Capacity Performance Quantifiable Risk (CPQR)

RASTF

January 31, 2023

Context

- This presentation is a follow-up to some of the discussion and comments raised at the January MRC regarding the Market Seller Offer Cap (MSOC) and evaluation of Capacity Performance (CP) risk for the 2025/2026 BRA following Winter Storm Elliot
- Focuses on the MSOC and development of CPQR under current rules
  - Not a review of the issues or potential reforms around the MSOC that have been discussed at prior RASTF meetings

MSOC = Net Avoidable Cost Rate (ACR) = ACR – Net E&AS Revenues

- ACR is defined as the incremental costs avoided by not operating the unit for the year and not taking on a capacity commitment, **including CPQR**
- Net ACR = ACR minus expected profits from energy & ancillary services markets (Net E&AS Revenues)

OATT Attachment DD, Section 6.8

CPQR (Capacity Performance Quantifiable Risk) consists of the quantifiable and reasonably-supported costs of mitigating the risks of non-performance associated with submission of a Capacity Performance Resource offer (or of a Base Capacity Resource offer for the 2018/19 or 2019/20 Delivery Years), such as insurance expenses associated with resource non-performance risks. CPQR shall be considered reasonably supported if it is based on actuarial practices generally used by the industry to model or value risk and if it is based on actuarial practices used by the Capacity Market Seller to model or value risk in other aspects of the Capacity Market Seller's business. Such reasonable support shall also include an officer certification that the modeling and valuation of the CPQR was developed in accord with such practices. Provision of such reasonable support shall be sufficient to establish the CPQR. A Capacity Market Seller may use other methods or forms of support for its proposed CPQR that shows the CPQR is limited to risks the seller faces from committing a Capacity Resource hereunder, that quantifies the costs of mitigating such risks, and that includes supporting documentation (which may include an officer certification) for the identification of such risks and quantification of such costs. Such showing shall establish the proposed CPQR upon acceptance by the Office of the Interconnection.

Review of CPQR

- CPQR is intended to be a reflection of the market seller's assessment of the cost of mitigating the risk associated with taking on a Capacity Performance commitment, as long as the seller is able to reasonably support it
- The Commission has recognized that the assessment of such risk *"…depends on the company-specific nature of valuing performance risk*" and in reviewing unit-specific MSOC submissions of market sellers, *"…the Market Monitor and PJM may not substitute their assessment of costs or risks permitted in the ACR formula for the seller's unless PJM and the Market Monitor determine the seller has failed to support and justify them*" (Docket No. ER21-2444)
- As we discuss inputs and potential approaches to CPQR, nothing herein precludes market sellers from using alternative methods that are reasonably supported

Performance Assessments during Winter Storm Elliot

277 Performance Assessment Intervals (PAIs) across Dec. 23 and Dec. 24 for the RTO (about 23 hours)

Start	End	# Intervals
Dec. 23, 2022 17:30	Dec. 23, 2022 23:00	**66**
Dec. 24, 2022 04:25	Dec. 24, 2022 22:00	**211**

- Significant portion of the fleet failed to perform during the PAIs
- Initial **rough** estimate of non-performance charges across Dec. 23 and Dec. 24 provided at January MIC in the $1 billion to $2 billion range
  - item-0x---winter-storm-elliott-overview.ashx (pjm.com)

CPQR Factors

- There are a number of factors that may impact a market seller's assessment of CPQR, including:
  - Number of PAIs
  - Unit performance during the PAIs
  - Balancing Ratio (*impacts Expected Performance during PAIs*)
  - Non-performance charge rate (*known value*)
  - Excusals from non-performance
  - Bonus payment rate
  - Stop-loss (*known value*)

CPQR Factors: Number of PAIs

Historical **hours with Emergency Actions** that triggered (or would have) a PAI for the RTO and/or MAAC region:

	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23
RTO	7	5	30	-	-	-	-	-	-	-	-	23+
RTO + MAAC	11	9	48	-	-	-	-	-	-	-	-	23+

Note: Additional hours experienced in individual zones or sets of zones in prior years, including 2 hours during the October 2019 event in the AEP, DOM, BGE, and PEPCO zones

Reliance on historical data in the risk assessment provides one approach that we view as reasonable (although not exclusive)

Unit performance reflects the expected Actual Performance of the unit during PAIs

Potential options for estimating unit performance during PAIs include:

- For thermals, historical outage data
  - May consider the unit's outage data experienced during historical events
  - May consider weather-correlated outage data and be estimated based on weather seen during historical PAIs
- For intermittent resources:
  - May consider the unit's performance during historical PAIs (actual or back-casted)
  - May be based on the expected output during PAIs given estimated timing of PAIs and expected output profile across the year

CPQR Factors: Balancing Ratio

Balancing ratios are used to set a unit's Expected Performance during the PAIs

- Assessment of non-performance charges occur when the unit's performance is below the Expected Performance during PAIs

- Preliminary and final balancing ratios of PAIs stored in Data Miner 2:
  - Data Miner 2 - Performance Assessment Interval Preliminary balancing ratio (pjm.com)
  - Data Miner 2 - Performance Assessment Interval Final balancing ratio (pjm.com)

- Preliminary data for PAIs during Winter Storm Elliot:

Date/Time	Area(s)	Average BR	Min BR	Max BR
Dec. 23 17:00–23:00	RTO	85.48%	83.00%	86.58%
Dec. 24 04:25–22:00	RTO	80.62%	78.39%	82.73%

- Estimated balancing ratios for events prior to implementing CP were included in PJM filings during the CP proceeding: ~85% on average for RTO events

CPQR Factors: Non-Performance Charge Rates

The Non-Performance Charge Rate is a **known factor** based on yearly Net CONE, a divisor (i.e., an assumed 30 Emergency Action hours per year) and the number of Real-Time Settlement Intervals in an hour (12)

Charge Rate =
(Net CONE * # days in the Delivery Year) / (30 * 12)

- On a $/MWh shortfall basis, 22/23 DY RTO penalty rate equal to about $3,000/MWh
- A unit subject to the RTO charge rate that fully underperformed during the ~23 hours of recent PAIs would expect a charge of about $56,000 per committed UCAP MW

22/23 DY Non-Performance Charge Rates

Locational Deliverability Area	Net CONE ($/MW-Day, ICAP Price)	Non-Performance Charge Rate ($/MW-interval)
ATSI	218.79	221.83
ATSI-CLEVELAND	218.79	221.83
BGE	214.87	217.85
COMED	235.27	238.54
DAY	214.82	217.80
DEOK	212.27	215.22
DPL-SOUTH	224.18	227.29
EMAAC	246.18	249.60
MAAC	232.67	235.90
PEPCO	246.34	249.76
PPL	237.69	240.99
PS-NORTH	254.8	258.34
PSEG	254.8	258.34
RTO	247.26	250.69
SWMAAC	230.61	233.81

CPQR Factors: Excusals and Bonus Payment Rates

A seller may consider excusals from non-performance in their assessment of CP risk as it can impact assessed penalty charges

- Tied to unit performance expectations during PAIs (e.g. if only considering forced outages in estimating unit performance, would not expect any of the resulting outage MW to be excused)

Bonus Payment Rates ($/MW-interval during PAIs) are based on the pool of charges collected and total Bonus MW during PAIs

- May differ from the non-performance charge rate

- Limited historical data to rely on for excusals and bonus payment rates
  - Bonus rates in Oct. 2019 PAIs a fraction of non-performance charge rates
  - Generally, bonus rates expected to be close to non-performance charge rates when there are minimal excused MW during the PAI

CPQR Factors: Annual Stop-loss

The annual stop-loss is a **known factor** that caps the exposure to CP risk of non-performance charges each Delivery Year

- **The maximum yearly Non-Performance Charge =**

  1.5 * LDA Net CONE * days in the Delivery Year * max daily CP UCAP MW commitment from June of the Delivery Year through the end of the billing month for which the Non-Performance Charge was assessed

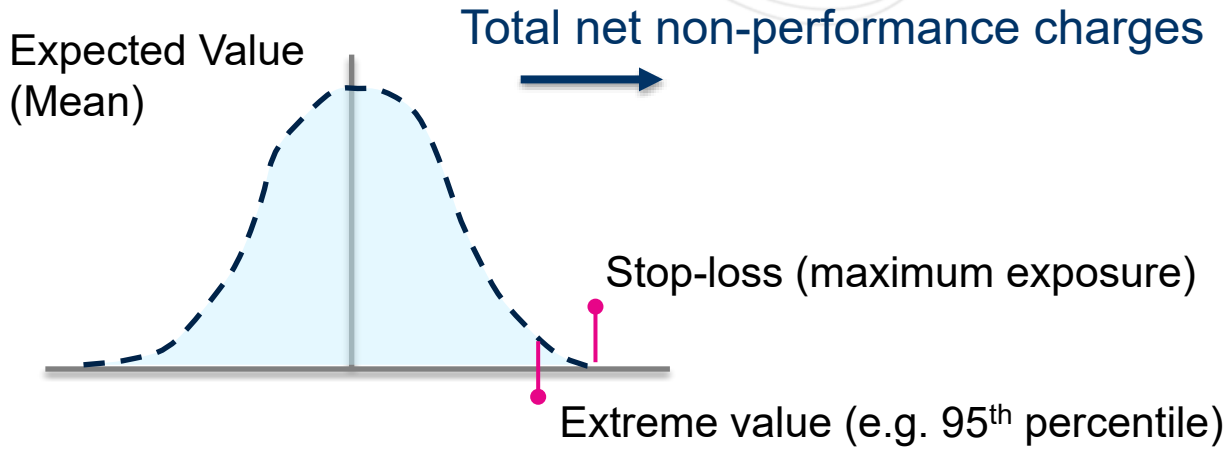
  Stop-loss for Seasonal Capacity Performance Resource considers the number of days in the applicable season.

Potential Approaches to Modeling CPQR

- Deterministic analysis based on expected values that factor into CPQR
  - E.g. Unit X has the following expected values:
    - Average expected unit performance during PAIs = 0.5 (relative to UCAP)
    - Average expected balancing ratio = 0.85 (relative to UCAP)
    - Non-Performance charge rate = $3,000/MWh
    - Expected number of hours of Emergency Actions triggering PAIs: 8 hours
    - Expected non-performance charges = (0.85 - 0.5) * $3,000 * 8 = $8,400 / MW-year
- Probabilistic analysis / simulations that factor in the uncertainty of inputs and outcomes to produce a distribution of potential non-performance charges
  - Market seller analysis / models that provide support for the analysis and inputs
  - IMM modeling framework: simulated approach that relies on weather experienced during historical PAIs and condition probabilities (based on weather) for estimating number of PAIs and outages of units (item-03---cpqr-methodology-and-examples---imm.ashx (pjm.com))

Potential Approaches to Modeling CPQR (cont'd)

- Distribution of potential net non-performance charges capturing risk beyond expected value



PJM views it as reasonable for a market seller to reflect in CPQR the cost of mitigating downside risk beyond the Mean

- One option of valuing the risk (*consistent with IMM methodology*)
  - CPQR = Expected Value (Mean) + Risk Cost * (Extreme Value – Mean)
  - E.g.

Mean ($/MW-day)	**Extreme Value** (%ile)	**Extreme Value** ($/MW-day)	**Risk Cost** (e.g. company cost of capital)	**CPQR** ($/MW-day)
$15	95th	$150	10%	$28.50

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