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Load Distribution On The Expansion Of The Medium Voltage Distribution Network From Single Phase To Three Phase In Gondorio Using Etap 12.0

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Abstract
The Gondoriyo 1-phase network has a network length of 3.2 km supplied by a 1-phase network that is charged in phase S on BSB 1. The extent of the service area makes the load on phase S jump high. The measurement results obtained by the load current during peak load reached a total of 62A. While the load current of the repeater at the time of peak load is phase R of 32A, phase S of 98A, and phase T of 44A. With such conditions, it is necessary to expand the medium voltage distribution network in the Gondoriyo area with the aim of balancing the load on the BSB 1 extension. To facilitate load sharing in the expansion of the Gondoriyo area, the ETAP powerstaion 7.5.0 simulation program is used. which consists of 1 phase simulation before expansion and 3 phase simulation after expansion. From the results of this engineering shrinkage simulation, the total engineering shrinkage value in the 1-phase network before the expansion was 6480 kW, after the network expansion, the total engineering shrinkage changed to 2510.4 kW. With the simulation that has been made, it is expected to produce a load sharing plan that will make it easier for PT PLN (Persero) Rayon Boja to share the load on the network after the expansion.

Keywords:
power system, distribution network engineering

Abstrak
Jaringan 1 fasa Gondoriyo memiliki panjang jaringan 3,2 km disuplai oleh jaringan 1 fasa yang dibebankan di fasa S pada penyulang BSB 1. Luasnya daerah pelayanan membuat beban pada fasa S melonjak tinggi. Hasil pengukuran yang didapat arus beban yang pada saat beban puncak mencapai total 62A. Sedangkan arus beban penyulang pada saat beban puncak adalah fasa R sebesar 32A, fasa S sebesar 98A, dan fasa T sebesar 44A. Dengan kondisi seperti itu perlu diadakan perluasan jaringan distribusi tegangan menengah daerah Gondoriyo dengan tujuan untuk menyeimbangkan beban pada penyulang BSB 1. Untuk memudahkan dalam hal pembagian beban di perluasan daerah Gondoriyo digunakan simulasi program ETAP powerstaion 7.5.0. yang terdiri dari simulasi 1 fasa sebelum perluasan dan simulasi 3 fasa setelah perluasan. Dari hasil simulasi susut teknik ini didapatkan nilai susut tenik total di jaringan 1 fasa sebelum perluasan sebesar 6480 kW, setelah dilakukan perluasan jaringan maka susut teknik total berubah menjadi 2510,4 kW. Dengan simulasi yang telah dibuat maka diharapkan akan menghasilkan rencana pembagian beban sehingga lebih memudahkan PT PLN (Persero) Rayon Boja dalam melakukan pembagian beban di jaringan setelah perluasan.

Kata Kunci : Sistem Tenaga Listrik, Jaringan Distribusi, Teknik

INTRODUCTION

The load on an unbalanced feeder can cause significant losses. Although losses cannot be avoided, they can be minimized so that efficiency can be tolerated within the reasonable limits set by the company. To address this issue, network modifications need to be made. One of them is to expand the network in an area with heavy load. This can involve balancing the load of single-phase taps/branches into three phases.

METHOD

Existing Network Case Study Location

Daerah Gondoriyo sendiri sebelumnya mendapat supply energi listrik dari feeder/penyulang BSB 1, and is a single-phase load on phase R. Because its working area is very large while it is only loaded on phase R, it causes a significant spike in the load on phase R. Therefore, phase balancing is needed, and

with the network expansion, it is hoped that it can balance the feeder phase load in addition to reducing power losses due to the large load current. The network expansion carried out by PT PLN (PERSERO) Rayon Boja on the medium voltage network from single-phase to three-phase in the Gondoriyo area is being executed starting from pole B6 – 88 to B6 – 88/51 with a length of about 2.78 km. There are 28 single-phase distribution transformers in the Gondoriyo area network.

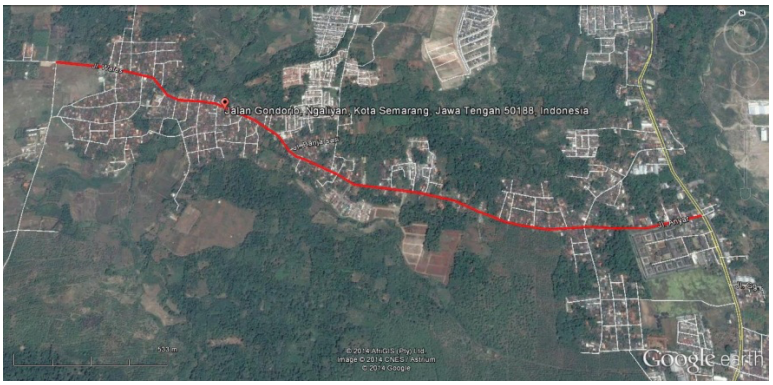

Figure 1. Satellite image of the Gondorio area

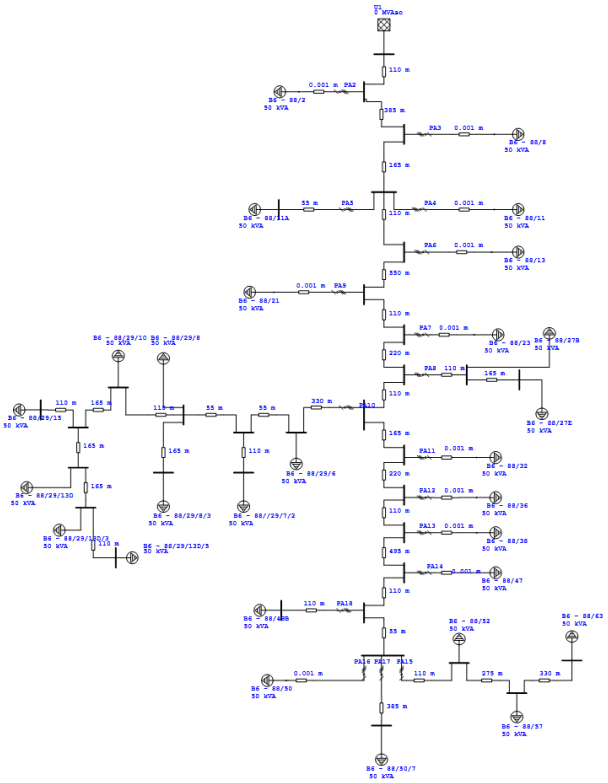

Figure 2. Single Line Diagram of Gondorio

Existing Network Data of the Case Study Location

Table 1 Electric Load at the Research Site

No	Pole Number	Load (Amperes)
1	B6 - 88/2	1.5
2	B6 - 88/8	1.9
3	B6 - 88/11	1.4
4	B6 - 88/11A	2.9
5	B6 - 88/13	1.9
6	B6 - 88/21	2.6
7	B6 - 88/23	2.8
8	B6 - 88/27B	2
9	B6 - 88/27E	1.5
10	B6 - 88/29/6	1.9
11	B6 - 88/29/7/2	2.9
12	B6 - 88/29/8	1.2
13	B6 - 88/29/8/3	2.4
14	B6 - 88/29/10	2.2
15	B6 - 88/29/13D	1.6
16	B6 - 88/29/13D/3	2.1
17	B6 - 88/29/13D/5	2.7
18	B6 - 88/29/15	1.1
19	B6 - 88/32	2.7
20	B6 - 88/36	3.8
21	B6 - 88/38	3.4
22	B6 - 88/47	3.1
23	B6 - 88/49B	3.2
24	B6 - 88/50	1.6
25	B6 - 88/50/7	1.3
26	B6 - 88/52	1.8
27	B6 - 88/57	2.4
28	B6 - 88/63	2.1

RESULT AND DISCUSSION

Three-Phase Load DistributionThe load distribution here is carried out by trying several load distribution scenarios, which are then simulated using Etap software. The results of the load distribution plan are selected based on the scenario with the least voltage drop and reduction.

Table 2 Electric Load at the Research Site

No	Pole Number	Beginning	Moving In	Load (A)		
				R	S	T
1	B6 - 88/2	S	R	3.5		
2	B6 - 88/8	S	R	3.5		
3	B6 - 88/11	S	R	3.5		
4	B6 - 88/11A	S	R	3.5		
5	B6 - 88/13	S	R	3.5		
6	B6 - 88/21	S	R	3.5		
7	B6 - 88/23	S	R	3.5		
8	B6 - 88/27B	S	R	3.5		
9	B6 - 88/27E	S	R	3.5		
10	B6 - 88/29/6	S	S		3.5	
11	B6 - 88/29/7/2	S	S		3.5	
12	B6 - 88/29/8	S	S		3.5	
13	B6 - 88/29/8/3	S	S		3.5	
14	B6 - 88/29/10	S	S		3.5	
15	B6 - 88/29/13D	S	S		3.5	
16	B6 - 88/29/13D/3	S	S		3.5	
17	B6 - 88/29/13D/5	S	S		3.5	
18	B6 - 88/29/15	S	S		3.5	
19	B6 - 88/32	S	S		3.5	
20	B6 - 88/36	S	T			3.5
21	B6 - 88/38	S	T			3.5
22	B6 - 88/47	S	T			3.5
23	B6 - 88/49B	S	T			3.5
24	B6 - 88/50	S	T			3.5
25	B6 - 88/50/7	S	T			3.5
26	B6 - 88/52	S	T			3.5
27	B6 - 88/57	S	T			3.5
28	B6 - 88/63	S	T			3.5
	Total			31.5	35	31.5

Table 3. Results of Simulation Stage 1 Maximum Load Phase

Voltage Drop		Power Loss	
Value (Volt)	%	Value (Watt)	%
142.02	1.23	6480.6	0.72

Table 4 Results of Simulation Stage 3 Maximum Load Phase

Voltage Drop		Power Loss	
Value	%	Value (Watt)	%
54.7	0.47	3118.9	0.27

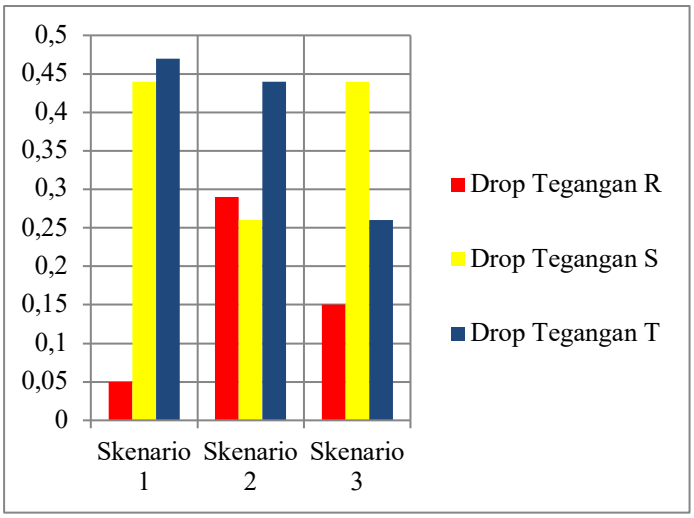

Figure 3 Graph of Voltage Drop Simulation Results with Etap 12.0 Software

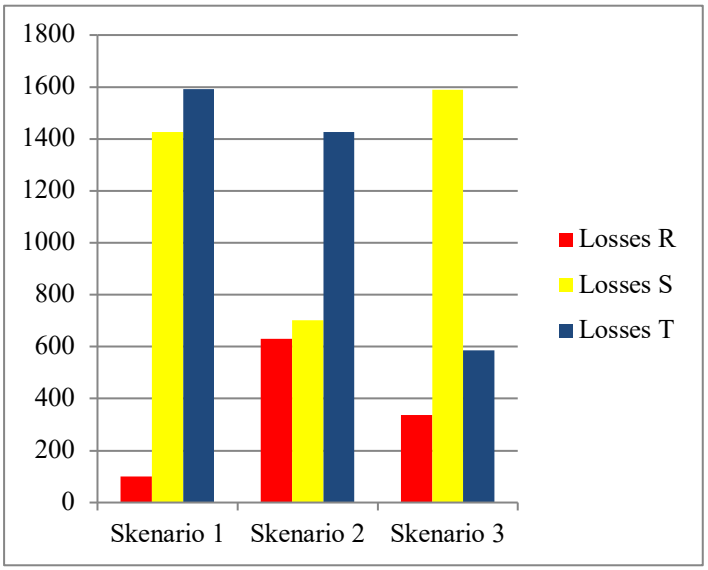

Figure 4. Graph of the Simulation Results of Losses/ Power Losses using Etap 12.0 Software

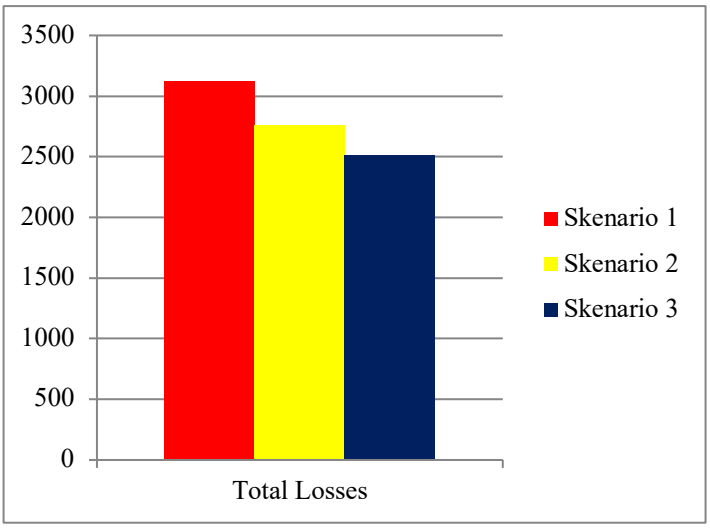

Figure 5 Total Simulation Results Graph of Losses/Power Reduction

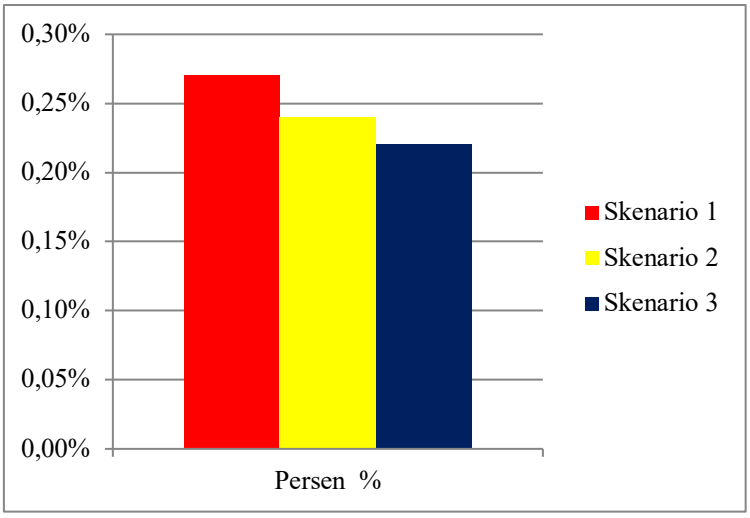

Figure 6. Graph of Simulation Results Losses/ Power Decrease in Percent

If we look at the graph above, the magnitude of losses that occur varies at each phase. The smallest total losses is found in scenario 3 with a total of 2513.9 Watts or 0.22%. Based on the voltage drop and the losses/power dissipation that arise in each scenario, it can be concluded that Scenario 3 is the best scenario because the values of voltage drop and losses/power dissipation are the smallest compared to other scenarios.

CONCLUSION

1. Based on the calculation results in the single-phase maximum load simulation, the maximum voltage drop is 1.23% and the maximum power loss is 6408.6 Watts or 0.72% in the single-phase network before the expansion.
2. Based on the results of the three-phase load distribution simulation from the three scenarios, the best scenario was chosen, which is scenario 3, because the voltage drop and power loss that occurred were the smallest compared to the other scenarios.

3. Based on the calculations of voltage drop and power loss in the load distribution simulation for scenario 3, the voltage drop on phase R is 0.15%; phase S is 0.44%; phase T is 0.26%, and the power loss on phase R is 338.0 Watts, on phase S is 1590.3 Watts, and on phase T is 585.6 Watts. The total power loss in the three-phase network after the expansion at maximum load is 2513.9 Watts or 0.22%.

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