

In the distribution management system (DMS), an essential application for the energy efficiency improvement is loss reduction. Loss reduction often involves the control of reactive power (var) resources to optimize the var flow in the network. Traditionally, most available var resources in the distribution network have been switchable shunt capacitor banks. Today distributed energy resources (DER) are becoming another significant var resource due to their increasing penetration, which brings new opportunities as well as challenges for loss reduction. This paper proposes an advanced loss reduction approach to achieve the optimal control coordination among multiple capacitors and DERs. The proposed approach and solution are developed on the basis of the detailed multi-phase distribution network modeling and the state-of-the-art optimization technology. This work also investigates the impact of the DER var control on the loss reduction improvement and voltage violation correction. The effectiveness of the proposed approach is demonstrated on practical utility distribution circuits with varying degree of unbalance and model complexity. The performance of the solution method proves the capability of online solution speed for large and complex distribution systems.

