COST OF SECURITY IN POWER SYSTEM TRANSMISSION

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ABSTRACT

This paper presents the cost of security in power system transmission sector. The implementation is done by doing the analysis of the security action available. The cost comparison between the security actions could be seen by doing the simulation using MATLAB (MATPOWER). Security cost analysis is important in electricity markets to address the correlation between market operation and power system operation. Moreover, by doing this analysis, it will help utilities to provide the suitable and best action taken for certain contingencies. This will improve the operation and transmission of the electricity to consumers. Consumers also will get benefits from the good service by paying less of electricity. This paper also can be used as a reference to utility so that one day Malaysia could have its own Voltage of Lost Load (VoLL). The analysis could be used as a solution for short and long term period. For example, if one area having electric breakdown frequently, therefore a solution to make sure the cost of security action taken is reasonable and compatible at that time as well as in future consequences.

ABSTRAK

Tesis ini membentangkan tentang langkah-langkah keselamatan di dalam Sistem Kuasa dari segi kos penyempurnaan dan perlaksanaan. Kajian yang dilaksanakan adalah berdasarkan rumusan daripada MATLAB (MATPOWER) yang digunakan sebagai alat untuk menjana jumlah kos yang diperlukan sekiranya beberapa langkah keselamatan di dalam Sistem Kuasa dilaksanakan oleh pihak pengurusan. Kos keselamatan di dalam Sistem Kuasa amat penting ke atas ekonomi dan pasaran elektrik yang berhubung kait di antara pasaran operasi dan operasi Sistem Kuasa. Selain itu, pihak pengurusan dapat menentukan di antara langkah keselamatan yang diambil dalam masa yang sama memberikan impak yang baik ke atas kos operasi dan sebagainya. Dengan cara ini, pihak pengurusan dapat menyelenggarakan Sistem Kuasa dengan lebih baik kerana bijak mengatur strategi. Di samping itu, dengan kos penghantaran elektrik yang rendah sekaligus menguntungkan para pengguna sendiri. Selain itu, tesis ini juga amat berguna kepada pihak pengurusan elektik negara kerana mungkin dapat menggunakan semua data sebagai rujukan untuk menghasilkan voltan terbeban yang hilang (Voltage of Lost Load) tersendiri. Contohnya, satu kawasan yang

kerap berlakunya gangguan bekalan elektrik. Dengan penyelesaian yang dibuat dan kos yang kompetitif bukan sahaja dapat menyelesaikan masalah untuk sehari malah dapat digunakan untuk jangka masa yang panjang.

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CHAPTER I

INTRODUCTION

1.1 Project Background

Security of supply has been always been a key factor in the development of the electric industry. Adequacy, quality of supply, stability, reliability and voltage collapse along with costs have been always carefully considered when planning the future of the electric power system. Since 1982, when world's deregulation process started, the introduction of the competition at generation level brought new challenges, while the proper operation of the electric power system still require physical coordination between non cooperatives agents. The increasing development of SCADA/EMS systems, the growing number of market participants and the development of more

complex market schemes have been more and more relying on Information Technologies, making the physical system more vulnerable to cyber security risks. Now cyber security risks look bigger than the physical ones.

Maintaining power system security is one of the major challenges facing transmission system operators today. In fast moving and de-regulated electricity markets, transmission companies across the globe often have a dual and conflicting responsibility for maintaining system security and for achieving high transmission performance levels. These increased pressures are set against a backdrop of higher system loads, greater interconnection of networks and increasingly diverse generation sources – factors which combine to create a higher potential for system instability. The power system security is defined as the degree to which the performance of electrical system could results in power being delivered to consumers within accepted standards and in desired amount. There are two concepts; adequacy and security. Adequacy is the ability of a power system to supply consumers' the electric power and energy requirements at all times. It implies that sufficient generation and transmission resources are available to meet projected needs plus reserves for contingencies. Security is the ability of power system to withstand sudden disturbances and the power system will remain intact even after outages or equipment failures.

1.2 Objective & Scope of Study

Objective and scope of study are as follows:

a) To determine the security action/strategy that could be taken if disturbance occurred at any single transmission line with such contingency analysis without violating normal operating conditions.
b) To study the security actions available if disturbances occurred in a transmission line.
c) To identify the security action that will be implemented for the system in order to overcome the problem without violating the normal operating conditions.
d) To compare all the security actions in terms of cost for implementation and operation.
e) To analyze the best strategy among all in terms of cost comparison.
f) The project will be focused on the three security actions such as,
    i. Load Shedding Analysis
    ii. Re-scheduling the Power Generation
g) To study on the cost of implementation and operation for all the security actions.

1.3 Research Methodology

Research methodology will be conducted as follows:

i. The project will be focused on the security actions such as load shedding analysis and re-scheduling the power generation.
ii. The IEEE 14-Bus Test System is used to perform the simulation of load bus.

References

[1] Power System Security, S. Sterpu, Member IEEE, W. Lu, Y.Besanger, Member

IEEE, N. HadjSaid, Member, IEEE.

[2] Power system static security assessment and evaluation using external system equivalents, J. Srivani, K.S. Swarup.

[3] Cost based reactive power pricing with voltage security consideration in restructed power systems, C.Y. Chung, T.S. Chung, C.W. Yu, X. J. Lin.

[4] John J.Grainger,William D. Stevenson,Jr , " Power System Analysis", McGraw Hill International Editions.

[5] Visualizations for Power System Contingency Analysis Data, Yan Sun, Student Member, IEEE, and Thomas J. Overbye, Senior Member IEEE.

[6] Effect of demand prioritization and load curtailment policy on minimum emission dispatch, George A. N. Mbamalu.

[7] Low Power System Scheduling and Synthesis, Niraj K. Jha, Department of Electrical Engineering, Princeton University, Princeton, NJ 08544.

[8] Power Systems Volatge Security Assessment and Optimal Load Shedding by CBR Approach, N. P. Patidar, Non-member, Jaydev Sharma, Non-member.

[9] The Effects of Generation Redispatch on Hopf Bifurcations in Electric Power Systems.

[10] Security and Vulnerability in Electric Power Systems, David Watts.

[11] Valuation of reactive power support services based on sensitivity and risk analysis, Nan Xu[a,b,*] , C. W. Yu[b] , F. S. Wen[a,c] .

[12] Re-Dispatching Generation to Incraese Power System Security Margin and Support Low Voltage Bus, Ronghai Wang, Student Member, IEEE, Robert H. Lasseter, Fellow, IEEE.

[13] "An Overview of Selected Studies on the Value of Loss Load (VOLL)" [Online]. Available in http://www.power.uwaterloo.ca, [Accessed on Oct 20, 2009].

[14] " A quarterly electronic newsletter on renewable energy and environment" [Online]. Available in http://www.terienvis.nic.in, [Accessed on Oct 20, 2009].

[15] "Budgetary Cost and Preliminary Dimensions and Weights" [Online]. Available in http://www.nepsi.com, [Accessed on Sept 11, 2009].

[16] "Power Plant Cost Index: Coal Plant Construction Presents a Low Cost Option" [Online]. Available in http://www.reuters.com, [Accessed on Oct 15, 2009].

[17] "Thermal Power Plant" [Online]. Available in http://www.ecoling.ch, [Accessed on Oct 20, 2009].

[18] "Value of Lost Load – A Critical Parameter for Optimum Utility Asset Investment" [Online]. Available in http://metalab.uniten.edu.my, [Accessed on Sept 11, 2009].

[19] "Load Shedding Scheme Protects Utility from Voltage Collapse" [Online]. Available in http://tdworld.com, [Accessed on Oct 20, 2009].

[20] "Renewable Resources" [Online]. Available in http://www.oregon.gov, [Accessed on Sept 11, 2009].

[21] “Dynamic Competition in Electricity Markets: Hydropower and Thermal Gneration” [Online]. Available in http://www.parisschoolofeconomics.eu, [Accessed on Sept 9, 2009].

[22] “Cost and Performance Baseline for Fossil Energy Plants” [Online]. Available in http://www.netl.doe.gov, [Accessed on Sept 9, 2009].

[23] “Electric Power Plant” [Online]. Available in http://blog.maxdunn.com, [Accessed on Sept 6, 2009].

[24] “Comparisons with other methods of energy production” [Online]. Available in http://www.vae.lt, [Accessed on Sept 6, 2009].