

# **Constraint Specific Transmission Demand Curves – Comparison of ISO/RTO Transmission Shortage Treatment**

---

**Jennifer Boyle**

Associate Energy Market Design Specialist

MIWG

February 21, 2018, Krey Corporate Center



# Today's Agenda

- Project Plan/Deliverables
- Scope of Study
- ISO/RTO Transmission Shortage Summary
- Treatment of Transmission Shortages
  - NYISO
  - CAISO
  - ERCOT
  - ISO-NE
  - MISO
  - PJM
  - SPP
- Next Steps

# Project Objectives

- **The NYISO is considering ways to avoid potentially over and under valuing transmission constraints related to the current transmission constraint pricing (TCP) logic.**
  - Currently, the NYISO uses a single graduated mechanism to value all transmission shortages for facilities/Interfaces with a non-zero value constraint reliability margin (CRM).
- **The study will seek to identify under what system conditions transmission constraints may be over or under valued.**
  - Identify instances where a transmission constraint may be routinely “relaxed” because there are frequently insufficient resources to resolve the constraint.
  - Identify scenarios where a transmission constraint has a high Shadow Price which may be over valuing the reliability need.
  - The study will seek to determine the appropriate CRM level, if any, for facilities at less than the 230kV transmission level and the implications thereof on the application of a graduated pricing mechanism.

# Scope of Study

## Initial Step: NYISO staff will study:

1. The impact of the NYISO's implementation of revised TCP logic (implemented on June 20<sup>th</sup>, 2017), which included:
  - The modification of the value for the second step of the graduated Transmission Shortage Cost mechanism from \$2,350 to \$1,175/MWh.
  - The application of the graduated Transmission Shortage Cost mechanism more broadly to include all non-zero CRM facilities.
2. How other ISO/RTO's value transmission shortages.
3. How the NYISO values reliability, including factors such as CRM values, Shadow Price capping mechanisms, and "relaxation" of transmission constraints.

**Second Step: The NYISO will propose potential enhancements and conduct impact assessment to test concepts for improved transmission constraint pricing.**

**Third Step: The NYISO will publish a report summarizing the results of both proposed improvements and impact assessment, with recommendations for market enhancements.**

# Definitions

- **Constraint Relaxation** – Allowing a constraint such as a transmission limit to be modified to ensure that a commitment and dispatch solution can be achieved when available resources are insufficient to resolve the constraint(s). (Constraint is not priced).
- **Constraint Price Capping**– represents a parameter value limit at which the market software will relax a transmission constraint up to the capped limit rather than continuing to re-dispatch resources to relieve congestion. If there is a resource beyond the capped limit to resolve the constraint the capped limit will be used to price the constraint.
- **Demand Curve** – a graduated or stepped transmission shortage pricing mechanism that sets gradually increasing shortage prices, determined by the severity of the overload or other established factors (e.g., voltage level or operating conditions).

# ISO/RTO Transmission Shortage Summary

ISO/RTO	Terminology	Constraint Relaxation	Constraint Price Capping	Constraint Demand Curve	Constraint Demand Curve Steps	Constraint Demand Curve Cost Steps (\$/MWH)	Constraint Price Cap Limits
CAISO	Market Parameter Values		X				Varies by DA, 15min and 5min Mkts (\$1,000 - \$5,000)
ERCOT	Transmission Shadow Price Caps		X				Varies by Contingency and Voltage Level (\$2,800 - \$5,000)
ISO-NE	Transmission Constraint Penalty Factor (TCPF)	X	X				Not published in documents/Tariff
MISO	Transmission Constraint Demand Curves (TCDC)			X	Varies by Voltage Level and Overload	\$400 - \$4,000	
NYISO	Transmission Shortage Pricing	X	X	X	0 to 5, >5 to 20	\$350, \$1175	\$4000/MWh
PJM	Marginal Value Limits (MVLs)	X	X				\$1,000/MWh
SPP	Violation Relaxation Limits (VRLs)		X				Varies by percent of loading at network constraint (\$750 - \$1,500)

# NYISO's Treatment of Transmission Constraints

- The following limits on Shadow Prices are applied in instances of transmission shortages:

Type	Demand (MW)	Demand Curve Price (\$)	Price Cap
Facilities with non-zero CRM	Up to 5 >5 to 20	\$350 \$1,175	\$4,000
Facilities with zero CRM	N/A	N/A	\$4,000

- For facilities with a non-zero CRM, the software will seek redispatch at a shadow price up to \$4,000, with consideration of the 20 MW of relief afforded by the two-step demand curve.
- For zero CRM facilities the software will seek redispatch at a shadow price up to \$4,000, without consideration of 20 MW of relief afforded by the two-step demand curve.
- In situations where there are insufficient resources to resolve a constraint, the limit is increased to the flow that can be achieved on the constraint by the available resources, including, if applicable, consideration of the resource capacity made available by the demand curve MWs (i.e., 20MW). This is also known as “relaxation.”

# CAISO's Treatment of Transmission Constraints

- CAISO does not use a stepped demand curve to price transmission shortages. Instead transmission constraints may be relaxed at a price.
- CAISO uses specific “Market Parameter Values” (MVLs) in the context of the dispatch optimization, which govern the conditions under which constraints may be relaxed and the setting of market prices when any constraint is relaxed.
- Transmission penalty prices are based on two runs in the optimization software; the scheduling run value and pricing run value.
  - In the scheduling run, transmission constraints are enforced up to the point where the shadow price of the constraints reaches the applicable parameter value, at which point the constraint is relaxed. This run establishes the scheduled MW.
  - The pricing run parameter was established to match the bid cap and is currently set to \$1,000/MW.



# ERCOT's Treatment of Transmission Constraints

- ERCOT's "Shadow Price Caps" are intended to reflect the level of reduced reliability that occurs when a constraint is not able to be resolved
- Generic transmission Shadow Price Caps are used in the optimization software unless ERCOT determines that a constraint is irresolvable:
  - Base Case/Voltage Violation: \$5,000/MW
  - N-1 Constraint Violation
    - 345kV: \$4,500/MW
    - 138kV: \$3,500/MW
    - 69kV: \$2,800/MW
- ERCOT can modify the Shadow Price Cap value when a transmission network constraint is consistently irresolvable because the software is unable to find a dispatch combination to reduce the flows on the transmission element(s) of concern to a reliable operational level.
  - In these instances, the constraint regularly reaches the Shadow Price Cap,
  - The Shadow Price is recalculated based upon the mitigated offer cap of existing resources with a defined shift factor threshold.
- When a transmission network constraint violation occurs, the maximum shadow prices directly determine the LMP for ERCOT's real time market

# ISO-NE's Treatment of Transmission Constraints

- **ISO-NE does not use a demand curve to price transmission violations.**
  - “Transmission Constraint Penalty Factors” are used to allow the market software to achieve a feasible dispatch solution.
  - If a feasible solution is not found, system operators have the ability to relax the transmission limit.
- **Most transmission limits have built-in safety margins that are below the normal limit.**
  - Similar to the NYISO's Constraint Reliability Margins

# MISO's Treatment of Transmission Constraints

- MISO uses 2 groups of “Transmission Constraint Demand Curves” (TCDCs) to price transmission constraints during intervals in which a transmission constraint cannot be managed within its binding limit. “Market-to-Market Constraints” do not apply.
- Group 1 demand curves:

		Type and Voltage (V)			
		V <= 100kV	>100kV and <161kV	>= 161kV	IROL
		\$/MWh	\$/MWh	\$/MWh	\$/MWh
Binding Constraint Exceedance Percentage	>=102%	\$500	\$1,000	\$2,000	\$4,000
	>100% and <102%	\$400	\$700	\$1,000	\$3,000

Within Group 1, constraints associated with Transmission Loading Relief (TLR) events are defined as the MW amount above the binding limits.

Group 1		TLR \$/MWh
Constraint Exceedance MW	>= 10 MW	\$2,000
	>0 MW and < 10 MW	\$1,000

# MISO's Treatment of Transmission Constraints

- Group 2 demand curves (based on the potential impact on reliability):

Group 2		Type and Voltage (V)		
		V ≤ 100kV	>100kV and <161kV	V ≥ 161kV
		\$/MWh	\$/MWh	\$/MWh
Binding Constraint Exceedance Percentage	≥102%	\$1,000	\$2,000	\$3,000
	>100% and < 102%	\$700	\$1,000	\$2,000

Group 2 demand curves are utilized when constraints raise any of the following unique reliability issues:

1. The constraint is frequently violated for more than two consecutive intervals because it cannot be managed under Group 1.
2. The constraint is not subject to operating guides or other actions to manage flows that are available to other constraints in the same voltage class.
3. The operators believe the reliability consequences of allowing the flow to exceed the limit on the constraint are more severe than for the other constraints in the same voltage class.

# PJM's Treatment of Transmission Shortages

- **Use “Marginal Value Limits” (MVL).**
  - A transmission penalty factor associated with the violation of a transmission constraint.
  - Acts as a cap, the system will not dispatch beyond the MVL to control a constraint.
  - The default MVL for PJM constraints is \$2,000/MWh.
- **PJM does not use MVLs to set prices.**
  - In the case that a constraint is violated, PJM relaxes the limit on the constraint (increases it) in order to arrive at a feasible solution.
  - Typically the shadow price will then be set by a resource, not the transmission MVL.
  - LMP is not related to marginal unit offers
- **PJM is currently discussing options with its stakeholders to eliminate/reduce use of constraint relaxation and allow transmission penalty factor values to set price.**

# SPP's Treatment of Transmission Constraints

- SPP does not use a stepped demand curve to price transmission shortages. Instead transmission constraints may be relaxed at a price.
- SPP uses specific “Violation Relaxation Limit Values” (VRLs) which govern the conditions under which constraints may be relaxed and the setting of market prices when any constraint is relaxed.
  - Limits are applied in SPP’s day-ahead market, “Reliability Unit Commitment” (RUC) and “Real-Time Balancing Market” (RTBM) “Security Constrained Economic Dispatch” (SCED).
- SPP implements “stepped” VRLs dependent on the percentage of loading at each network constraint.
  - The VRL value limits the cost of redispatch by capping the shadow price depending on the level of the violation.

# Next Steps

- ✓ *December 5, 2017 - Present at MIWG meeting to review feedback and provide potential criteria for study.*
- ✓ *January 16, 2018 – Review NYISO’s historical analysis.*
- ✓ *February 21, 2018 – Review treatment of transmission shortages by other ISO/RTOs.*
- Q1 2018 – Continue analysis of NYISO’s current TCP logic.
- April 10, 2018 – Review NYISO’s reliability criteria
- Q2 2018 - Review concepts for potential enhancements to the current TCP logic and impact assessment plan.
- Q3 2018 - Complete study and present results.

# The Mission of the New York Independent System Operator, in collaboration with its stakeholders, is to serve the public interest and provide benefits to consumers by:

- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policy makers, stakeholders and investors in the power system



[www.nyiso.com](http://www.nyiso.com)



# References

- **CAISO**
  - Tariff Section 31.4, Uneconomic Adjustments in the IFM
  - Market Parameter Values <https://bpmcm.caiso.com/Pages/BPMDetails.aspx?BPM=Market%20Operations>.
- **ERCOT**
  - Methodology for Setting Maximum Shadow Prices for Network and Power Balance Constraints <http://www.ercot.com/mktrules/obd/obdlist>.
- **MISO**
  - Tariff Schedule 28-A Demand Curves for Transmission Constraints <https://www.misoenergy.org/legal/tariff/>.
- **PJM**
  - [Transmission Constraint Control Logic in Market Clearing Engines](http://ftp.pjm.com/~media/committees-groups/committees/mic/20170308/20170308-informational-only-transmission-constraint-control-logic-in-mces.ashx) <http://ftp.pjm.com/~media/committees-groups/committees/mic/20170308/20170308-informational-only-transmission-constraint-control-logic-in-mces.ashx>.
- **SPP**
  - Southwest Power Pool - Open Access Transmission Tariff, Sixth Revised Volume No. 1 - Attachment AE Integrated Marketplace - Attachment AE (MPL) Section 8 - Attachment AE (MPL) Section 8.3 - Attachment AE (MPL) Section 8.3.2 <https://www.spp.org/etariff/>.