FTR/ARR Funding and Education

FTRSTF
June 11, 2014
ARR/FTR Evolution

• Locational Marginal Pricing (LMP)
  – Consists of System, Congestion, and Loss Components
    • Congestion occurs when the least costly resources cannot be dispatched to meet demand due to physical limitations.
    • Congestion results in price uncertainty to purchase power to serve obligations
  – ARR/FTR Market
    • Developed in conjunction with LMP market in 1998 to provide hedging mechanism for Load Serving Entities for congestion
    • Auction based product allowed for non Load Serving Entities to participate and provide greater liquidity and price certainty
    • Long Term Transmission rights added in 2006
<table>
<thead>
<tr>
<th>Planning Period</th>
<th>Revenue Adequacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007-08</td>
<td>100%</td>
</tr>
<tr>
<td>2008-09</td>
<td>100%</td>
</tr>
<tr>
<td>2009-10</td>
<td>97%</td>
</tr>
<tr>
<td>2010-11</td>
<td>85%</td>
</tr>
<tr>
<td>2011-12</td>
<td>81%</td>
</tr>
<tr>
<td>2012-13</td>
<td>66%</td>
</tr>
<tr>
<td>2013-14</td>
<td>72%</td>
</tr>
</tbody>
</table>
FTR Revenue Inadequacy Causes

A. Infeasible ARR Stage 1A facilities

B. Congestion along PJM borders
   - Increase in M2M flowgates
   - Inconsistent market flow calculation between real-time and M2M billing
   - External wind, outages, and topology differences

C. Negative balancing congestion (Voltage Surrogates, Emergency Outages)

D. Reduced Capability
   - Increase in transmission outages/RTEP upgrades
   - Increase in facility rating reductions (NERC derates)
   - Lower excess margin which could offset revenue inadequacy
Timeline

• January 2011: FTR Technical Conference was held describing ARR/FTR process, funding, modeling, PJM daily activities, and 2011/2012 Annual modeling

• March 2011: FTR Task Force Created
  – Resulted in several process improvements and small rule change related to zero cost bids
  – Member consensus for no major change

• April 2012: PJM published FTR Revenue Report and Options to Address FTR Underfunding
  – Described detailed revenue inadequacy causes, supporting data, and options that could address FTR underfunding
  – Monitoring Analytics produced separate report for options to address FTR underfunding

• October 2012-June 2013: FTR Task Force
  – Resulted in auction changes to allow modeling of normal limits to reduce infeasibilities on facilities over allocated in stage 1A or as a result of transmission outages.
  • Impact to be determined
ARR/FTR Long Term Transmission Rights (LTTR)

• 10 Year ARR rights
  – Provides a LTTR based on a priority Stage 1A ARR allocation for base load that ensures longer term certainty with flexibility to opt-out on an annual basis
  – Creates a link between the PJM planning process and the Stage 1A ARR allocation to ensure transmission system is upgraded to maintain Stage 1A ARR for base load plus projected 10 year growth of base load

• Long Term FTR Auction
  – Provides a process to purchase Long-Term FTRs on an annual basis that covers one or three planning years.
Stage 1A Allocation

- Annual Allocation Stage 1A allows ARR requests from historical generation resources to zone

- Total ARR MWs capped at historical generation capability and zonal base load
  - Zonal Base Load equals minimum of daily peaks for 10/22-10/21 period (i.e. 10/22/2013-10/22/2014)

- Proration not allowed in Stage 1A
  - Transmission Limits must be increased to allow Stage 1A requests to clear (i.e. ignore SFT)
    - Translates into FTR Revenue Inadequacy because over subscribed system
  - Constraints infeasible may be upgraded through 10-year Stage 1A process
    - Grand Prairie Gateway Project approved by PJM board to address ComEd stage 1A infeasibilities
Stage 1A Allocation – Infeasible facilities

- Quantity of Infeasible facilities have increased over last several years
  - Increased Transmission Outages
  - Increased uncompensated power flow (i.e. Loop Flow)
  - Additional M2M Flowgates
Stage 1A Allocation – Inadequacy

FTR revenue shortfall from Stage 1A infeasible facilities continues to increase

- Inadequacy of Stage 1A ARRs calculated as follows:
  - Value the MWs of infeasible Stage 1A ARRs utilizing the day-ahead congestion prices (MW * (DA Sink LMP – DA Source LMP)*hours in period)
  - Day-ahead congestion LMPs used because the MWs of infeasible ARRs translates into additional FTR MW capability available in FTR auctions as either Self Scheduled FTRs or purchased FTRs.
  - PJM can “buy back” capability on infeasible facilities by utilizing excessive auction revenue but this is difficult and only moves the risk of inadequacy into the FTR auctions as reduced revenues.

<table>
<thead>
<tr>
<th>Planning Period</th>
<th>Congestion dollars ($millions)</th>
<th>Total FTR Revenue Inadequacy ($ millions)</th>
<th>FTR Revenue Inadequacy %</th>
<th>FTR Revenue Inadequacy from Stage 1A Infeasible ARRs ($ millions)</th>
<th>Stage 1A Infeasible ARRs % of FTR Revenue Inadequacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012/2013</td>
<td>$622.6</td>
<td>$288</td>
<td>68%</td>
<td>$75</td>
<td>26%</td>
</tr>
<tr>
<td>2013/2014 (June thru March)</td>
<td>$1,698</td>
<td>$575</td>
<td>75%</td>
<td>$164</td>
<td>29%</td>
</tr>
</tbody>
</table>
Stage 1 Allocation – Historical Resources

Generation Retirements

- Requires remapping historical resources to an equivalent generator or creating a dummy generator for ARR/pricing purposes only
  - Idea was to preserve the historical transmission system rights
  - May create additional Stage 1A infeasibilities
- Substantial amount of retirements not expected when Stage 1A process originally designed.

15.4% of Stage 1 historical generation has retired or submitted deactivation notices representing 25,543.7 MWs
Stage 1A infeasibility impact
### Example: Infeasible Stage 1A facility – 7/12/12

**Oak grove-Galesburg**

<table>
<thead>
<tr>
<th>FTR Market</th>
<th>Day-Ahead Market</th>
<th>Real-Time Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>External world flow</td>
<td>Day-ahead external world flow</td>
<td>Real-time external world flow</td>
</tr>
<tr>
<td>Rating</td>
<td>Day-ahead Rating</td>
<td>Real-time rating</td>
</tr>
<tr>
<td>Stage 1A ARR MW Market Flow</td>
<td>Day-ahead Revenue Inadequacy</td>
<td>Balancing Revenue</td>
</tr>
<tr>
<td>Stage 1A over allocated amount</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FTR Market Flow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FTR Market Flow: 158
Stage 1A ARR MW Market Flow: 158
Stage 1A over allocated amount: 84
FTR Market Flow: 158

- Day-ahead Market flow: 175
- Day-ahead Rating: 215
- Day-ahead Market Flow: 40
- Day-ahead Revenue Inadequacy: -$152,959
- Real-time Market Flow: 35
- Real-time Rating: 215
- Real-time Market Flow: 180
- Balancing Revenue: -$4,175

Stage 1A ARRs could not be prorated which resulted in FTR market flow ≠ Day-ahead Market flow and negative day-ahead revenue adequacy.

Day-ahead and Real-Time market flows close and results in only small amount of negative balancing congestion.
Long Term Transmission Rights
FERC Compliance Requirements
Code of Federal Regulations:

PART 42 – LONG-TERM FIRM TRANSMISSION RIGHTS IN ORGANIZED ELECTRICITY MARKETS


1. The long-term firm transmission right should specify a source (injection node or nodes) and sink (withdrawal node or nodes), and a quantity (MW).

2. The long-term firm transmission right must provide a hedge against day-ahead locational marginal pricing congestion charges or other direct assignment of congestion costs for the period covered and quantity specified. Once allocated, the financial coverage provided by a financial long-term right should not be modified during its term (the “full funding” requirement) except in the case of extraordinary circumstances or through voluntary agreement of both the holder of the right and the transmission organization.
3. Long-term firm transmission rights made feasible by transmission upgrades or expansions must be available upon request to any party that pays for such upgrades or expansions in accordance with the transmission organization’s prevailing cost allocation methods for upgrades or expansions.

4. Long-term firm transmission rights must be made available with term lengths (and/or rights to renewal) that are sufficient to meet the needs of load serving entities to hedge long-term power supply arrangements made or planned to satisfy a service obligation. The length of term of renewals may be different from the original term. Transmission organizations may propose rules specifying the length of terms and use of renewal rights to provide long-term coverage, but must be able to offer firm coverage for at least a 10 year period.

5. Load serving entities must have priority over non-load serving entities in the allocation of long-term firm transmission rights that are supported by existing capacity. The transmission organization may propose reasonable limits on the amount of existing capacity used to support long-term firm transmission rights.

– FERC added this guideline in recognition of the expected reluctance of transmission organizations to commit all of their existing grid capacity to long-term firm transmission rights due to uncertainty regarding load growth, changes in power flows and the full funding requirement. This will also help to accommodate load serving entities that prefer short-term rights. In addition, commentators claim that the principal need for long-term firm transmission rights is to support long-term power supply arrangements for base load generation, not peaking or intermediate generation.

6. A long-term transmission right held by a load serving entity to support a service obligation should be re-assignable to another entity that acquires that service obligation.

7. The initial allocation of the long-term firm transmission rights shall not require recipients to participate in an auction.
Possible Stage 1 changes

1. **Allow proration in Stage 1A**
   - Improves FTR funding by removing infeasibilities
   - Improves confidence in FTR values
   - Minimal impact on ARR revenues
   - More constrained ARR/FTR facilities usually increases ARR credits (i.e. 2014/2015 ARR credits higher although less ARRs cleared)
   - Revenue Adequacy should improve and provide confidence to FTR bidders to not devalue bids
   - Stage 1A 10-Year process still exists

2. **Remove Stage 1 historical resources when they physically retire**
   - Units do not exist so transmission system rights from generator not necessary
   - Should reduce stage 1A infeasibilities
   - Creates correct model
Example: Balancing Congestion
• FTR awarded for 300 MW from A to B
Example – Revenue Adequate (DAY AHEAD)

LMP @ A = $50

LIMIT = 300 MW
FLOW = 300 MW

LMP @ B = $80

500 MW

200 MW

300 MW @ $80

500 MW @ $50

<table>
<thead>
<tr>
<th>DAY AHEAD</th>
<th>A</th>
<th>B</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gen MW</td>
<td>300 MW</td>
<td>200 MW</td>
<td>500 MW</td>
</tr>
<tr>
<td>Gross Gen Rev</td>
<td>$15,000</td>
<td>$16,000</td>
<td>$31,000</td>
</tr>
<tr>
<td>Load MW</td>
<td>0 MW</td>
<td>500 MW</td>
<td>500 MW</td>
</tr>
<tr>
<td>Load Payment</td>
<td>$0</td>
<td>$40,000</td>
<td>$40,000</td>
</tr>
<tr>
<td>Congestion Charge</td>
<td>--</td>
<td>--</td>
<td>$9,000</td>
</tr>
<tr>
<td>FTR ALLOCATION</td>
<td></td>
<td></td>
<td>$9,000</td>
</tr>
</tbody>
</table>

\[ \text{FTR ALLOCATION} = 300 \text{MW} \times ($80 - $50) \]
**Example – Revenue Adequate (REAL TIME)**

- **LMP @ A = $50**
- **LMP @ B = $80**
- **Limit = 300 MW**
- **Flow = 300 MW**
- **500 MW @ $50**
- **250 MW**
- **Load B higher in Real Time**
- **GEN B higher in Real Time**
- **550 MW**

### BALANCING

<table>
<thead>
<tr>
<th></th>
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<th>B</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gen MW DELTA</td>
<td>0 MW</td>
<td>50 MW</td>
<td>50 MW</td>
</tr>
<tr>
<td>Gross Gen Rev</td>
<td>$0</td>
<td>$4,000</td>
<td>$4,000</td>
</tr>
<tr>
<td>Load MW DELTA</td>
<td>0 MW</td>
<td>50 MW</td>
<td>50 MW</td>
</tr>
<tr>
<td>Load Payment</td>
<td>$0</td>
<td>$4,000</td>
<td>$4,000</td>
</tr>
<tr>
<td>Congestion Charge</td>
<td>--</td>
<td>--</td>
<td>$0</td>
</tr>
</tbody>
</table>
Example – Revenue Adequate (SETTLEMENT)

REVENUE ADEQUACY =
(DAY AHEAD + BALANCING CONGESTION) – FTR ALLOCATIONS

DAY AHEAD CONGESTION = $9,000
BALANCING CONGESTION = $0
FTR ALLOCATIONS = $9,000

($9,000+$0) - $9,000 = 0 = REVENUE ADEQUATE
**Example – Revenue Inadequate (DAY AHEAD)**

LMP @ A = $50  
LMP @ B = $80

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<td>Gen MW</td>
<td>300 MW</td>
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<tr>
<td>Load MW</td>
<td>0 MW</td>
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<td>Load Payment</td>
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<td>$40,000</td>
</tr>
<tr>
<td>Congestion Charge</td>
<td>--</td>
<td>--</td>
<td>$9,000</td>
</tr>
<tr>
<td>FTR ALLOCATION</td>
<td></td>
<td></td>
<td>$9,000 300MW * ($80 - $50)</td>
</tr>
</tbody>
</table>
Example – Revenue Inadequate (REAL TIME)

<table>
<thead>
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<th>BALANCING</th>
<th>A</th>
<th>B</th>
<th>TOTAL</th>
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</thead>
<tbody>
<tr>
<td>Gen MW DELTA</td>
<td>-30 MW</td>
<td>30 MW</td>
<td>0 MW</td>
</tr>
<tr>
<td>Gross Gen Rev</td>
<td>-$1,500</td>
<td>$2,400</td>
<td>$900</td>
</tr>
<tr>
<td>Load MW DELTA</td>
<td>0 MW</td>
<td>0 MW</td>
<td>0 MW</td>
</tr>
<tr>
<td>Load Payment</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Congestion Charge</td>
<td>--</td>
<td>--</td>
<td>-$900</td>
</tr>
</tbody>
</table>

90% of Line Rating used in Real Time for voltage surrogate

LMP @ A = $50
LMP @ B = $80

LIMIT = 270 MW
FLOW = 270 MW

500 MW @ $50
270 MW
300 MW @ $80
230 MW

500 MW

GEN A lower due to rating
GEN B higher due to rating

90% of Line Rating used in Real Time for voltage surrogate

Balancing:

- Gen MW DELTA: A -30 MW, B 30 MW, TOTAL 0 MW
- Load MW DELTA: A 0 MW, B 0 MW, TOTAL 0 MW
- Load Payment: A $0, B $0, TOTAL $0
- Congestion Charge: A --, B --, TOTAL -$900
Example – Revenue Inadequate (SETTLEMENT)

REVENUE ADEQUACY =
(DAY AHEAD + BALANCING CONGESTION) – FTR ALLOCATIONS

DAY AHEAD CONGESTION = $9,000
BALANCING CONGESTION = -$900
FTR ALLOCATIONS = $9,000

($9,000-$900) - $9,000 = -$900 = REVENUE INADEQUATE