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Two-Phase Optimal PMU Placement Considering Complete Topological Observability Level for Single Line Contingency

Y. Matsukawa[1], M. Watanabe[1], Y. Mitani[1], M. L. Othman[2]

[1]Depertment of Electrical and Electronic Engineering, Kyushu Institute of Technology, 1-1 Sensui-cho, Tobata-ku, Kitakyushu, 804- 8550, Japan

[2]Center for Advanced Power and Energy Research (CAPER), Department of Electrical & Electronic, Faculty of Engineering, University Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

*****Corresponding author's e-mail: p349532y@mail.kyutech.jp

Abstract. In order to monitor constantly power systems states, the accurate monitoring technique by Phasor Measurement Unit (PMU) has drawn attention. The use of the PMU as a meter in state estimation for constant understanding the power system state will improve the estimation accuracy and the computational burden. However, the number and the location of installed PMUs that realize topological observability for state estimation have to be optimized because of the economic perspective. Furthermore, the PMU measurement network redundancy for a single line contingency in a power system needs to be taken into account. Hence, this research proposes an optimal PMU placement by a two-phase optimization method. The first phase strategy minimizes the number of placed PMUs and the second phase strategy maximizes a PMU measurement redundancy index called Complete Topological Observability Level (CTOL) for a single line contingency. Improving the CTOL means that the PMU placement has higher possibility to carry out state estimation by complete topological observability. Because of the problem characteristics, Mutation and Reposition Binary Particle Swarm Optimization (MRBPSO) for the first phase, and Simulated Annealing (SA) for the second phase are applied to solve the problem. As a result of optimization, the suboptimal solution in the second phase is improved compared to the first one in each parametric constraint in example power systems of IEEE 57-bus and RTS-96.