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by Alimuddin Alimuddin

A POWER CAPASITOR OPTIMUM PLACEMENT ON TRANSMISSION EMPLOYING GENETIC ALGORITHM COMPUTATION METHOD

Alimuddin[1], Yulis Tristyanto[2],Supriyanto[3],
[1, 2, 3] Department of Electrical Engineering Faculty of Engineering Sultan Ageng Tirtayasa University (UNTIRTA)
Jl. Jendral Sudirman Km 03, Cilegon, Banten, Indonesia, 42435
[1]alimudyuntirta@yahoo.co.id, [2]leez_go@yahoo.com, [3]supriyanto@ft-untirta.ac.id

Abstract— *the capacitor has been widely applied in electric power distribution system to reduce power loss and loss-energy, discharge capacity of the system, and to keep the voltage profile within the limits allowed. To determine the location of the optimal installation of capacitors, required an appropriate method so that the results can effect for improvement of voltage, reduction in power loss and loss-cost savings. The genetic algorithm is one method that has been widely applied to optimization problems. By using the method of genetic algorithm, optimal capacitor installation location on pulmonary channel was on the Bus with a size of 150 kVAR 4, Bus 8-size 1650 kVAR, and 12 Buses with the size of the 1950 kVAR. Large reduction in power loss-loss obtained i.e. 66,729 kW and annual cost savings of Rp. 428.459.891.5. The magnitude of the values of minimum and maximum voltage is 0,954 pu and 0,976.pu*

Keywords: determination of the optimal location, capacitors, genetic algorithm

I. Introduction

The capacitor has been widely applied in electric power distribution system to reduce power loss and loss-energy, discharge capacity of the system, and to keep the voltage profile within the boundaries permitted [1]. Capacitor placement issues include determining the number, location, size, and type of capacitor that is optimal in order to be able to minimize the cost of annual loss-power loss and cost to use capacitor. But to choose the optimal location of the capacitor is no easy matter, because of the determination of the location of the concerning to do with the costs which have been mentioned above.

Systems of artificial intelligence or artificial intelligence are known by many as scientists developed a solution to resolve the problem. One branch of artificial intelligence that have been applied to the problem of determining the location of genetic algorithms [2]. This method aims to solve a variety of complex problems because it has very different probability algorithms of other random algorithm which combines elements of a stochastic basis tracking and targeted advertising.

Research on installation of capacitors has been mostly done by some researchers with different resolution methods of [3, 4, 5]. Research by using fuzzy logic 6 has resulted in a reduction in power loss and loss-repair voltage in the system. The expected voltage condition however has not been in accordance with the standard limit are allowed. Further research about the improvement effort exposed the factors of power using a capacitor. Of such research, power factor improvement resulting in annual cost savings but do not include the cost of the capacitor as a consideration in installation of capacitors. [7]

Based on this, in this thesis will expose mounting research on the capacitor by using one of the methods of artificial intelligence systems algorithms to genetics. With this research, is expected to obtain repair loss-power loss and voltage on the system optimally considering the limitations of standard voltage is allowed as well as the annual cost of the capacitor.

The first research discusses the determination of location of switched 20 kV power capacitors. The method of this research is conducted by calculating the voltage drop and the system power factor, capacitors placement optimization is done using a program Borland Delphi 5.0. Doing research on channels Jatirogo in East Java. [3] The results showed that after the installation of 900 kVAR capacitor on 627, Channels Jatirogo having power factor improvement to 0.99 and the increase of voltage of 4,141.

The Second research discusses the determination of optimal location of power capacitor in Substation Hyphen Jantho. The method of this research is conducted by calculating the voltage drop of mounting a power capacitor based on distance to the bus using the ETAP programmed Power Station. This research was conducted at 20 kV distribution system.[4] The results showed that after the installation of the capacitors of 1600 kVAR, bus voltage improvement experienced Tanoe Abee of 6.78 6.72 of Jantho, buses, buses and bus 5,43 Saree of Lamteba of 5,43.

The third research discusses the improvements in distribution system voltage profile primer using a capacitor. The method of this research is conducted by calculating the voltage profile on a channel then does the installation and optimization of capacitor capacity using the program EDSA Technical 2000. This research was conducted on cahnnels Shrinkage in the Network Area of East Bali. [5].The results showed that after program optimization using EDSA Technical 2000, then the location of the installation of the capacitors on the channels shrink was 34,022 km from the source of electricity or on the bus with a capacity of 70 A capacitor of 2100 kVAR. The lowest voltage conditions that previously experienced by bus 97 A, increased after the installation of the capacitors. If the original amount of 17.94 kV, now risen to 19.07 kV.

The fourth research discusses the optimization of placement of capacitors using methods of fuzzy logic. This research was conducted on the system bus using an IEEE program 33 MATLAB. [6] The results showed that after a capacitor placement optimization using fuzzy logic, then obtained a reduction in power loss and loss-repair voltage. The initial power loss loss-which was originally the magnitude of 202, 68 kW, are now reduced to 145,287 kW. Condition of the original voltage profile 0,913 pu, experienced a slight increase being 0,936 pu.

Goal study is: the first, to know the value of loss – loss of power, voltage and the annual costs on the distribution system before the installation of the capacitors, the second. To know the optimum capacitor location in order to provide loss-reduction of power loss, repair of the voltage and the annual cost savings in distribution systems using genetic algorithms. The third, to find out the value of repair loss-loss of power, voltage and annual fees that accrue after the installation of the capacitors.

II. RESEARCH METHOD

In this study, the instruments used consisted of research data and tools. Research Data includes data distribution system pulmonary tract Tangerang and cost data. Substation electrical substation is Singapore Carriers that serve the needs of load with voltage of 20 kV. This flow of electricity mains substation to substation through the distribution channel. Lung line is one of the channels that the electricity supplied from the transformer Substation of stem 3 Tangerang. The channel has a pretty big burden because of the burden that is borne the burden of the industry. In addition it also has sufficient electricity transmission line length when compared to other channels. Based on the foregoing, it is in the study of pulmonary tract will become objects in the collection of research data

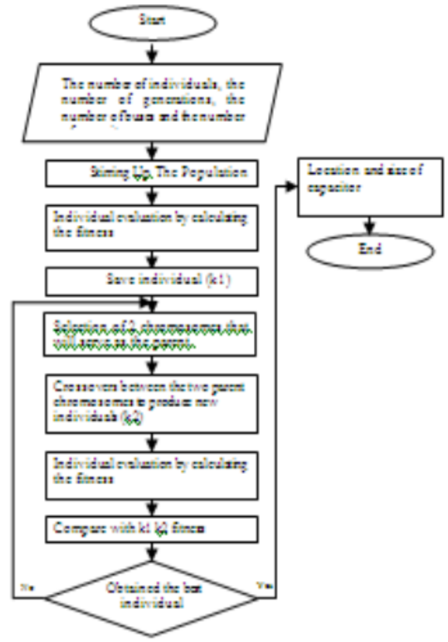

Figure 1. Flowchart of Capacitor Determination with Genetic Algorithm.

III. RESULT AND DISCUSSION

Conditions Before the Installation of the Capacitors Before Determining the mounting Location of the capacitor,

Prior to the installation of capacitors, advance power flow analysis is performed to determine the initial conditions of the pulmonary tract. The result can be seen in Table 1

Table 1 the initial conditions of the system

Number Bus/Subtation	Name Bus/Subtation	Voltage (pu)	Ompisation	
			P (kW)	Q (kVAR)
2	KC.39	0,951	189,775	50,791
3	KC.273	0,947	122,815	12,329
4	TG.311	0,929	108,235	50,45
5	KC.161	0,925	397,276	255,577
6	TG.47A	0,921	309,399	232,049
7	TG.47	0,917	162,107	89,691
8	TG.294A	0,913	147,674	81,706
9	TG.294	0,911	584,789	353,180

10	KC.164K	0,909	1323,144	506
11	TG.292	0,904	958,843	599
12	KC.291	0,904	230,39	88,13
Power Losses Total (kW)				373,109
Cost of Years (Rp)				2.441.520.825,480

Description: the number 1 Bus is a bus that has a reference voltage of 1 pu and have no imposition, so in this table do not need to be listed.

According to Table 1, be seen that the voltage condition of each bus/substation low enough. The voltage for the bus number 3 to 12 were below the allowable standard voltage condition. 2 Mounting location of the optimal mounting location determination of Capacitors capacitors by done by genetic algorithms. By doing a running program by as much as 10 times, then the obtained results in the form of a combination of the mounting location of the capacitor is accompanied by its size. The result can be seen in Table 2.

Table .2 Location And Size Of Capacitor

Combination	Location And Size Of Capacitor (kVAR)
1	Bus 3=150, Bus 7=1650, Bus 11=1950
2	Bus 4=1200, Bus 5=1500, Bus 8=1350, Bus 12=600
3	Bus 4=1350, Bus 5=1950, Bus 12=900
4	Bus 3=300, Bus 6=600, Bus 7=1950, Bus 8=1650
5	Bus 3=900, Bus 4=750, Bus 7=2100, Bus 8=1200, Bus 9=150
6	Bus 6=600, Bus 8=150, Bus 9=1650, Bus 10=1650
7	Bus 3=1350, Bus 4=300, Bus 5=450, Bus 8=1200, Bus 9=1800
8	Bus 2=1500, Bus 3=1200, Bus 5=1200, Bus 10=1650
9	Bus 3=1650, Bus 4=450, Bus 8=1500, Bus 9=900, Bus 12=450
10	Bus 4=1650, Bus 6=1050, Bus 8=600, Bus 12=1650

The magnitude of the influence of each capacitor mounting combination against a reduction in the total power losses can be seen in Figure 2

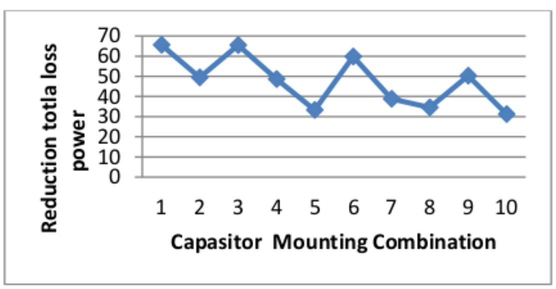

Figure 2. The Mounting Influence Of Capacitors On Power Loss-Loss Reduction Total

Based on Figure 3, a combination installation of capacitors to 1 capable of delivering a reduction in loss-greater power loss compared to the other capacitor installation combinations. This is apparent from the graph that has the highest saving position between positions mounting the capacitor combination more.

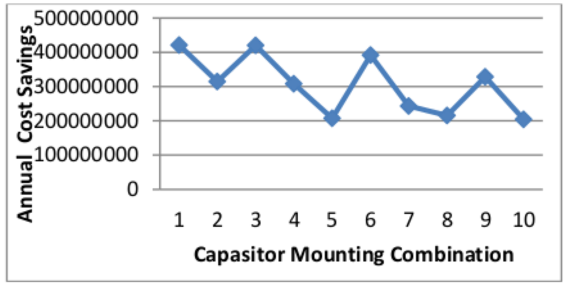

Figure 3. The Influence Of Installation Of Capacitors To The Annual Cost Reduction

Based on Figure 3 mounting the capacitor combination, look number one able to provide annual cost reductions even greater when compared to the other capacitor installation combinations.

Conditions after the installation of the Capacitors after determining the mounting location of the capacitor,

The capacitor combination is capable of delivering improved loss-power loss total and annual cost savings is best combination to 1. The location of the installed capacitor i.e. bus 4 = 150 kVar, bus 8 = 1650 kVar and bus 12 = 1950 kVar. The result can be seen in Table 5.3

Table.3 Final Conditions

Name Bus/Subtation	Voltage (pu)	Ompisation	
		P (kW)	Q (kVAR)
KC.39	0,974	189,775	50,791
KC.273	0,972	122,815	12,329
TG.311	0,966	108,235	50,45
KC.161	0,964	397,276	255,577
TG.47A	0,964	309,399	232,049
TG.47	0,961	162,107	89,691
TG.294A	0,959	147,674	81,706
TG.294	0,958	584,789	353,180

KC.164K	0,956	1323,144	506
TG.292	0,956	958,843	599
KC.291	0,955	230,39	88,13
Total Power Losses(kW)			307,51
Cost of Years (Rp)			2.020.308.337

IV. CONCLUSION

Based on the research that has been conducted on Lung Channels, optimal capacitor mounting locations are on a Bus sized 4 with 150 kVAR, Bus 8-size 1650 kVAR, and 12 Buses with the size of the 1950 kVAR. After the installation of the capacitors, the condition of Lung channels experienced improvements in terms of loss-power loss, annual fees and voltage. The initial power losses which was originally the magnitude of 373,109 kW, reduced to 306,38 kW. The annual fee of the amount of Rp. 2.441.520.825,480, reduced to Rp. 2.020.308.337. Value. The minimum and maximum voltage is 0,954 pu and 0,976 pu. The value of the savings obtained after installation of capacitors for power losses total is 66,729 kW. While the savings rate for annual fee is Rp. 428.459.891.5.

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Alimuddin is PhD specialization Control, Computer, Conversion Energy, Information Communication Technology, Telecommunication and Lecture the Department of Electrical Engineering and Faculty of Engineering, Sultan Ageng Tirtayasa University (UNTIRTA), Banten, Indonesia, Megister Engineering Informatics and Megister Information Management Graduate Binus University (BINUS) Jakarta, Megister electrical engineering, Graduate Mercubuana University (UMB) Jakarta, Megister computer science graduate STIMIK Nusa Mandiri Jakarta, He received B.S.and Megister Management from Indonesia Moeslem University and Megister Engineering for Electrical Engineering from Hasanuddin University. Makassar, Indonesia in 1999, 2002 and 2003 respectively. He is a Doctor at the Bio-Informatics and Control, Instrumentation Engineering, Conversion Energy Bogor Agricultural University (IPB), Indonesia. He followed Sandwich Program research in Grant in University of Tsukuba, Japan, 2009 sponsored by Government of Indonesia (the Ministry of Education and the State Ministry of Indonesia)., He has more than 15 years of experience in teaching several Universities. His research interests include Control System, Telecomunication, ICT, Model and Simulation, Artificial Intelligent and its application. optimization and information system, Energy Conversion System, Information Technology and Computer, Distribution System, Power System Control and optimization, Transportation. He has published more than ten papers national Journal. He has also presented more than twelve research articles in national and international conferences. He is currently with few projects sponsored by government of Indonesia (the Ministry of Education and the State Ministry).

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