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# Managing Transmission Curtailment Risk in Wholesale Power Markets

*Risk resulting from transmission loading relief calls made by transmission system operators can be managed with information estimated by a statistical model capable of predicting one day in advance the probability that a particular wholesale power transaction might be curtailed. The model predicts this probability with a reasonable degree of accuracy using information on variables that can be obtained publicly.*

*Mathew J. Morey and Laurence D. Kirsch*

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## I. Introduction

The North American Electric Reliability Corporation (NERC) has established procedures by which transmission system operators can manage the flow of power on lines that approach their loading limits – that is, become congested. These procedures, which are known as transmission loading relief (TLR) calls, are used by transmission operators to limit flows on congested lines so that transmission reliability standards,

also set by NERC, can be maintained. TLR calls curtail transmission transactions in real time with very little notice. For power traders who engage in power transactions on a daily basis and rely on short-term non-firm transmission reservations to support them, TLR calls can prove costly when expensive substitutes must be found for the curtailed power. Consequently, in view of the uncertainty about the firmness of transmission service, power traders need to consider

transmission curtailment risk in valuing the forward transmission reservations they have made to support their power trades.

This article lays out a transmission curtailment risk management process that uses the logistic or “logit” statistical model to make day-ahead hourly predictions of TLR curtailment probabilities. This article draws upon earlier research (Morey *et al.*, 2007) sponsored by the Electric Power Research Institute (EPRI).

The article is organized as follows. Section II defines transmission deliverability risk and the typical circumstances that give rise to curtailments on transmission interconnections within the Eastern Interconnection. Section III reviews our TLR probability modeling method, which uses the logit model and depends upon publicly available data. Section IV addresses the predictive accuracy of the TLR forecasting model. Section V describes the process by which an estimated TLR forecasting model can be used on a day-ahead basis to assist a power trader in risk adjusting a transmission reservation. Section VI provides an example that illustrates the theoretical discussion of previous sections. Section VII offers conclusions.

## II. Transmission Deliverability Risk

“Transmission deliverability” refers to the availability of

transmission service to a particular customer, such as a power trader with a non-firm transmission reservation between source and sink points in two markets. Transmission availability depends on a variety of factors that affect transmission interface capacity and flows.

Transmission availability is determined by reliability coordinators (RCs) following procedures defined by the North

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American Electric Reliability Corporation (NERC). RCs monitor interconnected transmission systems and take appropriate remedial actions as determined by system conditions. They use a program called the Interchange Distribution Calculator (IDC) to determine whether transmission interface capacity is sufficient to handle all requested flows or whether the flow on any pathway needs to be reduced to maintain reliability standards.<sup>1</sup> When flows must be reduced, the RC declares that a transmission loading relief (TLR) call will be made in the next hour. The TLR call indicates the extent

to which each particular transmission line might require loading relief through generation redispatch or curtailment of some or all the transmission transactions that are contributing flow to the particular line.

The severity of TLR calls is indicated by a numbering system under which 0 represents no threat of transmission overload and values from 1 to 6 indicate contingencies of increasing severity. Transmission operators begin curtailing non-firm power transactions at TLR level 3, and may curtail firm transactions at level 4 depending upon the duration of the transmission reservation – longer duration reservations have higher priority and get curtailed last. At level 5, all non-firm transactions will be curtailed and firm transactions will be curtailed on a pro rata basis. Level 6 requires emergency actions that could deeply curtail significant numbers of transmission reservations on a particular interconnection.<sup>2</sup>

The value of transmission service between two locations depends primarily on the difference between the future expected spot prices at those locations. It also depends on the cost of the associated transmission reservation (i.e., the tariff wheeling rate).

A forward transmission reservation can be viewed as an option to obtain future transmission service. Consequently, it can be modeled

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