

## **Voltage Stability Index Calculation by Hybrid State Estimation Based on Multi Objective Optimal Phasor Measurement Unit Placement**

### **ABSTRACT**

Operation of a power system close to the voltage stability limit due to increasing of load demand and limited power sources may result in disastrous economic loss with voltage collapse of the entire power system. A system operator has to understand how far the system is from the critical boundary of the voltage collapse. This paper investigated the influence of State Estimation (SE) in the calculation of the Critical Boundary Index (CBI) as a voltage stability index. For SE, Hybrid State Estimation (HSE), including the measurement set of both Remote Terminal Unit (RTU) in Supervisory Control and Data Acquisition (SCADA) and Phasor Measurement Unit (PMU), is employed. Concurrently, the CBI is estimated using voltage phasor estimated by HSE based on optimal PMU location, which is selected from a Pareto optimal front obtained by the Non-dominated Sorting Genetic Algorithm II (NSGA-II). As a result of CBI estimation, HSE using PMU is relatively accurate in voltage stability index estimation compared to SCADA SE, which uses the RTU alone. However, when a mixed measurement condition in some lines affects the CBI estimation, it is suggested that it may be necessary to discard PMU measurements in some cases.

**Keyword:** Phasor measurement unit; Voltage stability; Voltage collapse; Multi objective optimization; State estimation