California ISO
Shaping a Renewed Future

Draft Final Proposal

Bid Cost Recovery Mitigation Measures

April 6, 2012

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1 Introduction and background

Bid cost recovery (BCR) is the process by which the ISO ensures that scheduling coordinators are able to recover start up, minimum load costs and bid costs for generating units, system resources (resources located outside of the ISO balancing authority area) and participating loads. Currently, the BCR calculation is performed over the entire trade day and netted across the day-ahead (DA) and real-time (RT) markets for that trade day.

The ISO has proposed as part of the RI-MPR Phase 1 initiative to change the bid cost recovery rules so that bid cost recovery amounts calculated for the DA and RT markets, respectively, are not netted together. This change, which was approved by the ISO Board in December 2011, is an important element of the RI-MPR Phase 1 proposal because it will provide increased incentives to provide economic bids in the RT market. More economic bids in the RT market, and fewer self-schedules, will be vital to managing the grid reliably as more variable energy resources (VERs) come online. This change will increase the incentive for submitting economic bids to the RT market because it will tend to increase resources' eligibility for RT bid cost recovery.

In addition to the proposed change to separate the DA and RT markets in the bid cost recovery calculations, as part of the RI-MPR Phase 1 initiative the ISO began developing several performance measures to incorporate in the bid cost recovery calculations. These performance measures are intended to ensure that dispatched energy receiving bid cost recovery is delivered and to address a potential strategy to artificially increase bid cost recovery payments by persistently deviating from ISO dispatch. Specifically, the ISO began the development of a performance metric (PM) and a persistent uninstructed imbalance energy (PUIE) check. The separation of netting of the bid cost recovery calculations as an element of the RIMPR Phase 1 proposal was approved by the ISO Board in December 2011 with the ISO's commitment to further develop those mitigation measures prior to filing tariff changes associated with revisions to bid cost recovery. Through this BCR Mitigation Measures initiative, the ISO has worked with stakeholders to complete the design of the modified day-ahead metered energy adjustment factor (MEAF), the real-time PM and the real-time PUIE check.

2 Schedule

Date	Event
February 22, 2012	Post Straw Proposal
March 7	On-site stakeholder meeting, 1:30 – 4 pm
March 20	Stakeholder comments due *
April 6	Post draft final proposal
March 30	Market Surveillance Committee meeting
April 12	Stakeholder conference call, 1:00 – 3:00 pm
April 19	Stakeholder comments due *
May 16-17	ISO Board of Governors meeting

* Please submit written comments to BCRMitigationMeasures@caiso.com

3 Overview of the draft final proposal

In this section, an overview of each of the elements of the draft final proposal for BCR mitigation measures is provided. Stakeholder feedback is summarized, and changes in the proposal from the ISO's straw proposal are described.

In summary, the ISO proposes the following three BCR mitigation measures be put in place simultaneously with the separation of the netting of day-ahead and real-time BCR calculations, and the lowering of the energy bid floor:

1. **NEW:** The straw proposal did not include a metered energy adjustment factor (MEAF) for DA BCR. The ISO now proposes a modified version of the current metered energy adjustment factor (MEAF) to the energy portion of the DA BCR calculation. This modified MEAF will not reduce DA BCR for units that are dispatched downward by the ISO in the real-time market.
2. **MODIFIED:** The ISO proposes to modify the real-time performance metric (PM) as outlined in the straw proposal to only address under-delivery of incremental or decremental energy. This PM will scale components of the real-time bid cost recovery calculation for under-delivered incremental or decremental energy and will replace the current real-time metered energy adjustment factor (MEAF).
3. **MODIFIED:** The ISO proposes to modify the approach as outlined in the straw proposal for applying the real-time persistent UIE (PUIE) check. This modification consists of only disqualifying that portion real-time energy revenue shortfall attributable to PUIE. The ISO proposes refinements to the thresholds for the threshold for the PUIE check, as described in section 3.3.4 to provide an additional "safe harbor" under which real-time energy revenue shortfall will not be removed from the real-time BCR calculation.

3.1 Modified day ahead metered energy adjustment factor

In the fourth revised straw proposal on the RI-MPR Phase 1 initiative, the ISO recommended to base day-ahead bid costs on scheduled amounts versus delivered amounts, i.e., not apply the day-ahead metered energy adjustment factor (MEAF) in the DA BCR calculations. The rationale for this proposal was that it was consistent with the ISO's proposal to eliminate the netting of costs and revenues in DA against those in RUC and RT. Removing the netting severs the connection between the two markets for the purpose of BCR calculations. One of the stated goals in this initiative is to ensure that bid cost recovery provides the proper incentive for the targeted bidding behavior. As discussed above, to limit disincentives to submit economic bids in the real-time, it is important to decouple the markets and eliminate the netting of costs and revenues across markets.

Notwithstanding the reasoning described above, the ISO is refining its proposal to include the application of a modified version of the DA MEAF. The impetus for this change to the proposal is the ISO's identification of an adverse incentive created by a having the day ahead market cost recovery calculations for a resource be completely isolated from its actual performance in real time.

Specifically, a resource could have the incentive to bid in such a way as to get BCR in the DA market, and then not deliver its DA schedule in RT. In this case the resource would still receive its DA BCR including minimum load cost (MLC) recovery, but does not participate in the RT market. This is not consistent with the intended interaction of the day-ahead and real-time market markets. The day-ahead market runs in order to set up feasible schedules. The real-time market, in turn, makes incremental changes to these schedules. Thus, the bidding practice described here can have negative market and reliability impacts.

The ISO proposes to address this potential adverse incentive through a modified DA MEAF. This MEAF will not impact DA BCR if the ISO dispatches a unit downward from its DA schedule in the real-time market, but will reduce DA BCR if a unit operates below its DA schedule in real-time without being dispatched down by the ISO. The lowering of the cap on the registered cost option for minimum load, proposed under a separate stakeholder initiative, will also address this adverse incentive.[1] A lower registered cost cap for ML would reduce the incentive to engage in a strategy that leaves the resource running at minimum load in the RT.

The current DA MEAF is calculated using the following[2] formula (simplified from actual):

$$DA\ MEAF = \frac{Metered\ Energy - DA\ ML\ Energy}{DA\ Sched\ Energy - DA\ ML\ Energy}$$

The modified DA MEAF proposed by the ISO is shown below:

$$Modified\ DA\ MEAF = min\left\{1, \left|\frac{Metered\ Energy - DA\ ML\ Energy - Regulation\ Energy}{\min\{TEE, DA\ Sched\ Energy\} - DA\ ML\ Energy}\right|\right\}$$

Table 3.1-1 summarizes how this MEAF would be applied:

Table 3.1-1: Application of the modified day ahead metered energy adjustment factor

Costs *	Revenues	Apply PM to…
+	+	Costs
+	–	Costs & Revenues
–	+	n/a
–	–	Revenues

* "Costs" refer to DA energy bid costs, and "Revenues" refers to revenues for the DA schedule above minimum load.

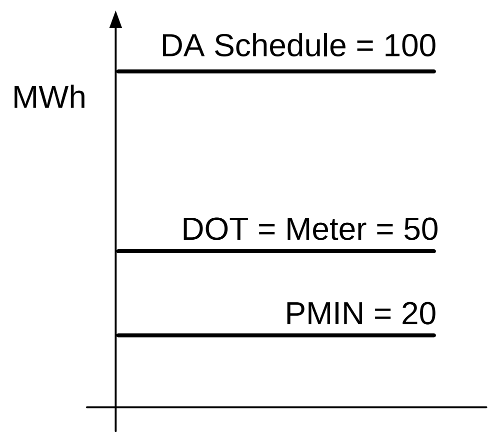
The simplified example below shows the fundamental difference between the current DA MEAF and the proposed, modified DA MEAF. The example shows that the current calculation of the DA MEAF would result in a scaling of elements of the day-ahead BCR calculation in the case that a generating resource has a day-ahead schedule of 100 MWh and then heads the ISO's

[1] http://www.caiso.com/informed/Pages/StakeholderProcesses/CommitmentCostsRefinement2012.aspx

[2] The two emergency BCR filings modify the rules to set the DA MEAF equal to 1 for revenues in the case of decremental real-time dispatch and sets the DA MEAF = 1 for costs in the case of negatively priced energy bids.

decremental dispatch to 50 MWh in the real time market. Under the modified approach, the day ahead BCR calculation would not be scaled in such a case because, as shown in the formula above, metered energy is evaluated relative to the lower of the DA scheduled energy and the real-time ISO dispatch rather than simply the DA scheduled energy. The ISO asserts that this is compatible with the RIMPR Phase 1 design intent to provide incentives to follow real-time decremental dispatch instructions.

Figure 3.1-1: Example of current DA MEAF and proposed modified DA MEAF in the case of a decremental real-time dispatch



Current DA MEAF =
(50 - 20) / (100 – 20) = 0.375

Modified DA MEAF =
min [1, abs((50-20) / (min(50, 100) – 20))] = 1

The original FERC order for MRTU addressing day-ahead BCR specified that the ISO should not pay BCR for DA energy that was not delivered in real time. Previously this was accomplished through the day-ahead MEAF. Under this draft final proposal, the ISO will not reduce day-ahead BCR payments if, in real time, the ISO dispatches the unit down below its day-ahead scheduled energy. This is to accomplish the over-arching goad of encouraging decremental energy bids in the real-time market. Market participants will have stronger incentives to submit real-time bids if being dispatched downward in real-time does not reduce day-ahead bid cost recovery payments. Consistent with the prior FERC order, the proposed design will not to provide cost recovery for undelivered day-ahead energy. The ISO proposes the exception that bid cost recovery for day-ahead energy still be paid if the ISO instructs a generating resource to reduce its output in real time. The ISO believes that this balances the intent of the original FERC order with today’s increasing need for real-time dispatch responsiveness.

Note that the day-ahead minimum load costs, start-up costs and MSG transition costs are still subject to the same rules as today. The modified day-ahead MEAF has no impact on these costs.

3.2 Real time performance metric

The ISO proposes to apply a performance metric to the real-time bid cost recovery calculations to scale the bid cost recovery payment in proportion to the amount of incremental or decremental energy delivered in response to ISO real-time dispatch instructions.

The performance metric is essentially a fraction by which components of the bid cost recovery calculation are scaled. The fraction is a proportion of the real-time dispatch by which the resource under-delivered. Real-time net costs or net revenues in the bid cost recovery calculation will be scaled by the performance metric.

3.2.1 Stakeholder feedback on the real time performance metric straw proposal

Calpine Corporation (Calpine)

> Calpine supports the modification of the proposal such that the PM is applied only to the real time incremental dispatch. Calpine seeks clarification on the timing of the beginning and end of the suspension of application of the PM for start-up, shut-down, transition and FOR crossing events. Calpine asserts that minimum load dispatched in real time be fully covered with BCR if the resources meets that minimum load quantity. Calpine supports the change of the tolerance band of the PM to be based on 5 MWh or 3% pmax instead of 5 MWh or a calculated PM of 3% stating that this simplifies settlement and transparency.

GenOn Energy (GenOn)

> GenOn contends that "[t]here is not an apparent difference in the operational impact of an uninstructed deviation in a particular settlement interval by a resource that is eligible for BCR from a similar uninstructed deviation by a self-scheduled resource in the same interval – yet the consequence of the uninstructed deviation is greater to the BCR resource by the amount of the scaled loss of BCR by the PM."

NRG Energy (NRG)

> NRG cites FERC's 2006 Order on the ISO's MRTU proposal which they interpret as "requiring the CAISO to pay the full amount of DA (or RT) BCR is the resources is generating the full amount of the DA schedule (or RT instruction." NRG contends that the ISO's proposal to implement the PM in real time is inconsistent with that FERC Order. NRG further asserts that "[i]f the CAISO wants to discourage resources from generating energy above their instructed levels, the CAISO is free to propose to reinstate uninstructed deviation penalties."

Pacific Gas & Electric (PG&E)

> PG&E does not support the performance metric as proposed in the ISO's straw proposal because they contend that "it should also be applied to reduce day-ahead eligible costs." PG&E states that the PM, although a step in the right direction, will not be sufficient to address potential adverse incentives. While PG&E recognizes the benefits of separating the netting of the DA and RT BCR calculations, they express concern that applying the PM only to the RT calculations "does not do enough to limit the possibility of exploiting the IFM bid cost recovery process" as seen in the two emergency FERC filings made by the ISO in the first half of 2011.

Southern California Edison (SCE)

SCE generally supports the changes to the PM described by the ISO in the straw proposal. SCE further states that removing the DA MEAF is appropriate as long as the start-up and minimum load costs are not recoverable when those costs are not actually incurred by a generating resource. SCE seeks clarification on the timing of the beginning and end of the suspension of application of the PM for start-up, shut-down, transition and FOR crossing events.

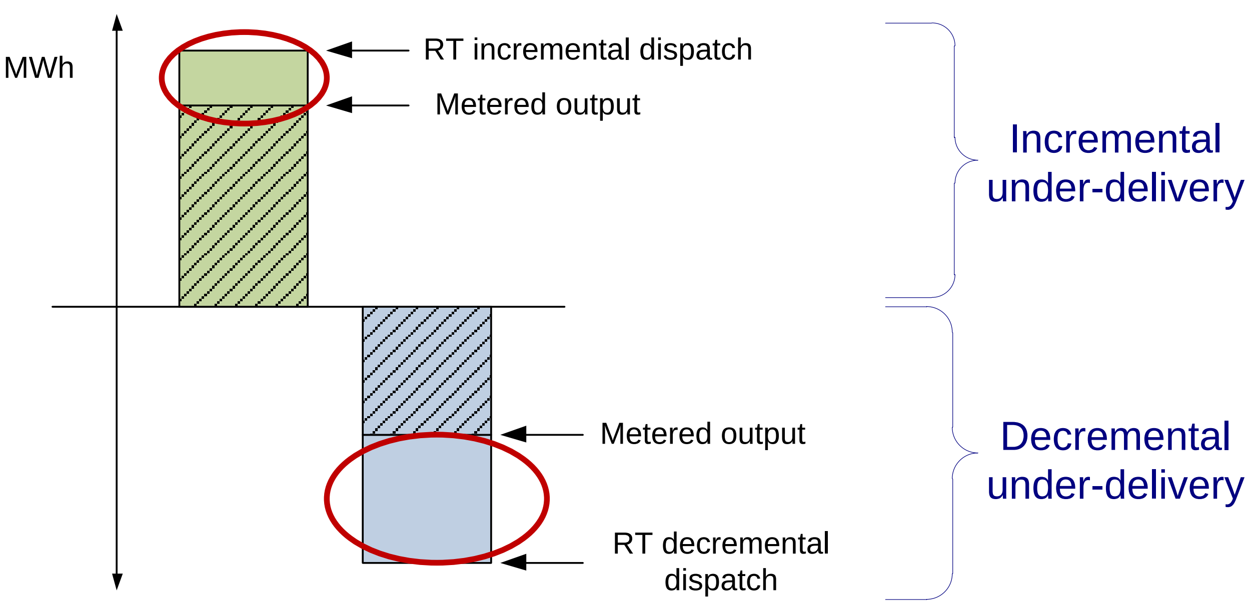
Western Power Trading Forum (WPTF)

WPTF objects to scaling BCR payments for energy deliveries above a generating resource's dispatch. WPTF asserts that an uninstructed deviation penalty would be a more appropriate way to penalize uninstructed deviations.

3.2.2 Draft final proposal for the real time performance metric

The ISO proposed in its straw proposal to apply the performance metric in instances of under delivery and over delivery. Based on further analysis and stakeholder feedback, the ISO is modifying its proposal such that the performance metric will be applied in only the case that a resource under-delivers on its real-time ISO instruction. Note, though, that this applies to instances in which incremental energy in under-delivered and to cases in which decremental energy is under-delivered. These circumstances are pictured in the figure below. The areas in red designate undelivered incremental or decremental energy for which the performance metric will apply.

Figure 3.2.2-1: Incremental and decremental under delivery



This change to the ISO's proposal is based on stakeholder feedback that reducing BCR for over-delivery was not justified as a BCR mitigation measure and seemed more broadly targeted at uninstructed deviations. This is because resources are not eligible for BCR for over-delivered energy in the first place

The proposed real-time PM is distinct from the current real-time MEAF in the following two ways:

1. The real-time PM applies to RUC or real-time minimum load costs in addition to the energy portion of the real-time BCR calculation; and
2. A tolerance band, described in the following section, is applied around the real-time PM.

The ISO is proposing that the performance metric (PM) be calculated per dispatchable resource and per settlement interval in the following manner:

$$Performance\ Metric = \min\left\{1, \left|\frac{Metered\ Energy - DA\ Energy - Regulation\ Energy}{Total\ Expected\ Energy - DA\ Energy}\right|\right\}$$

> Note 1: Regulation energy is "deemed delivered" since it is provided by a resource under the ISO's control via direct electronic signal. For this reason, regulation energy is excluded in the performance metric calculation. Furthermore, and for the same reason, regulation energy is not included in the calculation of total expected energy. And so, by subtracting regulation energy from metered energy in the performance metric formula, it is ensured that the numerator and denominator are capturing like terms.
>
> Note 2: As a result of the change to the proposal – namely to apply the performance metric to RUC and real-time – the ISO has made a change in the formulation of the performance metric. The performance metric will only be applied to the incremental or decremental real-time schedule. It is for this reason that the above formula for the PM has been modified so that the day-ahead scheduled energy is subtracted out of both the numerator and denominator.

It is also important to note that, except in the case that a resource is committed in day ahead and de-committed in real time, the current performance measurement against RUC or real-time minimum load cost, startup cost and MSG transition cost by comparing the meter with the respective Pmin of the resource or configurations will stay in this proposal. In the event that a resource is committed in DA and de-committed in RT, then the ISO proposes not to use the standard 3%/5MWh tolerance band for the day-ahead minimum load cost. In this case we propose instead to apply the PM to the real-time negative minimum load cost. The rationale for this is that using the standard tolerance band could provide incentives not to follow ISO dispatch instructions to shut-down or stay off-line. By using the PM in this case, elements of the BCR calculation will be scaled back if the resource were to disregard the ISO instruction to shut-down in RT.

The following table shows the quantity, either costs, revenues or both depending on the signs of their values to be adjusted under the PM approach. Because negative revenues are essentially like costs in that they can contribute to a shortfall which could result in a cost recovery uplift payment, the performance metric will be applied to those as well. Likewise, negative costs can contribute to a shortfall and so, in the event of a shortfall in this situation, the PM will be applied to revenues in that settlement interval. Note that when the performance metric describes the portion of the output that is instructed. Therefore, when the PM is applied to the BCR calculation components below, these quantities are multiplied by (1-PM).

<u>Figure 3.2.2-2</u>: Application of the real time performance metric

Costs *	**Revenues**	**Apply PM to…**
+	+	Costs
+	–	Costs & Revenues
–	+	n/a
–	–	Revenues

* In the case of the RT PM, "Costs" refer to RT energy bid costs, and RUC/RT minimum load costs. The PM is also applied to DA minimum load cost only in the case that a resource is committed by the ISO in DA and de-committed by the ISO in RT as noted above. "Revenues" refers to the real-time energy market revenues including those for minimum load energy. The ISO proposes that the real-time PM be applied to pumped storage and demand response resources.

The ISO clarifies that, in the case of an exception dispatch, a generating resource is paid based on rules specific to those circumstances. Bid cost recovery, and thus the PM, is not applicable in such circumstances.

3.2.2.1 RT performance metric DA modified MEAF tolerance band

The ISO proposes the following performance metric boundary to avoid an undue negative impact of the performance metric in cases of small incremental dispatches. The importance of this boundary is that it prevents the scaling of energy bid costs and minimum load costs for very small deviations from dispatch that may legitimately be due to ramping constraints or other such operational constraints.

$$\sim if \sim$$

$$|Metered\ Energy - Regulation\ Energy - Total\ Expected\ Energy| \leq \max\{\frac{5\ MWh}{6},\ \frac{(0.03 * pmax)}{6}\} + Ramping\ Tolerance$$

$$\sim where \sim$$

$$Ramping\ Tolerance = |Total\ Expected\ Energy\ based\ on\ Dipatch\ Operating\ Point - Total\ Expected\ Energy\ based\ on\ Dispatch\ Operating\ Target|$$

$$\sim then \sim$$

$$Performance\ Metric\ is\ not\ Applied$$

The reason for dividing the elements of the maximum function in the criteria above by 6 is that the PM is applied by settlement interval. Therefore, the MWh values should likewise be consistent with those 10-minute intervals.

As noted in the straw proposal, the boundary is based on 3% of the resource pmax instead of being based on a calculated PM of 3%.

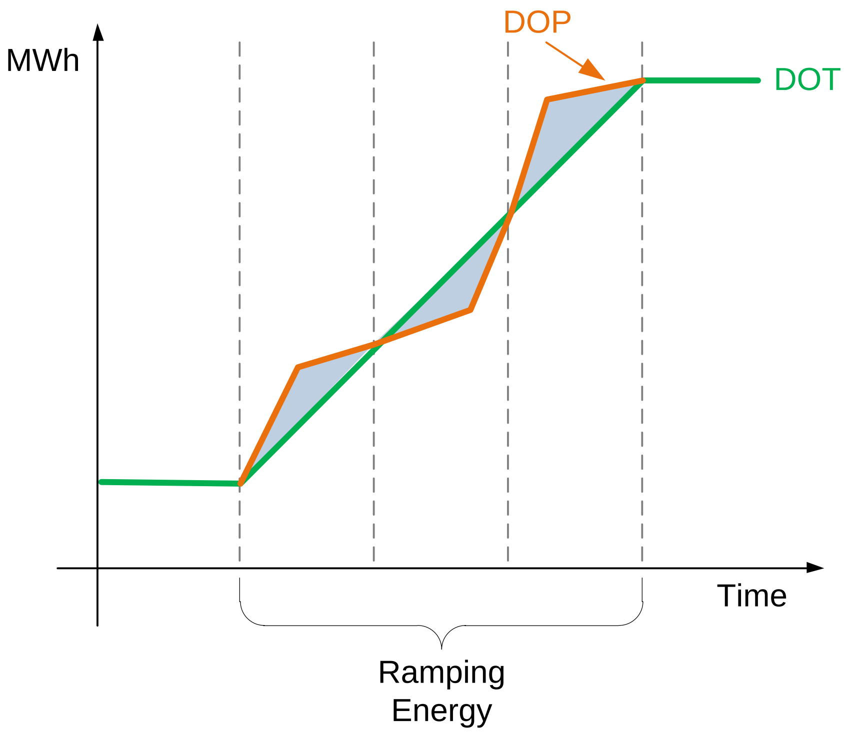
The threshold values of 5 MWh and 3% are consistent with our current market performance and our experience with realistic and justifiable deviation around dispatch and the ISO has employed the “5 MWh or 3%” thresholds even prior to the launch of the LMP market in April 2009. The ISO has used these thresholds for other operating performance by a generating resource such as when the plant-level or configuration-level minimum operating level has been achieved. These values also reflect justifiable deviations that result from the modeling of resource ramp rates as four-segment “curves” rather than as continuous or smooth curves as they are in actuality.

In addition to the threshold value, the performance metric will not be calculated during the startup, shutdown, MSG transition periods, or during crossing periods over a forbidden operating region as long at the resource is in fact in the instructed operation. This is out of recognition that the output of a resource cannot be controlled exactly during these events.

The ISO considers the time periods that the market uses in instructing those events. As long as the unit follows the instruction, there is no PM applied in these cases. The current rules for early or late shut-up, shut-down, and transition still apply.

The ISO further proposes to include the Ramping Tolerance criterion to accommodate instances in which the ramp rate can change over the course of the interval. When the ISO issues an instruction for a generator to ramp to a different output level, the expected energy based on the new target output level – the dispatch operating target (DOT) – can differ from the expected energy based on the dispatch operating point (DOP) which reflects the generator’s actual incremental movements interval-by-interval toward the target output level. This difference will exist whenever there is a ramp-rate change within the 5-minute interval window. A stylized depiction of a difference between expected energy based on DOP and that based on DOT is shown in the diagram below. The green line shows the ISO instruction from current output to the DOT while the orange line shows the resources incremental output levels as it moves toward the DOT. The area under the green line is total expected energy (TEE) based on DOT, and the total expected energy based on DOP would be the area under the orange line. The differences between these two calculations of expected energy are related to the physical operation of the generating resource and so the ISO proposes not to apply the PM in the case that the generator’s output is within the ramping tolerance, that is, within the blue shaded areas as depicted below.

<u>Figure 3.1-2</u>: Ramping Tolerance



Ramping Tolerance = | TEE based on DOP – TEE based on DOT |

3.3 Persistent uninstructed imbalance energy

The performance metric described above scales components of each real-time settlement interval's bid cost recovery calculation when a resource is deviating from its ISO dispatch. However, the PM may not fully remove certain incentives to inflate BCR payments for reasons explained below. In particular, there is the possibility that a generating resource can deviate *persistently* from the real-time ISO dispatch and thereby inflate its BCR payments.

Under the current ISO tariff, a resource's real-time uninstructed energy is not considered for bid cost recovery in settlement intervals associated with deviations from ISO dispatch instructions of the same interval. However, real-time dispatch uses a resource's telemetry value[3] as the basis for deriving the resource's initial condition. Therefore, if a resource's dispatch is ramp-constrained in an interval, then the uninstructed deviations of the generator in previous intervals will have a cumulative effect on the amount of energy of the current settlement interval that is subject to bid cost recovery. Figure 4.3.1(a) below provides a depiction of the persistent deviation strategy.

[3] Telemetry refers to either actual telemetered value or state-estimator value.

3.3.1 Stakeholder feedback on the persistent uninstructed imbalance energy straw proposal

Calpine Corporation (Calpine)

Calpine does not support the PUIE check asserting that the check is not transparent. Additionally, Calpine states that they are not convinced that the thresholds proposal by the ISO are conclusive of adverse market behavior and that the PUIE check may therefore lead to “false positives” and unintended consequences. Calpine states that they could support the proposal if the clawback were not automatic and that, instead, resources that exceeded the threshold were “evaluated for compliance with the pre-existing tariff requirements to follow dispatch orders.”

GenOn Energy (GenOn)

GenOn expresses concern that persistent uninstructed deviations can be due to circumstances over which the resource operator has little control. GenOn also requests examples to illustrate that Measures A and B are reasonable.

Northern California Power Agency (NCPA)

As a load-following metered sub-system (MSS), NCPA is already subject to a load-following deviation penalty which provides a strong incentive for them to manage their resource deviations within a tight tolerance band. NCPA asserts that they therefore be exempted from the PUIE. The ISO concurs, and accordingly proposes not to apply the PUIE to load-following MSS.

NRG Energy (NRG)

NRG questions whether nor not “forfeiting BCR in all hours with positive uninstructed deviation in a day in which either the “A” or “B” thresholds is reached is just and reasonable.” The ISO clarifies that energy BCR is disqualified only for intervals (not hours) with persistent uninstructed imbalance energy (not simply uninstructed energy).

Pacific Gas & Electric (PGE)

PG&E requests additional information on the PUIE check and the proposed thresholds.

Southern California Edison (SCE)

“SCE supports applying the PUIE check to discourage intentional divergence from dispatch to gain BCR uplifts, but only to the point to where manipulative behavior is mitigated. SCE trusts that the CAISO’s proposed thresholds are sufficient to accomplish this.” SCE requests additional detail on the application of the PUIE through detailed examples.

Western Power Trading Forum (WPTF)

WPTF asserts that a resource may have persistent uninstructed imbalance energy when it is in fact endeavoring to follow ISO dispatch instructions. WPTF is concerned about the reasonableness of the proposed thresholds. WPTF also notes that more transparency is needed to help market participants validate adjustments in BCR payments as a result of the triggering of the PUIE check.

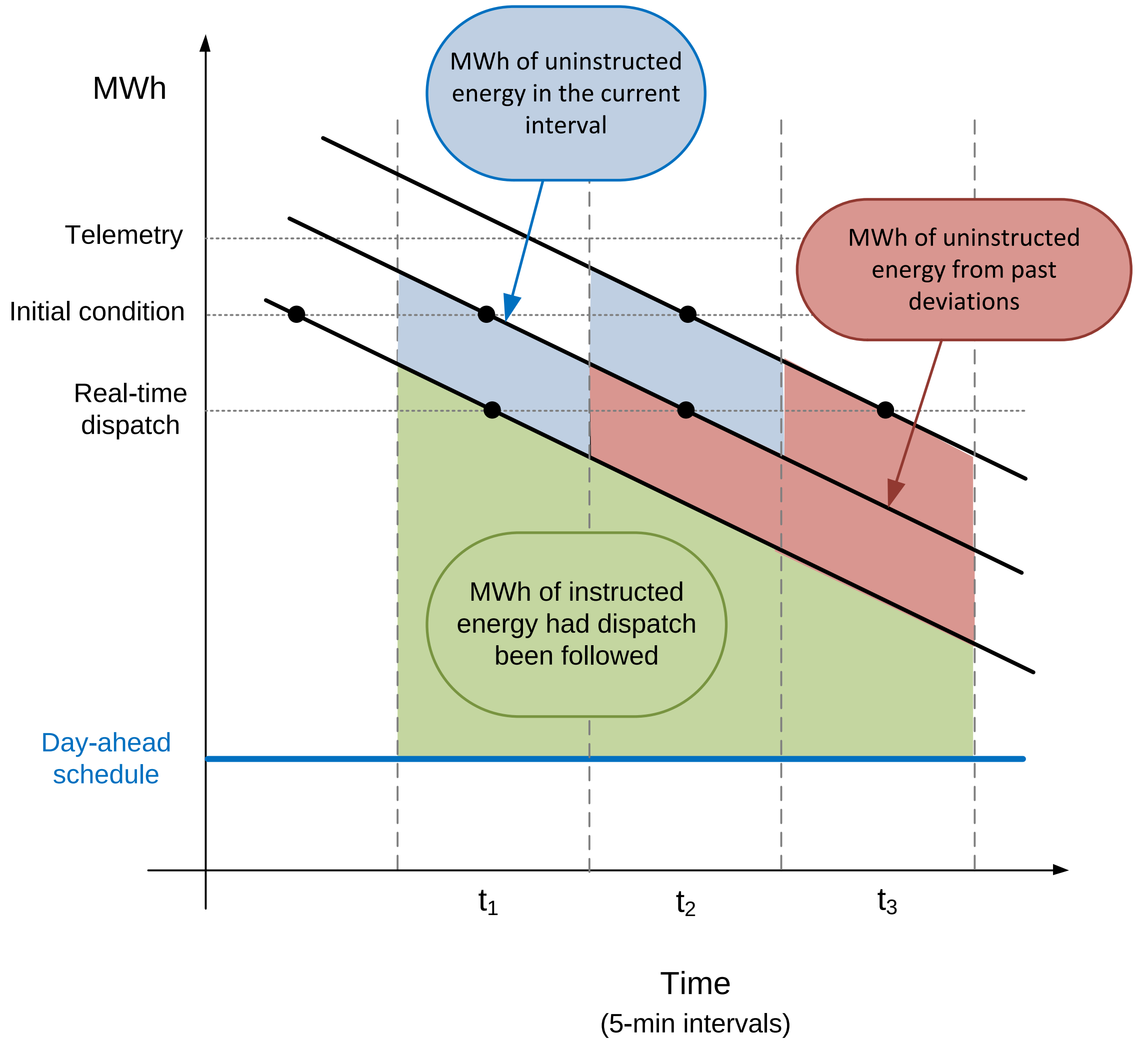
3.3.2 Persistent uninstructed imbalance energy

In the diagram below, the ISO real time dispatch is depicted relative to a generating unit’s output. The ISO dispatch at t_1 is not followed and so, at t_2, the ISO issues a new dispatch from projected initial condition rather than from the targeted output based on the t_1 dispatch. The diagram shows this strategy being employed three times in a row. In this scenario, the ISO was trying to dispatch the resource down which indicates that the LMP was likely below the resource's energy bid price. By ignoring the ISO dispatch instructions and knowing that the ISO dispatch would be based on telemetry, the resource has essentially forced the ISO to perpetually dispatch it at some uneconomic level, thereby strategically expanding the energy bid cost portion of their BCR calculation from what would have been should the resource followed the ISO dispatch instruction.

The red and the green areas together represent the total amount of instructed imbalance energy in the interval for the generating resource. The green area represents the instructed energy had the generator followed the dispatch trajectory of the first real-time dispatch shown here. The red colored areas show the uneconomic instructed energy attributable to past uninstructed deviations from the real-time dispatch. The blue area is uninstructed energy resulting from re-dispatch based on telemetry. The blue area is the portion of each individual interval's UIE that may contribute to the accumulation of uneconomic instructed energy in intervals that follow.

The potential for the practice of deviations described above is not created by the fundamental proposal to remove the netting of bid cost recovery across the day ahead and real-time markets. It would, however, be exacerbated by the separation of the netting because any real-time bid cost recovery would be paid and not netted against any DA market surpluses.

Figure 3.2-1: Persistent deviation from real-time ISO dispatch



3.3.3 The persistent uninstructed imbalance energy check [4]

Again noted above, the ISO's dispatch is based in part on a resource's actual output, which may reflect uninstructed output. The ISO proposes to implement a persistent UIE (or, PUIE) check in addition to the interval-by-interval PM since the PM on its own would not otherwise fully measure the impact of uninstructed energy associated with the persistent deviation.

4 More detail on the PUIE is available in the technical paper at the following link: http://www.caiso.com/Documents/RIMPR1TechnicalAppendixPersistentUninstructedEnergyCheck.pdf

By comparing real-time costs and revenues, one can determine the following four values:

- Incremental energy
    - Surp_Inc: Cost minus Revenue for the RT incremental energy over the MW range where LMP > Bid Price. If there is a surplus associated with incremental energy in this interval, this quantity will be negative
    - Short_Inc: Cost minus Revenue for the RT incremental energy over the MW range where LMP < Bid Price. If there is a shortfall associated with incremental energy in this interval, this quantity will be positive
- Decremental energy
    - Surp_Dec: Cost minus Revenue for the RT decremental energy over the MW range where LMP < Bid Price. If there is a surplus associated with decremental energy in this interval, this quantity will be negative
    - Short_Dec: Cost minus Revenue for the RT decremental energy over the MW range where LMP > Bid Price. If there is a shortfall associated with decremental energy in this interval, this quantity will be positive

The PUIE algorithm produces the following four values.

- UIEbcr_Up: for a given interval with incremental energy, this dollar quantity is increase in cost/rev netting due to persistent upward deviation;
- UIEbcr_Dn: for a given interval with decremental energy, this dollar quantity is increase in cost/rev netting due to persistent downward deviation;
- UIEEffect_Up: for a given interval with incremental energy, this MWh quantity is the amount of energy contributed to the shortfall by persistent downward deviations in previous intervals; and
- UIEEffect_Dn = for a given interval with decremental energy, this MWh quantity is the amount of energy contributed to the shortfall by persistent downward deviations in previous intervals.

The following aggregations are then calculated:

- UIEBCR = UIEBCR_Up + UIEBCR_Dn
- UIEEffect = UIEEffect_Up + UIEEffect_Dn
- UNENbcr = Short_Inc + Short_Dec

Measures A and B are then calculated as follows:

- Measure A (%) = UIEbcr / UNENbcr
- Measure B ($) = UIEbcr / UIEEffect

For an example that takes all these values for two 5-minute intervals, aggregates to a ten-minute interval, and calculates measures A and B, please see Appendix A to this draft final proposal.

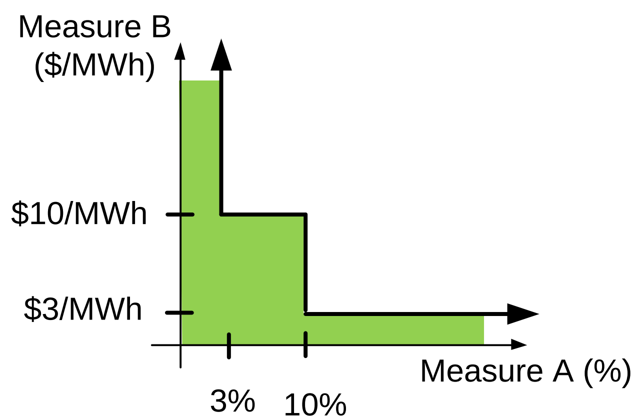
As part of this draft final proposal the ISO proposes an additional refinement to the PUIE algorithm. The refinement takes into account the possibility that the telemetry for a generating resource can be off which could contribute to a dispatch operating target (DOT) that the generating resource is not able to meet at the target time, thus resulting in a real-time uninstructed deviation. Such uninstructed energy does not reflect the adverse behavior by the generating resource, but could increase the calculated value of Measure A. The ISO therefore proposes this refinement to filter out this effect on UIE before calculating the PUIE check. Please see Appendix B for more detail on this refinement.

The actual implementation of the PUIE check will account for the effects of dynamic ramp rates, and will also consider the operating characteristics of multi-stage generating (MSG) resources.

3.3.4 Scaling of real-time energy revenue shortfall based on the PUIE check

The ISO proposes that when either Measure A or Measure B exceeds its respective thresholds, (10%, $10/MWh respectively) then real-time energy revenue shortfall be reduced. In other words, this provides a "safe harbor" in which if Measure A and Measure A are both under their respective thresholds, then real-time energy revenue shortfall will not be reduced. The ISO additionally proposes to expand the "safe harbor" to include values of Measure A that are 3% or less and values of Measure B that are $3/MWh or less. This is illustrated in the figure below. The green areas correspond to the safe harbor.

Figure 3.3.4-1: Measure A and Measure B thresholds



In the Market Surveillance Committee meeting on March 30, 20120, the Committee and stakeholders expressed concern that the ISO's proposal was that intervals with PUIE have their energy bid costs excluded from the real-time BCR calculations rather than only disqualifying the amount of energy costs/revenues associated with the PUIE. Accordingly, t

he ISO now proposes to disqualify only the portion of energy revenues/costs due to persistent uninstructed deviations. (In Figure 3.2-1, this portion is represented by red areas.)

Note that the PM is first applied to the real-time bid cost recovery each settlement interval and then PUIE will be applied to the remaining shortfall on a daily basis.

3.3.5 Empirical analysis of Measures A and B

In the final RI-MPR Phase 1 proposal, it was noted that the values of the trade-off curve used as the threshold for the persistent uninstructed deviation check would be developed by considering analysis of past market outcomes as well as analysis of counter-factual situations. The idea was that if threshold values are too loose then resources can readily gain undue cost recovery when they are persistently deviating from the ISO dispatch. On the other hand, threshold values that are too tight can unduly disqualify energy bid costs from real-time bid cost recovery calculations and thus may discourage the submission of real-time energy bids.

This analysis was done for approximately 190 dispatchable resources. Taken in aggregate, these data from these resources gives a robust picture of the overall behavior of generating resources as measured by these criteria. The distribution of generation technology types within the sample group closely approximates that of the generation fleet with the ISO with the exception that non-dispatchable resources such as wind, solar, and qualifying facilities (QFs) were removed from the sample.

All of the charts below depict the same data underlying data, but it different ways. After empirical analysis at the dispatch-interval level, the data are “rolled up.” Thus, what is shown in the charts below is Measures A and B calculated for each day, and for each resource with a net shortfall.

The data were grouped into “bins” or ranges and the number of instances of the relevant measure was calculated. Recall that Measure A describes the percentage of the shortfall that is due to uneconomic energy that is the result of deviations from previous intervals. The first bin was thus 0%, that is to say that none of the shortfall was due to persistent UIE. From there, the bins are in 10% increments. Measure B calculates the $/MWh value associated with the shortfall due to uneconomic energy from previous intervals. Again, the first bin is $0/MWh which corresponds to the case of no shortfall resulting from persistent UIE. The following five bins are in $10/MWh increments, and beyond that the data are placed in $50/MWh bins. The reason for the increased increment for the higher dollar per MWh bins is that there simply are not that many observations in these categories. By displaying the data using these bins, the information from this large number of observations can be presented in a way that facilitates visual interpretation, and smooths over anomalous data points.

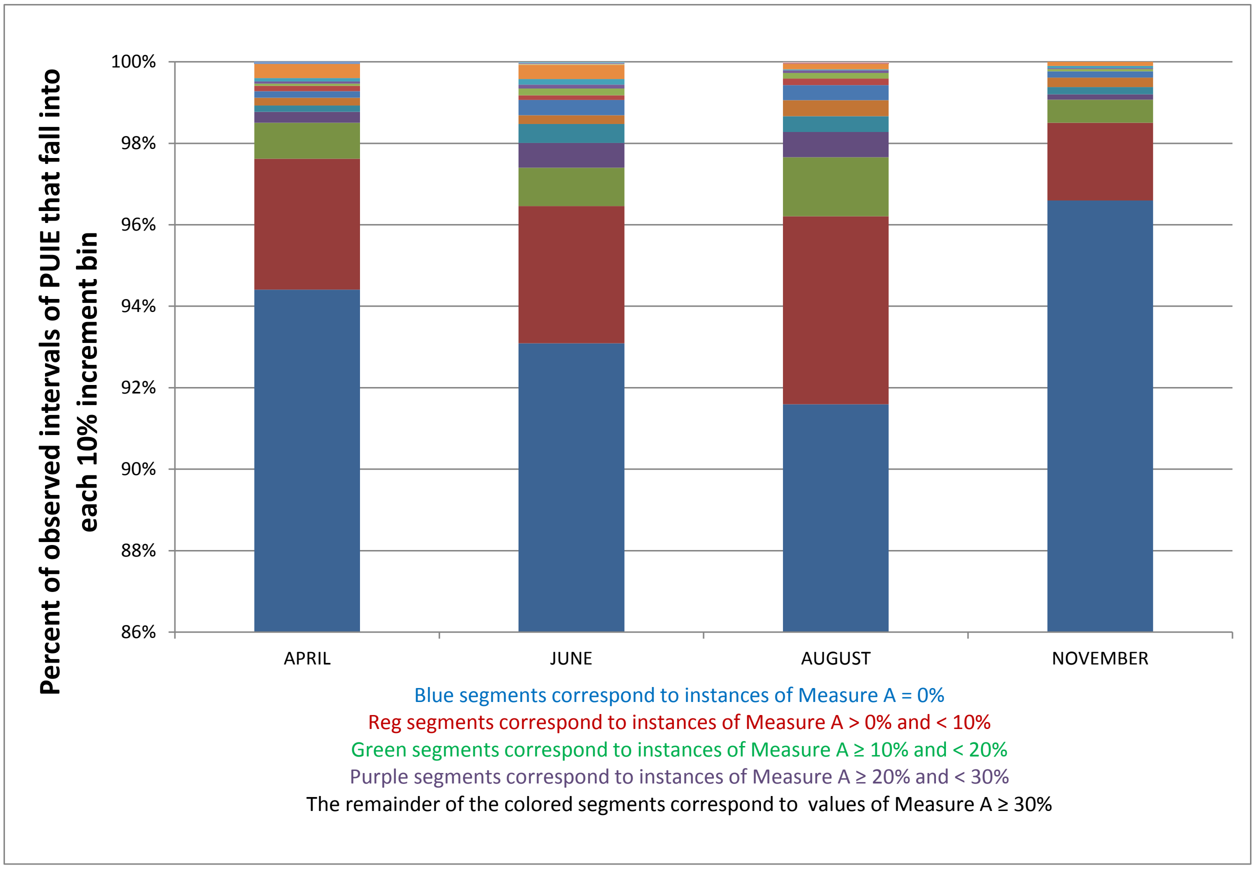
This empirical analysis considers four months of 2011: April, June, August, and November. In the first three months, the charts below show that there was a greater number of instances in which there were which there were shortfalls that were due in whole or in part to the deviations of prior intervals. It is likely that, especially in summer months of June and August when load is higher and more resources are online, there are credible reasons why persistent deviations can occur. The increase in instances of PUIE appears to be high in absolute terms, but the actual percentage increase is modest. It is also possible that the market behavior prompting the emergency filings in March and at the end of June contributed to persistent uninstructed deviations. November shows a significant improvement.

The two charts depict the percentage of observations (that is resource-days with net shortfalls) that fall into each of the bins described above.

The first chart describes this for Measure A. Note that the blue and red segments of each column, which correspond to the first two bins (0%, and 0 to 10% respectively), capture over 96% of the observations for the studied months.

<u>Figure 3.2.2-1</u>: PUIE check – Measure A

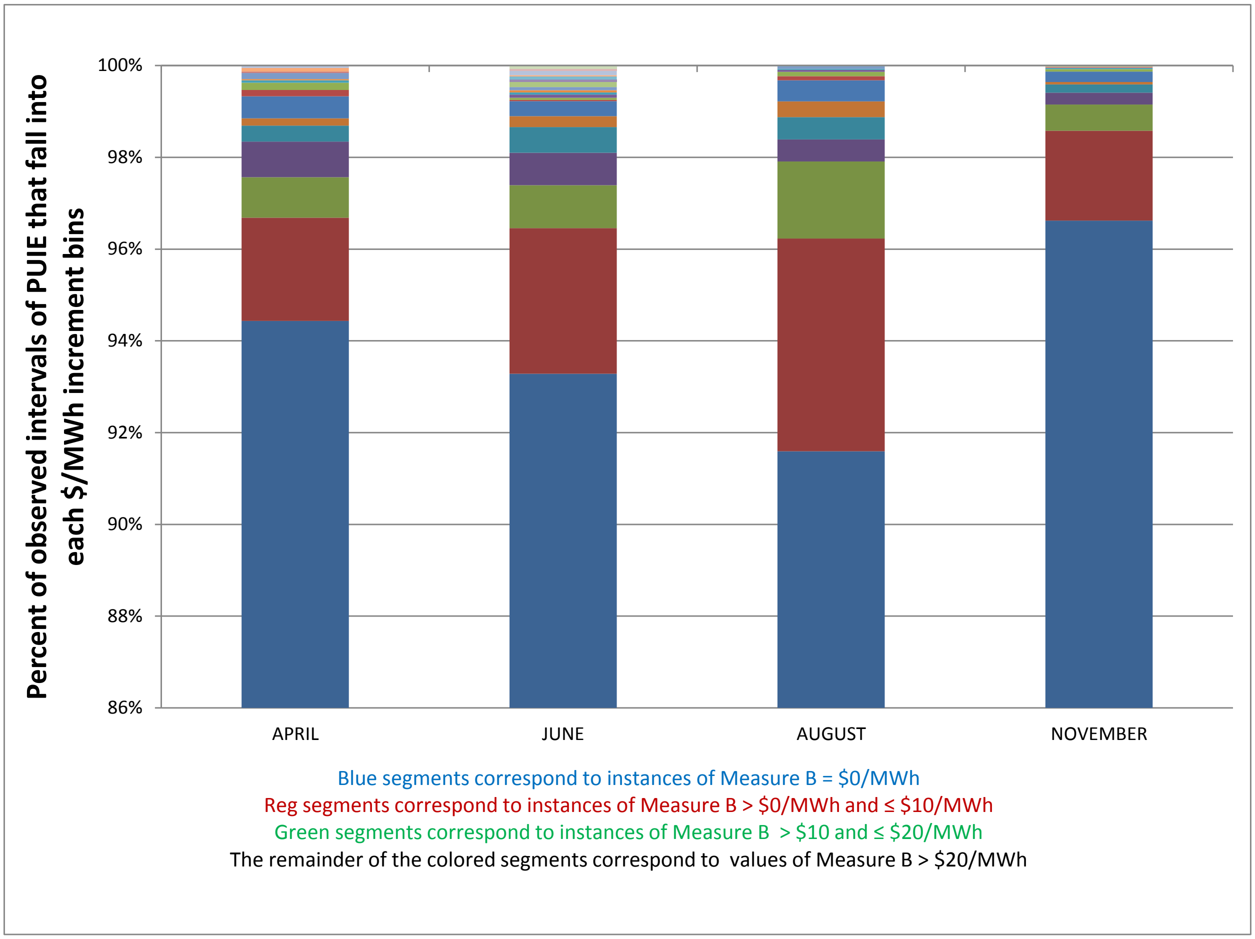
Percentage of resource-days with net shortfalls with Measure A values by bin



The second chart describes the percentage of observations (again, resource-days with net shortfalls) that fall into each of the bins described above for Measure B. Note that the blue and red segments of each column, which correspond to the first two bins ($0/MWh, and $0/MWh to $10/MWh) capture more than 96% of the observations for the studied months.

Figure 3.2.2-2: PUIE check – Measure B

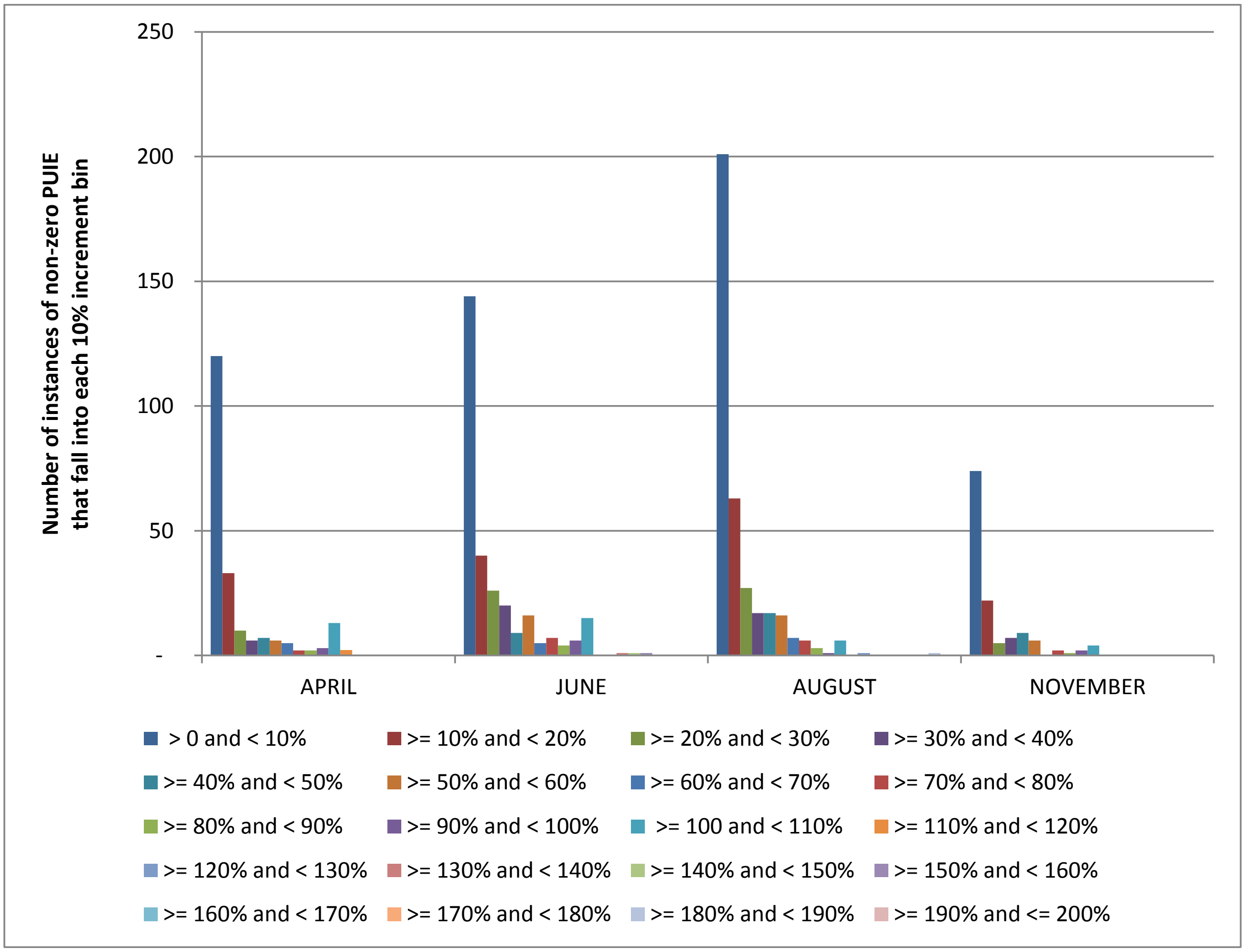
Percentage of resource-days with net shortfalls with Measure B values by bin



The second set of two charts provided below display the information from the analysis slightly differently. They show, by month, the number of resource-days for which Measure A and Measure B values populate the bins described above. Note though that in the following two charts, the Measure A bin of "0%" and the Measure B bin of "$0/MWh" have been left out. As was shown in the previous two charts, for the majority of resource-day shortfalls, there was no persistent UIE captured by Measures A and B. Leaving those bins out of the charts below enables one to better see the distribution of the net shortfall resource-days with only non-zero values for PUIE.

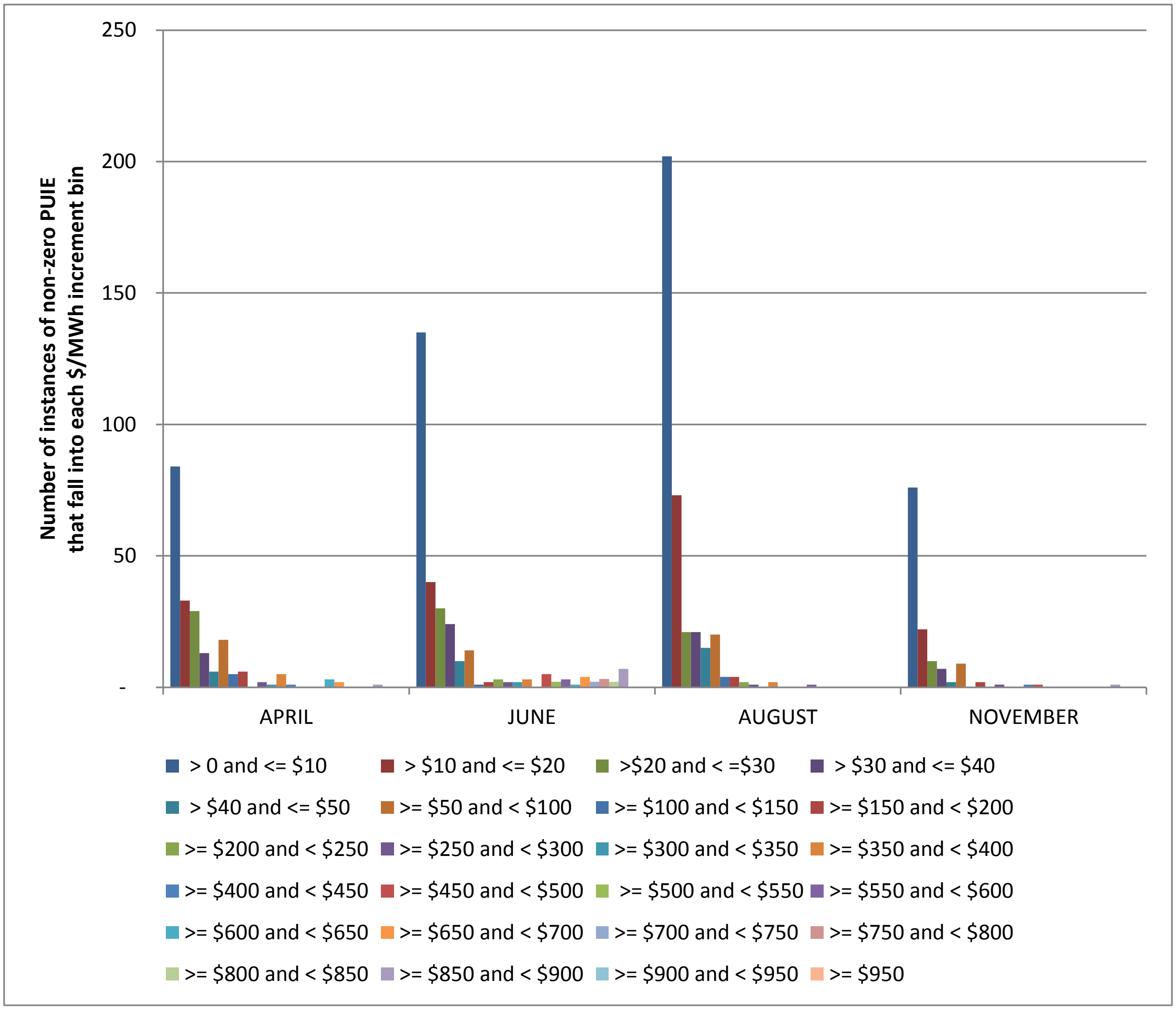
<u>Figure 3.2.2-3</u>: PUIE check – Measure A

Number of resource-days with net shortfalls with Measure B values by bin



<u>Figure 3.2.2-4</u>: PUIE check – Measure B

Number of resource-days with net shortfalls with Measure B values by bin

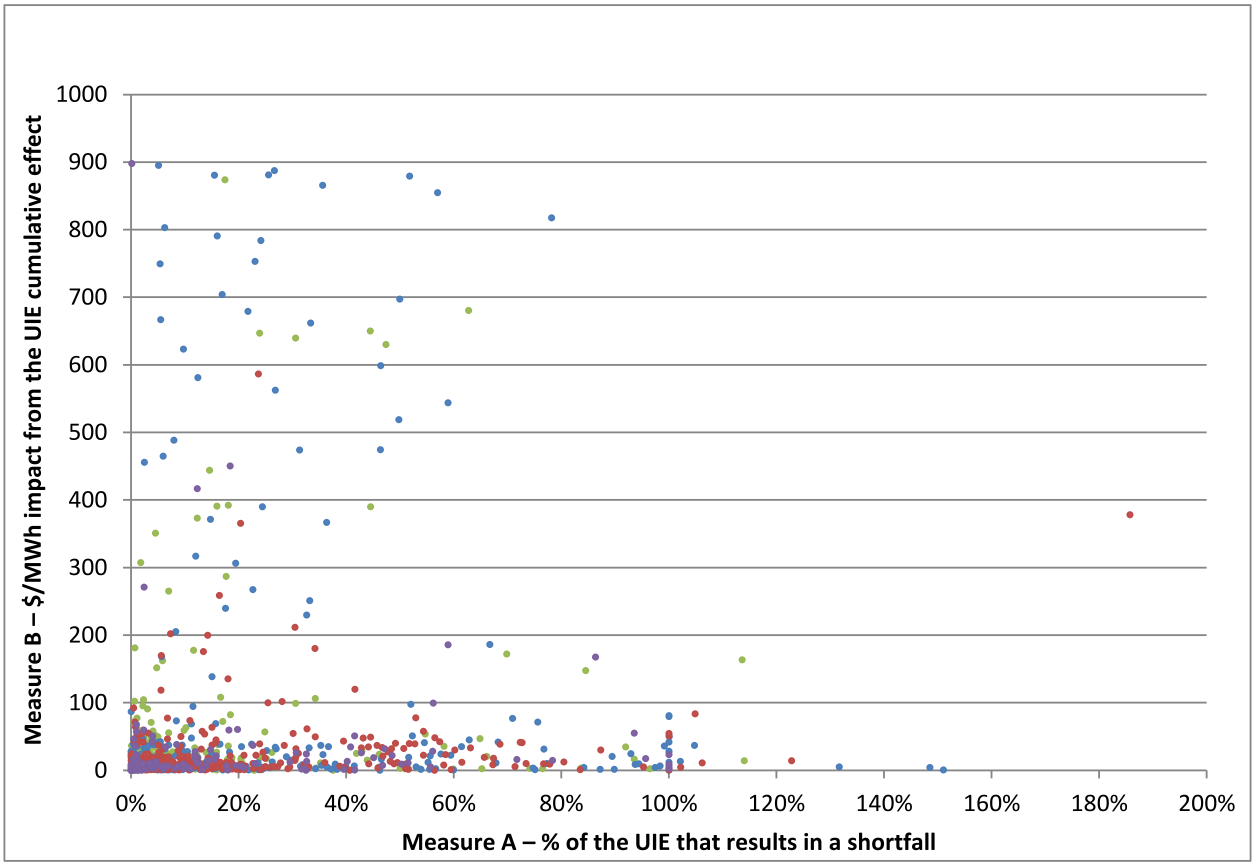


The ISO proposes that the threshold for Measure A be set at 10%, and that the threshold for Measure B be set at $10/MWh. That is to say that if **<u>either</u>** Measure A is calculated to be over 10% **<u>or</u>** Measure B is calculated to be greater than $10/MWh, then Measure A would be applied to the energy portion of the real-time energy revenue shortfall. As noted above, this captures over 96% of the instances of persistent UIE leading to a net shortfall over a day. Additionally, in most cases there is a significant drop-off in the number of observations above these values – they represent natural "break-points" in the data.

In this draft final proposal, the ISO also proposes to expand this "safe harbor" to include values of Measure A that are less than or equal to 3%, and values of Measure B that are less than or equal to $3/MWh.

The thresholds for Measures A and B are shown in the chart below. Two important points should be considered when studying this chart. First, the safe harbor area is not precisely depicted. Second, the vast majority of the observations are close to zero and thus their data point markers obscure one another. In other words, there are many more observations in the safe harbor area than are readily apparent in the chart.

Figure 3.3.2-5: Measures A and B with "safe harbor" area



The ISO will monitor PUIE and will also re-evaluate the thresholds for Measure A and Measure B to make sure that they are set at a level that establishes the appropriate tolerance.

3.3.6 Persistent uninstructed energy to avoid a shut-down instruction

The ISO has expressed concern that a generator could employ a strategy of persistent upward uninstructed deviations to avoid a shut-down instruction by the ISO. Specifically, a generator could position itself at MW level from which it takes more than one RTPD interval to ramp down the minimum load level for shutdown. By doing so, the generator would be able to avoid an economic shutdown instruction issued by the ISO and would continue to be online at level above the minimum load. Under the current tariff, the generator would receive the bid cost recovery for its minimum load cost.

The ISO evaluated the potential for developing an automated methodology to detect and quantify the impact of such market behavior. We have determined that such a detection algorithm is highly complex to develop and that the benefit of undertaking this effort is low. The conclusion about the benefit of developing the algorithm is due in part to the proposal of the PUIE check which (subject to the tolerance levels) disqualify the generator employing this strategy from real-time energy cost recovery. As noted above, the ISO is currently evaluating modifications to the cost cap for registered minimum load costs through the Commitment Costs

Refinements 2012 stakeholder initiative. The ISO expects that lower minimum load cost values will decrease the incentive to engage in this market behavior.

4 Conclusion

The ISO will conduct a stakeholder conference call to review this straw proposal on April 9, 2012. The ISO appreciates stakeholder comments. Please send your comments by close of business on April 16, 2012 to BCRMitigationMeasures@caiso.com.

5 Appendix A: Example of PUIE calculations

PUIE algorithm output for 5-minute intervals

5-minute interval 1	
Surp_Inc	0.00
Short_Inc	15.75
Surp_Dec	0.00
Short_Dec	0.00
UIEEffect (Up)	0.00
UIEBCR (Up)	0.00
UIEEffect (Down)	0.00
UIEBCR (Down)	0.00

5-minute interval 2	
Surp_Inc	0.0000
Short_Inc	0.0000
Surp_Dec	0.0000
Short_Dec	30.2500
UIEEffect (Up)	0.0000
UIEBCR (Up)	0.0000
UIEEffect (Down)	0.7500
UIEBCR (Down)	5.5000

Aggregating the PUIE output for a 10-minute interval

(The same methodology is used in aggregating over the day)

10-minute interval 1	
Surp_Inc	0.00
Short_Inc	15.75
Surp_Dec	0.00
Short_Dec	30.25
UIEEffect (Up)	0.00
UIEBCR (Up)	0.00
UIEEffect (Down)	0.75
UIEBCR (Down)	5.50

Intermediate values used in Measures A and B
UIEBCR (Total) = UIEBCR (Up) + UIEBCR (Down) UIEBCR (Total) = 5.50
UNENbcr = Short_Inc + Short_Dec UNENbcr = 46.00
UIEEffect (Total) = UIEEffect (Up) + UIEEffect (Down) UIEEffect (Total) = 0.75

Measures A and B
if net short > 0 then Measure A = XBCR (10) / Short (10) else Measure A = 0 In this case, Measure A = 0.12 or 12%
if XUIE > 0 then Measure B = XBCR (10) / XBCR (10) else Measure B = 0 In this case, Measure A = 7.33 or $7.33/MWh

If There is a net shortfall over the whole day And Measure A > 10% OR Measure B > $10/MWh Then Measure A x Energy revenue shortfall from settlements for settlement intervals with PUIE is disqualified from the final RT BCR calculation

6 <u>Appendix B</u>: Accounting for telemetry error

The PUIE algorithm evaluates the BCR shortfall resulting from persistent uninstructed deviations. The positive UIE that gives rise to incremental uneconomical energy in subsequent intervals, and the negative UIE that gives rise to decremental uneconomical energy in subsequent intervals are separately accumulated.

A generating resource's telemetered output (telemetry) is use in projecting its initial condition in RTD for determining the dispatch trajectory and thus plays a role in causing UIE of a generator. If the telemetry for a generating resource is off by some amount, RTD could yield a dispatch operating target (DOT) that the generator is not able to meet at the target time, resulting in uninstructed deviation in RT. Such a telemetry error could inflate Measure A. Filtering out this effect on UIE before processing the accumulated values will improve the accuracy of the PUIE approach.

A , The ISO has developed a refinement to the PUIE algorithm which uses the *effective* UIE for the accumulation of uneconomical energy. The effective UIE is no greater than UIE in magnitude. It is calculated based on both UIE, and on the difference between the actual energy change and the expected energy change. Using the difference in energy change is captures generator performance in following dispatch instructions subject to telemetry error. Though the accuracy of telemetry is not known to the market system, this option adjusts for the possibility that dispatch instructions are influenced by an error in telemetry. The calculation of effective UIE (EUIE) for a given interval is described next.

As noted above, the effective UIE considers the difference between the actual energy change and the expected energy change. The expected energy change is defined as the energy at the DOT level for the binding interval minus the energy at the initial condition level for the previous interval. The actual energy change is defined as metered energy of the binding interval minus the metered energy of previous interval.

Consider the scenario in which the telemetry of a generator indicates that its MW level is such that the bid price exceeds the LMP. RTD dispatches the generator downward and the generator is expected to reduce its energy production. Positive uninstructed deviation in conjunction above the incremental energy will increase the shortfall amount in subsequent intervals. However, should the actual energy also reduced by the same amount meaning that generator follows the instruction in terms of the energy change, this option will set effective UIE to zero despite of any positive original UIE. Hence no uninstructed deviation will be counted into the accumulation.

In detail,

If expected energy change < 0, then
    If UIE ≥ 0 then
        EUIE is set to the actual energy change minus the expected energy change but bounded within 0 and UIE
    Else
        EUIE is set to UIE
    End if
End if.

For expected energy change > 0 meaning dispatch generator upward, similar logic applies.

If expected energy change > 0, then
    If UIE ≤ 0 then
        EUIE is set to the actual energy change minus the expected energy change but bounded within 0 and UIE
    Else
        EUIE is set to UIE
    End if
End if.