



Comments of Pacific Gas and Electric Company

On Flexible Ramping Product Workshop

Submitted by		Company	Date Submitted
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I. Introduction

Pacific Gas & Electric (“PG&E”) appreciates the opportunity to participate in the stakeholder process for the California Independent System Operator’s (“CAISO”) Flexible Ramping Product (“FRP”) Initiative and to submit comments regarding the September 18th Workshop.

Although PG&E supported the development of the FRP, we do not support the current proposal. Most importantly, PG&E will not support the expansion of this initiative to include the integration of the Integrated Forward Market (IFM) and Residual Unit Commitment (RUC) processes as part of proposal to be presented to the CAISO Board in November. It is premature to consider such a fundamental market change which will require considerable investment in time and money from the stakeholders and the CAISO. This element of the initiative must be subject to the CAISO’s Road Map governance structure to assess and prioritize future initiative work. It is inappropriate to make such a significant commitment without assessing the opportunity cost of doing this work or performing a cost-benefit analysis.

In addition, PG&E will not support the FRP initiative until the CAISO includes as part of the proposal the stylized mathematical formulations¹ of the requirements determination and the unit commitment and dispatch of FRP. The CAISO has largely presented the proposal in narrative description and through examples. Although the examples have been helpful, they are not comprehensive. The mathematical formulations for such a complex design should be included so stakeholders have a complete and deep understanding of the design. This knowledge is not only important for stakeholders to perform their role in assessing the design but to also understand and interpret market results. Moreover, requiring the CAISO to provide the mathematical formulations is a useful step for the CAISO since doing so may uncover issues not illustrated with simple examples.

PG&E’s principal comments on the Workshop are:

¹ The term stylized indicates the mathematical formulation is at a high level. Not all the details are included.

1. Integration of IFM and RUC: PG&E will not support this initiative at the November CAISO Board meeting if IFM/RUC integration is included as part of proposal.
2. Request for Additional Clarification: CAISO needs to provide the stylized mathematical formulations for FRP before PG&E can support the proposal. Specifically, the mathematical formulations should focus on the following in the Second Revised Draft Final proposal:
 - Determination of requirement for FRP Up and Down in Real-Time using demand curve
 - Modeling and defining the FRP in the Day Ahead (“DA”) market
 - Method used to model procurement of FRP and changes to energy dispatch
3. Cost Allocation: PG&E requests that CAISO monitor the correlation of FRP procurement with the proposed cost allocation metric used to divide total procurement costs into three categories (load, supply and fixed ramp) and publish a report evaluating the appropriateness of cost allocation metrics as compared to the cost drivers one year after the implementation of FRP.
4. Regional Requirements: PG&E asks the CAISO to provide a report to stakeholders before the November Board meeting on how much of the flexible ramping procured through the enforcement of the constraint is inaccessible due to congestion.

II. Summary of Workshop

FRP Requirement and Demand Curve

- FRP will cover at a minimum the real ramp from RTD interval t to RTD interval $t+5$.
- More FRP capacity greater than the minimum and up to 95 confidence level (“CL”) will be procured using an administratively determined demand curve.

Merging DA Market and RUC

- The pool of FRP capacity will not be limited to the physical resources committed in the DA market but will also include the resources committed in RUC.
- Therefore, the IFM and RUC will be merged to produce a co-optimized solution.

Cost Allocation

- Basis - Allocation of costs (to load and supply) for the FRP based upon RT deviations.
 - For the load category, allocate costs based upon uninstructed imbalance energy;
 - For internal resources that are dispatched, allocate costs based upon changes in uninstructed energy that is outside a 3% threshold based upon the resource’s instruction;

- For internal resources that are self-scheduled and not dispatched above self-schedule, allocate costs based upon gross honored ramp; and
- For interties resources, allocate costs based upon the net SC movement.

III. PG&E Comments on Workshop

1. Integration of IFM and RUC

PG&E will not support this initiative at the November CAISO Board meeting if IFM/RUC integration is included as part of proposal.

While PG&E is open to exploring the benefits of merging the DA and RUC markets, this is a large undertaking and not feasible under the current timeline.² This endeavor deserves its own stakeholder process with several technical conferences. Moreover, before the CAISO considers this undertaking, this initiative should be evaluated with all other possible initiatives in the CAISO's Roadmap process.³ Not using the Roadmap process can result in the proliferation of stakeholder initiatives which has the effect of preventing CAISO and stakeholders from having the sufficient time to evaluate the consequences of making major changes to the market.

Integration of IFM and RUC is a large undertaking with many areas that are unclear; more details needs to be provided regarding the proposed integration.

- More details regarding the formulation of the proposed integrated unit commitment and dispatch problem to be solved would aid participants in evaluating the proposal. A stylized mathematical formulation that gives the approach that would be used to combine the problem should be provided.
- Market implications should be presented. One area that is unclear is how it would treat a fast start resource that may be given an advisory commitment by today's RUC and given a binding decision closer to Real-Time. If it is committed in a combined IFM-RUC based on CAISO's DA forecast but found not to be needed later, would the fast start resource be financially bound by any minimum energy dispatch that must be included in the IFM portion of the combined process?

PG&E does not support taking this initiative to the November Board meeting if the CAISO continues to propose merging the IFM and RUC as part of its FRP proposal. There are difficult formulation and market issues related to combining the two processes and stakeholders have not had a chance to consider them and vet their concerns.

² The CAISO plans to request Board Approval of the FRP Initiative at the November meeting.

³ The propose of the Roadmap process is to assign a ranking of stakeholder initiatives based upon which initiative will provide the most benefit to the CAISO market and stakeholders.

2. Request for Additional Clarification

PG&E will not support the FRP initiative until the CAISO includes as part of the proposal the stylized mathematical formulations of the requirements determination and the unit commitment and dispatch of FRP. The CAISO has largely presented the proposal in narrative description and through examples. Although the examples have been helpful, they are not comprehensive. Below, PG&E fully explains the information that it is seeking.

A. PG&E asks that CAISO document how it proposes to determine the limits for FRP Up and Down in Real-Time in conjunction using the demand curve.

PG&E believes that the upper and lower limits on FRP procurement in Real-Time should be based on the uncertainty in the forecast of net load (*i.e.*, based upon load + export – import – wind schedules – solar schedules – supply deviations for example) in upcoming 5-minute dispatch intervals made prior to the RTD run covering those intervals. For example, at time $t-7$ minutes, CAISO forecasts net load for t , $t+5$, $t+10$, *etc.* The uncertainty in the forecasts for net load in $t+5$, $t+10$, *etc.* will drive the potential demand for FRP in intervals t , $t+5$, *etc.* In scheduling FRP in interval t , the RTD will consider the forecast net load in interval t and the uncertainty about the forecast of net load in interval $t+5$.

The previous proposals and presentations were confusing as to when the uncertainty would be evaluated. It was unclear whether CAISO would evaluate the range of ramp from one five minute period to the next over an historic period or whether CAISO would evaluate the uncertainty in ramp from one five minute period (t) to the next ($t+5$) based on the uncertainty in the forecast of net load in period $t+5$ given the most recent forecast. In the last workshop, CAISO clarified that they propose the latter. This should be documented in the Second Revised Draft Final Proposals to ensure that there is a clear understanding of the proposed method.

Also, we would request that CAISO describe how they propose to develop the 95% confidence interval about the net load forecast in each 5 minute interval. For example, does CAISO propose to treat the inputs for the net load forecasting process as random variables and evaluate the variation in those inputs to develop the confidence interval? If that is the case, does CAISO propose to model the inputs as independent random variables? A description of the approach used to develop the confidence intervals about the net load forecast would be useful in evaluating the proposal.

B. PG&E asks that CAISO provide more details regarding how the FRP requirements will be defined in the Day-Ahead Market.

The Second Revised Draft Final Proposal should provide additional detail regarding the way in which CAISO proposes to determine the maximum FRP requirement that it will procure in the DA process. PG&E believes that CAISO is proposing to determine forecasts of net load in each hour of the DA market. For each hour, the CAISO will also determine a 95% confidence interval about the ramp that would be required to move from the forecast of net

load in the given hour to net load in the next hour.⁴ A description of what uncertainties may be considered and how they will be taken into account would help evaluate the proposal.

Also, CAISO proposes to use the same demand curve that it develops for procuring 5 minute ramp in RTD given the uncertainty in RT forecasts to procure DA ramp. The Second Revised Draft Final Proposal should discuss why the DA FRP can use the same demand curve as the RT FRP.

C. PG&E asks that CAISO provide more details of the mathematical formulation of the method used to incorporate FRP in the economic dispatch model.

With the examples and details provided in the proposals and presentations, it is difficult to determine with certainty some modeling details that can impact how FRP is procured and priced. An area that should be clarified is whether procurement of FRP is modeled to be able to meet the potential uncertainty in net load in the next interval with or without the ramp projected to be used for a least cost energy dispatch (used to meet forecast net load in the next interval). PG&E provides a numerical example in Appendix A that discusses how the FRP can be procured under these two different modeling approaches.

As stated above, the Second Revised Draft Final Proposal should clearly specify what modeling approach that is being taken. Again, a more detail in a stylized mathematical formulation of the problem would help prevent misunderstandings that can arise.

3. Cost Allocation

PG&E requests that CAISO monitor the correlation of FRP procurement with the proposed cost allocation metric used to divide total procurement costs into three categories.⁵

PG&E asks the CAISO to monitor the cost allocation based on gross UIE and publish a report evaluating the appropriateness of the cost allocation metrics as compared to the cost drivers one year after the implementation of FRP. The correlation study should be based on data of 10-minute granularity, and include the proposed cost drivers such as changes in 10-min observed load, changes in 10-min UIE, 10-min gross UIE, 10-min change in MWh deemed delivered for interties, and demonstrate the correlation of these metric with flex ramp procurement in each of the three categories, i.e., load, supply and fixed ramp. PG&E believes the correlation analysis based actual market operation data will provide transparency to market participants regarding the appropriateness of these cost allocation drivers.

Another aspect that should be included in the analysis is the correlation of regional FRP procurement with regional cost drivers, such as FRP procurement in NP15 and SP15 versus cost drivers in each of these two regions, to demonstrate regional procurement impact.

⁴ The 95% confidence interval would measure the uncertainty inherent in the forecast of net load in that next hour.

⁵ The three categories are load, supply and fixed ramp.

4. Regional Requirements

In previous proposal, the CAISO discussed the possibility of enforcing regional FRP requirements.⁶ However, this issue has not been discussed in detail. For example, what metrics will the CAISO use to determine if it should enforce regional constraints? How will the regional requirements be calculated?

These questions become increasingly important if for example, transmission congestion prohibits the energy that is dispatched from FRP capacity in the SP 26 from reaching the areas in NP 26. If this were to be the case, then not enforcing regional constraints could result in entities in the north could paying for FRP capacity without receiving the benefits.

Consequently, PG&E asks the CAISO to provide a report to stakeholders before the November Board meeting on how much of the flexible ramping procured through the enforcement of the constraint is inaccessible due to congestion. This will help to inform stakeholders the whether it's necessary to enforce regional FRP constraints immediately, or whether it's prudent to defer this until a later date.

⁶In its April 9th Draft Final Proposal, the CAISO stated that it “*may also enforce regional requirements if it is necessary to keep certain ramping flexibility in certain regions. If a regional flexible ramping requirement constraint is binding, the regional flexible ramping cost will be allocated in the corresponding region*”.

Appendix A: Method Used to Model Procurement of FRP and Changes to Energy Dispatch

Consider a simple example with three generators and two intervals.

	PMax (Mw)	Energy Price (\$/MWh)	Ramp Price (\$/MW/5min)	Max Ramp Rate (MW/5min)
G1	60	20	2	10
G2	60	24	2	10
G3	60	50	1	10

With requirements:

	Energy (MWh)	Max FRP Up Requirement (MW/5min)
Period 1	100	7
Period 2	105	-

If the constraint that ensures that the maximum ramp requirement can be met at the end of Period 1 is formulated to just procure the cheapest available ramp available at the end of Period 1 while ignoring the ramp projected to be used to move from the dispatch in Period 1 to the projected dispatch to meet net load in Period 2, the least cost procurement would be:

	Energy Period 1 (MWh)	FRP Up Period 1 (\$/MW/5min)	Energy Period 2 (MWh)
G1	60	0	60
G2	40	0	45
G3	0	7	0

That is, the procurement of FRP product at the end of Period 1 only looks at the cost of the cheapest ramp that could be used to meet the maximum possible ramp between net load in

Period 1 and in Period 2. It would buy ramp on G3 that would not be used when dispatching to actually move from meeting the expected net load in Period 1 to meeting the expected net load in period 2.

If the constraint to enforce the maximum ramp capability at the end of Period 1 were formulated to procure the cheapest available ramp available at the end of Period 1 that would allow CAISO to meet the maximum possible ramp need between Periods 1 and 2 while taking into account the ramp required to meet the projected least cost dispatch to meet forecast net load in Period 2, the least cost procurement change. It would be:

	Energy Period 1 (MWh)	FRP Up Period 1 (\$/MW/5min)	Energy Period 2 (MWh)
G1	60	0	60
G2	40	5	45
G3	0	2	0

The problem can be formulated so that ramp capability that is used in the moving from the least cost dispatch that meets expected net load from one interval to the next counts toward meeting the FRP requirement in the same direction at the end of the first interval but does not result in increasing the requirement for FRP in the other direction.