Comments on Flexible Ramping Products Straw Proposal
Incorporating FMM and EIM

Department of Market Monitoring
July 7, 2014

The Department of Market Monitoring (DMM) appreciates the opportunity to provide comments on the Flexible Ramping Products Straw Proposal. DMM is supportive of the Flexible Ramping Products as a more effective way of ensuring operational flexibility than the current flexible ramping constraint. There are several issues and clarifications that could be addressed in the next paper.

- **Flexible Ramping Product Demand Curve –** The proposal states that the demand curve can be constructed using historical data on power balance violations. However, this will not provide the correct counter factual of what the incidence of power balance violations would have been in the absence of the FRP. Data generated after the implementation of the Flexible Ramping Constraint will face the same issue. Using data generated before the Flexible Ramping Constraint may not accurately reflect the value of capacity, particularly as conditions continue to change in the future. Alternatively, the distribution of net load forecast errors could be used to construct flexible ramping product demand curves. A potential approach for consideration is outlined in Appendix A below.

- **Penalty Price on Minimum Requirement –** The proposal includes a $250 penalty price if the minimum FRP requirement is not met. In the upward FRP case, the penalty price is triggered if there is insufficient ramping capacity to meet load in t+5. In this situation, the optimization is projecting a power balance violation. This appears as though it is triggering two separate penalty prices for a violation of fundamentally the same constraint ($250 during interval *t* and $1,000 during interval *t*+5). The FRP demand curve described in Appendix A below establishes a more appropriate upper limit on the marginal value of FRP. This upper limit is derived from PBC violation penalty prices and the probability distribution of load forecast errors for the next interval.

- **Separate FRP offer prices/bidding –** DMM does not support separate FRP offer prices that do not represent marginal costs to providing the FRP capacity. Unless such costs are demonstrated, DMM does not support separate offer prices for FRP.

- **Day-Ahead FRP Procurement and Awards –** CAISO commented that it would provide more information on how Day-Ahead flexible ramping needs and procurement would be determined in a forthcoming paper. This will be very helpful in gaining a better understanding of how the FRP will work. It would also be helpful to have more details on how the FRP needs and procurement will work in the 15-minute market, and on the mechanics of how 5-minute ramping needs will be translated into 15-minute and hourly awards.

- **Interaction of FRP with Real-Time IIE Settlements –** CAISO currently has multiple charge codes for settling Real-Time Instructed Imbalance Energy such as Optimal Energy, Residual Imbalance Energy, Standard Ramping Energy, or Ramping Energy Deviation, etc. It may be helpful if the CAISO indicated what, if any, interactions the FRP will have with these charge codes. For example, suppose a generator with an energy bid of $30/MWh is dispatched up 1 MW on a $25/MWh LMP in order provide 1 more MW of upward FRP. If the generator was setting the FRP price it would be $5/MWh. The $25/MWh LMP plus the $5/MWh FRP price would support the generator's dispatch and cover its costs. However, if the energy was determined to be Residual Imbalance Energy, it would be settled on the $30/MWh bid rather than the LMP. The Residual Imbalance Energy settlement would make the generator whole for the $5/MWh difference, and the capacity payment would pay another $5/MWh. Would this capacity payment be the second payment to cover the generator's cost? Is it even possible for such a scenario to occur? A better understanding of potential interactions between the FRP settlement and other Real-Time non-LMP based settlements would be helpful to better understand these issues.

Appendix A

Developing a Demand Curve for Flexible Ramping Product

The Flexible Ramping Product (FRP) is designed to reduce power balance constraint (PBC) violations in RTD by procuring ramping capacity to meet expected and unexpected ramping needs.

The FRP Straw Proposal[1] develops a demand curve based on a historical distribution of PBC violations. This method will not be practical going forward. The distribution of PBC violations may change over time. Therefore, the historic distribution will not be representative of the current distribution. It will also not be possible to update the distribution with any data more current than the date the flexible ramping constraint was introduced into the CAISO markets. This is because it will not be possible to know the PBC violations that would have occurred in a market run with the flexible ramp constraint or products unenforced.

In this appendix, we propose an alternative method for developing the FRP demand curve. The error distribution around the net load forecast for future intervals should be used to create the current interval's demand curve for FRP capacity. This method assumes that the forecasted net load (expected net load) and its associated distribution of errors is a reasonable description of the true distribution of net load.

Figure 1 shows a stylized probability distribution function (PDF) of net load less the forecasted (expected) net load. This is the distribution of forecast errors. Assuming enough ramping capacity to meet the expected net load, the area to the right of the expected error (zero) represents the potential megawatts short if there is no additional ramping capacity (the area in blue).

[1] http://www.caiso.com/Documents/StrawProposal_FlexibleRampingProduct.pdf

Figure 1 – PDF of Net Load less Forecasted Net Load (Expected)

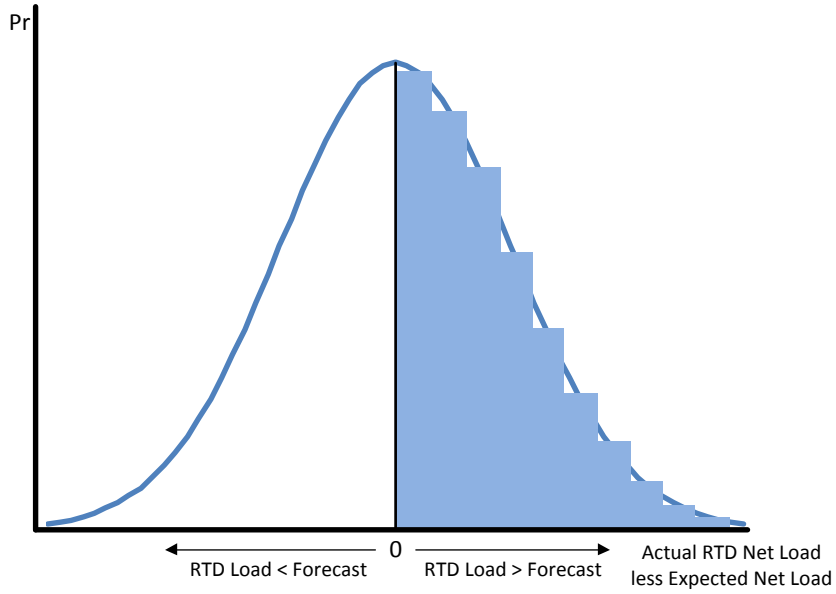


Figure 2 converts this into the PDF for PBC violation costs, assuming a $1,000 penalty price. Net load realizations below the expected net load do not trigger PBC violations.[2] Realizations above the expected net load would trigger PBC violations. Expected costs would equal the sum of the entire blue area. However, if an additional megawatt of ramping capacity were made available, a one megawatt forecast error would no longer trigger a PBC violation. This has the effect of reducing the expected PBC costs by the light blue area. This light blue area is therefore the marginal value of the first MW of ramp capacity. Charting the marginal value of each successive megawatt of ramp capacity yields the demand curve. An example is illustrated in Figure 3.

[2] In the upward direction.

Figure 2 - Expected PBC Costs

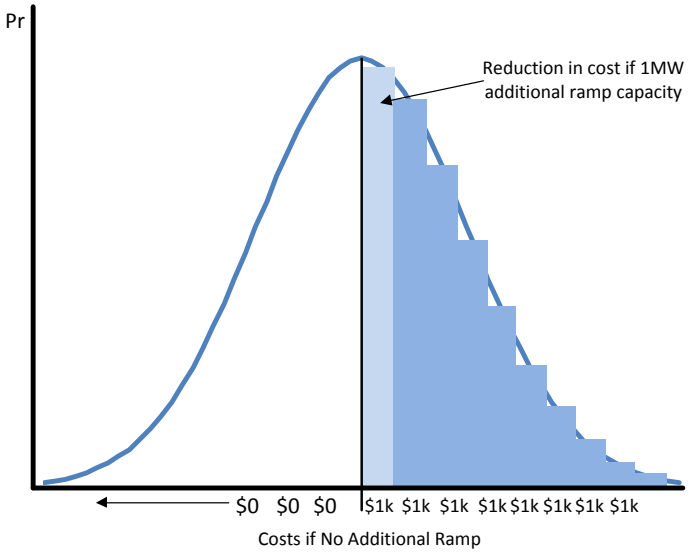


Figure 3 – Marginal Value of FRP Capacity

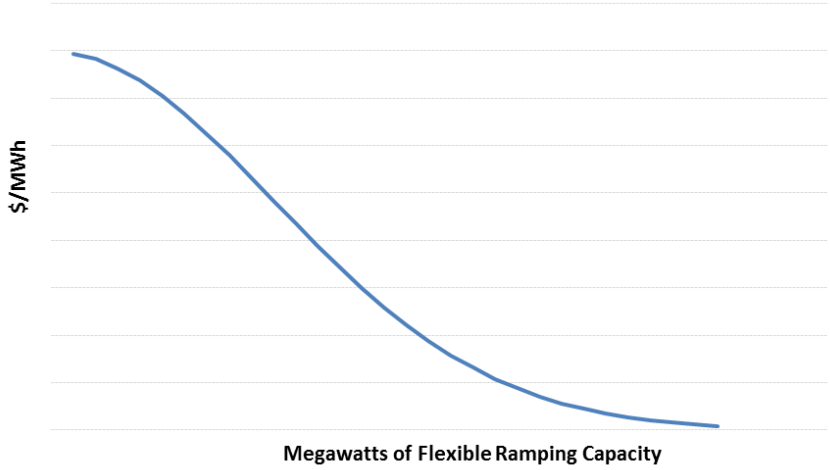


Figure 4 illustrates a case where there is not enough ramping capacity to meet forecasted net load (the minimum upward requirement in the Straw Proposal). The expectation is for a shortfall, and the probability of no shortfall is relatively small (the white area). Figure 5 shows the PDF of PBC costs under this case.

Figure 4 - PDF of Net Load less Forecasted Net Load (Expected) – Expected Shortfall

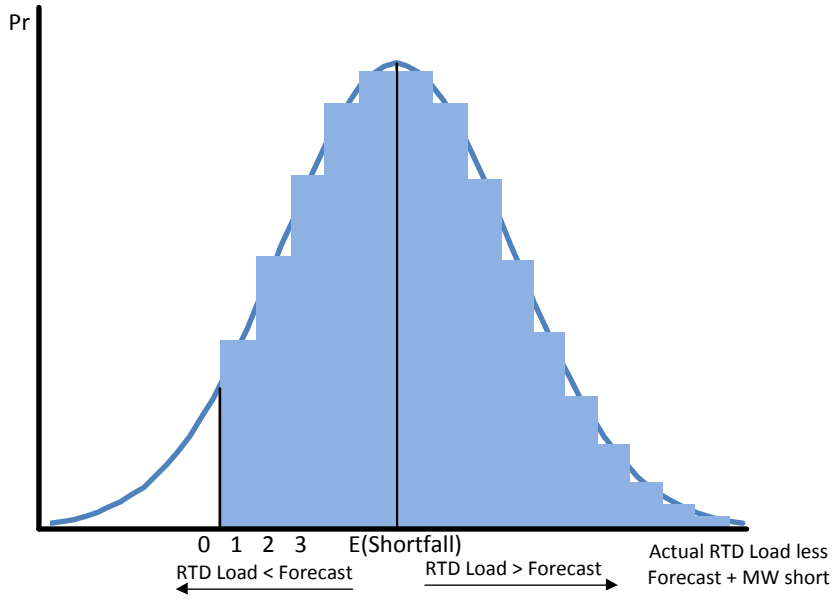
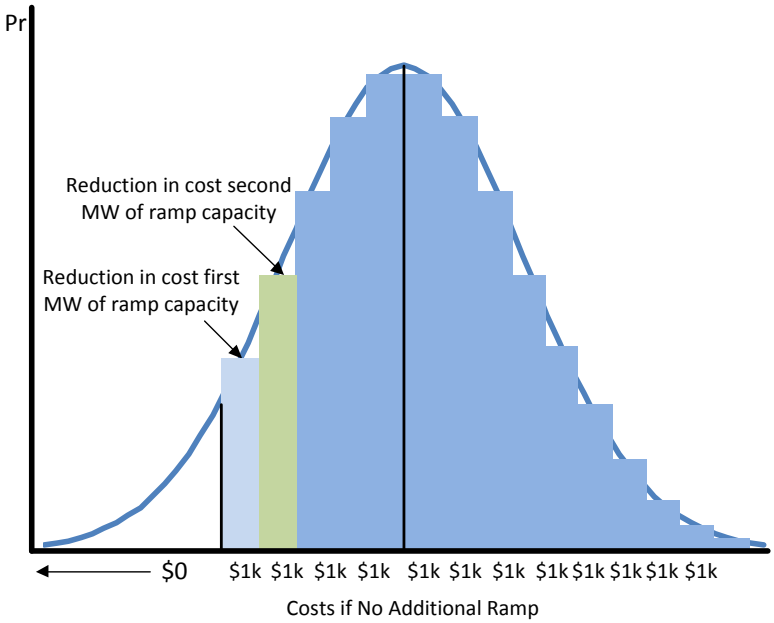


Figure 5 – Expected PBC Costs when Expected PBC Violation in Interval t+1

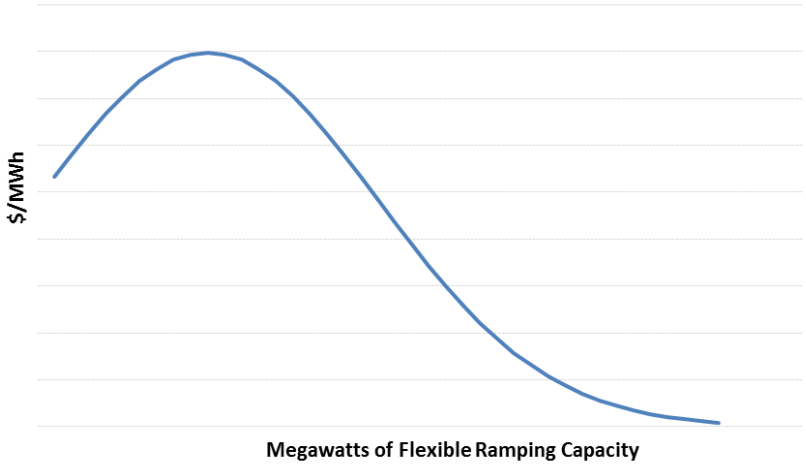


In the case shown in Figure 5, adding an additional megawatt of ramping capacity reduces the expected PBC violation costs by the light blue area. Adding a second megawatt of ramp capacity would reduce the expected PBC violation costs by the green area. This second megawatt of ramp capacity has a higher marginal value than the first

megawatt. The demand curve for FRP Up is therefore increasing for ramping capacity to ramp from the load forecast at interval t to the expected load forecast at interval t + 5.

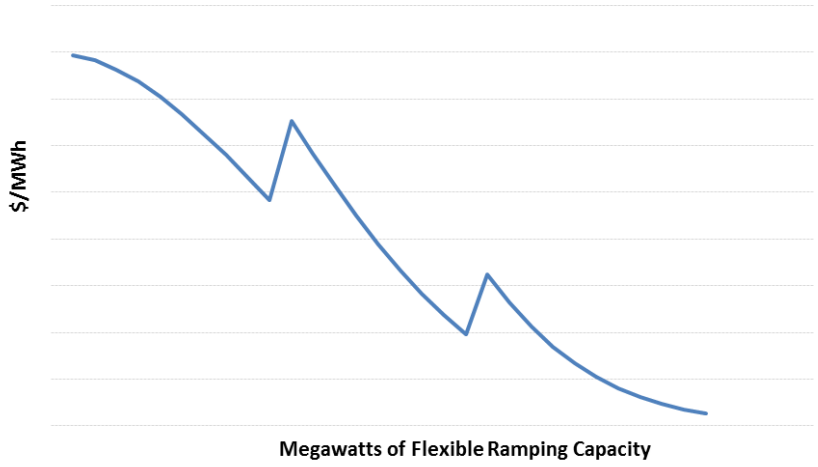
Figure 6 illustrates an example of a demand curve that incorporates the possibility of insufficient ramp capacity to meet forecasted load. This result illustrates a flaw in setting a predetermined administrative price for FRP when the minimum ramp capacity requirement is not met. The marginal value of FRP in such a situation will be less than the peak value of a demand curve derived from PBC violation penalty prices and probability distributions of load forecast realizations. The marginal value of FRP is therefore unrelated to an administrative penalty price of $250. The FRP demand curve described in this appendix establishes a more appropriate upper limit on the marginal value of FRP.

Figure 6 – Marginal Value of FRP Capacity



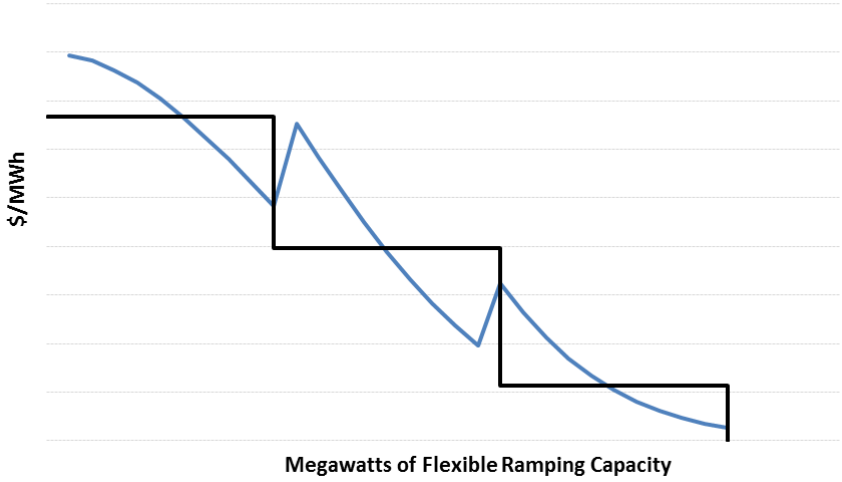
In the examples above, the FRP capacity demand curves were constructed using a single penalty price. When multiple penalty prices are used, there may be jumps in the demand curve as shown in Figure 7.

Figure 7 – Marginal Value of FRP Capacity with Multiple Penalty Prices



Both the increasing marginal value of FRP and jumps from changing penalty prices can be appropriately handled using a step function that ensures monotonicity. This is illustrated in Figure 8.

Figure 8 – Monotonic Adjustments to FRP Demand Curve



This appendix outlines one potential alternative methodology for creating FRP demand curves. There would still be many details to work out if such a method were used. These include: the number of steps and end points in a monotonically non-increasing demand curve; the monotonicity adjustment methodology; and whether to create demand curves in real-time as forecasts are produced or to use demand curves created from recent net load forecast distributions.