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Dynamic ramping model including intraperiod ramp-rate changes in unit commitment

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Abstract— The growing increase of renewable generation worldwide is posing new challenges for a secure, reliable, and economic operation of power systems. In order to face the uncertain and intermittent production of renewable sources, operating reserves must be allocated efficiently and accurately. Nowadays, these reserves are mainly assigned to thermal units, especially gas-fired generators, due to their operation flexibility and fast response. However, the ramping capabilities of these units define the grade of flexibility offered to the system operation. In practical applications, ramping limits are dynamic, i.e., they are a function of the unit's generating output. Omitting this feature leads to suboptimal or even infeasible reserve allocations, thus increasing not only operating reserve requirements but also transactions in real-time balancing markets needed to back up deviations of renewable generation. This paper contributes with a mixed-integer linear programming model for units' dynamic ramping allowing intraperiod changes in the unit commitment problem. As a result, operating reserves are better allocated and the units' flexibility is managed more efficiently than traditional ramping models found in the literature. Different case studies illustrate the functioning and benefits of the proposed formulation.

Index Terms— Dynamic ramping, mixed-integer linear programming, reserves, unit commitment, thermal units.

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