



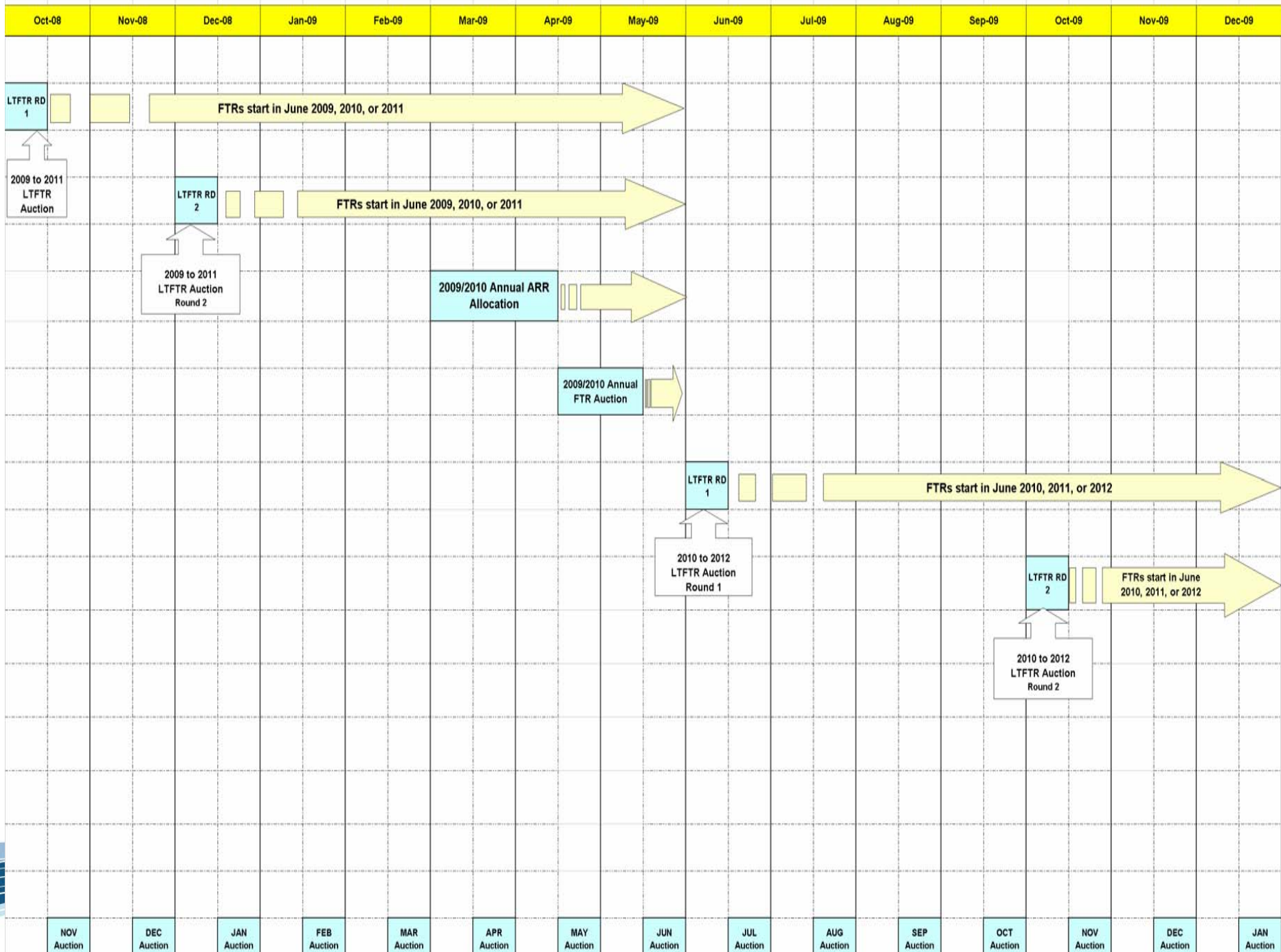
Long Term FTR Market Training

9/3/08

- Long Term FTR Auction Overview
- Overview of Financial Transmission Rights (FTRs)
- Overview of Simultaneous Feasibility test (SFT)
- FTR Auctions and Bilateral Trading
- Market Settlements

Long Term FTR Auction Overview

2008/2009 FTR Market Timeline





Long Term FTR for 2009-2011

	Opens 0001	Closes 1700	Results 1700
Round 1	October 1, 2008	October 3, 2008	October 10, 2008
Round 2	December 1, 2008	December 3, 2008	December 10, 2008

FTRs will be effective in June 2009, June 2010, or June 2011

- On an annual basis, subsequent to the annual FTR auction, PJM conducts a long term auction for FTRs effective for the three planning years following the planning year of the current annual FTR auction.
- The Long Term FTR Auction offers for sale the residual system capability available assuming the self-scheduling of ARRAs that may occur on an annual basis. These ARRAs will be modeled as fixed injections and withdrawals in the Long Term FTR Auction along with already approved Long Term FTRs
- Future transmission upgrades will not be included in model

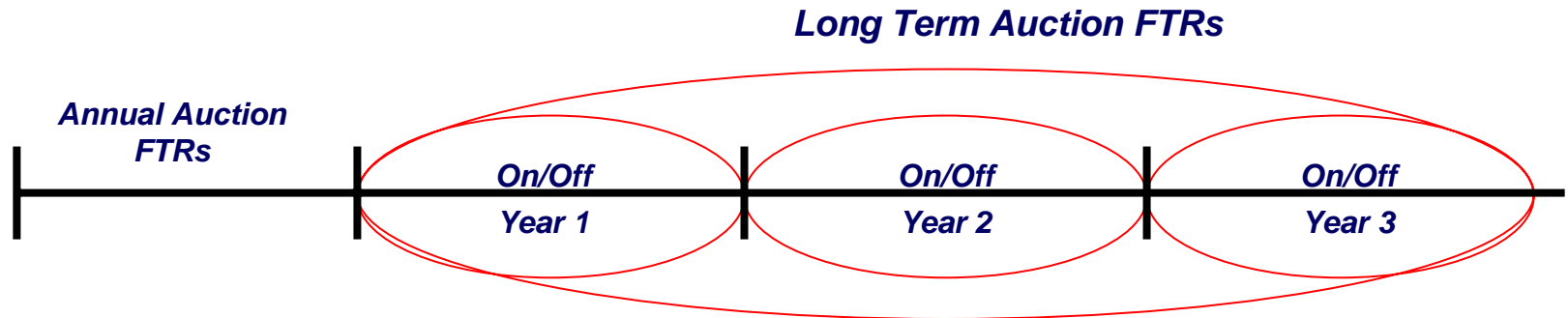
- The Long Term FTR Auction is a multi-round auction consisting of two rounds in which 50% of the feasible FTR capability will be offered in each round.
- FTR Option products are not available in the Long Term FTR Auctions
- FTR acquired in the Long Term FTR Auctions may have terms of one year, for each of the three planning years covered by the auction, or a term of three years, for the entire three-year period covered by the auction.

- Residual FTR capability of the transmission system
 - “left over” capability assuming Self-Scheduling of current planning year ARR
 - Approved Long Term FTRs modeled as fixed injections.
- Single-product auction
 - FTR Obligations only
- Multi-round auction
 - Consisting of two rounds held 6 months apart (2 months for first LTFTR Auction) with 50% 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



The Long Term FTR Auction is a multi-round auction consisting of 2 rounds...

- 50% of the feasible FTR capability of the PJM system is awarded in each round
- The Long Term FTR Auction offers for sale the residual system capability available assuming the self-scheduling of ARR that may occur on an annual basis. These ARRs will be modeled as fixed injections and withdrawals in the Long Term FTR Auction along with already approved Long Term FTRs.
- FTRs that are awarded in previous Long Term FTR Auctions that are effective for the market interval may be sold in either round
- FTRs that are awarded in round one may be offered for sale in round two

- Relevant data associated with the Long Term FTR Auction will be posted under the Long Term FTR Auction section of the FTR Auction User Information Page.
 - Data includes valid market name, bidding periods, biddable nodes, etc.
- FTR Credit Calculator includes periods for Long Term FTR Auction and is located under the FTR Credit section of the FTR Auction User Information Page

- The Long-Term FTR auctions are billed for in the monthly bill for which the FTRs are 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.

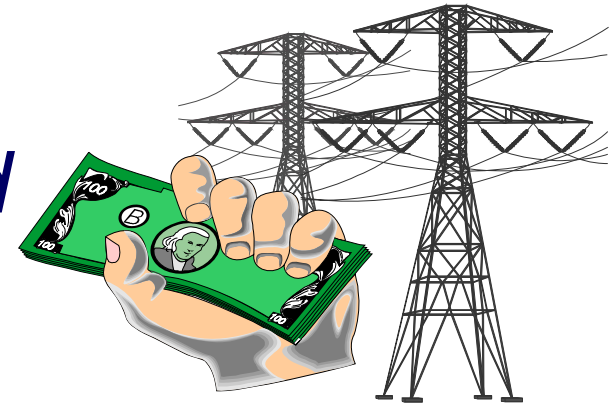
Overview of Financial Transmission Rights (FTRs)

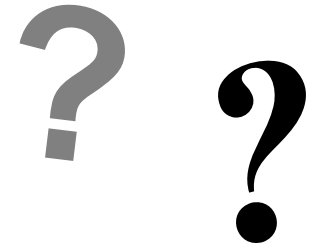


Financial Transmission Rights are ...

*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*





- 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*

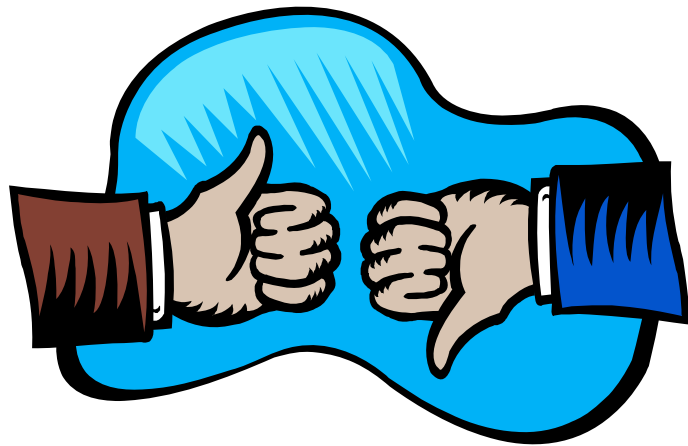
- ✓ Economic value based on Day-Ahead Congestion Prices
- ✓ Defined from source to sink
- ✓ can be in form of obligation or option
 - ✓ obligation can be benefit or liability
 - ✓ option can be benefit but never liability
- ✓ Financial entitlement, *not* physical right
- ✓ Independent of energy delivery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

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



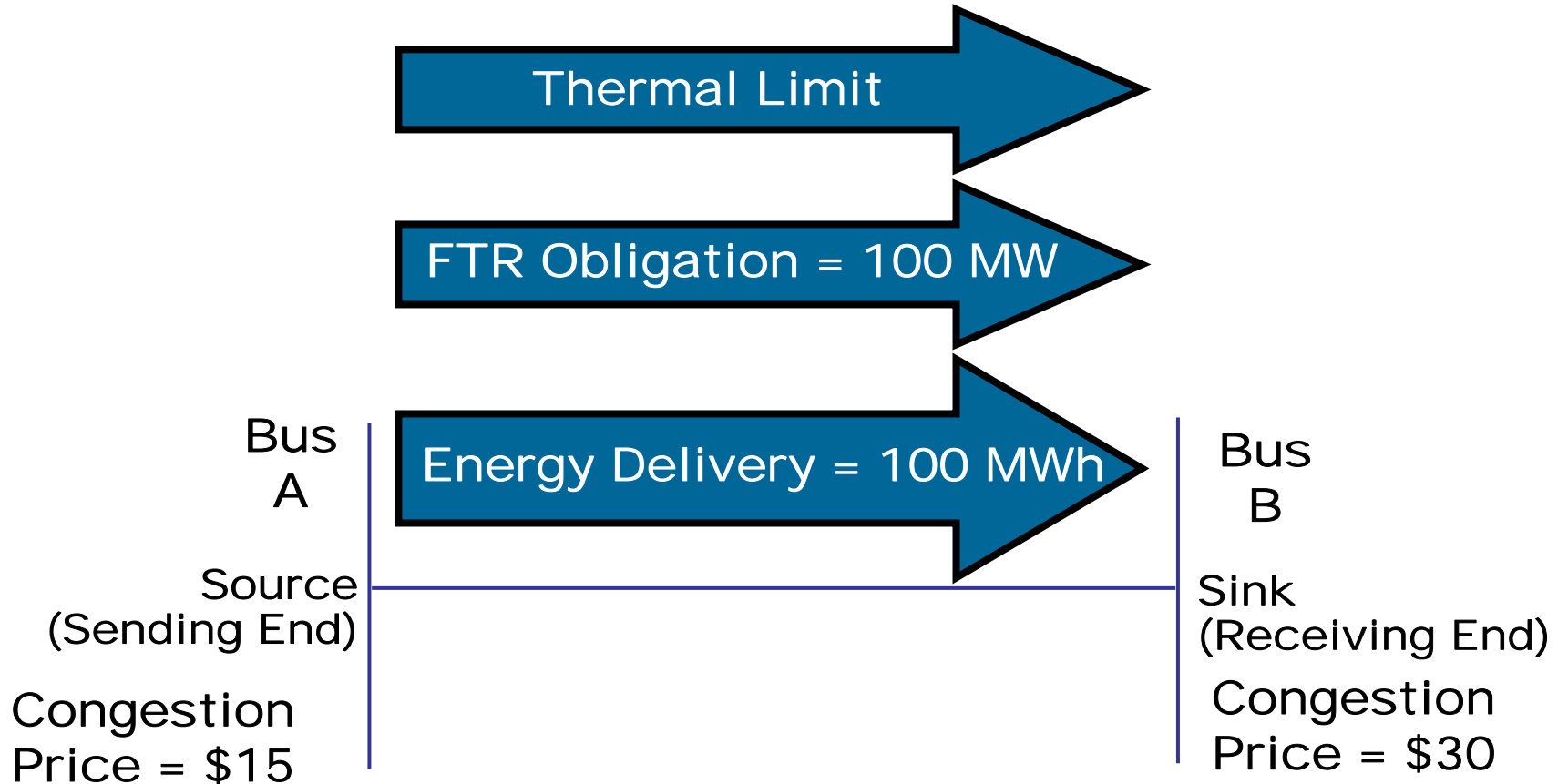


FTR Credits and Congestion Charges

Congestion Charge =
 $MWh * (\text{Day-ahead Sink Congestion Price} - \text{Day-ahead Source Congestion Price})$

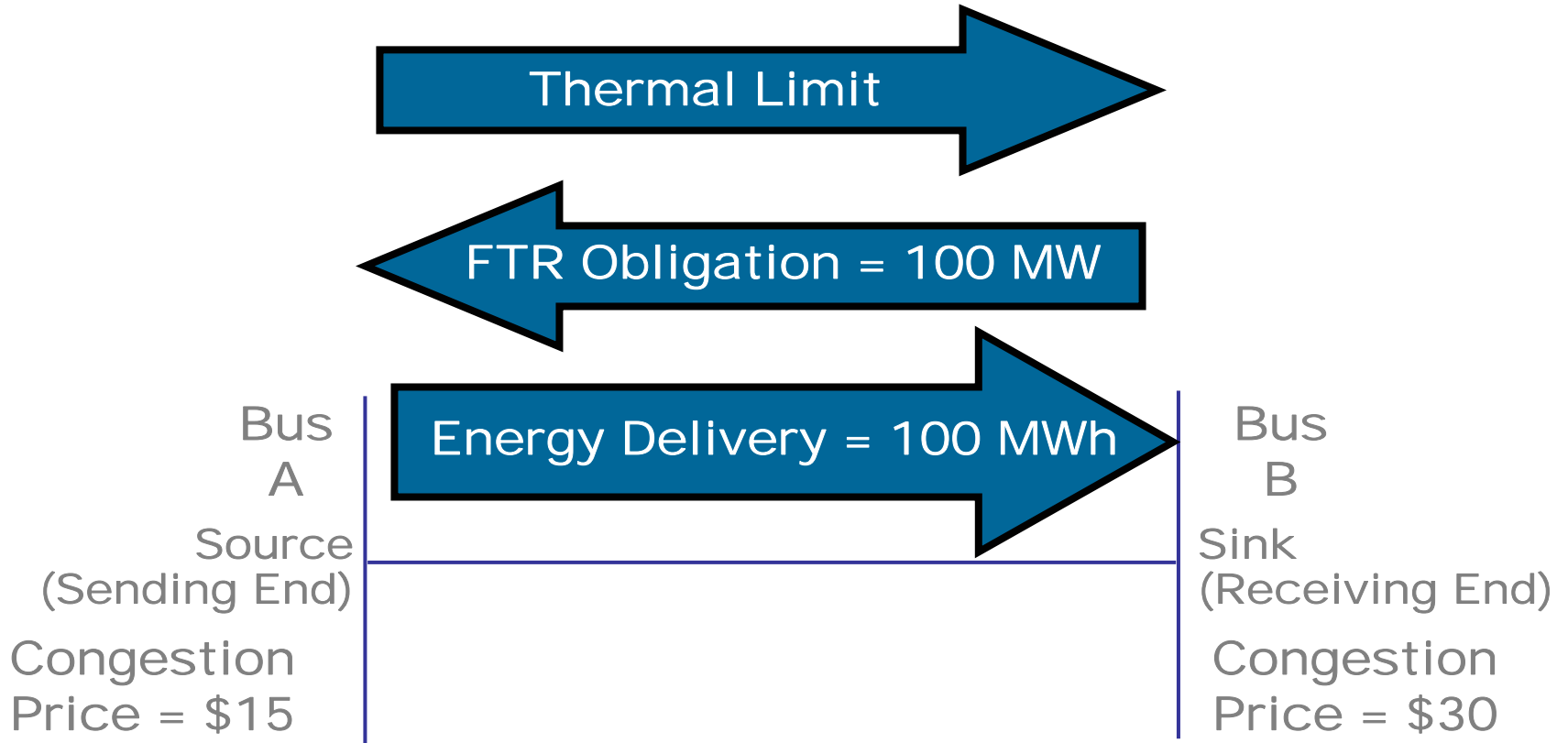
FTR Credit =
 $MW * (\text{Day-ahead Sink Congestion Price} - \text{Day-ahead Source Congestion Price})$

FTR Obligation is a Benefit



$$\text{Congestion Charge} = 100 \text{ MWh} * (\$30 - \$15) = \$1500$$

$$\text{FTR Obligation Credit} = 100 \text{ MW} * (\$30 - \$15) = \$1500$$



$$\text{Congestion Charge} = 100 \text{ MWh} * (\$30 - \$15) = \$1500$$

$$\text{FTR Obligation Credit} = 100 \text{ MW} * (\$15 - \$30) = \$-1500$$

Overview of Simultaneous Feasibility Test (SFT)

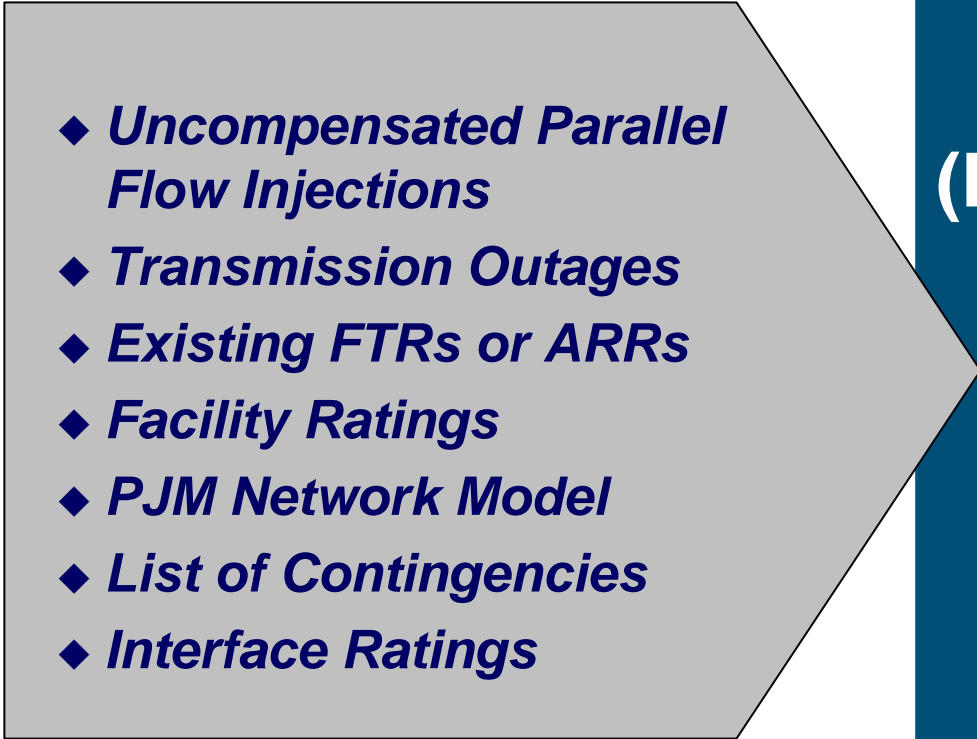


What is a Simultaneous Feasibility Test?

- 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

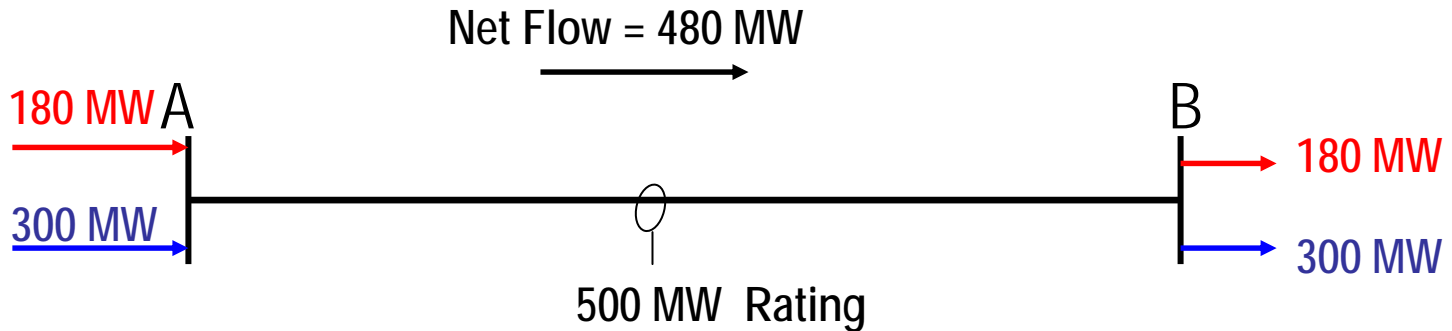
- ARRs must be simultaneously feasible to ensure that Annual FTR Auction revenues are sufficient to cover ARR Target Allocations
- FTRs must be simultaneously feasible to ensure that total congestion charges collected from Day Ahead and Balancing Markets are sufficient to cover FTR Target Allocations

- FTRs or ARRAs 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

- 
- A large grey arrow with a black outline, pointing from the list of data inputs on the left towards the SFT box on the right.
- ◆ *Uncompensated Parallel Flow Injections*
 - ◆ *Transmission Outages*
 - ◆ *Existing FTRs or ARRs*
 - ◆ *Facility Ratings*
 - ◆ *PJM Network Model*
 - ◆ *List of Contingencies*
 - ◆ *Interface Ratings*

A dark blue 3D rectangular box with a slight shadow on the bottom and right sides, containing the text "SFT (DC Powerflow)".

**SFT
(DC Powerflow)**



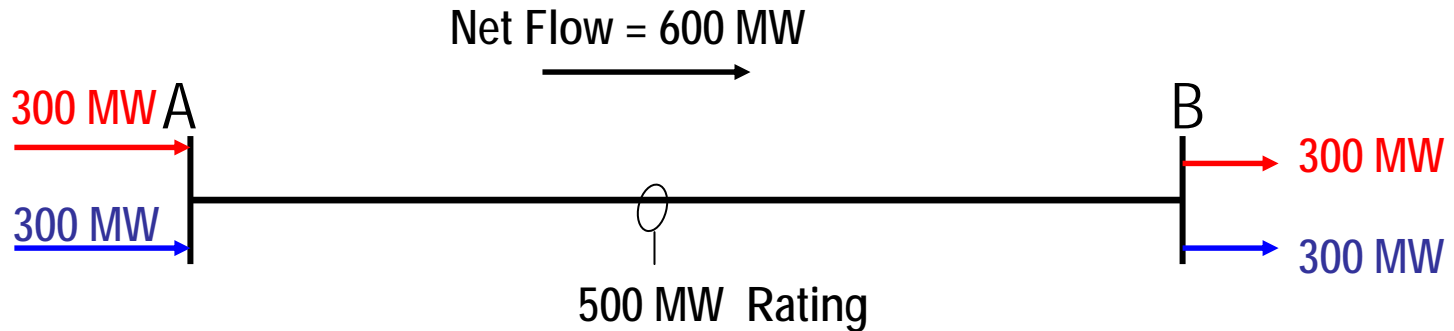
FTR 1 : 300 MW Obligation from A to B

FTR 2 : 180 MW Obligation from A to B

Net Flow on Line A-B = 480 MW

Line A-B Flow = Line A-B Rating therefore

both FTRs are simultaneously feasible



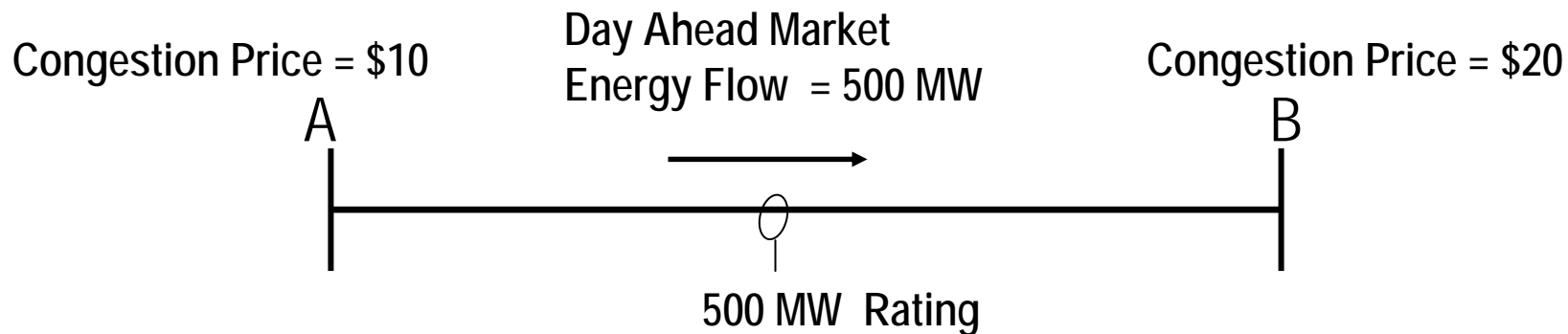
FTR 1 : 300 MW Obligation from A to B

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



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

FTR Target Allocation (using SFT Example 1 FTRs)

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

FTR Target Allocation (using SFT Example 2 FTRs)

Total FTR Target Allocation = 600 MW (\$20 - \$10) = \$6,000

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

FTR Auctions & Bilateral Trading



FTRs are acquired in several market mechanisms ...

1. Annual FTR Auction
 - multi - round
 - entire system capability minus approved Long-Term FTRs
2. Long Term FTR Auction
 - multi - round
 - purchase residual system capability assuming the self-scheduling of ARR
3. Monthly FTR Auction
 - single - round
 - purchase “left over” capability
4. FTR Secondary Market
 - bilateral trading



- 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



- Residual FTR capability of the transmission system
 - “left over” capability assuming Self-Scheduling of current planning year ARRAs
 - Approved Long Term FTRs modeled as fixed injections.
- Single-product auction
 - FTR Obligations only
- Multi-round auction
 - Consisting of two rounds held 6 months apart with 50% 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



- 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



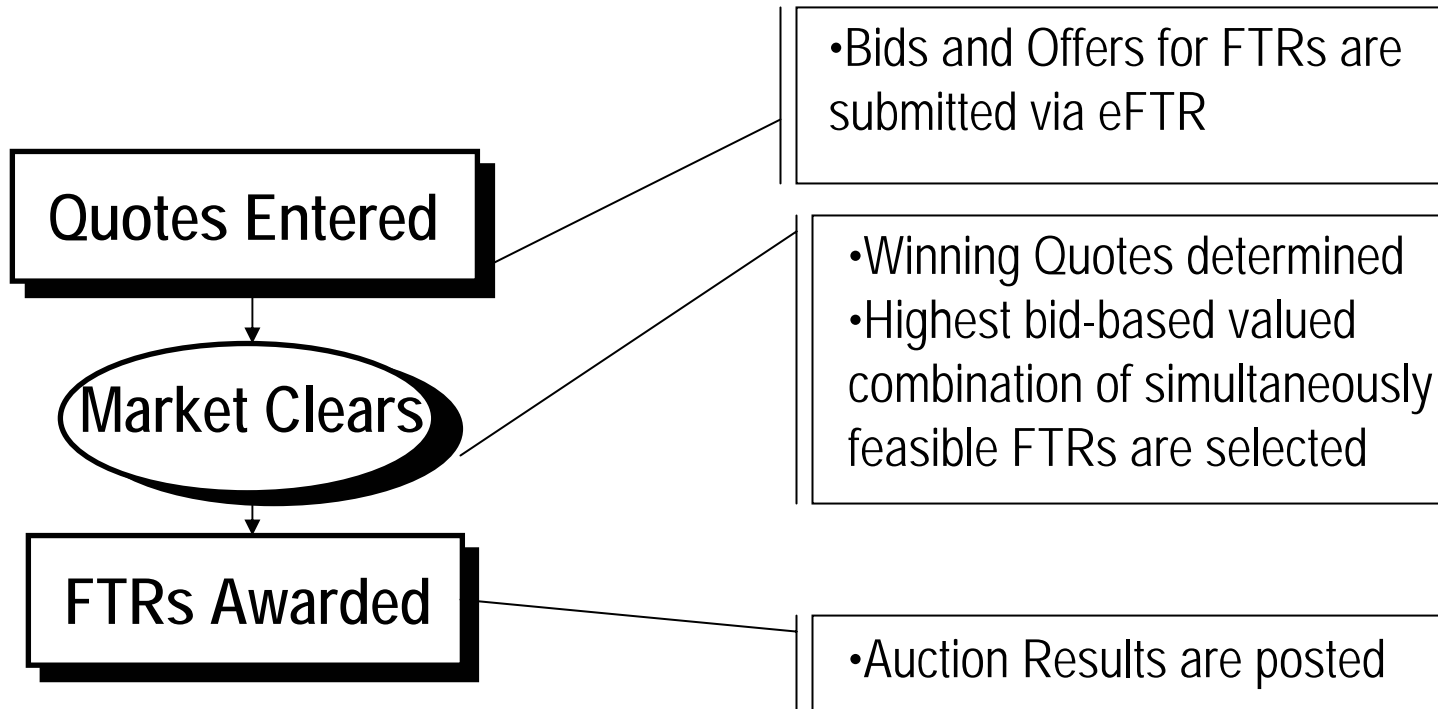
Comparison of FTR Auctions

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

	Annual and Long Term FTR Auctions	Monthly FTR Auctions Next Calendar Month	Monthly FTR Auctions Quarters and 2 nd /3 rd Month
FTR Obligations	<p><i>Valid Sources & Sinks are limited to:</i></p> <ul style="list-style-type: none"> •Hubs •Zones •Aggregates •Interface Buses •Generator Buses 	<p><i>Valid Sources & Sinks include any single bus or combination of buses for which a <u>Day-ahead LMP</u> is calculated & posted:</i></p> <ul style="list-style-type: none"> •Hubs •Zones •Aggregates •Interface Buses •Generator/Load Buses 	<p><i>Valid Sources & Sinks are limited to:</i></p> <ul style="list-style-type: none"> •Hubs •Zones •Aggregates •Interface Buses •Generator Buses
FTR Options*	<p><i>Only a subset of paths will be eligible for FTR Options in order to prevent potential auction clearing performance issues</i></p>		

**Option Product not available in Long-Term FTR Auction*

- 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 Software

- ◆ *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*

- ◆ *FTRs Awarded in Auction*
- ◆ *FTRs Sold in Auction*
- ◆ *Nodal Prices*
- ◆ *Option Clearing Prices*
- ◆ *Aggregate Prices*
- ◆ *Binding Constraints*

The Annual, Long Term, and Monthly 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
- FTRs awarded in the Annual FTR Auction have a term of one year
- FTRs awarded in the Long Term FTR Auctions have a term on one or three years.
- The various products are cleared simultaneously and the clearing prices of products which overlap are related

eFTR is an internet application that allows PJM Market Participants to participate in ...

- ***Annual ARR Allocation***
- ***FTR Auctions***
- ***FTR Secondary Market***

- 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 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 ARR's

- Credit requirements apply to All FTR auctions
 - For prompt-month monthly products, credit requirement only applies to “new” auction participants
 - "New" participants defined as those with less than six months of completed activity prior to the auction
 - 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 ARR 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 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.

- 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
 - Required posted within one business day
 - Load-serving entities would get offsets for ARR



FTR Credit Example

Historical LMPs and Hours

NODE	HISTORICAL LMP											
	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
A	\$23	\$25	\$27	\$23	\$18	\$56	\$52	\$49	\$47	\$35	\$29	\$25
B	\$36	\$38	\$40	\$54	\$49	\$34	\$30	\$27	\$25	\$45	\$42	\$38
C	\$34	\$36	\$38	\$34	\$29	\$23	\$27	\$25	\$45	\$44	\$40	\$36
D	\$14	\$20	\$24	\$65	\$60	\$42	\$31	\$33	\$29	\$44	\$26	\$22
E	\$37	\$40	\$43	\$37	\$52	\$24	\$33	\$31	\$60	\$56	\$47	\$42
F	\$67	\$69	\$71	\$13	\$8	\$65	\$61	\$58	\$56	\$23	\$73	\$69
G	\$34	\$36	\$38	\$26	\$21	\$45	\$41	\$38	\$36	\$32	\$40	\$36
H	\$3	\$5	\$7	\$67	\$62	\$13	\$9	\$6	\$4	\$16	\$9	\$5

Assume On-Peak, Off-Peak, and 24-HR historical LMPs are the same for example.

	# of On-Peak Hours	# of Off-Peak Hours	# of 24-HR Hours
JUN 2007	336	384	720
JUL 2007	336	408	744
AUG 2007	368	376	744
SEP 2007	304	416	720
OCT 2007	368	376	744
NOV 2007	336	385	721
DEC 2007	320	424	744
JAN 2008	352	392	744
FEB 2008	336	360	696
MAR 2008	336	407	743
APR 2008	352	368	720
MAY 2008	336	408	744
Total	4080	4704	8784



FTR Credit Example

Annual Bids

Auction Open

FTR ID	Source	Sink	Period	Tradetype	Bid MW	Hedge Type	Class Type	Bid (\$MW-period)	Payment
1	A	C	All	Buy	1	Obligation	ON	\$900	\$900
2	B	D	All	Buy	1	Obligation	ON	-\$600	-\$600
3	C	E	All	Buy	1	Obligation	OFF	\$5,000	\$5,000
4	A	F	All	Buy	1	Option	ON	\$1,000	\$1,000

$$(\$900 * (336/4080) - ((1-0.1)(\$34-\$23)(1 \text{ MW})(336 \text{ Hrs}))$$

10% discount for volatility

$$(\$900*320/4080) - ((1+0.1)(\$27-\$52)(1 \text{ MW})(320 \text{ Hrs}))$$

10% adder for counterflow bid in which Sink LMP < Source LMP

FTR ID	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	Bid Credit Requirement
1	-\$3,252	-\$3,252	-\$3,562	-\$2,943	-\$3,562	\$12,271	\$8,871	\$9,370	\$813	-\$2,647	-\$3,407	-\$3,252	\$31,325
2	\$8,082	\$6,603	\$6,423	-\$3,054	-\$3,697	-\$2,469	-\$335	-\$1,953	-\$1,259	\$320	\$6,143	\$5,864	\$33,436
3	-\$629	-\$1,035	-\$1,292	-\$681	-\$7,384	\$63	-\$1,839	-\$1,700	-\$4,477	-\$3,963	-\$1,927	-\$1,770	\$63
4	-\$13,223	-\$13,223	-\$14,483	\$75	\$90	-\$2,639	-\$2,514	-\$2,765	-\$2,639	\$82	-\$13,853	-\$13,223	\$247

$$(\$1000*304/4080) - ((1+0.1)(\$13-\$23)(1 \text{ MW})(304 \text{ Hrs}))$$

\$0

Bid Credit Requirement equals sum of positive months' credit requirement.

\$Expected Value is set to zero if Sink LMP < Source LMP and Hedge Type=Option

Cleared Credit Requirements

FTR ID	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
1	-\$3,252	-\$3,252	-\$3,562	-\$2,943	-\$3,562	\$12,271	\$8,871	\$9,370	\$813	-\$2,647	-\$3,407	-\$3,252
2	\$8,082	\$6,603	\$6,423	-\$3,054	-\$3,697	-\$2,469	-\$335	-\$1,953	-\$1,259	\$320	\$6,143	\$5,864
3	-\$629	-\$1,035	-\$1,292	-\$681	-\$7,384	\$63	-\$1,839	-\$1,700	-\$4,477	-\$3,963	-\$1,927	-\$1,770
4	-\$13,223	-\$13,223	-\$14,483	\$75	\$90	-\$2,639	-\$2,514	-\$2,765	-\$2,639	\$82	-\$13,853	-\$13,223
MONTHLY SUBTOTAL	-\$9,022	-\$10,907	-\$12,914	-\$6,603	-\$14,553	\$7,226	\$4,183	\$2,953	-\$7,562	-\$6,208	-\$13,044	-\$12,381

Total Credit Requirement

\$14,362

Total credit requirement equals the sum of positive monthly subtotals

- Specific timetable for credit release
- The individual monthly credit requirements for FTRs is removed after the billing date of each month
 - 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



Market Settlements



$$\text{FTR Target Allocation} = (\text{FTR MW}) * (\text{Congestion Price}_{\text{FTR Sink}} - \text{Congestion Price}_{\text{FTR Source}})$$

- 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 $\text{Congestion Price}_{\text{FTR Sink}} < \text{Congestion Price}_{\text{FTR Source}}$
 - the FTR is a liability if FTR defined as Obligation
 - the FTR has zero value if defined as Option