Natural disasters, human errors, and technical issues have caused disastrous blackouts to power systems and resulted in enormous economic losses. Moreover, distributed energy resources have been integrated into distribution systems, which bring extra uncertainty and challenges to system restoration. Therefore, the restoration of power distribution systems requires more efficient and effective methods to provide resilient operation.

In the literature, using Q-learning and multiagent system to restore power systems has the limitation in real system application, without considering power system operation constraints. In order to adapt to system condition changes quickly, a restoration algorithm using Q-learning and multiagent system, together with the combination method and battery algorithm is proposed in this study. The developed algorithm considers voltage and current constraints, while finding system switching configuration to maximize the load pick-up after faults happen to the given system. The algorithm consists of three parts. First, it finds switching configurations using Q-learning. Second, the combination algorithm works as a backup plan in case of the solution from Q-learning violates system constraints. Third, the battery algorithm is applied to determine the charging or discharging schedule of battery systems. The obtained switching configuration provides restoration solutions without violating system constraints. Furthermore, the algorithm can adjust switching configurations after the restoration. For example, when renewable output changes, the algorithm provides an adjusted solution to avoid violating system constraints.

The proposed algorithm has been tested in the modified IEEE 9-bus system using the real-time digital simulator. Simulation results demonstrate that the algorithm offers an efficient and effective restoration strategy for resilient distribution system operation.

Major: Electrical Engineering

Educational Career:
Bachelor’s of Electrical Engineering, BS, 2015, South Dakota State University
Bachelor’s of Electrical Engineering, BS, 2015, Sung Kyun Kwan University

Committee in Charge:
Wei Sun, Chair, Electrical & Computer Engineering
Qipeng Zheng, Industrial Engineering & Management Systems
Qun Zhou, Electrical & Computer Engineering

Approved for distribution by Wei Sun, Committee Chair, on June 15, 2017.

The public is welcome to attend.