Regulation Signal Saturation Analysis

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- Issue Description

- Causal Factors

- Potential Solutions

- Regulation Service provides fine-tune system correction to balance the Area Control Error (ACE) to zero
  - Load + Losses = Generation + Interchange
  - ACE = Interchange Error + Frequency Error + Manual Adders
  - Day-Ahead Market → RAC → CTO → ITSCED → RTSCED
  - Regulation capability is reserved from the energy stack
- "Deploying the reserve" sends a ACE-correcting-signal (ACS) to participating resources, adjusting output relative to a basepoint
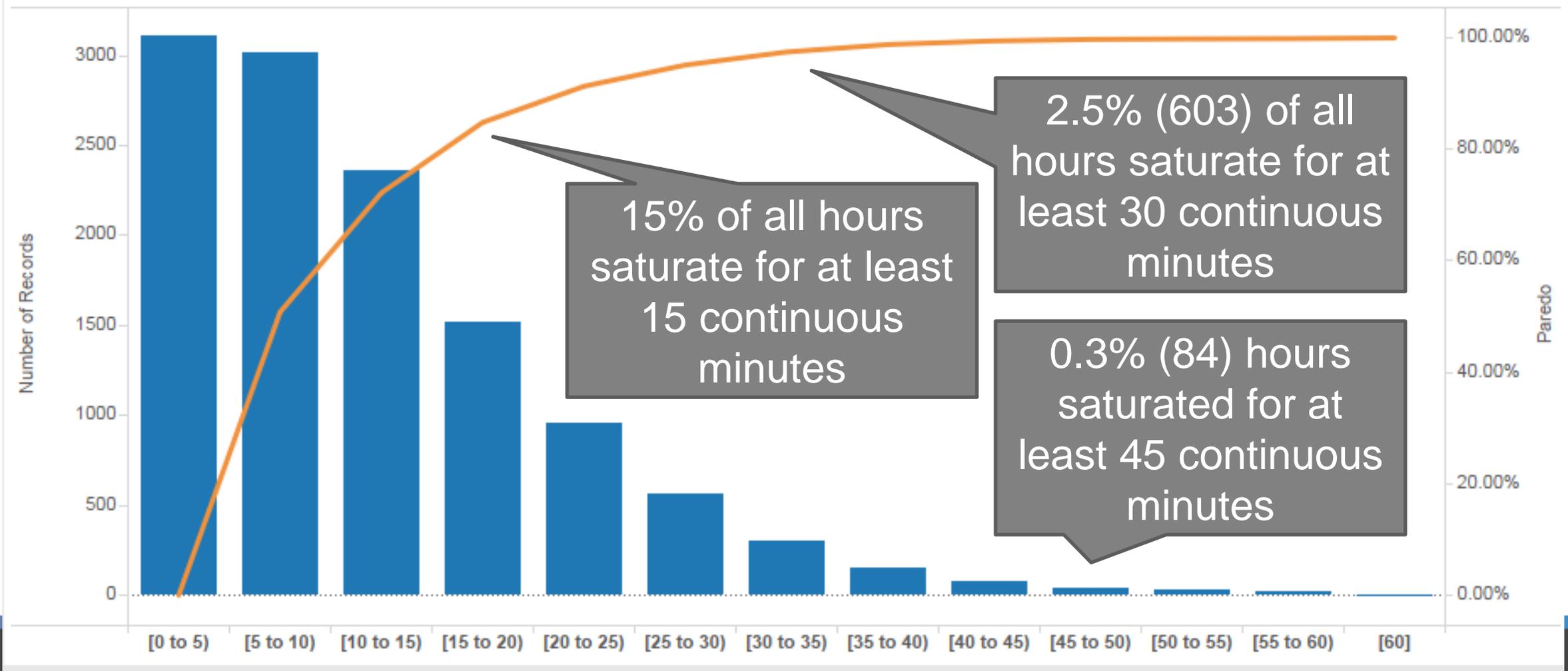
- Regulation corrects for errors in the system that occur within the 15 minute window of RTSCED
  - Very Short-term Load Forecast Error (ramp prediction, time of day)
  - Small Unit Loss (non-DCS scale resources, random)
  - Interchange Volatility
  - Eastern Interconnection Frequency (outside disturbance, random)
- Longer-term / large-scale deviations are designed to be corrected by energy re-dispatch or by commitment adjustments

- Regulation is an hourly product (today)
- Resource type characteristics play a role in regulation service
  - Simple steam & combined cycles have low ramp capability, but can sustain any desired output for any duration
  - Hydro & CTs have higher ramp capability and can sustain any desired output for any duration
  - Batteries & flywheels have highest ramp capability, but are charge limited and cannot sustain an output (today)
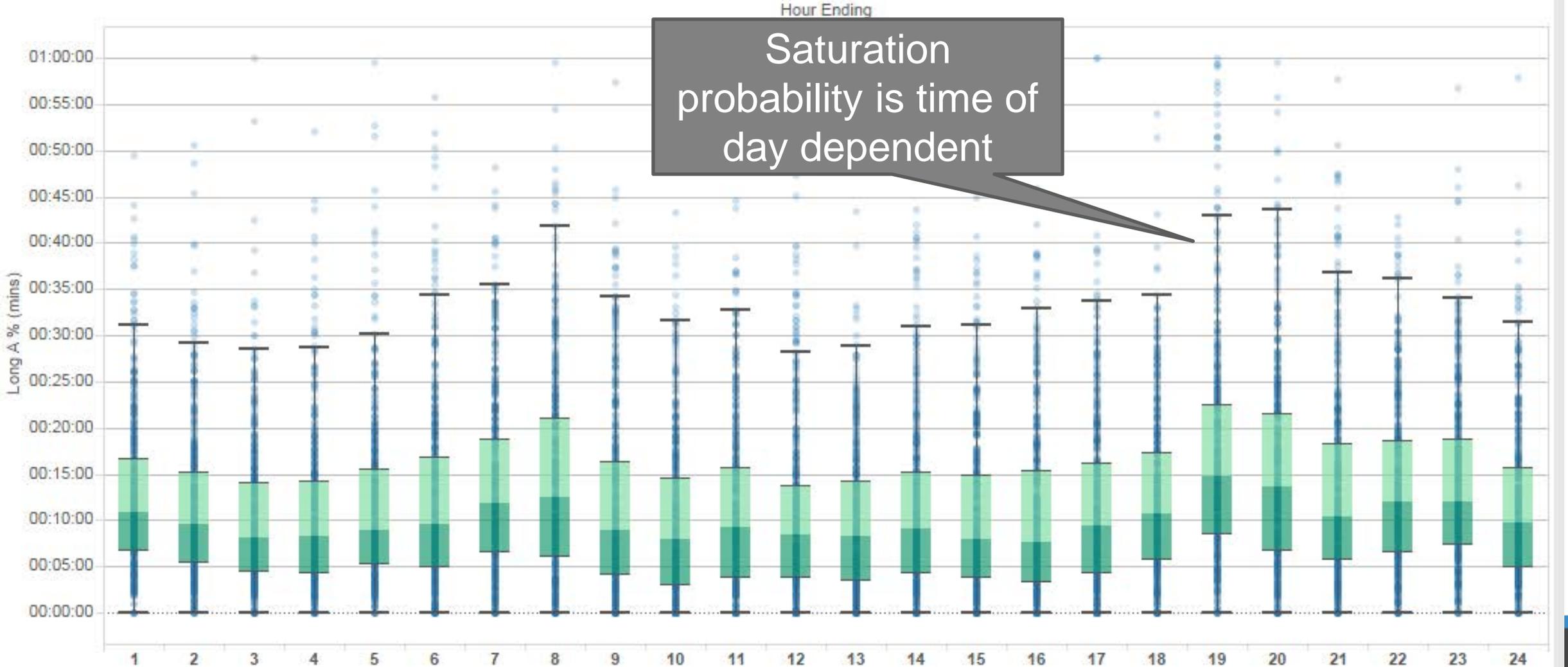
- Dispatch's primary focus is reliability (Is My ACE Zero?)

- Regulation Service is a product to be utilized
  - Prepositioning for known deviation outside the market stack
  - For most of the service's lifespan, sustained deviation had no operational impact

- Performance Based Regulation changed the incentives
  - Regulation D displaces Regulation A as "effective MW"
  - Value of sustaining output was not understood

- Service clears to requirement; deploys to capability
  - AGC signals varies between +/- TREG, by signal type
- Large instantaneous ACE deviations
- Steady state convergence (ACE → 0 with Signal ≠ 0)
  - ACE is f(Interchange Delta) = Economic Delta + Regulation Delta

- Saturation Metric: Abs Signal > 95% of TREG
  - "Full raise" when signal is equal to + total capability; all units output at basepoint + assignment, in MW
  - "Full lower" when signal is equal to – total capability; all units output at basepoint – assignment, in MW

For Jan 2015 – May 2016, saturation duration (in minutes by hour)

15% of all hours saturate for at least 15 continuous minutes

2.5% (603) of all hours saturate for at least 30 continuous minutes

0.3% (84) hours saturated for at least 45 continuous minutes

For Jan 2015 – May 2016, total TREG-A vs TREG-D

Saturation probability is time of day dependent

Common causes of signal "pegging" include:

- Reduced total capability (TREG) from clearing on effective MW
- Very Short-term Load Forecast Error
- Small Unit Loss (Non-DCS scale)
- Interchange & Frequency Variability
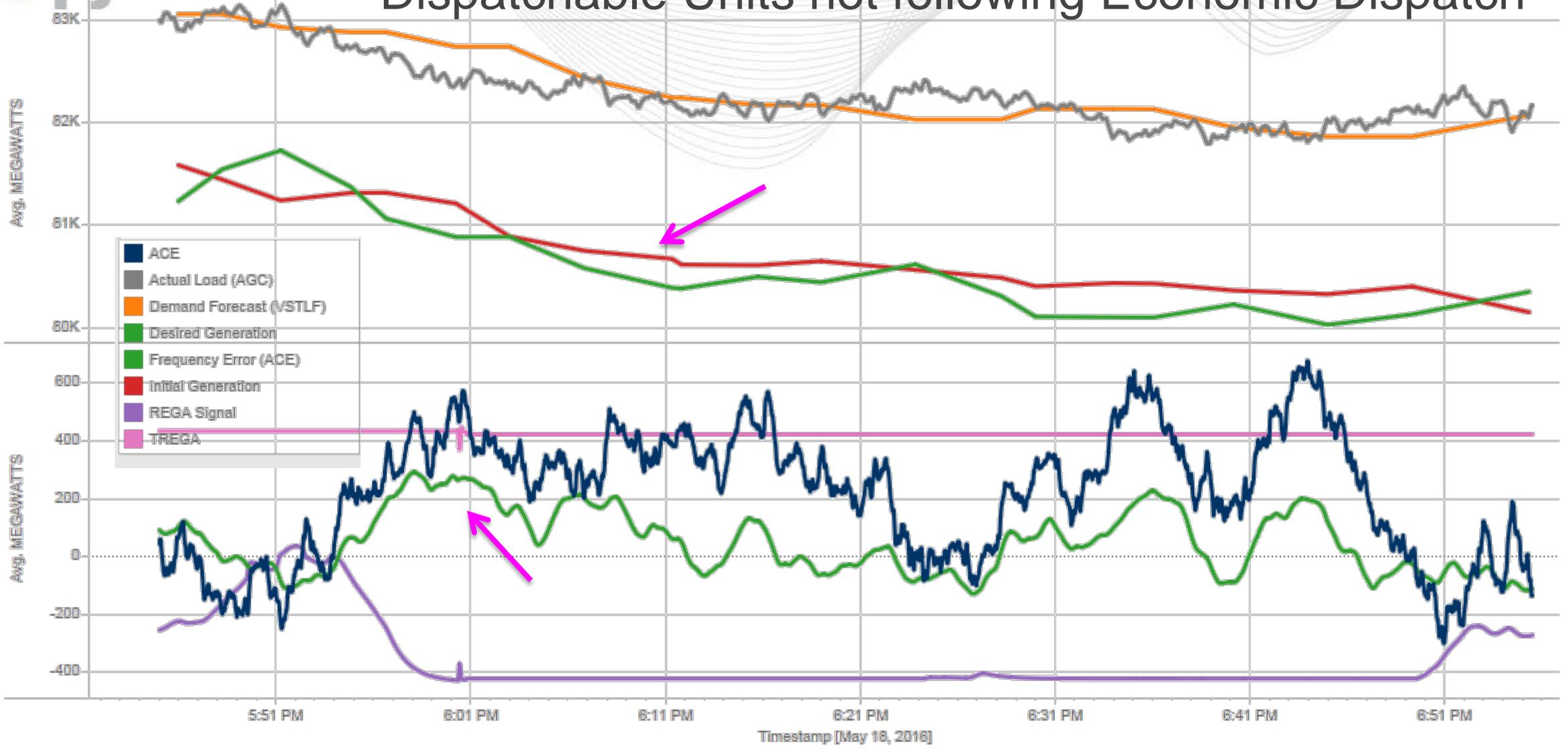- RTSCED Units Not Following Economic Dispatch

Monthly Average Total Capability, by signal type

- Each additional RegD with BF > 1 counts as more MW
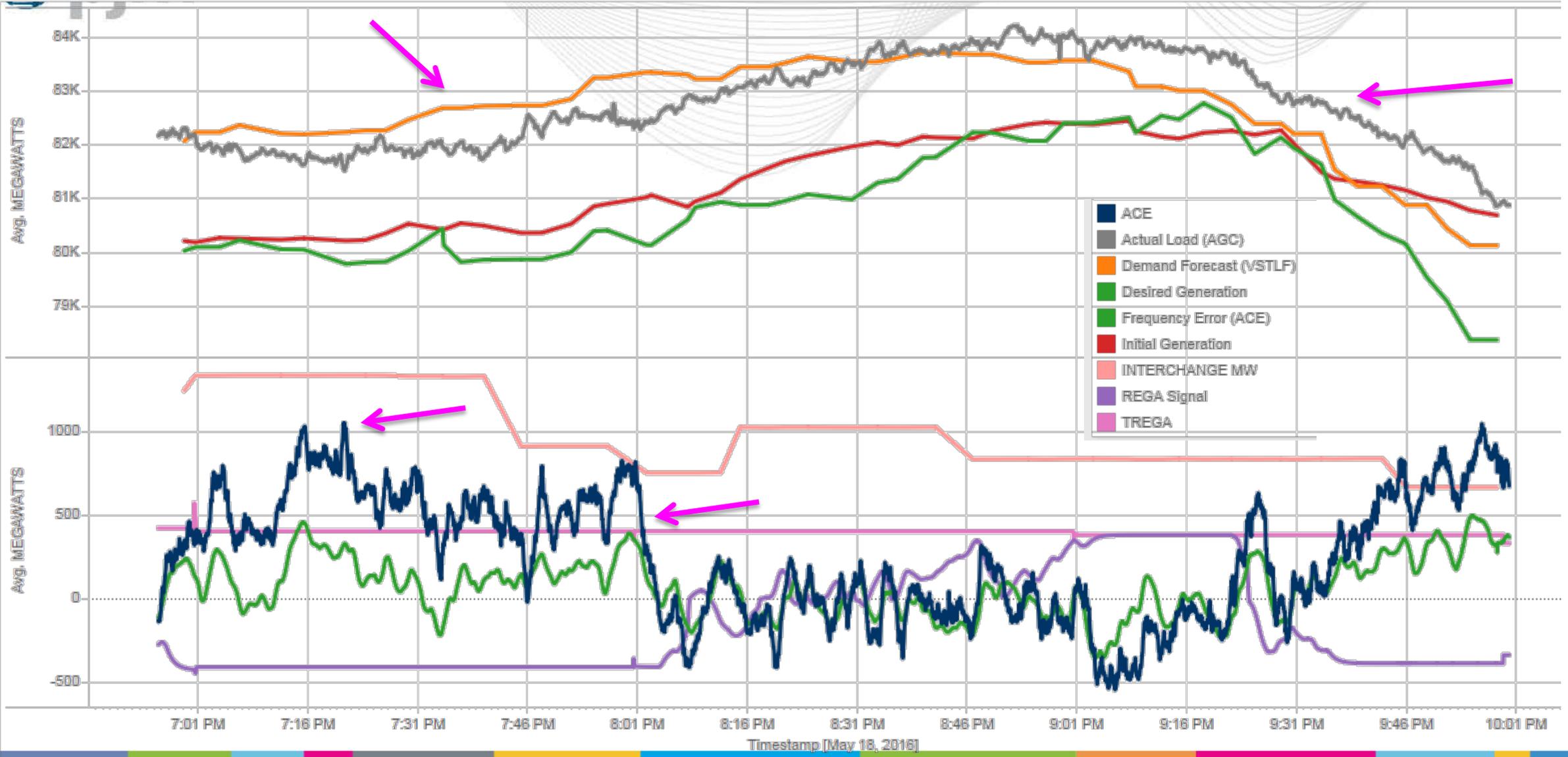- Reduced avg. TREG capability from 680 MW to 630 MW
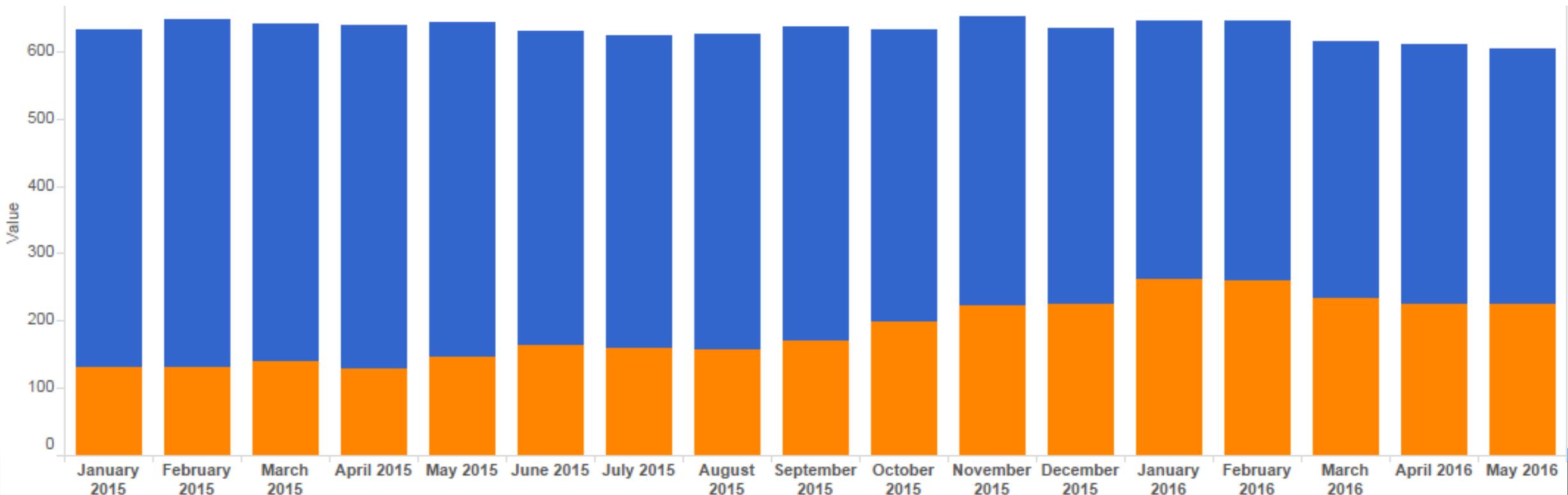
Interchange & Frequency Variability
Dispatchable Units not following Economic Dispatch

- Within the scope of RMISTF
  - Determine appropriate requirement levels
  - Refactor signals to improve neutrality management
- Outside the scope of RMISTF
  - Improve short-term load forecast timing of evening pickup
  - Increase penalties for not following real-time economic dispatch
  - Feedback to RTSCED to automatically "reset" regulation