# Regulation and Control Metrics

- Regulation Signals are in a full raise or lower state (+/- TREG) when there is a generation/load imbalance and ACE is at extremes
    - Regulation A will continues to hold at a full raise or lower until ACE returns to normal bounds
    - Regulation D logic brings the signal back to zero, which goes against ACE correction

- Operators utilize the regulation manual move to force signal to specific utilization percentages
    - Forcing Regulation D to extreme depletes batteries, lowering scores

- **Reg A Signal Pegged-** represents the number of hours when the RegA signal was pegged (either high or low) for a duration of longer than 15 minutes

- **Operator Manual Moves-** represents the number of hours when the regulation signals were manually moved by the operator
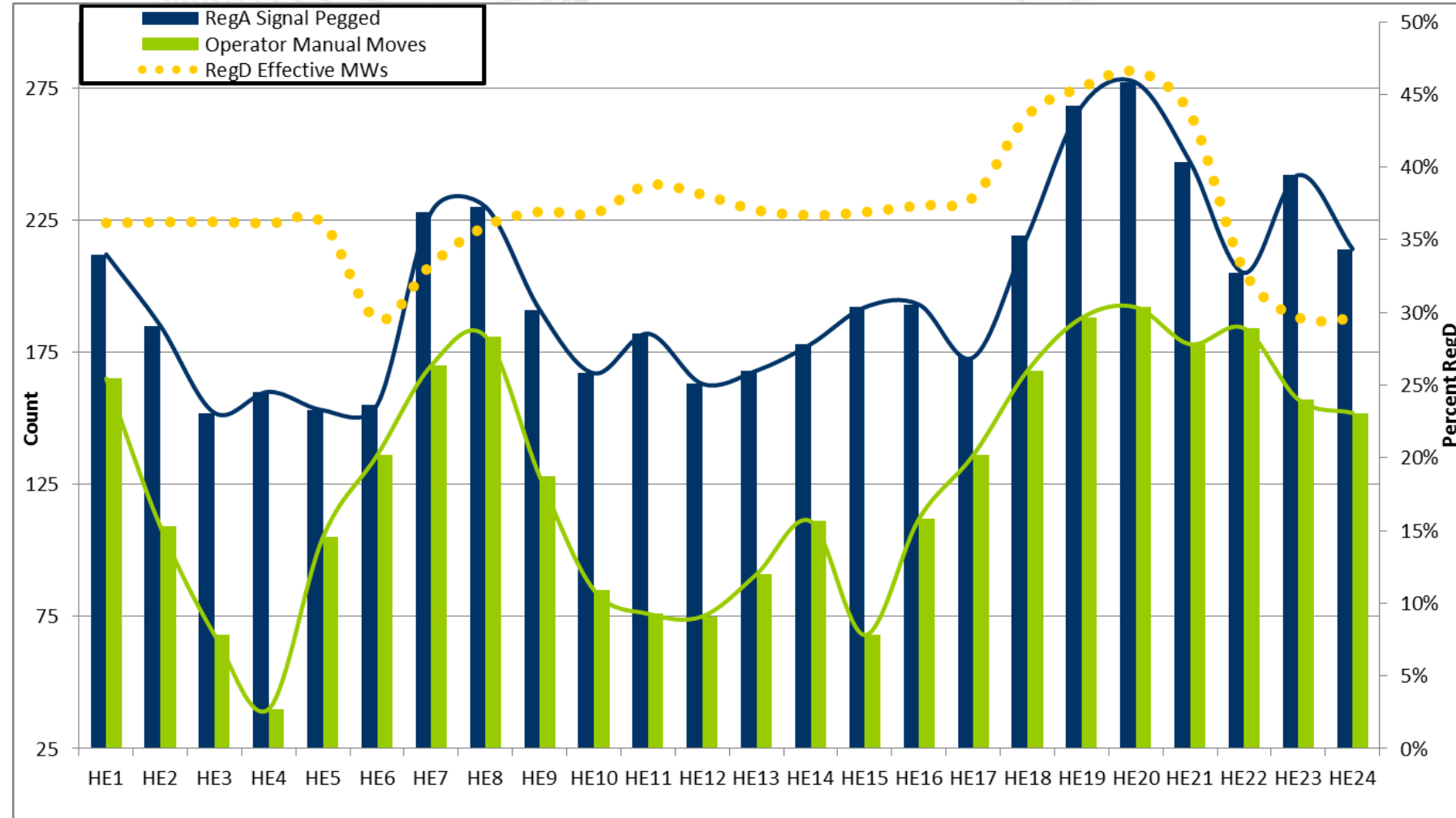
- **R1.** The Responsible Entity **shall operate such that the Control Performance Standard 1 (CPS1)**, calculated in accordance with Attachment 1, **is greater than or equal to 100 percent** for the applicable Interconnection in which it operates for each preceding 12 consecutive calendar month period, evaluated monthly.

$$CPS1 = 100 \left[ 2 - \frac{(RTO\ ACE)(FA - FS)}{-10\beta\ \varepsilon 1^2} \right]$$

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- **R2.** Each Balancing Authority **shall operate such that its clock-minute average of Reporting ACE does not exceed its clock-minute Balancing Authority ACE Limit (BAAL) for more than 30 consecutive clock-minutes**, calculated in accordance with Attachment 2, for the applicable Interconnection in which the Balancing Authority operates
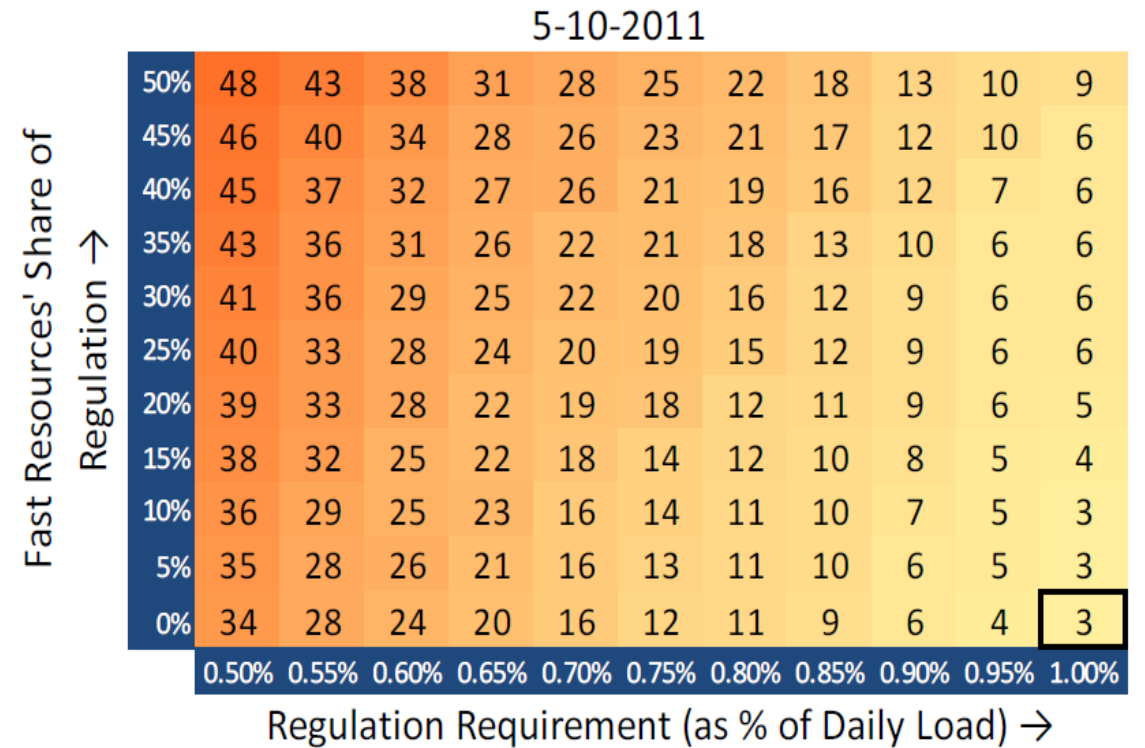
$$BAAL_{Low} = (-10B_i \times (FTL_{Low} - F_S)) \times \frac{(FTL_{Low} - F_S)}{(F_A - F_S)}$$

$$BAAL_{High} = (-10B_i \times (FTL_{High} - F_S)) \times \frac{(FTL_{High} - F_S)}{(F_A - F_S)}$$

- Contour plots developed suggesting that CPS1 performance can be maintained with the relationship between increased fast resources and the regulation requirement



Contour plot for CPS1, 4-11-2011
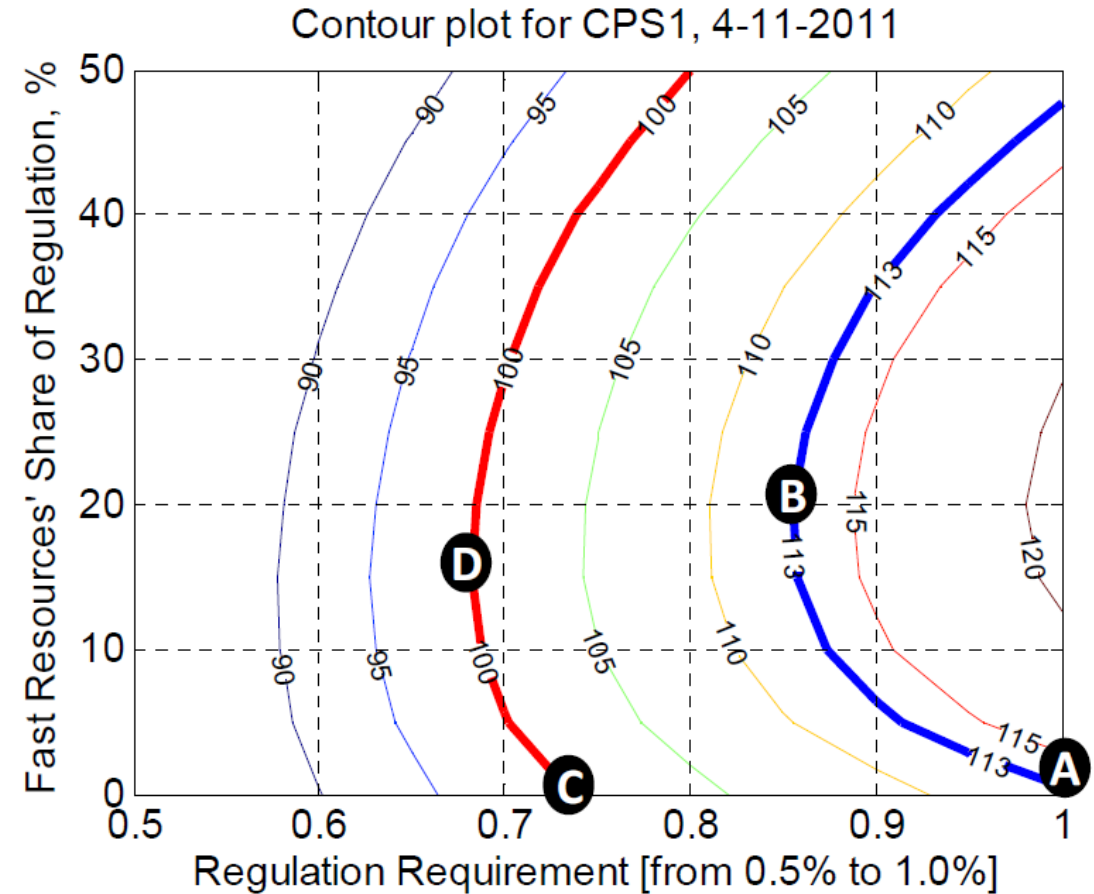
- When CPS1 is already very high, the BAAL violations tend also to be low; when CPS1 is closer to the lower ranges, BAAL violations tend to increase more quickly than CPS1 decreases

- Decreasing regulation requirements and increasing fast regulation participation in regulation tends to increase the number of BAAL violations

- The degree with which the BAAL worsens appears to be aligned with the days with lower CPS1 scores

**5-10-2011**

| Fast Resources' Share of Regulation → | 0.50% | 0.55% | 0.60% | 0.65% | 0.70% | 0.75% | 0.80% | 0.85% | 0.90% | 0.95% | 1.00% |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50% | 48 | 43 | 38 | 31 | 28 | 25 | 22 | 18 | 13 | 10 | 9 |
| 45% | 46 | 40 | 34 | 28 | 26 | 23 | 21 | 17 | 12 | 10 | 6 |
| 40% | 45 | 37 | 32 | 27 | 26 | 21 | 19 | 16 | 12 | 7 | 6 |
| 35% | 43 | 36 | 31 | 26 | 22 | 21 | 18 | 13 | 10 | 6 | 6 |
| 30% | 41 | 36 | 29 | 25 | 22 | 20 | 16 | 12 | 9 | 6 | 6 |
| 25% | 40 | 33 | 28 | 24 | 20 | 19 | 15 | 12 | 9 | 6 | 6 |
| 20% | 39 | 33 | 28 | 22 | 19 | 18 | 12 | 11 | 9 | 6 | 5 |
| 15% | 38 | 32 | 25 | 22 | 18 | 14 | 12 | 10 | 8 | 5 | 4 |
| 10% | 36 | 29 | 25 | 23 | 16 | 14 | 11 | 10 | 7 | 5 | 3 |
| 5% | 35 | 28 | 26 | 21 | 16 | 13 | 11 | 10 | 6 | 5 | 3 |
| 0% | 34 | 28 | 24 | 20 | 16 | 12 | 11 | 9 | 6 | 4 | 3 |

Regulation Requirement (as % of Daily Load) →

- PJM currently controls ACE to BAAL limits and has been a field trial participant since 2005

- BAAL (Balancing Authority ACE Limit) is used to maintain interconnection frequency and RTO ACE within a predefined profile

- Any excursion outside of the BAAL limits will be considered a 'BAAL minute'
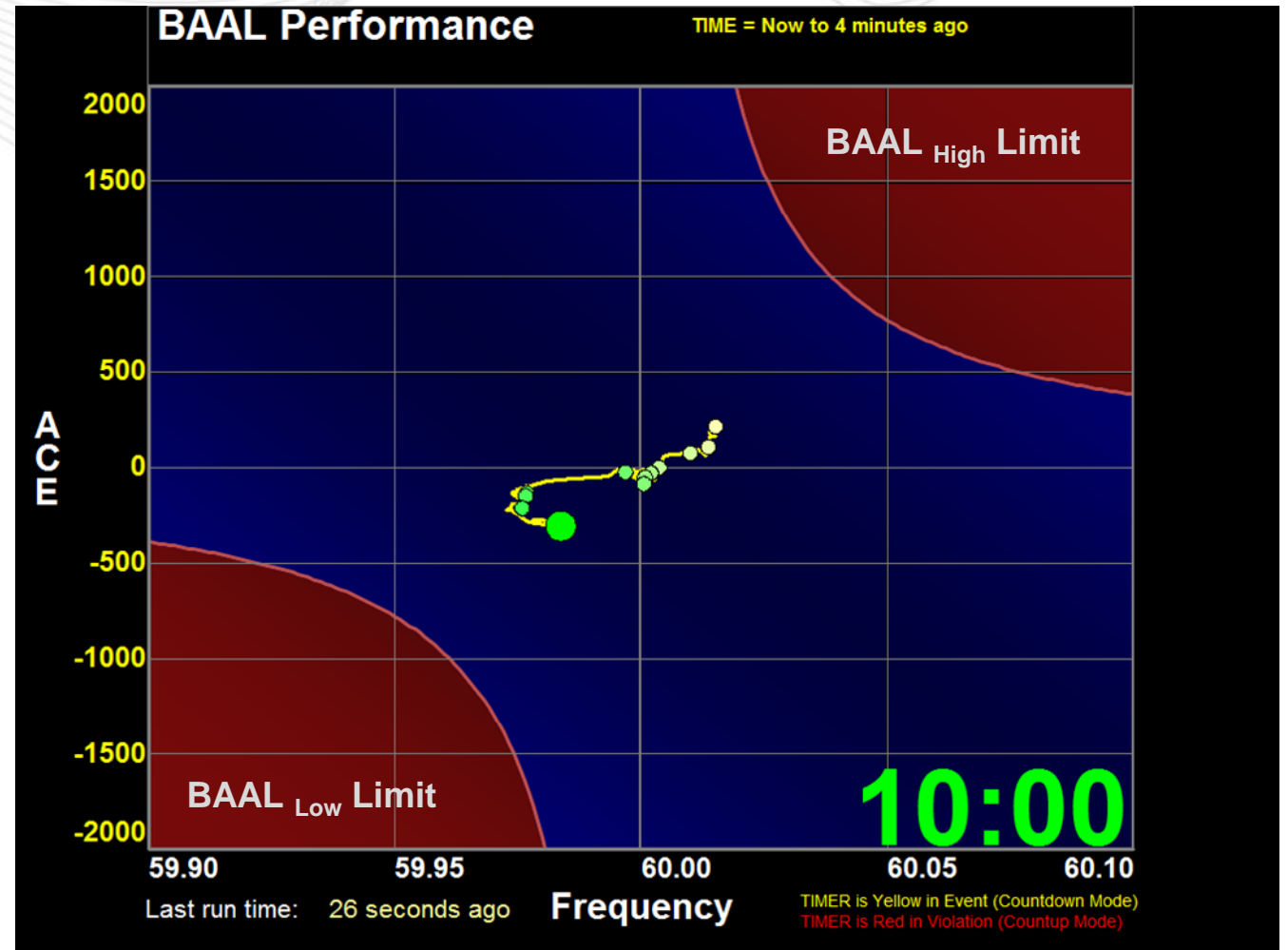
PJM Control Performance
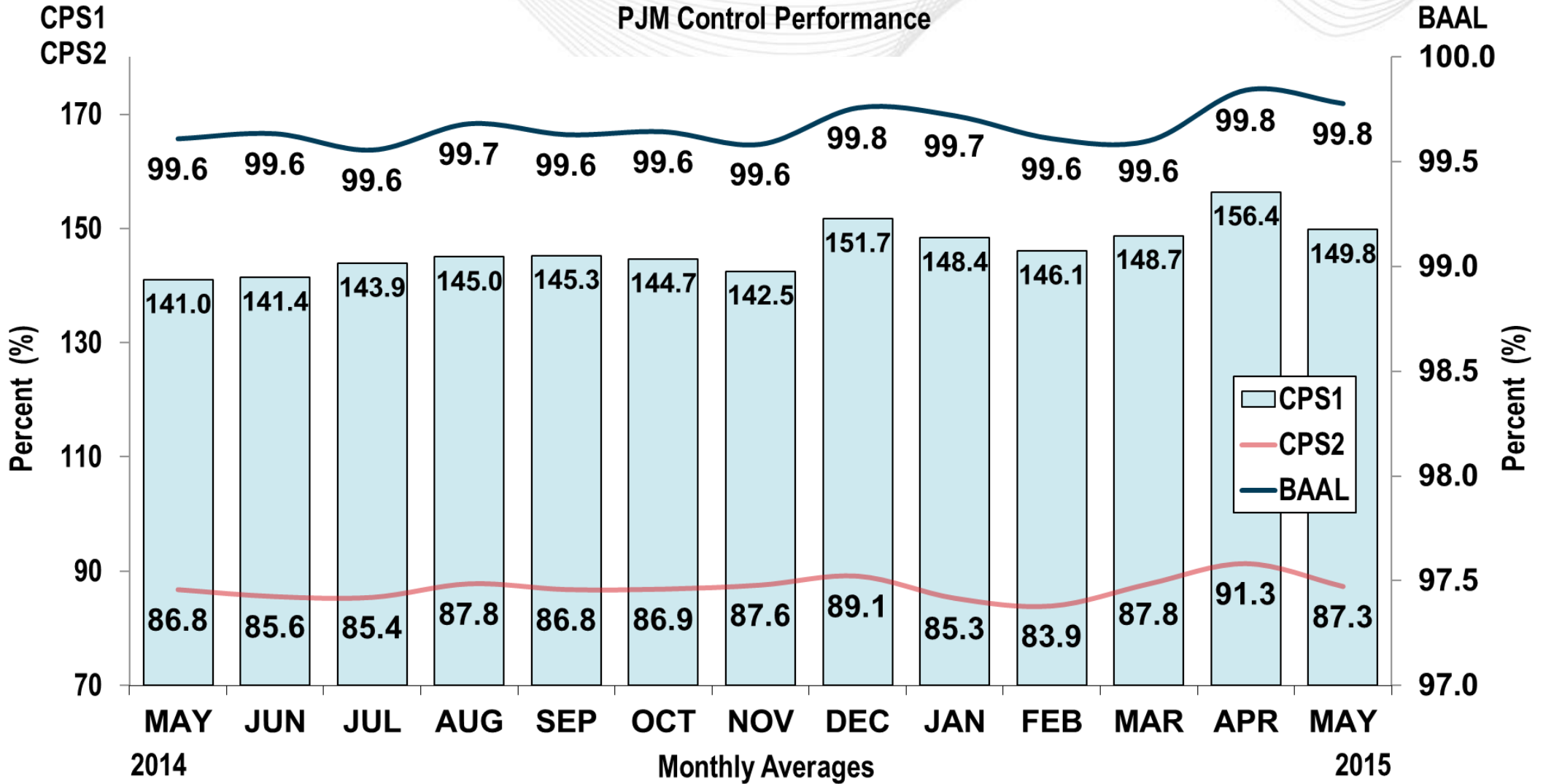
Hourly Average CPS1 Performance