

Distribution System Operator Services: A Comparative Assessment of Multi-Product Co-Optimization for Congestion Management and Voltage Control Using a Local Flexibility Market

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Abstract-

The increasing penetration of distributed energy resources into distribution grids poses significant planning and operational challenges for power systems, particularly for local congestion and voltage regulation. This paper presents an assessment of a multi-product and multi-service Local Flexibility Market (LFM) aimed at supporting distribution system operators (DSOs) in procuring flexibility products based on active (P) and reactive (Q) power for DSO services of congestion management (CM) and voltage control (VC). The proposed linearised LFM model incorporates AC sensitivity factors for network representation into the market-clearing formulation to capture non-linear interactions between flexibility procured from service providers and resulting grid impacts. Using a synthetic medium-voltage network derived from a real Polish grid, this paper evaluates the technical and economic performance of different service-product market designs (e.g. CMVC_PQ) to address local network needs. The results demonstrate that jointly P and Q in an LFM for CM and VC can significantly reduce DSO network needs and total flexibility procurement costs, compared to traditional single-service or single-product approaches. These findings underscore the value of coordinated market designs in effective and cost-efficient flexibility deployment in distribution grids.

Index Terms- Active power, congestion management, DSO services, flexibility products, local flexibility markets, reactive power, voltage control.

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