Renewable Integrated Multi-Area Smart optimization Framework for Distribution Network Operators

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Abstract:

Increasing population growth results in expansion of distribution grids by connecting multiple areas under a main distribution substation, owned by a single distribution network operator (DNO). Optimal operation of this multi-area grid is quite challenging as demand profile and load criticality level of a pure residential area is significantly different from that of an area containing both residential and commercial consumers. The solution process becomes further challenging because of penetration of distributed renewable energy resources and battery storages. Comparatively lesser computational burden makes conventional centralized optimization techniques attractive for energy management, however their lengthy solution time and biases towards critical customers are the main impediments to its real world implementation. Aiming to suggest a secure, reliable, unbiased, customer friendly, economic and fast energy management framework to DNO for serving multiple renewable penetrated areas, this article presents a Stackelberg Game based distributed optimization strategy. A detailed case study simulation has been demonstrated on a 132 bus distribution grid, having one substation with four underneath areas, to showcase a comprehensive study between centralized and proposed distributed optimization approaches for providing smart solutions to the DNOs.