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The FGR vs. FTR debate: Facts and Misconceptions

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Summary
This note comments on the section concerning the definition of transmission rights in FERC's working paper on Standardized Transmission Service and Wholesale Electric Market Design. The comments below endorse the following positions

1. Support FERC's recommendation to use of flowgate rights in conjunction with point to point rights for hedging congestion cost.
2. Recommend that point to point rights (FTRs) be defined only as two sided financial instruments and not be offered as options.
3. Recommend that flowgate rights (FGRs) be offered only as one sided instruments (options for the buyer and obligation for the seller)

The comments are also intended to clarify a number of misconceptions surrounding the FGR vs. FTR debate.

Background
Several of the emerging RTO proposals recognize the merit of having flowgate transmission rights (FGRs) if not exclusively then in conjunction with point to point transmission rights (FTRs). FERC staff in their white paper outlining their vision for a standardized market design had the foresight to endorse this pluralistic approach. Yet the debate surrounding this subject is raging with arguments that tend to throw darkness on the issues. Because of the highly technical nature of the arguments many misconceptions have taken hold that are based primarily on associations of the proponents with other positions that have little to do with the fundamental issues concerning FGRs and FTRs. For instance, many erroneously believe that FGRs are physical rights whereas FTRs are financial. Likewise, some believe that FGRs require socialization of congestion cost whereas FTRs represent direct assignment of such costs.

Since FGRs are associated with physical capacity of specific network components they can be easily interpreted as physical rights or awarded on a long term basis in exchange for entitlements or investment in specific network components independently of other rights. By contrast FTR awards are interrelated and must satisfy simultaneous feasibility conditions, which requires frequent reconfiguration auctions and makes them virtually impossible to define as physical rights. Nevertheless, both FTRs and FGRs can be defined as financial rights that are settled on the basis of real time locational marginal cost pricing of transmission assets. Defining them as financial rights is desirable since such definition prevents withholding and provides the system operator with flexibility to use the transmission system efficiently regardless of ownership. The difference between financial FTRs and FGRs is that FTRs are entitlements (or obligations) to the nodal price

difference between two locations on the network, whereas FGRs are entitlements to the shadow price on one or more flow constraints imposed on the economic dispatch. In either case, the financial rights can be settled on the basis of real time locational prices (nodal or shadow prices) without any direct impact on actual operation.

Admittedly, some proponents of FGRs have advocated that the rights be physical with a "use it or loose it provision". Some have also argued that that financial FGR settlements should be based on averaged monthly or annual shift factors and that the cost implication of the deviation between the real time and the average shift factors be socialized. Such proposals are misguided and do not represent what FGRs are all about.

Discussion of specific issues

Following is a brief discussion and clarification of some key issues in the FGRs vs. FTR debate.

1. The relationship between FGRs and FTRs

A basic equation characterizing economic dispatch in an electric power network is that the nodal price difference between any two locations A and B equals the summation, over all the network elements, of the corresponding shadow prices times the respective shift factors from A to B. A shift factor from A to B with respect to a network element in a specific direction represents the fraction of a MW injected at node A and withdrawn at node B that flows through the element in the specified direction. A consequence of the above equation is that the real time settlement of a 1 MW FTR from node A to node B equals the settlement of a portfolio of FGRs totaling 1 MW in proportions mirroring the shift factors from node A to node B with respect to corresponding elements.

One may think of the FGRs as individual stocks and of FTRs as index funds. Typically, a relatively small number of congested elements (often referred to as commercially significant constraints) account for the congestion and resulting nodal price differences in a system, during any given settlement period. To the extent that these congested floodgates are persistent and predictable, it is possible to replicate a large variety of FTRs with a relatively small number of FGRs on the commercially significant constraints. This is analogous to assembling a market index tracking fund for the NASDAQ from a limited set of stocks.

In order to reduce the number of FGRs in the system and to facilitate liquidity FGRs can be issued on bundles of nearly parallel elements. Similarly, when a limiting element is represented by multiple power flow constraints reflecting multiple contingencies, it is possible to aggregate the constraints corresponding to a single element across all contingencies and issue a single FGR for the bundle. Whenever an FGR represents a financial right on a bundle of constraints, the settlement equals the sum of the shadow prices on all the constraints in the bundle.

The main difference between an FTR and the replicating FGR portfolio lies in the insurance that these financial instruments provide against contingencies. An FTR between two nodes will be settled at the nodal price differences regardless of changes in

shift factors that can result from contingencies. A replicating FGR portfolio, on the other hand will deviate from the nodal price difference if shift factors change and it is the responsibility of the holder to track such changes in order to hedge real time congestion costs. This difference has implications on the hedging capabilities of the different rights and on the number of rights that can be issued as we will discuss below.

2. Options vs. obligation.

The various market design proposals that have adopted the pluralistic approach to transmission rights (i.e. FTRs and FGRs) as well as the FERC white paper have suggested that the two types of rights be offered as options and as obligations. Unfortunately, such proposals reflect some basic misconceptions that will result in implementation difficulties. It is important to recognize that FTRs are inherently two sided instruments that can at any point in time be either entitlement or obligations. This feature results from the fact that FTR settlements are based on the differences between pairs of nodal prices that may be positive or negative depending on the direction for which the right is defined relative to the congestion. When an FTR between two nodes has negative value the corresponding real time congestion charge between the two is also negative which means that a new transaction in the opposite direction of the FTR reduces congestion through counterflow and will be paid a negative congestion charge. The corresponding FTR on the other hand is liable for the negative nodal price difference. In such a situation the FTR can be interpreted as a financial liability for the counterflow. Such liability can be offset by executing a matching physical transaction which is entitled to an equal sum of negative congestion charge. Defining FTRs as options is problematic, however. The financially "correct" definition of a 1 MW FTR option between two nodes is an entitlement to the positive part of the corresponding nodal price difference between the nodes. Unfortunately, while it is easy to define the settlement of such a financial instrument it makes the simultaneous feasibility problem that must be solved in the award auction, intractable. The difficulty arises from the fact that unlike two sided FTRs, it is not possible to represent an FTR option as a portfolio of flowgate rights. Such a representation is essential to the simultaneous feasibility test which is typically formulated as a system of linear constraints representing the flow constraints on the network elements (under n-1 contingency criteria). These constraints are imposed on the simultaneous exercise of all the awarded rights.

An alternative way to define an FTR option is as a subset of the FGRs comprising the corresponding two-sided FTR in which all the FGRs for which the shift factor may turn negative (under any n-1 contingency) is removed. Such an instrument is guaranteed to have a positive payoff under any of the n-1 contingencies. Representing such an instrument in the simultaneous feasibility test is easy since it is defined as a bundle of FGRs. The difficulty arises in the settlement stage. Should the above instrument be settled based on the real time value of the FGRs in the portfolio or should it be settled based on the positive part of the nodal price difference? A settlement rule that is based on the FGRs content of the FTR option will result in a discrepancy between the real time congestion charge and the settlement. On the other hand, a settlement that is based on the positive part of the nodal price difference overpays the right holder and may result in a revenue shortfall for the system operator.

FGRs are inherently one-sided instruments where the seller undertakes an obligation while the buyer owns an option. A 1 MW FGR is a direction right that entitles its holder to receive the real time shadow price on the corresponding flow constraint (or on a bundle of constraints). Since the shadow prices are guaranteed to be nonnegative the FGR is naturally an option. It will be exercised only when its value is positive. The FERC white paper like other RTO proposals (e.g. MISO) allude to FGR obligations without properly defining such obligations. There is an unstated implication in these proposals that an FGR can be defined as a two-sided instrument so that when the congestion reverses direction, the settlement for such an instrument will turn negative. This is a misconception that must be clarified. A change in direction of congestion does not change the sign of the shadow price on an element. Such a change in direction will bring the shadow price corresponding to flow capacity in one direction down to zero and make the shadow price on the flow capacity in the opposite direction positive. Even if we define a two sided FGR as a bundle of the two FGRs in the two possible flow directions the settlement of such an instrument is the sum of the two shadow prices which is always nonnegative.

The only meaningful way of defining an FGR obligation is as a short position on an FGR option. A producer of counterflow may sell such an instrument and collect a forward payment that essentially mortgages its real time negative congestion income. Taking such a short position on an FGR amounts to an obligation to produce or pay for real time counterflow on the respective element. In a joint FTR/FGR auction a system operator may wish to purchase FGRs from counterflow producers and rebundle them so as to increase the FTR capacity.

A true two-sided FGR can be formed by bundling an FGR option in one direction with a short sale of an FGR option in an opposite direction. Such an instrument will have the property of producing a positive settlement when the flow is constrained in the direction of the primary direction and resulting in a financial liability when the congestion occurs in the opposite direction. There seems, however, little justification for an RTO to create such a two sided instrument since market participants can synthesize them on their own, as stated.

3. Hedging capability

Both FTRs and FGRs provide hedges against real time congestion charges. FTRs can be viewed as portfolios of FGRs reflecting the flow distribution of a point to point transaction according to the shift factors. The difference is that FTRs provide perfect point to point hedges that insure their holders against changes in the shift factors whereas an FGR portfolio can also provide a perfect point to point hedge only if it is readjusted to track changes in the shift factors. However, the number of FTRs are constrained by simultaneous feasibility conditions which guarantee that congestion revenues can cover the FTR settlement. These conditions imply that some transmission capacity will be unsold and not all transactions can be hedged. Furthermore, the additional protection that FTR holders get as compared to the replicated FGR portfolio at auction time is cross subsidized by congestion revenues paid by unhedged transactions.

The common myth is that only FTR can provide a perfect hedge against congestion charges which will guarantee price certainty for transmission service customers. In fact, a portfolio of FGRs can be constructed for any point to point transaction that is guaranteed to pay at least the real time congestion charge between the two points under any n-1 contingencies. Such a portfolio will be based on the maximal shift factors under all n-1 contingencies. Of course like in the FTR case such protection cannot be offered to all the transactions and some transactions will be unhedged. The basic tradeoff that must be considered is the level of protection offered to hedged transaction vs. the fraction of total transaction that can be hedged within the restriction of the simultaneous feasibility constraints. An important feature of FGRs is that selling off all the feasible FGR capacity with or without FTRs enables all the transmission capacity to be sold off and all transactions to be hedged in the aggregate (although some transactions may be overhedged while others underhedged).

4. Liquidity

Because FTRs are subject to simultaneous feasibility constraints they have limited liquidity. Experience at PJM confirms that there is virtually no secondary trading of FTRs and most of the trading takes place through the periodic reconfiguration auctions conducted by the ISO. FGRs on the other hand are linked to physical capacity of one or groups of elements, which is determined separately for each FGR. Furthermore, it is often the case that the number of flowgates that are commercially significant is limited. Consequently, most of the point to point congestion can be traced to a small number of bottlenecks. To the extent that these bottlenecks are persistent and predictable the ISO can issue for them FGRs over long durations whereas any reconfiguration can be handled by secondary trading. The limited number of FGRs and the fact that their available quantities are determined independently for each FGR fosters their liquidity and makes them amenable to temporal segmentation (into hourly or daily rights) and secondary trading.

5. Contingencies

The simultaneous feasibility conditions imposed on the FTRs typically include n-1 contingency considerations. Contingency considerations reduce the number of FTRs issued but do not increase the number of FTR types needed in order to offer perfect congestion hedges for any point to point transaction. In the case of flowgates, since every contingency changes the shift factors, a flowgate may be represented in the economic dispatch problem by multiple constraints corresponding to different contingencies. Thus, the number of commercially significant constraints may be as many as the number of flowgates times the number of relevant contingencies. If we define FGRs for each constraint in the economic dispatch problem we may end up with too many. However, it is possible to bundle constraints corresponding to different contingencies much like bundling parallel elements and cover each bundle with a single FGR. Such bundling reduces the available capacity that can be sold as FGRs but will increase the FGRs liquidity.