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Maximizing Profit Using Optimal Control by Exploiting the Flexibility in Thermal Power Plants

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Abstract : The next generation power systems are equipped with abundantly available free renewable energy resources (RES). During their low-cost operations, the price of electricity significantly reduces to a lower value, and sometimes it becomes negative. Therefore, it is recommended not to operate the traditional power plants (e.g. coal power plants) and to reduce the losses. In fact, it is not a cost-effective solution, because these power plants exhibit some shutdown and startup costs. Moreover, they require certain time for shutdown and also need enough pause before starting up again, increasing inefficiency in the whole power network. Hence, there is always a trade-off between avoiding negative electricity prices, and the startup costs of power plants. To exploit this trade-off and to increase the profit of a power plant, two main contributions are made: 1) introducing retrofit technology for state of art coal power plant; 2) proposing optimal control strategy for a power plant by exploiting different flexibility features. These flexibility features include: improving ramp rate of power plant, reducing startup time and lowering minimum load. While, the control strategy is solved as mixed integer linear programming (MILP), ensuring optimal solution for the profit maximization problem. Extensive comparisons are made considering pre and post-retrofit coal power plant having the same efficiencies under different electricity price scenarios. It concludes that if the power plant must remain in the market (providing services), more flexibility reflects direct economic advantage to the plant operator.

Keywords : discrete optimization, power plant flexibility, profit maximization, unit commitment model
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