Brattle

MEMORANDUM

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| TO | PJM Market Implementation Committee |
| FROM | Samuel A. Newell, Kathleen Spees, J. Michael Hagerty, Andrew W. Thompson, Travis Carless |
| SUBJECT | Responses to Stakeholder Feedback on Quadrennial Review Reports |
| DATE | May 17, 2022 |

This memorandum responds to questions and feedback received on our two studies we have recently published in the context of the Fifth Quadrennial Demand Curve Review, the "Net CONE Study" and "VRR Curve Study" reports.[1]

## STAKEHOLDER COMMENTER 1

1. **Question/Comment: We appreciated the approach used in the current quad review. We support a similar approach to examining multiple resources for future reviews the examination of different technologies.**

   Response: We note the approach for assessing multiple resources for future reviews was well-received.

2. **Question/Comment: Good to see the FT costs included in O&M but the values seem low for zones where FT availability is lacking. We appreciate the review of the posted rates that are available but an assessment of the availability at these rates is missing. It is likely to be much more costly if a new pipe is needed or the pipe in question is largely subscribed. Amounts can easily be double or triple the values included in Table 9 of the CONE study from Brattle.**

[1] Spees *et. al., Fifth Review of PJM's Variable Resource Requirement Curve*, April 19th, 2022 ("VRR Curve Study") and Newell *et. al., PJM CONE 2026/2027 Report*, April 21st, 2022 ("Net CONE Study").

Response: It is possible firm gas would cost more in some circumstances (although it would be difficult to identify and quantify generically by zone). Other factors could work in the other direction, however, to mitigate possible higher gas costs. In particular, the generator can realize the value of firm transportation during constrained periods when the local spot price of gas can significantly exceed the cost of commodity plus transportation under the tariff rate. The generator can realize such value by generating and earning high energy margins when economic; or when uneconomic and not in electricity shortage conditions, by releasing pipeline capacity or remarketing the gas locally. Other possible ways to avoid high costs of incremental firm capacity include the permitting oil backup in some circumstances, or simply bearing exposure to capacity performance penalties.

In light of such countervailing possibilities, the assumed tariff rates provide a reasonable balance. This is one of many such reasonable judgments necessary for estimating CONE.

3. **Question/Comment: Figure 8 in the CONE study shares evidence that demonstrates the ATWACC should be less than 8%. However, 8% is recommended. We believe the ATWACC should be closer to 7%. We recognize that debt cost is going up but ROE is falling rapidly and 8% ATWACC is too high.**

   Response: To estimate the ATWACC for a merchant developer in PJM, we relied on the best available market data as of the date of the analysis (end of March 2022), following a similar approach as we have used in past CONE studies. In that approach, we assemble a comprehensive set of reference points that inform the appropriate discount rate for analyzing the cash flows for a merchant generation facility and then assess the relative risk of a merchant generation facility versus the reference points. Based on the reference we identified, we believe 8.0% is a reasonable estimate. At this time, we are in a period of significant market volatility that may require re-visiting the ATWACC closer to the filing date.

## STAKEHOLDER COMMENTER 2

### VRR CURVE REPORT

4. **Question/Comment: Winter Reliability Risk. On page 3 of the Curve Report, Brattle indicates that "its assessment of procurement levels in the winter season remains**

**inconclusive as to whether the winter season has excess or deficient capacity supply." See similar text on page 6. Could Brattle please explain what its assessment involved?**

Response: Our assessment was focused on procurement levels in the RPM as compared to the final reliability assessment and load forecast. This analysis, though notionally an annual analysis, was primarily a summer-focused analysis given that the RPM does not articulate a clear winter reliability requirement nor fully assess winter supply commitments. A more complete analysis of winter procurement levels would be needed to conduct an analysis of underlying winter reliability drivers, an appropriate winter reliability requirement, and whether winter UCAP ratings are accurate.

5. **Question/Comment: Additional Supply after BRA to Delivery Year. On page 12, Brattle suggests that if the BRA were to clear short at a high price, it cannot predict how PJM or market participants might respond, even though a sharp price signal would likely delay retirements, speed up new capacity, bring on incremental DR, etc. Does Brattle not believe that if RPM cleared at an unexpectedly high price market participants would react by increasing the supply of capacity resources? We also request further chronological analysis of how additional supply might be available in time for the delivery year where direct observations of market participant reactions in shortage conditions are not possible.**

   Response: We agree that it is plausible that the scenario envisioned here (high prices in the BRA, followed by continued short conditions) could attract additional supply into the IAs. However, we are not able to predict what quantity of additional supply might be attracted, given the lack of historical experience with a scenario when additional supply was needed in the IAs. As summarized in Table 3, historical experience shows that the volume of supply available has always contracted between the BRAs and subsequent IAs (but this has always coincided with a scenario when incremental supply was not needed).

   In our modeling analysis (as summarized in Appendix D) we assume that the IAs can attract up to 1,000 MW of incremental supply compared to the BRA if the BRA clears at a shortfall, though we acknowledge the lack of historical evidence to confirm this assumption. If the BRA clears with excess, we assume that 53% of the excess will be re-offered and available in the subsequent IAs, an assumption that is derived from historical experience.

6. **Question/Comment: Overprocurement. The VRR report p. viii claims, "…the above-recommended reforms will largely address the potential for over-procurement." Please**

**explain which reforms you believe will address over-procurement and why, and provide analysis of the degree to which the reforms Brattle has proposed to be implemented as part of this Quadrennial Review will do so.**

Response: Section II.B of the VRR Curve Study outlines the reforms to address over-procurement and Figure 3 provides an indicator of the impact of each reform option on reducing over-procurement (though the magnitude of the impact will vary each year along with the system supply-demand balance and changes to system parameters).

7. **Question/Comment: Point A at 99% of Reliability Requirement. Brattle's basis for setting the price cap quantity at or above IRM-1% does not seem to reflect the reality of RPM price trends, which have a long and consistent history of correcting themselves after a significant spike or drop. Brattle's basis for setting the price cap quantity at 99% of IRM is that this is the threshold below which PJM would consider corrective actions, such as a backstop reliability auction. However, such an auction is held only if the auction clears below this reliability backstop threshold three years consecutively, which is extremely unlikely based on price history. Does Brattle have any basis for asserting that Point A should be 99% of the Reliability Requirement besides this extremely low risk of backstop procurement being needed?**

   Response: The 99% level as the quantity point for the price cap is informed by a number of factors including the backstop threshold for intervention; the slope of the MRI curve indicating the increase in reliability metrics as quantities decline; and model-based simulation results indicating the trade-off among performance metrics (frequency at the cap, frequency of shortfalls, price volatility, average reliability). The current 99% quantity point for the price cap was adopted after the Third Triennial Review, which also contains a more complete discussion of implications of alternative quantity points for the price cap.[2]

8. **Question/Comment: Net CONE Uncertainty. Brattle refers extensively to Net CONE uncertainty as an influential factor in determining the shape of the curve; however, the model for Net CONE is one of long-term equilibrium in spite of significant changes in input costs and environmental regulations. Because the factors that might contribute to "Net CONE uncertainty," tend to result in very small changes in cleared quantities, RPM supply curves change very slowly over time. The Quadrennial Review sets the VRR curve based on simulation of supply curves against it. Brattle should offer meaningful, real-world**

[2] See in particular Pfeifenberger et. al., *Third Triennial Review of PJM's Variable Resource Requirement Curve*, May 15, 2014, Sections V.A.3 and V.C.1.

**examples or interpretations for the concept of Net CONE uncertainty and how they inform the use of sensitivities such as the +/- 40% Net CONE error. Moreover, Brattle should explain how the indicative uncertainty analysis results presented in the CONE report informs its selection of the Net CONE error sensitivities, if at all.**

Response: As explained in the Net CONE Study, Section III.I.4: "*Most of the uncertainty surrounds volatile inflation, relevant technologies and plant designs, and the analyst's judgment on economic life and long-term cost recovery. For example, a less constrained plant design with dual fuel and cooling towers could cost as much as $87/MW-day less; or a shorter 15-year economic life could add $52/MW-day, or more if technologies are more constrained by environmental regulations. These examples indicate an uncertainty range on Net CONE of -29% to +16%; the full uncertainty range may be greater when considering uncertainties beyond those we analyzed. In that context, the VRR curve must be steeper to perform well even if Net CONE is mis-estimated, and we recommend testing robustness under stress tests of +/-40%, as discussed in our parallel VRR Curve report.*"

9. **Question/Comment: LDA where combined cycle resources cannot be built. The Curve report suggests that if there's an LDA where gas resources can't be built, PJM should develop a BESS Net CONE, which according to Brattle's calculations would be much higher cost. Brattle should provide an assessment of the implications of the resulting shift in the demand curve, as well as alternative approaches to anchoring the demand curve, or its shape, in such circumstances.**
    i. **Does it make sense to potentially shift the VRR curve much higher in such zones? Explain?**
    ii. **Do you think that shift will push entities in such zones to FRR?**
    iii. **If demand curve shifts higher, should it perhaps also be made much steeper, to keep procurement reasonable at moderate prices?**
    iv. **Other ideas on what to do in such zones?**

    Response: From our review of state mandates, policies, current law, and evidence provided by stakeholders, we have not yet identified any LDA that would preclude a gas CC from being built within the relevant study timeframe. However, given stated environmental goals, Section V of the Net CONE Study did provide an indicative estimate for a widely scalable and carbon-free resource, a BESS Net CONE, in a potential future where a gas plant could not be built. This was intended to give "*stakeholders a starting point for future reviews or before then if the recommended reference resource, the gas-fired CC, is*

*determined to be infeasible to be built within the Quadrennial Review period.*"[3] We clarify that this analysis does not constitute a complete Net CONE assessment of a clean energy resource and the impact of using a clean reference technology on LDA VRR Curves is out of scope of the current review.

Responding to the other sub-questions:

i. The Net CONE in all LDAs should reflect the long-run marginal cost of supply, or the capacity price needed to maintain resource adequacy. It is possible that price could be higher in locations where fossil resources cannot be built, but this is not a forgone conclusion.

ii. We do not have a view on whether the selection of a clean reference resource would affect decisions to utilize the FRR Alternative.

iii. No. The localized VRR curves are already quite steep.

iv. As discussed in Section III.F of the VRR Curve Study, we recommend to consider developing MRI-based locational curves and clearing, beginning with the approach utilized in New England as a starting point.

## NET CONE REPORT

**10. Question/Comment: CT construction history: Brattle states that "CTs continue not to be built" (CONE Report at 18), and in Table 2 states that gas CTs are not clearly economic sources of capacity because "few recently built." These somewhat inconsistent and incomplete descriptions leave an unclear picture on an important point. Can Brattle provide more detail as to when CTs have been built since 2011, and whether they were built at brownfield or greenfield sites? Table 22 likewise provides information on CTs constructed in PJM since 2011, but does not specify construction dates.**

Response: Since 2011, about 1,000 MW of CTs have been built in PJM. The majority of the capacity is included in a few projects: Kearny Generating Station (386 MW in 2012), Doswell (330 MW in 2018), and Perryman CT6 (120 MW in 20-15).

[3] Net CONE Study, Section V, pg. 69.

11. **Question/Comment: Fuel Supply for Reference CC: Brattle states that contracts for firm transportation of gas cost more than dual-fuel capability in most locations, citing a 2015 report covering a wider geographic area. Is more recent, or PJM-specific data available?**

    Response: We have not reviewed more recent or PJM-specific studies that come to the same conclusion. Our internal analysis of costs of alternative plant configurations demonstrates that CONE increases with a shift from dual fuel capability to gas-only with a firm gas transportation contract.

12. **Question/Comment: Brattle states that confidential data provided by PJM indicates that "nearly all new gas-fired plants that entered the market since the 2016/2017 BRA obtain firm transportation service to ensure adequate fuel supply." (CONE Report at 25). Brattle should explain whether this trend applies in all PJM LDAs or whether there are some LDAs where firm transportation service is not typically obtained, as this may affect the specifications of the reference resource in those zones.**

    Response: Based on the BRA results we reviewed, this trend towards firm gas applies to all PJM LDAs in which the development of new gas CCs occurred.

13. **Question/Comment: Brattle should state how it estimated the cost of firm transportation service – was this also confidentially obtained from PJM? Page 37 of the CONE report states that additional information is available in Appendix A, but Appendix A does not address firm transportation service costs, only gas interconnection costs.**

    Response: Table 11 in the Net CONE Study summarizes the pipelines we assumed for each CONE area and the representative firm gas capacity costs. The Net CONE Study pg. 37 also states our approach: "To estimate the costs of acquiring firm transportation service for SWMAAC we escalated the Cost of Firm Gas Capacity per Month of $4.96 (2022$ per Dth/d) from the 2018 PJM CONE study by 2.9% annually to 2026. For the EMAAC, Rest of RTO, and WMAAC CONE Areas, we combined the reservation and usage rates, resulting in a tariff rate for each pipeline. Then the pipeline tariff rates are averaged and escalated by 2.9% annually to 2026 by CONE area to calculate the representative firm gas capacity." Footnote 10 also states: "PJM provided the fuel supply arrangements for 20,848 MW of new gas plants that first cleared the capacity market in the 2016/2017 BRA to the 2020/2021 BRA, including firm transportation, dual fuel capability, and installing gas laterals to multiple pipelines."

14. **Question/Comment: Relevance of 2022/23 Auction prices: Brattle states on page 56 of the CONE Report that the 2022/23 prices should be disregarded as an indicator of willingness to enter because of the compressed forward period. Despite the compressed forward period, new resources entering in the 2022/23 auction would still have been required to offer at Net CONE, which represents the price at which a resource is willing to enter. Can Brattle please explain its view of 2022/23 prices as irrelevant to the true cost of new entry, or empirical Net CONE?**

    Response: With the compressed forward period, new plants would already have made the decision whether to build (perhaps anticipating higher prices) such that most of their capital costs were already sunk and their net going-forward cost of new entry would have been very low.

15. **Question/Comment: CC 2x1 v. 1x1. Brattle's report notes that 1x1 CC configurations are more common than 2x1, but doesn't discuss preliminary findings that Brattle had presented to stakeholders that 2x1s have lower Net CONE than 1x1s. *See* Fifth Review of the Net CONE Draft Results, Market Implementation Committee Special Session, March 25, 2022, p. 6. As several of our organizations raised previously, if the 2x1 appears more economical but the market is building 1x1, this strongly suggests that the analysis is failing to quantify all of the benefits of the more flexible 1x1 configuration. Brattle should provide some additional context for its recommendation that the reference resource be a 1x1 CC, including an assessment of whether and how current methods for determining the E&AS offset may not reflect the full revenue picture that developers apparently see for this configuration.**

    Response: After further analysis considering economies of scale when building plants in the common configuration with two 1x1 units, we estimated a capital cost premium of only about 3%, increasing gross CONE by $13/MW-day over a comparably-sized 2x1 plant (based on our 2018 analysis of the 2x1 CC escalated to 2026). Then PJM's analysis of E&AS revenues indicated greater offsets for the slightly more efficient and flexible 1x1 plants than the 2x1s, such that the overall Net CONE of the 1x1 is similar to the 2x1. (Although we do not have a perfect comparison with the same cooling systems).

## STAKEHOLDER COMMENTER 3

16. **Question/Comment: The firm transport costs included in FOM for the reference 1x1 CC do not appear to include costs associated with the need to build out additional pipeline capability to support firming the CC's withdraws. Given that pipelines in PJM are heavily subscribed – more so than they were over the last 5-6 years of history – it is likely that any CC connecting to a pipeline in the region would drive the need for pipeline capacity additions and, in turn, additional costs above what has been experienced historically. Did Brattle do any outreach to gas pipeline companies to understand their ability to accommodate CC additions with existing pipeline capability, whether capacity additions would be necessary to accommodate new CCs, and, if capacity additions are required to accommodate a CC addition, what associated costs would be passed along to the interconnecting generator?**

    Response: We did discuss with a gas marketer who agreed that the tariff rates provided a good estimate of the firm transport costs a new CC would face.