

ORIGINAL ARTICLES

System Loss Reduction of a Test Distribution System by Selecting Open points

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ABSTRACT

The aim of this paper is to represent the system loss reduction of a test distribution system by selecting open points. The main theme for opening point is to reduce the system losses while maintaining supply for all stations. To get the minimum power losses, only one open point can be selected between two substations at one time. If blackout happened in some other substation when choosing the opening point, that opening point is consider not suitable for the system. The system is designed such a way that can ensure the reliability and quality of the power system along with the reduction of system loss.

Key words: Test distribution system, system loss, selecting open point, power quality

Introduction

About 40 percent of electric energy produced by power plants is lost during transmission and distribution to consumers (Feng *et al.*, 2009). Generation, transmission and distribution are the main parts of the power system. The electricity is generated in the power station, which is installed with generators, control and instrumentation equipments, switchgears and other associated plants and equipments (Hannan *et al.*, 2005, Salam *et al.* 2010). Transmission lines are required to transport the bulk electricity from the power stations to various locations to enhance supply reliability as well as to achieve effective utilization of power (Hannan *et al.*, 2009). Transmission of electricity is usually at high voltage so as to reduce transmission losses, substations equipped with transformers are required to step down electricity from high voltages to low voltages to suit the requirements of the various categories of consumers such as commercial, industrial and domestic (Sallehuddin *et al.*, 2009, Hannan *et al.*, 2011, Ghani *et al.* 2012). At present the transmission system in Malaysia is at voltages of 66kV, 132kV, 275kV. Electrical energy is distributed to consumers via distribution system. The distribution system represents the final linkage between the consumers and the power stations and the distribution process starts at the termination of the transmission lines at distribution substations domestic (Hannan *et al.*, 2012, Ghani *et al.* 2012, Subiyanto *et al.*, 2011). The voltage is then stepped down by step down transformers to supply to the load centers via the distribution network. The distribution voltages used in Malaysia are 33 kV, 11 kV and 415/240.

This paper deals with the test distribution system that was given as project based learning (PBL) task. Methodologies and a real time simulation of the given task has been developed for audit base case load flow and short circuit and electromagnetic transient analysis. In the simulation, protection scheme reduce the system losses, improve the protection of the proposed network system, analyze the inrush current and frequency and maintain the reliability of the power system (Hannan *et al.*, 2004, Benmouyal *et al.* 1999, Yorkshire Electricity, Verma *et al.*, 1979).

Test Distribution System:

A distribution system comprises of network operating at medium voltage (MV) and low voltage (LV) levels that obtains power from the transmission network or the grid (Hannan *et al.*, 2006, Hannan *et al.*, 2009). In some cases, the distribution network may also have embedded generators connected to it. Most customers are connected to the distribution network at MV or LV levels. In this project, the distribution network is connected to the grid with some loads being supplied by a remote mini-hydro (Mhydro) generating unit (Hannan *et al.*, 2012, Subiyanto *et al.*, 2011). The following sections describe a distribution network and to complete the project tasks, it will be necessary for modeling the network and obtain the correct load flow and short-circuit results.

The commercial software named ETAP Power System (Electrical Transient Analyzer Program) is used because it is one of the widely used software for industrial power system. In addition to that, it has the capability of designing a power distribution system and also it is suitable in performing load flow and short circuit analysis.

The PSCAD/EMTDC software has also been considered for the purpose of capacitor switching study. PSCAD/EMTDC is a powerful and flexible graphical user interface, which is completely integrated to schematically construct a circuit, run simulation, analyze the results, and manage the data with a graphical environment and view the results directly during simulation. It is one of the most powerful and intuitive CAD software packages available.

Reducing Losses by Selecting Open Points:

The main idea for opening point is to reduce the system losses while maintaining supply for all stations. In order to decrease the losses, we have applied by selecting open point at one time method to analyze the load flow and determine the total demand, loads and losses using the ETAP software.

Selecting One Open Point at One Time:

To get the minimum power losses, only one open point is allowed to be set between two substations at one time, for example between the substations Paper Mill and the substation Hospital, the losses will be 1.51 MW as shown in Table 1.

Selection of 2 Open Points at One Time:

On the other hand, two open points set at one time as shown in Table 2 to Table 12. For example, one open point was put between Paper Mill and Hospital, another was put between Cowan and Plastic, therefore the loss is 1.83 MW. The losses are greater than the previous system which is 1.513 MW. So, the open point is not allowed. Results obtained are shown at tables below for all possible location. Open point is not allowed to be set at the security 1 area. SS A and B are fixed open point whereas C and D are new test point.

Table 1: System Losses for 1 Open Point for Each Selected Location For 1 Open Test Point

SS A	SS B	System Losses(MW)
Paper Mill	Hospital	1.51
Main Cowan 1		1.579
Main Cowan 2		1.579
Cowan	Plastic	1.814
Plastic	Fabric	1.67
Fabric	Cd-Rom	1.6
Main Durian		1.541
Durian	Kelapa	1.523
Kelapa	Kgboh	1.516
Main Papermill2		1.571
Main Papermill1		1.571
Main Jaya		1.607
Jaya	Sun	1.586
sun	Puchong	1.556
Puchong	Hospital	1.537

Table 2: System Losses for Fixed Point between SS Paper Mill and Hospital For 2 Open Test Point

SS A	SS B	SS C	SS D	System Losses(MW)
Paper Mill	Hospital	Main Cowan 1		1.586
		Main Cowan 2		1.586
		Cowan	Plastic	1.83
		Plastic	Fabric	1.699
		Fabric	Cd-Rom	1.638
		Main Durian		1.624
		Durian	Kelapa	1.599
		Kelapa	Kgboh	1.585
		Main Papermill2		1.694
		Main Papermill1		1.694
		Main Jaya		Blackout
		Jaya	Sun	Blackout
		Sun	Puchong	Blackout
		Puchong	Hospital	Blackout

Table 3: System Losses for Fixed Point at Main Cowan 1 For 2 Open Test Point

SS A	SS B	SS C	SS D	Power Losses(MW)
Main Cowan1		Main Cowan 2		2.604
		Cowan	Plastic	1.83
		Plastic	Fabric	1.699
		Fabric	Cd- Rom	1.638
		Main Durian		1.625
		Durian	Kelapa	1.6
		Kelapa	Kgboh	1.588
		Main Papermill2		1.637
		Main Papermill1		1.637
		Main Jaya		1.673
		Jaya	Sun	1.653
		Sun	Puchong	1.622
		Puchong	Hospital	1.596

Table 4: System Losses for Fixed Point at Main Cowan 2 For 2 Open Test Point

SS A	SS B	SS C	SS D	Power Losses(MW)
Main Cowan 2		Cowan	Plastic	1.83
		Plastic	Fabric	1.699
		Fabric	Cd-Rom	1.638
		Main Durian		1.625
		Durian	Kelapa	1.6
		Kelapa	Kgboh	1.588
		Main Papermill2		1.637
		Main Papermill1		1.637
		Main Jaya		1.673
		Jaya	Sun	1.653
		Sun	Puchong	1.622
		Puchong	Hospital	1.596

Table 5: System Losses for Fixed Point between SS Cowan and Plastic For 2 Open Test Point

SS A	SS B	SS C	SS D	Power Losses(MW)
Cowan	Plastic	Plastic	Fabric	Blackout
		Fabric	Cd-Rom	Blackout
		Main Durian		Blackout
		Durian	Kelapa	Blackout
		Kelapa	Kgboh	Blackout
		Main Papermill2		1.865
		Main Papermill1		1.865
		Main Jaya		1.9
		Jaya	Sun	1.88
		Sun	Puchong	1.85
		Puchong	Hospital	1.831

Table 6: System Losses for Fixed Point between SS Paper Mill and Hospital For 2 Open Test Point

SS A	SS B	SS C	SS D	Power Losses(MW)
Plastic	Fabric	Fabric	Cd-Rom	Blackout
		Main Durian		Blackout
		Durian	Kelapa	Blackout
		Kelapa	Kgboh	Blackout
		Main Papermill2		1.721
		Main Papermill1		1.721
		Main Jaya		1.756
		Jaya	Sun	1.736
		Sun	Puchong	1.706
		Puchong	Hospital	1.687

Table 7: System Losses for Fixed Point between SS Fabric and CDRom For 2 Open Test Point

SS A	SS B	SS C	SS D	Power Losses(MW)
Fabric	CDRom	Main Durian		Blackout
		Durian	Kelapa	Blackout
		Kelapa	Kgboh	Blackout
		Main Papermill2		1.651
		Main Papermill1		1.651
		Main Jaya		1.686
		Jaya	Sun	1.666
		Sun	Puchong	1.636
		Puchong	Hospital	1.617

Table 8: System Losses for Fixed Point at Main Durian For 2 Open Test Point

SS A	SS B	SS C	SS D	Power Losses(MW)
Main Durian		Durian	Kelapa	Blackout
		Kelapa	Kgboh	Blackout
		Main Papermill2		1.592
		Main Papermill1		1.592
		Main Jaya		1.627
		Jaya	Sun	1.607
		Sun	Puchong	1.577
		Puchong	Hospital	1.558

Table 9: System Losses for Fixed Point between SS Durian and Kelapa For 2 Open Test Point

SS A	SS B	SS C	SS D	Power Losses(MW)
Durian	Kelapa	Kelapa	Kgboh	Blackout
		Main Papermill2		1.581
		Main Papermill1		1.581
		Main Jaya		1.609
		Jaya	Sun	1.589
		Sun	Puchong	1.559
		Puchong	Hospital	1.541

Table 10: System Losses for Fixed Point between SS Kelapa and Kgboh For 2 Open Test Point

SS A	SS B	SS C	SS D	Power Losses(MW)
Kelapa	Kgboh	Main Papermill2		1.574
		Main Papermill1		1.574
		Main Jaya		1.602
		Jaya	Sun	1.582
		Sun	Puchong	1.559
		Puchong	Hospital	1.534

Table 11: System Losses for Fixed Point at Main Paper Mill 2 For 2 Open Test Point

SS A	SS B	SS C	SS D	Power Losses(MW)
Main Papermill2		Main Papermill1		1.763
		Main Jaya		1.766
		Jaya	Sun	1.733
		Sun	Puchong	1.679
		Puchong	Hospital	1.641

Table 12: System Losses for Fixed Point at Main Paper Mill 1 For 2 Open Test Point

SS A	SS B	SS C	SS D	Power Losses(MW)
Main Papermill1		Main Jaya		1.766
		Jaya	Sun	1.733
		Sun	Puchong	1.679
		Puchong	Hospital	1.641

Conclusion:

This paper has described a methodology that selects one or to open points to reduce system loss of a test distribution system. Several tests were performed using the ETAP software, and the results have shown that selecting one open point is better than selecting two open point. These solutions have produced more efficient configurations of a test distribution system. Thus, the performance of the distributed system has been considerably enhanced and the system can be applied to real distribution networks.

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