Offer Cap Fuel Variance Analysis

The analysis presented within this document provides additional detail related to PJM's compliance with FERC Order No. 831, which requires, among other things, that each RTO/ISO implement a verification process for cost-based incremental offers above $1,000/MWh that ensures a resource's cost-based incremental energy offer reasonably reflects that resource's actual or expected cost.

In accordance with the guidelines of FERC Order 831, PJM developed an offer verification methodology that was presented at the Market Implementation Committee (MIC) on May 3, 2017 for member review, and included in PJM's May 8, 2017 Order No. 831 Compliance Filing. The methodology presented focused on the input, computation and output of information. While robust member discussion took place on each of the topics presented, a key interest area for members was the creation of a fuel variance adder that is a component of the formulaic computation of the maximum allowable incremental cost ($/MWh). The maximum allowable incremental cost ($/MWh) is a combination of a calculated maximum allowable operating rate (cost of operations calculated from fuel input) and a participant's bid production cost (cost of operation of inputted data).

Fuel Variance

To account for uncertainty, PJM will increase the fuel price within the maximum allowable incremental cost computation by a variance adder of 10%. This adder is intended to cover fuel cost variance, transportation cost, and other costs not explicitly modeled, and is necessary because the pricing data PJM receives from the third-party vendor may not be wholly representative of the Market Seller's actual fuel costs. This is particularly true during times of extreme market illiquidity, such as those experienced during the 2014 Polar Vortex, which is precisely when a cost-based incremental offer is likely to exceed $1,000 MWh. During these times, fuel costs can rise dramatically as a result of, among other things, natural gas-fired resources' inability to obtain capacity on natural gas pipelines due to transportation constraints. Therefore, the fuel variance adder is necessary to account for potential volatility in fuel cost.

In order to determine the amount of the fuel variance adder, an initial analysis was conducted using historical natural gas price information of natural gas trading hubs within the PJM footprint. This initial analysis was presented to stakeholders at the May 3, 2017 MIC meeting, and supported PJM's proposed 10% fuel variance adder as suggested in PJM's May 8, 2017 Compliance Filing.

After stakeholder discussions and requests from stakeholders made at the May 3, 2017 MIC meeting, PJM conducted additional analysis that was completed on May 11, 2017. The results of both analyses are reviewed below.

Initial Analysis

Assumptions & Calculation

- **Analysis Season**: Winter season (November through February)
- **Data Points**: Used all days from November through February
- **Hubs**: Selected five representative natural gas trading hubs:
    - Dominion South
    - TCO
    - TETCO M3
    - Transco Z6 (Non-NY)
    - Transco Z6 (NY)
- **Computation One**: The objective of computation one is to calculate, at each hub for each day, the percent change of the high price of the day minus the settlement index price.
    - For each hub @ each day:
        - [(High Price of Day – Settlement Price) / Settlement Price]
- **Computation Two**: The objective of computation two is to calculate the mean, standard deviation based off of computation one output data.
    - Calculate Mean, Standard Deviation for all days @ each hub.
- **Computation Three**: The objective of computation three is to calculate distribution percentage at 68%, 95%, and 99%.
    - @ 68%: Mean + 1*STDEV, @ 95%: Mean + 2*STDEV, @ 99%: Mean + 3*STDEV

Results

Statistic	Distribution Percentage	2014 2015	2015 2016	2016 2017	3-Year
Mean + 1 σ	68%	11.6%	11.8%	5.2%	10.1%
Mean + 2 σ	95%	18.1%	17.2%	7.4%	15.2%
Mean + 3 σ	99%	24.5%	22.6%	9.5%	20.4%

The results indicate that, over the last 3 winter seasons, a 10.1% variance adder to the weighted average price of natural gas would be sufficient to cover 68% of the total days used as part of the calculation.

Over the last 3 winter seasons, 95% of the days have less than a 15% variance, and 99% of the days have less than a 20% variance.

Additional Analysis

Objective

- Based off of stakeholder feedback, additional analysis was conducted to account for the 30 highest load days.

Assumptions & Calculation

- **Analysis Season**: Winter season (November through February)
- **Data Points**: Only selected the top 30[1] highest electric demand days from November through February
- **Hubs**: Selected five representative natural gas trading hubs:
    - Dominion South
    - TCO
    - TETCO M3
    - Transco Z6 (Non-NY)
    - Transco Z6 (NY)
- **Computation One**: The objective of computation one is to calculate, at each hub for each day, the percent change of the high price of the day minus the settlement index price.
    - For each hub @ each high demand day:
        - [(High Price of Day – Settlement Price) / Settlement Price]
- **Computation Two**: The objective of computation two is to calculate the mean, standard deviation based off of computation one output data.
    - Calculate Mean, Standard Deviation for 30 days @ each hub.
- **Computation Three**: The objective of computation three is to calculate distribution percentage at 68%, 95%, and 99%.
    - @ 68%: Mean + 1*STDEV, @ 95%: Mean + 2*STDEV, @ 99%: Mean + 3*STDEV. The 3-year computation is over the data points (90) of the three winter seasons.

[1] 30 data points is the generally accepted minimum for statistical significance

Results

Statistic	Distribution Percentage	2014 2015	2015 2016	2016 2017	3-Year
Mean + 1 σ	68%	19.8%	14.6%	7.5%	14.8%
Mean + 2 σ	95%	30.2%	20.6%	10.9%	22.4%
Mean + 3 σ	99%	40.6%	26.6%	14.3%	29.9%

The results indicate that, over the last 3 winter seasons, a 14.8% variance adder to the weighted average price of natural gas would be sufficient to cover 68% of the total days used as part of the calculation. Over the last 3 winter seasons, 95% of the days have less than a 22.4% variance, and 99% of the days have less than a 29.9% variance.

Conclusions

At the May 3, 2017 MIC, representatives of generation resources indicated that they had observed extreme price volatility during the 2014 and 2015 winter seasons, and thus the verification fuel price variance would require a larger spread than the proposed 10%. The subset of data for the 2014-2015 Winter season confirms this, where the price variance between highest trade to mean was +19.8% at one standard deviation. Recent years show less variance, and the three-year fuel variance on these high electric demand days was determined to be +14.8%. In the initial analysis, it was determined that 95% of all normal days have a variance of less than +15.2%. Given that extreme weather days are rare, a fuel price variance generated from only high demand days will greatly over-estimate the fuel variance observed on normal winter days. PJM believes that a 10% variance adder is an appropriate compromise that captures the balance of extreme and non-extreme volatile winter days, and choosing a variance adder that is greater than 10% would be excessive.