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Analysis Comparison of the Voltage Drop Before and After Using the Turbine in the Bintang Asih Microhydro Power Plant System

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ABSTRACT

One of the renewable energy sources that are being developed is mini-scale hydropower. Microhydro power plant in Deli Serdang Regency a power generation system that works off-grid against PT. PLN system. A very complex problem in the Microhydro Power plant System requires thorough analysis due to the use of technology used in the system. The current load service is uneven resulting in a tense fall in value. With regard to this matter, a potential comparative analysis with a wheel and turbine system is made known to the potential difference resulting from each system. Based on the results obtained next value regulation voltage drop that occurs in the direct distribution when using the wheel on the load time of 4.421% used and after the generation and distribution system is converted into a grid system that makes the value of voltage drop at the load becomes 0.968%.

KEY WORDS: *Microhydro Power, unbalance, Voltage Drop*

NOMENCLATURE

PLN	Perusahaan Listrik Negara
ΔV	Voltage Drop
V_{reg}	Voltage Regulation

1.0 PRELIMINARY

One of the renewable energy sources that are being developed is mini-scale hydropower. The generator can be interconnected with a distribution on grid [1], however, every plant in general will experience many obstacles that can hamper the production process resulting in a decrease in production. Considering the importance of the sustainability process of the production of Microhydro Power Plants in the future, it needs good handling [2, 3].

Electrical energy in rural areas is generally used for lighting, the addition of power in each phase is uneven so that the load conditions cause unbalances in each phase. Therefore a system is needed control the load in each phase to get a balanced operating condition and increase the working voltage. This is done to reduce the real power loss on transmision and the possibility of using a three phase transformer which is placed at the end of the channel before reaching the first load [4]

In the distribution of electricity, distribution network reliability must be really considered, because in the distribution network it is very likely the voltage and power losses in the conductor wire and the power losses that occur in the distribution transformer will occur. Therefore, attention is needed to technical and non-technical aspects in increasing reliability or quality of distribution networks [5,7]. Microhydro power plant Bintang

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Asih is located in Deli Serdang Regency. The plant currently has a capacity of 800 VA with a load of 21 houses. Uneven use causes a voltage drop in the generating system. Based on this very necessary analysis to determine the *voltage drop.* So the basis of this need to be done on the load side analysis to determine the voltage drop. This study contains a discussion that analyzes the system of load usage.

2.0 THEORETICAL BASIS

2.1 Power System Network

Electric Power System is a system consisting of several components in the form of generation, transmission, distribution and load are interconnected and work together to serve the needs of electric power for customers as needed is shown in figure 1 [8].

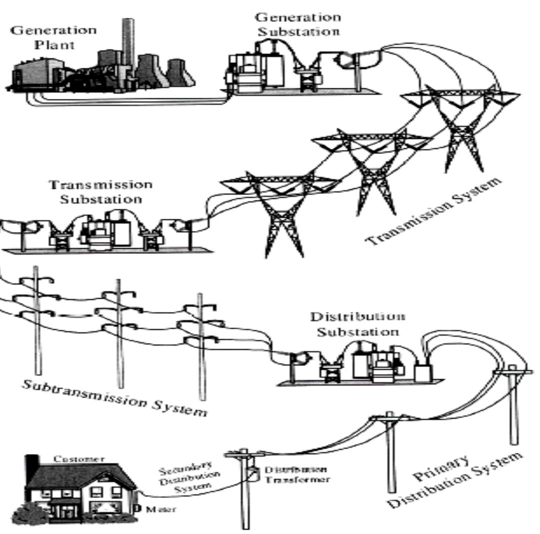

Figure 1. Power System

2.2 Electric Power Distribution Network Component

The distribution system is the whole component of a power system that connects directly between a large power sources (such as a transmission substation) with a consumer of electric power.

2.3 Voltage Drop

Low voltage network that is too long will cause a voltage drop, where the difference in voltage on the send side with voltage on the receiving side. Communities located in areas far from the main distribution cables tend to receive voltages that are smaller in value than those in areas close to the main distribution cables. According to SPLN 1: 1995, the Service Line voltage tolerance (SP) is + 5%. of the low voltage standard voltage at the base side and -10% on the edge side [6]. This happens because the amount of current flowing along the low voltage wire (Low Voltage Twisted Cable = LVTC) is not the same, because the load only flows at the distribution cable distribution points only. So it can be said that the magnitude of the current at the first flowing point is greater than the magnitude of the current in the second pole and so on the smaller until the last pole. While the magnitude of losses that occur along the network is the square of the current multiplied by the total resistance of the network cable. Since the magnitude of the current varies across the network, it is very difficult to calculate the overall voltage drop of the wire. As a result of unequally distributed load, the length of the conductor channel is too far, then the sum of the three phase currents is no longer equal to zero, since the load is not balanced so that on the neutral wire there will be a current flowing from the neutral conductor to the earth's electron (grounding *rod*) the voltage drop on the conduit and the power losses to the conductor.

The voltage drop on transmision line:

$$\Delta V = \frac{\rho \, x \, L \, x \, I \, x \cos phi}{A} \quad \text{......(1)}$$

While voltage regulation can be obtained using the equation:

$$V_{reg} = \frac{Vs - Vr}{Vr} \, x \, 100\%1 \quad \text{......(2)}$$

3.0 METHODOLOGY

3.1 Research sites

This research was conducted on the distribution network of Microhydro Power Plant Bintang Asih in Deli Serdang Regency located at coordinates 3 ° 15'12.8 "N 98 °44'43.2" E 3.253551, 98.745342 as shown in the following figure 2.

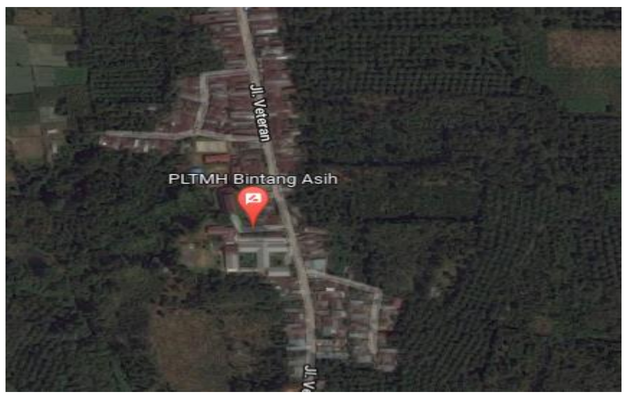

Figure 2. Research location of Microhydro Power Plant

The plant serves 20 houses and 1 house of worship but the distribution is still poor, and in the picture below is a distribution system used in Microhydro Power Bintang Asih.

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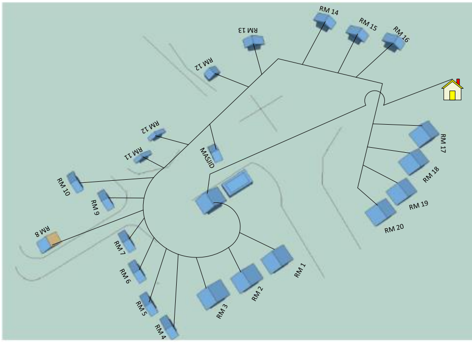

Figure 3. Distribution Network Before Modified

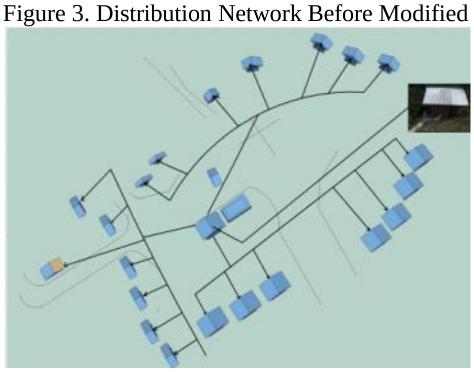

Figure 4. Distribution Network After Modified

3.2 In Generators Before and After Power Capacity is Improved

In Table 1 shows the voltage distributed at each load and the current flowing at each load before the power capacity is increased.

Table 1 Measurement Data on Generators Before Improved

House	Voltage (Volt)		Current (Ampere)		Frequency (Hz)
	Before	After	Before	After	
House 1	103	220	0.31	0.31	50
House 2	92	213	0.23	0.39	50
House 3	100	209	0.23	0.71	50
House 4	89	220	0.20	0.28	50
House 5	100	203	0.25	0.49	50
House 6	41	214	0.6	0.66	50
House 7	101	210	0.28	0.41	50
House 8	101	211	0.2	0.50	50
House 9	102	209	0.29	0.47	50
House 10	92	214	0.26	0.26	50
House 11	87	220	0.3	0.3	50
House 12	95	219	0.12	0.12	50
House 13	86	216	0.31	0.34	50
House 14	94	218	0.18	0.12	50
House 15	84	209	0.24	0.46	50
House 16	112	212	0.29	0.29	50
House 17	107	219	0.13	0.13	50
House 18	100	209	0.13	0.62	50
House 19	97	207	0.56	0.56	50
House 20	95	210	0.14	0.14	50
House 21	103	207	0.25	0.11	50

Tabel 2. Voltage regulation before and After upgrading.

No	Beban	Voltage (Volt)		Persentasi regulasi (%)	
		Before	After	Before	After
1	House 1	103	220	14 (%)	0 (%)
2	House 2	92	213	23 (%)	3,8 (%)
3	House 3	100	209	16 (%)	6 (%)
4	House 4	89	220	25 (%)	0 (%)
5	House 5	103	203	14,1 (%)	7,7 (%)
6	House 6	41	214	65 (%)	2,7 (%)
7	House 7	101	210	15,8 (%)	4,5 (%)
8	House 8	101	211	15,8 (%)	4 (%)
9	House 9	102	209	15 (%)	5 (%)
10	House 10	92	214	23 (%)	2,7 (%)
11	House 11	87	220	27,5 (%)	0 (%)
12	House 12	95	219	20,8 (%)	0,4 (%)
13	House 13	86	216	27,5 (%)	1,8 (%)
14	House 14	94	218	21,6 (%)	0.9 (%)
15	House 15	84	209	30 (%)	5 (%)
16	House 16	112	212	6,6 (%)	3,6 (%)
17	House 17	107	219	10,8 (%)	0,4 (%)
18	House 18	100	209	16,6 (%)	5 (%)
19	House 19	97	207	19,1 (%)	5,9 (%)
20	House 20	95	210	20,8 (%)	4,5 (%)
21	House 21	103	207	14,1 (%)	5,9 (%)

4.0 DISCUSE

4.1 Analysis Regulatory of Load Voltage Drop

When viewed in terms of the distribution of electric power, the plant is only distributing electrical energy ± 20 houses and a house of worship with a distribution distance ± 650 m .

From the measurement of data before the increase will do analysis of voltage drop regulation on each load as follows:

$$Home\ Voltage\ Loss\ (\Delta V1) = 120\ Volt - 103\ Volt = 17\ Volt$$

$$V_{Reg}House = \frac{17}{120}\ x\ 100\% = 14\ \%$$

Using the data obtained for the obtained percentage analysis of voltage drop regulation with the results of the analysis. From the results of the analysis above data obtained percentage of graph shown in figure 5.

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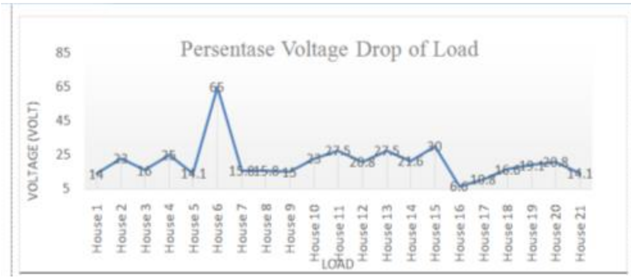

Figure 5. Graph of the Relationship Between Load And Voltage Drop Regulation Before the increase

Based on the picture above shows that the voltage regulation before the voltage capacity is increased, with the result of regulation difference of voltage drop at each load. Then from the data in the data table before upgrading capacity will do the analysis of voltage drop regulation on each load with equations (2).

4.2 Voltage Regulation On Load After Power system Increase

From the results of the analysis above data obtained percentage of graph as follows:

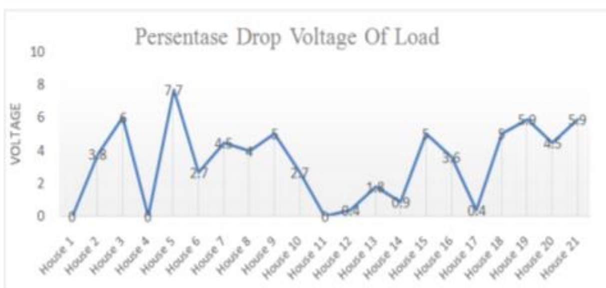

Figure 6. Graph of the Relationship Between Load And Drop Voltage Regulation After the Voltage Improvement .

Based on Figure 6 shows that the voltage regulation after the power capacity is increased by the result of the voltage drop regulation difference that occurs not less than 8 volt, compared to before the generating capacity is increased voltage drop regulation at each load reaches more than 20 volts.

4.3 Percentage of Voltage Before And After Voltage Increase And Distribution System Changed.

After the analysis results of the comparison between the percentage of the wheel system generation capacity has not been upgraded and improved turbine after generation capacity precentation ratio is obtained as follows:

1. Analysis of percentage regulation of voltage drop on load before being increased

$V\ \%_{reg} = R_{eg\%\ rumah1} + Reg\%_{\ rumah2} + Reg\%_{\ rumah3}$ ....n

$\%_{reg}$ =14% + 23% + 16% + 25% + 14.1% + 65% + 15.8% + 15.8%+15% + 23% + 27.5% + 20.8% + 27.5% + 21.6% + 30% + 6.6% + 10.8% + 16.6% + 19.1% + 20.8% +14.1%
= 3.938 %

$$V_{reg} = \frac{69.8\ \%}{100\%} = 4{,}421\ \%$$

2. Analysis of percentage regulation of voltage drop on load After being increased

$V\ \%_{reg} = Reg\%_{\ rumah1} + Reg\%_{\ rumah2} + Reg\%_{\ rumah3}$ ....n

$\%_{reg}$ = 0% + 3.8% + 6% + 0% + 7.7% + 2.7% + 4.5% + 4% +5% + 2.7% + 0% + 0.4% + 1.8% + 6.6% + 0.9% + 5% + 3.6% + 0.4% +5% + 5.9% + 4.5% + 5.9%
= 69.8%

$$V_{reg} = \frac{69.8\ \%}{100\%} = 0.698\ \%$$

Figure 7 shows the difference in voltage drop that is very significant, when using the wheel the voltage drop value at a load of 4.421% and after using the turbine the voltage drop value is 0.698%.

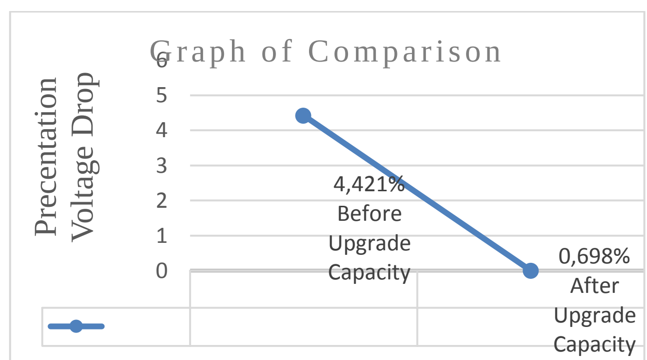

Figure 7 Graph of Comparison of Voltage And Comparison After Dan Before Enhanced Power .

5.0 CONCLUSION

From result of calculation and data analysis which have been done in this research can be concluded that result of analysis before power increase after the increase in power, the percentage comparison of data was obtained when using a regulated voltage drop system of 4.421% . Then when using a turbine generating system of 0.698% .

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