



Negative FTR Example

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Objectives

At the completion of this presentation, you should be able to understand the issues associated with the ...

- **Impact of Negative FTRs on Auction Revenue**
- **Potential Impact of a Negative FTR Holder's Default on the Allocation of Auction Revenues**
- **Potential Impact of a Negative FTR Holder's Default on the Settlement of FTRs in the Day-Ahead Energy Market**

This presentation presents the issues in relation to the FTR Auction example I wrote for section 6 of Manual 06 located on [http://www.iso-ne.com/cmsmss/Standard_Market_Design/Draft_Manuals/Manual 06](http://www.iso-ne.com/cmsmss/Standard_Market_Design/Draft_Manuals/Manual_06)



Understanding Negative FTRs



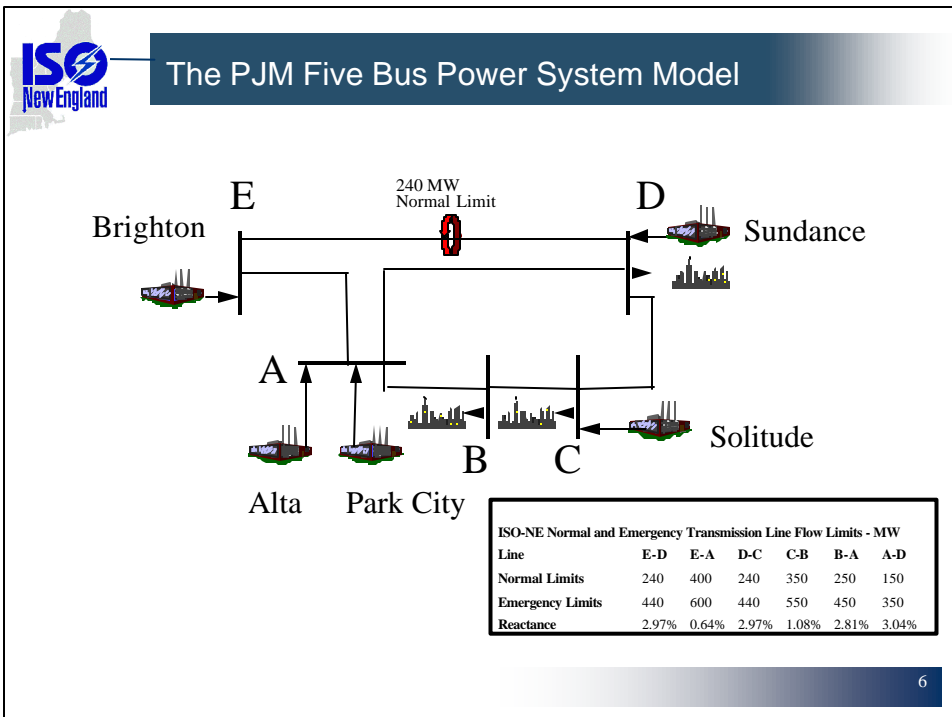
What is a Negative FTR?

A Negative FTR is ...

- An FTR with a negative bid for a path. The negative bid signifies a minimum payment that the Negative FTR Bidder would receive per MW of awarded FTR from the auction.
- When a Negative FTR is awarded it allows additional FTRs with flows counter to the Negative FTR to be awarded in the auction.
- The expectation is that FTRs which are negatively valued by the auction will incur Congestion Charges in the Day-Ahead Energy Market.

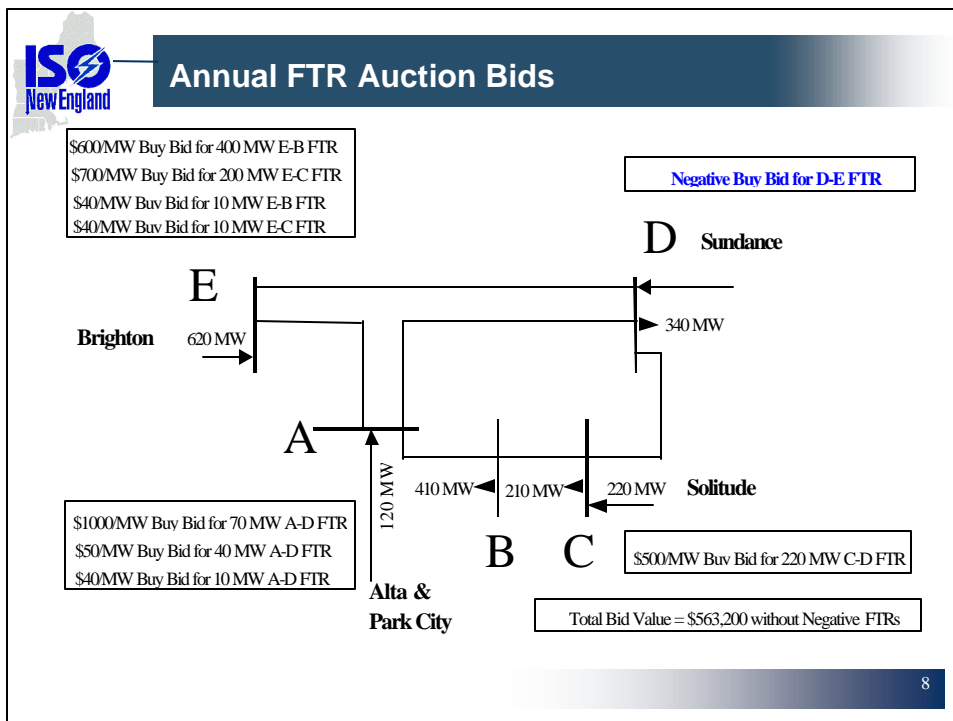


The Five Bus Power System Model





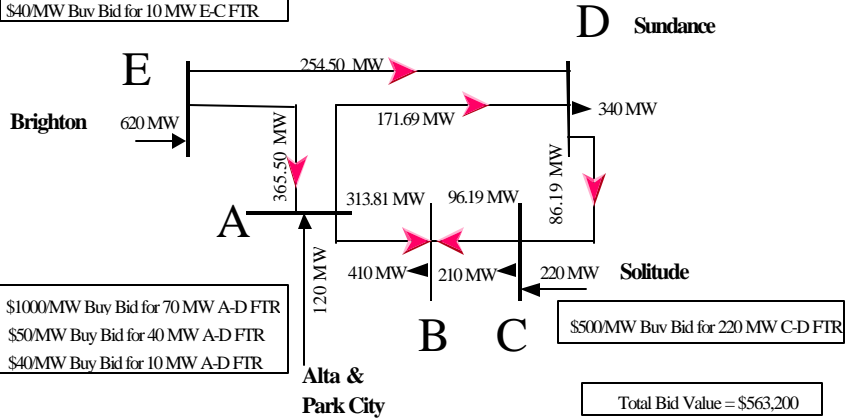
Impact of Negative FTRs on the Annual FTR Auction Example



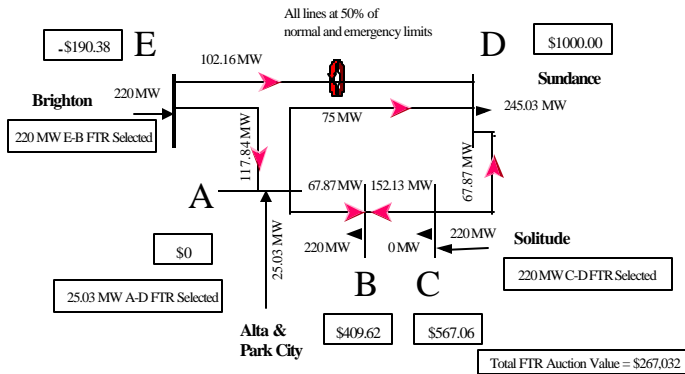


Annual FTR Auction without Negative Bids

\$600/MW Buy Bid for 400 MW E-B FTR
 \$700/MW Buy Bid for 200 MW E-C FTR
 \$40/MW Buy Bid for 10 MW E-B FTR
 \$40/MW Buy Bid for 10 MW E-C FTR



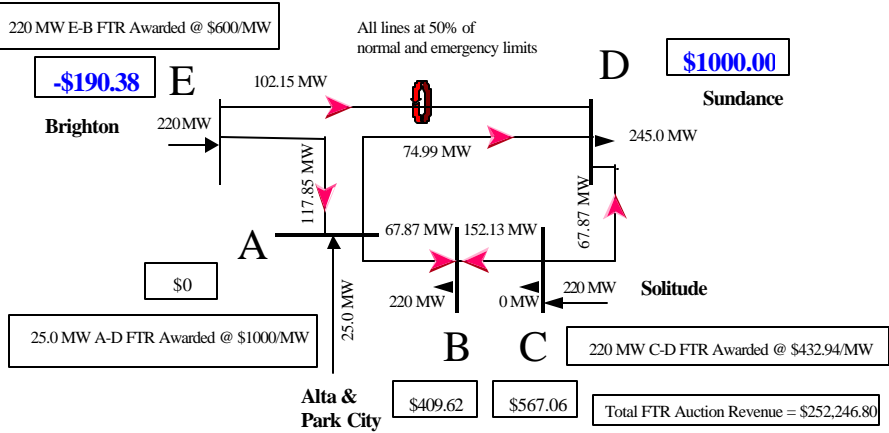
Annual FTR Auction Solution without Negative Bids



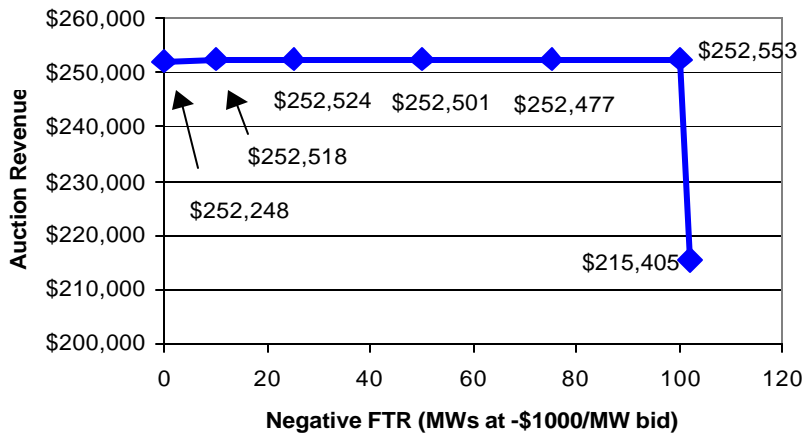
Transmission Line	Pre-Contingency Line Flows with All Lines In-Service	50% of Normal Limits	Post-Contingency Line Flows after Loss of Indicated Line						50% of Emergency Limits
			E-D	E-A	D-C	C-B	B-A	A-D	
E-D	102.16	120	0.00	220.00	133.19	32.62	133.19	151.30	220
E-A	117.84	200	220.00	0.00	86.81	187.38	86.81	68.70	300
D-C	-67.87	120	-99.24	-31.69	0.00	-220.00	0.00	-93.73	220
C-B	152.13	175	120.76	188.31	220.00	0.00	220.00	126.27	275
B-A	-67.87	125	-99.24	-31.69	0.00	-220.00	0.00	-93.73	225
A-D	75.00	75	145.79	-6.65	111.84	-7.58	111.84	0.00	175



Annual FTR Auction Results without Negative Bids



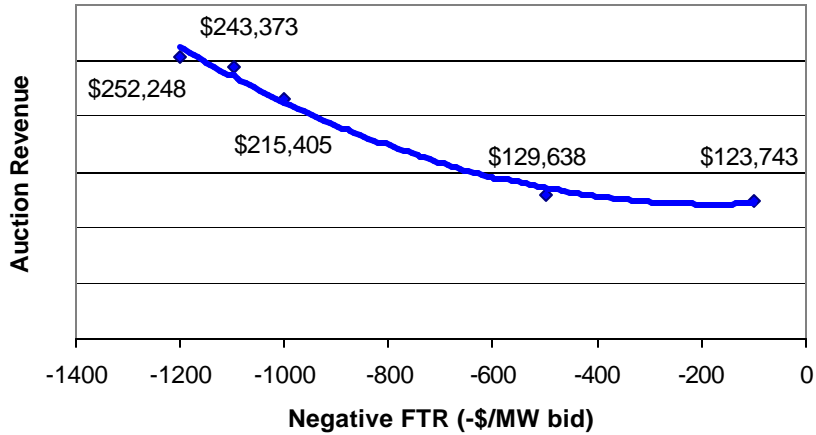
Auction Revenue vs. Negative FTR Bid from D to E



Auction revenue is relatively level until the negative FTR reaches saturation.



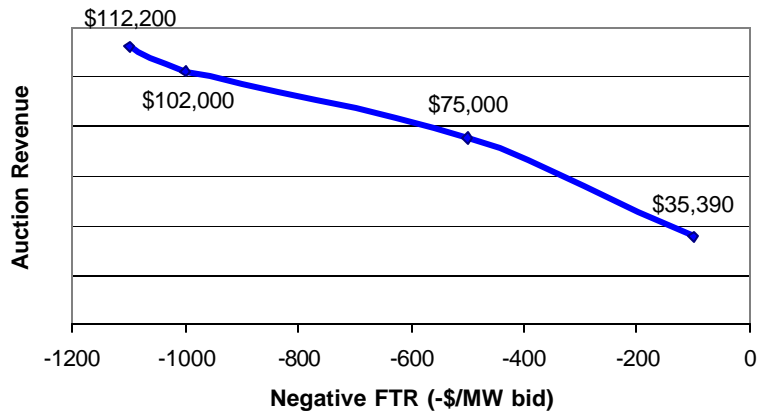
Auction Revenue vs. Negative FTR Bid from D to E



Auction revenue declines as the negative FTR sets the clearing price between D and E.



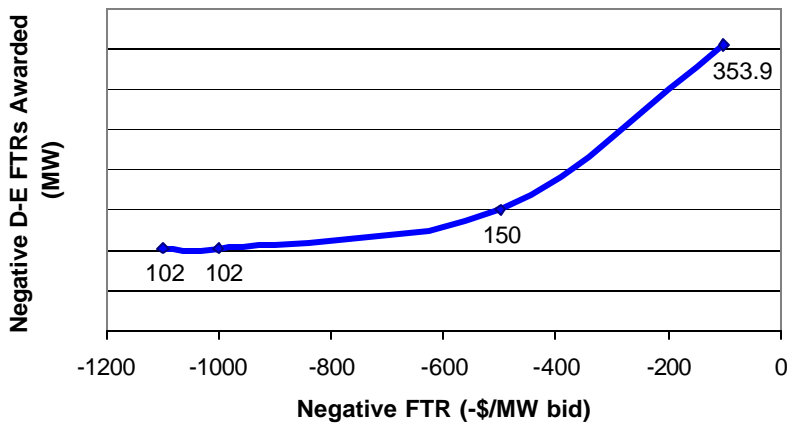
Auction Revenue Collected by Negative FTR Holder



As the FTR path clearing price between D and E declines, collections by the negative FTR Holder also declines.



FTRs Awarded vs. Negative FTR Bid from D to E



As the FTR path clearing price between D and E declines and the collections by the negative FTR Holder declines, the number of negative FTRs that become simultaneously feasible increases.



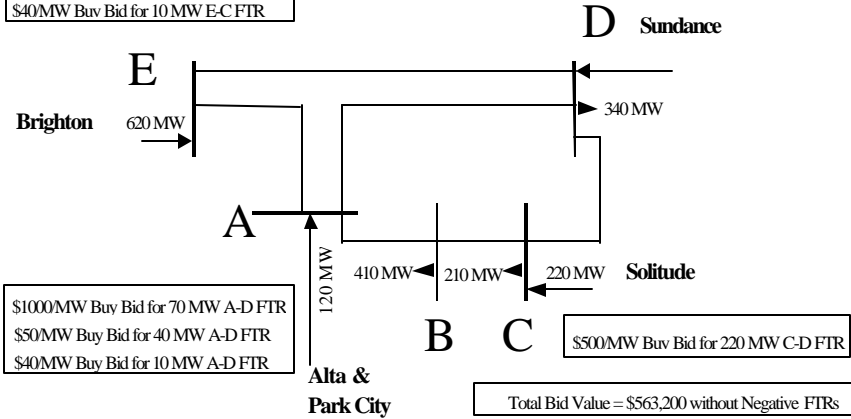
Potential Impact of a Negative FTR Holder's Default on the Allocation of Auction Revenues



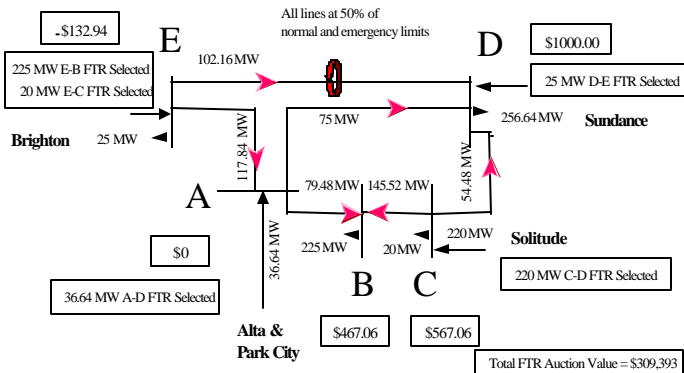
Annual FTR Auction Bids

\$600/MW Buy Bid for 400 MW E-B FTR
 \$700/MW Buy Bid for 200 MW E-C FTR
 \$40/MW Buy Bid for 10 MW E-B FTR
 \$40/MW Buy Bid for 10 MW E-C FTR

-\$1000/MW Buy Bid for 25 MW D-E FTR



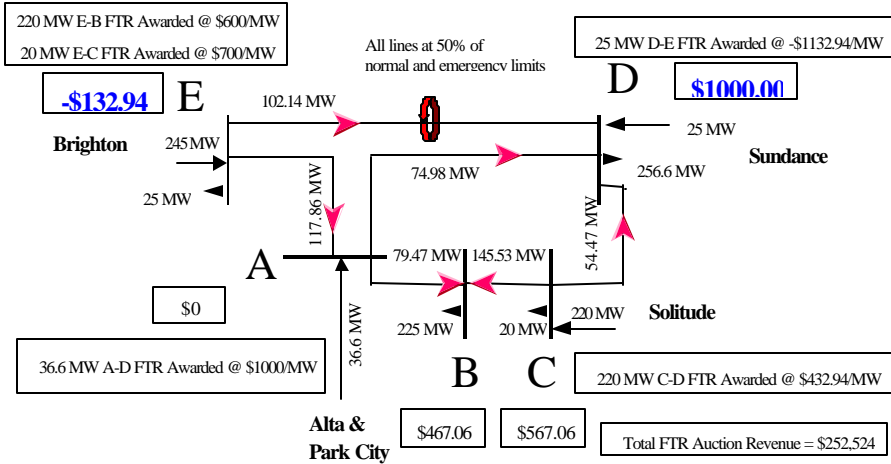
Annual FTR Auction Solution with a Negative D-E FTR



Transmission Line	Pre-Contingency Line Flows with All Lines In-Service	50% of Normal Limits	Post-Contingency Line Flows after Loss of Indicated Line						50% of Emergency Limits
			E-D	E-A	D-C	C-B	B-A	A-D	
E-D	102.16	120	0.00	220.00	127.07	35.64	138.50	151.30	220
E-A	117.84	200	220.00	0.00	92.93	184.36	81.50	68.70	300
D-C	-54.48	120	-85.85	-18.30	0.00	-200.00	25.00	-80.34	220
C-B	145.52	175	114.15	181.70	200.00	0.00	225.00	119.66	275
B-A	-79.48	125	-110.85	-43.30	-25.00	-225.00	0.00	-105.34	225
A-D	75.00	75	145.79	-6.65	104.58	-4.00	118.15	0.00	175



Annual FTR Auction Results with a Negative D-E FTR



19



Impact on Auction Revenue of a Negative FTR Holder Default

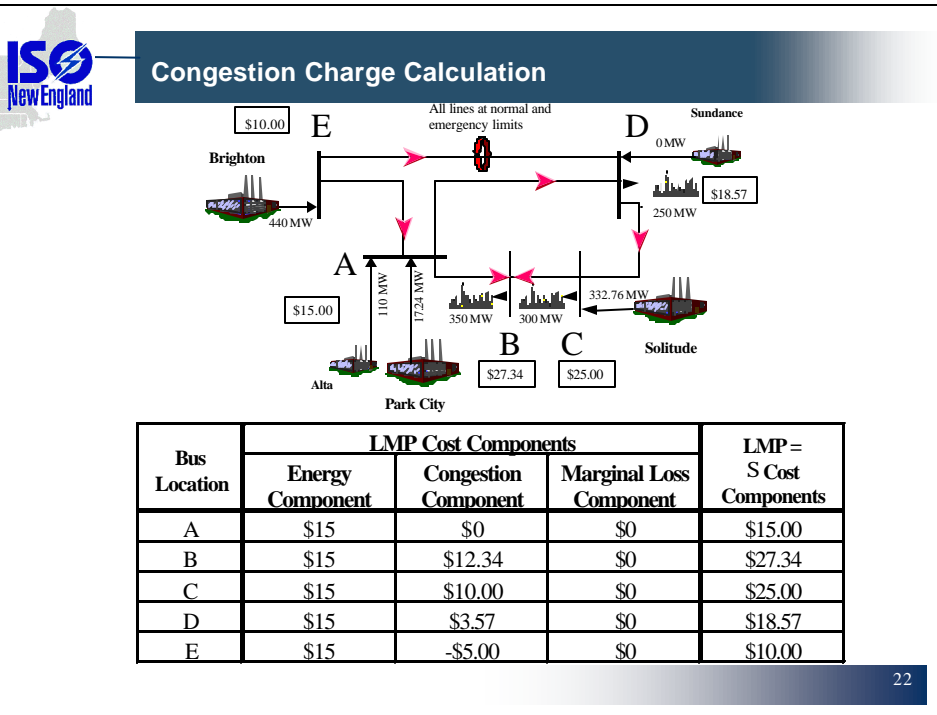
FTR Holder	FTR Path	FTR Clearing Price \$/MW	Auction Revenue Adequate		Auction Revenue Inadequate Under Default	
			FTR (MW)	FTR (\$)	FTR (MW)	FTR (\$)
Participant A	E-B	600.00	225.0	\$135,000	225.0	\$135,000
Participant B	E-C	700.00	20.0	\$14,000	20.0	\$14,000
Participant C	C-D	432.94	120.0	\$51,953	120.0	\$51,953
Participant D	A-D	1,000.00	36.6	\$36,600	36.6	\$36,600
Participant E	D-E	-1,132.94	25.0	-\$28,324	0.0	\$0
Participant E	C-D	432.94	100.0	\$43,294	0.0	\$0
				\$252,524		\$237,553

Auction revenue can be inadequate if a Negative FTR Holder defaults. In this hypothetical case, auction revenues are short \$14,971 (i.e. \$252,524 - \$237,553 = \$14,971).

20



Potential Impact of a Negative FTR Holder's Default on the Settlement of FTRs in the Day-Ahead Energy Market





Congestion Charge Calculation

$$\begin{aligned} \text{Total load charges} = & (350 \text{ MW at Bus B} * \$12.34/\text{MW}) + \\ & (300 \text{ MW at Bus C} * \$10.00/\text{MW}) + \\ & (250 \text{ MW at Bus D} * \$3.57/\text{MW}) \end{aligned}$$

$$\text{Total load charges} = \$8,211.50$$

The congestion cost as each generator (injection Node) is equal to the MW output of the generator times the Congestion Component of the LMP at that bus. Total generation credits are the sum of all of the generator credits.

$$\begin{aligned} \text{Total generation credits} = & (440 \text{ MW at Bus E} * \$-5.00/\text{MW}) + \\ & ((110 \text{ MW} + 17.24 \text{ MW at Bus A}) * \$0.00/\text{MW}) + \\ & (332.76 \text{ MW at Bus C} * \$10.00) \end{aligned}$$

$$\text{Total generation credits} = \$1,127.60$$

$$\begin{aligned} \text{Congestion Charge} = & \text{total load charges (over all withdrawal Locations)} \\ & - \text{total generation credits (over all injection Node)} \end{aligned}$$

$$\text{Congestion Charge} = \$8,211.50 - \$1,127.60 = \mathbf{\$7,083.90}$$

This \$7,083.90 Congestion Charge is reserved for distribution to FTR Holders.



Settlement

Distribution of Day-Ahead Market FTR Target Allocation

<u>FTR</u>	<u>Congestion Component</u>		<u>Positive Target</u>
	<u>Source</u>	<u>Sink</u>	<u>Allocation</u>
220 MW from E to B	-\$5.00	\$12.34	\$3,814.80
200 MW from E to C	-\$5.00	\$10.00	\$3,000.00
25 MW from A to D	\$0.00	\$3.57	\$ 89.25
150 MW from C to C	\$10.00	\$10.00	\$ 0.00
130 MW from D to D	\$3.57	\$3.57	\$ 0.00
93.1 MW from A to D	\$0.00	\$3.57	\$ 332.37
20 MW from E to B	-\$5.00	\$12.34	<u>\$ 346.80</u>
			\$7,583.22
<u>FTR</u>	<u>Congestion Component</u>		<u>Negative Target</u>
	<u>Source</u>	<u>Sink</u>	<u>Allocation</u>
210 MW from C to D	\$10.00	\$3.57	\$1,350.30

Note that FTRs do not hedge against losses.



Settlement

Settlement of FTRs in the Day-Ahead Market

Day-Ahead Market Congestion Charges	\$7,083.90
Negative FTR Target Allocation	<u>\$1,350.30</u>
	\$8,434.20
Positive FTR Target Allocation	\$7,583.22
ISO Managed Cash Fund	\$850.98

If the Negative FTR Holder were to default, the fund used to settle FTRs in the Day-Ahead Energy Market would be short \$499.32 in that hour (i.e. $\$7,083.90 - \$7,583.22 = -\$499.32$).



Observations



Observations

Negative FTRs can adversely impact the New England Markets:

- **Potential to reduce auction revenue allocations to ARR Holders and Interim Incremental ARR Holders.**
- **Default of an FTR Holder with negatively valued FTRs could cause a shortfall in the auction revenue fund used to cover ARR payments to ARR Holders and Interim Incremental ARR Holders.**
- **Default of an FTR Holder with negatively valued FTRs could cause a shortfall in the congestion fund used to cover FTR payments in the Day-Ahead Energy Market.**



Acknowledgements

To Dr. N. S. Rau for his tutelage in optimization theory.

To the PJM Interconnection for the five-bus power system model upon which this example is based.



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Questions?