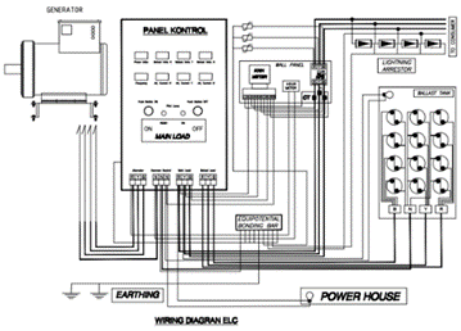

Figure 2. Wiring ELC

Failure in ELC operation resulting in component damage is something that must be avoided. In this case, the one selected must have a current and voltage rating above the required current and voltage.

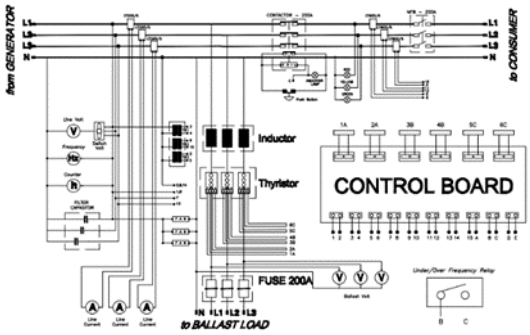

Figure 3. Wiring ELC

3.3. Pulley Genertor and Turbin

It is recommended to use a generator that is on the market, for example 1000 rpm or 1500 rpm. Lower rotation will ease the selection of the required speed transmission. The capacity of the generator is equal to or greater than the capacity that the turbine can generate. The selection of the type of generator to be used is also based on the following characteristics:

- Generator working voltage
- Generating capacity
- Possibility of parallel work units
- Simplicity of construction
- Genereter with production standards.

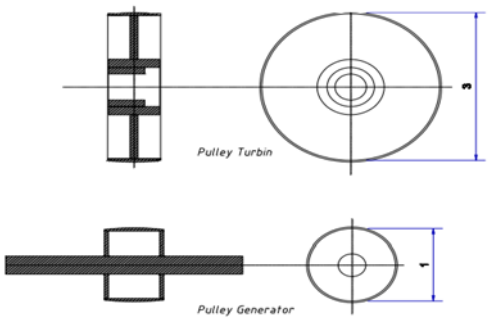

Figure 4. Pulley Generator And Turbine

3.4. Calculation of voltage drops

By using the digsilent application, the bits are determined from the initial current to the end of the current flow

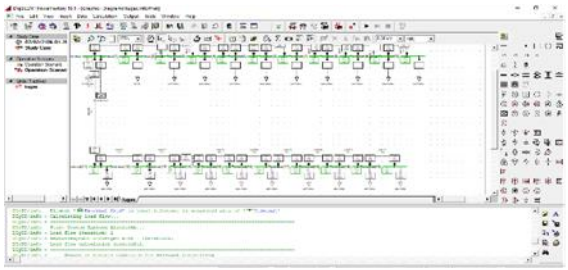

Figure 5. Digsilent Simulation 1

From the picture above, it can be done between one and the other, the optimal drop power from 380 volts is 90% has been running to 350 voltage from end to end.

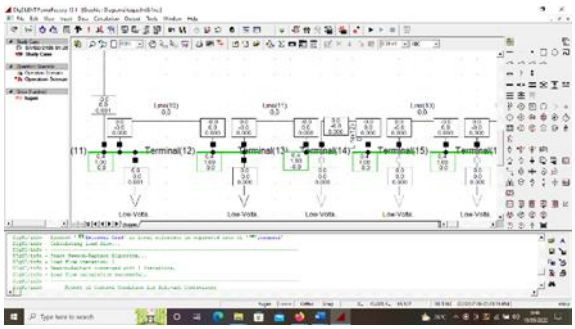

Figure 6. Figure 5. Digsilent Simulation 2

4. CONCLUSION

From the results of the analysis of the Design Study of a 15Kwp Micro Hydro Power Plant with a capacity at Curug Muncar, Kaliwung Village, Bruno District, Purworejo Regency, Central Java Province, it can be concluded as follows. The results of the estimated need of 34.68 Kwh per day at the Muncar waterfall in chapter 4.2 are in accordance with the electricity needs of chapter 3.2. For design simulations with the PLTMH application at Curug Muncar, Kaliwungu Village, with digsilent. The water source for the PLTMH comes from the Fountain River with a measured debit of 120 l/s at that time

REFERENCES

[1] Amirul, B., & Syahputra, S. (2022). Sosialisasi Pengelolaan Badan Usaha Milik Desa (Bumdes) Desa Timbang Jaya Kecamatan Bahorok Kabupaten Langkat. Journal Of Community Research And Service, 6(1). Https://Doi.Org/10.24114/Jcrs.V6i1.29270

[2] Galla, W. F. (2012). Potensi Pembangkit Listrik Tenaga Mikrohidro (Pltmh) Pada Saluran Irigasi Di Sungai Aesesa Kecamatan Aesesa Kabupaten Nagekeo. Jurnal Media Elektro. Https://Doi.Org/10.35508/Jme.V1i2.6262

[3] Hajar, I. (2020). Sosialisasi Pengolahan Sampah Menjadi Energi Listrik Di Desa Sukawali, Kecamatan Pakuhaji, Tangerang. Terang, 3(2). Https://Doi.Org/10.33322/Terang.V3i2.550

[4] Juwito, A. F., & Haryono, T. (2013). Optimisasi Energi Terbarukan Dalam Pembangkitan Energi Listrik Menuju Desa Mandiri Energi Di Desa Margajaya. Jurnal Nasional Teknik Elektro, 2(3).

[5] Muhammad Sukron, I. (2019). Pemanfaatan Energi Biogas Untuk Pembangkit Listrik Di Desa Tuwang Kecamatan Karanganyar Kabupaten Demak. Teknik Mesin, 10(2013).

[6] Prasetyo, Y. E. (2011). Pengorganisasian Masyarakat Desa Mandiri Energi: Studi Kasus Pltmh Di Desa Palakka, Kecamatan Maiwa, Kabupaten Enrekang, Sulawesi Selatan. Komunitas, 5(July).

[7] Suryadi, A., Faisal, M., Munthe, B., Eriyadi, M., & Burhan, J. (2020). Aplikasi Teknologi Pltmh Turbin Propeller Open Flume Sebagai Pembangkit Listrik Desa. Spekta (Jurnal Pengabdian Kepada Masyarakat : Teknologi Dan Aplikasi), 1(2). Https://Doi.Org/10.12928/Spekta.V1i2.2742

[8] (Kriswanto & Djufri, 2020)Eswanto, E., Sitompul, S. J., Siangian, T., Gunawan, I., & Aminur, A. (2020). Aplikasi Pltmh Penghasil Energi Listrik Di Sungai Lawang Desasimbang Jaya Kecamatan Bahorok. Dinamika : Jurnal Ilmiah Teknik Mesin, 11(2).Https://Doi.Org/10.33772/Djitm.V11i2.11678

[9] Fatahudin, D., & Kurniawan, I. H. (2020). Perancangan Pembangkit Listrik Tenaga Mikro Hidrokapasitas Daya 50 Kw. Jurnal Riset Rekayasa Elektro, 1(2). Https://Doi.Org/10.30595/Jrre.V1i2.5233

[10] Haryani, T., Wardoyo, W., & Hidayat, A. (2015). Pembangkit Listrik Tenaga Mikrohidro Di Saluran Irigasi Mataramperencanaan. Jurnal Hidroteknik, 1(2). Https://Doi.Org/10.12962/Jh.V1i2.1672

[11] Kriswanto, K., & Djufri, S. U. (2020). Perhitungan Daya Output Pltmh Di Jalan Bintara Sungaiduren Jambi. Journal Of Electrical Power Control And Automation (Jepca), 2(1). Https://Doi.Org/10.33087/Jepca.V2i1.24

[12] Saputra, I. W. B., Weking, A. I., & Jasa, L. (2017). Rancang Bangun Pemodelan Pembangkit Listrik Tenaga Mikro Hidro (Pltmh) Menggunakan Kincir Overshot Wheel. Majalah Ilmiah Teknologi Elektro, 16(2).Https://Doi.Org/10.24843/Mite.2017.V16i02p09

[13] M. Rizky, M. A. Setyo yudono, A. Suryana, and A. Nugraha, "Analisis potensi Pembangkit Listrik Tenaga Piko Hidro Archimedes screw turbine di Curug Sawer," MEDIA ELEKTRIKA, vol. 16, no. 01, p. 71, Jun. 2023. doi:10.26714/me.v16i01.10183