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Evaluation of economic regulation in distribution systems with distributed generation

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Abstract

The economic regulation impact on distribution system investment is evaluated by a network expansion planning model in this paper. Distributed generation (DG) integration has been taken into consideration in network investment worldwide. In most studies DG units are planned by distribution system operators (DSOs). However, in some countries DSOs are not allowed to own generation due to unbundling regulation. In the proposed model formulation, DG units are not owned by the DSOs. Moreover, fluctuation from load and DG in the planning periods, DG curtailment possibility and regulation on losses and DG connection fees are altogether considered. Different regulation arrangements are studied in the same testing network and the resulting network expansion costs are compared. The main value of this paper lies in the application of network planning model to the economic regulation analysis, in the quantification of the impact of different economic regulation frameworks, and in the implications of different regulation choices concerning distributed generation integration.

Keywords: network planning, distributed generation, distributed generation integration, reinforcement, connection fee, economic regulation, curtailment, loss

1. Introduction

Distribution system operators (DSOs) are natural monopolies; therefore, regulation is implemented to direct their investments and operation decisions. This paper studies the impacts that different economic regulation frameworks have on the DSOs' cost for integrating distributed generation (DG).

1.1. Motivation

More DG is expected to be connected to the distribution network. Studies have shown that DG integration has the potential benefits of improving system reliability, efficiency [1], and deferring network investment [2, 3]. These benefits have been shown to be significant when DG units are planned by DSOs [4, 5, 6, 7]. However, the unbundling rules defined by European Directive [8] prohibit DSOs from

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