



5 Minute Settlements

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- On a 5 minute basis, an imbalance is inherently introduced in RT Net Interchange due to different profiling
- As a result of different profiling, the sum of the twelve 5 minute intervals will not equal 0 MW
 - The current hourly RT Net Interchange does not equal 0 MW
 - $\sum \text{RT Net Interchange} + \text{Hourly Losses} + \text{Inadvertent} = 0 \text{ MW}$

Withdrawals

- + Demand (Flat profiled)
- + Exports (15 minutes)
- + IBT sales (Flat profiled)

Injections

- Generation (5 minutes)
- Imports (15 minutes)
- IBT purchases (Flat profiled)

- PJM will transition from an hourly calculation to a 5 minute calculation for Balancing Spot Market Energy Charges
 - Day-ahead Spot Market Energy charge for each hour for each Market Participant:
 - *Day-ahead Spot Market Energy Charge = (Hourly Day-ahead Net Interchange) * (Hourly Day-ahead System Energy Price)*
 - Balancing Spot Market Energy charge for each hour for each Market Participant:
 - *5 Minute Balancing Spot Market Energy Charge = (5 Minute Real-time Net Interchange – Flat Profiled Day-ahead Net Interchange) * (5 Minute Real-time System Energy Price)*

- Day Ahead Spot Market Energy Charge = the value of the DA losses
- 5 Minute Balancing Spot Market Energy Charge = the value of the balancing losses
 - *Spot Market Loss Value = Day Ahead Spot Market Energy Charge + Hourly Sum of 5 Minute Balancing Spot Market Energy Charges*

- PJM calculates the total hourly transmission loss charges by summing the day-ahead and balancing loss charges for each market participant plus the **spot market value of losses**, including an adjustment for the inadvertent interchange loss value.
- PJM allocates the total hourly transmission loss charges as hourly transmission loss credits for each market participant based on their hourly real-time load plus exports ratio share.

Generation and Load Imbalance Summary

5 Minute Gen / Load MW Imbalance component due to flat profiling



5 Minute RT Net Interchange



5 Minute Balancing Spot Market Energy Charge



Spot Market Loss Value



Total Hourly Transmission Loss Charges



Hourly Transmission Loss Credits allocate to market participants based on ratio share of hourly RT load plus exports

- PJM proposes to include the value of the Generation and Load imbalance in the Transmission Loss Charges calculation and the Transmission Loss Credits allocation.

- Goal: Determine the financial impact of the Generation and Load Imbalance on the Spot Market Loss Value
- *Spot Market Loss Value = Day Ahead Spot Market Energy Charge + **Hourly Sum of 5 Minute** Balancing Spot Market Energy Charges*
- Truths in the analysis
 1. Hourly Day-ahead Spot Market Energy Charges are not impacted
 2. Using 5 minute generation data impacts the RT Interchange
 3. Balancing Spot Market Energy Charges are recalculated using 5 minute generator SE MW data

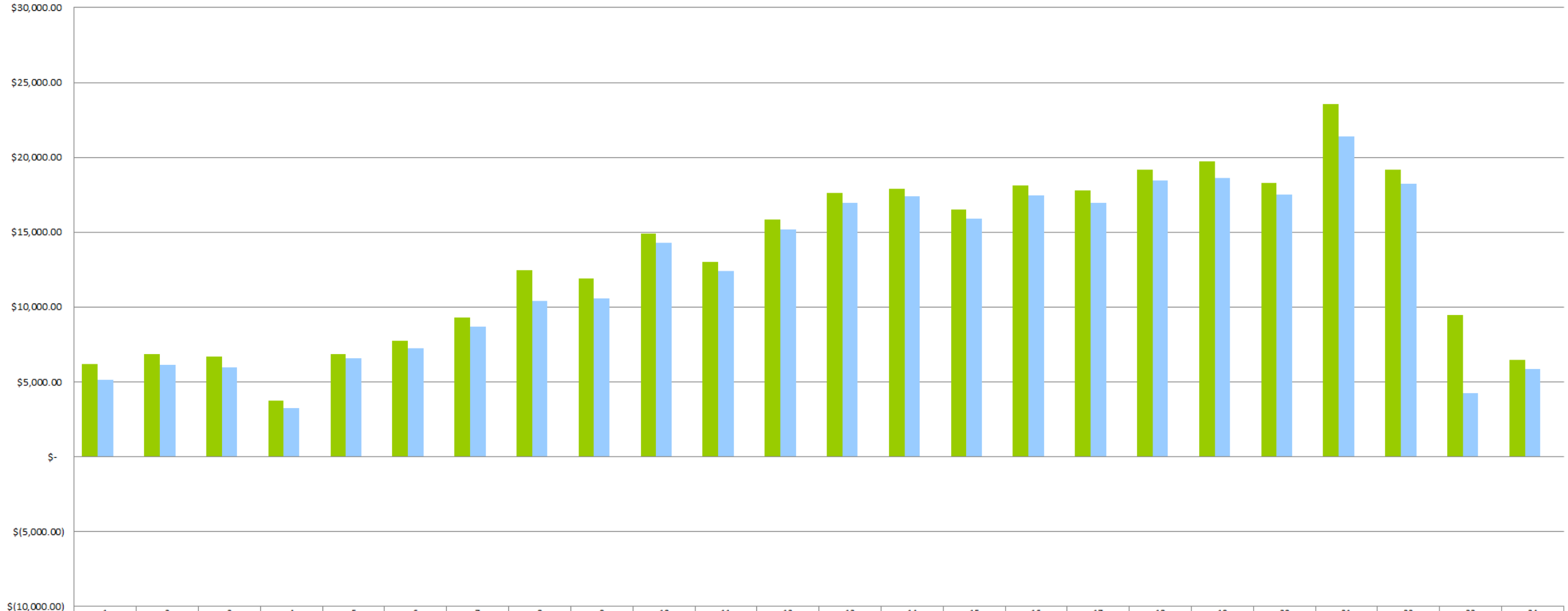
- Sample Data Set from 2016
 - May 8: Low load day
 - July 4: Negative LMP hours
 - August 12 and August 25: High load days

- Current Calculation - Balancing Spot Market Energy Charge on an hourly basis
 - $(\text{RT Interchange} - \text{DA Interchange}) * \text{RT Energy LMP}$

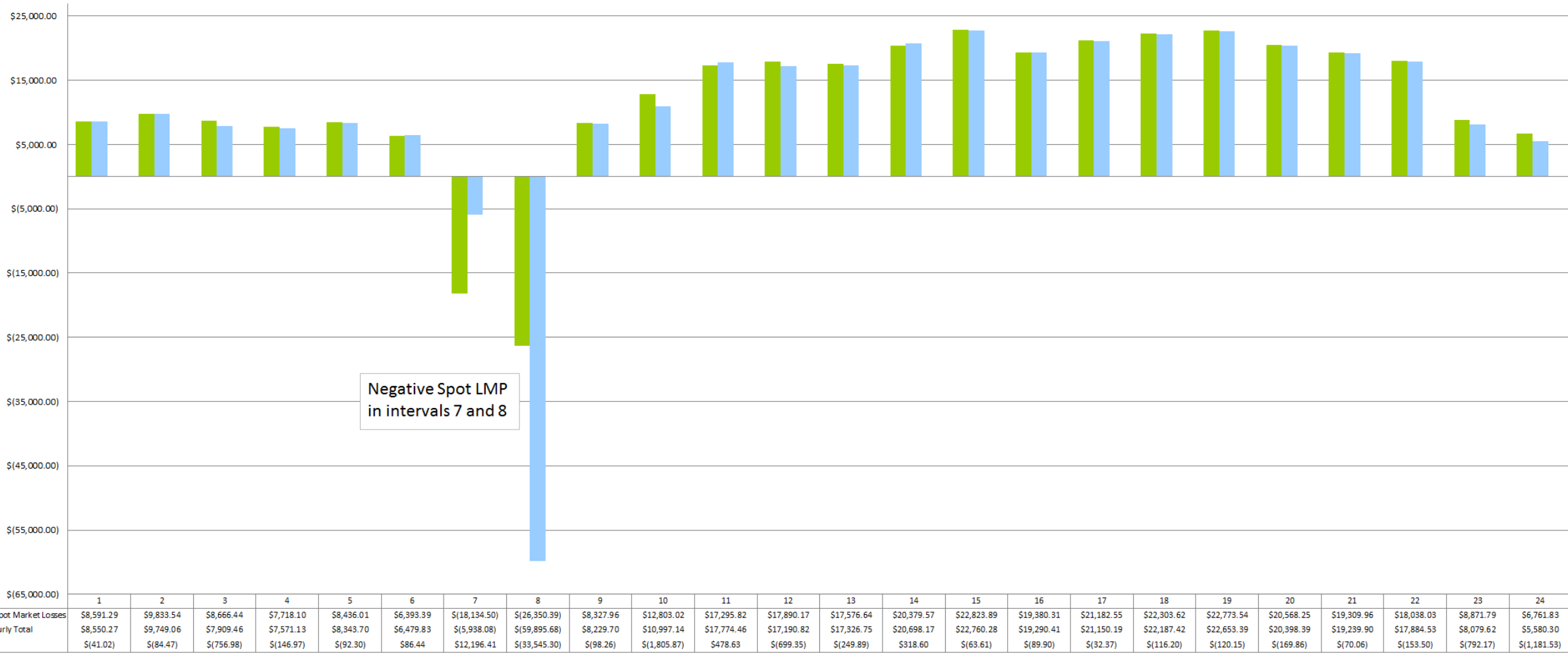
- Calculate 5 Minute Balancing Spot Market Energy Charge
 1. 5 minute generator SE MW scaled based on hourly Power Meter values
 2. Sum up all generator scaled MW values to get RTO interval total
 3. Determine the generation delta for each 5 minute interval
 - Hourly RT Gen – Interval RT Gen
 4. Adjust each 5 minute RT interchange by the generation delta
 5. Calculate 5 minute balancing interchange
 - Adjusted 5 minute RT Interchange – DA Interchange
 6. Calculate Interval Spot Market Loss Value
 - $(\text{5 minute balancing interchange} * \text{5 minute RT LMP}) / 12$
 7. Sum up the 12 intervals to get hourly total and compare to current calculation

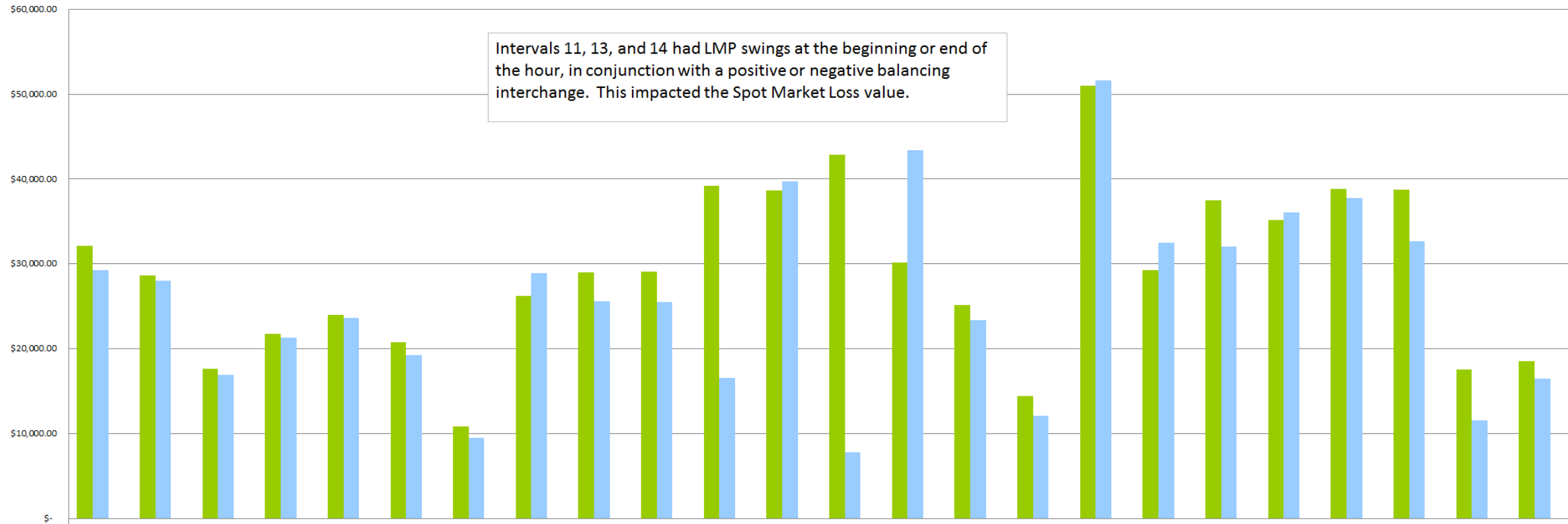
Date	Daily Spot Market Loss Change	Hourly Average Spot Market Loss Change	Hours with 5 Minute Spot Market Loss Value > Current Value	Daily Total Loss Credits	Percent change in Daily Total Loss Credits
May 5	-\$24,433	-\$1,018	0	\$248K	- 9.8%
July 4	-\$27,229	-\$1,136	3	\$261K	- 10.4%
August 12	-\$75,731	-\$3,155	6	\$1,934K	- 3.9%
August 25	-\$130,802	-\$5,450	6	\$730K	- 17.9 %

For all sample days, there is an overall reduction in the Transmission Loss Charges and consequently the Transmission Loss Credits.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Current Value Bal Spot Market Losses	\$6,190.59	\$6,876.43	\$6,708.24	\$3,747.05	\$6,838.93	\$7,762.12	\$9,313.87	\$12,473.70	\$11,890.28	\$14,898.46	\$13,017.68	\$15,841.85	\$17,615.20	\$17,909.88	\$16,500.16	\$18,107.90	\$17,763.90	\$19,160.26	\$19,716.85	\$18,271.40	\$23,562.72	\$19,147.74	\$9,473.73	\$6,485.22
Simulated 5Min hourly Total	\$5,145.21	\$6,152.48	\$5,985.04	\$3,261.05	\$6,592.20	\$7,225.07	\$8,696.68	\$10,393.26	\$10,555.40	\$14,310.13	\$12,400.72	\$15,178.82	\$16,945.40	\$17,374.48	\$15,905.17	\$17,426.15	\$16,968.59	\$18,443.00	\$18,641.18	\$17,528.84	\$21,390.51	\$18,243.47	\$4,224.29	\$5,852.95
Difference	\$1,045.38	\$723.95	\$723.21	\$486.00	\$246.73	\$537.05	\$617.19	\$(2,080.44)	\$(1,334.88)	\$(588.33)	\$616.95	\$(663.03)	\$(669.80)	\$(535.40)	\$(594.99)	\$(681.75)	\$(795.31)	\$(717.26)	\$(1,075.67)	\$(742.56)	\$(2,172.21)	\$(904.27)	\$(5,249.44)	\$(632.28)





Intervals 11, 13, and 14 had LMP swings at the beginning or end of the hour, in conjunction with a positive or negative balancing interchange. This impacted the Spot Market Loss value.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Current Value Bal Spot Market Losses	\$32,157.13	\$28,650.57	\$17,637.39	\$21,746.43	\$23,995.76	\$20,799.88	\$10,839.96	\$26,193.73	\$29,044.69	\$29,108.13	\$39,172.70	\$38,632.16	\$42,869.03	\$30,146.15	\$25,197.86	\$14,432.32	\$51,008.14	\$29,239.11	\$37,465.58	\$35,170.90	\$38,818.19	\$38,712.30	\$17,544.49	\$18,571.36
Simulated SM in hourly Total	\$29,253.44	\$28,016.89	\$16,898.17	\$21,314.35	\$23,594.16	\$19,261.52	\$9,479.67	\$28,915.35	\$25,630.09	\$25,481.02	\$16,609.71	\$39,761.27	\$7,804.41	\$43,418.18	\$23,375.41	\$12,070.19	\$51,605.30	\$32,460.38	\$32,030.32	\$36,050.43	\$37,762.25	\$32,633.12	\$11,547.91	\$16,448.32
Difference	\$(2,903.69)	\$(633.68)	\$(739.22)	\$(432.08)	\$(401.59)	\$(1,538.36)	\$(1,360.29)	\$2,721.62	\$(3,414.60)	\$(3,627.11)	\$(22,563.00)	\$1,129.11	\$(35,064.62)	\$13,272.03	\$(1,822.45)	\$(2,362.13)	\$597.16	\$3,221.27	\$(5,435.26)	\$879.53	\$(1,055.94)	\$(6,079.17)	\$(5,996.58)	\$(2,123.04)

