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OVERCOME VOLTAGE DROP BY UPRATING CONDUCTORS USING ETAP SOFTWARE

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ABSTRACT

This research aims to find out the percentage of network end voltage drop in PU.1 refiners, find out the effect of load breakdown and conductor uprating in PU.6 refiners on the improvement of end voltage quality in PU.1 refiners, and get the results of network end voltage drop analysis on PU.1 Refiners with ETAP 12.60 software. The research method was used in the form of a method of simulating voltage drop calculation using Etap 12.60 software. The data is taken in the form of long data, cross-sectional area, voltage, and distribution network load. From the results of the study obtained the percentage drop of the end voltage before uprating the conductor and the load breakdown on the PU.6 refiner on the measurement results are the voltage at the End Load = 24.12 %, the voltage in the Middle Load = 18.09 % and the voltage in the Load Is Even = 12.06 %. There is a voltage drop at the end of the distribution system network with the lowest end voltage at the end load, which is 15.1 kV and there is a voltage drop of 24.12%. After uprating conductor and breaking the load on the PU.6 refiner, the voltage at the end load at PU.1 at the ETAP result is 18.03 kV.

Keywords: Voltage Drop, Conductor Uprating, Distribution Network, ETAP Simulation

INTRODUCTION

This research was conducted at PU.1 Refiners in the working area of PT. PLN (Persero) Rayon Perbaungan with a long medium voltage network service area (JTM) and has the largest load among other travelers. People, especially in the village of Pantai Kelang (the end of the network), often there is the dimming of lighting lights or water machines that do not work optimally that occurs at night commonly called peak load time (WBP). This situation continues continuously, so a step is needed to overcome this problem. Therefore, research was conducted on the effect of load breaking and conductor uprating to overcome the drop voltage in PU.1 refiners. Overcome it by uprating conductors on PU.6 refiners where the cross-section area of conductors is still small because it still has a small load and a short voltage network so that it can break a load of PU.1 refiners as part to PU.6 refiners by using simulation of ETAP 12.60 applications[1], [2].

1. Electrical Quality

There are 2 (two) things that are a measure of electrical quality, namely voltage, and frequency[1][3].

a. The service voltage is determined by:

1) The voltage tolerance limit, in TM consumers, is (5%), while in consumer TR maximum + 5% and minimum - 10%.
2) Voltage balance at each connection point

3) Flickering due to the smallest possible loading
4) Loss of voltage for a moment due to maneuvering as quickly as possible

b. Frequency

The frequency tolerance limit is (1% of the standard frequency of 50 Hz)[4], [5].
Factors that make the quality of electricity in terms of distribution is the loading factor in the distribution system, namely unstable loading due to normal operation or because more due to disruptions in supply from GI and refinery[6].

2. Consistency of Loading Against Network Pattern Standards

In the operation of the Medium Voltage Power Grid, loading should not exceed the nominal capability of the network that has been planned, so that voltage drop and technical shrinkage are achieved[7], [8].

Table 1. AAAC Delivery

φ (mm2)	35	50	70	95	120	150	185	240
Δ V (%)	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00
R (Ω/km)	0,9774	0,6842	0,4887	0,3601	0,2851	0,228	0,1849	0,1432
X (Ω/km)	0,0536	0,0665	0,0754	0,0884	0,0957	0,1028	0,1094	0,1175
Cos φ	0,85							

Tables 2. Load Against TM AAAC Length Allowed For COS φ= 0.85, ΔV=5%

Load	Permitted Jtm Length (Kms) Per Type Of Delivery							
MVA	*35 mm2*	*50 mm2*	*70 mm2*	*95 mm2*	*120 mm2*	*150 mm2*	*185 mm2*	*240 mm2*
1,0	23,27	32,42	43,92	56,66	68,24	80,54	92,95	109,04
1,5	15,52	21,62	29,28	37,78	45,50	53,70	61,97	72,70
2,0	11,64	16,32	21,96	28,34	34,13	40,28	46,48	54,53
2,5	9,31	12,97	17,57	22,67	27,30	32,22	37,18	43,62
3,0	7,76	10,81	14,64	18,89	22,75	26,85	30,99	36,35
3,5	6,65	9,26	12,55	16,19	19,50	23,02	26,56	31,16
4,0	5,82	8,11	10,98	14,17	17,06	20,14	23,24	27,26
4,5	5,17	7,21	9,76	12,59	15,17	17,90	20,66	24,23
5,0	4,66	6,49	8,78	11,33	13,65	16,11	18,59	21,81
5,5	4,23	5,90	7,99	10,30	12,41	14,65	16,90	19,83
6,0	3,88	5,40	7,32	9,44	11,37	13,43	15,49	18,18
6,5	3,58	4,99	6,76	8,72	10,50	12,39	14,30	16,78
7,0	3,33	4,63	6,27	8,10	9,75	11,51	13,28	15,58
7,5	3,10	4,32	5,86	7,56	9,10	10,74	12,39	14,54
8,0	2,91	4,05	5,49	7,08	8,53	10,07	11,62	13,63
8,5	2,74	3,81	5,17	6,67	8,03	9,48	10,94	12,83
9,0	2,59	3,60	4,88	6,30	7,58	8,95	10,33	12,12
9,5	2,45	3,41	4,62	5,97	7,18	8,48	9,79	11,48
10,0	2,33	3,24	4,39	5,67	6,82	8,06	9,30	10,91

That is in section C - Voltage The end of the voltage drop is as follows[1]:

$$\% \text{ Drop Voltage} = (P*L*(R*\cos\theta + X*\sin\theta)*100)/(KV)^2$$

Where:
P = Channeled Nominal Power (MVA)
R = Network Resistance (ohm /km)
X = Network Reactance (Ohm/km)
L = Network length (km)

RESEARCH METHODS

The research method was used in the form of a method of simulating voltage drop calculation using Etap 12.60 software. Data were taken in the form of long data, cross-sectional area, voltage, and distribution network load.

Specifications of JTM

The following is a table of data on the type and size of cables delivering medium voltage network distribution systems of pu.1 and PU.6 refiner distribution network:

Tables 3. Data Length and Extent cross-section of Turtle Conductors PU.6

No	Point	Channel Length (Kms)	Conductor Kind	Conductor Size (mm2)
1	GI – End Voltage	16,300	AAAC	3x70

Average load data table on the Extension medium voltage network distribution system PU.1 and PU.6 Measurement results for 3 days.

Tables 4. Load Measurement Data on Refiners PU.1

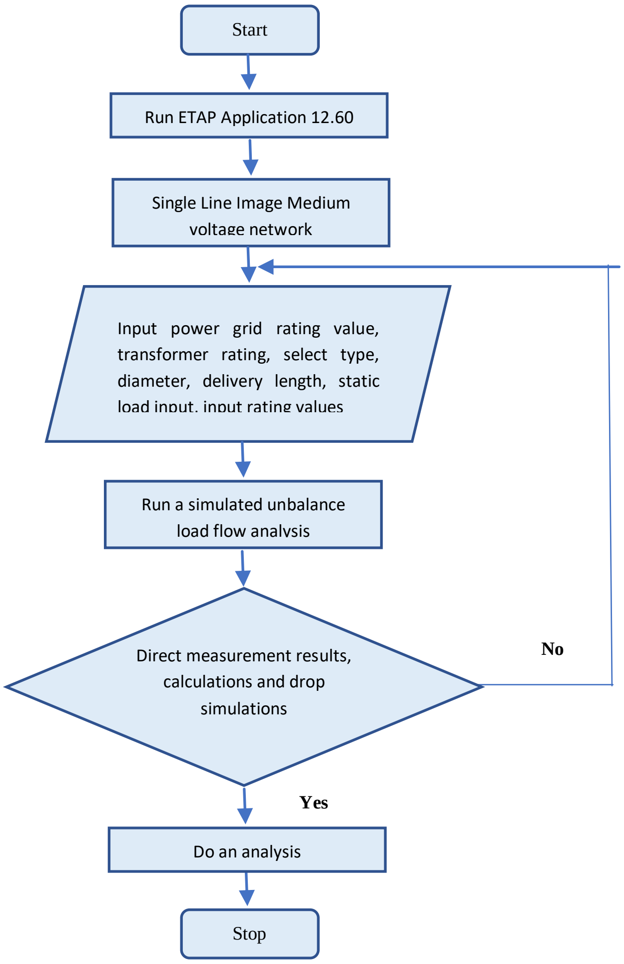
No	**Medium Voltage Network Point**	**Current (A)**
1	GI – Section A	63
2	Section A – B	34
3	Section B – C	42
4	Section C –Teg Ujung	68

The amount of load on the PU.1 Refiner is 202 A or 6.9 MVA Of Channeled Power.

Tables 5. Load **Measurement Data on Refiners PU.6**

No	**Medium Voltage Network Point**	**Current (A)**
1	GI –End Voltage	30

The steps of the study are illustrated in the research flow diagram below.



Figures 2. Flowchart Calculation of Voltage Drop Turtle PU.1

RESULTS AND DISCUSSIONS

From the results of calculations, it is known that the lowest voltage in PU.1 Refiners is at the end voltage, which is 15.1 kV, or there is a voltage drop of up to 24.12%. In addition to using reference data calculation results, the Author also analyzed the results of the simulation of the ETAP 12.60 application. The lowest voltage also occurs in the middle load voltage of 16.3 kV, or there is a voltage drop of up to 18.09%. Both results of the analysis showed that on the distribution network supplied from JTM Refinery PU.1 there has been a considerable voltage drop, and has exceeded the SPLN standard 72, 1987. By the voltage regulations determined by PLN, the network design on the system is boiled in the design so that the voltage fall at the end does not exceed 10%. One way to overcome the problem of end voltage drop is by uprating conductors and load solving, with the principle of working to divide the two loads contained in the previous refiner, PU.1 to other refiners (PU.6). Uprating conductors and breaking this load will have a good impact on the quality of electrical energy distribution voltage. From the results of the ETAP simulation can be known the voltage of the end of the PU.1 Refinery after uprating the conductor and the breakdown of the load to the PU.6 refiner has increased.

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4.1. For The Load at the End of the Turtle PU.1

Based on the data length and area of the cross-section in table 4. as well as data on the load measurement of the PU.1 Refinery distribution network in table 3, can be calculated the voltage drop for the load at the end of the network. That is in section C - Voltage The end of the voltage drop is as follows:

Cos θ = 0,85 (0,90) ,
Sin θ = 0,526 (0,435)
KV= Voltage L-L (20 kV)
%Drop Voltage = 6.9 x 78.2 (0.157 x 0.85 + 0.087 x 0.526) x 100)/(20)^2 =539.58 (0.133+0.045) x 100 / 400 = 24.12 % or 15.1 KV
So drop the voltage onsection C- Voltage The end of the magnitude up to 24.12% or 15.1 kV.

4.2. For The Burden in the Middle of The Turtle PU.1

In section B-section C the magnitude of the voltage drop can be calculated as follows:
% Drop Voltage = 6.9 x 78.2 (0.157 x0.85+ 0.087 x 0.526) x 0.75 x 100)/(20)^2 = 539.58 (0.133 + 0.045) x 0.75 x 100/400 =18.09 % or 16.3 KV
So drop the voltage in section B -section C magnitude up to 18.09 % or 16.3 kV

4.3. For The Burden of Even Turtles PU.1

In section GI-section A the magnitude of the voltage drop can be calculated as follows:
% Drop Voltage = 6.9x78.2 (0.157 x 0.85 + 0.087 x 0.526) x 0.50 x 100)/(20)^2 = 539.58 (0.133+0.045) x 0.50x 100/400 = 12.06 % or 17.5KV
Here are the results of the voltage drop simulation in the ETAP application

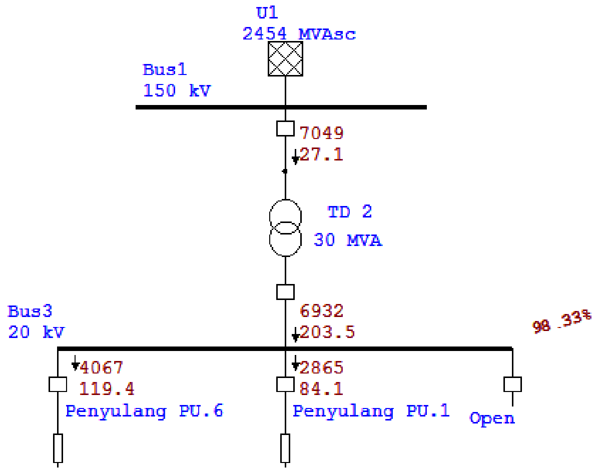
Tables 6. ETAP Voltage Drop Simulation Data

No	End Voltage (kV)	Voltage in the middle (KV)	Base Voltage (kV)
1	16.3 kV	17.4 kV	18.3 kV

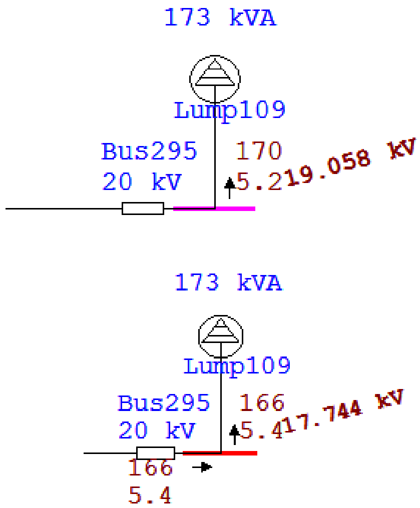
Tables 7. Comparison of Drop Voltage Teg End Simulation and Calculation Results

No	Data Base	*Drop Voltage* (kV)
1	Account	15.2
2	ETAP	16.3

By uprating, the conductor and breaking the load to the pu.6 comb refiner, the PU.6 refiner will support the remaining load of the PU.1 refiner, namely in Section B to the end tension, with a load of 119 A while PU.1 is 84 A following the results of the ETAP simulation in figure 9. PU.1 refiners who have the latest load of 84 A with a voltage value of 19 kV which was initiated with a load of 202 A the voltage value at the location of 17.7 kV can be seen in comparison to the results of the ETAP simulation in the image.



Figures 3. Results of ETAP Simulation of Turtle Load PU.1 and PU.6



Figures 4. Results of ETAP Simulation of Refinery Load Before and After PU.1 and PU.6

CONCLUSION

PU.1 refiners have a relatively large load of 202 A and also a long TM network is a factor causing a voltage drop. Percentage drop of end voltage before uprating conductor and load breakdown on PU.6 refiners on the measurement results are: voltage at Ujung Load: 24.12%, voltage in Middle Load: 18.09%, and voltage in Load Evenly: 12.06%. There is a voltage drop at the end of the distribution system network with the lowest end voltage at the end load, which is 15.1 kV, or there is a voltage drop of 24.12%. After uprating the conductor and breaking the load on the PU.6 refiner, the voltage at the end load at PU.1 at the ETAP result is 18.03 kV.

REFERENCE

[1] Umar and N. A. Murtadho, "Analysis voltage drop and alternative network manuvers in BRG-4 recovery PT. PLN (Persero) Salatiga service unit using etap power station 12.6," *AIP Conf. Proc.*, vol. 2114, 2019, doi: 10.1063/1.5112465.

[2] C. H. B. Apribowo, G. Faradiba, F. Adriyanto, and O. Listiyanto, "Study Analysis of Voltage Drop in a

Typical Office Building Lighting System: A Case Study of of FEM IPB Building Electrical Installation," *J. Electr. Electron. Information, Commun. Technol.*, vol. 1, no. 1, p. 26, 2019, doi: 10.20961/jeeict.v1i1.34510.

[3] L. Zhang, T. Ba, and X. Luo, "Research on High Voltage Capacitor Voltage Drop Device," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 466, no. 1, 2018, doi: 10.1088/1757-899X/466/1/012066.

[4] E. Wang and B. Huang, "Calculation and verification of voltage drop when starting tunnel axial-flow fan," *J. Phys. Conf. Ser.*, vol. 1187, no. 2, 2019, doi: 10.1088/1742-6596/1187/2/022068.

[5] F. Shahnia, "Analysis and Correction of Voltage Profile in Low Voltage Distribution Networks Containing Photovoltaic Cells and Electric Vehicles," no. August, Australia: Queensland University of technology, 2011, pp. 1–216.

[6] T. Gonen, *Electric Power Distribution Engineering*, Third edit., vol. 148. francis: CRC Press Taylor & Francis Group, 2014.

[7] M. H. Rashid, *Power Electronics, Circuits, Devices and Applications*, Third Edit., vol. 148. New Jersey: Prentice Hall, Englewood cliffs.

[8] W. Hofmann and W. Just, *Compensation a Practical Guide*, First edit. New Delhi, India: Wiley, 2012.