Defining and Implementing Transmission Maintenance Performance Incentives in LMP Markets

Presented by
Scott M. Harvey

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The authors are or have been consultants on electricity market design and transmission pricing, market power or generation valuation for Allegheny Energy Global Markets; American Electric Power; American National Power; California ISO; Calpine Corporation; Centerpoint Energy; Commonwealth Edison; Constellation Power Source; Coral Power; Dynegy; Edison Electric Institute; Entergy (SeTrans); General Electric Capital; GPU; GPU Power Net Pty Ltd; GWF Energy; Independent Energy Producers Association; ISO New England; Midwest ISO; Northwest RTO; Morgan Stanley Capital Group; New England Power; New York Energy Association; New York ISO; New York Power Pool; Ontario IMO; PJM Supporting Companies; Reliant Energy; San Diego Gas & Electric; Sempra Energy; Mirant/Southern Energy; Texas Genco; Texas Utilities; Transpower of New Zealand Ltd; Westbook Power; Williams Energy Group; and Wisconsin Electric Power Company.

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TOPICS

- FTR Revenue Adequacy and Transmission Outages
- Transmission Maintenance Scheduling Incentive Problems
- Conceptual Issues in Assigning Responsibility for Outage Costs
- ISO Performance Incentive Programs
  - PJM
  - New York ISO
- Regulatory Issues Impacting Performance Incentives

FTR Revenue Adequacy and Transmission Outages

REVENUE ADEQUACY

Overview

An important property of financial transmission rights is "revenue adequacy." When there is congestion under locational pricing, the differences in locational prices will cause the ISO to collect congestion rents.

- Congestion rents, not auction revenues, fund payments to financial rights holders.
  - Revenue adequacy means that the congestion rents the ISO collects in charges for congestion using LMP pricing will be sufficient for it to meet its financial obligations to financial transmission rights holders, regardless of the actual usage of the grid.

REVENUE ADEQUACY SFT

In LMP markets such as those coordinated by New York, PJM, MISO and ISO-New England, FTRs are allocated and/or auctioned subject to a simultaneous feasibility test to provide reasonable assurance of revenue adequacy.

- *Any* simultaneously feasible set of net injections and loads can describe a set of revenue-adequate FTRs, and that set of FTRs will remain revenue-adequate for that grid *even if actual grid use differs from the set of injections and loads matching the FTRs*.
- The power of the revenue adequacy theorem is that FTRs will be revenue adequate not only when grid use (e.g., the day-ahead schedules) matches the FTRs owned by grid users but even when grid use is completely different from the FTRs owned by grid users, as long as the transmission grid itself remains available.

REVENUE ADEQUACY — FTR Obligations

The revenue adequacy test for FTRs is relatively straightforward to implement if FTRs are defined as obligations.

- FTR obligations entitle the holder to payments if the price differential between the FTR sink and source is positive, but require payments to the ISO if the price difference is negative.
- A set of FTR obligations is revenue adequate if the set of injections and withdrawals corresponding to the FTRs is simultaneously feasible in a contingency constrained dispatch of the same grid that is used to settle the FTRs.

Revenue adequacy does not depend on actual load levels or generation availability.

REVENUE ADEQUACY Day-Ahead v. Real-Time

Application of the simultaneous feasibility test when allocating or auctioning FTRs assures that if the awarded FTRs also satisfy this test for the transmission grid used to settle the FTRs, then the ISO will be revenue-adequate (i.e., the ISO will collect sufficient congestion charges in settling that market to pay FTR holders).

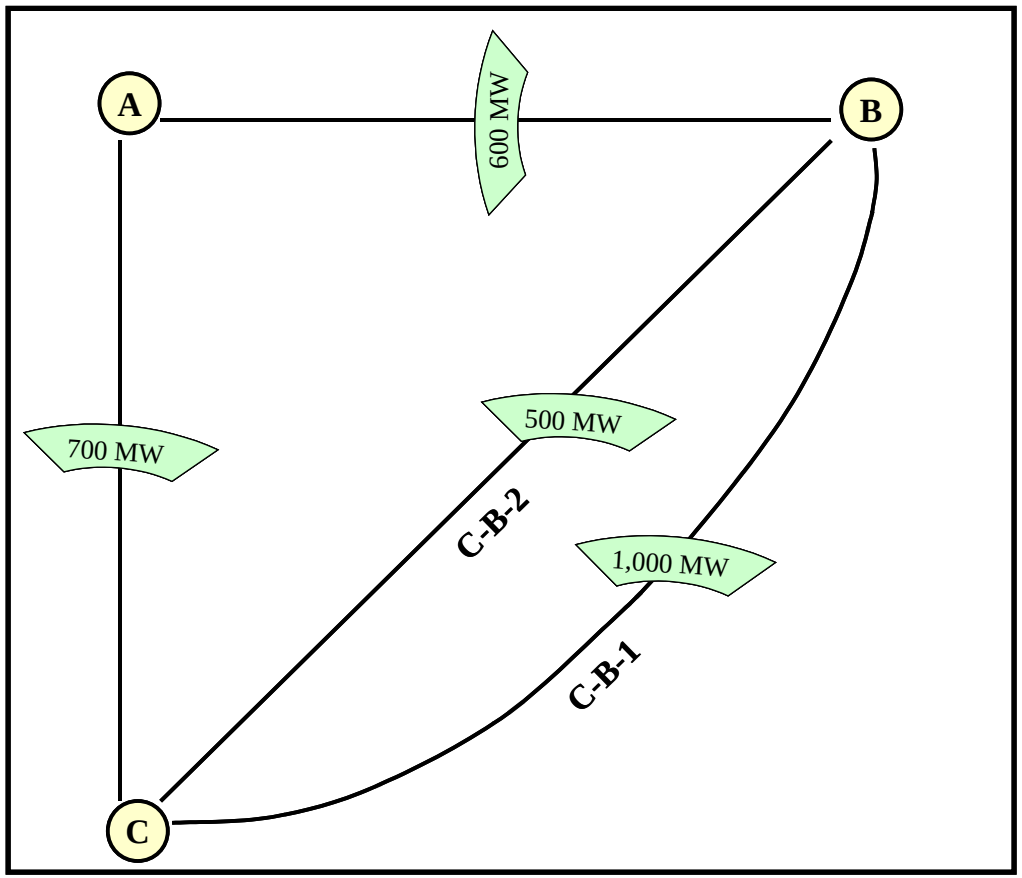
- Thus, if FTRs are settled in the day-ahead market and the awarded FTRs are simultaneously feasible on the transmission grid used to determine day-ahead schedules and prices, then the ISO will collect enough congestion rents in the day-ahead market to pay FTR holders.
- If there is no day-ahead market and FTRs are settled in the real-time market, then the ISO will be revenue-adequate if the awarded FTRs are simultaneously feasible on the real-time transmission grid.

REVENUE ADEQUACY — Impact of Outages

FTRs are not necessarily revenue adequate if the grid model used to test simultaneous feasibility is different from the grid model used to determine schedules, prices, congestion charges and payments to FTR holders (as a result, for example, of transmission outages).

Transmission outages impacting the market in which FTRs are settled that were not modeled in the simultaneous feasibility test used to allocate or auction these FTRs can result in the ISO collecting insufficient congestion rents to pay FTR holders.

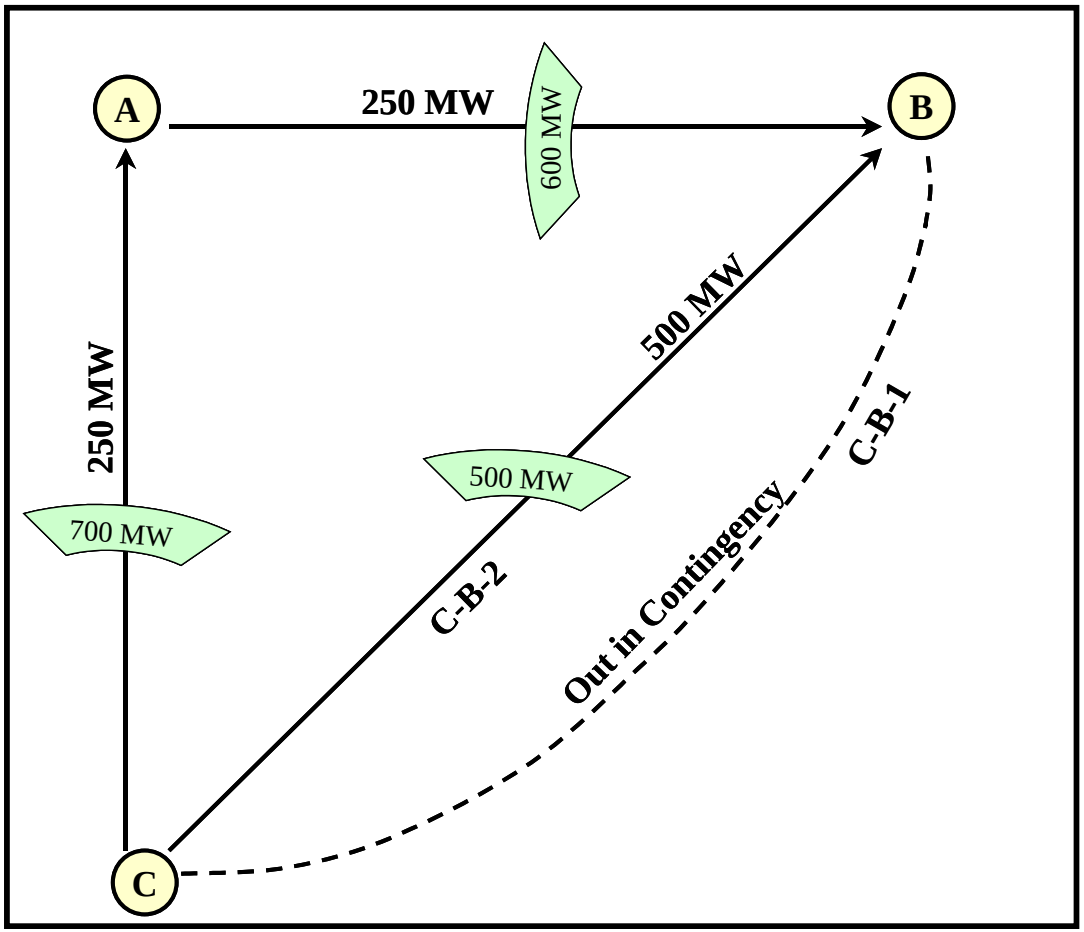
REVENUE ADEQUACY — Illustrative Grid



The impact of outages on FTR revenue adequacy can be illustrated using the simple, three-node grid portrayed above, with limits on A-B of 600 MW, on C-A of 700 MW, on C-B-2 of 500 MW and on C-B-1 of 1,000 MW. (All lines have equal impedance.)

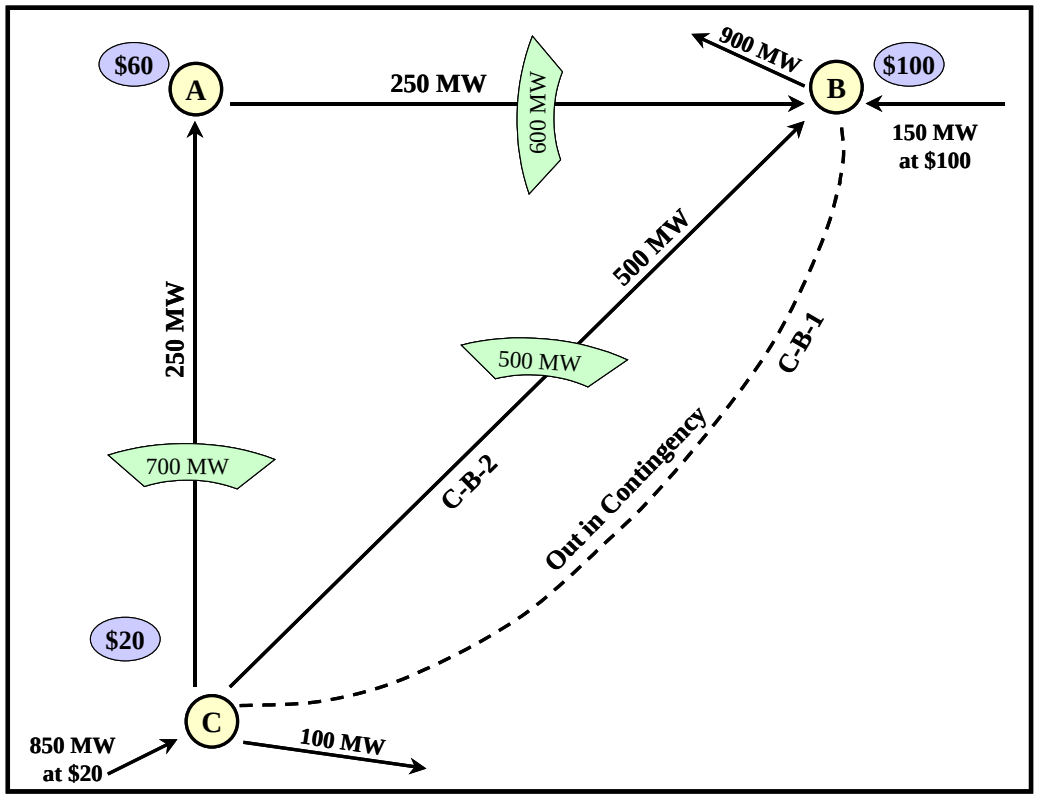
REVENUE ADEQUACY

Feasible FTRs



In the FTR auction, 750 MW of FTRs could be awarded from C to B as illustrated in the figure above, as the outage of C-B-1 would be the worst contingency in the simultaneous feasibility test for awarding FTRs.

REVENUE ADEQUACY — Day-Ahead Prices



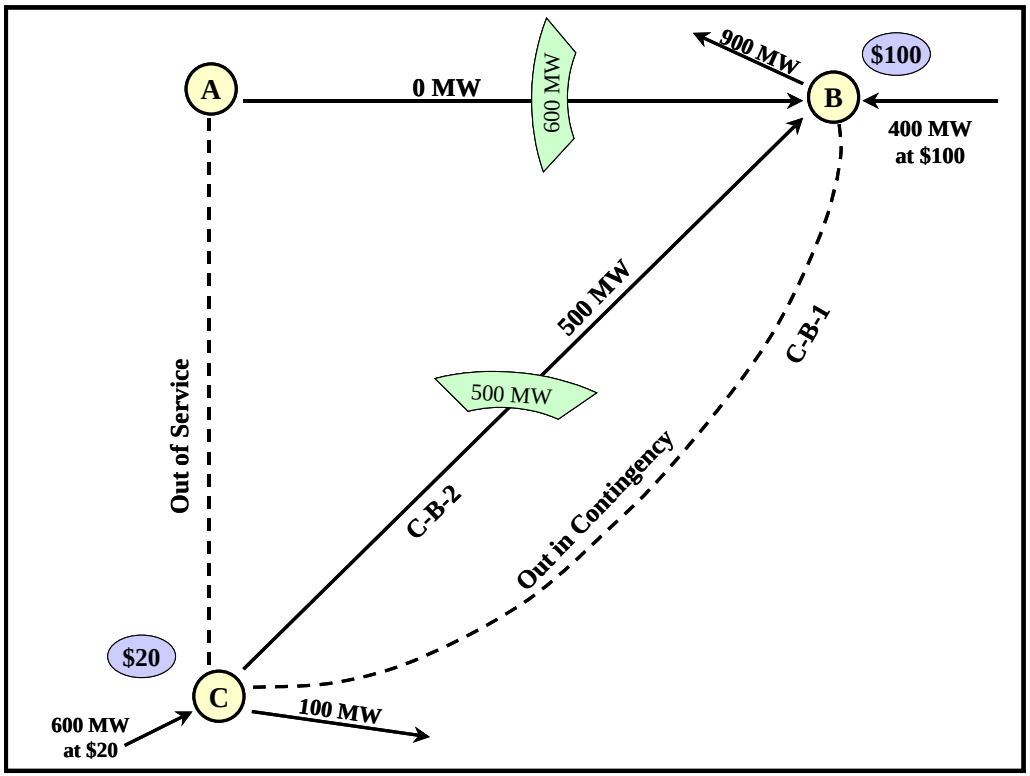
The outage of C-B-1 and the rating limit on C-B-2 are also the binding contingency constraint in scheduling the day-ahead market when there is high load at B. Suppose that in the least-cost scheduling and dispatch of the day-ahead market, the LMP price is $100 at B while only $20 at C.

REVENUE ADEQUACY — Day-Ahead Settlements

	MWh	Price	Payments
Generation Sales			
B	150	$100	$15,000
C	850	$20	$17,000
Total	1,000		$32,000
Load Purchases			
B	900	$100	$90,000
C	100	$20	$20,000
Total	1,000		$92,000
Net Congestion Rents			$60,000
FTR Values C-B			$80 * 750 = $60,000

In this example, with no transmission outages in the day-ahead market and 750 C-B FTRs, the ISO would be revenue-adequate. The ISO would collect congestion rents of $60,000, which would be just sufficient to fund payments to FTR holders.

REVENUE ADEQUACY — Transmission Outage



Suppose, however, that line C-A were unavailable in the day-ahead market due to a transmission outage. It can be seen that the contingency constraint on C-B-2 would continue to be binding, the transfer capability from C-B would fall to 500 MW, and 400 MW of high-cost generation at B would need to be scheduled to meet load in the day-ahead market.

REVENUE ADEQUACY — Revenue Inadequacy

	MWh	Price	Payments
Generation Sales			
B	400	$100	$40,000
C	600	$20	$12,000
Total	1,000		$52,000
Load Purchases			
B	900	$100	$90,000
C	100	$20	$20,000
Total	1,000		$92,000
Net Congestion Rents			$40,000
FTR Values C-B		$80 * 750 = $60,000	

The result of the outage would be a shortfall in congestion rent collections. The ISO would not collect enough congestion rents in the day-ahead market to fully pay FTR holders.

REVENUE ADEQUACY — Shortfall Funding

Different ISOs use different mechanisms to fund outage-related congestion rent shortfalls:

- PJM, ISO-NE, CAISO (proposed) and MISO prorate payments to FTR holders if congestion rents are insufficient to fully fund these payments.
- In NYISO, the transmission owners make up any shortfall in congestion rent collections and recover those costs in their transmission access charges (TSCs).
- All regions use congestion rent surpluses -- which may be earned in some hours -- as the first source of funding for congestion rent shortfalls in other hours.

REVENUE ADEQUACY — Social Cost of Outages

The congestion rent shortfalls associated with transmission outages reflect a real social cost, an increase in the resource cost of meeting load, not just a transfer of cost or revenue among market participants.

All Lines-In Production Cost			
	MW	**Price**	**Total Cost**
B	150	$100	$15,000
C	850	$20	$17,000
Total	1,000		$32,000
Production Cost with C-A Out			
B	400	$100	$40,000
C	600	$20	$12,000
Total	1,000		$52,000

Irrespective of how the congestion rent shortfall is allocated, transmission outages that reduce transfer capability at times when the transmission system is constrained have a real resource cost.

Transmission Maintenance Scheduling Incentive Problems

Cost Impact of Outages

The timing and duration of transmission outages scheduled for maintenance can have a direct impact on the cost of meeting load.

- Transmission outages that reduce transfer capability at times when the transmission system is constrained will likely require that higher-cost resources be committed or dispatched to meet load, and may also affect the cost of resources needed to provide ancillary services.
- Transmission outages that reduce transfer capability at times when the transmission system is constrained can also result in reduced generating profits through reduced capacity for exports.

INCENTIVE PROBLEMS

If the generation cost impacts of scheduled transmission maintenance outages fell directly on the shareholders of the transmission owner scheduling the maintenance outage, then the transmission owner would have efficient incentives for scheduling outages, with respect to choices such as:

- Time of week.
- Time of year.
- Duration.
- Coordination of outages of different equipment.

The transmission owner would have an incentive to make efficient tradeoffs between the production cost impact of alternative maintenance schedules and the maintenance cost difference between alternative schedules.

INCENTIVE PROBLEMS

Efficient Quantity of Maintenance

In addition, if some or all of the production cost impacts of *un*scheduled transmission outages fall directly on a transmission owner's shareholders, then the transmission owner would have efficient incentives with respect to choosing:

- Type of transmission maintenance to perform (upgrades, replacement of equipment)
- Frequency of transmission maintenance.

The transmission owner would have an incentive to make efficient tradeoffs between the generation cost impact of unscheduled outages and the cost, including potential generation cost impacts, of alternative programs for preventative maintenance.

INCENTIVE PROBLEMS Pre-LMP

Prior to LMP implementation, the cost of transmission outages could fall entirely on the responsible transmission owner.

- If LILCO took transmission lines serving Long Island out of service for maintenance, LILCO bore the cost of replacing low-cost, up-state power with power generated on Long Island.
- With point-to-point physical rights, the cost to the transmission owner of transmission outages could even exceed the social cost of outages, since the transmission owner's entitlement to use of the transmission system might be limited to a specific source-sink combination, which might not allow it to obtain even a partial benefit from its physical rights when there is an outage.

INCENTIVE PROBLEMS Pre-LMP

Nevertheless, prior to LMP (and in regions without LMP), changes in the cost of meeting load attributable to transmission outages did not always fall entirely on the responsible transmission owner's shareholders.

- These costs tended to fall on a combination of transmission owner shareholders and ratepayers, depending on the treatment of these costs in each utility's retail rates
- In meshed transmission systems with multiple transmission owners and users, the incidence depended on the specific rules used to adjust transmission entitlements for outages.
- In addition, some of the generation cost impacts of transmission outages have always fallen on others, through TLR curtailments of parallel path schedules or curtailment of non-firm transmission usage.

INCENTIVE PROBLEMS — LMP Impact

Under LMP, transmission outages also affect the cost of meeting load.

- For a vertically integrated utility, the effect appears through changes in the revenue adequacy of the FTRs used to hedge the cost of load that is not served by local generation.
  - Payments to these FTRs may be pro-rated.
  - An extra charge may be imposed to fund revenue inadequacy (in New York through the TSC).
- The incentive problem concerning transmission outage costs can be particularly acute under systems of financial rights because of the potential for a substantial proportion of the costs of infeasible FTRs to fall on someone other than the transmission owner responsible for an outage.

INCENTIVE PROBLEMS NYISO

Since the start-up of the NYISO, its tariff has provided that payments to TCC holders would be fully funded.

- Net congestion rent shortfalls in the NYISO day-ahead market are made up by the NYISO transmission owners and recovered in their TSC (access charge).
- The formula initially used to allocate congestion rent shortfalls among the transmission owners was based on the percentage of TCC auction revenues received by each transmission owner (interface megawatt-mile coefficient).
- This formula was not even loosely related to responsibility for the transmission outages that gave rise to the shortfalls.

INCENTIVE PROBLEMS NYISO

The initial NYISO shortfall allocation rule proved unsatisfactory as there were substantial transmission outage-related congestion rent shortfall charges that were allocated across the transmission owners in an arbitrary and unpredictable manner.

- The initial shortfall allocation rule led to cost shifting across the transmission owners and their ratepayers.
- The initial shortfall allocation rule also did not provide incentives for the responsible transmission owner to take steps to minimize the congestion impacts of maintenance outages.

INCENTIVE PROBLEMS New England and PJM

The New England, MISO and PJM FTR shortfall allocation mechanisms are superficially very different than New York's, as FTR payments are prorated by these ISOs in the event of shortfalls, rather than being funded by the transmission owners.

- The potential cost shifting and incentive problems, however, are very similar across New York, New England and PJM.
- Congestion rent shortfalls in PJM and NEPOOL that are attributable to the maintenance outages of one transmission owner are often borne by the customers of other transmission owners whose FTR payments or revenue from auction revenue rights are reduced.
- Thus, the outage costs are borne initially by parties that buy FTRs in the FTR auctions, and ultimately by the transmission customers through a reduction in the revenue they receive for auction revenue rights.

INCENTIVE PROBLEMS PJM

Figures in (000)

	Jan. 2003	Feb. 2003	Mar. 2003	Apr. 2003	May 2003	June 2003	July 2003	Aug. 2003	Sept. 2003	Oct. 2003	Nov. 2003
FTR Target Allocation	$94,491	$18,390	$42,122	$22,938	$40,747	$52,250	$85,328	$52,728	$44,365	$32,822	$17,042
Initial FTR Credit	$66,421	$14,089	$42,122	$22,938	$27,151	$51,513	$85,328	$52,728	$42,046	$31,963	$17,042
Initial % FTR Payout	70.3%	76.6%	100.0%	100.0%	66.6%	90.0%	100.0%	100.0%	94.8%	97.4%	100.0%
Initial Excess	$0	$0	$10,921	$3,585	$0	$0	$10,334	$5,841	$0	$0	$887
Initial Deficiency	$28,070	$4,301	$0	$0	$13,596	$5,737	$0	$0	$2,319	$859	$0

PJM had congestion rent shortfalls during several months in 2003. PJM attributed roughly 47 percent of the 2003 shortfall to loop flows not modeled in the FTR allocation and auction process and the remainder to transmission outages.

INCENTIVE PROBLEMS MISO

MISO FTRs were revenue-adequate from April through September 2005.

- There were small congestion rent shortfalls during the October and November maintenance season (94 percent payout in October; 92 percent in November).
- The payout ratio fell to 62 percent of the target FTR payments in December as a result of transmission outages in the day-ahead market that were not modeled in the FTR allocation process.

INCENTIVE PROBLEMS — Shortfall Issue

One approach to reducing or avoiding congestion rent shortfalls would be to allocate and sell fewer FTRs relative to the all-lines-in transfer capability of the transmission system, so as to reduce the payment obligation to FTR holders.

- While this approach would preserve the hedging value of the awarded FTRs, it would not address either the cost-shifting impacts of transmission outages nor provide efficient incentives for transmission owners to minimize the social cost of transmission outages.
- Moreover, the reduction in the awarded FTRs would prevent LSEs from fully utilizing the transfer capability of the grid to hedge congestion charges.

INCENTIVE PROBLEMS — Shortfall Issue

Awarding fewer FTRs would appear to reduce cost shifting because there would no longer be a reallocation of the congestion rent shortfall impact of outages among the customers of different transmission owners.

- Cost shifting would still occur in the form of: lost FTR revenue for the shareholders and ratepayers of transmission owners or LSEs that receive a smaller allotment of FTRs; reduced FTR auction revenue for shareholders and ratepayers due to the sale of fewer FTRs in the FTR auctions; and changes in the payments to the entities entitled to the congestion rent surplus.
- Incentive problems will remain because the benefits from reducing outage costs will flow to different parties than those who bear the costs of transmission maintenance.

The magnitude of the congestion rent shortfall depends, in part, on the assumptions that an ISO makes in running the simultaneous feasibility test for FTRs.

- If an ISO were to make conservative assumptions in running the simultaneous feasibility test for FTRs, fewer FTRs would be sold and allocated, which would generally reduce the congestion rent shortfall impact of transmission maintenance outages. This would not reduce the social cost of transmission maintenance outages.
- The magnitude of the congestion rent shortfall is therefore not a perfect indicator of the extent of the misalignment of incentives regarding transmission maintenance scheduling.

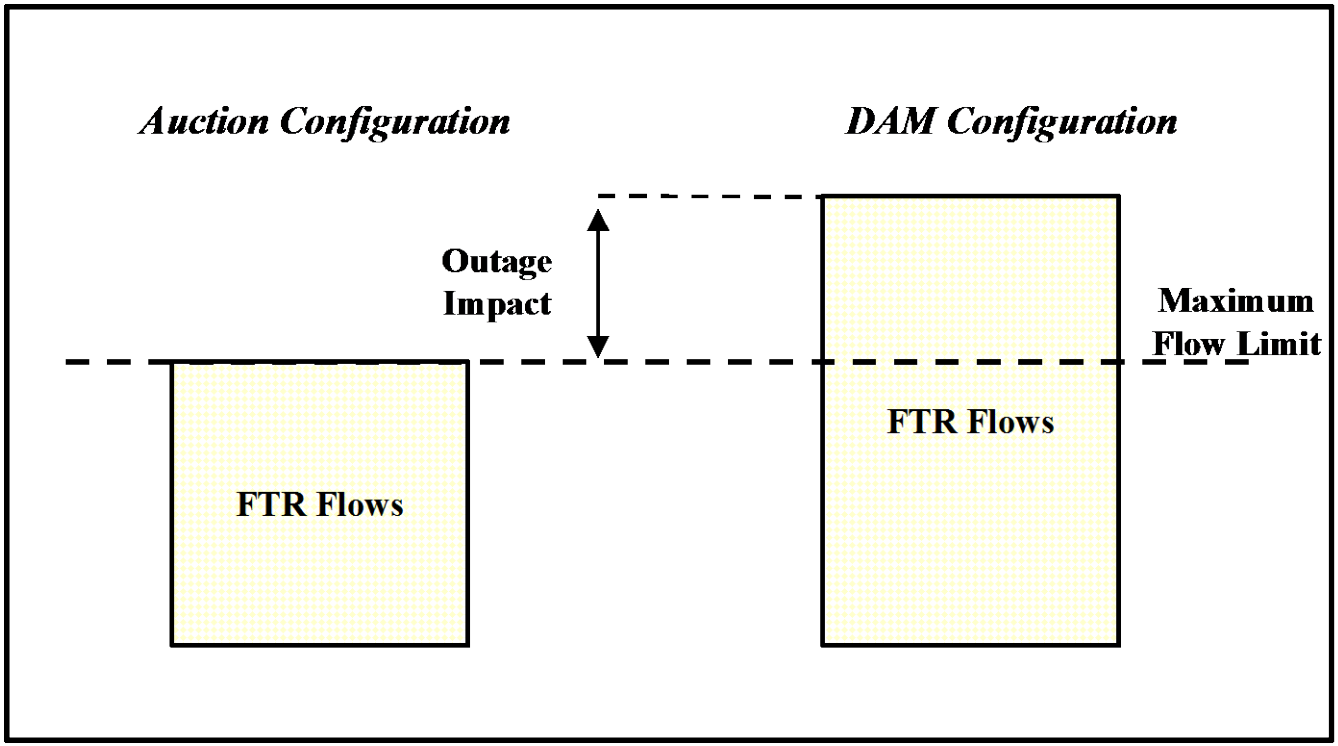
Conceptual Issues in Assigning Responsibility for Outage Costs

The role of the ISO in PJM and New York and the separation of the dispatch function from the ownership and operation of the transmission system provides an opportunity for the implementation of an ISO-coordinated system for assigning outage costs to the responsible transmission owner, perhaps in conjunction with performance incentives for transmission owners.

It is, in principle, straightforward to identify the congestion rent shortfall attributable to a transmission outage (or derating) in an LMP market.

- The congestion rent shortfall due to infeasible FTRs in a given hour of the day-ahead market is equal to the shadow price of each binding constraint, multiplied by the MW of FTR flows that are infeasible on that constraint.
- Once calculated, these outage costs could be assigned to the transmission owner responsible for the outage.

Outage Impact on FTR Flows



- Infeasible FTR flows can be calculated from a power flow of the FTRs on the day-ahead grid.
- An outage may cause FTR overloads on more than one constraint and for more than one contingency on the day-ahead grid.

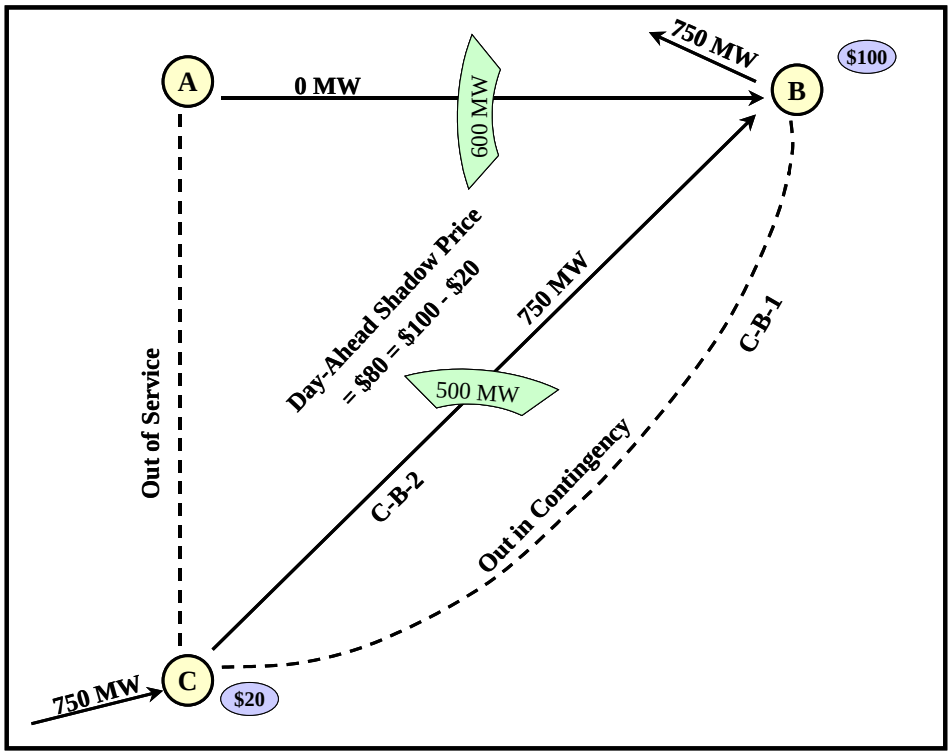
The shadow price of a binding constraint is the marginal cost (based on bids and offers in the day-ahead market) of the redispatch that is required to keep flows on the constraint at the rating limit.

- The constraint may occur in a contingency or in the base case power flow.
- The shadow price is determined in the least-cost, day-ahead dispatch, along with LMP prices.
- The shadow prices of binding constraints is one component of the calculation of LMP prices.

Under LMP pricing, the constraint shadow price is essentially a per-MWh charge for each MWh of energy scheduled to flow over a binding constraint.

- The constraint shadow price is also the per-MWh congestion payment the ISO owes for each MWh of FTR flows on the constraint.
- A shortfall occurs when the MWh power flows for which a charge is collected (which is equal to the rating limits for a binding constraint) are less than the FTR flows for which a payment is owed.

FTR Flows on Grid with A-C Out of Service



With line C-A out of service in the day-ahead market, the 750 MW of C to B FTRs that were allocated on this grid cause 250 MW of infeasible FTR flows in the C-B-2 constraint. The congestion rent shortfall is equal to the infeasible FTR flows (250 MW) times the shadow price of the transmission constraint ($80) or $20,000.

CONCEPTUAL FRAMEWORK — Example

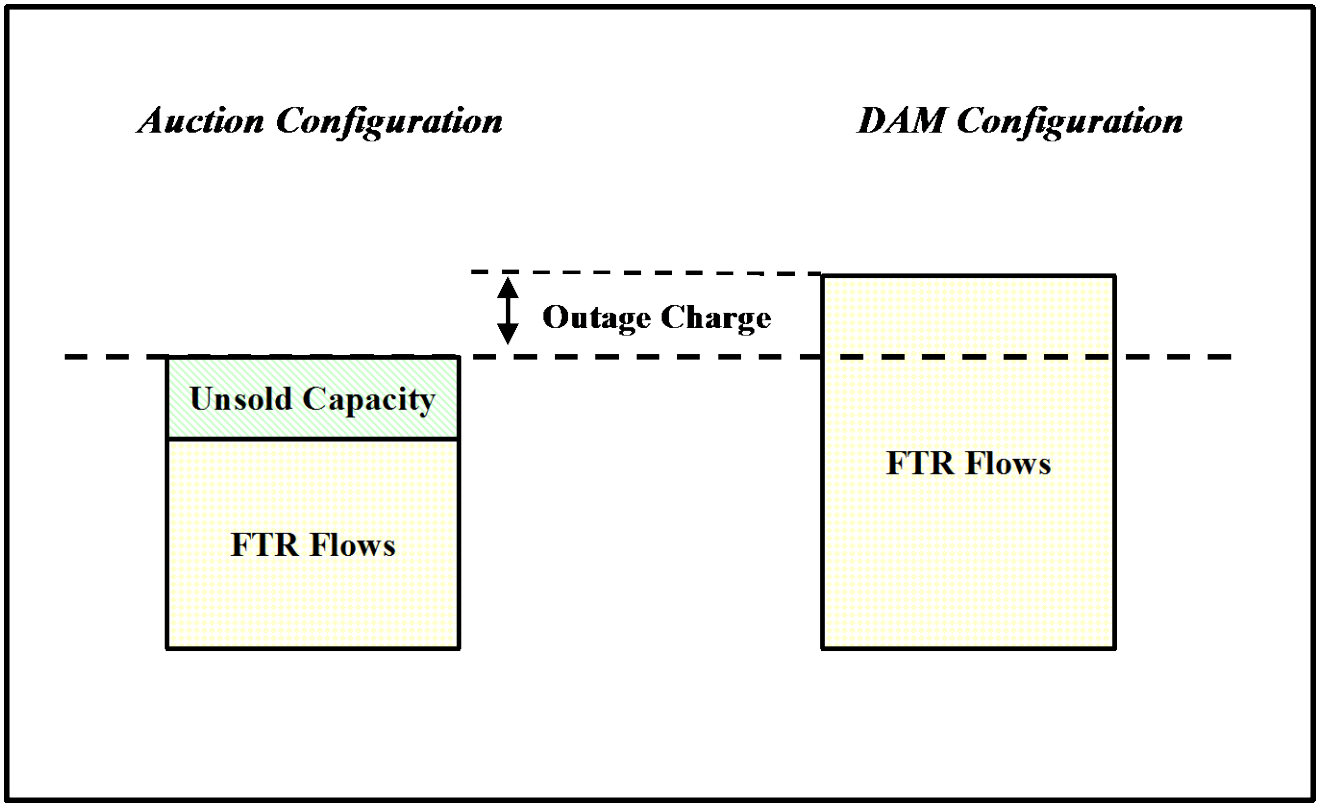
The congestion rent shortfall calculated as shadow price * infeasible FTR flows is exactly equal to the revenue inadequacy previously calculated for the day-ahead settlement with line A-C out of service.

- Thus, if the transmission owner responsible for A-C were charged $20,000, the awarded FTRs would be fully funded.
- The transmission owner would also have an incentive to schedule its transmission maintenance at a time when there is expected to be less congestion, as long as the incremental cost of the schedule change was less than the reduction in congestion costs.

This conceptual framework for calculating the congestion rent shortfalls means that:

- There is no congestion rent shortfall cost due to an outage if there are no constraints binding in the day-ahead market and all constraint shadow prices are equal to zero. (The congestion components of all LMP prices would also be zero.)
- There is only a congestion rent shortfall in situations in which there is a shadow price associated with a constraint in the day-ahead dispatch *and* the rating limit for the constraint in the day-ahead market is less than the flows the outstanding FTRs would cause on the constraint.

Outage Charge with Unsold Capacity



If not all capacity on a constraint is sold in the auction, the unsold capacity, in effect, provides a cushion against congestion rent shortfalls.

CONCEPTUAL FRAMEWORK — Discussion

While this methodology can accurately measure the impact of transmission outages on FTR revenue adequacy, it does not necessarily measure the social cost of the outages.

- An outage could raise the cost of meeting load yet produce no congestion rent shortfall if the impacted constraints were not binding (i.e., not fully sold) in the FTR auction/ allocation process.
- The congestion rent shortfall impact of an outage could exceed the production cost impact if the impacted constraint would not have been binding in the day-ahead market, absent the outage.
- In order to calculate the production cost impact of transmission outages, it would be necessary to clear the day-ahead market with and without the outages.

CONCEPTUAL FRAMEWORK Implementation Issues

While calculation and assignment of the cost of outage is straight-forward at a conceptual level, there are a number of practical issues that must be addressed in assigning outage costs in the real world.

- Rerunning the simultaneous feasibility test to calculate infeasible FTRs for each hour's grid configuration can be resource-intensive.
- There is almost always more than one outage, attributable to more than one transmission owner, in every hour; how should jointly incurred congestion rent shortfall costs be assigned among outages?
- If PAR schedules are not held constant between the auction/allocation simultaneous feasibility test and the calculation of infeasible FTRs, the magnitude of constraint overloads may reflect the changes in PAR schedules rather than the impact of transmission facility outages.

- If an outage requires that lines modeled as PAR-controlled in the auction/allocation simultaneous feasibility test be free-flowing in the day-ahead market, attempting to calculate overloads while modeling that line as PAR-controlled is likely to lead to spurious results.
- Maintenance outages on a particular transmission facility may require the simultaneous outage of interconnected facilities, so the owner of a transmission facility is not necessarily the transmission owner responsible for its outage.

CONCEPTUAL FRAMEWORK Implementation Issues

- The hourly congestion rent shortfall costs on most constraints in most hours tend to be very low (i.e., less than $10/hour), so it is not cost effective to spend resources trying to allocate these costs.
- If transmission outages can be scheduled in the auction/ allocation process, there needs to be a mechanism for assigning the costs of forgone auction revenues to the transmission owner responsible for the outage.
- If transmission outages can be scheduled in the auction/ allocation process, there also needs to be a mechanism for assigning the benefits of returning these lines to service in the day-ahead market to the responsible transmission owner.

- The outage of a transmission facility not only can lead to congestion rent shortfalls by changing the grid configuration, outages can also affect the nomograms that determine interface limits, leading to upratings or deratings.

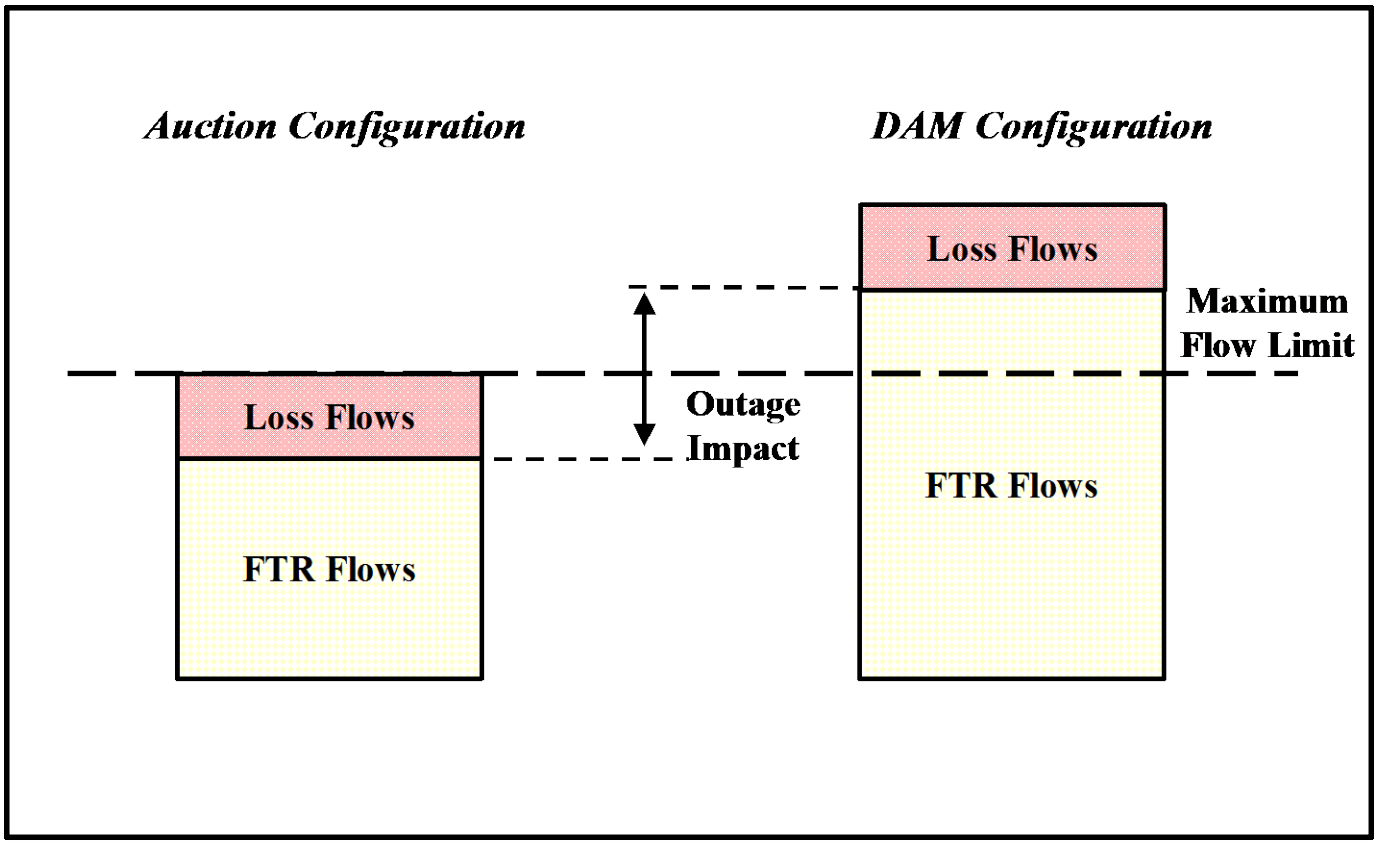
CONCEPTUAL FRAMEWORK — Number of Outages

One practical obstacle is that running a power flow to calculate infeasible FTR flows for each hour's grid configuration can be resource-intensive.

- Even on just the New York transmission grid, it is not unusual to have more than 200 different outages a month.
- Calculating the infeasible FTR flows for each of these outages would entail running 200 powerflows a month.

The practical impact depends on whether an AC or DC model is used to calculate FTR flows.

CONCEPTUAL FRAMEWORK Number of Outages



Using DC models to calculate FTR flows requires a method to account for loss flows, which would not be reflected in generation and load shift factors.

Multiple Outage Impacts

A second practical issue is that there is almost always more than one outage, attributable to more than one transmission owner, in every hour.

- A powerflow could be used to calculate the individual impact of each outage on FTR feasibility (i.e., one powerflow per outage).
- However, the separate impacts of multiple transmission outages will not necessarily add up to the impact that occurs when all of the outages occur at the same time.
  - The concurrent impact of several related outages may be much less than the sum of the individual impacts.
  - The concurrent impact of several outages may be much more than the sum of the individual impacts.

Multiple Outage Impacts

These possibilities raise the question of how to allocate jointly incurred outage costs among the transmission owners responsible for different outages.

- Methodologies could be developed to allocate outage costs among concurrent outages with algorithms that use data on the individual and combined impact of combinations of outages for a given hour.
- Such a methodology would entail running multiple powerflows in each hour and could greatly increase the resource requirements for assigning the costs of congestion rent shortfalls.

CONCEPTUAL FRAMEWORK

Multiple Outage Impacts

In practice, a simplified approach may be employed to allocate congestion rent shortfalls from concurrent outages.

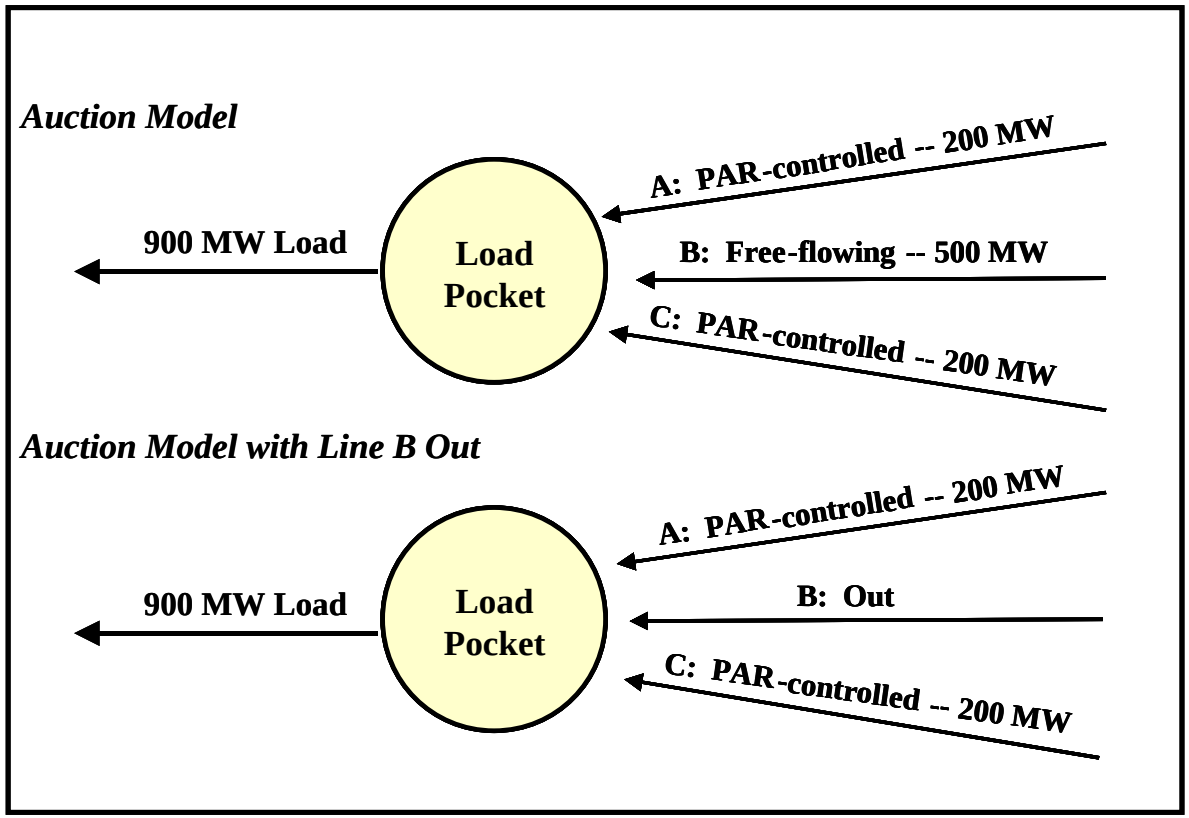
The development of practical rules is helped by the fact that the concurrent scheduling of planned transmission facility outages that would interact to have a combined impact that is more than the sum of the individual impacts would likely not be permitted by an ISO for reliability reasons if the impact were material.

A third practical issue is that if PAR schedules are not held constant between the auction/allocation simultaneous feasibility test and the calculation of infeasible FTRs, the magnitude of constraint overloads may reflect the changes in PAR schedules rather than the impact of transmission facility outages.

- Using auction PAR schedules to calculate infeasible FTR flows avoids arbitrary outage cost allocations.
- To the extent that changes in PAR schedules are used to reduce outage costs in the day-ahead market, this will be reflected in lower constraint shadow prices.

CONCEPTUAL FRAMEWORK — PAR Control

If an outage requires that lines modeled as PAR-controlled in the auction/allocation simultaneous feasibility test be free-flowing in the day-ahead market, attempting to calculate overloads while modeling that line as PAR-controlled is likely to lead to spurious results.



CONCEPTUAL FRAMEWORK

The maintenance outage of a particular transmission facility may require the simultaneous outage of interconnected facilities, so the owner of a transmission facility is not necessarily the transmission owner responsible for its outage.

- The outage cost allocation process must therefore track the identity of the transmission owner that is responsible for a transmission facility outage from a causation standpoint, not merely identify the facility owner.
- Ideally, the outage cost allocation process would allow transmission owners to coordinate the outage of related facilities and agree among themselves on the allocation of outage costs.

CONCEPTUAL FRAMEWORK — Costs Often Low

The hourly congestion rent shortfall costs on most constraints in most hours tend to be very low, less than $10/hour, so it is not cost effective to spend resources trying to allocate these costs.

- The total congestion shortfall impact of a transmission outage would only be known after congestion rent shortfall costs on all constraints were assigned to outages.
- Most outage costs can be assigned to the appropriate transmission owner if the allocation calculation is applied only to constraint/hours with substantial overload costs.

CONCEPTUAL FRAMEWORK

Outages in FTR Auction

If transmission outages can be modeled in the auction/allocation process, there needs to be a mechanism for assigning the costs of forgone auction revenues to the transmission owner responsible for the outage.

- Calculating outage costs based on infeasible FTR flows only charges transmission owners for transmission that is out of service in the day-ahead market, but not out of service in the prior FTR auction.
- No congestion rent shortfall and no outage charge would arise if there were no change in grid configuration between the grid used for the simultaneous feasibility test for the FTRs and the grid used in scheduling the day-ahead market.

CONCEPTUAL FRAMEWORK

Outages in FTR Auction

Absent an outage cost allocation applicable to the auction, a transmission owner could avoid outage charges in the day-ahead market by having outages modeled in the FTR auction.

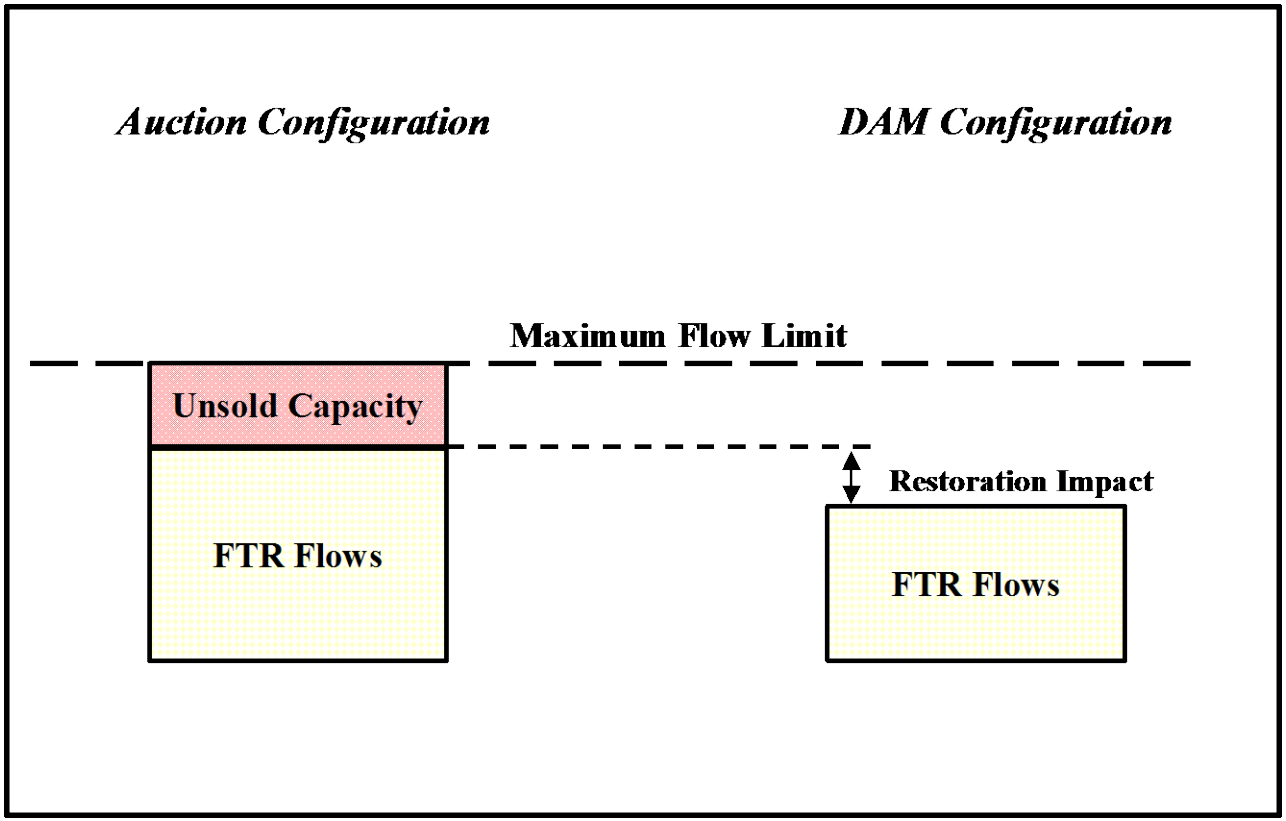
- To avoid this incentive, charges for outages scheduled in the auction could be based on the constraint shadow prices in the FTR auction (i.e., the marginal price bidders would have been willing to pay for more FTRs).
- The additional FTRs that would have been allocated or auctioned absent the outage can be calculated from the bids in the auction process or nominations in the allocation process and the incremental FTR flows on each constraint calculated.
- The auction outage cost is the sum over the constraints of the product of the incremental FTR flows and the constraint shadow prices.

CONCEPTUAL FRAMEWORK — Return to Service

If some transmission facility outages are modeled in the auction/ allocation process, the outage cost allocation cost methodology also needs to pay transmission owners for returning transmission facilities to service in the day-ahead market that were out of service in the prior FTR auction.

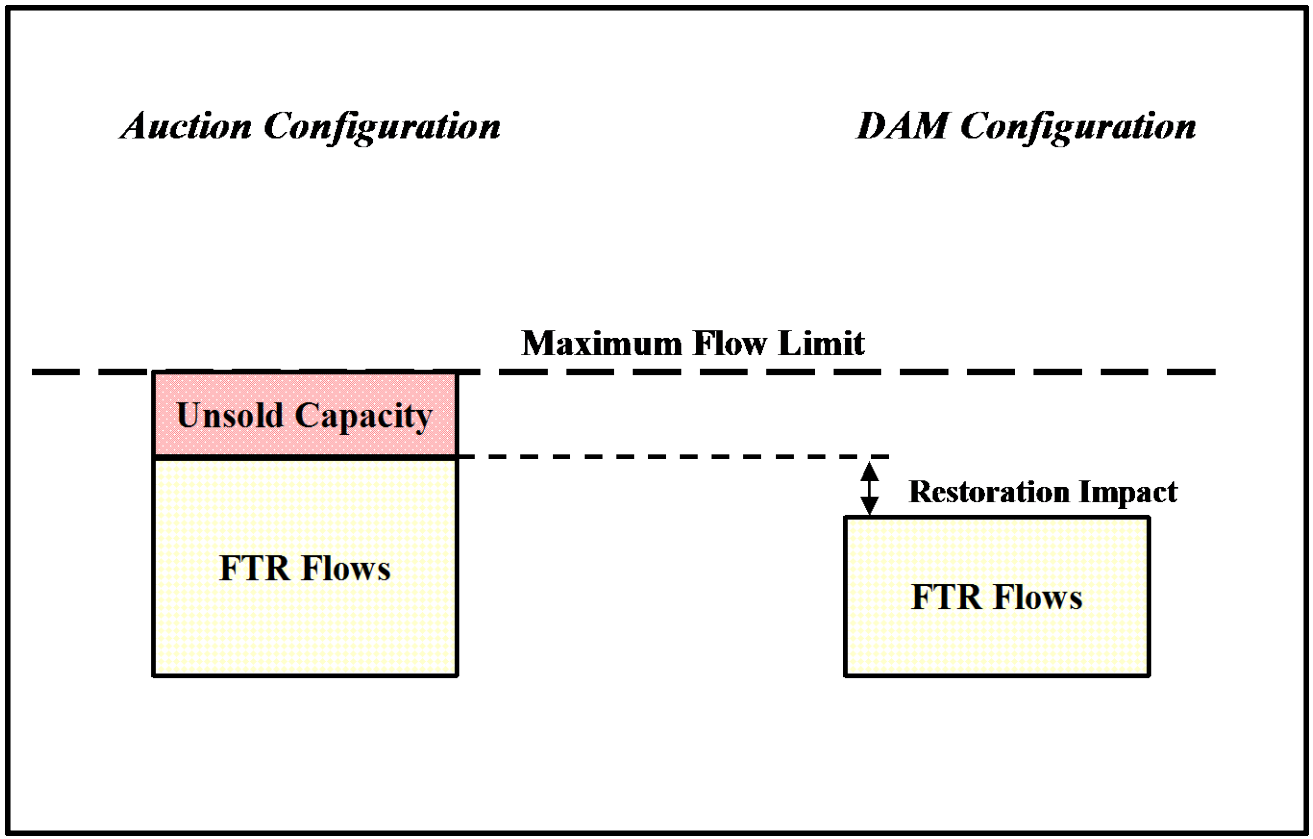
- If a transmission facility were returned to service ahead of schedule and reduced congestion, it would lead to a congestion rent surplus.

CONCEPTUAL FRAMEWORK — Return to Service



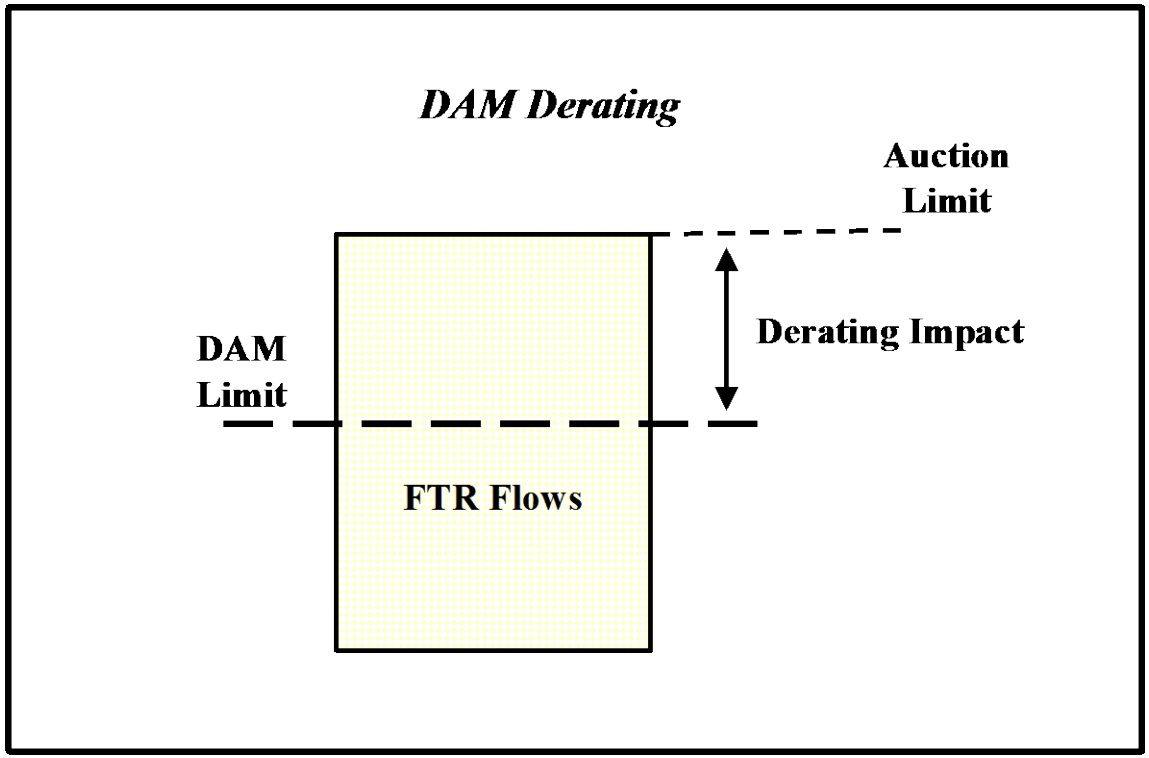
The congestion rent surplus attributable to returning the line to service could, in principle, be calculated similarly to that of a transmission outage.

CONCEPTUAL FRAMEWORK Return to Service



The calculation of return-to-service payments would need to take into account transmission capacity that was not assigned in the previous FTR auction or allocation process.

CONCEPTUAL FRAMEWORK — Rating Changes



- The outage of a transmission facility not only can lead to congestion rent shortfalls by changing the grid configuration, but also can affect the nomograms that determine interface limits, leading to upratings or deratings.
- The allocation of outage costs can also be applied to outage-related deratings.

ISO Performance Incentive Programs

Both PJM and NYISO have developed programs to reduce the costs of transmission maintenance outages.

- Given the difficulties inherent in addressing the complicating factors discussed above, PJM's program does not attempt to measure and allocate congestion rent shortfall costs; rather, it provides a mechanism for market participants to pay for schedule changes or schedule acceleration.
- The NYISO program has developed rules, with some simplifications, to address the complications of calculating and assigning congestion rent shortfalls attributable to outages and attempts to measure and allocate to a specific transmission owner most of these costs.

PJM's operating agreement requires the transmission owners to:

- Provide transmission outage schedules one year in advance for planned outages with an expected duration exceeding five days or that are expected to have significant impacts.
- Notify PJM of all planned outages by the first day of the month preceding the month in which the outage will commence.

PJM can require a transmission owner to reschedule an outage that would significantly affect the efficient and reliable operation of the PJM grid.

PJM Transmission Outage Acceleration Process

- PJM identifies outages lasting three days or longer that are estimated to give rise to a congestion rent shortfall of $500,000 or more, or outages of generator interconnections.
- Market participants can request that these outages be moved or accelerated.
- PJM will contact the transmission owner scheduling the outage and request an estimate of the cost to reschedule or accelerate the outage.
- The market participant requesting acceleration or rescheduling decides whether to pay for acceleration or rescheduling.
- Additional rules exist to account for instances in which multiple market participants are willing to pay for acceleration or rescheduling.

PJM Transmission Outage Acceleration Process

- Tariff changes filed: November 18, 2005
- Original Effective date: February 1, 2006.
- Implementation delayed by FERC staff questions.

Issues with the PJM approach:

- Differences in outage practices across transmission owners may result in one transmission owner being compensated for acceleration costs that are standard procedure for another transmission owner.
- The acceleration mechanism is mainly applicable to outages impacting LMP prices for a single generator or a particular LSE.

- Since FTRs are widely held, no single FTR holder will have an incentive to pay to accelerate or reschedule outages to reduce overall congestion rent shortfalls.
- Does not provide transmission owners with a direct incentive to determine efficient changes in transmission maintenance schedules.
  - Many costly outages will not be rescheduled although it would be efficient to do so.
  - Outages with low rescheduling costs will not necessarily be moved.

As in PJM, NYISO transmission owners must provide advance notice of planned outages.

- Transmission owners must submit 2-year outage schedules by October 1st each year, and also submit quarterly updates to their approved 2-year schedules.
- Transmission owners must schedule the outages of facilities expected to impact the transfer capability of the NYISO system (> 150 MW impact) no less than 30 days prior to the first day of the month in which the outage will occur.
- Exceptions to the 30-day scheduling requirement exist for outages that cannot be deferred or that will not have a significant impact on transmission congestion.

If an approved outage is cancelled, the transmission owner must try to reschedule it during the same month and during a time in which it will have a similar impact on transmission system congestion as the original schedule for the outage.

- The reasons for all outage cancellations are reviewed by the NYISO market monitoring unit.
- Like PJM, the NYISO can defer or cancel scheduled outages that would lead to a violation of reliability criteria.

The NYISO, NYISO transmission owners and other NYISO market participants developed a revised congestion rent shortfall allocation methodology that was filed at FERC on October 16, 2003 and approved by FERC on December 15, 2003.

- The financial impact of each transmission facility outage on the TCC congestion rent shortfall in the day-ahead market is calculated and the cost assigned to the transmission owner responsible for the outage.
- Initially, no analysis is made of shortfalls attributable to real-time outages.

The new shortfall allocation methodology was also integrated with the TCC auction.

- The financial impact on auction revenues of transmission facility outages in the six-month or monthly TCC auction is assigned to the responsible transmission owner.
- The financial impact on auction revenues of a transmission facility returned to service in the monthly TCC auction is credited to the responsible transmission owner.
- The financial impact on day-ahead congestion revenues of transmission facilities modeled as out-of-service in the monthly TCC auction but returned to service in the day-ahead market is credited to the responsible transmission owner.

Development of the NYISO shortfall allocation methodology had to address the issues previously discussed.

- Number of different outages
  - Thresholds
- Multiple outage impacts
  - Two-step process; pro rata allocation
- PAR flows
  - Auction schedules
- PAR-controlled lines free-flowing in day-ahead market
  - Special rules to address
- Assignment of responsibility for related outages
  - Special rules to address

- Low-cost outages
  - Thresholds
- Outage costs in auction
  - Rules to allocate auction outage costs
- Returns to service
  - Rules to cover
- Outage-related changes in nomograms
  - Addressed

Regulatory Issues Impacting Performance Incentives

Under license-plate access charge systems, improved ISO outage cost allocation rules could reduce cost shifting between the customers of different transmission owners.

- Improved outage cost assignment will not necessarily provide transmission owners with efficient incentives to incur extra maintenance costs (such as paying overtime to do maintenance on weekends when congestion costs are low) in order to reduce outage costs.
- If transmission owners can pass outage costs through in their transmission charge but cannot pass through the higher costs of carrying out maintenance in a manner that reduces outage costs, they will not have efficient incentives.

Improved outage cost allocation rules permit implementation of transmission maintenance performance incentives and may provide efficient short-run incentives for transmission owners operating under fixed retail rates, but action by FERC and state regulators is necessary to achieve the full potential benefits of improving transmission owner performance incentives.

- Retail rate passthroughs of changes in outage costs could greatly reduce the incentive of the transmission owner to incur maintenance costs that cannot be passed through in order to reduce outage costs that could be passed through.
- Full passthrough of changes in outage costs in the access charge would reduce the performance incentive of transmission owners facing substantial retail competition.

The NYISO shortfall allocation rules attempt to eliminate cost shifting across transmission owner customers and also provide direct performance incentives for some transmission owners.

- Reductions in congestion rent shortfalls from improved maintenance scheduling are reflected in lower outage payments by the responsible transmission owner.
- These reduced payments are offset, however, by reduced charges by the transmission owner through the TSC account.

REGULATORY ISSUES — New York

- If the transmission owner is also the LSE for most of the load paying the TSC and if the transmission owner's retail rate is not tied to the TSC, the reduction in TSC costs would be retained by the transmission owner.
- If the retail rate calls for TSC passthrough, however, it would not be economic for the transmission owner to incur additional transmission maintenance costs in order to reduce outage costs.

REGULATORY ISSUES PJM

The PJM system provides for transmission customers to reimburse the transmission owner for the cost of moving or accelerating outages.

- The transmission owner is not incented to identify opportunities to reduce outage costs; it is simply compensated for responding to opportunities identified by others.
- There is no apparent opportunity for improved shareholder returns from improved performance.

Even with complete passthrough of changes in outage costs by the transmission owner, such a cost allocation system for outage costs can improve overall incentives by enabling the transmission owner to more accurately price outages to third parties.

- Outages for cell maintenance.
- Outages for generation interconnection.
- Outages attributable to damages to the transmission system by third parties.

REGULATORY ISSUES

Next Step

The next step would be for federal regulators to consider access charge systems that do not fully pass through outage costs, providing an incentive for the transmission owner to incur higher maintenance costs in order to reduce outage costs.

The best approach from a short-term incentive standpoint would be to base the access charge on a target level of outage costs and maintenance costs with no passthrough of increases or decreases in either cost.

- At the margin, the transmission owner would bear all the costs and benefits of changes in maintenance and outage costs.
- Such a system would be difficult to implement because it would need to allow for low probability, very high outage costs (storms) in setting the benchmark.

A more practical approach that would still provide improved marginal incentives would be to provide for a partial passthrough of normal year-to-year increases and decreases in outage and maintenance costs and to provide for full passthrough of costs outside the band of normal activity (perhaps subject to conventional prudence reviews).

SCOTT M. HARVEY (617) 761-0106 **sharvey@lecg.com**
SUSAN L. POPE (617) 761-0104 **spope@lecg.com**

350 Massachusetts Ave. Suite 300 Cambridge, MA 02139 (617) 252-9994 (617) 621-8018 – fax	33 West Monroe Suite 2300 Chicago, IL 60653 (312) 267-8200 (312) 267-8220 - fax	2700 Earl Rudder Freeway So. Suite 4800 College Station, TX 77845 (979) 694-2421 (979) 694-2442 - fax	One Main Place 1201 Main St., Suite 1950 Dallas, TX 75202 (214) 753-5000 (214) 753-5050 - fax	2000 Powell St. Suite 600 Emeryville, CA 94608 (510) 653-9800 (510) 653-9898 – fax
1603 Orrington Ave. Suite 1500 Evanston, IL 60201 (847) 475-1566 (847) 475-1031 – fax	5 Houston Center 1401 McKinney, Suite 2300 Houston, TX 77010 (713) 374-7900 (713) 374-7990 - fax	333 South Grand Avenue Suite 3750 Los Angeles, CA 90071 (213) 621-0228 (213) 621-0277 - fax	424 Church Street Suite 2550 Nashville, TN 37219 (615) 726-7960 (615) 726-7970 - fax	675 Third Avenue 21st Floor New York, NY 10017 (212) 468-7878 (212) 468-7879 – fax
335 Bryant Street Third Floor Palo Alto, CA 94301 (650) 473-4200 (650) 322-1483 - fax	201 South Main Suite 450 Salt Lake City, UT 84111 (801) 364-6233 (801) 364-6230 – fax	201 Mission Street Suite 700 San Franciso, CA 94105 (415) 267-0300 (415) 267-0310 - fax	1018 Garden Street Suite 208 Santa Barbara, CA 93101 (805) 963-5770 (805) 963-5792	1725 Eye Street, NW Suite 800 Washington, DC 20006 (202) 466-4422 (202) 466-4487 - fax
1255 Drummers Ln. Suite 320 Wayne, PA 19087 (610) 254-4700 (610) 254-1188 - fax	Level 3, 12 Viaduct Harbour Ave Viaduct Basin, PO Box 2475 Shortland St, Auckland, NZ 64 9 913 6240 64 9 913 6241 - fax	Cerrito 866, Piso 4 C1010AAR Buenos Aires Argentina 54 11 4816 1001 54 11 4813 4999 – fax	40/43 Chancery Lane London WC2A 1JA United Kingdom 44 20 7269 0500 44 20 7269 0515 - fax	Level 28, 303 Collins St GPO Box 5034Y Melbourne 3000, Australia 61 3 9678 9066 61 3 9678 9009 - fax
	Level 24, 9 Castlereagh St Sydney NSW 3000 Australia 61 2 9221 2628 61 2 9221 0868 - fax	180 Bloor Street West, Suite 1400 Toronto, Ontario M5S 2V6 Canada (416) 926-4200 (416) 926-4210 – fax	9th Floor, 1 Willeston St. P.O. Box 587 Wellington, New Zealand 64 4 472 0590 64 4 472 0596 - fax	

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