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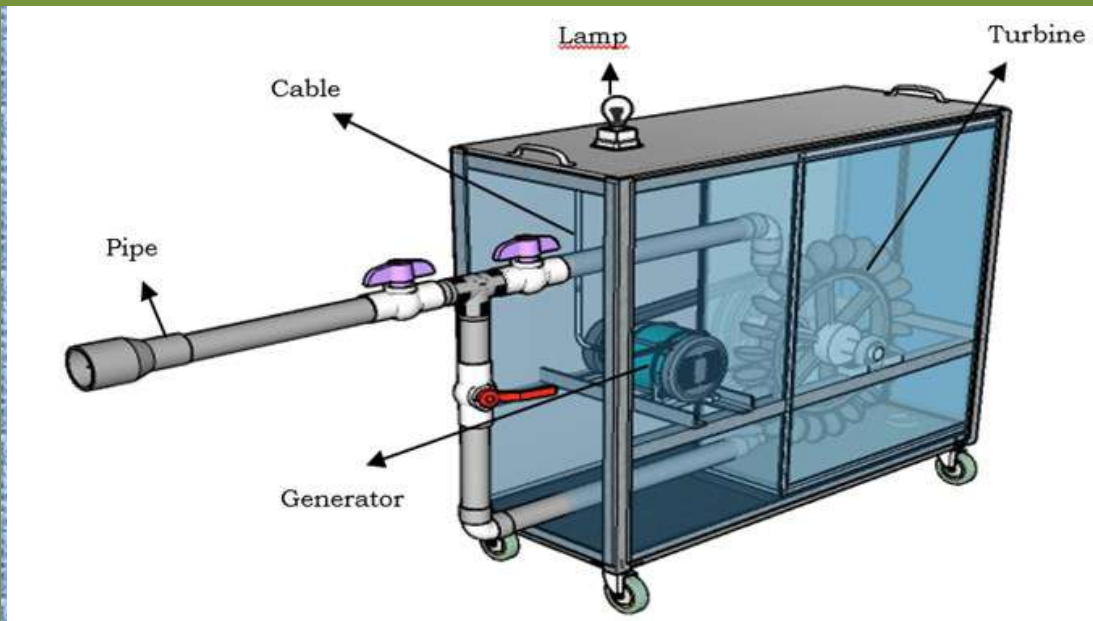

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MAIN ISSUE

DESIGN OF PORTABLE NANOHYDRO GENERATOR FOR LIGHTING IN MOUNTAIN AREAS

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Design of Portable Nano-hydro Generator for Lighting in Mountain Areas

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Abstract

Electricity needs in mountainous areas have not been optimal, so there need to be alternative power plants to meet the electricity supply in the mountainous area. For this reason, this study made an alternative power plant tool with the title Nano-hydro Generator Design Easy to Carry for Lighting In Mountainous Areas. The creation of this tool has several stages, including the first stage of making graphic design through SketchUp applications, then the second stage of the tool assembly in the form of mechanical design and civilian build, then the third stage of testing tools through water media, and the last stage of data retrieval to see if this tool works optimally. Based on the results of trials and data collection obtained, the average rotation speed of the turbine of 48.6 rpm, the rotation speed of the generator of 194.3 rpm, and a voltage of 6.3 volts.

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Kata kunci: *Generator, Nanohidro, Pembangkit listrik alternative*

Abstrak

Kebutuhan tenaga listrik di daerah pegunungan belum optimal sehingga perlu adanya pembangkit listrik alternatif untuk mencukupi pasokan listrik di daerah pegunungan tersebut. Untuk itu pada penelitian ini dibuatlah alat pembangkit listrik alternatif dengan judul Desain Generator Nanohidro Mudah Dibawa Untuk Penerangan Di Daerah Pegunungan. Pembuatan alat ini memiliki beberapa tahap diantaranya: tahap pertama membuat desain grafis melalui aplikasi sketchup, kemudian tahap kedua perakitan alat berupa perancangan mekanik dan bangun sipil, selanjutnya tahap ketiga pengujian alat melalui media air, dan tahap terakhir pengambilan data untuk melihat apakah alat ini bekerja secara optimal. Berdasarkan hasil uji coba dan pengambilan data didapatkan rata-rata kecepatan rotasi turbin sebesar 48,6 rpm, kecepatan rotasi generator sebesar 194,3 rpm, dan tegangan sebesar 6,3 volt.

1. Introduction

Based on Plan data General The Provision of Electricity (RUPTL) The State Electricity Company (PLN) states that needs power electricity from 2010 to 2020 is estimated to reach 55,000 MW, and of the total power, only as much as 32,000 MW (57%) of the 55,000 MW that will be built by PLN, for ratio electrification in Indonesia until end new 2015 year reached 88%. However, the ratio of electrification in every province is different, and in Lampung Province, the ratio of electrification until the new 2015 year reached 84% (Radar Lampung, 2020). Based on Service data Mining and Energy Genre electricity in villages not yet spread optimally, especially more in the area mountains. Villages located in diarrhea mountains usually will difficult to get optimal supply power. Including which province of Lampung is in which province there is a mountainous area like Mountain Tanggamus, Pesagi, Rajabasa, et al. Micro hydropower Electricity plant (MhPEP) is generator electricity scale small (less than 200 kW), which utilizes energy (flow) of water as source producer energy. MhPEP, in principle, utilizes different heights and amounts of water discharge per second in the channel water flow irrigation, river, or waterfalls. This water flow will rotate the axis turbine, producing energy mechanics. Next, the energy drives the generator and generates electricity (Dimyati, 2015).

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One source of energy with very renewable potential in Lampung is the utilization of water energy, a potential area for developing generator electricity hydropower. Technology nano hydro is technology scale small that can be applied to the source water power for change potency existing hydropower Becomes practical power electricity for support activity social economy communities in rural areas (Trihadi, 2006). To fulfill the needs of electricity in rural and remote areas, it is necessary to develop a system of generator electricity hydropower that does not make it so big and can utilize potency available river. Generator electricity this called Nano Hydro Power Plant (NHPP). Because of that, the potential of energy produced will also vary. Source power natural could be used more effectively and efficiently with portable nano hydropower generator projects and popularized to users (Supardi & Atmojo, 2019). NHPP, in principle, utilize different height or corner slope and the amount of water discharged per second in the channel irrigation, rivers, and waterfalls. The water flow will rotate the turbine to produce energy mechanics (Ezkhelenergy, 2013).

Study of nano hydro has done by many researchers, like study about Analysis Source Energy New Renewable Nano-hydro from Flow of Small Flowing Water conducted by Warsito et al., (2011). Permanent Magnet Generator Prototype Research Use Double Stator Coils made by Hartono (1994), a generator designed capable produce current electricity on rotation low that starts from 300 rpm. The presence of a dual stator capable increases the power the electricity generated, as at 300 rpm, rotation increases up to 115.73% of the single stator. Moment round raised to 600 rpm power electricity increase by 69.61%, as well as at 900 rpm and 1200 rpm the power electricity increaseed by 28.43 % to 36.85 % of the single stator.

Research conducted, making tools to fulfill the needs of electricity in rural areas and areas in need of electricity in life every day. Election type turbine could be determined based on advantages and disadvantages from types turbine, particularly for something very design specific. Stage start, election type turbine could be considered with the specific parameters that affect system operation turbine Pelton (Bachtiar & Putra, 2014).

2. Research Methods

Study nano hydro generator design easy brought for lighting in the area mountains consist from planning mechanics, and design gets up civil. Design mechanic that is nano hydro generator manufacture and design get up civil made of from penstock. Generator electricity power nano hydro in research this utilizing PAM water, by PVC pipe flow from well drilling at the address Jl. Tirtaria Gg. Jasmine Vl village. Way Kandis sub -district Cape Happy Bandar Lampung. Tools and materials used in research include DC generators, water turbines, PVC pipes, lamps incandescent, multimeter, tachometer, stopwatch, acrylic 3 mm thick with 75 cm long, 30 cm wide, and 50 cm high, iron elbow which is 1.5 mm thick with 75 cm long, 30 cm wide, and 50 cm high, and glue. Procedures carried out in research this that is generator design.

2.1 Design of Generator

The generator is converter energy from form energy mechanic. It Becomes energy electricity in the area's magnetic field (Zuhal, 1995). The design that will conduct covers making a box, waterwheel, and testing. The ultimate plan is to make a Suite box a receptacle for generators and water turbines. For box made of 2 sticks long iron elbow initially 6m later iron elbow cut with size 75 cm long, 30 cm wide and 50 cm high. Then iron elbow assembled shape box. The design nano hydro generator box can be seen in Figure 1.

Figure 1. Nano-hydro generator box.

Next, make a design generator design on research. This use sketch-up the app with materials used, namely PVC pipes, stop faucets, acrylic, panels, dc generators, and water turbines from wheel bicycles. To protect the turbine so that it is not rusty so required box is made from acrylic so as not to be exposed to water in the pipe spout. The design generator design can be seen in Figure 2.

The next plan makes the design tool on a nano hydro generator that uses a sketch-up application. Materials from the tool consist of acrylic, spandex, PVC pipe, lamp, generator, turbine, and cable. So that the water spray on the pipe to turbine more assertive, then made two bursts on the pipe. This thing aims to enlarge the power turn on the turbine. Because of that, the turbine used in the research is a type turbine, Pelton. The design tool whole can be seen in Figure 3.

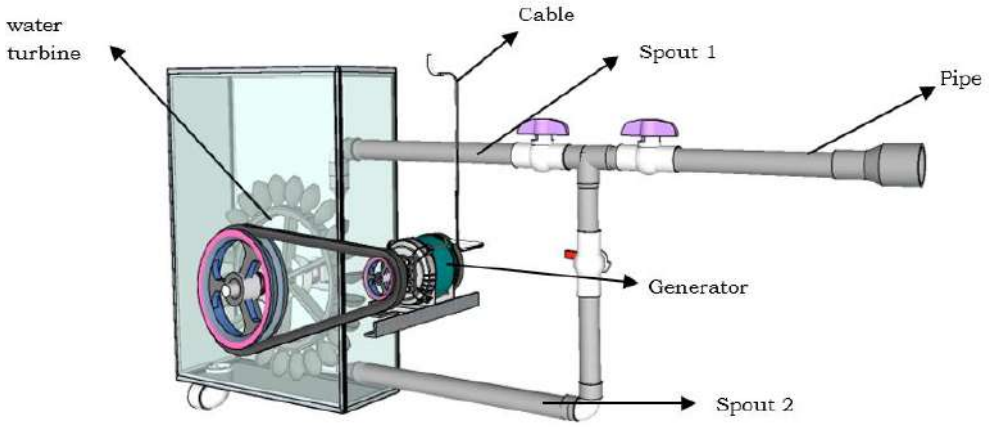

Figure 2. Design of generator.

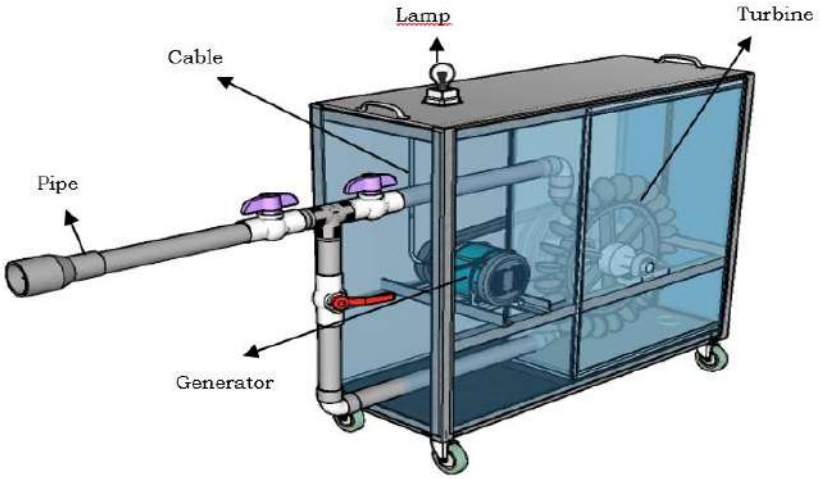

Figure 3. Design of portable nano-hydro generator.

2.2 Design Mechanic

It was making a water turbine and installing iron elbow, acrylic, spandex, and wheels as a shaped container box for nano hydro generator and turbine the water. Generators and turbines have been assembled and then installed in the box that has been designed. Making Suite tools that have been installed can be seen in Figure 4.

Figure 4. Suite tool installed.

Design system mechanic covers turbines and devices support such as PVC pipes, stop faucets, lights, turbines, acrylic, and spandex. Water turbine plays a role in changing water energy becomes energy mechanic in form round shaft, rotation axis this converted by the generator to energy electricity. Generated source from round pinwheel will produce electricity. Channel source the connected with light bulb terminals and a digital multimeter so that the light is on and the voltage can be detected. Source electricity earned will produce a score big or small based on the speed moving wheel. Heavy The total generator is 6 kg placed on a box size 75 cm long, 30 cm wide, and 50 cm high. The diameter of the turbine used is 16 cm.

2.3 Design Building Civil

The assembly generator, electricity power nano hydro generator, and water turbine are placed in the skeleton box. The ingredients are iron elbow, acrylic, spandex, and wheels for iron elbow total of 2 sticks each with a size long initially one stick iron elbow 6 m. The stem iron elbow cut, each with sizes 75 cm, 30 cm, and 50 cm. For box as a generator container can be seen in Figure 5.

Figure 5. Generator container.

Iron the elbow already cut, then assemble and shape a box. Then coated with acrylic and spandex, for acrylic with 2m long with a thickness of 3 mm, so that the generator that has been placed in no-hit by a spray of the pipe, then coated with acrylic with size 38 cm long, is 16 cm wide and 50 cm high. Whereas spandex size 1mm thick with 1m long, paired with four wheels that work as the tool can move around the place.

2.4 Penstock (PVC Pipe)

Penstock (PVC pipe) works for distributing and directing water to the chimney turbine (Penche, 1998). Penstock pipe used in the study is the type of PVC pipe used amount four fruit. Four-pipe fruit, from the largest to most minor, have diameter sizes are 3 2 inch pipes and 1 1 inch pipes, with each pipe 4 m long. Pipe connection from size biggest until slightest aim for make water flow through the pipe to an increasing diameter small has pressure push big water so that turbine driven by water will rotate fast. Whereas for penstock pipe can see in Figure 6.

Figure 6. Penstock (PVC Pipe)

Penstock is a working pipe for draining water from a good drill going to the turbine, which has a lower position. Making penstock pipe covers material selection, penstock diameter, thickness, and type connection. Material selection is based on considering condition operation, weight, system connection, and cost. Water flow from the excellent drill flowed by the penstock pipe to the turbine, turbine designed to get optimal results. A House turbine is designed to optimize the performance of the turbine. The House turbine is made from ingredient acrylic to form the turbine's pattern. Channel this working for drain water from well drilling going to generator wheel. Some PVC pipes used four pieces, with Each pipe diameter being different. A pipe installed long with direction to direction turbine with a small diameter so that water pressure leading to miser will be the bigger so that pinwheel could turn fast. The pipe is installed straight without turning so that the pipe is straight.

2.5 Design of Turbine

Water turbine plays a role in changing energy from water from energy potential, pressure, and energy kinetic, be energy mechanic in form round shaft. The generator will convert around the axis turbine to power electricity. The generator trigger on the generator is needed in a state where there is supplied current, forming a magnetic field in the generator and keeping the output voltage constant (Erhaneli, 2013). Determination of type turbine based on

factor tall effective waterfall and the amount blades on the turbine. For tall water drop so that practical so made two bursts on the pipe so that power turn on the turbine bigger so that selected turbine is type turbine platoon. The turbine platoon can be seen in Figure 7.

Figure 7. Turbine Pelton.

In research, this turbine platoon has some advantages over the other turbine. It generated considerable power, simple construction, easy simple maintenance, and technology accessible applied in isolated areas (Simamora, 2017). Turbine designed Pelton with use rim iron wheel which has a diameter of 16 cm. Whereas the number of spoons on the plan this totaling 15 pieces made from an iron spoon diameter of 4 mm. For planning or making a turbine, this step starts with a cut spoon for taking the spoon course. Next, use nail ripped for uniting the blade or head spoon with the rim wheel bicycle. The Pelton turbine has a forming blade arranged bowl use a head designed spoon like that appearance in formation turbine will produce score efficiency from the turbine and generators.

3. Results and Discussions

3.1 Data Retrieval

Data collection is done in one day in four twenty-second seconds every two seconds. Retrieval of data as much as two twenty times. From the measurements that have been conducted obtained, data is as in Table 1.

Table 1. Measurement results of the nano hydro generator.

No	Time (s)	Voltage (Volt)	Speed Turbine Rotation (rpm)	Speed Generator Rotation (rpm)
1	2	6,7	53	212
2	4	6,0	44	176
3	6	6,3	49	196
4	8	5,5	39	156
5	10	5,3	38	152
6	12	5,5	39	156
7	14	5,7	41	164
8	16	6,1	46	184
9	18	6,7	53	212
10	20	6,6	52	208
11	22	6,7	53	212
12	24	7,1	59	236
13	26	6,9	58	232
14	28	5,9	43	172
15	30	6,0	44	176
16	32	6,6	52	208
17	34	6,7	53	212
18	36	6,9	58	232
19	38	6,3	49	196
20	40	6,4	48	194
	Average	6,3	48,6	192,3

Table 1 shows results measurements on a nano hydro generator. Based on the results, the measurement generated voltage gets the average value is 6.3 volts. In contrast, a speed rotation turbine gets an average value of 48.6 rpm, and at the speed of the generator, rotation gains an average value of 192.3 rpm.

3.2 Data Analysis

Data retrieval has been conducted using the voltage generated by the generator, speed rotation turbine, and speed of the resulting generator rotation. Measurement voltage is measured with a digital multimeter, while score speed rotation turbine (RPM) and speed generator rotation (RPM) using a tachometer. For generator voltage data retrieval, using a digital multimeter requires a time of 40 seconds every 2 seconds very will get 5.3 volts to 7.1 volts to produce a speed rotation turbine from 38 rpm to 59 rpm. The more considerable the voltage generated by the generator, the speed generated turbine will the more substantial. Chart connection Among generator voltage versus speed rotation turbine can be seen in Figure 8.

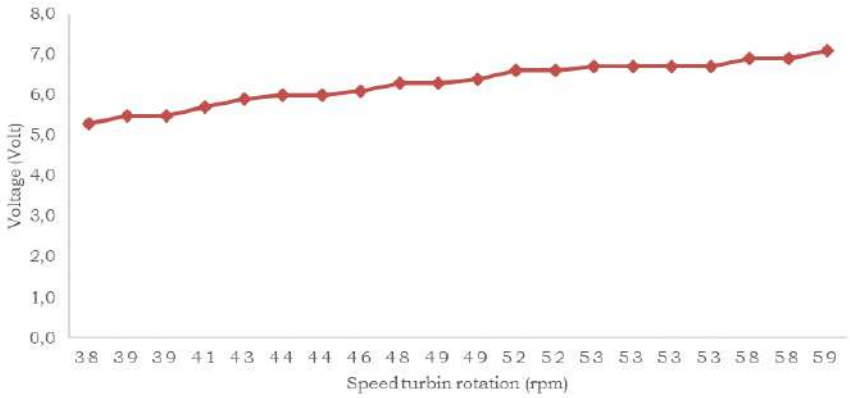

Figure 8. Chart of voltage versus speed rotation turbine.

Generator voltage data retrieval using a digital multimeter requires a time of 40 seconds every 2 seconds very, so get 5.3 volts to 7.1 volts with produce speed generator rotation is 152 rpm to 236 rpm. The more considerable the voltage generated by the generator, the speed generated generator rotation, the more significant. Chart connection Among generator voltage versus speed generator rotation can be seen in Figure 9.

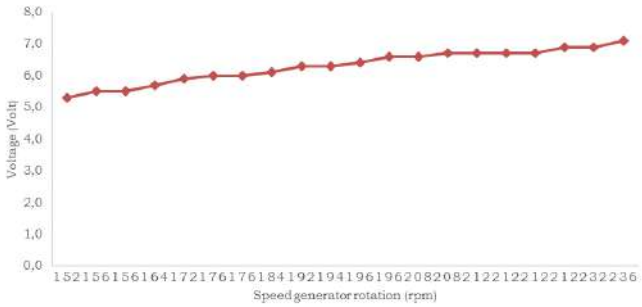

Figure 9. Chart of voltage versus speed generator rotation.

Next, data collection for speed rotation turbine using a tachometer requires a time of 40 seconds. Every data retrieval requires 2 seconds, so get 38 rpm to 59 rpm with produce speed rotation turbine of 152 rpm to 236 rpm. The more faster speed rotation rotating turbine will produce speed strong generator rotation. Chart connection Among speed rotation turbine versus speed generator rotation can be seen in Figure 10.

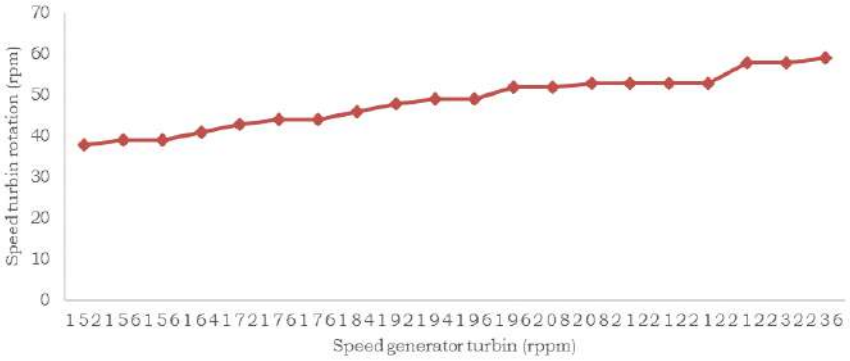

Figure 10. Chart of speed rotation turbine versus speed generator rotation.

Retrieval at speed rotation turbine needs time for 40 seconds experience change value, which influences score voltage. For data retrieval, generator voltage generated worth constant gets the average score of 6.3 volts. For data retrieval at speed rotation turbine worth constant gets the average score of 48.6 rpm. For data retrieval at speed generator rotation gain constant value get the average score of 192.3 rpm. The higher speed of water hitting pinwheel will make miser the faster rotate, so that generated voltage will be the more considerable.

4. Conclusions

Based on research conducted, obtained concluded that tool generator electric generator nano hydro made capable produce spinning wheel with constant, the generator voltage is 5.3 volts to 7.1 volts. The generator voltage generated in the experiment this worth constant and produce an average voltage of 6.3 volts. Speed rotation turbine

in the experiment, this worth constant in 40 seconds produces an average speed of 48.6 rpm. Speed generator rotation in the experiment this worth constant in a time of 40 seconds, earning an average speed of 192.3 rpm.

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