Price Verification Education and Proposal

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MIC Special Session

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- Identify and implement efficiencies in the current price verification and posting process

  - Seek stakeholder feedback on the LMP posting process as it applies to Real Time LMP and next day finalized LMP posting

- Minimize Market Operator discretion

- Determine areas in need of greater transparency

- Market Operators perform verification during and after the operating day is complete
  - May rerun LPC cases to correct any issues identified during the verification process
- Verified prices are posted the next business day to DataMiner2 and used in settlements
- Goal is to post verified prices by 10:30 AM the next business day; otherwise notify market participants of any delays

- Does the timing of when verified LMPs for the previous day are posted impact your business?

- Do you value accuracy or timeliness or both?

  – Accuracy: Accept the posted prices in Real-Time as near finalized

  – Timeliness: Consistently posting by 10 AM with best available information

- Is there value for the prices to be finalized sooner than the current 10:30 AM deadline the next business day?

- Would you like to see any changes to the current price posting process?

  – Real-Time or Next Day

- Do you feel the current price verification process is transparent?

  – Is there need for greater transparency? If so, what areas?
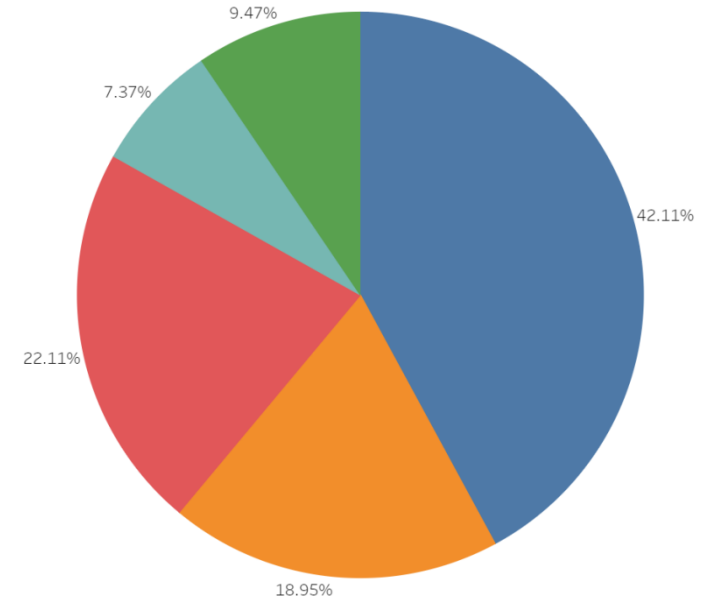
- Reproduce prices for Off SCED period

- Modifications to Output Consistency Checks (OCC)

- Logic for De-energized pnodes

- Language clarifications for Price Repostings

  – Schedule 1, Section 1.10.8 (E) of Attachment K of Operating Agreement

- Time period where Dispatchers are unable to dispatch the system using RTSCED application due to scheduled or unscheduled events
- During such periods:
  - Dispatchers decide when to go Off SCED and come back On SCED control
  - An all-call is made to notify GOs and TOs that PJM is manually controlling the system
  - EMS system is used to send zonal dispatch rates (drates) via AGC to manage generation
  - Drates are calculated in the EMS system based on current total generation output and anticipated required total generation
  - Transmission constraints are manually controlled
  - M2M constraint coordination is suspended
  - CTS coordination is suspended
  - Current regulation assignments may be carried forward

- Loss or degradation of PJM systems:
  - EMS capabilities
    - Telemetry (ICCP)
    - State Estimator
  - Dispatch tools and systems
- Miscellaneous/other

- Information Technology Impacts
  - Data transfer failures
  - Loss of internet
  - Network loss or degradations
  - Servers or database outages
  - System upgrades
  - Security patching
  - Code releases

- LMPs and Ancillary Services prices may need to be calculated for the impacted intervals
  - Use an approved RT SCED case closest to the event as reference case
  - Modify case input data to reflect the zonal dispatch rates communicated during the Off SCED period
  - Manually controlled constraints are reflected in the formation of LMPs
- During Off SCED periods, prices posted to the Operational Data page may be stale
  - May not reflect the current state of the system

Year	Number of Events	Total Number of 5 minute intervals	% of 5 minute intervals per year
2013	15	270	0.26%
2014	11	100	0.10%
2015	15	115	0.11%
2016	15	486	0.46%
2017	20	124	0.12%
2018	16	241	0.23%
2019	6	63	0.06%

- Very small number of Off SCED events over the past 6 years
- Average 0.2% of intervals per year over the past 7 years
- 90% of the total events are less than 2 hours long
  - 61% of the total events are less than 1 hour

Man Disp Duration (# of Events)
- ■ < 30 Minutes (40)
- ■ 30 to 59 Minutes (18)
- ■ 60 to 89 Minutes (21)
- ■ 90 to 119 Minutes (7)
- ■ > 120 Minutes (9)

- Overall process to calculate prices for the impacted LPC intervals is manual and cumbersome
  - Time consuming
  - Lack of transparency
- EMS dispatch rates sent out during Off SCED control may not align with LMPs calculated through the optimization engine
- Depending on the severity/duration of the event, it may cause delays in posting verified prices the next business day

- Create an automated and transparent process to calculate prices for intervals impacted by the Off SCED event

- Carry the latest approved pricing case prior to the Off SCED event for the duration of the Off SCED period

  – Continue binding constraints based on the last approved case for pricing

  – LPC case may be adjusted for system conditions

    • I.E Shortage, Voltage Reduction and Manual Load Dump actions

- Provide member visibility for pricing intervals where Off SCED control occurred

- Reasonability check of the LPC solution performed automatically in real-time for every LPC case
- Predefined thresholds prevent posting intervals with suspect prices
  - Balance between posting suspect prices versus accurate prices
  - If the solution passes the OCC checks, data is posted for market participants
  - If the solution fails the OCC check, no data is posted for the given interval
    - OCC check failures are further investigated during verification to determine if prices need to be revised

- Current price bounding thresholds:
  - Total LMP: Maximum ($6000) and minimum (-$2000)
  - SRMCP: Maximum ($1701) and minimum ($0)
  - PRMCP: Maximum ($851) and minimum ($0)
  - Reg MCP: Maximum ($6000) and minimum ($0)
  - Price differences between RTSCED and LPC cases ($0.01)
    - Energy LMP, SRMCP, and PRMCP
  - Maximum (45%) and minimum (-30%) Loss Percentage LMP
- Thresholds are predefined based on historical prices
  - Default values are reviewed and updated at PJM discretion

- Post prices for _**all**_ approved pricing intervals in Real Time, even if an interval fails OCC check

  – Any solution outside of the pre-defined thresholds will be posted with an indicator to notify stakeholders the solution is subject to additional review

- No change to current price bounding thresholds

  – Will continue to be reviewed and updated at PJM discretion

- Required to produce LMPs for all pricing nodes (pnodes) in the PJM network model for all intervals, including de-energized pnodes
- Per M-11, automated de-energized pnode replacement logic in LPC is used to find the closest suitable live pnode for a given de-energized pnode
  - Same station, same voltage level
  - Same station, different voltage level
  - Nearest neighboring station
  - If the automated process cannot find a suitable replacement the pnode is manually replaced as part of the LMP verification process
  - Market Operators also review de-energized pnodes that are automatically replaced by the engine to determine if a more optimal bus should be used

- Currently investigating improving the Market Clearing Engine's ability to find suitable replacement for de-energized pnodes based on Dijskstra algorithm.
  - The logic will continue to be automated as part of case execution
  - Offers a more robust way to find a suitable replacement for de-energized pnodes
  - Uses least resistance path to find a suitable replacement
  - Helps minimize operator intervention and manual bus replacements
  - Would be implemented in both the Day Ahead and Real Time Market Clearing Engines

(e)   If the Office of the Interconnection discovers an error in prices and/or cleared quantities in the Day-ahead Energy Market, Real-time Energy Market, Ancillary Services Markets or Day Ahead Scheduling Reserve Market after it has posted the results for these markets on its Web site, the Office of the Interconnection shall notify Market Participants of the error as soon as possible after it is found, but in no event later than 12:00 p.m. of the second Business Day following the Operating Day for the Ancillary Services Markets and Real-time Energy Market, and no later than 5:00 p.m. of the second Business Day following the initial publication of the results for the Day-ahead Scheduling Reserve Market and Day-ahead Energy Market. After this initial notification, if the Office of the Interconnection determines it is necessary to post modified results, it shall provide notification of its intent to do so, together with all available supporting documentation, by no later than 5:00 p.m. of the fifth Business Day following the Operating Day for the Ancillary Services Markets and Real-time Energy Market, and no later than 5:00 p.m. of the fifth Business Day following the initial publication of the results in the Day-ahead Scheduling Reserve Market and the Day-ahead Energy Market. Thereafter, the Office of the Interconnection must post on its Web site the corrected results by no later than 5:00 p.m. of the tenth calendar day following the Operating Day for the Ancillary Services Markets, Day-ahead Energy Market and Real-time Energy Market, and no later than 5:00 p.m. of the tenth calendar day following the initial publication of the results in the Day-ahead Scheduling Reserve Market. Should any of the above deadlines pass without the associated action on the part of the Office of the Interconnection, the originally posted results will be considered final. Notwithstanding the foregoing, the deadlines set forth above shall not apply if the referenced market results are under publicly noticed review by the FERC.

- Clarify the language for correcting prices that are posted that not all supported information can be posted due to confidentiality reasons
  - DA, RT, A/S, DASR: OA, Schedule 1, Section 1.10.8 (e)
  - FTR: OA, Schedule 1, Section 7.1.A.2, 7.3.7, 7.4.2
  - Capacity Markets: OA, Schedule 1, Section 5.11 (e)