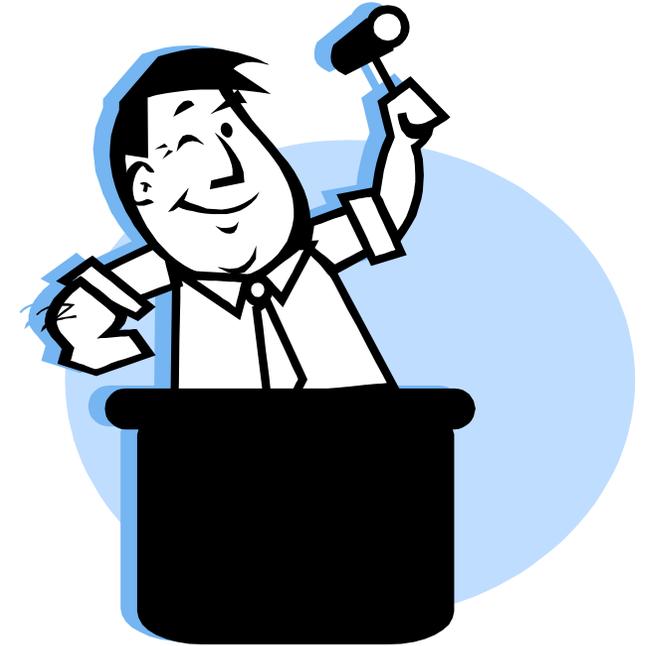


FTR Clearing Example

AFMTF
January, 2020

FTR Auction Example Case

- The clearing mechanism of the FTR Auctions will maximize the quote-based value of the set of simultaneous feasible FTRs awarded in the auction, or each round of the auction
- The clearing prices will be calculated for all FTR Obligations at all buses, regardless of whether they are bought or sold in the auction
- The clearing prices will be calculated for FTR Options for all valid FTR Option paths, regardless of whether they are bought or sold in the auction



Previously Awarded ARR

Market Participant	Firm Network	Firm Point-to-Point	ARR
LSE B	Peak Load 400 MW		400 MW from Brighton to LSE B
LSE C	Peak Load 350 MW		150 MW from Solitude to LSE C 200 MW from Brighton to LSE C
LSE D	Peak Load 350 MW		220 MW from Solitude to LSE D 130 MW from Sundance to LSE D
Alta		70 MW	70 MW from A to D

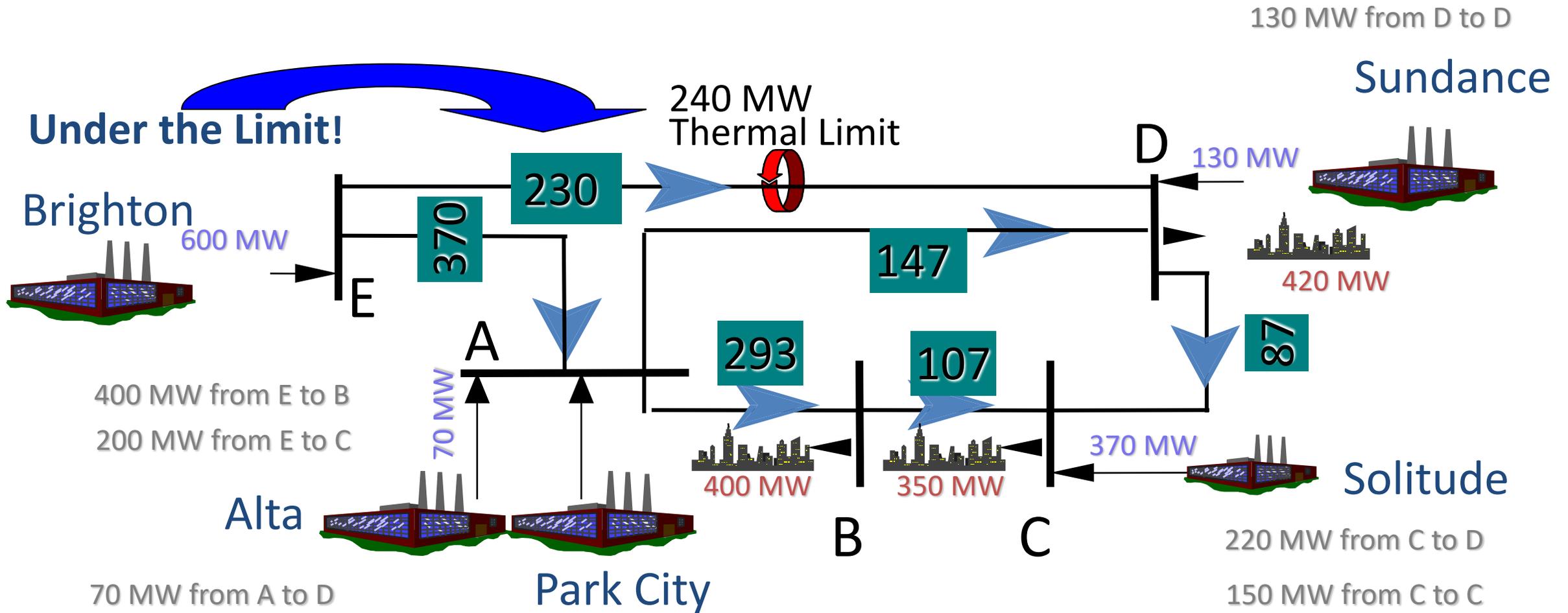
Simultaneous Feasibility Test

- Ensures all subscribed transmission entitlements are within the capability of the system
- Ensures that the energy market will be revenue adequate

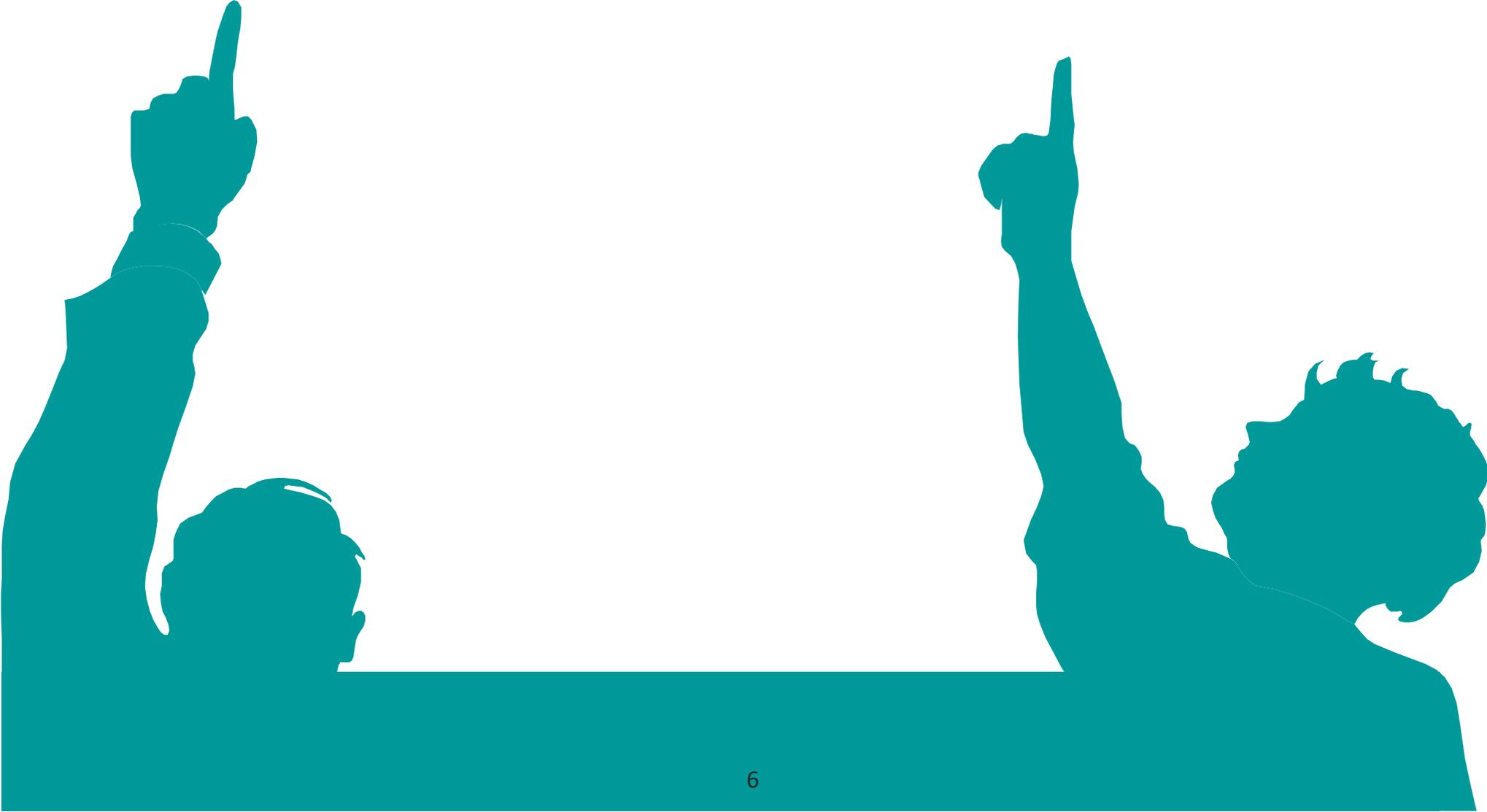
Summary of Generation and Load in SFT

	Generation	Load
LSE B		400 MW
LSE C		350 MW
LSE D		420 MW
Brighton	600 MW	
Solitude	370 MW	
Sundance	130 MW	
Alta	70 MW	

Simultaneous Feasibility Test



PJM Long Term Auction Opens!



Auction Quotes

FTR Buy Bids

\$5/MW Bid for 40 MW A-to-D FTR

\$4/MW Bid for 10 MW E-to-B FTR

\$4/MW Bid for 10 MW A-to-D FTR

\$4/MW Bid for 10 MW E-to-C FTR

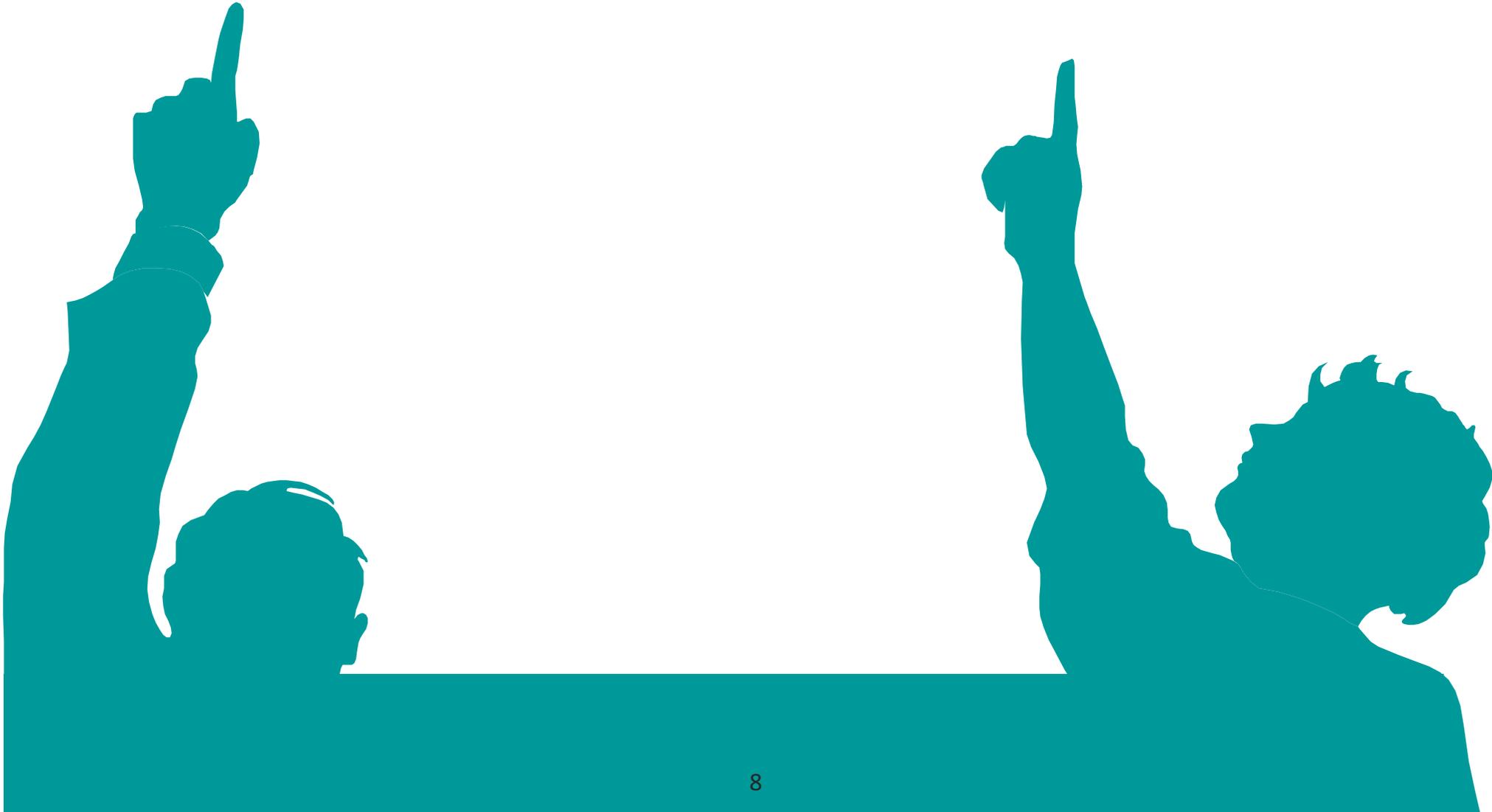
FTR Sell Offers

\$2/MW Sell Offer for 10 MW E-to-C FTR

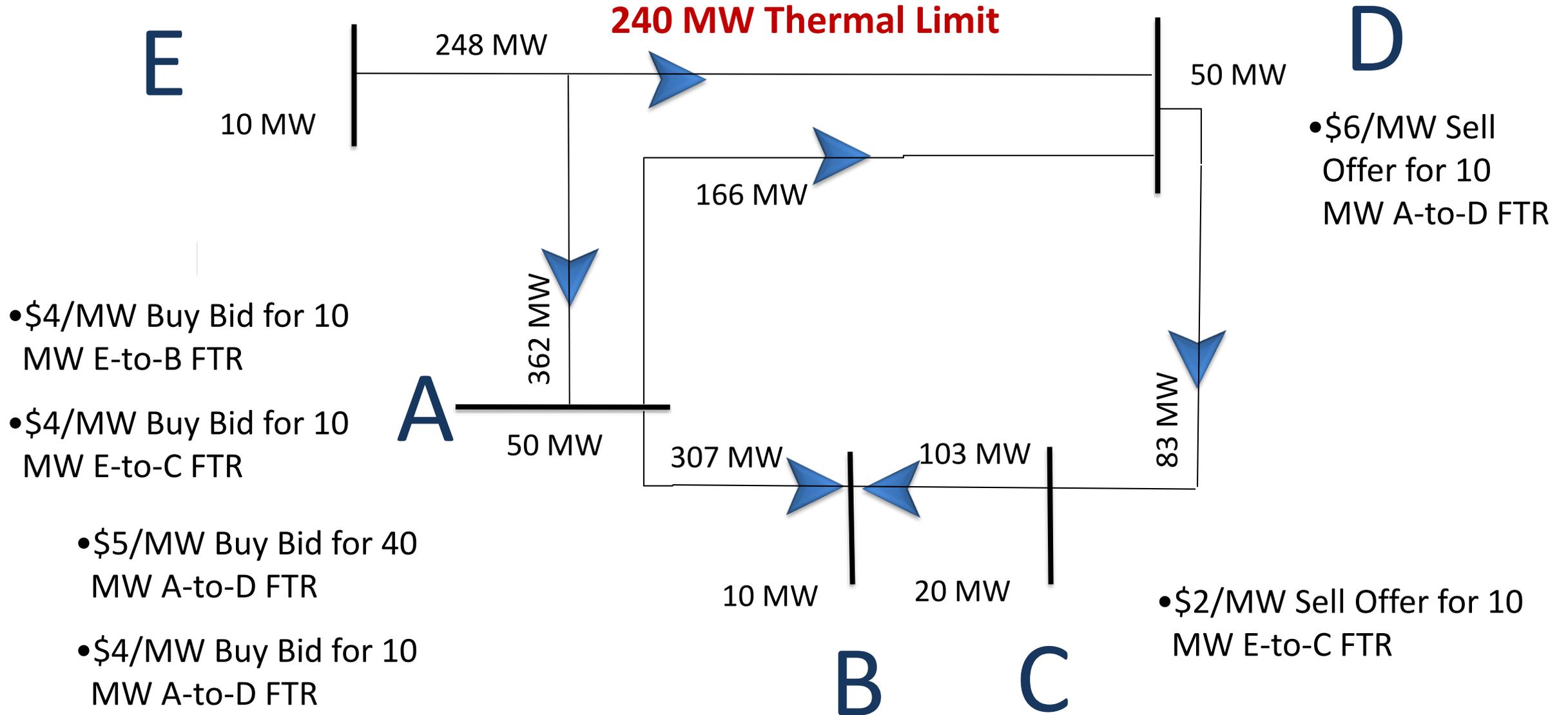
\$6/MW Sell Offer for 10 MW A-to-D FTR

NOTE: ALL BIDS IN THIS EXAMPLE ARE FOR FTR OBLIGATIONS

PJM Auction Closes!



Power Flows All Quotes Modeled



Selecting Winning Quotes (I)

Path	MW Quote	Quote Price	Sensitivity	Cost Effectiveness	Effect on E-D Capability
Buy Quotes					
E-to-B	10	\$4.00	0.2629	\$16.21	2.6
A-to-D	40	\$5.00	0.3685	\$13.57	14.7
E-to-C	10	\$4.00	0.3209	\$12.46	3.2
A-to-D	10	\$4.00	0.3685	\$10.86	3.7
Sell Quotes					
E-to-C	10	\$2.00	-0.32092	-\$6.07	-3.2
A-to-D	10	\$6.00	-0.3685	-16.28	-3.7

Sensitivity - portion of FTR that flows on Line E-D

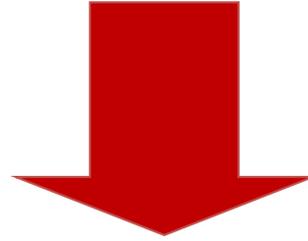
Cost Effectiveness - ratio of price to sensitivity

Effect on Line E-D - MW times Sensitivity

Selecting Winning Quotes (II)

1. Award bids by selecting from highest to lowest cost effectiveness, until all Line E-D capability is utilized
2. Compare sell offer cost effectiveness ratios (sorted highest to lowest) to cost of last marginal bid
 - If cost effectiveness of sell offer is favorable to marginal bid cost effectiveness, sell offer is awarded
3. Additional bids are awarded to consume the FTR capability made available during Step 2
4. Repeat Steps 1, 2, and 3 until all capability is utilized

What is the Commodity?



Quote	Effect on Line E-D	Remaining Capability on Line E-D	Portion of Quote Awarded
Buy 10 MW from Line Line E-B	2.6	7.4 MW	10 MW buy (10 MW buy quote)
Buy 40 MW from Line A-D	7.4	0 MW	$7.4/0.36849 = 20$ MW buy (40 MW buy quote)
Sell 10 MW from Line E-C	-3.2	3.2 MW	10 MW sell (10 MW sell quote)
Buy 40 MW from Line A-D (20 MW remaining)	3.2	0 MW	$3.2/0.36849 = 8$ MW buy 8 MW + 20 MW = 28 MW buy (40 MW buy quote)

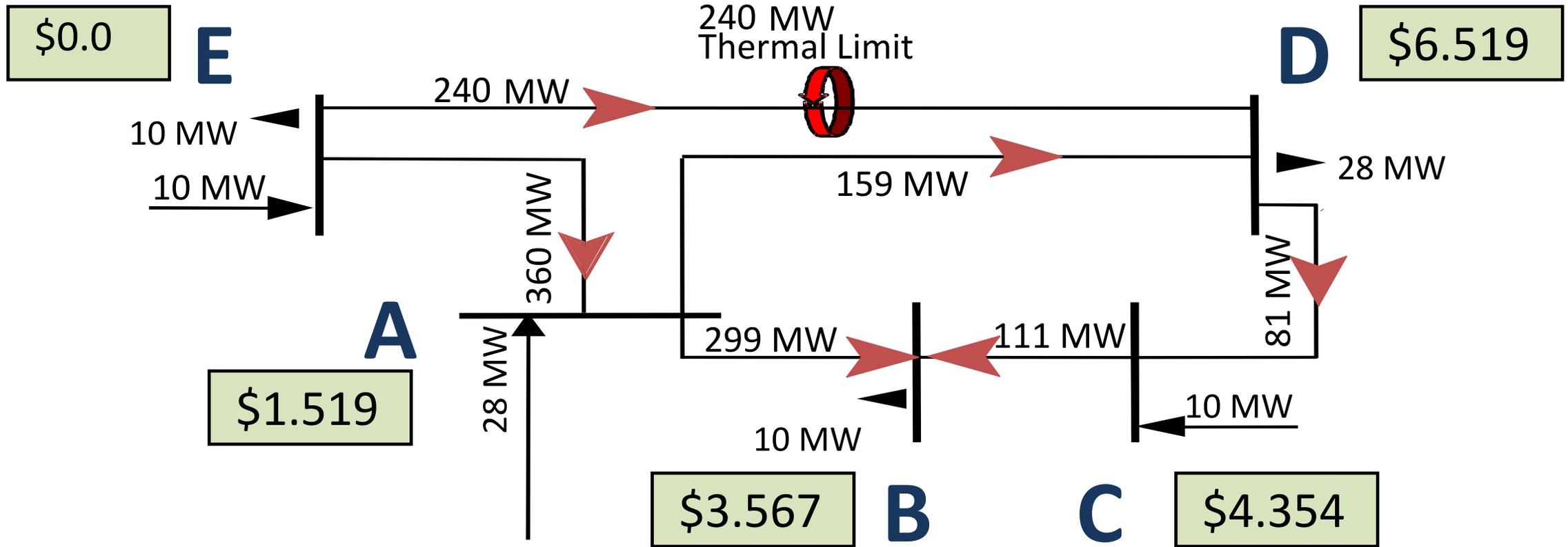
Clearing Price Calculation

Source	Sink	Portion of FTR that flows on Line E-D	Clearing Price Calculation
A	D	0.36849	A – D is the Marginal FTR Path
A	B	0.15094	$\$5.00 * 0.15094/0.36849 = \2.05
A	C	0.20895	$\$5.00 * 0.20895/0.36849 = \2.83
A	E	-0.11196	$\$5.00 * -0.11196/0.36849 = -\1.52
E	D	0.48045	$\$5.00 * 0.48045/0.36849 = \6.52
E	C	0.32092	$\$5.00 * 0.32092/0.36849 = \4.35
E	B	0.26290	$\$5.00 * 0.26290/0.36849 = \3.57
B	C	0.05802	$\$5.00 * 0.05802/0.36849 = \0.79
B	D	0.21755	$\$5.00 * 0.21755/0.36849 = \2.95
C	D	0.15953	$\$5.00 * 0.15953/0.36849 = \2.16

Auction Results

FTR Buy Bids	Quotes Cleared
\$5/MW Bid for 40 MW A-to-D FTR	28 MW @ \$5.00/MW
\$4/MW Bid for 10 MW E-to-B FTR	10 MW @ \$3.57/MW
\$4/MW Bid for 10 MW A-to-D FTR	0 MW
\$4/MW Bid for 10 MW E-to-C FTR	0 MW
FTR Sell Offers	Quotes Cleared
\$2/MW Sell Offer for 10 MW E-to-C FTR	10 MW @ \$4.35/MW
\$6/MW Sell Offer for 10 MW A-to-D FTR	0 MW
FTR Auction Revenues	
$(28 \text{ MW})(\$5.00/\text{MW}) + (10 \text{ MW})(\$3.57/\text{MW}) - (10 \text{ MW})(\$4.35/\text{MW}) = \$132.20$	

Auction Results Clearing Prices by Path



Sink Source	A	B	C	D	E
A	0	2.0481	2.8353	5	-1.5191
B	-2.0481	0	0.7872	2.9519	-3.5672
C	-2.8353	-0.7872	0	2.1647	-4.3544
D	-5	-2.9519	-2.1647	0	-6.5191
E	1.5191	3.5672	4.3544	6.5191	0