Balancing Ratio Determination Issue

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Issue Recap

- PJM raised the issue regarding the Balancing Ratio ($\bar{B}$) used in the default Market Seller Offer Cap (MSOC) for RPM auctions in Sept. 2017
  - *Default MSOC = Net CONE$_{LDA}$ * $\bar{B}$*
  - Current tariff rules to calculate $\bar{B}$ rely on having Performance Assessment Hours (PAHs) occur in the three calendar years that immediately precede the BRA, and becomes indeterminable when that does not occur
- Members indicated a desire to also discuss the assumed number of PAHs to occur in a single year, as used in the Non-Performance Charge Rate
  - Currently, 30 hours assumed
  - *Non-Performance Charge Rate = (Net CONE$_{LDA}$ * 365 days) / 30 hours*
- Approved at October, 2017 MRC and assigned to MIC
- Issue Charge revised at April, 2018 MRC

Approved Issue Charge Revisions (Redline)

Expected Deliverables

1. A more comprehensive methodology to determine the Balancing Ratio used in the calculation of the default MSOC
2. A recommendation to the MRC on the methodology used to determine the Non-Performance Charge Rate, and corresponding changes to the default MSOC

Out of Scope Items

1. The general ~~determination~~ underlying logic of the default Market Seller Offer Cap[1] ~~as Net $CONE_{LDA}$ * Balancing Ratio~~

[1] The calculation of the MSOC will remain the same as derived in equations 1-7 on page 5 of Appendix 1 of PJM's April 10, 2015 filed response in Docket No. ER15-623-000. The calculation shall reflect appropriate values as determined by the working group and as updated on a regular basis.

Rationale for April, 2018 Issue Charge Revision

- The default offer cap of *Net CONE*$_{LDA}$ * $\overline{B}$ is derived from the equation of a competitive CP sell offer, and is a direct function of the Non-Performance Charge Rate

*CP Competitive Offer = PPR * H * $\overline{B}$ + max{0, (ACR - PPR * H * $\overline{A}$)}*

1. *Default MSOC*$_{\$/MW\text{-}year}$ = *PPR * H * $\overline{B}$ + max{0, (ACR - PPR * H * $\overline{A}$)}*
2. *Default MSOC*$_{\$/MW\text{-}year}$ = *[Net CONE * 365 / H] * H * $\overline{B}$*
3. *Default MSOC*$_{\$/MW\text{-}year}$ = *Net CONE * 365 * $\overline{B}$*
4. *Default MSOC*$_{\$/MW\text{-}day}$ = *Net CONE * $\overline{B}$*

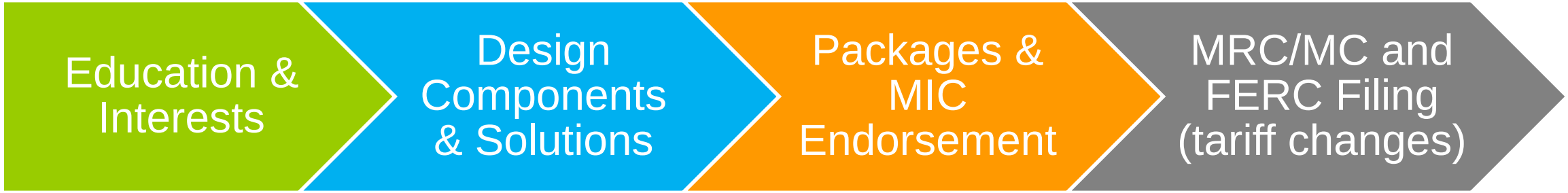
Term	Description
PPR	Non-Performance Charge Rate
H	Expected number of PAHs
$\overline{B}$	Expected Balancing Ratio
$\overline{A}$	Expected unit availability
ACR	Net avoidable costs

- Therefore, proposed changes to the Non-Performance Charge Rate should also consider any impacts and corresponding changes needed to the default offer cap to keep the CP design logic intact

Key Work Activities

1. Provide education on the calculation of the MSOC and Balancing Ratio
2. Provide education on the determination of Non-Performance Charge Rates
3. Develop and discuss alternative Balancing Ratio calculation methodologies for use in the determination of the default MSOC
4. Develop and discuss alternative methods to determine the Non-Performance Charge Rate

Expected Timeline



Feb-Mar MIC	Mar-May MIC	Jun-Jul MIC	Jul-Aug MRC (Sept MC)

★ File endorsed changes with FERC by early October 2018

MSOC Balancing Ratio Solution Option A

Solution Option Description

To estimate an expected future average Balancing Ratio for use in the default MSOC…

Take the average Balancing Ratios during the three Delivery Years that immediately precede the BRA using:

a) actual Balancing Ratios calculated during RTO PAIs of the Delivery Year, *and*

b) for any Delivery Year with less than "H" clock hours of PAIs, estimated Balancing Ratios calculated during the peak load hours of the RTO that do not overlap a PAI

- "H" represents expected number of hours of PAIs in the DY (currently 30)

CP Default MSOC = Net CONE x estimated Balancing Ratio

Solution Option Example of Delivery Year with less than "H" Clock Hours (30) of PAIs

Hour Count	Date	HE	PAIs	Peak Hour	Hourly Avg Bal Ratio
1	Jul 18	14	8	Y	93.4%
2	Jul 18	15	12	Y	93.7%
3	Jul 18	16	12	Y	95.2%
4	Jul 18	17	12	Y	95.1%
5	Jul 18	18	4	Y	90.8%
6	Aug 2	15	12	Y	89.5%
7	Aug 2	16	12	Y	90.9%
8	Jan 11	7	4	-	83.4%
9	Jan 11	8	12	Y	84.2%
10	Jan 11	17	6	Y	84.3%
11	Jan 11	18	12	-	76.7%
12	Jan 11	19	12	-	78.5%
13	Jul 18	13	-	Y	93.1%
14	Jul 19	16	-	Y	92.8%
15	Jul 19	17	-	Y	92.5%
16 - 30	…	…	…	…	…

(a) 12 hourly average Balancing Ratios from actual PAIs (118 in total)

(b) 18 hourly estimated Balancing Ratios during RTO peak hours that do not overlap a PAI

Balancing Ratio for the DY equals average of both (a) and (b)

Solution Option Pros

1. Straight-forward solution that augments the existing methodology by providing reasonable proxy hours and Balancing Ratios to use when no, or relatively few, actual PAIs occur
   – Peak load hours used as reasonable proxies due to correlation of high load hours and PAI triggers

2. Resultant Balancing Ratios appear on par with the values calculated from actual data during historical RTO emergency actions

3. Determinable in time to inform the unit-specific offer cap submission deadline for documentation
   – 120 days prior to the BRA (mid-January)

Comparison of Balancing Ratios under Existing and Proposed Methodologies

Delivery Year	Existing	Proposed	Prior 3 DYs
2018/2019	85.0%	88.3%	11/12, 12/13, 13/14
2019/2020	81.0%	85.3%	12/13, 13/14, 14/15
2020/2021	78.5%	83.8%	13/14, 14/15, 15/16
2021/2022	78.5% *	86.8%	14/15, 15/16, 16/17

Balancing Ratios during historical RTO emergency actions from 2011-14

Summer (16 hours): Avg = 93.5% Min = 87.7% Max = 95.1%

Winter (26 hours): Avg = 78.3% Min = 71.5% Max = 84.9%

Appendix

Assumed Performance Assessment Hours “H” in the Non-Performance Charge Rate

Non-Performance Charge Rate

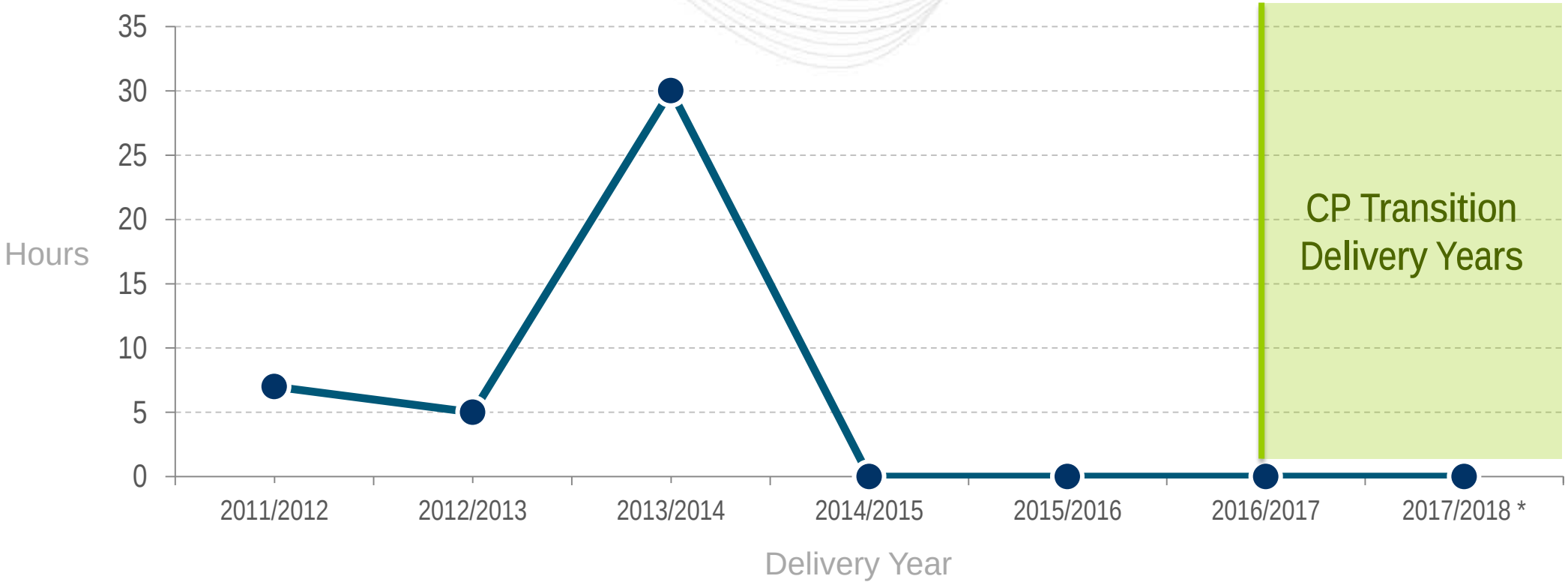
Non-Perf. Charge Rate* = **Net CONE x 365 days / "H" (30 hours)**

Where:

- Net CONE is the Net Cost of New Entry (stated in $/MW-Day, ICAP terms) for the relevant Delivery Year and LDA in which the resource is modeled
- "H" or 30 hours is the current estimated number of Performance Assessment Hours that may occur in a Delivery Year
- Non-Performance Charge Rate is expressed in $/MWh to be multiplied by a unit's Performance Shortfall to calculate the assessed penalty charges

* Charge Rate does not reflect the filed change with 5-minute Settlements, which further divides the rate by the number of Real-Time Settlement Intervals in an hour

Historical RTO Performance Assessment Hours



Note: Hours shown prior to 2016/2017 reflect Emergency Actions that would have triggered a Performance Assessment Hour under the CP rules

GE MARS Preliminary Study to Estimate “H”

GE MARS is a planning software tool capable of calculating standard reliability indices for a given power system (e.g. daily and hourly LOLE)

The tool also allows for review of emergency operating procedures, by calculating the expected number of days per year at a specified margin

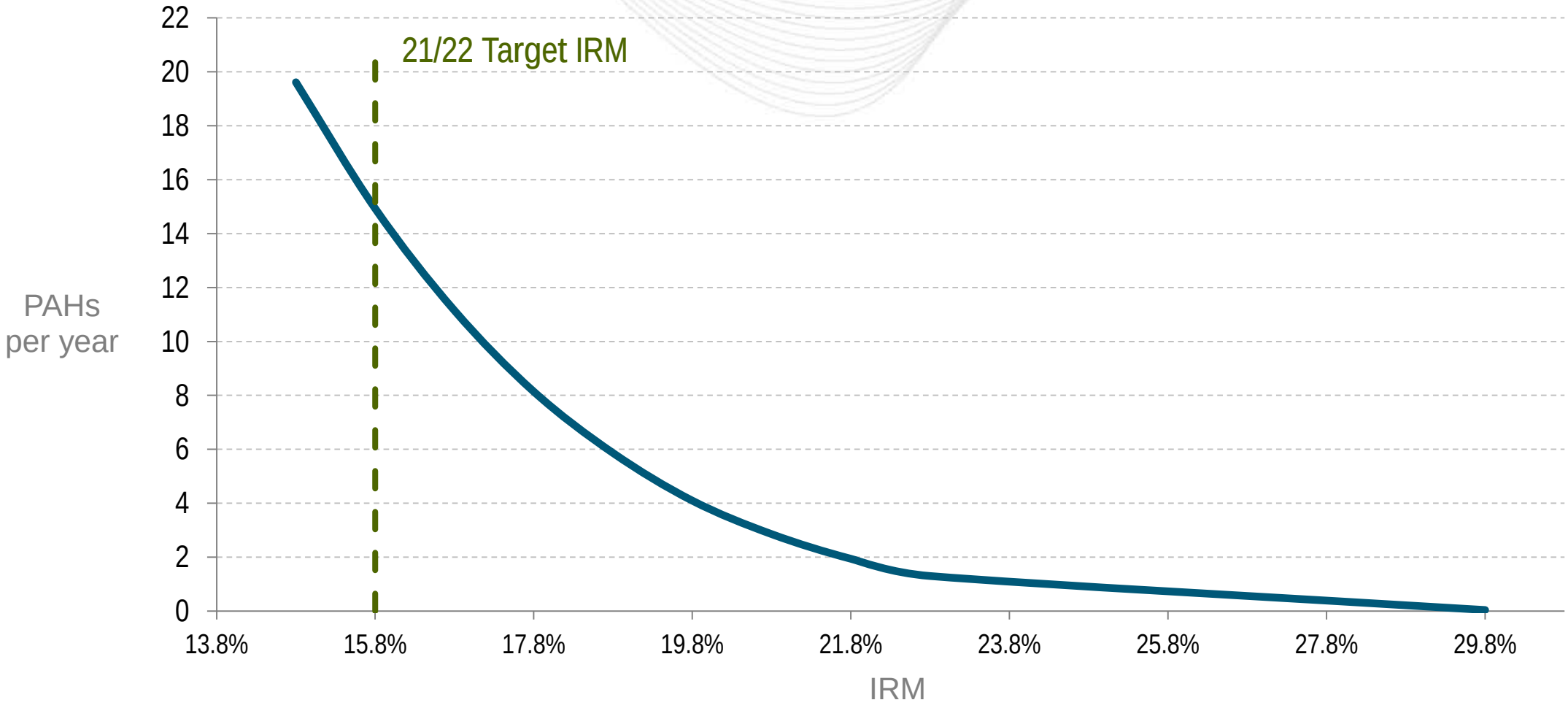
- e.g. A margin set at the typical Primary Reserve requirement might be used to estimate the number of Primary Reserve Warnings

The tool uses a sequential Monte Carlo simulation to calculate the probability of events, and requires a fair number of inputs and assumptions to run

GE MARS Study Assumptions

1. Same generator supply used in IRM Study
   - Operating histories randomly generated with each Monte Carlo replication for all units (reflects unit-specific forced outages rates)
   - Total Available Capacity determined for each hour
2. Solved peak load from IRM Study at reserve requirement
   - Monthly load shape using forecasted monthly peak loads; daily and hourly loads determined from an historical typical load shape
   - Hourly load levels varied in MARS simulations based on 7 load uncertainty levels, each with an associated probability
3. Specified Margin based on dispatch of Pre-Emergency DR
   - Estimated DR (8200 MW)
   - Operating Reserves/Regulation (3400 MW)

GE MARS Study Results
(1,000 replications run at each load level)



GE MARS Study Results / Observations

"H" significantly varies at different assumed reserve levels for the future DY

- IRM of 15.8%: ~ 15 Hours
- IRM of 21.8%: ~ 2 Hours

Virtually no Performance Assessment Hours occurred in winter months of the preliminary analysis; almost all risk and emergency hours in summer months

- Balancing Ratios calculated during the triggered Performance Assessment Hours of the program around 95 to 96 percent on average

GE MARS Study Conclusions

"H" in the Non-Performance Charge Rate should reflect the expected PAHs at the target IRM

- Consistent with using Net CONE in the numerator, as both represent the long-term market at equilibrium
- Consistent with CP design that aims to discourage non-performing resources from taking on capacity obligations due to penalties offsetting capacity revenues, especially when new entry is needed

Recommend using an "H" between 15 and 30 hours in denominator of the Non-Performance Charge Rate

- 15 hours seen at target IRM in GE MARS Study for just summer months
- 30 hours seen historically (i.e. 13/14 DY, even with high reserve margin)