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Memorandum

Subject: Proposed Default MSOC

From: Paul M. Sotkiewicz, Ph.D.

To: PJM RASTF

CC:

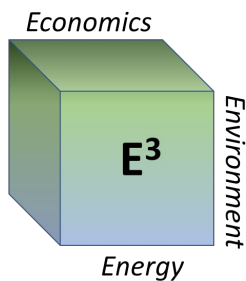
Date: March 14, 2022

Deriving the Optimal No-Look Offer Cap Considering Only Performance Penalties

The optimal offer cap under Capacity Performance is based on the decision of a generation resource to choose to be a capacity resource or to be an energy only resource. In taking on the obligations to become a capacity resource, a generation resource accepts revenues up front to take on the risk it incurs by being subject to performance penalties for not delivering its committed capacity when needed. While there is the possibility of bonus payments, these are quite limited relative to the downside risk of performance penalties

In contrast, if a generation resource chooses to be energy only, then it forgoes the upfront capacity payment but faces no performance risk of penalties and can only earn performance bonuses if it performs during a capacity emergency. Any performance greater than zero will earn bonus payments as the expected performance of an energy only resource is zero under Capacity Performance.

In this sense, a generation resource deciding to participate in the capacity market will submit an offer based on a capacity price at which its expected net revenue equates these two potential options: whether taking on a capacity commitment but be exposed to penalty risk is equal, or to or greater than its expected net revenues as an energy-only resource where it would forego capacity revenue as an energy only resource but also avoid the downside performance risk.



I. **Deriving the Optimal Offer**

The analysis and recommendation set out below is based on a derivation provided by the PJM Independent Market Monitor (“IMM”) following ISO-NE’s derivation.¹

The net revenue from taking on a capacity obligation is defined as the following:

$$R_{cap} = UCAP \times [P + (Penalty_i \times H_{expected} \times (\bar{A} - \bar{B}) - Net\ ACR]$$

The net revenue from being an energy only resource is:

$$R_{energy} = UCAP \times \left[\sum_{i=1}^{H_{expected}} (Bonus_i \times A_i) - Net\ GFC \right]$$

Where:

R_{cap} – net revenue for a resource with a capacity commitment.

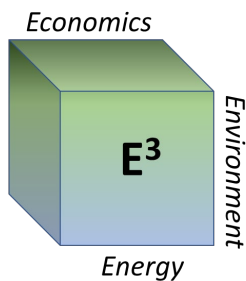
$UCAP$ – is the unforced capacity or ELCC capacity committed for a resource with a capacity commitment.

P – capacity market price at which a resource is indifferent between taking a capacity commitment and being an energy only resource. This is also the optimal offer \$/MW-year UCAP.

i – index of performance assessment hours.

$Penalty_i$ – non-performance penalty rate expressed in \$/MWh. The penalty rate is Net CONE in \$/MW-year divided by the number of assumed hours, $H_{penalty}$, $Penalty_i =$

¹ See Answer and Motion for Leave to Answer of the Independent Market Monitor for PJM, PJM Interconnection, LLC Docket No. ER15-623-000, PJM Interconnection, LLC V. PJM Interconnection, LLC, Docket No. EL15-29-000, Appendix A: Competitive offer for a Capacity Performance Resource in PJM, February 25, 2015. Available at http://www.monitoringanalytics.com/Filings/2015/IMM_Answer_and_Motion_for_Leave_to_Answer_Docket_No_s_ER15-623-000_EL15-29-000_20150225.pdf. See also, ISO New England Inc. and New England Power Pool, Filings of Performance Incentives Market Rule Changes, Docket No. ER14-1050-000 (January 17, 2014), Attachment I-1e (Joint Testimony of David LaPlante and Seyed Parviz Gheblealivand) at 57–58. (as cited).



$(Net\ CONE/H_{penalty})$ the expected number of performance hours during the year. The penalty rate is the same for all performance assessment hours.

$H_{expected}$ – is the number of expected performance assessment hours in the obligation period. PJM historical data

$Bonus_i$ – capacity performance bonus rate for hour i in (\$/MWh), varies with the hour

$A_i = (MWh_i/UCAP)$ - availability or MWh output during performance assessment hour i .

$\bar{A} = \frac{\sum_{i=1}^{H_{expected}} (MWh_i/UCAP)}{H_{expected}}$ average availability across all expected performance assessment hours.

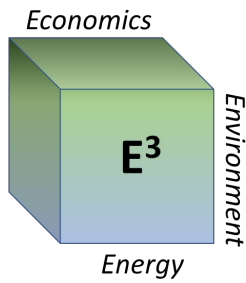
B_i – balancing ratio during performance assessment hour i , ratio of total load and reserve requirement during the hour to total committed UCAP.

$\bar{B} = \frac{\sum_{i=1}^{H_{expected}} (B_i)}{H_{expected}}$ – average balancing ratio across all performance assessment hours in a delivery year.

$Net\ ACR$ – net avoidable costs incurred by a resource to remain available and in commercial operation. The net going forward costs are equal to the total fixed going forward costs which includes fixed O&M and future capital investments needed to remain in commercial operation less expected net energy and ancillary service revenues.

R_{energy} – net revenue for a resource that is energy only and that does not have a capacity commitment that sells energy and ancillary services only.

To be indifferent between taking on a capacity obligation and being an energy only resource, the net revenues from taking on the capacity obligation should be equal to those of being an energy only resource. To unambiguously take on a capacity obligation, the net revenues from doing so must be greater than being an energy only resource. The following condition accounts for both cases:



$$R_{cap} \geq R_{energy}$$

Since Net ACR appears in both equations and is multiplied by the UCAP value, these offset one another. So, to take on a capacity obligation means that the capacity payment, less any expected net penalties must be greater than the stream of bonus payments (assuming energy only resource can also receive such bonus payments):

$$UCAP \times [P + (Penalty_i \times H_{expected} \times (\bar{A} - \bar{B}))] \geq UCAP \times \sum_{i=1}^{H_{expected}} (Bonus_i \times A_i).$$

UCAP appears in both equations as a multiplier so it can be eliminated. Then rearranging to solve for the capacity offer price results in the following:

$$P \geq \sum_{i=1}^{H_{expected}} (Bonus_i \times A_i) - (Penalty_i \times H_{expected} \times (\bar{A} - \bar{B})).$$

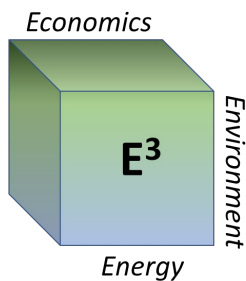
Then substituting the penalty rate $Penalty_i = (Net\ CONE/H_{penalty})$ into the above equation for the optimal offer results in the following:

$$P \geq \sum_{i=1}^{H_{expected}} (Bonus_i \times A_i) - (Net\ CONE/H_{penalty}) \times H_{expected} \times (\bar{A} - \bar{B}).$$

II. **Deriving the Net CONE * B Optimal Offer**

The optimal offer of Net CONE x B that has prevailed prior the recent FERC Order preceding the upcoming 2023/2024 BRA relies on two assumptions given there was no experience with the realization of performance assessment hours, nor the level of bonus payments that would prevail under CP: (1) For each performance assessment hour the penalty rate is equal to the bonus rate, $Penalty_i = Bonus_i$; and (2) the number of hours used to set the penalty is exactly equal to the number of expected performance hours, $H_{penalty} = H_{expected}$. Under these two assumptions the optimal offer reduces to:

$$P \geq Net\ CONE \times \bar{B}$$



III. ***Deriving a Modified Optimal Offer where Penalty Hours and Expected Hours Differ***

The FERC Order on the MSOC identified the mismatch of expected performance assessment hours and the number of hours, yet the Commission did nothing to work within the existing CP framework to correct this discrepancy. Given historic data since 2011 through 2021, the average number of performance assessment hours has been just over 7 hours. The current penalty rate remains based upon 30 hours.

If the Commission had adjusted the penalty hours to the historic expectation, which would have adjusted the penalty rate upward considerably, the Net CONE x B offer cap could have remained in place without any further adjustment.

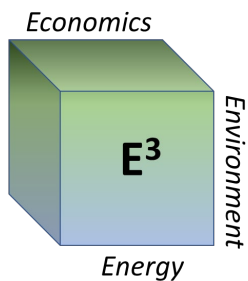
However, the new MSOC could have also been adjusted for the difference in expected performance hours (7) and hours used to calculate the penalty rate (30).

This can be easily derived if the assumption about the penalty hours and expected hours differ and could have been easily derived. More generally, if $H_{penalty}$ representing the assumed hours to determine the penalty factor and $H_{expected}$ represents the expected assessment hours with $H_{expected} \leq H_{penalty}$, then the optimal offer is:

$$P \geq Net\ CONE \times \frac{H_{expected}}{H_{penalty}} \times \bar{B}$$

With an RTO Net CONE of \$274.95/MW-day, and the known historic hours at 7 since 2011, and 30 used for the penalty, and a balancing ratio of 0.85, the new optimal offer would be \$54.33/MW-day in RTO.

$$\$54.33 \geq 274.95 \times \frac{7}{30} \times \overline{0.85}$$



This MSOC offers generators the ability to craft their offers based on their assessment of risk and uncertainty while also being low enough to have any offer over this value to be evaluated by the IMM and PJM for market power. It also allows those resources with zero or below zero Net ACR offers (before accounting for risk) to reflect these risks in their offers. Coincidentally, this also with 10 percent of the clearing price in the previous BRA in which Net CONE x B was still in place, which should provide assurances to loads concerned about market power that this would be an avenue to exercise market power. Finally, this will reduce the administrative burden on the IMM and PJM to evaluate so many offers when most of those offers have no ability to exercise market power.

The proposed mechanism also has a key updating feature in that the average number of hours declines with each year there are no performance hours. On the other hand, if we get a year with many performance hours, such as 2014 would have been if CP had been in place, the default MSOC will increase based on the expectation of more hours on average over time.