



## Transmission Penalty Factors

### Problem/Opportunity Statement

The transmission constraint penalty factors used by PJM in the market clearing software for the day ahead and real time markets affect market prices.<sup>1</sup> PJM has wide discretion related to the application of transmission constraint penalty factors and to changing associated transmission limits. The current PJM practice is to modify the market clearing so that the transmission constraint penalty factors do not directly set the constraint shadow price. The resulting clearing prices are inefficient and do not accurately reflect market conditions.

The transmission constraint penalty factors and the process used by PJM in applying transmission constraint penalty factors are not included in the PJM Tariff or Manuals.

### *Description*

In the PJM energy market security constrained economic dispatch, the objective is to minimize overall production cost while satisfying all applicable constraints, including transmission constraints. Regarding transmission constraints, PJM's goal is to maintain the power flow at or below the relevant line rating at a shadow price that is at or below the transmission constraint penalty factor. However, if there is no supply available to solve the constraint or if the cost of redispatch is greater than the transmission constraint penalty factor, the dispatch will violate the relevant line limit of the transmission constraint. Absent any intervention, the resulting shadow price of the transmission constraint and the locational marginal prices derived from those shadow prices reflect transmission penalty factors.<sup>2 3</sup>

PJM dispatchers have the discretion to lower the rated limits of constrained transmission lines under certain conditions. The adjusted line limits are used in the PJM market clearing engines. The line limits are one of the key parameters, along with the generator offer prices, generator parameters and the estimated load that affect market prices. For example, a lower line limit increases the likelihood of violating a transmission constraint, requiring use of a

---

<sup>1</sup> See "Information Only - Transmission Constraint Control Logic in Market Clearing Engines," PJM Market Implementation Committee – Special Session, March 8, 2016.

<sup>2</sup> Whenever a transmission constraint is violated the shadow price equals the transmission penalty factor. Whenever a transmission constraint is binding, the shadow price equals the savings from redispatching marginal generators due to a 1 MW increase in the specified line limit of the transmission constraint.

<sup>3</sup> The use of penalty factors is common in optimizations.

transmission penalty factor and higher LMP. The IMM believes it is important to have clear, transparent and unambiguous guidelines on changes in line ratings that are not based on a physical issue with a line because transmission line ratings affect market prices.

PJM's current practice is to avoid the direct use of the transmission constraint penalty factors as the constraint shadow price. Instead, PJM runs a second iteration of the optimization that increases the transmission constraint limit to ensure that the power flow is less than or equal to the limit. The resultant prices are inefficient and do not accurately reflect the local supply and demand conditions. In addition, PJM's use of transmission constraint relaxation procedures is not consistent with the way PJM calculates other scarcity prices. Reserve penalty factors from a defined ORDC are used to calculate reserve market clearing prices and locational marginal prices during reserve shortages.<sup>4</sup>

The policy on the use of the transmission penalty factors is not defined in the PJM Tariff or Manuals including: the level of penalty factors; the triggers for the use of penalty factors; the appropriate triggers for changing line limits; the appropriate magnitude of changes in line limits; the allowed duration for the change in line limits and the allowed duration of violations of transmission constraints.

The IMM believes it is important to have clear, transparent and unambiguous guidelines on all aspects of the use of transmission penalty factors in setting prices because transmission penalty factors affect market prices.

---

<sup>4</sup> See PJM Manual 11, Section 2.9.