PJM ARR and FTR Market
Objectives

At the completion of this training, you should be able to describe ...

• the concepts and principles of Auction Revenue Rights and Financial Transmission Rights

• how to participate in the Annual ARR Allocation and FTR Auctions

• the Market Settlements for FTRs and ARRs

• the Market Participant activities that can be performed using PJM FTR Center
Agenda

• Introduction
• Overview of Financial Transmission Rights (FTRs)
• Overview of Auction Revenue Rights (ARRs)
• Overview of Simultaneous Feasibility Test (SFT)
• Annual Allocation Process
• FTR Auctions & Bilateral Trading
• Market Settlements
Appendices

• Appendix A: FTR Center - Market User Interfaces
• Appendix B: ARR Reassignment Example
• Appendix C: FTR Manual
• Appendix D: FTR Center User Guide
• Appendix E: Frequently Asked Questions
Introduction
What are ARRs

- Auction Revenue Rights ...

  *are entitlements allocated annually to Firm Transmission Service Customers that entitle the holder to receive an allocation of the revenues (or charges) from the Annual FTR Auction*
What are FTRs?

- Financial Transmission Rights are financial instruments awarded to bidders in the FTR Auctions that entitle the holder to a stream of revenues (or charges) based on the hourly Day Ahead congestion price differences across the path.
ARR/FTR Relationship

ARRs provide a revenue stream to the firm transmission customers, as a result of the FTR Auction, to hedge against congestion charges.

Entire PJM System Capability

Annual Allocation

ARRs allocated (MWs)

Annual FTR Auction

FTRs awarded to bidders (MWs & price)

Hourly

DA & RT Congestion revenue

Auction Revenue Rights

Congestion revenue

7/13/2013
Overview of Financial Transmission Rights (FTRs)
What are FTRs?

- Financial Transmission Rights are ...

  financial instruments awarded to bidders in the FTR Auctions that entitle the holder to a stream of revenues (or charges) based on the hourly Day Ahead congestion price differences across the path
Why do we need FTRs?

• Challenge:
  – LMP exposes PJM Market Participants to price uncertainty for congestion cost charges
  – During constrained conditions, PJM Market collects more from loads than it pays generators

• Solution:
  – Provides ability to have price certainty
  – FTRs provide hedging mechanism that can be traded separately from transmission service
Characteristics of FTRs

• Economic value based on Day-Ahead Congestion Prices
• Defined from source to sink
• Can be in form of obligation or option
  – obligation can be benefit or liability
  – option can be benefit but never liability
• Financial entitlement, *not* physical right
• Independent of energy delivery
• Must be simultaneously feasible
Economic Value of FTRs

\[
\text{FTR Target Allocation} = (\text{FTR MW}) \times (\text{Congestion Price}_{\text{FTR Sink}} - \text{Congestion Price}_{\text{FTR Source}})
\]

- FTR Target Allocation (\text{$ needed$}) is equal to the FTR MW amount times the congestion price difference from the FTR sink point to the FTR source point.
- Congestion Price based on the clearing prices from Day-Ahead Market.
- If \(\text{Congestion Price}_{\text{FTR Sink}} < \text{Congestion Price}_{\text{FTR Source}}\)
  - the FTR is a liability if FTR defined as Obligation
  - the FTR has zero value if defined as Option.
How are FTRs Acquired?

FTRs are acquired in several market mechanisms ...

• Annual FTR Auction
  – four rounds
  – entire system capability minus approved Long-Term FTRs

• Long-Term FTR Auction
  – multi-round
  – purchase residual system capability assuming the self-scheduling of ARRs

• Monthly FTR Auction
  – single-round
  – purchase “left over” capability

• FTR Secondary Market
  – bilateral trading
FTRs can be acquired in two forms ...

FTR Obligations

FTR Options
What are FTR Obligations Worth?

**Benefit**
- the hourly congestion value is positive
- FTR same direction as congested flow

**Liability**
- the hourly congestion value is negative
- FTR opposite direction as congested flow
What are FTR Options Worth?

A Benefit

– the hourly congestion value is positive
– FTR same direction as the congested flow

Neither a Benefit or a Liability

– the hourly congestion value is zero
– FTR opposite direction to the congested flow

FTR Option cannot have negative value
FTR Credits and Congestion Charges

Congestion Charge =
MWh * (Day-ahead Sink Congestion Price - Day-ahead Source Congestion Price)

FTR Credit =
MW * (Day-ahead Sink Congestion Price - Day-ahead Source Congestion Price)
FTR Obligation is a Benefit

Thermal Limit

FTR Obligation = 100 MW

Energy Delivery = 100 MWh

Bus A
Source (Sending End)
Congestion Price = $15

Bus B
Sink (Receiving End)
Congestion Price = $30

Congestion Charge = 100 MWh * ($30-$15) = $1500

FTR Obligation Credit = 100 MW * ($30-$15) = $1500
FTR Obligation is a Liability

 Thermal Limit

 FTR Obligation = 100 MW

 Energy Delivery = 100 MWh

 Bus A  
 Source  
 (Sending End)
 Congestion Price  
 = $15

 Congestion Charge = 100 MWh * ($30-$15) = $1500

 FTR Obligation Credit = 100 MW * ($15-$30) = $-1500

 Bus B  
 Sink  
 (Receiving End)
 Congestion Price  
 = $30
FTR Option is a Benefit

- **Thermal Limit**

- **FTR Option = 100 MW**

- **Energy Delivery = 100 MWh**

**Bus A**
- Source (Sending End)
- Congestion Price = $15

**Bus B**
- Sink (Receiving End)
- Congestion Price = $30

**Congestion Charge**
- $100 MWh * ($30-$15) = $1500

**FTR Option Credit**
- $100 MW * ($30-$15) = $1500
FTR Option is Neither a Benefit/Liability

**Thermal Limit**

**FTR Option = 100 MW**

**Energy Delivery = 100 MWh**

- **Bus A**
  - Source (Sending End)
  - Congestion Price = $15

- **Bus B**
  - Sink (Receiving End)
  - Congestion Price = $30

**Congestion Charge = 100 MWh * ($30-$15) = $1500**

**FTR Option Credit = 100 MW * ($15-$30) = $-1500 = $0**

***When calculated, the FTR Option Credit is negative, therefore the economic value will equal zero.******
Summary

• FTRs are financial instruments used to hedge congestion costs

• FTRs can be acquired in the Annual FTR Auction, Long Term FTR Auction, Monthly FTR Auction, or Secondary Market

• FTRs can be Obligations or Options
  – obligation can be benefit or liability
  – option can be benefit but never liability

• FTRs must be simultaneously feasible
Overview of
Auction Revenue Rights (ARRs)
What are ARRs

• Auction Revenue Rights ...

*entitlements allocated annually to Firm Transmission Service Customers that entitle the holder to receive an allocation of the revenues from the Annual FTR Auction*
Annual ARR Allocation

- **Allocated to Firm Transmission Service Customers annually in a two-stage allocation process**
  - First stage protects native load utilization of the transmission system providing long-term certainty
  - Second stage provides flexibility to adjust hedging paths annually

- **property rights allocated to Firm Transmission Customers as Auction Revenue Rights**

- **Supports retail programs by reassigning ARRs/FTRs as load switches between LSEs within planning period**
Characteristics of ARRs

• Economic value based on LMPs from the Annual FTR Auction
  – Defined from source to sink
  – Only available as an obligation
    • obligation can be benefit or liability
  – Financial entitlement, *not* physical right
  – Must be simultaneously feasible
Economic Value of ARR

\[
\text{ARR Target Allocation} = (\text{ARR MW}) \times (\text{LMP}_{\text{ARR Sink}} - \text{LMP}_{\text{ARR Source}})
\]

- ARR Target Allocation (\$\text{needed}) is equal to the ARR MW amount times the average price difference from the ARR sink point to the ARR source point over the 4 rounds.
- LMPs based on the average nodal clearing prices over the 4 rounds of the Annual FTR Auction.
- ARRIs can be a benefit or a liability.
How Are ARRs Acquired?

ARRs are acquired in the following mechanisms ...

1. Annual Allocation

   Auction Revenue Rights (ARRs) requested by Firm Transmission Customers are allocated on an annual basis

2. Daily ARR Reassignment

   ARRs allocated for the planning period will be reassigned on a proportional basis within a zone as load switches between LSEs within the planning period
What Can The Holder Do With the ARR?

• “Self-scheduling” ARR into Annual FTR Auction on exact same path as ARR

• Reconfigure ARR by bidding into Annual Auction to acquire FTR on alternative path or for alternative product

• Retain allocated ARR and receive associated allocation of revenues from the auction
Daily ARR Reassignment

ARRs allocated for the planning period will be reassigned daily on a proportional basis within a zone as load switches between LSEs within the planning period

- An LSE that loses load in a zone will lose ARRs if the LSE has a **net positive economic** ARR position for that zone
- An LSE that loses load in a zone will not lose ARRs if the LSE has a **net negative economic** ARR position for that zone
- An LSE that opted for a direct allocation of FTRs and that loses load will lose a proportional share of each FTR
Daily ARR Reassignment Process - Here is What We Do

**STEP 1**
How Does Load Shifts?

- Compare each LSE’s daily deviation of Network Peak Load in zone

**STEP 2**
Who Loses ARR?

- Analyze each LSE’s net economic position
  - For each LSE losing load AND have a net positive position for that zone
    - Determine load lost %
    - Reduce each ARR owned by that percentage

**STEP 3**
Who Gains ARR?

- Assign total set of forfeited ARRs to LSEs that gain load in zone
  - a. determine percentage of ARRs to be assigned to each LSE gaining load
  - b. assign LSE gaining load % of each ARR in this set of forfeited ARRs
Daily ARR Reassignment

ARRs are allocated in **March** for the next planning period using an estimate of peak load contributions for June 1.

A reassignment will occur on **June 1** by comparing the actual June 1 load contribution to the estimated June 1 load contribution.

An ARR reassignment for **January 1** will not be conducted because new zonal loads are uploaded and allocated on January 1.
Example - ARR Candidates

ABC company requests 600MW ARR from Generator A to the load at Bus D

ABC company requests 300MW ARR from Generator B to the load at Bus D

ABC company does NOT request an ARR from Generator C to load at Bus D

ABC company requests 100MW ARR from Generator A to Interface X for its long-term firm point-to-point transmission service

*Historical Day-Ahead LMPs
ARRs entitle the holder to receive allocation of Annual FTR Auction revenues

ARRs are allocated to Firm Transmission Service Customers

ARRs may be self-scheduled to an FTR before the first round of the Annual FTR Auction

ARRs are reassigned on a proportional basis within a zone as load switches between LSEs within the planning period

ARRs are only available as an obligation
  - obligation can be benefit or liability

ARRs must be simultaneously feasible

Residual ARRs may be available within a planning period for increased transmission capability
Overview of Simultaneous Feasibility Test (SFT)
What is a Simultaneous Feasibility Test?

• Test to ensure that all subscribed transmission entitlements are within the capability of the existing transmission system

• Test to ensure the PJM Energy Market is revenue adequate under normal system conditions

• **NOT** a system reliability test

• **NOT** intended to model actual system conditions
Feasibility of ARRs and FTRs

- ARRs must be simultaneously feasible to ensure that Annual FTR Auction revenues are sufficient to cover ARR Target Allocations.

- FTRs must be simultaneously feasible to ensure that total congestion charges collected from Day Ahead and Balancing Markets are sufficient to cover FTR Target Allocations.
Test Conditions and Criteria

• FTRs or ARRs are modeled as generation at source point and load at sink point

• Single contingency test criteria

• Perform DC powerflow analysis to
  – Evaluate ability of all system facilities to remain within normal thermal ratings
  – Evaluate ability to sustain the loss of any single contingency event with all system facilities remaining within applicable short-term, emergency ratings
SFT Data Inputs

- Uncompensated Parallel Flow Injections
- Transmission Outages
- Existing FTRs or ARRs
- Facility Ratings
- PJM Network Model
- List of Contingencies
- Interface Ratings
FTR 1: 300 MW Obligation from A to B

FTR 2: 180 MW Obligation from A to B

Net Flow on Line A-B = 480 MW

Line A-B Flow is < the Line A-B Rating therefore both FTRs are simultaneously feasible
SFT Example #2

Calculated Net Flow = 600 MW

FTR 1: 300 MW Obligation from A to B
FTR 2: 300 MW Obligation from A to B

Net Flow on Line A-B = 600 MW

Line A-B Flow > Line A-B Rating therefore both FTRs are NOT simultaneously feasible
Revenue Adequacy using SFT Examples

Day Ahead Congestion Charge = 500 MW ($20 - $10) = **$5,000**

FTR Target Allocation (using SFT Example 1 FTRs) 480 MW

Total FTR Target Allocation = 480 MW ($20 - $10) = **$4,800**

FTR Target Allocation (using SFT Example 2 FTRs) 600 MW

Total FTR Target Allocation = 600 MW ($20 - $10) = **$6,000**
FTR 1: 500 MW Obligation from B to A
FTR 2: 1000 MW Obligation from A to B
Net Flow on Line A-B = 500 MW
Line A-B Flow = Line A-B Rating therefore
both FTRs are simultaneously feasible
SFT Example #4

Net Flow = 500 MW or 1000 MW

FTR 1: 500 MW Option from B to A
FTR 2: 1000 MW Obligation from A to B

Net Flow on Line A-B = 500 MW
- or –
Net Flow on Line A-B = 1000 MW (must ignore counterflow created by Option)

Line A-B Flow > Line A-B Rating therefore both FTRs are NOT simultaneously feasible
Revenue Adequacy using SFT Examples


Day Ahead Congestion Charge = 500 MW ($20 - $10) = $5,000

FTR Target Allocation (using SFT Example 3 FTRs)
FTR 1 Target Allocation = 500 MW ($10 - $20) = -$5,000
FTR 2 Target Allocation = 1000 MW ($20 - $10) = $10,000
Total FTR Target Allocation = $5,000

FTR Target Allocation (using SFT Example 4 FTRs)
FTR 1 Target Allocation = 500 MW ($10 - $20) = 0
FTR 2 Target Allocation = 1000 MW ($20 - $10) = $10,000
Total FTR Target Allocation = $10,000
Maintaining Feasibility

Feasibility of requests is maintained by:

**Annual Allocation**
requests prorated in proportion to MWs requested and inverse proportion to effect on binding constraint

**Annual/Long-Term/Monthly Auctions**
requests awarded to highest bidder
ARR Annual Allocation Process
Characteristics of the Annual Allocation

• Long Term Allocation on an annual basis
  – ARRs are acquired for duration of Planning Period

• Allocated to Firm Transmission Service
  – Network Integration Service
  – Firm Point to Point

• Entire Capability of the Transmission System

• Within Planning Period,
  – Network ARRs are reassigned as load shifts
  – Shorter term Pt-to-Pt ARRs may be requested via OASIS
Two – Stage Allocation Process

Stage 1 assigns candidate ARR sources for each zone from resources historically designated to serve load in the zone

- Stage 1A for historical resources up to base load
  - Base Load defined as minimum of daily peak loads for each transmission zone from previous year escalated by one-year’s projected load growth
  - Maximum MW available to each historical resource will be share of the historical resource capability
  - Qualifying Firm Point-to-Point Customers may request up to 50% of the qualifying transmission service reservation MW level

- Stage 1B for historical resources up to peak load
  - Maximum MW available to each historical resource will be share of the historical resources capability minus Stage 1A MWs allocated from resource
  - Qualifying Firm Point-to-Point Customers may submit request for the remainder of their qualifying transmission service reservation MW level that was not covered by Stage 1A ARR MWs
Characteristics of the Annual Allocation (cont.)

• Stage 2 is a 3 round iterative approach which allows LSEs to request additional ARRs from a variety of potential ARR source points

• Total MWs requested by LSE cannot exceed LSE’s share of zonal peak load and each round of Stage 2 is limited to 1/3 of the remaining peak load amount not covered in Stage 1 allocation
### Annual Allocation – Business Rules

#### Stage 1A and 1B
- Stage 1A and Stage 1B performed separately with both using a Single Allocation Process
- The ARR source is designated from Generation Resources that historically served load in each transmission zone or historic load aggregation Zone
- Entire system capability is available for allocation

#### Stage 2
- 3 Round Allocation Process
- The ARR source is designated from any generation bus, hub, zone or interface
- 1/3 of remaining system capability allocated in each round

Sink points are zone or aggregate where load is located
Stage 1 - Annual Allocation Process

- Stage 1A performed prior to Stage 1B
- Each LSE in a zone assigned a pro-rata amount of the MW capability from each historical generation resource assigned to the zone
- LSE chooses the set of ARRs that it wants to request based on the resources assigned
- ARRs must source at the designated resource and sink at the LSE’s aggregate load in the transmission zone or load aggregation zone
- ARR request is limited to an amount not greater that the assigned resource MW capability
- Total ARR MW request cannot exceed LSE share of zonal base load for Stage 1A and zonal peak load in stage 1B
Stage 1 - Annual Allocation Process (cont.)

- Firm Pt-to-Pt requests are made for reservations deemed as Qualifying up to 50% of Reservation MW level for Stage 1A and remainder in Stage 1B
- PJM performs Simultaneous Feasibility Test (SFT) to determine the set of ARRs that can be awarded to each LSE
- PJM notifies each LSE of the ARR awards and binding constraints from Stage 1A and Stage 1B
- A participant may surrender any portion of the ARRs awarded in Stage 1 prior to commencement of Stage 2 subject to Simultaneous Feasibility
Historical Generation Resource

- PJM determines a set of eligible ARR sources for each transmission zone or for each historic load aggregation zone within a transmission zone based on the historical reference year that corresponds to the LMP-based market implementation for the transmission zone.

- Historic load aggregation zone is a sub-region of a zone that was served under a separate set of supply contracts than other load in zone.

Stage 1 - Valid Sources

1998 = Reference Year for PJM
2002 = Reference Year for APS and RECO
2004 = Reference Year for ComEd, AEP, Dayton, DUQ
2005 = Reference Year for Dominion
2010 = Reference Year for ATSI
Stage 1A link to Planning Process

- PJM will conduct annual SFT of Stage 1A ARRs to assess feasibility for each year remaining in the term of the rights
- Zonal growth rate applied to each zone’s base load to develop zonal base loads for years 2 through 10
- SFT of all requested Stage 1A ARRs plus additional ARRs to cover load growth
- Zonal load growth covered by "dispatching" the Stage 1 resources available to each zone in economic order according to historic LMP values
- If a SFT violation occurs in any year of the analysis then upgrade is identified and recommended for inclusion into the PJM RTEP
Stage 2 - Annual Allocation Process

- Stage 2 is an iterative allocation process that consists of three sequential rounds, with 1/3 of the remaining system ARR capability allocated in each round
- LSE may view results of each round before submitting ARR request for the next round
- In each round, LSE chooses the set of ARRs that it wants to request from any generator bus, hub, external interface or zone
- Total ARR MWs requested by LSE in each round of Stage 2 is limited to 1/3 of the remaining peak load amount not covered in Stage 1 allocation
Qualifying Pt-to-Pt requests in each round of Stage 2 is limited to 1/3 of the service level not covered in Stage 1 allocation.

Firm Pt-to-Pt Transmission not deemed as Qualifying but subject to base transmission charge eligible for ARR requests in Stage 2.

PJM performs Simultaneous Feasibility Test (SFT) to determine the set of ARRs that can be awarded to each LSE.

PJM notifies each LSE of the ARR awards and binding constraints after each round of Stage 2.
Annual Eligibility Requirements (Point-to-Point)

- Requests for annual ARRs must be associated with firm point-to-point service that spans entire planning period (either by its term or by renewal) and is confirmed by opening of the Annual ARR Nomination period
  - Annual requests must be made during nomination period via email/spreadsheet
  - Qualifying reservations are eligible in Stage 1
  - 1/3 of requested ARR MW associated with service not deemed as Qualifying is placed in each round of Stage 2
  - Qualifying reservations are posted on PJM Web Site

- ARR requests associated with shorter term point-to-point service may be made within the planning period
Simultaneous Feasibility Test

• All ARR requests are tested for feasibility
• If all ARR requests are simultaneously feasible then all requests can be approved
• If all ARR requests are not simultaneously feasible then ARRs are allocated proportional to MW requested and inversely proportional to effect on constraint

\[
\text{Prorated ARR} = \text{Line Capacity} \times \frac{\text{Requested ARRs MW}}{\text{Total ARR MWs}} \times \frac{1}{\text{effect on constraint}}
\]
## Proration Example

**Line AB Capacity = 50 MW**

### Requests

<table>
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<tr>
<th>#</th>
<th>Requested ARRs (FTRs)</th>
<th>Path</th>
<th>Effect on Line AB</th>
<th>Line AB Flow</th>
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**Total Flow on Line AB**

150 MW

Requests cannot be fully allocated without exceeding Line A-B capacity.

line flow exceeds line capability by 100 MW
### Proration Example (cont.)

**Line AB Capacity = 50 MW**

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<th>Requests</th>
<th>Requested ARRs (FTRs)</th>
<th>Path</th>
<th>Prorated ARRs (FTRs)</th>
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**Total Flow on Line AB**

50 MW

*Prorated ARR requests can be fully allocated*

50 MW line capability fully subscribed
Summary

• Auction Revenue Rights are allocated to Firm Transmission Service customers (Network and Firm Point-to-Point)

• ARRs are requested annually during the Annual Allocation and are acquired for the entire next planning period

• The Annual Allocation is a two-stage allocation process

• All Requests must be simultaneously feasible

• Within the Planning Period,
  – Network Service ARRs are reassigned as load shifts within a zone
  – Requests associated with shorter term point-to-point service may be made via OASIS
Market User Interfaces for Annual Allocation
FTR Center is an internet application that allows PJM Market Participants to participate in ...

- Annual ARR Allocation
- FTR Auctions
- FTR Secondary Market
### ARR Requests for 2006/2007 ARR

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<td>DELA DPL13 KV G2</td>
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</tr>
</tbody>
</table>
ARR Requests - Stage 1

ARR Requests

Market: 2007/2008 ARR
Sink Zone: DPL

Stage: [Stage 1B (Open)]
Sink: [DOVER, DEMEC, DOVER, DPL, DDEC, EASTON, OCCIDENTAL]

Total Bid MW: 2
Round Capability: 500 MW

ARR Requests for 2006/2007 ARR

<table>
<thead>
<tr>
<th>Source</th>
<th>Sink</th>
<th>MW Capability</th>
<th>Bid MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAYVIEW 4 KV G1</td>
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<td>BAYVIEW 4 KV G3</td>
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</table>

Non-eSuite Tools

- eDART
- eGADS
- efuel
- Emerg. Procedures
ARR Requests - Stage 2

No data found for this market.

ARR Requests for 2006/2007 ARR

<table>
<thead>
<tr>
<th>Source</th>
<th>Sink</th>
<th>Bid MW</th>
</tr>
</thead>
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<tr>
<td>AECO</td>
<td>DEMEC</td>
<td></td>
</tr>
<tr>
<td>AEPGEN HUB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APS</td>
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<td>DPL</td>
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<td>DUQ</td>
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<td>IMQ</td>
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<td>MICHFE</td>
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<tr>
<td>MISO</td>
<td></td>
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</tr>
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</table>

Market: 2007/2008 ARR  Stage: Stage 2 Round 1 (Open)  Sink Zone: DPL

Total Bid MW: 0  Round Capability: 200  NSPL: 600
No data found for this market.

ARR Results by Participant for 2006/2007 ARR

<table>
<thead>
<tr>
<th>Source</th>
<th>Sink</th>
<th>Bid MW</th>
<th>Cleared MW</th>
</tr>
</thead>
</table>

ARR Results by Participant

Market: 2007/2008 ARR  Stage: Stage 2 Round 1 (Open)
FTR Auctions & Bilateral Trading
Characteristics of the Annual FTR Auction

• Entire FTR capability of the transmission system minus approved Long-Term FTRs

• Multi-product auction
  – FTR Options & FTR Obligations

• Multi-round auction
  – consisting of 4 rounds with 25% available in each round

• Multi-period auction
  – On Peak, Off Peak, 24 Hour
  – FTRs have a term of one-year
The Annual FTR Auction is a multi-round auction consisting of 4 rounds...

- 25% of the feasible FTR capability of the PJM system is awarded in each round
- FTRs that were awarded in Long-Term FTR Auctions that are effective for Annual Auction interval are modeled as fixed injections
- FTRs awarded in one round are modeled as fixed injections in future rounds
- FTRs awarded in Long-Term FTR Auction may be offered for sale in Annual Auction
- FTRs that are awarded in one round may be offered for sale in subsequent rounds
- FTRs that are self-scheduled must be submitted in Round 1
Annual FTR Auction Process

- Round Begins
- Quotes Entered
- Market Clears
- FTRs Awarded
- Calculate ARR Target Allocation
- Round Ends

- 25% of the feasible system capability is awarded in each of the four rounds
  - FTRs that were awarded in Long-Term FTR Auctions that are effective for Annual Auction interval are modeled as fixed injections
  - Awarded FTRs from each round are modeled as fixed injections in next Round
  - FTRs awarded in Long-Term FTR Auctions may be offered for sale in Annual Auction
  - FTRs that are awarded in one round may be offered for sale in subsequent rounds

- Auction Revenues distributed to ARR Holders in proportion to the economic value of the ARRs
Self Scheduled FTRs

ARR holders have the option to convert their ARRs into FTRs by “Self-Scheduling” FTRs in the Annual FTR Auction only

Characteristics of Self Scheduled FTRs ......

☑ Same Source and Sink of ARR
☑ Up to ARR MW amount
☑ “Price Taker”
☑ 24 Hour FTR Obligation
☑ Scheduled in Round 1 of Annual FTR Auction
☑ 25% of MW amount will clear in each round
Characteristics of the Long-Term FTR Auctions

- Residual FTR capability of the transmission system
  - “left over” capability assuming Self-Scheduling of current planning year ARRs
  - Approved Long-Term FTRs modeled as fixed injections

- Single-product auction
  - FTR Obligations only

- Multi-round auction
  - Consisting of three rounds held 3 months apart with one-third available in each round

- Multi-Period auction
  - On Peak, Off Peak, 24 Hour
  - Any of next three planning years or the full three year period following the planning year of the current annual FTR auction
  - FTRs have a term of one year or three years
Valid Bidding Periods

– Individual year in next three planning periods after current Annual Auction FTRs
– Three-year period following current Annual Auction FTRs
Characteristics of the Monthly FTR Auctions

• Residual FTR capability of the transmission system
  – “left over” capability from Long-Term and Annual FTR Auction

• Multi-product auction
  – FTR Options & FTR Obligations

• Single-round auction

• Multi-Period auction
  – On Peak, Off Peak, 24 Hour
  – Any of next three individual calendar months or remaining full planning period quarters
  – FTRs have a term of one month or a three month quarter
Monthly FTR Auctions

Valid Bidding Periods

- Next 3 individual calendar months remaining in planning period
- Any complete planning period quarter remaining in planning period
FTR Secondary Market

• Bilateral Trading of existing FTRs only
• Bulletin Board system in PJM FTR Center
• FTRs can be split into smaller increments (duration/mw/period) that total the original FTR
• New owner takes on cost responsibility of purchased FTR
• FTRs cannot be reconfigured
  – path and product type (Option or Obligation) must remain same
• Successful trades in FTR Center transfer ownership
  – adjustments in Monthly Billing Statement
  – independent trades outside of FTR Center are not adjusted in Monthly Billing Statement
# Comparison of FTR Auctions

<table>
<thead>
<tr>
<th>Capability Auctioned</th>
<th>Annual FTR Auction</th>
<th>Long-Term FTR Auction</th>
<th>Monthly FTR Auction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Entire FTR capability of the transmission system minus approved Long-Term FTRs</td>
<td>Residual FTR capability of the transmission system assuming Self-Scheduling of current planning year ARRs</td>
<td>Residual FTR capability of the transmission system</td>
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<tr>
<td>Auction Format</td>
<td>Multi Round</td>
<td>Multi Round</td>
<td>Single Round</td>
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<tr>
<td>FTR Products</td>
<td>FTR Obligations</td>
<td>FTR Obligations</td>
<td>FTR Obligations</td>
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<tr>
<td></td>
<td>FTR Options</td>
<td></td>
<td>FTR Options</td>
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<tr>
<td>FTR Class Types</td>
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<tr>
<td></td>
<td>Off peak</td>
<td>Off peak</td>
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</tr>
<tr>
<td></td>
<td>24 Hour</td>
<td>24 Hour</td>
<td>24 Hour</td>
</tr>
<tr>
<td>FTR Period</td>
<td>One Year</td>
<td>One Year</td>
<td>One Month</td>
</tr>
<tr>
<td></td>
<td>One three-year planning period</td>
<td></td>
<td>One three-month planning period quarter</td>
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</table>

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## Valid Sources and Sinks

<table>
<thead>
<tr>
<th>FTR Obligations</th>
<th>Annual and Long-Term FTR Auctions</th>
<th>Monthly FTR Auctions Next Calendar Month</th>
<th>Monthly FTR Auctions Quarters and 2nd/3rd Month</th>
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</thead>
<tbody>
<tr>
<td>Valid Sources &amp; Sinks are limited to:</td>
<td>Valid Sources &amp; Sinks include any single bus or combination of buses for which a Day-ahead LMP is calculated &amp; posted:</td>
<td>Valid Sources &amp; Sinks are limited to:</td>
<td></td>
</tr>
<tr>
<td>• Hubs</td>
<td>• Hubs</td>
<td>• Hubs</td>
<td></td>
</tr>
<tr>
<td>• Zones</td>
<td>• Zones</td>
<td>• Zones</td>
<td></td>
</tr>
<tr>
<td>• Aggregates</td>
<td>• Aggregates</td>
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<tr>
<td>• Interface Buses</td>
<td>• Interface Buses</td>
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<tr>
<td>• Generator Buses</td>
<td>• Generator/Load Buses</td>
<td>• Generator Buses</td>
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</tr>
</tbody>
</table>

**FTR Options***

Only a subset of paths will be eligible for FTR Options in order to prevent potential auction clearing performance issues

*Option Product not available in Long-Term FTR Auction

---

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Auction Clearing Mechanism

• The FTR Auctions maximize the quote based bid value of a set of simultaneous feasible FTRs awarded in the auction

• The FTR Auctions evaluate the simultaneous feasibility of all outstanding FTRs, in conjunction with new FTRs to be awarded or surrendered by Market Participants
FTR Auction Process

1. Quotes Entered
2. Market Clears
3. FTRs Awarded

- Bids and Offers for FTRs are submitted via FTR Center
- Winning Quotes determined
- Highest bid-based valued combination of simultaneously feasible FTRs are selected
- Auction Results are posted
Post FTR Auction Input and Output

- Uncompensated Parallel Flow Injections
- Transmission Outage Schedules
- Pre-existing FTRs
- Facility Ratings
- FTR Quotes (Buy or Sell)
- PJM Network Model
- List of Contingencies
- Aggregate Price Definitions

FTR Auction Software

- FTRs Awarded in Auction
- FTRs Sold in Auction
- Nodal Prices
- Option Clearing Prices
- Aggregate Prices
- Binding Constraints
The FTR Auctions are multi-period auctions with FTR products that can overlap across multiple timeframes...

- FTR products can be On Peak FTRs, Off Peak FTRs and 24 Hour FTRs
- The various products are cleared simultaneously and the clearing prices of products which overlap are related
## Multi-period FTR Auction - Example #1

**Simple radial system**

- **Line AB On Peak Rating**: 100 MW
- **Line AB Off Peak Rating**: 120 MW

### Auction Results

<table>
<thead>
<tr>
<th></th>
<th>FTR Bids</th>
<th>Bid Price</th>
<th>MW Cleared</th>
<th>Clearing Price</th>
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</thead>
<tbody>
<tr>
<td><strong>On Peak</strong></td>
<td>130 MW</td>
<td>$100/MW</td>
<td>100 MW</td>
<td>$100/MW</td>
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<tr>
<td><strong>Off Peak</strong></td>
<td>130 MW</td>
<td>$95/MW</td>
<td>120 MW</td>
<td>$95/MW</td>
</tr>
<tr>
<td><strong>24 Hour</strong></td>
<td>130 MW</td>
<td>$180/MW</td>
<td>0 MW</td>
<td>$195/MW</td>
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<tr>
<td><em>(On Peak + Off Peak)</em></td>
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### Multi-period FTR Auction - Example #2

#### Simple radial system

<p>| | | |</p>
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</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td>B</td>
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</tbody>
</table>

#### Line AB
- **On Peak Rating**: 100 MW
- **Off Peak Rating**: 120 MW

#### Auction Results

<table>
<thead>
<tr>
<th></th>
<th>FTR Bids</th>
<th>Bid Price</th>
<th>MW Cleared</th>
<th>Clearing Price</th>
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</thead>
<tbody>
<tr>
<td><strong>On Peak</strong></td>
<td>90 MW</td>
<td>$100/MW</td>
<td>90 MW</td>
<td>$ 85/MW</td>
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<tr>
<td><strong>Off Peak</strong></td>
<td>130 MW</td>
<td>$ 95/MW</td>
<td>110 MW</td>
<td>$ 95/MW</td>
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<tr>
<td><strong>24 Hour</strong></td>
<td>130 MW</td>
<td>$180/MW</td>
<td>10 MW</td>
<td>$180/MW</td>
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</tbody>
</table>

*Example* #2

- Simple radial system
- **Line AB On Peak Rating**: 100 MW
- **Line AB Off Peak Rating**: 120 MW
Submitting Valid Auction Quotes

- Market
- Source
- Sink
- Class (on-peak, off-peak or 24 hour)
- Period
- Hedge (option or obligation)
- Trade (buy, sell or self-schedule for Round 1 of annual auction)
- Bid MW
- Bid Price ($/MW-three year for three year Long-Term FTR product or $/MW-year for yearly product or $/MW-month for monthly product or $/MW-quarter for quarterly product)
FTR Auction Credit Requirement

• FTR Auction participants must establish an Auction Credit Limit prior to bidding into auction

• Credit Requirement for a participant’s bids may not exceed Credit Limit

• Credit Requirement for individual FTR bids is price of the FTR bid minus estimate of revenue from the FTR

• Participant’s Credit Requirement is sum of Credit Requirement for each individual FTR bid offset by total value of Participant’s ARRs
FTR Auction Credit Rules

• Credit requirements apply to All FTR auctions
  – Use monthly weighted average of past three years (50%-30%-20%) when calculating historical value
  – Separate historic values for on-peak, off-peak and 24-hour FTRs
  – Discount historical value by 10% when calculating credit requirements for FTR paths with positive expected value and add 10% for FTR paths with negative expected value

• Specific timetable for credit release

• No credit requirement for participants that self-schedule their ARRs into FTRs since ARR credits offset FTR costs in full
Credit Requirement Calculation

1. Starts with a monthly credit calculation for each FTR
   • Monthly Price minus discounted historical value for each month for each FTR

2. Within each month individual FTR credit numbers are added across all FTRs to result in 12 monthly subtotals for the account
   • For cleared FTRs only, negative individual FTR credit numbers will offset positive numbers within the same month.
   • ARR credits in the account are subtracted from credit requirements each month
     ▪ Monthly ARR value

3. Credit requirement is the sum of positive monthly subtotals
FTR Auction Credit Rules

- FTR credit requirements for undiversified FTR auction bidding
  - Undiversified Portfolio Definitions
    - Flow Undiversified = the FTR Portfolio is net counterflow which means the total value of the portfolio is negative based on FTR auction clearing prices
    - Geographically Undiversified = The FTR portfolio is Flow Undiversified and the FTR portfolio has lower projected target allocations because of a single transmission outage
    - The FTR portfolio is the cumulative position for all current and future FTRs cleared in previous auctions and FTRs cleared in any current preliminary auction case
FTR Auction Credit Rules

Check performed after preliminary auction clearing completed

- Screen for undiversified portfolios (geographically and by flow)

- Additional collateral:
  - 2 times absolute value of FTR auction-based value if flow undiversified
  - 3 times absolute value of FTR auction-based value if flow and geographically undiversified

- PJM issues demand for additional credit as required by diversification test

- Participants bids are removed from auction if demand not satisfied by 4:00 pm next day
Credit Release Schedule

• Specific timetable for credit release

• The individual monthly credit requirements for FTRs is removed after the month is complete and PJM bill is sent out to participant
  – If monthly subtotal is negative than there will be no change in total credit requirement
  – If monthly subtotal is positive than the total credit requirement will be reduced by positive monthly subtotal of completed month

• Credit requirements can change as historical monthly values are updated on a yearly basis
Summary

• The FTR Auctions maximize the quote based bid value of a set of simultaneous feasible FTRs awarded in each auction

• Annual FTR Auction revenues are distributed to ARR Holders in proportion to the economic value of the ARRs

• The Annual FTR Auction offers for sale the entire FTR capability of the transmission system

• The Annual FTR Auction is a multi-product, multi-period, and multi-round auction

• In the Annual FTR Auction, ARR holders have the option to convert their ARRs into FTRs by “Self-Scheduling” FTRs
  – this option must be selected in Round 1
The Long-Term FTR Auctions offer FTRs for one or three years after the current Annual FTR Auction where the residual capability after assumed modeled Self-Scheduled ARRs and already approved Long-Term FTRs is available.

The Monthly FTR Auctions offer for sale or purchase the residual FTR capability of the transmission system for the term of one month or one quarter.

The Monthly FTR Auctions are multi-product, multi-period, single round auctions.

FTR credit requirements apply to all FTR Auctions.
Market Settlements
Annual FTR Auction Settlements

• The Annual FTR Auction and corresponding ARRs will be settled for on a weekly basis over the course of the planning period for which the Annual FTRs are in effect

• Since ARR ownership can change daily through ARR reassignment, PJM Settlements calculates:
  – daily Annual FTR Auction revenues by dividing annual auction revenues by the number of days in the planning period
  – daily ARR credits by dividing ARR Target Allocation by the number of days in the planning period
**Economic Value of ARR**

\[
\text{ARR Target Allocation} = (\text{ARR MW}) \times (\text{LMP}_{\text{ARR Sink}} - \text{LMP}_{\text{ARR Source}})
\]

- ARR Target Allocation is equal to the ARR MW amount times the average price difference from the ARR sink point to the ARR source point over the 4 rounds.

- LMPs based on the average nodal clearing prices over the 4 rounds of the Annual FTR Auction.

- ARRs can be a benefit or a liability.
ARR Settlements (cont.)

• If sufficient revenues are collected from the Annual and Monthly FTR Auctions to satisfy ARR Target Allocations then:
  – ARR Credits = ARR Target Allocation

• Excess auction revenues are used to fund any deficiencies in FTR Target Allocation payments

• If insufficient revenues are collected from the Annual, Long-Term, and Monthly FTR Auctions to satisfy ARR Target Allocations then:
  – ARR Credits are prorated proportionately
  – ARR deficiencies are funded from (1) any annual excess congestion charges remaining at the end of a planning period after fully funding all FTR target allocations for the planning period then (2) an uplift charge assessed to FTR holders on pro-rata basis according to total Target Allocations for all FTRs held at any time during the planning period
Long-Term FTR Auction Settlements

- The Long-Term FTR auctions are billed for in the weekly bill for which the FTRs were in effect.
- Revenues from the Long-Term FTR auctions are used to first fund any shortfall in ARR Target Allocations then FTR target allocations for the planning period in which the Long-Term FTR is in effect.
Monthly FTR Auction Settlements

• The monthly auctions are billed for in the weekly bill for which the FTRs were in effect

• Revenues from the monthly auctions are used to first fund ARR Target Allocations then FTR Target Allocations
FTR Settlements

\[
\text{FTR Target Allocation} = (\text{FTR MW}) \times (\text{Congestion Price}_{\text{FTR Sink}} - \text{Congestion Price}_{\text{FTR Source}})
\]

- FTR Target Allocation is equal to the FTR MW amount times the congestion price difference from the FTR sink point to the FTR source point.
- Congestion Price based on the clearing prices from Day Ahead Market.
- If Congestion Price\(_{\text{FTR Sink}} < \text{Congestion Price}_{\text{FTR Source}}\)
  - the FTR is a liability if FTR defined as Obligation.
  - the FTR has zero value if defined as Option.
FTR Settlements (cont.)

• If sufficient congestion charges are collected from the Day Ahead and Balancing Market to satisfy FTR Target Allocations then:
  – FTR Credits = FTR Target Allocation

• Excess congestion charges are used to
  – cover any deficiencies in FTR Target Allocations within month
  – cover any deficiencies in FTR Target Allocations within planning period
  – any remaining year-end excess covers any deficiencies in ARR Target Allocation from previous months within planning period
  – any remaining year-end excess distributed to FTR participants pro-rata to total FTR Target Allocations
ARR & FTR Settlements

**SUM OF MONTHLY ARR TARGET ALLOCATIONS**

- **ARE ARR TARGET ALLOCATIONS FULLY-FUNDED FOR MONTH?**
  - **NO**
    - **FUND ARRs PRO-RATA TO ARR TARGET ALLOCATION**
  - **YES**
    - **MONTHLY EXCESS**

**ANNUAL FTR AUCTION REVENUE**

**MONTHLY FTR AUCTION REVENUE**

**SUM OF MONTHLY FTR TARGET ALLOCATIONS**

- **ARE FTR TARGET ALLOCATIONS FULLY-FUNDED FOR MONTH?**
  - **NO**
    - **FUND FTRs PRO-RATA TO FTR TARGET ALLOCATION**
  - **YES**
    - **MONTHLY EXCESS**

**DAY AHEAD MARKET CONGESTION CHARGES**

**BALANCING MARKET CONGESTION CHARGES**

**ANNUAL EXCESS ARR REVENUE AND CONGESTION CHARGE BUCKET**

**MONTHLY DEFICIENCY**

- **IF EXCESS EXISTS**
  - **DISTRIBUTED TO FTR PARTICIPANTS PRO-RATA TO FTR TARGET ALLOCATION**
  - **YEARLY DEFICIENCY**
  - **FUND BY RATIO SHARE OF TOTAL FTR TARGET ALLOCATIONS**

**ANNUAL FTR DEFICIENCY BUCKET**

**MONTHLY DEFICIENCY**

**ANNUAL EXCESS ARR REVENUE AND CONGESTION CHARGE BUCKET**

**YEARLY DEFICIENCY**

**YEARLY DEFICIENCY**

**YEARS DEFICIENCY**
Questions?

PJM Client Management & Services
Telephone: (610) 666-8980
Toll Free Telephone: 866-400-8980
Website: www.pjm.com

The Member Community is PJM’s self-service portal for members to search for answers to their questions or to track and/or open cases with Client Management & Services
Appendix A:
FTR Center - Market User Interfaces
### Portfolio Management

**eSUITE**

**Portfolios**

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<tbody>
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**Source**

- AEP
- BGE

**Sink**

- EASTERN HUB
- WESTERN HUB

**Non - eSuite Tools**

- eDART
- eGADS
- eFuel
- Emerg. Procedures

**Submit Upload**
The Monthly FTR Auctions valid source/sink list for Obligations and Options is located under the Auction User Information.
### Reports for 03/04 Annual Auction - round 1

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<td>Obligation Clearing Prices By Node</td>
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<td>Option Clearing Prices By Path</td>
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# Quotes by Portfolio

## FTR Quotes by Participant

**Portfolio:** TIMTEST  
**Market:** DEC 2005 Auction (Closed)  
**Period:**

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## Market Results - Obligation Clearing Prices

### Clearing Prices

- **Portfolio:** TIMTEST
- **Market:** 05/06 Annual Auction (Annual)
- **Round:** 1 (Cleared)

### Clearing Prices for 05/06 Annual Auction - round 1

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**Records:** 1 - 4 of 4 matches.
## Market Results - Option Prices

### Option Prices

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**Round:** 1 (Cleared)

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## Market Results by Portfolio

### Market Results by Portfolio for JUN 2003 Auction

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## Market Results - Constraints

### Constraints

**Market:** JUN 2003 Auction (Cleared)  
**Period:**

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# FTR Trading - Post FTRs

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**Path:** [WESTERN HUB: PSEG]  
**Start Date:** 01/04/08

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- **Records:** 1 - 23 of 23 matches.
- **Pages:** 2

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**Additional Links:**

- [CAM](#)
- [eCapacity](#)
- [eData](#)
- [EES](#)
- [FTR](#)
- [eAMKT](#)
- [eMTR](#)
- [eSchedule](#)
- [eSuite Messages](#)
- [Load Response](#)
- [MCA Capacity](#)
- [OASIS](#)

---

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- [Training](#)
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---

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Total equals some of positive monthly values only
Total for “Cleared” credit type is sum of positive and negative monthly cleared credit values.
## ARR Requests - Stage 1

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</tr>
<tr>
<td>BAYVIEW 4 KV</td>
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<td>2.0</td>
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<td>DOVER</td>
<td>2.0</td>
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<tr>
<td>CHR138 12 KV</td>
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<tr>
<td>CRISPIE 4 KV</td>
<td>DOVER</td>
<td>2.5</td>
<td>0.0</td>
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<td>DOVER</td>
<td>112.0</td>
<td>0.0</td>
</tr>
<tr>
<td>EDGEMOOR13 KV</td>
<td>DOVER</td>
<td>112.0</td>
<td>0.0</td>
</tr>
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<td>DOVER</td>
<td>13.0</td>
<td>0.0</td>
</tr>
<tr>
<td>DELA DPL13 KV</td>
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<td>DELA DPL13 KV</td>
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No data found for this market.

### ARR Requests for 2006/2007 ARR

<table>
<thead>
<tr>
<th>Source</th>
<th>Sink</th>
<th>Bid MW</th>
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<tr>
<td>AECO</td>
<td>DEMEC</td>
<td></td>
</tr>
<tr>
<td>AEP GEN HUB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APS</td>
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</tr>
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<td>BGE</td>
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</tr>
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<td>COMED</td>
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<tr>
<td>DAV</td>
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</tr>
<tr>
<td>DPL</td>
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<td></td>
</tr>
<tr>
<td>DUO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IMO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MICHFE</td>
<td></td>
<td></td>
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</table>
ARR Results

ARR Results by Participant

No data found for this market.

ARR Results by Participant for 2007/2008 ARR

<table>
<thead>
<tr>
<th>Source</th>
<th>Sink</th>
<th>Bid MW</th>
<th>Cleared MW</th>
</tr>
</thead>
</table>

7/13/2013
Appendix B: Reassignment of ARRs Example
Daily ARR Reassignment

ARRs allocated for the planning period will be reassigned daily on a proportional basis within a zone as load switches between LSEs within the planning period

- An LSE that loses load in a zone will lose ARRs if the LSE has a net positive economic ARR position for that zone
- An LSE that loses load in a zone will not lose ARRs if the LSE has a net negative economic ARR position for that zone
Daily ARR Reassignment (cont.)

• The economic value of the total set of ARRs to be forfeited from LSEs losing load in a zone is reassigned to those LSEs gaining load in the zone.

• The total economic value of all ARRs in this set is assigned to the LSEs gaining load in proportion to each LSE’s MW load gain relative to the total load pickup in the zone.
Daily ARR Reassignment Process

STEP 1
How Does Load Shifts?

Compare each LSE’s daily deviation of Network Peak Load in zone

STEP 2
Who Loses ARR?

Analyze each LSE’s net economic ARR position. For each LSE losing load AND have a net positive ARR position for that zone
a. determine load lost %
b. reduce each ARR owned by that percentage

STEP 3
Who Gains ARR?

Assign total set of forfeited ARRs to LSEs that gain load in zone
a. determine percentage of ARRs to be assigned to each LSE gaining load
b. assign LSE gaining load % of each ARR in this set of forfeited ARRs
Daily ARR Reassignment Example

Demonstrates the following.....

• How PJM analyzes load shifting between LSEs
• How ARRs are forfeited
• How ARRs are reassigned
### Initial ARR Allocation for Zone 1

<table>
<thead>
<tr>
<th>LSE</th>
<th>Load (MW)</th>
<th>ARR (MW)</th>
<th>ARR Path</th>
<th>ARR Value</th>
<th>Total ARRs</th>
<th>Net $ ARR Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDC 1</td>
<td>1000</td>
<td>600</td>
<td>Bus 1 to Zone 1</td>
<td>$80,000</td>
<td>800 MW</td>
<td>$70,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200</td>
<td>Bus 2 to Zone 1</td>
<td>-$10,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSE A</td>
<td>200</td>
<td>70</td>
<td>Bus 3 to Zone 1</td>
<td>$12,000</td>
<td>100 MW</td>
<td>$7,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30</td>
<td>Bus 4 to Zone 1</td>
<td>-$5,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSE B</td>
<td>300</td>
<td>200</td>
<td>Bus 5 to Zone 1</td>
<td>$20,000</td>
<td>200 MW</td>
<td>$20,000</td>
</tr>
<tr>
<td>LSE C</td>
<td>500</td>
<td>200</td>
<td>Bus 6 to Zone 1</td>
<td>-$12,000</td>
<td>250 MW</td>
<td>-$9,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50</td>
<td>Bus 7 to Zone 1</td>
<td>+3,000</td>
<td></td>
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</tr>
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</table>
## ARR Reassignment Step 1

Compare each LSE’s network service peak load in a zone to the peak load of the previous day

<table>
<thead>
<tr>
<th></th>
<th>Load 6/1/04</th>
<th>ARRs 6/1/04</th>
<th>Net $ ARR Position 6/1/04</th>
<th>Load 6/2/04</th>
<th>Load Loss (MW)</th>
<th>Load Gain (MW)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>1000</td>
<td>800</td>
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<td>1025</td>
<td>25</td>
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</tr>
<tr>
<td>LSE A</td>
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<td>100</td>
<td>7,000</td>
<td>100</td>
<td>-100</td>
<td></td>
</tr>
<tr>
<td>LSE B</td>
<td>300</td>
<td>200</td>
<td>20,000</td>
<td>425</td>
<td></td>
<td>125</td>
</tr>
<tr>
<td>LSE C</td>
<td>500</td>
<td>250</td>
<td>-9,000</td>
<td>450</td>
<td>-50</td>
<td></td>
</tr>
<tr>
<td>TOTAL ZONE</td>
<td>2000</td>
<td>1350</td>
<td>88,000</td>
<td>2000</td>
<td>-150</td>
<td>150</td>
</tr>
</tbody>
</table>

Result: LSE A loses 100 MW of load in Zone 1  
LSE C loses 50 MW of load in Zone 1  
EDC 1 gains 25 MW of load in Zone 1  
LSE B gains 125 MW of load in Zone 1
## ARR Reassignment Step 2

Analyze each LSE’s net economic ($) ARR position. For each LSE losing load and having a net positive economic ARR position for that zone:

<table>
<thead>
<tr>
<th></th>
<th>Load 6/1/04</th>
<th>ARRs 6/1/04</th>
<th>Net $ ARR Position 6/1/04</th>
<th>Load 6/2/04</th>
<th>Load Loss (MW)</th>
<th>Load Gain (MW)</th>
<th>Load Loss %</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDC 1</td>
<td>1000</td>
<td>800</td>
<td>70,000</td>
<td>1025</td>
<td></td>
<td></td>
<td>25</td>
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<tr>
<td>LSE A</td>
<td>200</td>
<td>100</td>
<td>7,000</td>
<td>100</td>
<td>-100</td>
<td></td>
<td>-50%</td>
</tr>
<tr>
<td>LSE B</td>
<td>300</td>
<td>200</td>
<td>20,000</td>
<td>425</td>
<td></td>
<td>125</td>
<td></td>
</tr>
<tr>
<td>LSE C</td>
<td>500</td>
<td>250</td>
<td>-9,000</td>
<td>450</td>
<td></td>
<td>-50</td>
<td></td>
</tr>
<tr>
<td>TOTAL ZONE</td>
<td>2000</td>
<td>1350</td>
<td>88,000</td>
<td>2000</td>
<td>-150</td>
<td>150</td>
<td></td>
</tr>
</tbody>
</table>

Result: ONLY LSE A’s ARRs have a net positive $ value  
LSE A loses 50% of load
### ARR Reassignment Step 2 (cont.)

b. reduce each ARR owned by each LSE by this same percentage

<table>
<thead>
<tr>
<th>ARR Path</th>
<th>ARR (MW) 6/1/04</th>
<th>ARR Value 6/1/04</th>
<th>Total ARRs 6/1/04</th>
<th>Net $ Position 6/1/04</th>
<th>ARR (MW) Reduced</th>
<th>ARR (MW) 6/2/04</th>
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<tr>
<td>EDC 1</td>
<td>Bus 1 to Zone 1</td>
<td>600</td>
<td>$80,000</td>
<td>800 MW</td>
<td>$70,000</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>Bus 2 to Zone 1</td>
<td>200</td>
<td>-10,000</td>
<td></td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>LSE A</td>
<td>Bus 3 to Zone 1</td>
<td>70</td>
<td>$12,000</td>
<td>100 MW</td>
<td>$7,000</td>
<td>-35</td>
</tr>
<tr>
<td></td>
<td>Bus 4 to Zone 1</td>
<td>30</td>
<td>-5,000</td>
<td></td>
<td>-15</td>
<td>35</td>
</tr>
<tr>
<td>LSE B</td>
<td>Bus 5 to Zone 1</td>
<td>200</td>
<td>$20,000</td>
<td>200 MW</td>
<td>$20,000</td>
<td>200</td>
</tr>
<tr>
<td>LSE C</td>
<td>Bus 6 to Zone 1</td>
<td>200</td>
<td>-12,000</td>
<td>250 MW</td>
<td>-$9,000</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>Bus 7 to Zone</td>
<td>50</td>
<td>$3,000</td>
<td></td>
<td></td>
<td>50</td>
</tr>
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</table>

Result: Change (-50%) in LSE A ARR MW = 50 MW forfeited
ARR Reassignment Step 3 (cont.)

Assign the total set of forfeited ARRs to LSEs that gain load in the zone

a. determine the percentage of ARRs to be assigned to each LSE gaining load. The percentage will be equal to the MW load gain by the LSE divided by the total MWs of load shifting in the zone

<table>
<thead>
<tr>
<th>LSE</th>
<th>Load 6/1/04</th>
<th>ARRs Position 6/1/04</th>
<th>Net $ ARR Position 6/1/04</th>
<th>Load 6/2/04</th>
<th>Load Loss (MW)</th>
<th>Load Gain (MW)</th>
<th>% of ARRs to be assigned</th>
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<tr>
<td>EDC 1</td>
<td>1000</td>
<td>800</td>
<td>70,000</td>
<td>1025</td>
<td>25</td>
<td>17%</td>
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<td>200</td>
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<td>7,000</td>
<td>100</td>
<td>-100</td>
<td>-100</td>
<td></td>
</tr>
<tr>
<td>LSE B</td>
<td>300</td>
<td>200</td>
<td>20,000</td>
<td>425</td>
<td>125</td>
<td>83%</td>
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</tr>
<tr>
<td>LSE C</td>
<td>500</td>
<td>250</td>
<td>-9,000</td>
<td>450</td>
<td>-50</td>
<td>-50</td>
<td></td>
</tr>
<tr>
<td>TOTAL ZONE</td>
<td>2000</td>
<td>1350</td>
<td>88,000</td>
<td>2000</td>
<td>-150</td>
<td>150</td>
<td></td>
</tr>
</tbody>
</table>

Result: EDC 1 gains 17% (25/150) of ARRs reassigned
LSE B gains 83% (125/150) of ARRs reassigned
ARR Reassignment Step 3

b. each LSE gaining load will be assigned a percentage of each ARR in this set

<table>
<thead>
<tr>
<th>ARR Path</th>
<th>ARR Path</th>
<th>ARR Value</th>
<th>ARR Value</th>
<th>Total ARRs</th>
<th>Total ARRs</th>
<th>Net $ Position</th>
<th>Net $ Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDC 1</td>
<td>Bus 1 to Zone 1 Bus 2 to Zone 1 Bus 3 to Zone 1 Bus 4 to Zone 1</td>
<td>600.000 200.000 5.833 2.500</td>
<td>$80,000.00 $10,000.00</td>
<td>$80,000.00 $808.333</td>
<td>800.000 808.333</td>
<td>$70,000.00 70,583.33</td>
<td></td>
</tr>
<tr>
<td>LSE A</td>
<td>Bus 3 tp Zone 1 Bus 4 to Zone 1</td>
<td>70.000 30.000 15.000</td>
<td>$12,000.00 $5,000.00</td>
<td>$6,000.00 $2,500.00</td>
<td>100.000 50.000</td>
<td>$7,000.00 3,500.00</td>
<td></td>
</tr>
<tr>
<td>LSE B</td>
<td>Bus 5 to Zone 1 Bus 3 to Zone 1 Bus 4 to Zone 1</td>
<td>200.000 29.167 12.500</td>
<td>$20,000.00</td>
<td>$20,000.00 $5,000.00</td>
<td>200.000 241.667</td>
<td>$20,000.00 22,916.67</td>
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<tr>
<td>LSE C</td>
<td>Bus 6 to Zone 1 Bus 7 to Zone</td>
<td>200.000 50.000 200 50</td>
<td>-$12,000.00 $3,000.00</td>
<td>-$12,000.00 $3,000.00</td>
<td>250.000 250.000</td>
<td>-$9,000.00 -9,000.00</td>
<td></td>
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</table>

Result: EDC 1 gains 8.333 MW ARRs (17% of 50 MW forfeited)  
LSE B gains 41.667 MW ARRs (83% of 50 MW forfeited)
## Summary

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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EDC 1</strong></td>
<td>1000</td>
<td>800</td>
<td>70,000</td>
<td>1025</td>
<td>25</td>
<td>8.333</td>
<td>+583.33</td>
<td>808.333</td>
<td>70,583.33</td>
</tr>
<tr>
<td><strong>LSE A</strong></td>
<td>200</td>
<td>100</td>
<td>7,000</td>
<td>100</td>
<td>-100</td>
<td>-50.000</td>
<td>-3,500.00</td>
<td>50.000</td>
<td>3,500.00</td>
</tr>
<tr>
<td><strong>LSE B</strong></td>
<td>300</td>
<td>200</td>
<td>20,000</td>
<td>425</td>
<td>125</td>
<td>41.667</td>
<td>+2,916.67</td>
<td>241.667</td>
<td>22,916.67</td>
</tr>
<tr>
<td><strong>LSE C</strong></td>
<td>500</td>
<td>250</td>
<td>-9,000</td>
<td>450</td>
<td>-50</td>
<td>0</td>
<td>0</td>
<td>250.000</td>
<td>-9,000.00</td>
</tr>
<tr>
<td><strong>TOTAL ZONE</strong></td>
<td>2000</td>
<td>1350</td>
<td>88,000</td>
<td>2000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1350.000</td>
<td>88,000.00</td>
</tr>
</tbody>
</table>
Appendix C:
FTR Manual
Getting to ... the FTR Manual

The PJM manuals are the administrative, planning, operating and accounting procedures of the PJM Interconnection and are available below in PDF format. Prior versions of the manuals are also below for comparison of the changes that occurred between the current and prior versions of the manuals.

M-6: Financial Transmission Rights focuses on how Financial Transmission Rights (FTRs) are acquired, both from PJM and in the secondary market, and on how the value of FTRs is determined. [Redline Version]

http://www.pjm.com/contributions/pjm-manuals/pdf/m06.pdf
Appendix D: FTR Center User Guide
Getting to … the FTR Center Users Guide

From the PJM Home Page, scroll over eTools, then click on Tool Information…

…then click on FTR Center (and repeat)…
...and click on FTR Center User Guide for step-by-step instructions on using the software

Appendix E:
Frequently Asked Questions
From the PJM Homepage, scroll over Markets then click on FTR directly (do not scroll over to Model Information, Auction User Info, etc)

...and click on FTR FAQs for answers to frequently asked questions on FTRs and ARRs

Questions?

PJM Client Management & Services
Telephone: (610) 666-8980
Toll Free Telephone: (866) 400-8980
Website: www.pjm.com

The Member Community is PJM’s self-service portal for members to search for answers to their questions or to track and/or open cases with Client Management & Services