Proceedings of Symposium on Electrical, Mechatronics and Applied Science 2018 (SEMA'18), pp. 117-118, 8 November 2018

Comparative Studies of Bus Voltages and Power Losses of Power System Networks

Noor Ropidah Bujal[1*], Marizan Sulaiman[2], Meysam Shamshiri[3], Naji Eltawil[4] and Aida Fazliana Abdul Kadir[5]

[1, 2, 3, 5)] Centre for Robotics and Industrial Automation (CeRIA), Faculty of Electrical Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia
[4)]Higher Institute for Water Technology, Agelat, Libya

noorropidah@gmail.com

Keywords: Power World, OpenDSS, load flow analysis

ABSTRACT – This paper compares the performance of four software packages namely Power World, OpenDSS, DIgSILENT, and MATLAB and presents the efficient method to perform power flow analysis. The software packages are tested on IEEE 14-bus system and IEEE 30-bus test system. Therefore, this paper presents the results of voltage magnitude and active power losses obtained by Power World and OpenDSS. To verify the effectiveness, the results will be compared to the results from the DIgSILENT Power factory (14 Bus) and MATLAB simulation tools (30 Bus). The results indicate the efficient method to be used in an author's future research.

1. INTRODUCTION

Voltage instability issues of the power system are directly related to load buses. It is occurring when the bus voltage decrease below the allowable range due to power losses. High power losses will cause the voltage to drop at particular buses and the voltage can no longer support the loads that attach to the related load bus. It caused the power system tends to be collapsed due to serious voltage instability problem. Therefore, this research will focus mainly on the reduction of real power losses (P_L) because it is more significant in order to observe the voltage drop on the power system network buses. Thus, power flow studies will present the overall performance of the network.

2. METHODOLOGY

Two test systems have been chosen as the case for power flow studies which are IEEE 14-Bus system and IEEE 30-Bus system as shown in Figure 1 and Figure 2.

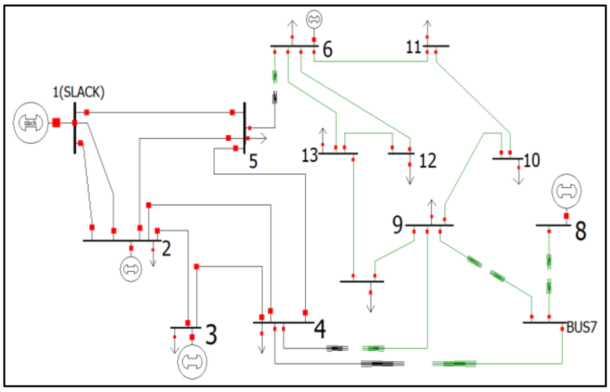

Figure 1 IEEE 14-Bus Network

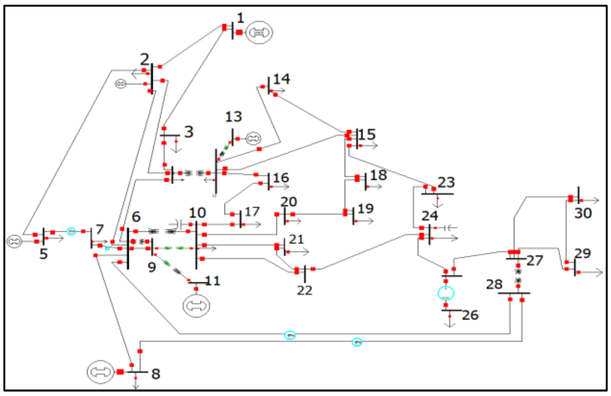

Figure 2 IEEE 30-Bus Network

The main objective of load flow analysis is to calculate unspecified bus voltages magnitude and angles at each bus in the steady state, active and reactive powers, line loadings and their connection real and reactive losses for a certain generation and load conditions[1-2]. In this paper, power flow analysis is done to obtain the bus voltages and power losses. The simulation is carried out using Power World, OpenDSS, DIgSILENT and MATLAB [2,3,4].

3. RESULTS AND DISCUSSION

Table 2, Table 4, Figure 3 and Figure 4 show the bus voltages of IEEE 14-bus and IEEE 30-bus network using three software respectively.

Table-2 Bus voltage of IEEE 14-Bus Network

Bus	PW	OpenDSS	DIgSilent
No.	**V (p.u)**	**V (p.u)**	**V (p.u)**
1	1.060	1.060	1.060
2	1.045	1.045	1.045
3	1.010	1. 009	1.010
4	1.019	1.020	1.019
5	1.020	1.024	1.020
6	1.070	1.033	1.070
7	1.062	1.040	1.062
8	1.090	1.076	1.090
9	1.056	1.028	1.056
10	1.051	1.021	1.051
11	1.057	1.023	1.057
12	1.055	1.018	1.055
13	1.051	1.014	1.050
14	1.036	1.003	1.036

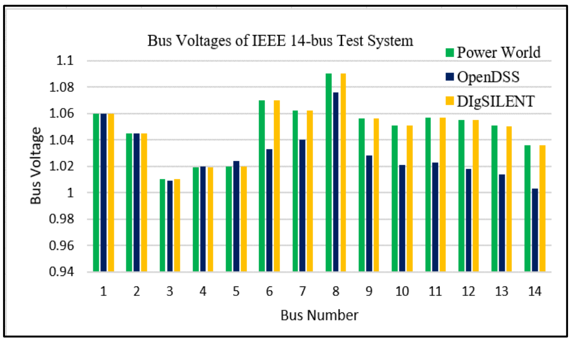

Figure 3 Bus Voltages of IEEE 14-bus Network

Table 3 Power Losses of IEEE 14-Bus

Power World		OpenDSS		DIGSilent	
MW	MVAR	MW	MVAR	MW	MVAR
13.39	26.20	13.26	24.70	13.39	26.20

Table 4 Bus voltage of IEEE 30-Bus Network

Bus No.	PW V (p.u)	OpenDSS V (p.u)	MATLAB V (p.u)
1	1.060	1.060	1.060
5	1.010	1.010	1.010
10	1.047	1.045	1.044
15	1.040	1.037	1.038
20	1.032	1.030	1.029
21	1.035	1.033	1.032
22	1.036	1.033	1.033
23	1.030	1.027	1.027
24	1.024	1.022	1.022
25	1.021	1.017	1.019
26	1.004	1.000	1.001
27	1.028	1.023	1.026
28	1.011	1.007	1.011
29	1.008	1.003	1.006
30	0.997	0.992	0.995

Table 5 Power Losses of IEEE 30-Bus Network

Power World		OpenDSS		DIGSilent	
MW	MVAR	MW	MVAR	MW	MVAR
17.58	22.08	17.55	33.05	17.59	22.24

Load flow analysis is carried out for IEEE 14-bus test systems using Power World and OpenDSS software denote to simulation results from DIgSILENT Power Factory as a reference. While load flow analysis for IEEE 30-bus is carried out by using Power World and OpenDSS software and are compared with the result from MATLAB in [3] as a reference.

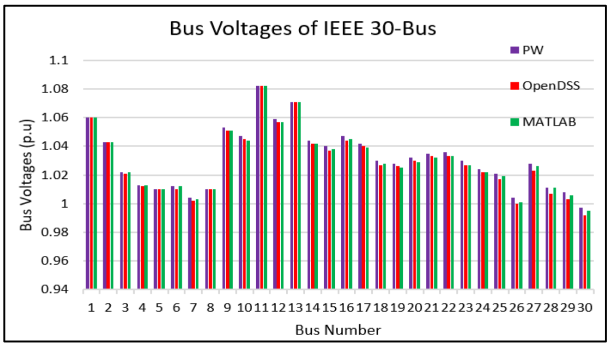

Figure 4 Bus Voltages of IEEE 30-bus

As can be seen in Figure 3, per unit voltage from Power world gives better bus voltage and all bus voltage are more than 1p. u and the value are almost very similar to reference. All three software presents that bus 3 had the lowest bus voltage 1.01p.u. While as in Table 4, the results from Power World were really close to MATLAB compared to OpenDSS. However, the results from OpenDSS are still acceptable. Figure 4 shows the bus voltage IEEE 30-bus system by using three software with bus 7 and bus 26 have low bus voltages.

Table 3 and Table 5 present the power losses for IEEE 14-bus and IEEE 30-bus network using three software that mentions above. As can be seen in both table, power losses using power world was more accurate to compare with using OpenDSS. In this case, active power losses, P_L(MW) are more significant in the power system to monitor the voltage drop at each line. Commonly, power losses (MW) in a transmission system happen through heat dissipation and will increase if the line current increase as in equation (1). While reactive power losses, Q_L (MVAR) are an exchange of energy stored in term of an electric field or magnetic field.

$$P_L = I^2R \quad (1)$$

4. CONCLUSION

The comparative studies showed that Power World, OpenDSS and DIgSILENT give the same results on average. However, the Power World presents more precise results compare to OpenDSS. Therefore, both software can be utilized in investigating voltage stability indices efficiently.

REFERENCES

[1] Dharamjit and D.K Tanti. (2012). Load Flow Analysis on IEEE 30 bus System, *Int. J. Sci. Res. Publ.*,2(11)1–6.

[2] K. S. Sastry Musti, R. B. Ramkhelawan, and K. S. Sastry. (2012). Power System Load Flow Analysis using Microsoft Excel. *eJSiE*, 6(1).

[3] H. Kaur and J. S. Randhawa. (2010). Optimal Power Flow Using Power World Simulator in *2010 IEEE Electrical Power & Energy Conference*, 1–6.

[4] D. Montenegro, M. Hernandez, and G. A. Ramos. (2012). Real time OpenDSS framework for distribution systems simulation and analysis. *2012 Sixth IEEE/PES Transm. Distrib. Lat. Am. Conf. Expo.*, 1–5.