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Assessing the impact of inertia and reactive power constraints in generation expansion planning

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Abstract-

On the path towards power systems with high renewable penetrations and ultimately carbon-neutral, more and more synchronous generation is being displaced by variable renewable generation that does not currently provide system inertia nor reactive power support. This could create serious issues of power system stability in the near future, and countries with high renewable penetrations such as Ireland are already facing these challenges. Therefore, this paper aims at answering the questions of whether and how explicitly including inertia and reactive power constraints in generation expansion planning would a ect the optimal capacity mix of the power system of the future. Towards this end, we propose the novel Low-carbon Expansion Generation Optimization model, which explicitly accounts for: unit commitment constraints, Rate of Change of Frequency inertia requirements and virtual inertia provision, and, a secondorder cone programming approximation of the AC power ow, accounting for reactive power constraints. An illustrative case study underlines that disregarding inertia and reactive power constraints in generation expansion planning can result in additional system cost, system infeasibilities, a distortion of optimal resource allocation and inability to reach established policy goals.

Index Terms- Generation expansion planning; Inertia; Reactive power; Unit commitment

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