



April 27, 2012

The Honorable Kimberly D. Bose  
Secretary  
Federal Energy Regulatory Commission  
888 First Street, NE  
Washington, DC 20426

**Re: California Independent System Operator Corporation  
Docket Nos. ER12\_\_\_\_-000; RM11-7; AD10-11**

**Order 755 Compliance Filing – Frequency Regulation Compensation  
in the Organized Wholesale Power Markets**

Dear Secretary Bose:

The California Independent System Operator Corporation (ISO) submits this tariff amendment in compliance with the Commission's final rule concerning compensation for frequency regulation in organized wholesale power markets.<sup>1</sup> The ISO requests an order accepting this tariff amendment in September 2012, and an effective date of April 9, 2013, subject to the ISO providing two weeks prior notice to the Commission as to the actual effective date. This effective date coincides with the ISO's planned release of market enhancements for the spring of 2013, and will permit the ISO and market participants to deploy and test market systems to implement *Order 755*. The ISO requests that the Commission waive the requirement of 18 C.F.R. § 35.3 that a rate schedule be filed not more than 120 days from the effective date.

**I. Background**

In 2011, the Commission issued *Order 755*, which adopted a final rule for compensation of frequency regulation in organized wholesale power markets. The Commission determined that current compensation methods for regulation

---

<sup>1</sup> *Frequency Regulation Compensation in the Organized Wholesale Power Markets*, 137 FERC ¶ 61,064 (October 2011) (*Order 755*); *rehearing denied* 138 FERC ¶ 61,123 (February 2012) (*Order 755-A*). The ISO also submits this filing pursuant to Section 205 of the Federal Power Act, 16 U.S.C. § 824d, and Section 35.13 of the Commission's regulations, 18 C.F.R. § 35.13.

service in regional transmission operator (RTO) and independent system operator (ISO) markets fail to acknowledge the inherently greater amount of regulation service provided by faster-ramping resources and that certain practices result in economically inefficient economic dispatch of regulation resources. To remedy these issues, the Commission's final rule requires RTOs and ISOs to compensate regulation resources based on the actual service provided, including a capacity payment that reflects the marginal unit's opportunity costs and a performance payment that reflects the quantity of regulation service actually provided by a resource when the resource accurately follows a dispatch signal.<sup>2</sup> *Order 755* requires the use of a market-based rather than administrative price on which to base performance payments.<sup>3</sup>

The ISO conducted a stakeholder process after the issuance of *Order 755* to examine its current market design for regulation services and assess what changes it needed to make to comply with the Commission's final rule. The ISO believes its current practices satisfy the Commission's requirement that resources providing regulation receive a capacity payment that reflects the marginal unit's opportunity costs.

The ISO also examined the concept of mileage with stakeholders to measure a resource's movement in response to a dispatch signal. This actual movement will serve as the basis for a performance payment. The ISO, in consultation with stakeholders, developed a separate mileage constraint to include in the market software in order to establish a uniform market clearing price for regulation up and regulation down performance payments. The ISO will use this price to compensate resources based on their actual movement in response to a dispatch signal, subject to an accuracy adjustment. The ISO

---

<sup>2</sup> *Order 755* adds a definition at 18 C.F.R. § 35.2(g) for frequency regulation to read as follows:

The term *frequency regulation* as used in this part will mean the capability to inject or withdraw real power by resources capable of responding appropriately to a system operator's automatic generator control signal in order to correct for actual or expected Area Control Error needs.

*Order 755* also adds a new paragraph at 18 C.F.R. § 35.28(g)(3) to read as follows:

Each Commission-approved independent system operator or regional transmission organization that has a tariff that provides for the compensation of frequency regulation service must provide such compensation based on the actual service provided, including payment that includes the marginal unit's opportunity costs and a capacity payment for performance that reflects the quantity of frequency regulation service provided by a resource when the resource is accurately following the dispatch signal

<sup>3</sup> *Order 755* at P 128.

believes that the tariff revisions it is proposing in this compliance filing will provide additional compensation to resources that move more than other resources in response to ISO control signals. Resources that respond with greater accuracy will also receive higher payments.

## **II. Overview of ISO's current regulation service**

In the ISO's current market, regulation is a service provided by resources certified to respond automatically to control signals in an upward or downward direction to balance demand and resources in real-time.<sup>4</sup> The ISO market procures regulation for many reasons including frequency response and market imbalances that occur between 5 minute dispatch intervals as well as for forecast inaccuracies or supply deviations. The ISO uses a regulation forecasting procurement tool that adjusts the procurement of regulation in the day-ahead market throughout the operating day based on varying operational needs arising from anticipated demand levels as well as potential changes in generator and intertie schedules.<sup>5</sup> The ISO market also procures incremental regulation requirements in the real time unit commitment process.<sup>6</sup>

As part of its energy management system, the ISO uses regulation resources on automatic generation control to manage the difference between its scheduled and actual interchange, as well as its share of correcting the frequency of the Western interconnection. Resources qualified for regulation must respond to a control set point.

The ISO market pays resources with regulation awards an ancillary service marginal price established for that ancillary service region in which the

---

<sup>4</sup> Appendix A of the ISO's tariff defines Regulation as follows: "The service provided either by resources certified by the CAISO as equipped and capable of responding to the CAISO's direct digital control signals, or by System Resources that have been certified by the CAISO as capable of delivering such service to the CAISO Balancing Authority Area, in an upward and downward direction to match, on a Real-Time basis, Demand and resources, consistent with established NERC and WECC reliability standards, including any requirements of the NRC. Regulation is used to control the operating level of a resource within a prescribed area in response to a change in system frequency, tie line loading, or the relation of these to each other so as to maintain the target system frequency and/or the established Interchange with other Balancing Authority Areas within the predetermined Regulation Limits. Regulation includes both an increase in Energy production by a resource or decrease in Energy consumption by a resource (Regulation Up) and a decrease in Energy production by a resource or increase in Energy consumption by a resource (Regulation Down). Regulation Up and Regulation Down are distinct capacity products, with separately stated requirements and ASMPs in each Settlement Period."

<sup>5</sup> ISO tariff section 8.3.1. See also, ISO Technical Bulletin 2009-12-02 AS Procurement Regulation dated December 30, 2009. <http://www.caiso.com/2494/2494c16876b0.pdf>.

<sup>6</sup> ISO tariff section 8.3.1.

resource is located.<sup>7</sup> Regulation up and regulation down have separate ancillary service marginal prices. These capacity prices include the foregone opportunity cost, if any, of the marginal resource in an ancillary service region for not providing energy or other types of ancillary services the marginal resource is capable of providing in the relevant market interval.<sup>8</sup> For instance, regulation up can substitute for spinning reserve and non-spinning reserve in the ISO's market.<sup>9</sup> Regulation down is the only downward ancillary service and does not substitute for other ancillary services in the ISO's market.

For resources with a regulation up award that receive a signal from the ISO's energy management system to move from their set point, the ISO market pays those resources the applicable locational marginal price for the instructed imbalance energy generated by the resource. Resources providing regulation down are effectively charged the locational marginal price for dispatches of regulation down energy, which is then settled as real time instructed imbalance energy. The ISO nets energy from regulation up and regulation down dispatches over a 10 minute settlement interval, settling the energy as real time instructed imbalance energy at the applicable locational marginal price. The ISO is not proposing to change this practice as part of this tariff amendment.<sup>10</sup>

### **III. Proposed tariff amendments**

The ISO's tariff amendments encompass three general categories: (1) amendments to implement a uniform capacity payment for resources providing regulation that includes the marginal unit's opportunity costs; (2) amendments to establish a performance payment that reflects the quantity of regulation service provided by a resource when the resource accurately follows a dispatch signal; and (3) amendments to address ramp-rate certification requirements and a minimum performance threshold for resources providing regulation. Beyond proposed maximum and minimum bid prices for mileage bids, the ISO does not believe any additional mitigation measures are necessary at this time to implement the compensation approach directed by *Order 755* for resources providing regulation.

---

<sup>7</sup> ISO tariff section 27.1.2.

<sup>8</sup> ISO tariff section 27.1.2.2.

<sup>9</sup> ISO tariff section 8.2.3.5.

<sup>10</sup> In *Order 755*, the Commission stated it will take no action on net energy balancing and that ISO and RTOs may retain their current rules. *Order 755* at P 161.

### **A. Tariff amendments to address uniform capacity payments for regulation up and regulation down**

*Order 755* requires RTO and ISO markets to provide a capacity, or option, payment for keeping a resource's capacity in reserve to provide real-time regulation service.<sup>11</sup> *Order 755* states that this payment must be a uniform payment to all cleared resources providing regulation based on competitive bids and must include the marginal unit's opportunity costs.<sup>12</sup> In addition, the RTO or ISO must calculate and include in its market-clearing process the cross-product opportunity costs of each resource offering its capacity.<sup>13</sup> Finally, a resource may include inter-temporal opportunity costs in its offer to sell regulation, with the requirement that the cost be verifiable.<sup>14</sup>

The ISO's existing regulation market provides for a uniform capacity payment for resources providing regulation that includes the marginal unit's opportunity costs. Under its current tariff, the ISO market pays resources with regulation awards an ancillary service marginal price for that ancillary service region.<sup>15</sup> The ISO tariff defines two ancillary service regions: the *system region* (*i.e.*, the ISO balancing authority area) and the *expanded system region* (*i.e.*, the system region and the intertie scheduling points with adjacent balancing authority areas), and eight sub-regions within them.<sup>16</sup> Within these regions, the ISO may procure both regulation up and regulation down and set uniform clearing prices for that capacity. This design serves as the basis for the ISO's scarcity pricing demand curves when there is an insufficient supply of ancillary service capacity.<sup>17</sup> As stated by the Commission in *Order 755-A*, the use of ancillary service regions is a reliability and procurement concern.<sup>18</sup> The Commission stated that it will allow each RTO and ISO to propose in its compliance filing how the requisite uniform payment will apply in its particular pricing regions and that an RTO or ISO may propose to use zones or pricing regions as part of its Order No. 755 compliance filing.

---

<sup>11</sup> *Order 755* at 198.

<sup>12</sup> *Id.*

<sup>13</sup> *Id.*

<sup>14</sup> *Order 755* at P 103.

<sup>15</sup> ISO tariff section 27.1.2.

<sup>16</sup> *Id.* at section 8.3.3; see also ISO Business Practice Manual for Market Operations at 70-73. <https://bpm.caiso.com/bpm/bpm/list>

<sup>17</sup> ISO tariff at section 27.1.2.3.

<sup>18</sup> *Order 755-A* at 15, citing *Order 755* at P 181.

The ISO's final proposal to implement *Order 755* continues to use established ancillary service regions within the ISO's system.<sup>19</sup> This approach ensures that resources receive a uniform market clearing price but also ensures the ISO procures sufficient regulation distributed across its system to reliably operate the grid. These capacity prices include the foregone opportunity cost, if any, of the marginal resource in the ancillary service region for not providing energy or other types of ancillary services that the marginal resource is capable of providing in the relevant ISO market interval.<sup>20</sup> Through this tariff amendment, the ISO is proposing to augment this design by authorizing resources to calculate and submit their own inter-temporal opportunity costs with their regulation up and regulation down capacity bids. The ISO has added language to existing tariff section 30.5.2.6.1 regarding regulation up and regulation down bid information to reflect this feature, subject to the requirement that the inter-temporal costs be verifiable as directed by *Order 755*. The ISO's ancillary service bid cap of \$250 would still apply to regulation capacity bids.<sup>21</sup>

#### **B. Tariff amendments to implement a performance payment for regulation up and regulation down**

*Order 755* requires RTO and ISO markets to provide regulation resources a performance payment that reflects the amount of work each resource performs in real-time and the accuracy with which each resource responds to the system operator's dispatch signal.<sup>22</sup> The Commission specified that the performance payment must be based on resource bids, but provided flexibility to RTOs and ISOs to propose a method for measuring a regulation resource's accuracy in response to a dispatch and reflecting that accuracy in the resource's payment.

The ISO's proposed tariff amendments to implement a performance payment for regulation up and regulation include provisions to address the following:

- Establishing a mileage requirement in order to calculate uniform market clearing prices for performance payments to resources providing regulation

---

<sup>19</sup> See Section 5.1 of ISO's addendum to draft final proposal to implement *Order 755* at 5. [http://www.caiso.com/Documents/Addendum-DraftFinalProposal-Pay\\_PerformanceRegulation.pdf](http://www.caiso.com/Documents/Addendum-DraftFinalProposal-Pay_PerformanceRegulation.pdf)

<sup>20</sup> ISO tariff section 27.1.2.2.

<sup>21</sup> ISO tariff section 39.6.1.3.

<sup>22</sup> *Order 755* at PP 199-200.

- Measuring regulation performance, including the accuracy of a resource's response to the ISO's dispatch signal
- Modifying bidding rules for resources using regulation energy management
- Calculating mileage bids costs
- Calculating regulation performance payments
- Allocating costs for performance payments
- Calculating mileage market clearing prices for regulation up and down based on mileage awards
- Adopting parameters for mileage bids

**i. Establishing a mileage requirement in order to calculate a uniform market clearing prices for performance payments to resources providing regulation**

The ISO proposes to revise tariff section 8.2.3.1 to establish a mileage procurement requirement in order to calculate a uniform market clearing price based on mileage bids for performance payments to resources providing regulation. The proposed tariff language provides that mileage requirements for either regulation up or regulation down will reflect the minimum of (a) the product of the respective regulation capacity requirement and the system mileage multiplier (b) the average instructed mileage for the applicable trading hour from the prior calendar week; or (c) the product of a resource's resource-specific mileage multiplier and a resource's self-provided or bid-in regulation capacity, which number is then summed for all resources. The mileage requirement is subject to operator adjustment to reflect system needs. The ISO is proposing to establish new defined tariff terms for mileage, system mileage multiplier, and instructed mileage as follows:

*Mileage* shall mean the service provided by a resource with a regulation up and regulation down capacity award in response to the ISO's energy management system signal.

*System mileage multiplier* shall mean a quantity reflecting expected mileage from 1 MW of regulation up and regulation down capacity in a given hour.

*Instructed mileage* shall mean the absolute change in automatic generation control set points between each four (4) second interval.

The ISO proposes to calculate a resource-specific mileage multiplier based on the historic accuracy of a resource and the resource's certified 10-minute ramp capability.<sup>23</sup> For any settlement period in which it is necessary to procure regulation capacity, the ISO will establish an explicit mileage requirement. Currently, the ISO market implicitly purchases mileage (or the ability of a resource to move in response to a control signal) through regulation capacity awards. This attribute is implicit in regulation capacity and the ISO is not changing how it establishes regulation capacity procurement requirements. By calculating a mileage requirement based on regulation capacity requirements, actual instructed mileage from a prior week or regulation capacity bid or self-provided by certified resources, the ISO will ensure that the market price for a performance payment reflects the capability of resources to supply sufficient mileage.

Section 8.2.3.1 also provides that the ISO will publish on its open access same-time information system, the mileage requirements for each hour of the day-ahead market and each fifteen (15) minute period in the real-time market for the applicable trading day. The ISO also commits to publish on its open access same-time information system the instructed mileage for each hour of a trading day. This number will reflect the total movement that the ISO's energy management system requested of resources during an applicable trading hour.

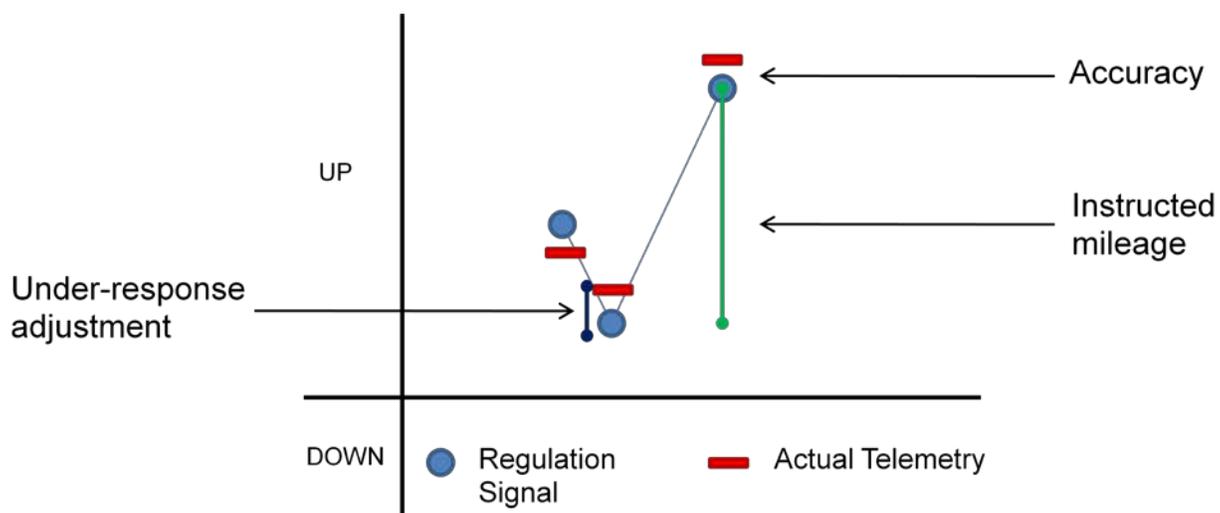
**ii. Measuring regulation performance, including the accuracy of a resource's response to the ISO's dispatch signal**

The ISO proposes to add new section 8.2.3.1.1 to its tariff to describe how it will measure regulation performance, including the accuracy of a resource's response to the ISO's energy management system and the ISO's adjustment to a resource's under-response to an ISO's set point instruction. The actual movement of resources in response to dispatch instructions will serve as the basis for a performance payment required by the Commission's final rule. The following diagram depicts an example of how the ISO will calculate instructed mileage for regulation up in a 15 minute interval. The blue circles reflect the set points to which the ISO's regulation signal has directed the resource to move. The sum of all the green bars reflects the instructed mileage during the applicable settlement interval.

---

<sup>23</sup> See also, proposed ISO tariff section 27.1.3 and proposed definition for *Historical Regulation Performance Accuracy* in Appendix A.





The ISO is also proposing to use the measurements of a resource's historical accuracy as well as a resource's certified ramp rate as part of its assessment of regulation up and regulation down capacity bids. In this way, the ISO can assess a resource's capability to respond accurately to a dispatch signal in awarding capacity as well as in a performance payment. The ISO is proposing to calculate this accuracy factor each month on a thirty (30) day simple average of 15 minute accuracy measurements.<sup>24</sup> In the event that the resource does not provide mileage in a fifteen minute interval, the ISO will not include the 15 minute interval in calculating the resource's accuracy percentage. In the event that a resource has not provided regulation up or regulation down over the prior thirty (30) day period, the ISO will use the simple average accuracy for all resources from the prior month as an initial adjustment factor.

### iii. Modifying bidding rules for resources using regulation energy management

The ISO is proposing to modify section 8.4.1.2 of its tariff relating to regulation energy management. This feature will allow greater participation by non-generator resources in the ISO's ancillary services market.<sup>25</sup> These tariff changes clarify that resources using this market enhancement may submit both regulation capacity and regulation mileage bids. The ISO plans to implement

<sup>24</sup> See proposed new defined term *Historical Regulation Performance Accuracy* in Appendix A of the ISO's tariff.

<sup>25</sup> These resources have the capability to be dispatched to any operating level within their operating range but are subject to constraints with respect to the amount of energy they can generate or curtail. Examples of non-generator resources include, but are not limited to, battery storage, flywheels and dispatchable demand response.

regulation energy management in the fall of 2012, but believes it is appropriate to make the proposed tariff change in this amendment.

**iv. Calculating mileage bids costs**

In tariff sections 11.8.2.1.6 and 11.8.4.1.6, the ISO has proposed revisions to describe the calculation of mileage bid costs in the day-ahead market and real-time market for purposes of any bid cost recovery. Bid cost recovery is the ISO's settlement process by which resources recover their bid costs as defined by the ISO's tariff. The ISO proposes to treat mileage bids in the same manner as regulation up and regulation down capacity bids for purposes of calculating bid cost recovery. Revisions to tariff sections 11.8.2.1.6 and 11.8.4.1.6 specify that ancillary services bid costs shall include mileage bid costs.

**v. Calculating regulation performance payments**

The ISO proposes to add a new tariff section 11.10.17 to describe performance payments to resources providing regulation, including how the ISO will treat dispatches of real-time regulation awards as opposed to day-ahead market regulation awards. This tariff language provides that resources supplying mileage from contracted or self-provided regulation capacity in the day-ahead market are paid a mileage clearing price for each MW of instructed mileage during the settlement period. As defined above, instructed mileage is the absolute change in automatic generation control set points between each four (4) second interval. If a resource is awarded incremental regulation capacity in the real-time market, the instructed mileage shall be divided between the day-ahead market and real time market based on a weighted average of the capacity awards. The ISO will adjust a resource's mileage payments by applying accuracy percentages calculated for each resource based on the resource's response to energy management system signals. If data is missing to assess a resource's accuracy for settlement purposes, the ISO will use the simple average of the resource's previous ten 15 minute accuracy percentages for the periods of missing data for settlement purposes.<sup>26</sup>

**vi. Allocating costs for performance payments**

The ISO proposes to add new tariff sections 11.10.2.1.5 and 11.10.2.2.4 to address the allocation of performance payments for regulation down and regulation up, respectively. In short, the ISO is proposing to allocate these costs in the same manner that it allocates the costs of regulation up and down capacity payments. Similar to regulation capacity, the ISO will allocate performance payments made to resources based on a scheduling coordinator's ancillary service obligations. Performance payments for resources with regulation up

---

<sup>26</sup> See, proposed ISO tariff section 8.2.3.1.1.

awards will be allocated to scheduling coordinator's with regulation up ancillary service obligations. Performance payments for resources with regulation down awards will be allocated to scheduling coordinator's with regulation down ancillary service obligations. The ISO will also apply a bid segment fee of \$0.005 to resources submitting mileage bids. This charge applies to all bids and does not require a tariff change.<sup>27</sup>

**vii. Calculating uniform mileage market clearing prices for regulation up and down**

The ISO proposes to add a new section 27.1.3 to describe the calculation of uniform mileage market clearing prices for regulation up and regulation down across the ISO's system. These prices will serve as the basis for performance payments that will reflect instructed mileage as adjusted by a resource's accuracy in responding to the ISO's dispatch signal. This tariff section provides that the ISO will calculate market clearing prices across its expanded system region based on the intersection of the demand curve for mileage requirements and supply curve for bid-in mileage. The ISO will publish on its open access same-time information system the market clearing prices for each hour of the day-ahead market and each fifteen (15) minute period in real-time for each trading day.

**viii. Adopting parameters for mileage bids**

The ISO proposes to adopt specific tariff rules for mileage bids, including stating that scheduling coordinators submitting mileage bids must state a bid price in dollars separately for regulation up and regulation down. The ISO has proposed a change to existing tariff section 30.5.2.6.1 to implement this rule. The ISO also proposes to modify existing tariff section 30.7.3.1 to state that if scheduling coordinators with self-provided or bid-in regulation capacity do not submit a mileage bid, the ISO will generate a \$0 mileage bid on their behalf. Finally, the ISO proposes to establish a maximum mileage bid price of \$50 and minimum mileage bid price of \$0.<sup>28</sup> The ISO's current maximum ancillary service bid price is \$250.00. For purposes of establishing the maximum mileage bid price, the ISO assumed a mileage multiplier of 5 and divided the current \$250.00 regulation capacity maximum bid price accordingly.

---

<sup>27</sup> See, ISO tariff section 11.22.5.

<sup>28</sup> See, proposed ISO tariff sections 39.6.1.3.1; 39.6.1.5.1

### **C. Tariff amendments to address certification requirements and establish a minimum performance threshold**

The ISO is proposing to modify its tariff to specify the maximum regulation capacity that a resource may offer in either the day-ahead market or real-time market. In addition, the ISO is proposing a minimum performance threshold for resources that provide regulation services.

Currently, the ISO's tariff sets the maximum regulation capacity that a resource may offer as the amount reached within a period that may range from a minimum of 10 minutes to a maximum of 30 minutes, as such period may be specified by the ISO. The ISO's current business practice is to specify this period as 10 minutes. The ISO is proposing to modify tariff section 8.4.1.1(c) as well as Appendix K, Part A of the ISO's tariff to standardize the duration of the ramping interval to 10 minutes. By using the 10 minute ramp, the certification process will use the same ramp measurement interval for regulation, spinning reserves and non-spinning reserves.

In connection with this enhancement, the ISO proposes to establish a minimum performance threshold for resources providing regulation. In order to calculate payments to regulation resources based on the accuracy of their response to the ISO's dispatch signal, the ISO will collect data on individual resource performance. The ISO proposes to include language within new tariff section 8.2.3.1.1 to establish this minimum performance threshold at 50 percent accuracy for both regulation up and regulation down as measured over a calendar month. If a resource violates the minimum performance threshold, the resource will have ninety days to re-certify to provide regulation from the date the ISO provides notice to the scheduling coordinator. If the resource does not re-certify within the ninety days, the ISO will change the master file to reflect that the resource is no longer certified to provide regulation. The ISO is also proposing to amend tariff sections 8.4.1.1 and Appendix K, Part A of the ISO's tariff to reference the minimum performance threshold as a requirement for providing regulation services. In the event a resource falls below the minimum performance threshold for one regulation service (e.g. regulation down), the resource will only be required to re-certify to provide that regulation service. The ISO may request changes to the minimum performance threshold as the ISO gains more experience with performance payment for regulation services.

### **D. The ISO believes it has proposed sufficient mitigation measures**

*Order 755* requires RTOs and ISOs either to submit tariff provisions for market power mitigation methods appropriate to their redesigned regulation markets or explain how their current mitigation methods are sufficient to address

market power concerns.<sup>29</sup> The ISO is proposing to co-optimize mileage awards with regulation capacity and energy. The ISO is also proposing a minimum and maximum mileage bid price. The ISO believes that this design sufficiently addresses any market power concerns. By co-optimizing mileage awards with regulation capacity and energy bids, the ISO will ensure resources that receive an award to provide regulation capacity will also meet mileage requirements at just and reasonable prices.

The ISO's Market Surveillance Committee issued an opinion supporting the ISO's approach to implement *Order 755* but raised market efficiency concerns that may result from the difference between the actual mileage provided by resources that receives compensation and the expected mileage from resources the ISO calculates for purposes of conducting its market optimization.<sup>30</sup> The Market Surveillance Committee also identified concerns that fast ramping resources may employ a bidding strategy to collect high bid cost recovery payments. The ISO intends to monitor market outcomes under *Order 755* and will propose adjustments to its market design as necessary, if these issues materialize.

The ISO's Department of Market Monitoring also expressed support for the ISO's proposal. At this time, the Department of Market Monitoring does not recommend pursuing mitigation options to bid cost recovery or to limit mileage bids beyond constraining the mileage maximum bid price to \$50.<sup>31</sup> In the immediate future, the Department of Market Monitoring has determined that the market for regulation is highly competitive due to a large amount of overall supply relative to regulation capacity requirements. In the near future, it is likely that competition from these existing resources will ensure that regulation capacity prices continue to be low, and that there will be a similar impact on mileage prices. The Department of Market Monitoring observes that there are currently few if any very fast ramping resources providing regulation in the ISO market that have the opportunity and incentive to employ a bidding strategy aimed at increasing bid cost recovery payments. Fast ramping resources providing regulation in the current market are typically hydro-electric resources, which are owned by the regulated load serving entities. The Department of Market Monitoring expects that participation by substantial amounts of new merchant resources capable of providing very fast ramping regulation – such as battery

---

<sup>29</sup> *Order 755* at P 136.

<sup>30</sup> A copy of the ISO's Market Surveillance Committee's Opinion is available at the following Web site: [http://www.caiso.com/Documents/Decision\\_PayForPerformanceRegulation-MSCOpinion-MAR2012.pdf](http://www.caiso.com/Documents/Decision_PayForPerformanceRegulation-MSCOpinion-MAR2012.pdf)

<sup>31</sup> The ISO's Department of Market Monitoring memorandum to the ISO Board of Governor's on this issue is available at the following Web site: [http://www.caiso.com/Documents/Department\\_MarketMonitoringReport-MAR2012.pdf](http://www.caiso.com/Documents/Department_MarketMonitoringReport-MAR2012.pdf)

storage or flywheels – may only occur over a much longer time horizon and, accordingly, recommends that the ISO monitor market performance after implementation and be prepared to modify software or market rules as appropriate.

Since many design elements of this proposal are based upon historical data, the ISO believes it is prudent to evaluate the design and determine if any modifications are necessary. The ISO proposes to conduct an operational review based on one year of data after this enhancement reaches production to evaluate the ISO's design, including, but not limited to, the appropriateness of the minimum performance threshold level, the historical data used to calculate the mileage multiplier, whether the regulation capacity procurement target should reflect historical accuracy of resources, the level of the mileage maximum bid price and mileage scarcity price, and the change in resource participation in regulation under the new compensation mechanism. Thereafter, the ISO will continue to monitor its market design and will propose software or market rule changes as appropriate.

#### **IV. Stakeholder Process**

The ISO believes there is generally broad support for its tariff revisions to implement *Order 755*. This support ranges from load serving entities to storage interests. In the fourth quarter of 2011, the ISO commenced a stakeholder holder process to design a performance payment for resources providing regulation. The ISO issued an initial proposal on December 2, 2012. Over the course of the next three months, the ISO held three conference calls with stakeholders and issued revisions to its proposal for additional stakeholder review and comment. During this process, the ISO considered stakeholder input and either modified its proposal or responded to stakeholder concerns.<sup>32</sup> On March 23, 2012, the ISO's Board of Governors authorized the ISO to revise its tariff and request authorization to implement *Order 755* in the spring of 2013.<sup>33</sup> At that meeting, stakeholders provided comments in support of the ISO's proposal. The ISO, however, is aware that at least one stakeholder still supports an earlier effective date than that proposed by the ISO. The ISO addresses this argument in Section V below.

---

<sup>32</sup> The ISO has posted materials related to its stakeholder process to implement Order 755 at the following Website:  
<http://www.caiso.com/informed/Pages/StakeholderProcesses/PayforPerformanceRegulation.aspx>

<sup>33</sup> The ISO has attached to this filing the materials presented to the ISO's Board of Governors as well as a record of the Board of Governor's vote. These materials are also available at the following Web site:  
[http://www.caiso.com/Documents/Board%203\)%20Decision%20on%20pay%20for%20performan%20regulation](http://www.caiso.com/Documents/Board%203)%20Decision%20on%20pay%20for%20performan%20regulation)

The ISO discussed concerns with stakeholders in connection with compensating two attributes of a single service based on separate market clearing prices for regulation capacity and regulation mileage. The ISO and stakeholders examined deploying separate constraints for regulation capacity and regulation mileage in the market optimization because of concerns that the market optimization could not simultaneously determine a price for regulation capacity and mileage. The ISO's current proposal overcomes this concern by determining a uniform clearing price for mileage that takes into consideration expected mileage associated with regulation capacity awards even though the ISO market will compensate only actual mileage.

Several stakeholders requested the ISO calculate a dynamic mileage multiplier to assess expected mileage and help establish a mileage requirement for any hour. In response to these concerns, the ISO revised its proposal to calculate an hourly mileage multiplier based on the actual mileage of the prior week for each hour. The ISO will multiply this mileage multiplier by the regulation capacity requirement in any given hour as one calculation to determine an hourly mileage requirement.

The ISO also received input from stakeholders on the how the ISO settles net energy dispatched from regulation resources. One stakeholder recommended that the ISO settle these dispatches at the higher of the real-time locational marginal price or the resource's bid and the settle net energy consumed at the lower of the real-time locational marginal price or the resource's bid. The ISO's Market Surveillance Committee raised a similar concern that there may be instances in which a resource with a regulation award receives a locational marginal price for regulation energy at a price below its energy bid. The ISO does not use energy bids to determine its regulation dispatch but the ISO believes market participants can mitigate any risk of receiving a net energy payment that is less than their energy bids through other means, including through the pricing of their regulation capacity bids. As described above, the ISO is not modifying its rules for netting injection and withdrawals of energy over the applicable 10 minutes settlement period.

Another stakeholder requested that the ISO defer the inclusion of inter-temporal opportunity costs in this enhancement because they may introduce significant complexity with limited benefits and potential gaming opportunities. The ISO explained that it did not intend to implement additional market constraints within the market optimization to consider inter-temporal opportunity costs in connection with *Order 755*. But the ISO explained that compliance with the Commission's final rule requires the ISO to allow scheduling coordinators to include any inter-temporal opportunity costs in their regulation bids. Stakeholders also requested that the ISO provide information used by the ISO's market systems to validate resource-specific mileage multipliers and the ISO has agreed to make this information available.

Beyond these comments, stakeholders have recommended that the ISO examine how to allocate costs of implementing *Order 755* among market participants and continue to assess various aspects of the design of a performance payment for regulation resources. The ISO has committed to examine how it allocates the costs for regulation service in a separate cost allocation initiative but believes any assessment of how the ISO market allocates regulation costs will require a longer discussion in light of the reasons the ISO secures and dispatches regulation capacity. The ISO has also committed to conduct a review of its market design to comply with *Order 755* based on one year of operation data. The ISO hopes this review will assist stakeholders in assessing whether modifications to the existing design are needed.

Finally, the ISO has incorporated the majority of suggestions made by stakeholders during the development of tariff language to support this market enhancement. The ISO believes the tariff stakeholder process has improved the clarity of the tariff revisions proposed in this filing.

## **V. Effective Date and Request for Order**

The ISO requests that the Commission make the tariff revisions contained in this filing effective as of April 9, 2013, and therefore respectfully requests that the Commission waive the requirement of 18 C.F.R. § 35.3 that a rate schedule be filed not more than 120 days from the effective date. The ISO also requests that the Commission issue an order on its proposed tariff revisions by September 2012, which will provide regulatory certainty to allow the ISO and market participants to test their systems and conduct a market simulation.

The Commission directed ISOs and RTOs to file tariff changes to implement the Commission's final rule on compensation for frequency regulation service within 120 days of its effective date, or by April 30, 2012.<sup>34</sup> *Order 755* stated that the Commission would allow an additional 180 days from April 30, 2012 for ISOs and RTOs to implement the final rule.<sup>35</sup> On November 21, 2011, ISO-New England requested an extension of time to implement *Order 755* in order to develop necessary software changes and associated business procedures. The Commission issued a notice denying this request.<sup>36</sup> In its notice, however, the Commission stated that that ISO-New England could reassert arguments pertaining to the implementation deadline of *Order 755* when it submits its compliance filing. Consistent with the Commission's notice, the ISO

---

<sup>34</sup> *Order 755* at P 201.

<sup>35</sup> *Id.*

<sup>36</sup> Notice Denying Extension of Time in Commission Docket RM11-7, dated December 13, 2011.

is requesting to implement the Commission's final rule in the spring of 2013. Good cause exists to accept this implementation date.

The ISO has already committed and will commit significant resources to develop and implement a market design for a regulation performance payment. Implementing this functionality is a *bid to bill* endeavor and requires changes to software across the ISO's market systems. Existing market participants also require the opportunity to test their own systems and validate that the functionality is working through a market simulation. Coincident with these efforts, the ISO's release planning process anticipates significant new functionality in the fall of 2012. The ISO must coordinate a performance payment for regulation with these other enhancements, some of which the Commission has directed the ISO to implement. Finally, emerging resources need to take steps to interconnect to the grid to take advantage of a regulation performance payment. Extending implementation until the spring of 2013, therefore, will not create any prejudice for market participants and will promote greater assurance of a successful market launch of this functionality.

**A. The ISO has accelerated its market design work to comply with Order 755**

The Commission should recognize the ISO's efforts and commitment to comply with *Order 755* in assessing whether to provide adequate time to implement this new market design. After the issuance of *Order 755*, the ISO promptly commenced a stakeholder process to examine market design issues. In December 2011, the ISO issued an initial proposal to its stakeholders. Over the course of the next three months, the ISO accepted stakeholder comments and held multiple conference calls with stakeholders to refine this proposal. On March 23, 2012, the ISO's Board of Governors authorized the ISO to file the instant tariff amendment. Thereafter, the ISO conducted an additional stakeholder process to develop and refine proposed tariff language. The ISO has accelerated its work to meet *Order 755*'s compliance timeline while providing adequate review by stakeholders, the ISO's Market Surveillance Committee, Department of Market Monitoring and its Board of Governors.

**B. The design of a performance payment for regulation services in the ISO's market requires a *bid to bill* solution**

During the stakeholder process to develop a market design to comply with *Order 755*, the ISO commenced efforts to assess the impact on the ISO's market systems. The ISO has completed this impact assessment and is now working to finalize business requirement specifications for necessary system changes. As reflected in the Declaration of Janet Morris, appended hereto as Attachment D, these changes touch multiple ISO systems, including, but not limited to, the ISO's master file, scheduling infrastructure business rules, market optimization

software, enterprise data repository, energy management system, open access same-time information system, and settlements and market clearing interface.

The ISO will need to update its master file to reflect regulation capacity certified over a 10 minute ramp as well as implement procedures to implement its proposed minimum performance threshold. Mileage bids will require scheduling infrastructure business rules. The ISO must make changes to its optimization software to calculate mileage requirements and recognize new constraints in order to establish a uniform market clearing price for performance payments in both the integrated forward market and real-time market. In addition, the ISO will need to update functionality to inform market participants of mileage awards and implement a suite of system changes to calculate the accuracy of resources' response to the ISO's signal. The ISO's enterprise data repository will require structural changes to store information to ensure resources receive correct performance payments for responding to the ISO's energy management system signals. In terms of the ISO's energy management system, the ISO will need to develop upgrades to measure the accuracy of a resource's response to these signals and validate that the information is correct. The ISO is also proposing to publish its mileage prices, the system mileage multiplier and instructed mileage on its open access same-time information system. This effort requires that the ISO's market systems are correctly delivering data payloads. Likewise, the ISO must build new features into its settlements and market clearing interface and operate that system with upstream systems to ensure market participants receive accurate settlement statements.

Once the ISO has completed its business specification requirements, it will develop system specification requirements to address necessary architectural changes to market systems. Thereafter, the ISO will develop, implement and test software code. Beyond the need for the ISO to complete its internal work to implement *Order 755*, the Commission should also consider user interface impacts. One of the ISO's stakeholders has requested that ISO finalize business requirements up to 8 months prior to starting a market simulation start and provide market participants with at least 2-3 months of market simulation. The ISO anticipates it can accelerate this schedule, but market participants will need to validate that they have configured their systems appropriately to participate in this new market enhancement. Accomplishing this effort before a performance payment for regulation service enters production is a necessary step. For this reason, the ISO plans to conduct a market simulation in the first quarter of 2013.

When the ISO undertakes a *bid to bill* market enhancement, there is generally a long lead time to design, implement and test such a change. For example, the ISO's effort to implement regulation energy management is taking over a year. Like the enhancements directed by *Order 755*, regulation energy management should enhance the opportunity for emerging technologies to participate in the ISO's markets although it is unclear how many, if any, non-

generator resources will be ready to use regulation energy management before 2013.

Finally, market participants have requested and the ISO has adopted standard release dates – one in the fall and one in the spring. Order 755 implementation should align with a standard release date. The ISO's request to implement this feature as part of its spring 2013 standard release is reasonable and the Commission should accept the proposed effective date.

**C. The ISO is currently planning to implement many other market enhancements in the fall of 2012**

The ISO is currently undertaking a number of enhancements and, in many cases, the same resources the ISO is devoting to implementing *Order 755* are also allocated to these other projects. The ISO is capable of designing, implementing and testing multiple enhancements at the same time, but there is a limit both for the ISO and its market participants. The ISO respectfully requests that the Commission weigh the number and the scope of enhancements the ISO plans to implement in the fall of 2012 and determine that the ISO's proposed effective date to implement Order 755 is reasonable. The ISO currently plans to implement the following initiatives in the fall of 2012:<sup>37</sup>

***Real-Time Market Power Mitigation Enhancements and Real Time Competitive Path Assessment:*** These proposed enhancements reflect significant changes to identify and mitigate competitive transmission path in the real-time market.

***Data Release Phase 3:*** This enhancement reflects the final phase of an initiative established in 2009 to address the request of market participants to review the ISO's data release and accessibility policy following the implementation of the new market design. Software design is underway with the intent to deploy in the fall of 2012.

***Order 745 Net Benefits Test:*** The ISO intends to automate the demand response bidding rule from Order 745 that would reject bids below the threshold as determined by the net benefits test. This enhancement is scheduled for the fall of 2012.

***Regulation Energy Management:*** The ISO intends to implement phase 2 of its regulation energy management functionality in the fall

---

<sup>37</sup> For more information on the ISO's market initiatives release plan see memorandum to ISO Board of Governors dated March 15, 2012:  
<http://www.caiso.com/Documents/MarketInitiativesReleasePlan-MAR2012.pdf>

of 2012, which will facilitate new types of storage resources, such as batteries and electric vehicles, to provide regulation service.

**Greenhouse Gas Regulations:** The ISO is examining refinements to its commitment costs to allow generators in response to the State of California's cap-and-trade program for greenhouse gas emissions. The ISO is targeting a fall release for this functionality to coincide with the start date of the cap and trade program of January 2013.

**Transmission Reliability Margin:** The ISO implements certain adjustments to intertie schedules within operating hours. Using a mechanism known as *Transmission Reliability Margin*, the ISO will be able to anticipate these transmission constraints in advance by reflecting them in market processes before schedules are awarded in the hour-ahead scheduling process. This functionality will help avoid intertie schedule curtailments. The ISO plans to implement the system changes in the fall of 2012. The ISO is currently working on an interim solution so the transmission reliability margin can be utilized during the summer months when it is most beneficial.

**Contingency Dispatch Enhancements:** The ISO intends to modify its energy dispatch order so it can prioritize the real-time energy dispatch of resources that are certified and have been awarded operating reserves (spin and non-spin) over energy-only resources to recover from a disturbance control standard event. These enhancements are planned for the fall of 2012.

**72 Hour Residual Unit Commitment:** This feature is intended to improve economic efficiency and reliability by extending the unit commitment process to 72 hours, rather than the current process of 24 hours. It will automate extremely long start process that economically commits the extra long start units for the trade days after the next day. The ISO intends to deploy this functionality in the fall of 2012.

**Valley Electric:** The ISO is preparing for the planned inclusion of the Valley Electric Association into the ISO balancing authority area as of January 1, 2013. In addition to changes in the full network model, the ISO is planning to address other system and business process changes to incorporate the new load zone seamlessly into system operations.

**D. Implementing Order 755 in the spring of 2013 will not prejudice new entrants**

The ISO believes a successful market launch of functionality to implement *Order 755* outweighs any prejudice to parties that may result from changing the implementation date from October 2012 until April 2013. At least one stakeholder has requested implementation this year, but that stakeholder does not have a resource interconnected to the ISO grid that is certified to provide regulation service. In order to benefit from a regulation performance payment, it is necessary to operate a resource certified to provide regulation service. The Commission should recognize the lead time involved to accomplish this effort. Apart from site development and the execution and approval of necessary contracts, a new resource must request that the ISO update its full network model, conduct commercial testing and obtain necessary certifications to provide regulation. The ISO recently released a schedule for its data base 60 full network model that reflects the time necessary for the ISO to include new resources in its full network model.<sup>38</sup> The schedule requires new resource owners to provide resource-specific information to the ISO approximately four months in advance of entering production. In light of these requirements and lead times, authorizing the ISO to adopt an effective date less than 6 months after the implementation date directed by *Order 755* will not prejudice new entrants. The fact that the ISO will implement *Order 755* in the near future provides certainty for new entrants to make necessary resource investments to participate in the ISO's regulation market.

**VI. Communications**

Communications regarding this filing should be addressed to the following individuals, whose names should be put on the official service list established by the Commission with respect to this submittal:

---

<sup>38</sup>

<http://www.caiso.com/Documents/DataBase60FullNetworkModelSchedulePosted.htm>

Sidney M. Davies\*  
Assistant General Counsel  
California Independent System  
Operator Corporation  
250 Outcropping Way  
Folsom, CA 95630  
Tel: (916) 608-7144  
Fax: (916) 608-7222  
[sdavies@caiso.com](mailto:sdavies@caiso.com)

Andrew Ulmer\*  
Director, Federal Regulatory Affairs  
California Independent System  
Operator Corporation  
250 Outcropping Way  
Folsom, CA 95630  
Tel: (202) 239-3947  
Fax: (916) 608-7222  
[aulmer@caiso.com](mailto:aulmer@caiso.com)

\* Individuals designated for service pursuant to Rule 203(b)(3).<sup>39</sup>

## **VII. Service**

The ISO has served copies of this transmittal letter, and all attachments, on the California Public Utilities Commission, the California Energy Commission, parties with effective scheduling coordinator service agreements under the ISO tariff, and service lists for Commission Dockets RM11-7 and AD10-11. In addition, the ISO is posting this transmittal letter and all attachments on the ISO Web site.

## **VII. Attachments**

The following attachments, in addition to this transmittal letter, support the instant filing:

Attachment A	Revised ISO tariff sheets
Attachment B	Proposed changes to the ISO tariff shown in black-line format
Attachment C	Materials presented to the ISO's Board of Governors as well as a record of the Board of Governor's vote.
Attachment D	Declaration of Janet Morris

## **VIII. Conclusion**

---

<sup>39</sup> 18 C.F.R. § 385.203(b)(3).

The ISO's proposed tariff amendment complies with the requirements of Order 755 to compensate resources providing regulation through a capacity payment that includes the marginal unit's opportunity costs and a payment for performance that reflects the quantity of regulation service provided by a resource when the resource accurately follows a dispatch signal. The ISO requests an order accepting this tariff amendment by September 2012, and a proposed effective date of April 9, 2013. As explained in this filing, this effective date coincides with the ISO's planned release of market enhancements for the spring of 2013. The ISO commits to provide two weeks prior notice to the Commission as to the actual effective date.

Please contact the undersigned if you have any questions regarding this matter.

Respectfully submitted,

**By: /s/ Andrew Ulmer**

Nancy Saracino

General Counsel

Sidney M. Davies

Assistant General Counsel

Andrew Ulmer

Director, Federal Regulatory Affairs

California Independent System

Operator Corporation

250 Outcropping Way

Folsom, CA 95630

Tel: (202) 239-3947

Fax: (916) 608-7222

[aulmer@caiso.com](mailto:aulmer@caiso.com)

Attorneys for the California Independent  
System Operator Corporation

## CERTIFICATE OF SERVICE

I hereby certify that I have served the foregoing document upon the parties listed on the official service list in the captions proceedings, in accordance with the requirements of Rule 2010 of the Commission's Rules of Practice and Procedure (18 C.F.R § 385.2010).

Dated at Folsom, California this 27<sup>th</sup> date of April, 2012

/s/ Cayden Jenness  
Cayden Jenness

**Attachment A –Clean Tariff**  
**Order 755 Compliance Filing – Frequency Regulation Compensation**  
**in the Organized Wholesale Power Markets**

**April 27, 2012**

\* \* \*

### **8.2.3.1 Regulation Service**

The CAISO shall maintain sufficient resources immediately responsive to the CAISO's EMS control in order to provide sufficient Regulation service to allow the CAISO Balancing Authority Area to meet NERC and WECC reliability standards, including any requirements of the NRC by continuously balancing resources to meet deviations between actual and scheduled Demand and to maintain Interchange Schedules. The quantity of Regulation Down and Regulation Up capacity needed for each Settlement Period of the Day-Ahead Market and in each fifteen (15) minute period in Real-Time shall be determined by the CAISO as a percentage of the applicable CAISO Forecast of CAISO Demand for the Day-Ahead and Real-Time Markets. In HASP, the amount of advisory Regulation from Dynamic System Resources required for each Settlement Period in the next Trading Hour is also determined based on the CAISO Forecast of CAISO Demand. The advisory awards of Regulation from Dynamic System Resources in HASP are not binding and are re-optimized through the RTUC and RTD processes in the Real-Time Market. The CAISO's determination is based upon its need to meet the NERC and WECC reliability standards, including any requirements of the NRC.

The requirement for Regulation Down or Regulation Up needed for each Settlement Period of the Day-Ahead Market and in each fifteen (15) minute period in Real-Time shall each be accompanied by a requirement for Mileage as determined by the CAISO. The CAISO shall determine the Mileage requirements in any Settlement Period based on Regulation capacity requirements as well as the Bid-in Regulation capacity for that Settlement Period. Subject to operator adjustment, the Mileage requirement for either Regulation Up or Regulation Down will reflect the minimum of (a) the product of the respective Regulation capacity requirement and the System Mileage Multiplier; (b) the average Instructed Mileage for the applicable Trading Hour from the prior calendar week; or (c) the product of each resource's resource specific Mileage multiplier(s) and its Bid-in Regulation capacity summed for all resources.

The CAISO will publish on OASIS the estimated quantity, or the percentage used to determine the estimated quantity, of Regulation Reserves required for each hour of the Day-Ahead Market and in each fifteen (15) minute period in Real-Time for the Trading Day. The CAISO will publish on OASIS the estimated quantity, or the percentage used to determine the estimated quantity, of Regulation Reserves

required for each hour of the Day-Ahead Market and in each fifteen (15) minute period in Real-Time for the Trading Day. The CAISO will publish on OASIS the Mileage requirements for each hour of the Day-Ahead Market and each fifteen (15) minute period in Real-Time for the Trading Day. The CAISO will also publish on OASIS the Instructed Mileage for each hour of a Trading Day no later than seven (7) calendar days after the applicable Trading Day.

#### **8.2.3.1.1 Regulation Performance**

The CAISO will measure the accuracy of a resource's response to CAISO EMS signals. The CAISO will sum a resource's Automatic Generation Control set points for each four (4) second Regulation interval every fifteen (15) minutes and then sum the total deviations from the Automatic Generation Control set point for each four (4) second regulation interval during that fifteen (15) minute period. The CAISO will divide the sum of the resource's Automatic Generation Control set points less the sum of the resource's total deviations by the sum of the resource's Automatic Generation Control set points. The CAISO will apply the resulting percentage to a resource's Instructed Mileage to calculate the resource's Regulation performance payments. The CAISO will adjust a resource's Automatic Generation Control set point deviations when the CAISO EMS signal sent to a resource changes direction and the resource under-responds in the prior interval. The adjusted Automatic Generation Control set point will reflect the Automatic Generation Control set point to which the EMS signal directed the resource to move in the prior interval.

The CAISO will use a resource's Historic Regulation Performance Accuracy and certified ramp capability to determine a resource-specific expected Mileage for purposes of awarding Regulation Up and Regulation Down capacity. The CAISO will calculate a separate Historic Regulation Performance Accuracy for both Regulation Up and Regulation Down.

A minimum performance threshold of fifty (50) percent will apply for a resource to offer Regulation Up and Regulation Down capacity. If a resource's measured accuracy, based on a simple average of fifteen (15) minute intervals during a calendar month, is less than fifty (50) percent for Regulation Up or Regulation Down, the resource must re-certify to provide the respective service within ninety (90) days from the date the CAISO provides notice to the resource's Scheduling Coordinator of the resource's failure to meet the minimum performance threshold. In the event of lost accuracy data, the CAISO will not use data from

these intervals to calculate the resource's Historic Regulation Performance Accuracy or to assess the minimum performance threshold.

\* \* \*

#### **8.4.1.1 Regulation**

**THIS TARIFF SECTION WILL BECOME EFFECTIVE ON NOVEMBER 27, 2012.**

A resource offering Regulation must have the following operating characteristics and technical capabilities:

- (a) it must be capable of being controlled and monitored by the CAISO EMS by means of the installation and use of a standard CAISO direct communication and direct control system, a description of which and criteria for any temporary exemption from which, the CAISO shall publish on the CAISO Website;
- (b) it must be capable of achieving at least the Ramp Rates (increase and decrease in MW/minute) stated in its Bid for the full amount of Regulation capacity offered;
- (c) the Regulation capacity offered must not exceed the maximum Ramp Rate (MW/minute) of that resource times ten (10) minutes;
- (d) the resource to CAISO Control Center telemetry must, in a manner meeting CAISO standards, include indications of whether the resource is on or off CAISO EMS control at the resource terminal equipment;
- (e) the resource must be capable of the full range of movement within the amount of Regulation capability offered without manual resource operator intervention of any kind;
- (f) each Ancillary Service Provider must ensure that its CAISO EMS control and related SCADA equipment for its resource are operational throughout the time period during which Regulation is required to be provided;
- (g) Regulation capacity offered must be dispatchable on a continuous basis for at least sixty (60) minutes in the Day-Ahead Market and at least thirty (30) minutes in the Real-Time Market after issuance of the Dispatch Instruction. The CAISO

will measure continuous Energy from the time a resource reaches its award capacity. Scheduling Coordinators for Non-Generator Resources located within the CAISO Balancing Authority Area that require Energy from the Real-Time Market to offer their full capacity as Regulation may request the use of Regulation Energy Management as described in Section 8.4.1.2; and

- (h) Regulation capacity offered must meet or exceed the minimum performance threshold for responding to the CAISO's EMS control signal.

#### **8.4.1.2 Regulation Energy Management**

##### **THIS TARIFF SECTION WILL BECOME EFFECTIVE ON NOVEMBER 27, 2012.**

The CAISO will make Regulation Energy Management available to Scheduling Coordinators for Non-Generator Resources located within the CAISO Balancing Authority Area that require Energy from the Real-Time Market to offer their full capacity as Regulation. A Scheduling Coordinator for a resource using Regulation Energy Management may submit a Regulation Bid for capacity (MW) of up to four (4) times the maximum Energy (MWh) the resource can generate or curtail for fifteen (15) minutes after issuance of a Dispatch Instruction. In the Real-Time Market, a Scheduling Coordinator for a resource using Regulation Energy Management will procure Imbalance Energy as needed to satisfy the sixty (60) minute continuous Energy requirement for Regulation Awards in the Day-Ahead Market.

Scheduling Coordinators may request to use Regulation Energy Management for these Non-Generator Resources by submitting a request to certify such a resource to provide Regulation using Regulation Energy Management. The owner or operator of a Resource using Regulation Energy Management must execute both a Participating Generator Agreement and/or Participating Load Agreement and may provide only Regulation in the CAISO Market. A resource using Regulation Energy Management may not provide Energy other than Energy associated with Regulation. Scheduling Coordinators for Resources using Regulation Energy Management may define a Ramp Rate for operating as Generation and a Ramp Rate for operating as Load, respectively. These resources shall comply with the requirements to provide Regulation as specified in this Section 8, Appendix K, and the CAISO's Operating Procedures, including

the requirement to undergo a market simulation using Regulation Energy Management as part of the certification procedure.

Scheduling Coordinators for resources using Regulation Energy Management shall register these resources in the Master File. Scheduling Coordinators may only submit Bids for Regulation Up and Regulation Down and Mileage for these resources. Scheduling Coordinators may not submit Energy Bids, Energy Self-Schedules, Residual Unit Commitment Bids, or Ancillary Service Bids other than Regulation and Mileage for these resources. Scheduling Coordinators may not submit any type of commitment costs as part of their Regulation Up and Regulation Down Bids for resources using Regulation Energy Management, including Start-Up Cost, Minimum Load Costs, Pumping Cost or Pump Shut-Down Costs, or Transition Cost. All other bidding rules for Regulation set forth in Section 30 shall apply to resources using Regulation Energy Management.

The CAISO will settle Dispatches from resources using Regulation Energy Management as Instructed Imbalance Energy. The portion of Demand of Non-Generator Resources using Regulation Energy Management that is dispatched as Regulation in any Settlement Interval shall not be considered Measured Demand for purposes of allocating payments and charges pursuant to Section 11 during that Settlement Interval.

The CAISO shall control the resource's operating set point through its Energy Management System with the objective of maintaining the resource's operating set point at its preferred operating point. In the Day-Ahead Market and Real-Time Unit Commitment, the procurement of Regulation from resources using Regulation Energy Management will not be constrained by the resource's MWh limit to generate, curtail the consumption of, or consume Energy continuously. In the Real-Time Dispatch, the CAISO will base the Dispatches on the resource's capability to provide Regulation. When the resource has a physical MWh limit, the CAISO will observe the resource's MWh constraint during Real-Time Dispatch and will assess whether the CAISO can support the resource's self-provided Regulation capacity or Regulation award with Real-Time Market Dispatches. To the extent the CAISO determines in the Integrated Forward Market or Real-Time Unit Commitment processes that the MWh constraint of resources using Regulation Energy Management limits the capability of the CAISO, through Real-time Dispatch, to support these resources' self-provided Regulation capacity or Regulation awards, the CAISO may disqualify resources

using Regulation Energy Management on a pro rata basis across the System Region from providing Regulation, which shall result in the rescission of the disqualified portion of the resources' self-provided or awarded Regulation capacity payments.

\* \* \*

#### **11.8.2.1.6 IFM AS Bid Cost**

For any Settlement Interval, the IFM AS Bid Cost shall be the product of the IFM AS Award from each accepted IFM AS Bid and the relevant AS Bid Price, divided by the number of Settlement Intervals in a Trading Hour. The CAISO will determine and calculate IFM AS Bid Cost for a Multi-Stage Generating Resource at the Generating Unit or Dynamic Resource-Specific System Resource level. The IFM AS Bid Cost shall also include Mileage Bid Costs. For any Settlement Interval, the IFM Mileage Bid Cost shall be the product of Instructed Mileage associated with a Day Ahead Regulation capacity award and the relevant Mileage Bid price, divided by the number of Settlement Intervals in a Trading Hour. The CAISO will determine and calculate IFM Mileage Bid Cost for a Multi-Stage Generating Resource at the Generating Unit or Dynamic Resource-Specific System Resource level.

\* \* \*

#### **11.8.4.1.6 RTM AS Bid Cost**

For each Settlement Interval, the Real-Time Market AS Bid Cost shall be the product of the average Real-Time Market AS Award from each accepted AS Bid submitted in the Settlement Interval for the Real-Time Market, reduced by any relevant tier-1 No Pay capacity in that Settlement Interval (but not below zero), with the relevant AS Bid price. The average Real-Time Market AS Award for a given AS in a Settlement Interval is the sum of the 15-minute Real-Time Market AS Awards in that Settlement Interval, each divided by the number of 15-minute Commitment Intervals in a Trading Hour and prorated to the duration of the Settlement Interval (10/15 if the Real-Time Market AS Award spans the entire Settlement Interval, or 5/15 if the Real-Time Market AS Award spans half the Settlement Interval). For a Multi-Stage Generating Resource the CAISO will determine the RTM AS Bid Cost based on the Generating Unit or Dynamic Resource-Specific System Resource level. The Real-Time Market AS Bid Cost shall also include Mileage Bid Costs. For each Settlement Interval, the Real-Time Mileage Bid Cost shall be the product of Instructed Mileage associated with a Real-Time Regulation capacity award and the relevant

Mileage Bid price divided by the number of Settlement Intervals for the Real-Time Market in a Trading Hour. The CAISO will determine and calculate the Real Time Market Mileage Bid Cost for a Multi-Stage Generating Resource at the Generating Unit or Dynamic Resource-Specific System Resource level.

\* \* \*

#### **11.10.1.7 Regulation Performance Payments and Accuracy Adjustment**

Resources supplying Mileage from contracted or self-provided Regulation in the Day-Ahead Market are paid a Mileage clearing price for each MW of Instructed Mileage during the Settlement Period. If a resource is awarded incremental Regulation in the Real-Time Market, the Instructed Mileage shall be divided between the Day Ahead Market and Real Time Market, in proportion to the Day-Ahead and Real-Time Regulation Capacity awards. Instructed Mileage associated with a Day-Ahead Market award will be paid the Day-Ahead Mileage clearing price. Instructed Mileage associated with a Real-Time Market award will be paid the Real-Time Mileage clearing price. The CAISO will adjust a resource's Mileage payments based on the accuracy of the resource's response to CAISO EMS signals. To determine this accuracy adjustment, the CAISO will sum a resource's Automatic Generation Control set points for each four (4) second Regulation interval every fifteen (15) minutes and then sum the absolute value of the deviations from the Automatic Generation Control set point for each four (4) second regulation interval during that fifteen (15) minute period. The CAISO will divide the sum of the resource's Automatic Generation Control set points less the sum of the resource's total deviations by the sum of the resource's Automatic Generation Control set points. The CAISO will apply the resulting accuracy percentage to the resource's Regulation performance payments. In the event of lost accuracy data, the CAISO will use the simple average of the resource's previous ten (10) accuracy percentages for the periods of missing data for settlement purposes.

\* \* \*

#### **11.10.2.1.5 Regulation Down Mileage Costs**

The charges a Scheduling Coordinator must pay for Regulation Down Mileage in any Settlement Period of the Trading Day are the product of the Scheduling Coordinator's Ancillary Services Obligation

percentage in that Settlement Period and the user rate for Regulation Down Mileage (\$/MW) for that Settlement Period. The user rate for Regulation Down Mileage is the total cost for Regulation Down Mileage (\$) for each Settlement Period divided by the total Regulation Down Mileage (MW) for each Settlement Period.

\* \* \*

#### **11.10.2.2.4 Regulation Up Mileage Costs**

The charges a Scheduling Coordinator must pay for Regulation Up Mileage in any Settlement Period of the Trading Day are the product of the Scheduling Coordinator's Ancillary Services Obligation percentage in that Settlement Period and the user rate for Regulation Up Mileage (\$/MW) in that Settlement Period. The user rate for Regulation Up Mileage is the total cost for Regulation Up Mileage (\$) for each Settlement Period divided by the total Regulation Up Mileage (MW) for each Settlement Period.

\* \* \*

#### **27.1.3 Regulation Mileage Clearing Price**

As provided in Section 8.3, Regulation Up and Regulation Down are procured and awarded through the Day Ahead Market and Real-Time Market. The CAISO will calculate uniform Mileage clearing prices for Regulation Up and Regulation Down, respectively, based on the intersection of the demand curve for Mileage requirements and supply curve for Bid-in Mileage. These uniform Mileage clearing prices shall apply to the CAISO Expanded System Region.

The CAISO will calculate a System Mileage Multiplier for Regulation Up by summing the total Mileage provided by all resources with Regulation Up awards each week for a corresponding hour of each Trading Day and then dividing that sum by the Regulation Up capacity procured for that week in that same hour. The CAISO will calculate a System Mileage Multiplier for Regulation Down by summing the total Mileage provided by all resources with Regulation Down awards each week for a corresponding hour of each Trading Day and then dividing that sum by the Regulation Down capacity procured for that week in that same hour. For purposes of these calculations, each week shall start at the beginning of the hour ending 0100 on Sunday and end at the end of the hour ending 2400 the following Saturday. The CAISO will use

the System Mileage Multiplier to assess Mileage requirements for Regulation Up and Regulation Down capacity.

The CAISO will calculate resource specific Mileage multipliers and apply these multipliers to resources' Bid-in Regulation Up and Regulation Down capacity. The resource specific Mileage multipliers will reflect resources' Historic Regulation Performance Accuracy and certified 10-minute ramp capability. The CAISO will apply resource specific Mileage multipliers to Bid-in Regulation Up and Regulation Down capacity to determine the expected Mileage. In the event that a resource has not provided Regulation over the prior thirty (30) days, the CAISO will use the simple average Historic Regulation Performance Accuracy for all resources from the prior thirty (30) days as an initial adjustment factor. Upon request, the CAISO will provide a resource with historical data used to derive its Mileage multipliers. A resource will receive a Mileage award that is at least as much as its self-provided or awarded Regulation Up or Regulation Down capacity, but not more than the product of its resource specific mileage multiplier and its self-provided or awarded capacity. The CAISO will use Mileage awards to determine a uniform clearing mileage price for Regulation Up and Regulation Down, but the Mileage quantity awards will not be financially binding. Resources will receive payments based upon Instructed Mileage as calculated pursuant to Section 11.10.1.7. The CAISO will publish on OASIS the Mileage clearing prices for each hour of the Day-Ahead Market and each fifteen (15) minute period in Real-Time for the Trading Day.

\* \* \*

#### **30.5.2.6.1 Regulation Up or Regulation Down Bid Information**

In the case of Regulation Up or Regulation Down, the Ancillary Services Bid or submission to self-provide must also contain: (a) the upward and downward range of generating capacity over which the resource is willing to provide Regulation in ten (10) minutes; (b) the Bid price of the capacity reservation, stated separately for Regulation Up and Regulation Down (\$/MW) and (c) the Bid price (\$) of the Mileage stated separately for Regulation Up and Regulation Down. In the case of Regulation Up or Regulation Down from Dynamic System Resources, the Ancillary Services Bid must also contain the Contract Reference Number, if applicable. Scheduling Coordinators may include inter-temporal opportunity costs in their Regulation capacity bids, but these inter-temporal opportunity costs must be verifiable. Ancillary Services

Bids submitted to the Day-Ahead or Real-Time Market for Regulation need not be accompanied by an Energy Supply Bid that covers the Ancillary Services capacity being offered. A Regulation Down Bid will be erased unless there is an Energy Supply Bid or Energy Self-Schedule at a level that would permit the resource to provide Regulation Down to its lower Regulation Limit. A submission to self-provide Regulation Down will be erased unless there is an Energy Self-Schedule at a level that would permit the resource to provide Regulation Down to its lower Regulation Limit. A Regulation Up Bid will be erased unless there is an Energy Supply Bid or Energy Self-Schedule at a level that would permit the resource to provide Regulation Up within its Regulation Limit. A submission to self-provide Regulation Up will be erased unless there is an Energy Self-Schedule at a level that would permit the resource to provide Regulation Up within its Regulation Limit.

\* \* \*

#### **30.7.3.1 Validation Prior to Market Close and Master File Update**

The CAISO conducts Bid validation in three steps:

Step 1: The CAISO will validate all Bids after submission of the Bid for content validation which determines that the Bid adheres to the structural rules required of all Bids as further described in the Business Practices Manuals. If the Bid fails any of the content level rules the CAISO shall assign it a rejected status and the Scheduling Coordinator must correct and resubmit the Bid.

Step 2: After the Bids are successfully validated for content, but prior to the Market Close of the DAM, the Bids will continue through the second level of validation rules to verify that the Bid adheres to the applicable CAISO Market rules and if applicable, limits based on Master File data. If the Bid fails any level two validation rules, the CAISO shall assign the Bid as invalid and the Scheduling Coordinator must either correct or resubmit the Bid.

Step 3: If the Bid successfully passes validation in Step 2, it will continue through the third level of validation where the Bid will be analyzed based on its contents to identify any missing Bid components that must be either present for the Bid to be valid consistent with the market rules contained in Article III of this CAISO Tariff and as reflected in the Business Practice Manuals. At this stage the Bid will either be automatically modified for correctness and assigned a status of conditionally modified or modified, or if it can be accepted as is, the Bid will be assigned a status of conditionally valid, or valid. A Bid will be

automatically modified and assigned a status of modified or conditionally modified Bid, whenever the CAISO inserts or modifies a Bid component. The CAISO will insert or modify a Bid component whenever (1) a Self-Schedule quantity is less than the lowest quantity specified as an Economic Bid for either an Energy Bid or Demand Bid, in which case the CAISO extends the Self-Schedule to cover the gap; (2) for non-Resource Adequacy Resources, the CAISO will extend the Energy Bid Curve using Proxy Costs to cover any capacity in a RUC Bid component, if necessary; and (3) for a Resource Adequacy Resource that is not a Use-Limited Resource, the CAISO will extend the Energy Bid Curve using Proxy Costs to cover any capacity in a RUC Bid component and, if necessary, up to the full registered Resource Adequacy Capacity. The CAISO will insert a \$0 Mileage Bid whenever a Scheduling Coordinator submits a Regulation Bid but does not submit a Mileage Bid. The CAISO will generate a Proxy Bid or extend an Energy Bid or Self-Schedule to cover any RUC Award or Day-Ahead Schedule in the absence of any Self-Schedule or Economic Bid components, or to fill in any gaps between any Self-Schedule Bid and any Economic Bid components to cover a RUC Award or Day-Ahead Schedule. To the extent that an Energy Bid to the HASP/RTM is not accompanied by an Ancillary Services Bid, the CAISO will insert a Spinning Reserve and Non-Spinning Reserve Ancillary Services Bid at \$ 0/MW for any certified Operating Reserve capacity. The CAISO will also generate a Self-Schedule Bid for any Generating Unit that has a Day-Ahead Schedule but has not submitted Bids in HASP/RTM, up to the quantity in the Day-Ahead Schedule. Throughout the Bid evaluation process, the Scheduling Coordinator shall have the ability to view the Bid and may choose to cancel the Bid, modify and re-submit the Bid, or leave the modified, conditionally modified or valid, conditionally valid Bid as is to be processed in the designated CAISO Market. The CAISO will not insert or extend any Bid for a Resource Adequacy Resource that is a Use-Limited Resource.

\* \* \*

#### **39.6.1.3.1 Maximum Regulation Mileage Bid Price**

The maximum Mileage Bid price shall be \$50.

\* \* \*

#### **39.6.1.5.1 Minimum Regulation Mileage Bid Prices**

Regulation Mileage Bids submitted into CAISO markets must have Bid prices not less than \$0.

\* \* \*

## Appendix A

### Master Definitions Supplement

\* \* \*

#### **- Historic Regulation Performance Accuracy**

The monthly calculation to determine the accuracy of a resource's response to CAISO EMS signals. The CAISO will base this calculation on a thirty (30) day simple average of fifteen (15) minute accuracy measurements. In the event that the resource does not provide Mileage in a fifteen (15) minute interval, the CAISO will not include the fifteen (15) minute interval in calculating the resource's Historic Regulation Performance Accuracy. In the event that a resource has not provided Regulation over the prior thirty (30) days, the CAISO will use the simple average Historic Regulation Performance Accuracy for all resources from the prior thirty (30) days as an initial adjustment factor.

\* \* \*

#### **- Instructed Mileage**

Instructed Mileage is the absolute change in Automatic Generation Control set points between each four (4) second interval.

\* \* \*

#### **- Mileage**

The service provided by a resource with a Regulation Up and Regulation Down capacity award in response to the CAISO's EMS signal.

\* \* \*

#### **- System Mileage Multiplier**

A quantity reflecting expected Mileage from 1 MW of Regulation Up and Regulation Down capacity in a given hour.

\* \* \*

**Appendix K**  
**Ancillary Service Requirements Protocol (ASRP)**

**PART A**  
**CERTIFICATION FOR REGULATION**

\* \* \*

**A 1.1.2** the maximum amount of Regulation to be offered must be reached within a period of ten (10) minutes;

\* \* \*

**A 1.1.5** the resource must meet or exceed the minimum performance threshold for responding to the CAISO's EMS control signal.

\* \* \*

**Attachment B – Blacklined Tariff**  
**Order 755 Compliance Filing – Frequency Regulation Compensation**  
**in the Organized Wholesale Power Markets**

**April 27, 2012**

\* \* \*

### 8.2.3.1 Regulation Service

The CAISO shall maintain sufficient resources immediately responsive to the CAISO's EMS control in order to provide sufficient Regulation service to allow the CAISO Balancing Authority Area to meet NERC and WECC reliability standards, including any requirements of the NRC by continuously balancing resources to meet deviations between actual and scheduled Demand and to maintain Interchange Schedules. The quantity of Regulation Down and Regulation Up capacity needed for each Settlement Period of the Day-Ahead Market and in each fifteen (15) minute period in Real-Time shall be determined by the CAISO as a percentage of the applicable CAISO Forecast of CAISO Demand for the Day-Ahead and Real-Time Markets. In HASP, the amount of advisory Regulation from Dynamic System Resources required for each Settlement Period in the next Trading Hour is also determined based on the CAISO Forecast of CAISO Demand. The advisory awards of Regulation from Dynamic System Resources in HASP are not binding and are re-optimized through the RTUC and RTD processes in the Real-Time Market. The CAISO's determination is based upon its need to meet the NERC and WECC reliability standards, including any requirements of the NRC.

The requirement for Regulation Down or Regulation Up needed for each Settlement Period of the Day-Ahead Market and in each fifteen (15) minute period in Real-Time shall each be accompanied by a requirement for Mileage as determined by the CAISO. The CAISO shall determine the Mileage requirements in any Settlement Period based on Regulation capacity requirements as well as the Bid-in Regulation capacity for that Settlement Period. Subject to operator adjustment, the Mileage requirement for either Regulation Up or Regulation Down will reflect the minimum of (a) the product of the respective Regulation capacity requirement and the System Mileage Multiplier; (b) the average Instructed Mileage for the applicable Trading Hour from the prior calendar week; or (c) the product of each resource's resource specific Mileage multiplier(s) and its Bid-in Regulation capacity summed for all resources. The CAISO will publish on OASIS the estimated quantity, or the percentage used to determine the estimated quantity, of Regulation Reserves required for each hour of the Day-Ahead Market and in each fifteen (15) minute period in Real-Time for the Trading Day.

The CAISO will publish on OASIS the estimated quantity, or the percentage used to determine the estimated quantity, of Regulation Reserves required for each hour of the Day-Ahead Market and in each fifteen (15) minute period in Real-Time for the Trading Day. The CAISO will publish on OASIS the Mileage requirements for each hour of the Day-Ahead Market and each fifteen (15) minute period in Real-Time for the Trading Day. The CAISO will also publish on OASIS the Instructed Mileage for each hour of a Trading Day no later than seven (7) calendar days after the applicable Trading Day.

#### **8.2.3.1.1 Regulation Performance**

The CAISO will measure the accuracy of a resource's response to CAISO EMS signals. The CAISO will sum a resource's Automatic Generation Control set points for each four (4) second Regulation interval every fifteen (15) minutes and then sum the total deviations from the Automatic Generation Control set point for each four (4) second regulation interval during that fifteen (15) minute period. The CAISO will divide the sum of the resource's Automatic Generation Control set points less the sum of the resource's total deviations by the sum of the resource's Automatic Generation Control set points. The CAISO will apply the resulting percentage to a resource's Instructed Mileage to calculate the resource's Regulation performance payments. The CAISO will adjust a resource's Automatic Generation Control set point deviations when the CAISO EMS signal sent to a resource changes direction and the resource under-responds in the prior interval. The adjusted Automatic Generation Control set point will reflect the Automatic Generation Control set point to which the EMS signal directed the resource to move in the prior interval.

The CAISO will use a resource's Historic Regulation Performance Accuracy and certified ramp capability to determine a resource-specific expected Mileage for purposes of awarding Regulation Up and Regulation Down capacity. The CAISO will calculate a separate Historic Regulation Performance Accuracy for both Regulation Up and Regulation Down.

A minimum performance threshold of fifty (50) percent will apply for a resource to offer Regulation Up and Regulation Down capacity. If a resource's measured accuracy, based on a simple average of fifteen (15) minute intervals during a calendar month, is less than fifty (50) percent for Regulation Up or Regulation Down, the resource must re-certify to provide the respective service within ninety (90) days from the date the CAISO provides notice to the resource's Scheduling Coordinator of the resource's failure to meet the

minimum performance threshold. In the event of lost accuracy data, the CAISO will not use data from these intervals to calculate the resource's Historic Regulation Performance Accuracy or to assess the minimum performance threshold.

\* \* \*

#### **8.4.1.1 Regulation**

**THIS TARIFF SECTION WILL BECOME EFFECTIVE ON NOVEMBER 27, 2012.**

A resource offering Regulation must have the following operating characteristics and technical capabilities:

- (a) it must be capable of being controlled and monitored by the CAISO EMS by means of the installation and use of a standard CAISO direct communication and direct control system, a description of which and criteria for any temporary exemption from which, the CAISO shall publish on the CAISO Website;
- (b) it must be capable of achieving at least the Ramp Rates (increase and decrease in MW/minute) stated in its Bid for the full amount of Regulation capacity offered;
- (c) the Regulation capacity offered must not exceed the maximum Ramp Rate (MW/minute) of that resource times ~~a value within a range from a minimum of ten (10) minutes; to a maximum of thirty (30) minutes, which value shall be specified by the CAISO and published on the CAISO Website;~~
- (d) the resource to CAISO Control Center telemetry must, in a manner meeting CAISO standards, include indications of whether the resource is on or off CAISO EMS control at the resource terminal equipment;
- (e) the resource must be capable of the full range of movement within the amount of Regulation capability offered without manual resource operator intervention of any kind;
- (f) each Ancillary Service Provider must ensure that its CAISO EMS control and related SCADA equipment for its resource are operational throughout the time period during which Regulation is required to be provided; ~~and~~

- (g) Regulation capacity offered must be dispatchable on a continuous basis for at least sixty (60) minutes in the Day-Ahead Market and at least thirty (30) minutes in the Real-Time Market after issuance of the Dispatch Instruction. The CAISO will measure continuous Energy from the time a resource reaches its award capacity. Scheduling Coordinators for Non-Generator Resources located within the CAISO Balancing Authority Area that require Energy from the Real-Time Market to offer their full capacity as Regulation may request the use of Regulation Energy Management as described in Section 8.4.1.2; and-
- (h) Regulation capacity offered must meet or exceed the minimum performance threshold for responding to the CAISO's EMS control signal.

#### **8.4.1.2 Regulation Energy Management**

**THIS TARIFF SECTION WILL BECOME EFFECTIVE ON NOVEMBER 27, 2012.**

The CAISO will make Regulation Energy Management available to Scheduling Coordinators for Non-Generator Resources located within the CAISO Balancing Authority Area that require Energy from the Real-Time Market to offer their full capacity as Regulation. A Scheduling Coordinator for a resource using Regulation Energy Management may submit a Regulation Bid for capacity (MW) of up to four (4) times the maximum Energy (MWh) the resource can generate or curtail for fifteen (15) minutes after issuance of a Dispatch Instruction. In the Real-Time Market, a Scheduling Coordinator for a resource using Regulation Energy Management will procure Imbalance Energy as needed to satisfy the sixty (60) minute continuous Energy requirement for Regulation Awards in the Day-Ahead Market.

Scheduling Coordinators may request to use Regulation Energy Management for these Non-Generator Resources by submitting a request to certify such a resource to provide Regulation using Regulation Energy Management. The owner or operator of a Resource using Regulation Energy Management must execute both a Participating Generator Agreement and/or Participating Load Agreement and may provide only Regulation in the CAISO Market. A resource using Regulation Energy Management may not provide Energy other than Energy associated with Regulation. Scheduling Coordinators for Resources using

Regulation Energy Management may define a Ramp Rate for operating as Generation and a Ramp Rate for operating as Load, respectively. These resources shall comply with the requirements to provide Regulation as specified in this Section 8, Appendix K, and the CAISO's Operating Procedures, including the requirement to undergo a market simulation using Regulation Energy Management as part of the certification procedure.

Scheduling Coordinators for resources using Regulation Energy Management shall register these resources in the Master File. Scheduling Coordinators may only submit Bids for Regulation Up and Regulation Down and Mileage for these resources. Scheduling Coordinators may not submit Energy Bids, Energy Self-Schedules, Residual Unit Commitment Bids, or Ancillary Service Bids other than Regulation and Mileage for these resources. Scheduling Coordinators may not submit any type of commitment costs as part of their Regulation Up and Regulation Down Bids for resources using Regulation Energy Management, including Start-Up Cost, Minimum Load Costs, Pumping Cost or Pump Shut-Down Costs, or Transition Cost. All other bidding rules for Regulation set forth in Section 30 shall apply to resources using Regulation Energy Management.

The CAISO will settle Dispatches from resources using Regulation Energy Management as Instructed Imbalance Energy. The portion of Demand of Non-Generator Resources using Regulation Energy Management that is dispatched as Regulation in any Settlement Interval shall not be considered Measured Demand for purposes of allocating payments and charges pursuant to Section 11 during that Settlement Interval.

The CAISO shall control the resource's operating set point through its Energy Management System with the objective of maintaining the resource's operating set point at its preferred operating point. In the Day-Ahead Market and Real-Time Unit Commitment, the procurement of Regulation from resources using Regulation Energy Management will not be constrained by the resource's MWh limit to generate, curtail the consumption of, or consume Energy continuously. In the Real-Time Dispatch, the CAISO will base the Dispatches on the resource's capability to provide Regulation. When the resource has a physical MWh limit, the CAISO will observe the resource's MWh constraint during Real-Time Dispatch and will assess whether the CAISO can support the resource's self-provided Regulation capacity or Regulation award with Real-Time Market Dispatches. To the extent the CAISO determines in the Integrated Forward

Market or Real-Time Unit Commitment processes that the MWh constraint of resources using Regulation Energy Management limits the capability of the CAISO, through Real-time Dispatch, to support these resources' self-provided Regulation capacity or Regulation awards, the CAISO may disqualify resources using Regulation Energy Management on a pro rata basis across the System Region from providing Regulation, which shall result in the rescission of the disqualified portion of the resources' self-provided or awarded Regulation capacity payments.

\* \* \*

#### **11.8.2.1.6 IFM AS Bid Cost**

For any Settlement Interval, the IFM AS Bid Cost shall be the product of the IFM AS Award from each accepted IFM AS Bid and the relevant AS Bid Price, divided by the number of Settlement Intervals in a Trading Hour. The CAISO will determine and calculate IFM AS Bid Cost for a Multi-Stage Generating Resource at the Generating Unit or Dynamic Resource-Specific System Resource level. The IFM AS Bid Cost shall also include Mileage Bid Costs. For any Settlement Interval, the IFM Mileage Bid Cost shall be the product of Instructed Mileage associated with a Day Ahead Regulation capacity award and the relevant Mileage Bid price, divided by the number of Settlement Intervals in a Trading Hour. The CAISO will determine and calculate IFM Mileage Bid Cost for a Multi-Stage Generating Resource at the Generating Unit or Dynamic Resource-Specific System Resource level.

\* \* \*

#### **11.8.4.1.6 RTM AS Bid Cost**

For each Settlement Interval, the Real-Time Market AS Bid Cost shall be the product of the average Real-Time Market AS Award from each accepted AS Bid submitted in the Settlement Interval for the Real-Time Market, reduced by any relevant tier-1 No Pay capacity in that Settlement Interval (but not below zero), with the relevant AS Bid price. The average Real-Time Market AS Award for a given AS in a Settlement Interval is the sum of the 15-minute Real-Time Market AS Awards in that Settlement Interval, each divided by the number of 15-minute Commitment Intervals in a Trading Hour and prorated to the duration of the Settlement Interval (10/15 if the Real-Time Market AS Award spans the entire Settlement Interval, or 5/15 if the Real-Time Market AS Award spans half the Settlement Interval). For a Multi-Stage Generating Resource the CAISO will determine the RTM AS Bid Cost based on the Generating Unit or

Dynamic Resource-Specific System Resource level. The Real-Time Market AS Bid Cost shall also include Mileage Bid Costs. For each Settlement Interval, the Real-Time Mileage Bid Cost shall be the product of Instructed Mileage associated with a Real-Time Regulation capacity award and the relevant Mileage Bid price divided by the number of Settlement Intervals for the Real-Time Market in a Trading Hour. The CAISO will determine and calculate the Real Time Market Mileage Bid Cost for a Multi-Stage Generating Resource at the Generating Unit or Dynamic Resource-Specific System Resource level.

\* \* \*

#### **11.10.1.7 Regulation Performance Payments and Accuracy Adjustment**

Resources supplying Mileage from contracted or self-provided Regulation in the Day-Ahead Market are paid a Mileage clearing price for each MW of Instructed Mileage during the Settlement Period. If a resource is awarded incremental Regulation in the Real-Time Market, the Instructed Mileage shall be divided between the Day Ahead Market and Real Time Market, in proportion to the Day-Ahead and Real-Time Regulation Capacity awards. Instructed Mileage associated with a Day-Ahead Market award will be paid the Day-Ahead Mileage clearing price. Instructed Mileage associated with a Real-Time Market award will be paid the Real-Time Mileage clearing price. The CAISO will adjust a resource's Mileage payments based on the accuracy of the resource's response to CAISO EMS signals. To determine this accuracy adjustment, the CAISO will sum a resource's Automatic Generation Control set points for each four (4) second Regulation interval every fifteen (15) minutes and then sum the absolute value of the deviations from the Automatic Generation Control set point for each four (4) second regulation interval during that fifteen (15) minute period. The CAISO will divide the sum of the resource's Automatic Generation Control set points less the sum of the resource's total deviations by the sum of the resource's Automatic Generation Control set points. The CAISO will apply the resulting accuracy percentage to the resource's Regulation performance payments. In the event of lost accuracy data, the CAISO will use the simple average of the resource's previous ten (10) accuracy percentages for the periods of missing data for settlement purposes.

\* \* \*

#### **11.10.2.1.5 Regulation Down Mileage Costs**

The charges a Scheduling Coordinator must pay for Regulation Down Mileage in any Settlement Period of the Trading Day are the product of the Scheduling Coordinator's Ancillary Services Obligation percentage in that Settlement Period and the user rate for Regulation Down Mileage (\$/MW) for that Settlement Period. The user rate for Regulation Down Mileage is the total cost for Regulation Down Mileage (\$) for each Settlement Period divided by the total Regulation Down Mileage (MW) for each Settlement Period.

\* \* \*

#### **11.10.2.2.4 Regulation Up Mileage Costs**

The charges a Scheduling Coordinator must pay for Regulation Up Mileage in any Settlement Period of the Trading Day are the product of the Scheduling Coordinator's Ancillary Services Obligation percentage in that Settlement Period and the user rate for Regulation Up Mileage (\$/MW) in that Settlement Period. The user rate for Regulation Up Mileage is the total cost for Regulation Up Mileage (\$) for each Settlement Period divided by the total Regulation Up Mileage (MW) for each Settlement Period.

\* \* \*

#### **27.1.3 Regulation Mileage Clearing Price**

As provided in Section 8.3, Regulation Up and Regulation Down are procured and awarded through the Day Ahead Market and Real-Time Market. The CAISO will calculate uniform Mileage clearing prices for Regulation Up and Regulation Down, respectively, based on the intersection of the demand curve for Mileage requirements and supply curve for Bid-in Mileage. These uniform Mileage clearing prices shall apply to the CAISO Expanded System Region.

The CAISO will calculate a System Mileage Multiplier for Regulation Up by summing the total Mileage provided by all resources with Regulation Up awards each week for a corresponding hour of each Trading Day and then dividing that sum by the Regulation Up capacity procured for that week in that same hour. The CAISO will calculate a System Mileage Multiplier for Regulation Down by summing the total Mileage provided by all resources with Regulation Down awards each week for a corresponding hour of each Trading Day and then dividing that sum by the Regulation Down capacity procured for that week in that

same hour. For purposes of these calculations, each week shall start at the beginning of the hour ending 0100 on Sunday and end at the end of the hour ending 2400 the following Saturday. The CAISO will use the System Mileage Multiplier to assess Mileage requirements for Regulation Up and Regulation Down capacity.

The CAISO will calculate resource specific Mileage multipliers and apply these multipliers to resources' Bid-in Regulation Up and Regulation Down capacity. The resource specific Mileage multipliers will reflect resources' Historic Regulation Performance Accuracy and certified 10-minute ramp capability. The CAISO will apply resource specific Mileage multipliers to Bid-in Regulation Up and Regulation Down capacity to determine the expected Mileage. In the event that a resource has not provided Regulation over the prior thirty (30) days, the CAISO will use the simple average Historic Regulation Performance Accuracy for all resources from the prior thirty (30) days as an initial adjustment factor. Upon request, the CAISO will provide a resource with historical data used to derive its Mileage multipliers. A resource will receive a Mileage award that is at least as much as its self-provided or awarded Regulation Up or Regulation Down capacity, but not more than the product of its resource specific mileage multiplier and its self-provided or awarded capacity. The CAISO will use Mileage awards to determine a uniform clearing mileage price for Regulation Up and Regulation Down, but the Mileage quantity awards will not be financially binding. Resources will receive payments based upon Instructed Mileage as calculated pursuant to Section 11.10.1.7. The CAISO will publish on OASIS the Mileage clearing prices for each hour of the Day-Ahead Market and each fifteen (15) minute period in Real-Time for the Trading Day.

\* \* \*

#### **30.5.2.6.1 Regulation Up or Regulation Down Bid Information**

In the case of Regulation Up or Regulation Down, the Ancillary Services Bid or submission to self-provide must also contain: (a) the upward and downward range of generating capacity over which the resource is willing to provide Regulation ~~in within a range from a minimum of ten (10) minutes; to a maximum of thirty (30) minutes; and~~ (b) the Bid price of the capacity reservation, stated separately for Regulation Up and Regulation Down (\$/MW) and (c) the Bid price (\$) of the Mileage stated separately for Regulation Up and Regulation Down. In the case of Regulation Up or Regulation Down from Dynamic System Resources,

the Ancillary Services Bid must also contain the Contract Reference Number, if applicable. Scheduling Coordinators may include inter-temporal opportunity costs in their Regulation capacity bids, but these inter-temporal opportunity costs must be verifiable. Ancillary Services Bids submitted to the Day-Ahead or Real-Time Market for Regulation need not be accompanied by an Energy Supply Bid that covers the Ancillary Services capacity being offered. A Regulation Down Bid will be erased unless there is an Energy Supply Bid or Energy Self-Schedule at a level that would permit the resource to provide Regulation Down to its lower Regulation Limit. A submission to self-provide Regulation Down will be erased unless there is an Energy Self-Schedule at a level that would permit the resource to provide Regulation Down to its lower Regulation Limit. A Regulation Up Bid will be erased unless there is an Energy Supply Bid or Energy Self-Schedule at a level that would permit the resource to provide Regulation Up within its Regulation Limit. A submission to self-provide Regulation Up will be erased unless there is an Energy Self-Schedule at a level that would permit the resource to provide Regulation Up within its Regulation Limit.

\* \* \*

### **30.7.3.1 Validation Prior to Market Close and Master File Update**

The CAISO conducts Bid validation in three steps:

Step 1: The CAISO will validate all Bids after submission of the Bid for content validation which determines that the Bid adheres to the structural rules required of all Bids as further described in the Business Practices Manuals. If the Bid fails any of the content level rules the CAISO shall assign it a rejected status and the Scheduling Coordinator must correct and resubmit the Bid.

Step 2: After the Bids are successfully validated for content, but prior to the Market Close of the DAM, the Bids will continue through the second level of validation rules to verify that the Bid adheres to the applicable CAISO Market rules and if applicable, limits based on Master File data. If the Bid fails any level two validation rules, the CAISO shall assign the Bid as invalid and the Scheduling Coordinator must either correct or resubmit the Bid.

Step 3: If the Bid successfully passes validation in Step 2, it will continue through the third level of validation where the Bid will be analyzed based on its contents to identify any missing Bid components that must be either present for the Bid to be valid consistent with the market rules contained in Article III

of this CAISO Tariff and as reflected in the Business Practice Manuals. At this stage the Bid will either be automatically modified for correctness and assigned a status of conditionally modified or modified, or if it can be accepted as is, the Bid will be assigned a status of conditionally valid, or valid. A Bid will be automatically modified and assigned a status of modified or conditionally modified Bid, whenever the CAISO inserts or modifies a Bid component. The CAISO will insert or modify a Bid component whenever (1) a Self-Schedule quantity is less than the lowest quantity specified as an Economic Bid for either an Energy Bid or Demand Bid, in which case the CAISO extends the Self-Schedule to cover the gap; (2) for non-Resource Adequacy Resources, the CAISO will extend the Energy Bid Curve using Proxy Costs to cover any capacity in a RUC Bid component, if necessary; and (3) for a Resource Adequacy Resource that is not a Use-Limited Resource, the CAISO will extend the Energy Bid Curve using Proxy Costs to cover any capacity in a RUC Bid component and, if necessary, up to the full registered Resource Adequacy Capacity. The CAISO will insert a \$0 Mileage Bid whenever a Scheduling Coordinator submits a Regulation Bid but does not submit a Mileage Bid. The CAISO will generate a Proxy Bid or extend an Energy Bid or Self-Schedule to cover any RUC Award or Day-Ahead Schedule in the absence of any Self-Schedule or Economic Bid components, or to fill in any gaps between any Self-Schedule Bid and any Economic Bid components to cover a RUC Award or Day-Ahead Schedule. To the extent that an Energy Bid to the HASP/RTM is not accompanied by an Ancillary Services Bid, the CAISO will insert a Spinning Reserve and Non-Spinning Reserve Ancillary Services Bid at \$ 0/MW for any certified Operating Reserve capacity. The CAISO will also generate a Self-Schedule Bid for any Generating Unit that has a Day-Ahead Schedule but has not submitted Bids in HASP/RTM, up to the quantity in the Day-Ahead Schedule. Throughout the Bid evaluation process, the Scheduling Coordinator shall have the ability to view the Bid and may choose to cancel the Bid, modify and re-submit the Bid, or leave the modified, conditionally modified or valid, conditionally valid Bid as is to be processed in the designated CAISO Market. The CAISO will not insert or extend any Bid for a Resource Adequacy Resource that is a Use-Limited Resource.

\* \* \*

#### **39.6.1.3.1 Maximum Regulation Mileage Bid Price**

The maximum Mileage Bid price shall be \$50.

\* \* \*

**39.6.1.5.1 Minimum Regulation Mileage Bid Prices**

Regulation Mileage Bids submitted into CAISO markets must have Bid prices not less than \$0.

\* \* \*

**Appendix A**

**Master Definitions Supplement**

\* \* \*

**- Historic Regulation Performance Accuracy**

The monthly calculation to determine the accuracy of a resource's response to CAISO EMS signals. The CAISO will base this calculation on a thirty (30) day simple average of fifteen (15) minute accuracy measurements. In the event that the resource does not provide Mileage in a fifteen (15) minute interval, the CAISO will not include the fifteen (15) minute interval in calculating the resource's Historic Regulation Performance Accuracy. In the event that a resource has not provided Regulation over the prior thirty (30) days, the CAISO will use the simple average Historic Regulation Performance Accuracy for all resources from the prior thirty (30) days as an initial adjustment factor.

\* \* \*

**- Instructed Mileage**

Instructed Mileage is the absolute change in Automatic Generation Control set points between each four (4) second interval.

\* \* \*

**- Mileage**

The service provided by a resource with a Regulation Up and Regulation Down capacity award in response to the CAISO's EMS signal.

\* \* \*

**- System Mileage Multiplier**

A quantity reflecting expected Mileage from 1 MW of Regulation Up and Regulation Down capacity in a given hour.

\* \* \*

**Appendix K**

**Ancillary Service Requirements Protocol (ASRP)**

**PART A**

**CERTIFICATION FOR REGULATION**

\* \* \*

**A 1.1.2** the maximum amount of Regulation to be offered must be reached within a period of ten (10) minutes~~that may range from a minimum of ten (10) minutes to a maximum of thirty (30) minutes, as such period may be specified by the CAISO and published on the CAISO Website;~~

\* \* \*

**A 1.1.5** the resource must meet or exceed the minimum performance threshold for responding to the CAISO's EMS control signal.

\* \* \*

**Attachment C – Material Presented to the ISO’s Board of Governors  
Order 755 Compliance Filing – Frequency Regulation Compensation  
in the Organized Wholesale Power Markets  
April 27, 2012**

# Memorandum

**To:** ISO Board of Governors

**From:** Keith Casey, Vice President, Market & Infrastructure Development

**Date:** March 15, 2012

**Re:** **Decision on Pay for Performance Regulation**

---

*This memorandum requires Board action.*

## EXECUTIVE SUMMARY

Last fall, the Federal Energy Regulatory Commission adopted Order 755 to remedy what FERC identified as undue discrimination in the procurement of frequency regulation in the organized wholesale electric markets. The ISO uses frequency regulation for system balancing to manage the differences between generating units' responses to dispatch instructions and actual load within a 5-minute period. The final rule requires ISOs to adopt a two-part payment for frequency regulation: (1) a payment for regulation capacity and (2) a payment for performance of the resource in response to a regulation signal. FERC's order adopting the final rule requires the ISO to submit a compliance filing with proposed tariff language by April 30, 2012 and to implement the new provisions by October 2012.

To comply with Order 755, Management recommends the following market design enhancements:

- The market optimization will consider two separately priced components of frequency regulation in determining market awards: regulation capacity and expected movement in response to the regulation signal (mileage).
- In addition to a regulation capacity payment, compensation will include a payment based upon a resource's actual movement in response to the regulation signal. This payment will be adjusted based upon the accuracy of the resource's response to the regulation signal.

Due to the scope and complexity of these proposed modifications, it is not possible to implement these changes by the FERC deadline of October 2012. Therefore, Management also recommends requesting authority from FERC to implement this enhancement in the spring of 2013.

Management proposes the following motion:

***Moved, that the ISO Board of Governors approves the proposed pay for performance regulation market design, as described in the memorandum dated March 15, 2012; and***

***Moved, that the ISO Board of Governors authorizes Management to make all necessary and appropriate filings with the Federal Energy Regulatory Commission to implement the proposed tariff change.***

## **DISCUSSION AND ANALYSIS**

FERC Order 755 requires the ISO to revise its procurement of regulation service by addressing each of the following requirements:

1. Regulation capacity payments must include opportunity costs of the marginal resource;
2. Resources must be allowed to include inter-temporal opportunity costs as part of their regulation bid;
3. Payment to resources must be based upon their actual response to the regulation signals;
4. Payments to resources for their actual response should reflect the accuracy of the resource's response to regulation signals;
5. Resources must receive a two part payment for frequency regulation: (1) a payment for regulation capacity and (2) a payment for performance of the resource in response to a regulation signal; and
6. The payment for regulation performance must include two components: (1) the actual movement or mileage based upon the regulation signal and (2) an accuracy adjustment.

The following sections of this memorandum provide an overview of frequency regulation and then describe Management's proposal to comply with FERC Order 755.

### *Overview of frequency regulation*

The ISO uses frequency regulation for system balancing to manage the differences between generating units' responses to dispatch instructions and actual load within a 5-minute period. The ISO procures regulation up and regulation down as separate products. Regulation up is used to balance the system when actual load is higher than

generation dispatch. Regulation down is used to balance the system when actual load is lower than generation dispatch. In the day-ahead market, the ISO procures 100 percent of forecast regulation needs in hourly intervals. If additional regulation requirements arise in real-time, the ISO procures incremental regulation up and regulation down in 15 minute intervals during the real-time unit commitment process.

Frequency regulation services will be increasingly important as the ISO works to integrate increasing volumes of variable energy resources. The ISO has forecasted a substantial increase in hourly regulation requirements in some hours due to a more variable generation fleet.

#### *Regulation capacity payment includes opportunity costs*

Management is not recommending any modifications to the ISO's current approach for calculating opportunity costs for regulation capacity to comply with Order 755. The ISO currently considers opportunity costs when it co-optimizes energy and ancillary services as part of determining regulation capacity awards and market clearing prices. In the day-ahead market, the market clearing price for regulation capacity includes any opportunity costs incurred by providing regulation. This opportunity cost can be in the same hour as the regulation award, or can be an opportunity cost in another hour of the day resulting from inter-temporal constraints. In the real-time unit commitment process, the ISO procures incremental regulation capacity which also reflects energy opportunity costs calculated by the real-time unit commitment process. While the energy prices calculated by the real-time unit commitment process are not financially binding, they do reflect the energy prices projected at the time the market clearing price for regulation capacity is established.

#### *Inter-temporal opportunity costs*

Order 755 requires the ISO to allow resources to include other inter-temporal opportunity costs in a resource's offer to sell frequency regulation service, with the requirement that the costs be verifiable. An example of such inter-temporal opportunity costs would be a resource foregoing energy production in a future say in order to provide regulation. The order does not require the ISO to calculate inter-temporal opportunity costs for resources beyond what is already considered within the horizon of the market optimization. Management recommends allowing inter-temporal opportunity costs not considered in the current market optimization to be included in regulation bids. Scheduling coordinators would have the burden to justify inter-temporal opportunity costs contained within a resource's bid, upon request, and the \$250 capacity bid cap would remain.

#### *Uniform market clearing prices for regulation capacity and regulation mileage*

Management's proposed market modifications to comply with Order 755 follows two guiding principles. First, the ISO sought to minimize the impact to the current regulation capacity market design, including the economic substitution of regulation up for spinning

reserve and non-spinning reserve. Second, the proposal targeted the determination of a uniform clearing price for regulation mileage. Regulation mileage is the movement in output of a regulation resource in response to the ISO's regulation signal. While the clearing price for regulation mileage is based on expected mileage needed by the ISO, resources are compensated for the actual mileage they incurred in responding to the ISO regulation signal.

Regulation capacity and regulation mileage are two attributes of frequency regulation service. Therefore, a relationship exists between the regulation capacity awarded and regulation mileage awarded. The market optimization will consider both attributes to minimize the total cost of frequency regulation service.

Resources will not submit a mileage quantity to the market. Instead, the ISO will calculate a resource specific mileage multiplier and apply that multiplier to the resource's offered regulation capacity. The resource specific mileage multiplier will reflect the historical accuracy of the resource and the resource's certified 10-minute ramp capability. The resource specific mileage multiplier will then be applied to each resource's offered regulation capacity to determine the mileage offered.

A resource will receive a mileage award that is at least as much as its capacity award, but no more than the product of its resource specific mileage multiplier and its capacity award. The ISO will use mileage awards to determine a uniform mileage price but the mileage quantity awards will not be financially binding since resources will be paid based upon actual mileage resulting from the regulation signal.

Management does not propose to change its method for determining the amount of regulation capacity it procures for each hour to comply with Order 755. The ISO establishes hourly regulation capacity requirements that are largely driven by load levels and load forecast uncertainty.<sup>1</sup>

Management proposes to add a second element, the expected movement (or mileage) of resources in response to the regulation signal, to the regulation procurement requirement to comply with Order 755. This element will be used as part of the optimization's procurement decisions and will be used to determine the regulation mileage price. The mileage procurement requirement will be set at the minimum of three values:

1. The product of actual mileage observed for each MW of regulation capacity from the prior week and the regulation capacity requirement for the given hour;

---

<sup>1</sup> An hourly variable regulation capacity forecasting tool calculates the coincidental 10-minute peak requirement for regulation separately in the up and down direction for each hour based on changes in the demand forecast, generation self-schedule changes, and hourly inertia fluctuation.

2. The average actual mileage from the prior week for the given hour. The ISO may adjust the average requirement based on operational needs resulting from actual system conditions; and
3. The sum of each resource's specific mileage multiplier and its bid-in regulation capacity. This third variable is designed to avoid mileage scarcity by never setting the requirement more than what bid-in capacity is able to provide.

Resources will continue to submit regulation capacity bids and a MW quantity for both regulation up and regulation down. The current \$0.00 capacity bid floor and \$250.00 bid cap of will remain. The addition of the regulation mileage requirement should not increase regulation capacity procurement.

Under the pay for performance regulation market design, resources will also submit separate mileage bids for regulation up and regulation down. Management proposes a \$0.00 mileage bid floor and a \$50.00 bid cap . If a resource does not submit a mileage bid when submitting a regulation capacity bid, the ISO will generate a default mileage bid of \$0.00 for the resource.

#### *Payment and calculation of resource movement from regulation signal or mileage*

Every 4 seconds, the ISO sends a regulation signal that instructs resources providing regulation the output level needed. Management proposes to define mileage as the absolute change in regulation signals between the 4 second intervals. A resource will be compensated for its actual mileage delivered. Since the ISO procures separate capacity for regulation up and regulation down, there will be a separate mileage calculation for each of these two products. Each resource's actual mileage will be summed for each 15-minute settlement interval and paid at the uniform market clearing price for mileage subject to performance adjustments outlined below.

The ISO procures incremental regulation in the real-time market during the real-time unit commitment process for 15-minute intervals. Since mileage prices can differ between the day-ahead and real-time markets, Management proposes to establish a resource specific single mileage price for each 15-minute interval, similar to the current calculation of regulation capacity prices. In the event a resource is awarded incremental regulation in the real-time market, the mileage price for that 15-minute interval will be the weighted average price of both the day-ahead and real-time mileage clearing price.

#### *Calculation of accuracy adjustments to measure resource performance*

Accuracy is the absolute value of actual telemetry compared to the regulation signal in a given regulation interval. The ISO will determine an accuracy adjustment for each 15-minute interval for each resource based on its deviations from the regulation signal.

The ISO will calculate the simple average of all 15-minute interval accuracy calculations for each resource on a monthly basis. The average 15-minute accuracy will be used in determining the resource specific mileage multiplier for the following month. This will ensure that if all else is equal for two resources, the ISO will provide a regulation award to the more accurate resource.

In addition, Management proposes a minimum performance threshold for resources that provide frequency regulation service. A resource would have to be recertified to provide regulation if its performance falls below the minimum performance threshold. The minimum performance threshold will initially be set at 50% accuracy.

#### *Additional market design impacts*

The pay for performance regulation market design impacts numerous market rules, systems and policies. As such Management recommends the following in connection with this market enhancement:

- Include both regulation capacity and mileage revenue and costs in the bid cost recovery calculations;
- Allocate costs from mileage payments to scheduling coordinators' ancillary services obligations in the same manner as the current allocation of regulation capacity costs;
- Disqualify a resource from mileage payments for any period a resource is disqualified from regulation capacity payments;
- Measure resources' certified regulation ramp rate over a ten minute period;
- Publish the mileage price, system mileage multiplier, and actual mileage incurred on OASIS; and
- Subject mileage bids to the grid management charge bid segment fee of \$0.005.

#### *Conduct review after one year of operation experience*

Management proposes to review of this market enhancement one year after it is put into production. Since many design elements of this proposal are based upon historical data under the current regulation design, Management believes it will be prudent to evaluate this design once actual production data under the design is available and determine if any modifications are necessary. One year of operational data will be used to evaluate the design, including, but not limited to, the appropriateness of the minimum performance threshold level, the historical data used to calculate the system wide mileage multiplier, the level of the mileage maximum bid price and mileage scarcity

price, and the change in resource participation in regulation under the new regulation service design.

### *Implementation timing*

Management proposes to request an extension from FERC to spring of 2013 to implement the system changes to comply with Order 755. It will not be possible to comply with the October 2012 deadline mandated by Order 755. Implementing the market changes described in this memorandum to comply with Order 755 will require modifications across many of the ISO's market systems.

The requirement for separate bids for regulation capacity and mileage translates to data model changes for the market applications, new types of resource reference data, and new bid content, validation, and processing rules. The new mileage requirement and capacity-mileage constraints augment the model in the optimization engine that is used to clear the day-ahead and real-time markets. New external reports must be developed for the ISO's external facing systems. The new ex post mileage payment requires new settlement charge codes and procedures. Furthermore, regulation accuracy determination and actual regulation mileage measurements will need new calculations to be performed on real-time telemetry data.

## **POSITIONS OF THE PARTIES**

Stakeholders are generally supportive of the proposed market enhancements. The market design has evolved through the stakeholder process. The final proposal has taken into consideration the concerns raised by stakeholders, the Market Surveillance Committee and the Department of Market Monitoring. The concerns arise from the fact that Order 755 requires compensating two attributes of the single regulation service based on separate market clearing prices for capacity and mileage. The Market Surveillance Committee opinion on this topic is attached for your reference. Comments by the Department of Market Monitoring on this topic are provided in DMM's March Board report for this meeting.

## **MANAGEMENT RECOMMENDATION**

Management requests Board approval of the pay for performance regulation market design as described in this memorandum. The market design is intended to comply with Order 755 and will compensate resources that provide frequency regulation through a capacity payment and a performance payment.

# Opinion on Pay-for-Performance Regulation

by

**James Bushnell, Member**  
**Scott M. Harvey, Member**  
**Benjamin F. Hobbs, Chair**

**Members of the Market Surveillance Committee of the California ISO**

Final of March 9, 2012

## 1. Introduction

The Market Surveillance Committee (MSC) of the California Independent System Operator has been asked to provide an opinion on the ISO's proposal on Pay-for-Performance Regulation. This proposal has been made to respond to FERC Order 755 (October 20, 2011). In that order, the Commission required independent system operators to develop a mechanism to pay frequency regulation resources based on the actual services provided. These payments are to consist of two parts:

- a payment for capacity reserved for regulation services and
- a payment for performance based upon the amount of frequency regulation provided by resources when accurately following the automatic generator control (AGC) dispatch signals provided by the ISO.

In response to the order, the ISO has developed a proposal for regulation payment mechanism, whose most recent version was released on February 22, 2012.<sup>1</sup> The proposal has undergone significant evolution in response to stakeholder and other comments, and, in our view, has been highly responsive to the concerns that have been raised. In this opinion, we will comment on some issues that are inherently difficult because of the nature of frequency regulation and the specific requirements of the FERC order. We believe that the ISO's present proposal represents a largely effective response to these issues. Nonetheless, there are fundamental uncertainties about the effect of its implementation. These uncertainties mean that careful tuning of the parameters of the mechanism will be required as well as close monitoring to ensure that the desired incentives are put in place without providing opportunities for gaming and unnecessary inflation of costs to consumers.

The uncertainty arises from the fundamental difficulty that actual performance of a regulation resource (measured by 'mileage', the sum of absolute values of the movements of the resource in response to instructions) that is to receive payment is likely to differ substantially from the resource mileage that would be calculated in the ISO market optimization software when

---

<sup>1</sup> CAISO, Pay for Performance Regulation, Draft Final Proposal Addendum, February 22, 2012, [www.caiso.com/Documents/Addendum-DraftFinalProposal-Pay\\_PerformanceRegulation.pdf](http://www.caiso.com/Documents/Addendum-DraftFinalProposal-Pay_PerformanceRegulation.pdf)

determining the bid-based price for mileage. Actual performance is governed by the control rules embodied in the AGC system, and responds to unexpected very short-term deviations in supply-demand balance. Because performance is providing service for unexpected events, the exact usage is by definition impossible to precisely anticipate in advance. This divergence between actual and assumed mileage potentially creates incentives for non-cost based bidding behavior and gaming in an attempt to inflate payments, as we will explain. The ISO's proposal attempts to minimize those incentives and their possible impacts, but we believe that the risk remains for significant distortions. Consequently, the ISO must be prepared to adjust the parameters of the regulation payment mechanism quickly if problems arise.

In the rest of this opinion, we first summarize some determinants of the value and cost of regulation services, and the need for a market to reflect these (Section 2). We then consider some market design choices and how they affect potential gaming behavior (Sections 3 and 4). In Section 5, we discuss certain parameters governing the requirements for mileage in the market software as well as the capability of resources to provide that mileage, and the need for consistency in their definition. Section 6 briefly addresses three other issues in regulation markets, including payments for imbalance energy, bid caps, and cost allocation, while Section 7 summarizes our conclusions.

## **2. The Value and Cost of Regulation Capacity and Mileage: General Considerations**

The value of frequency regulation to the ISO system arises from the ability of regulation resources to respond quickly to changes in system supply and demand conditions to maintain system frequency as well as targeted exchanges with neighboring systems. This response consists of moving a resource (adding or subtracting supply or adjusting load) within a 10 minute interval in response to fluctuations in the supply-demand balance. Such movements may or may not restore a resource to its scheduled operating point by the end of the interval. A regulation resource can be viewed as providing several services: net imbalance energy over the interval (which may be negative); net movement in one direction over the interval; and absolute amounts of movement within the interval. The need for the first two services arises from load and supply forecast error, while the need for the third comes from the inevitable within-interval fluctuations of the supply-demand balance. Net energy is compensated for by payment at the real-time energy price. Capacity to provide net movement will be compensated for by the capacity portion of the regulation payment. Finally, absolute amounts of movement ('mileage') will be compensated for by the performance, or mileage, payment.

These services are very important to the system, but the precise amounts that are needed of each, and the extent (if any) to which more of one can substitute for less of another are uncertain. This was clear in the stakeholder and ISO discussions of the Regulation Energy Management proposal, in which no conclusion was reached concerning even the general magnitude of any value of the quicker response time of REM resources.<sup>2</sup> Under the present market design, this

---

<sup>2</sup> Regulation Energy Management Draft Final Proposal, California ISO, Jan. 13, 2011, [http://www.caiso.com/Documents/RevisedDraftFinalProposal-RegulationEnergyManagement-Jan13\\_2011.pdf](http://www.caiso.com/Documents/RevisedDraftFinalProposal-RegulationEnergyManagement-Jan13_2011.pdf)

greater responsiveness is not rewarded. In our opinion on the REM proposal, we stated that this value could be significant, but needed to be traded off against other resource attributes.<sup>3</sup> In general, requirements for regulation resources are informed by operator experience and modeling analyses, such as the ISO's 20% renewables study. However, we are unaware of studies that have examined the specific amounts needed of the individual services, especially mileage; such studies are needed.

Meanwhile, the cost of supplying these services varies from resource to resource. Energy costs for traditional regulation sources, of course, depend on fuel costs and efficiency. Also, for storage units, they depend on the round-trip efficiency of the resource in storing and generating energy and the cost of charging energy. Demand-side sources incur costs in form of foregone benefits of consumption if loads are reduced to provide up-regulation. Energy bids are not considered when selecting regulation resources, and because the AGC system does not operate resources based on their cost, it is quite possible that the real-time price does not cover the as-bid energy cost of a resource.

The cost of reserving generation capacity so that it can provide a net movement over the interval is largely the opportunity cost of not being able to use that resource to provide energy or other ancillary services in that interval. The co-optimization carried out in the market software automatically calculates prices that reflect and fully cover these opportunity costs when they occur, based on the prices of the other commodities and the resource's as-bid costs of providing those commodities. Because the ISO's market software will not capture the cost of foregoing opportunities to sell energy in intervals beyond the time horizon of the software (especially for energy-limited units), some opportunity costs may need to be reflected in the resource's bids to provide capacity for regulation. FERC's order explicitly allowed such opportunity costs to be included in bids. In the case of demand-side resources, there may be costs associated with operating in a mode in which they can reduce their power use in response to AGC instructions.

Finally, costs for moving a resource up and down within an interval can arise from increased maintenance expenses, deterioration in average heat rates for traditional power plants, and the expense of charging energy for storage sources. If demand-side resources provide these services, there can also be management costs and foregone consumption benefits.

Thus, regulation provides three distinct types of services to the ISO's markets. The amounts of each that the ISO requires (especially of mileage) and acceptable tradeoffs among them are uncertain at this time, so the regulation market design will need to be flexible so that it can be adapted to changing conditions and improved operator understanding about what is needed. Furthermore, the costs of providing those services will vary considerably among resources. Since those costs can be significant, this implies that market mechanisms are desirable in order to enable resources to reveal their costs of providing these services so that they can efficiently provided. The FERC order and the ISO's proposal attempt to respond to that need. The foregoing implies that an important criterion for evaluating any proposal is the extent to which it would incent cost-based bidding.

---

<sup>3</sup> Market Surveillance Committee of the California ISO, Opinion on Regulation Energy Management, Jan. 21, 2012, [www.caiso.com/Documents/FinalMSCOpiniononRegulationEnergyManagement.pdf](http://www.caiso.com/Documents/FinalMSCOpiniononRegulationEnergyManagement.pdf)

A fundamental challenge in designing markets that would allow for cost discovery and efficient acquisition of regulation resources is the gap between how a market mechanism would choose resources to provide mileage, and how the AGC system would actually utilize those resources. Ideally, the costs, as estimated by the market software, would be a close approximation of the actual costs incurred in actual operations, with the forward market using the same objective function as in actual operations. In theory, imbalances between the schedule and actual operation should average out around zero over time so that there is no predictable difference, and they should be settled at real-time prices.

However, these conditions will not be the case with mileage provided by regulation under the ISO's proposal. There are two ways in which the scheduling and pricing of regulation mileage differs from how most commodities in the ISO's markets are scheduled and settled.

- First, the market software will schedule regulation resources and estimate their mileage contributions based on minimizing as-bid cost, subject to the bounds (4) and (5) of the Proposal; in contrast, AGC moves regulation resources to maintain area control error (ACE) within the Balancing Area ACE Limit and to preserve as much rampability as possible. As a result, the amount and distribution of AGC-determined mileage and its distribution among regulation resources is likely to deviate systematically from what the market software 'schedules.'<sup>4</sup>
- Second, no settlement will be made on the basis of the mileage that is implicitly 'scheduled' by the market software; the market clearing price will be calculated by the market software based on its calculation of expected mileage, but resources will be paid for their AGC-determined mileage. Thus, if the mileage selected by the market software (which determines the price) consistently differs from the AGC mileage (which determines the quantity), price may be much lower than the as-bid cost of actually dispatched mileage for some resources, while potentially being much higher than the as-bid cost of mileage on other resources that are not actually used by AGC.

These two considerations mean that there is a significant danger of strong incentives for some regulation suppliers to bid in a way that systematically deviates from costs, as we explain below.

### **3. One versus Two Commodity Market Clearing Constraints and Prices**

The ISO's proposal involves defining two constraints for regulation in the market software: a requirement for capacity (constraint (1) on page 9 of the Feb. 22 proposal, hereafter called "the Proposal") and a requirement for mileage (constraint (3) in the Proposal). Each can be viewed as a constraint that the 'supply' of the commodity (capacity or mileage provided by regulation resources) equals or exceeds the 'demand' (the operator-imposed requirement). The objective function (preceding constraint (1) in the Proposal) includes terms representing the as-bid costs of

---

<sup>4</sup> Thus, in this opinion we will put quote marks around 'scheduled' when referring to the amount of mileage that is calculated by the market software. This is not a binding schedule in any physical or financial sense; it is just a device for calculating a market-clearing price.

regulation capacity and mileage for the resources. The shadow prices of the constraints are the respective market clearing prices for capacity and mileage. Those shadow prices may equal the bid of the last accepted resource, or (in the case of capacity) an opportunity cost if that capacity could otherwise have generated energy or provided another type of ancillary service, or finally, a scarcity value if too few resources are available to meet the constraint.<sup>5</sup>

An alternative formulation that was the basis of an earlier draft proposal by the ISO would instead have established just one constraint for regulation, which would have been defined as a weighted sum of mileage and capacity. The objective function coefficient for that composite regulation product would have been based on a weighted sum of the capacity and mileage bids. Then only a single composite price would have resulted which would have been decomposed after the fact into separate capacity and mileage prices. We believe that the use of a single constraint formulation would cause several problems.

- Using a single standard mileage rate for all resources would greatly underestimate the mileage faster resources would actually provide under AGC, resulting in incentives for them to understate their mileage bid and overstate their capacity bid in order to maximize the calculated mileage price. On the other hand, slower resources would have a significant risk of under recovery of costs because of the resulting depressed capacity prices and the fact that AGC would acquire much less mileage from them than the standard mileage rate.
- If instead resource-specific mileage rates were to be used to construct bids, this could penalize faster resources by increasing their apparent cost, unless a more complex formulation were used in the objective function.
- During times of high prices for energy or non-regulation ancillary services, mileage prices might incorrectly reflect a high opportunity cost, when in reality only regulating capacity can incur such a cost.

Therefore, we find the general two constraint approach of the ISO's proposal to be preferable to a regulation market based upon a single composite constraint. However, this is not to say that a two constraint approach will necessarily be free of potential unintended consequences, as we discuss next. The particular values that are chosen for the parameters in the market optimization (page 9 in the Proposal) could significantly affect the opportunities for and consequences of gaming and the likelihood of other unintended consequences.

---

<sup>5</sup> Although the requirement for mileage in constraint (3) cannot be more than the amount of regulation capacity that has been offered into the market weighted by their unit-specific mileage rates  $m_i$ , it is still possible for the price of mileage to be based on the scarcity price of \$55/MWh. This can occur if some of the offered regulation capacity is instead scheduled by the software to provide another commodity (energy or other ancillary services), so that the potential 'supply' of mileage is reduced.

#### **4. Equality versus inequality formulations of the mileage supply constraints and possible gaming**

In this section we discuss a key market design choice that has a profound effect on the mileage price and could lead to a gaming opportunity if the market clearing price of regulation capacity is not close to zero. The market design choice refers to the definition of a particular constraint in the market optimization. We discuss two alternatives; each strikes a different balance between the need for a positive and transparent mileage price per the FERC order and the need to avoid gaming opportunities. The approach embodied in the ISO's proposal meets the mileage pricing need, and we support it. However, this approach could result in a significant gaming opportunity if the market clearing price of regulation capacity is not close to zero. It is quite possible that with the implementation of a mileage payment, most of the costs that were previously reflected in the regulation capacity payment will be included in the mileage payment so that the price of regulation capacity will typically be close to zero, except perhaps when there are significant opportunity costs to providing regulation, but this is hard to know until we observe the new design in operation.

##### ***4.1 Alternative Constraint Formulations***

A key feature of the ISO's proposal is that the supply of mileage from a resource provided in constraint (3) can be any value between:

- the MW of regulation capacity that the resource supplies to constraint (1) (defined as the capacity that can be supplied in 10 minutes) and
- a mileage multiplier  $m_i$  times that capacity, expressing the amount of mileage that the resource could provide over an hour, which would range up to 6 for a normal resource (see constraints (4) and (5) in the Proposal).

The parameter  $m_i$  could take even higher values for unconventional fast resources. For instance, a fast resource that is 20 MW in size whose ramp rate might permit, say, 10 MW of mileage per MW of regulation capacity per 10 minute period, would then be allowed to supply between  $1 \cdot 20$  and  $6 \cdot 10 \cdot 20$  MW of mileage to the mileage constraint (3) if all 20 MW of its capacity is selected to meet the regulation capacity constraint (1). Of course, the AGC system's use of that resource will be unaffected by the amount of mileage "scheduled", be it 20 MW or 1200 MW, as only the regulation capacity made available and its ramp rate is considered by the AGC system, not the 'scheduled' mileage. If that fast resource submitted a high offer price for its mileage, while other regulation resources scheduled for capacity have more than enough cheap mileage to meet the mileage requirement (3), then the amount of mileage that clears from the fast resource will likely be 20 MW. This may be a great understatement of the mileage the AGC system would actually use on that fast resource.

This same potential discrepancy will exist for conventional resources, although the difference would be less extreme. Based on the proposed formulation of constraint (5), even a conventional resource could be sent AGC instructions to move up to six times as much as the mileage assumed in evaluating the economics of scheduling regulation. This discrepancy potentially provides an opportunity for gaming that we explain in Section 4.2.

An alternative formulation would make constraint (4) an equality. This would mean that the mileage ‘scheduled’ in the market software would precisely equal the amount of regulation capacity schedule times the resource’s specific mileage rate  $m_i$ . As a result, high mileage resources would be ‘scheduled’ to supply more mileage than low mileage resources, which would provide a more realistic estimate of the relative amounts of mileage that AGC would utilize from the various resources.

It is our understanding that the reason that the ISO formulates constraint (4) as an inequality, thus allowing resources to be ‘scheduled’ in the economic evaluation for much less mileage than they would actually be instructed to provide, is the desirability of a readily interpretable and positive price for mileage. In particular, the inequality formulation would likely result in a shadow price for the mileage requirement (3) that reflects the price offer of the most expensive ‘scheduled’ mileage.<sup>6</sup> This easily interpreted price is a seemingly straightforward implementation of the FERC order’s requirement for the mileage price to be based on mileage bids. Also, the price will be positive, unless the mileage requirement (right side of constraint (3)) is less than the capacity requirement (right side of constraint (1)), but this is very unlikely given that constraint (1) is expressed in regulating capacity per 10 minutes and the mileage requirement is expressed in mileage per hour. In that unlikely case, the minimum amount of mileage that can be provided based on constraint (5) would exceed the mileage requirement, which would cause (3) to be slack with a zero price.<sup>7</sup>

In contrast, using an equality formulation for (4) will, in general, result in a more complex interplay between capacity bids, mileage bids, and the prices for those two services. The mileage price could be below or above the highest accepted mileage offer price; similarly, the capacity price could also be below or above the highest accepted capacity offer price. A particular issue is that it would be more likely that the mileage constraint (3) would be slack--resulting in a zero

---

<sup>6</sup> Under the following three distinct conditions, this would not be true.

1. A mathematical condition called degeneracy may occur (where the total requirement is exactly met by the scheduled resources, and every resource providing mileage is either at its lower (5) or upper (4) bound).
2. If constraint (5) (the lower bound) is binding for the source of the most expensive mileage supplied, then that resource will not set the price, and the mileage price will generally be lower (except possibly if degeneracy occurs). The extreme case of this occurs if the mileage requirement (right hand side of (3)) is less than the capacity requirement (right side of (1)). This could occur for the mileage requirement is based on average mileage in similar previous periods, as proposed by the ISO. Then the mileage provided each resources selected for capacity will be at its lower bound (5) and the total mileage constraint will be slack (mileage provided will be strictly greater than the mileage requirement). The result will be a zero price for mileage.
3. Third, if all resources providing mileage are at their upper bound (4), the mileage constraint may be forcing more regulation capacity to be acquired than is required by the regulation capacity constraint itself (1); then the mileage price will also reflect the cost of capacity. This can happen if the mileage required in (3) is relatively high compared to the capacity required in (1).

<sup>7</sup> This assumes that  $m_i \geq 1$  for all resources. If this is not the case, then constraints (4) and (5) would be inconsistent, and there would be no feasible solution; one solution would be to drop constraint (5) for resources with  $m_i < 1$ , and make constraint (4) an equality.

mileage price--if the regulation capacity acquired could have more than enough mileage associated with it to meet that constraint.

Under the equality formulation, in general, both the capacity (1) and mileage (3) requirements can be binding and have positive prices, although it is possible for only one or the other to be binding in any particular situation. An important problem arises if only the capacity constraint is binding, which results in a situation that we believe is likely to be contrary to FERC's intent. If the mileage requirement (right side of (3)) is relatively low, then it is quite likely that it will be below the amount of mileage that the selected capacity resources could potentially supply, and only the capacity constraint will have a positive price. In this situation, the shadow price for the capacity constraint is likely to include the marginal cost of mileage. This occurs because increasing the accepted capacity from a marginal resource will mean that more mileage will also necessarily be acquired from that unit, if (4) is an equality constraint. The mileage price itself will be zero, which is contrary to the apparent intent of the FERC order. An additional perhaps surprising result of this situation is that fast resources will be penalized in this situation, as all else being equal, the optimization will prefer slower resources with fewer miles to be paid for. This would be contrary to one of the other ISO goals, which is to avoid a formulation that makes fast resources look artificially expensive just because they can provide more mileage.<sup>8</sup>

#### ***4.2 The Risk of Gaming from the Inequality Constraint***

The advantage of the equality formulation is that it would avoid the following game that can arise in the ISO's proposal. Consider a situation in which the requirements for capacity and mileage are set so that the resources selected to meet the regulation capacity constraint (1) could consistently provide more mileage (in terms of the sum of their capacity weighted by  $m_i$ ) than is required by the mileage constraint (3). As a result, not all the mileage that could be provided by the selected regulation capacity is 'scheduled' (and therefore "costed out") by the market software. The units with the highest offer prices for mileage will only be scheduled to provide the minimum mileage specified by constraint (5). Since the floor set by constraint (5) is only somewhat more than 1/6 the actual mileage capability of a conventional resource and a much smaller proportion of the mileage capacity of a fast resource, there is a potential for resources to take advantage of that situation to strategically offer their capacity in a way that could result in high BCR payments for excess mileage costs, inflating costs to consumers and potentially harming market efficiency.

The best way to explain this is with a simple example. For instance, say that the regulation capacity required by constraint (1) is  $Req_{reg} = 100$  MW, while the mileage requirement on the right side of (3) is 375 MW for an hour. Say that two resources,  $i=1,2$  are selected to provide regulation capacity, and that they are scheduled to provide 75 MW and 25 MW, respectively, of regulation capacity  $Reg_i$ . Assume that unit 1 is a relatively slow resource ( $m_1 = 5$ ) while unit 2 is

---

<sup>8</sup> On the other hand, it is possible that only the mileage constraint will be binding, if the mileage requirement is relatively high. Then the price of mileage will also reflect the cost of capacity of the marginal source of mileage because of constraint (4), while the price of capacity itself would be zero. This outcome is also unlikely unless the CAISO substantially reduces the regulation capacity requirement so that scheduling enough capacity to meet the mileage requirement will more than meet the capacity requirement.

a relatively fast resource ( $m_2 = 10$ ), with the former offering mileage at \$20/MW, and the latter at \$50/MW (the bid cap). The optimal mileage ‘schedule’ will then be 350 miles from resource 1 and 25 miles from resource 2 (since constraint (5) forces resource 2 to provide at least that amount). (Note that these resources could have provided up to  $5*75+10*25$  MW or 625 miles, well in excess of the 375 MW that is required, so the market software chose the cheapest possible source of mileage.) The mileage price will be the cost of marginal mileage (\$20/MW).<sup>9</sup> Assume that resource 1 set the capacity price at \$30/MW with its offer. As a result, if resource 2 actually produced 25 miles when dispatched by AGC, it would earn  $30*25 + 20*25 = \$1250$  in revenue. If its capacity was offered at \$0/MW, its as-bid cost ( $50*25 = \$1250$  for just mileage) would be just barely covered by its revenue. Based on the schedule from the market software, the overall estimated payments for regulation would be  $30*100+20*375 = \$10,500$ .

Now, consider what happens when those resources are actually dispatched by the AGC system. Assume that the overall mileage estimate of 375 MW used in constraint (3) was an accurate forecast of the AGC mileage. But because resource 2 is much faster than resource 1, if the resources were dispatched in proportion to their ramp capability over the hour, the AGC system might instruct resource 2 to provide, say, 150 miles, and resource 1 would provide 225 miles. Then resource 2 will incur a large apparent loss, as it will be paid  $30*25$  for its capacity and  $20*150$  for its mileage (or \$3750 total) but its as-bid cost for that capacity and mileage will be  $0*25$  and  $50*150$ , respectively (totaling \$7500). The difference (\$3750) will be eligible for bid cost recovery. If  $i=2$  is a storage device that has no other revenues from the ISO markets, then it will obtain a BCR payment in that amount. The total payment by the ISO for regulation will then be  $30*100$  for capacity plus  $20*375$  for mileage and \$3750 for BCR, or \$14,250. This is 35% higher than the \$10,500 regulation payments anticipated by the market software’s solution.

This opportunity for a large BCR payment arises because the use of an inequality constraint in (5) potentially distorts the ‘schedule’ of mileage from different sources. If market clearing capacity prices are significant, that potential payment provides an incentive for resources to simultaneously understate their capacity price offer and overstate their mileage price offer. If such a resource can be confident that the sum of those two offers will be less than the sum of the two clearing prices, it knows it will be selected to provide capacity and 1 MW of mileage for each MW of capacity. Its optimal bids are then to bid as low as possible to provide capacity and high as possible to provide mileage in order to maximize the amount of BCR it would receive.<sup>10</sup> These bids are subject to that constraint on the sum of the offers, and the restrictions that the capacity offer price cannot be negative and the mileage offer price cannot exceed the ISO’s proposed cap of \$50/mile.

This opportunity to strategically distort bids to maximize BCR has two potentially deleterious effects. One is the inflation in the payments ultimately made by consumers for the provided

---

<sup>9</sup> The mileage price is not \$50/MW, even though some mileage is acquired from resource 2 which offered that price for its mileage. The reason is that resource 2’s mileage is at its lower bound (constraint (5)). If the mileage requirement in (3) is increased, the additional mileage would come from resource 1 (@ \$20/MW), not resource 2.

<sup>10</sup> This assumes that the unit would make money from the capacity, mileage, and BCR payments that result; if not, then it should instead bid so that it is not selected to provide capacity.

regulation, as just described. The second is that the distorted relative as-bid costs of capacity and mileage could, in turn, result in a potential distortion in choices of resources to provide regulation, possibly inflating the true economic cost of providing regulation. As an example of how this can happen, consider that there might be a third resource ( $i = 3$ ) whose capacity bid was, say, \$35/MW and mileage bid was \$25/MW, and whose  $m_i$  was 5.5. It would not be chosen over resource  $i = 2$ , because its as-bid cost to supply 25 MW of regulation capacity and mileage would be  $35 \times 25 + 25 \times 25 = \$1500$ , whereas  $i = 2$ 's cost was  $0 \times 25 + 50 \times 25 = \$1250$ , but its as-bid cost of providing the 150 MW of mileage that resource 2 actually provided would have been only  $\$25 \times 150$  or  $\$3750$  compared to  $\$7500$  for resource 2. If the schedule that minimizes social cost was actually the two slow resources, the ability of resource 2 to distort its bid in a way that undercuts resource 3 instead harms market efficiency. This shows that the potentially large distortions in estimates of mileage by the market software could result in important misallocation of resources.

It is important to notice that this game is not an exercise of market power, in the sense that a large player is taking advantage of its ability to affect prices. Very small but fast resources can play this game just as readily as large fast resources. For instance, imagine that resource 2 in the above example actually consisted of ten 2.5 MW resources rather than a single 25 MW resource. Each of the 2.5 MW resources would have precisely the same incentive to minimize its capacity bid and maximize its mileage bid in an attempt to collect excessive BCR. Moreover, these inefficient outcomes can arise from purely cost-based bidding without any gaming behavior at all. There is nothing in the example concerning resources 1 and 2 that would be different if resource 2's actual capacity costs were zero and its actual mileage costs were \$50. If capacity clearing prices are material, there is a potential for cost-based bidding to lead to inefficient outcomes and excess BCR costs. The role of possible gaming is simply to magnify the potential costs.

However, the key element that creates the potential for the inefficient bidding in the example is that the clearing price of capacity is materially different from zero. If the clearing price of capacity is zero because most of the costs currently recovered in capacity payments would be shifted in the mileage bid, the potential to exploit this discrepancy will not exist. Lots of resources underbidding their capacity costs and inflating their mileage offers would also tend to drive down the capacity price and eliminate the potential for material distortions. Given the rather fundamental change in clearing prices that will accompany the shift to pay for performance bidding it is hard to predict the likely level of capacity clearing prices and hence to assess the realistic potential for inefficient outcomes.<sup>11</sup>

Therefore, it is important that the ISO closely monitor the level of capacity clearing prices, and the level of BCR payments to assess whether this kind of inefficient outcome is arising, either as

---

<sup>11</sup> That this gaming opportunity would persist if either capacity or mileage bids from slow resources are high can be seen as follows. If the cleared capacity bid price is high (say \$100/MW), then a fast resource would likely be able to provide a low capacity bid (say \$40/MW) and a high mileage bid (say \$50/MW) and be accepted, being 'scheduled' to provide its minimum of 1 MW of mileage per MW of capacity (by constraint (5)). Or if the cleared mileage price bid is high (say \$50/MWh), the fast resource could just undercut that and be accepted. The if the AGC obtains a much larger amount of mileage from the fast resource, that resource would be eligible for BCR.

a result of gaming behavior or from cost-based bidding behavior interacting with the discrepancy between the scheduling criteria and AGC instructions

### ***4.3 Possible Measures to Prevent the Game or Mitigate Its Effects***

We describe six alternative approaches for reducing the scope or impacts of the inefficient outcomes identified in the previous section. These are offered as possibilities to be considered should the problem described above become important in the market. With the possible exceptions of the first and third proposals, each has large significant disadvantages that mean that we do not recommend full implementation of any of them at the present time.

1. The first approach would be to lessen the scope for the game by tightening the lower bound on mileage ‘scheduled’ in constraint (5) of the Proposal. Presently, it is equivalent to one-sixth the regulation capacity, which is much closer to zero than it is to the likely typical use of a regulation resource.<sup>12</sup> For example, this lower bound could be raised or made proportional to  $m_i$  rather than set equal to 1 MW of mileage for each MW of capacity. We recommend that some such adjustment be considered as testing progresses of the proposed design between now and implementation.
2. A second approach would be the logical extreme of the first proposal in which the lower bound (5) could be set equal to the upper bound (4), which is the equality constraint proposal in Section 4.1. This would eliminate the potential for this kind of inefficient outcome entirely. But as pointed out in Section 4.1, it would also result in more difficult to interpret mileage prices which might also be zero more often.
3. A third approach would be to determine the  $m_i$  parameter for individual generators based upon a reasonable estimate of expected actual mileage under AGC, rather than using the ramp capability. Unlike approaches 1 and 2, this would tighten the constraints by lowering the upper bound (4) rather than raising the lower bounds (5). For instance, the ISO could multiply all  $m_i$ 's by some ratio of expected actual AGC mileage to potential mileage. Unfortunately, the MSC does not have access to past ISO mileage data, and cannot assess whether realistic  $m_i$  values would be much less than the maximum ramp capabilities that the ISO proposes to use. However, if the ISO's proposed values are biased but not too far off, it will also take market participants some time to figure out *how* they are biased. The ISO would then have some time to adjust the values as long as it tracks actual mileage and can makes adjustments promptly without a year long stakeholder process.
4. A fourth approach would be to eliminate the excess costs by not allowing BCR to be collected on the difference between ‘scheduled’ mileage from the market software and actual AGC mileage when a high mileage bid results in a generator's ‘scheduled’ mileage being at the lower bound (constraint (5)). This would eliminate gaming as there would be

---

<sup>12</sup> The one-sixth figure arises from noting that the formulation of constraint (5) assumes that it applies to a one hour time interval, whereas the capacity of a regulation resource is based on a 10 minute interval. So to obtain the ratio of the lower bound on miles per 10 minute interval to regulation capacity, that lower bound is divided by six.

no advantage to understating capacity costs and overstating mileage costs in order to exploit the difference between ‘scheduled’ and AGC mileage. A serious problem with this approach is that it would also not compensate resources who bid their costs and were moved far more by AGC than assumed in the evaluation. This outcome could drive these resources out of the market and perhaps discourage development of fast resources that would be particularly likely to be impacted by the discrepancy. Furthermore, this would set a perhaps unwelcome precedent of discriminating among different types of as-bid costs, allowing some to qualify for BCR but disallowing others.

5. The fifth alternative would be to allow BCR, but only on the difference between a defined “default mileage bid” (DMB) and the mileage price, rather than on the difference between the mileage price offer and the mileage price. If the actual AGC mileage exceeds the ‘scheduled’ mileage (say 3.5 MW vs 2 MW of miles per MW of regulation capacity), then the extra 1.5 miles would be eligible for BCR. The dollar amount eligible would be  $3.5 - 2 = 1.5$  MW times the DMB minus the mileage price. This might be viewed as being similar in philosophy to local market power mitigation, in that energy bids are re-set to the default energy bid for any incremental energy provided in the all-constraints run relative to the competitive constraints-only run of the market software. However, the complexity that would be introduced by the need to define DMBs would be significant, and might not even have any impact on excess BCR costs, since even cost-based bidding could lead to excess BCR costs.
6. A final alternative would be to alter the AGC algorithm so that it dispatches regulation using a cost-based criterion rather than simply on ramp capability. If the cost of mileage was used to prioritize resources for dispatch by the AGC, then its dispatch would be more likely to align with that ‘scheduled’ by the market software, and the scope for excess BCR to arise either from gaming or cost based bidding would be lessened. However, any such change would require significant changes in the AGC software as well as careful consideration of the reliability and area control error consequences of such a change.

## **5. The Need for Consistency in Defining Requirements and Mileage Multipliers**

There is an important interaction and a need for consistency between the definitions of the amount of mileage to be acquired by the market software (‘demand’, the right side of constraint (3) in the Proposal) and the amounts that resources can provide (‘supply’, defined by the constraints (4) and (5)). Inconsistencies can distort prices and increase the inefficient outcomes described in Section 4.2 whether arising from cost-based bidding or gaming.

There are two broad alternatives for consistent definitions of demand and supply of mileage. One is to base both on expectations (in the sense of a probability-weighted average) of mileage needs and use, so that the mileage amounts in the market software are reasonably representative of the amounts that AGC would be expected (on average) to use. The other alternative is to base the requirement on a target amount of mileage capability well in excess of the average so that there is enough capability in case an unexpectedly high amount of mileage is needed. Then the

supply should be based on the maximum amounts of mileage that resources could supply, which may be much greater than average mileage that AGC would demand of them.

An issue with the ISO's present proposal is that the definitions or requirements and supply capabilities appear inconsistent. On one hand, the mileage requirement is to be based on expected values, in particular the previous week's experience (at least until more accurate forecasting methods are developed). On the other hand, the supply that resources can provide is based on the maximum that could be supplied. In particular, estimates of  $m_i$  are to reflect certified ramp capability. This combination of a relatively low mileage requirement with a high potential supply means that the constraints (4) and (5) will be loose, in the sense that only some of the regulation resources chosen for capacity will have more mileage 'scheduled' than their minimum amount (in constraint (5)). This is likely to provide a distorted picture of the relative amount of mileage that will actually be provided from each resource. In particular, there will be significant opportunity for high mileage resources to play the game described in Section 4.2. And even if high mileage resources do not play the strategy of increasing their mileage bids in an attempt to inflate BCR payments, if their mileage costs are higher than for slower resources, such BCR payments may still be made frequently. Further, distortions in the choices between slow and fast units, as described at the end of Section 4.2, may still happen.

Another risk from this inconsistency is that faster resources may be undervalued and not scheduled to provide regulation capacity to the extent they should. This may occur because there will likely be intervals when AGC would have demanded a lot of mileage from fast resources if they were available, but perhaps only relatively slow resources were been scheduled because the expected mileage constraint of the market software was easily met by the ramp capability of the slow resources.

If the CAISO will want to have enough mileage capability to meet the mileage requirement when it is more than expected, the CAISO should set a target for procuring mileage capability that is greater than the expected mileage. (How much larger would depend on the balance between increasing the cost of resource of acquisition versus the probability and consequences of having less mileage capability than the AGC system would like.) Setting a target in this manner would also be more consistent with the use of values of  $m_i$  that reflect ramp capability rather than expected AGC usage.

For a given set of mileage price offers, this increase in the mileage requirement would increase the market clearing price of mileage (as more mileage would be 'scheduled'). However, we anticipate that offerers of regulation would recognize the fact that 'scheduled' mileage would then be more, on average, than actual AGC mileage, and so would likely adjust their mileage price offers down to reflect the probability of that AGC won't use all the ramp capability. As a result, the mileage price and payments might not be more than would be the case if expected mileage requirements were used in constraint (3) and  $m_i$  was based on some estimate of expected use by AGC of individual resources. This does require more sophistication on the part of regulation capacity owners, who must then factor in the probabilities of different levels of AGC utilization when bidding mileage.

## **6. Other comments**

### ***6.1 Bid Caps***

In theory, adding a mileage payment (with an associated cap of \$50/MWh) to the present regulation capacity payment (with its \$250/MWh cap) will, in effect, increase the overall cap on the offers to provide regulation and thus potentially the cost of regulation. However, under present market conditions, the price of regulation very rarely approaches that cap, and so the effective raising of the cap is unlikely to affect prices.

However, if the need to manage intermittent renewable supplies results in a tightening of the regulation market, then this effective increase in the cap might make a difference. This could be a concern especially for fast resources if it turns out that they are able to effectively manipulate market outcomes in the manner described in Section 4.2. This possibility should be monitored by the ISO.

### ***6.2 Payments for Energy Provided by Regulation***

Stakeholders have variously proposed that imbalance energy for regulation be paid-as-bid if the as-bid cost exceeds the real-time energy price (as PowerEx has requested), or that it be paid the generator's unit-specific default energy bid (SCE). We believe that the present system of paying the market clearing price is less likely to have negative impacts on market efficiency than either of those two proposals.

In the case of the pay-as-bid proposal, we believe that pay-as-bid systems, in general, have poor incentives for cost-based bidding and should be used sparingly or, preferably, not at all. In this particular circumstance, since energy bids would not factor into the market software's selection of regulation capacity, there is no market discipline placed on energy bids from energy generators. This could incent generators to make energy price offers well in excess of their marginal cost, at least for the portion of their capacity that they anticipate will be taken for regulation. We have been unable to identify a reasonably uncomplicated and nonarbitrary way to include energy costs into regulation bids.

Market participants can account for projected losses in the energy market by factoring them into regulation capacity or mileage bids, which would allow the ISO to take the costs into account in scheduling regulation.

In the case of the default energy bid proposal, we believe that its adoption would discourage resources from offering into the regulation market relative to other markets. Although we understand that the regulation market is highly competitive, we see no reason to impose rules that could negatively impact participation in the regulation market.

### **5.3 Cost Allocation**

We agree with the ISO and with several stakeholders that cost allocation for ancillary services, including regulation, should be based on causation to the extent possible. We believe that the appropriate forum for examining these issues and possibly restructure the ISO's mechanisms for recovering the costs of services is through the comprehensive review scheduled for later this year, and not in the context of a compliance filing such as this. We look forward to participating in that discussion.

## **6. Conclusions**

FERC Order 755 has mandated a bid-based mileage payment for regulation resources. Any system that calculates such a payment must deal with the fundamental contradiction that arises when, on one hand, price is calculated by a market optimization whose resulting schedule for mileage is neither physically or financially enforced while, on the other hand, the mileage that regulation providers are paid for is based on an entirely different, non-optimization-based algorithm. Prices then are very likely to be inconsistent with actual operations. This leads to incentives for non-cost based bidding and the possibilities of significant bid cost recovery payments and inefficient scheduling. These potential problems will be present with any system responsive to FERC Order 755, short of a wholesale redesign of the automatic generation control system to dispatch regulation based on as-bid costs; such a redesign is impractical at this time and would have uncertain reliability consequences.

We are highly supportive of the general approach taken by the ISO's pay for performance proposal in which prices for regulation capacity and mileage are calculated as shadow prices to capacity and mileage requirements constraints, respectively. Compared to a system in which only one composite regulation product is acquired, whose price would then be decomposed into capacity and mileage portions, this two commodity approach offers fewer opportunities for owners of regulation to game the pay for performance system at the expense of customers and market efficiency

However, the ISO's proposal cannot resolve the fundamental contradiction just indicated, nor can any other design short of a redesign of the AGC system. Some risks of market gaming or inefficiencies are inevitable, and therefore must be anticipated and monitored. We are concerned about the possibility for excess BCR costs, arising either from cost-based bidding or gaming, because of systematic differences that are likely to arise between the 'scheduled' mileage in the market software for such resources and the actual mileage resulting from the automated generation control (AGC) system. The possibility of a wide range of possible mileage 'schedules' between the scheduled regulation capacity and the hourly ramp capability of a resource provides a potential for AGC instructions to differ substantially from the mileage quantities assumed in economically evaluating resources to schedule regulation, and for excess bid-cost recovery payments. If the regulation market remains very deep and capacity prices are low, then the impact of this discrepancy would be small. Given the distinct possibility that this will be the case, we believe that there is time to make adjustments in the pay for performance system as experience is gained.

Among the possible actions that could be taken to mitigate this gaming opportunity, we believe that adjustments to the parameters of the mileage payment mechanisms, in particular to the required amount of mileage and the ramp capability of the resources, could to some extent reduce the scope for inefficient scheduling outcomes. Presently, the lower bound for ‘scheduled mileage’ in the optimization software (equal to one-sixth of the capability associated with the accepted regulation capacity bid) together with a total mileage requirement that is likely to be low relative to regulation capability results in a relatively loose set of constraints on the market software’s mileage ‘schedule’. This has the benefit of ensuring a positive mileage price, but increases the scope for the inefficient scheduling outcomes we have described above.

Unfortunately, there is insufficient information available at the present time about the mileage requirements of the system compared to the potential mileage resources could provide to ascertain whether this scope would be large or small under the present proposal. Historical data from the ISO’s AGC system on total mileage as well as variations in mileage obtained from individual resources is needed to understand how the proposal would perform, and we understand that this data is being developed. This data should be obtained for a wide range of system conditions and carefully evaluated before implementation of pay for performance, with appropriate adjustments made in the mileage requirements and/or the procedures for calculating the resource mileage multipliers. In particular, increases in the lower bound for mileage (5) should be evaluated as part of the pre-implementation testing of the pay for performance mechanism.

If the analysis reveals that the scope for inefficient scheduling or regulation and its effects on the market are potentially large, implementation of more elaborate design changes should be considered. Hence, the ISO should closely monitor developments in this market and be poised to quickly adjust the parameters of the pay for performance mechanism if problems arise; it should not wait a year to make such adjustments if problems appear soon after implementation. It is desirable that the parameters can be adjusted quickly if problems emerge.

Regarding other issues, we offer the following conclusions:

- We believe that the requirements for mileage should reflect not average AGC mileage for the system, but higher values to accommodate occasions when significantly more mileage is needed.
- We do not believe that the effectively higher overall bid cap for regulation that results from having separate caps for mileage and capacity will yield higher prices, at least under present market conditions.
- Imbalance energy for regulation should be paid the real-time energy price because of the inefficient incentives that the pay-as-bid or default energy bid alternatives would provide owners of regulation resources.
- Finally, we look forward to addressing cost allocation issues in a comprehensive manner for all ancillary services, and do not recommend their separate consideration in this initiative.

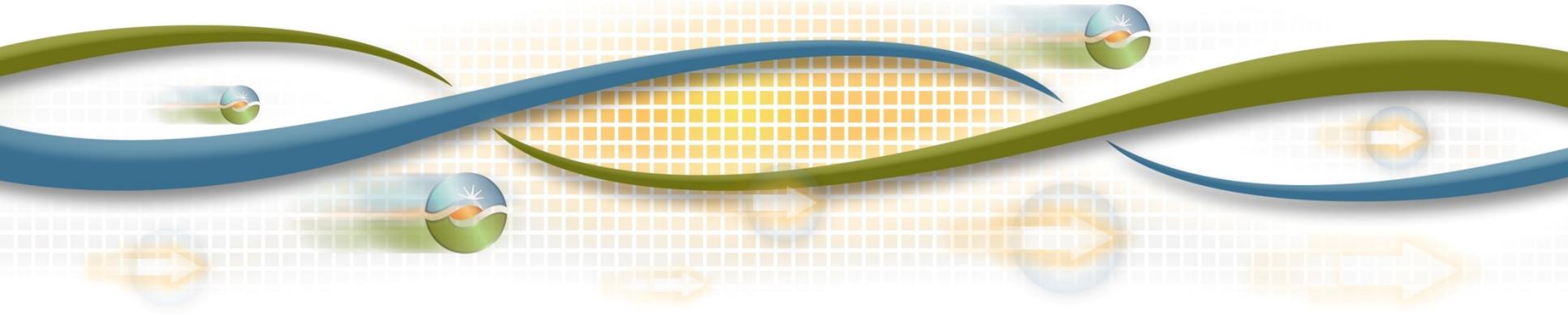
# Decision on Pay for Performance Regulation

Greg Cook

Director, Market and Infrastructure Development

Board of Governors Meeting

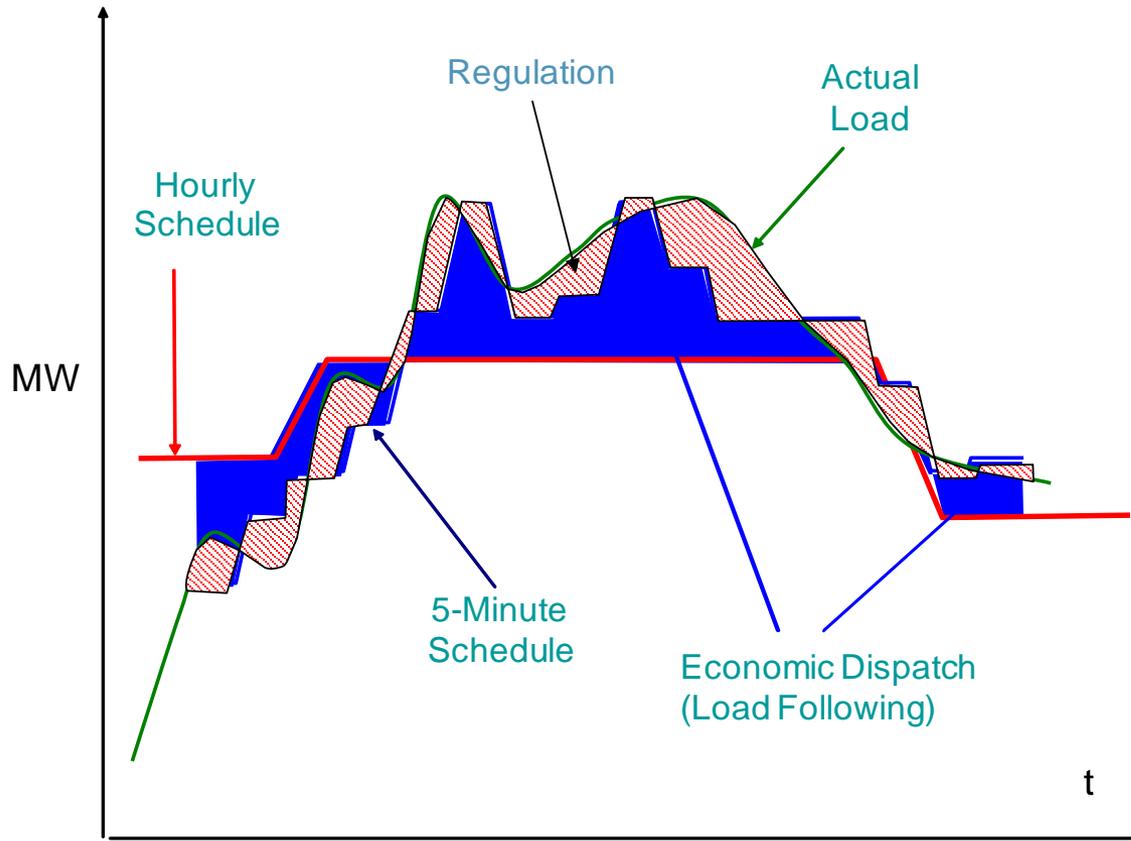
March 22-23, 2012



# FERC Order 755 requires significant changes in the procurement of frequency regulation.

- Currently, faster resources may receive more regulation dispatches than slower resources, but paid the same capacity price
- The final rule requires a two part payment for frequency regulation:
  1. A payment for regulation capacity, and
  2. A payment for performance of the resource in response to a regulation signal.

Frequency regulation maintains reliability by balancing load and generation within the 5 minute dispatch.



The ISO procures regulation up and regulation down as separate products.

To comply with Order 755, the ISO must modify its current regulation product:

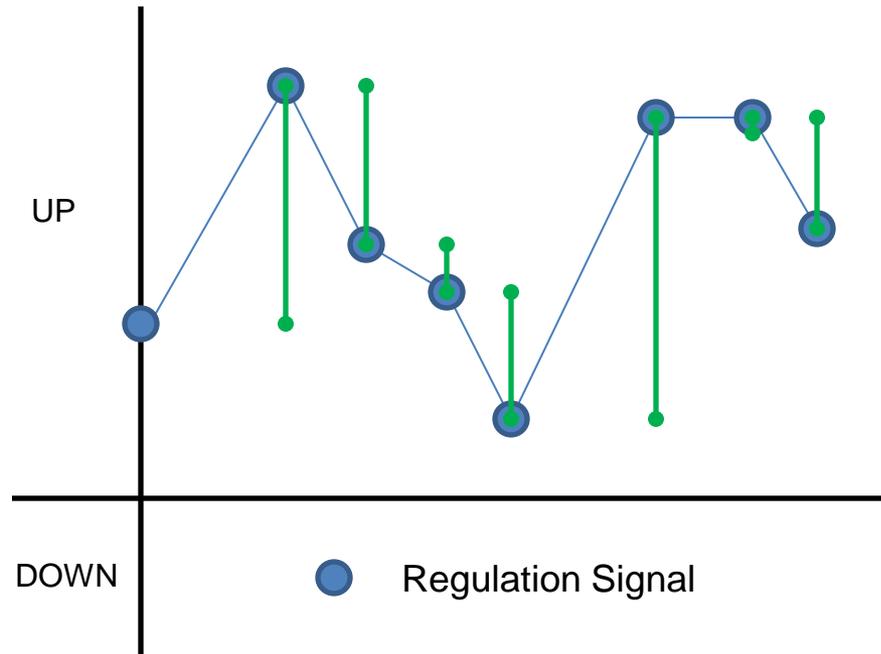
- Pay resources based upon their actual response to the regulation signals; and
- Payments to resources for their actual response should reflect the accuracy of the resource's response to regulation signals.

*FERC ordered tariff language to be filed by April 30, 2012 and to implement by October 2012.*

## Proposal includes payments based on mileage and accuracy:

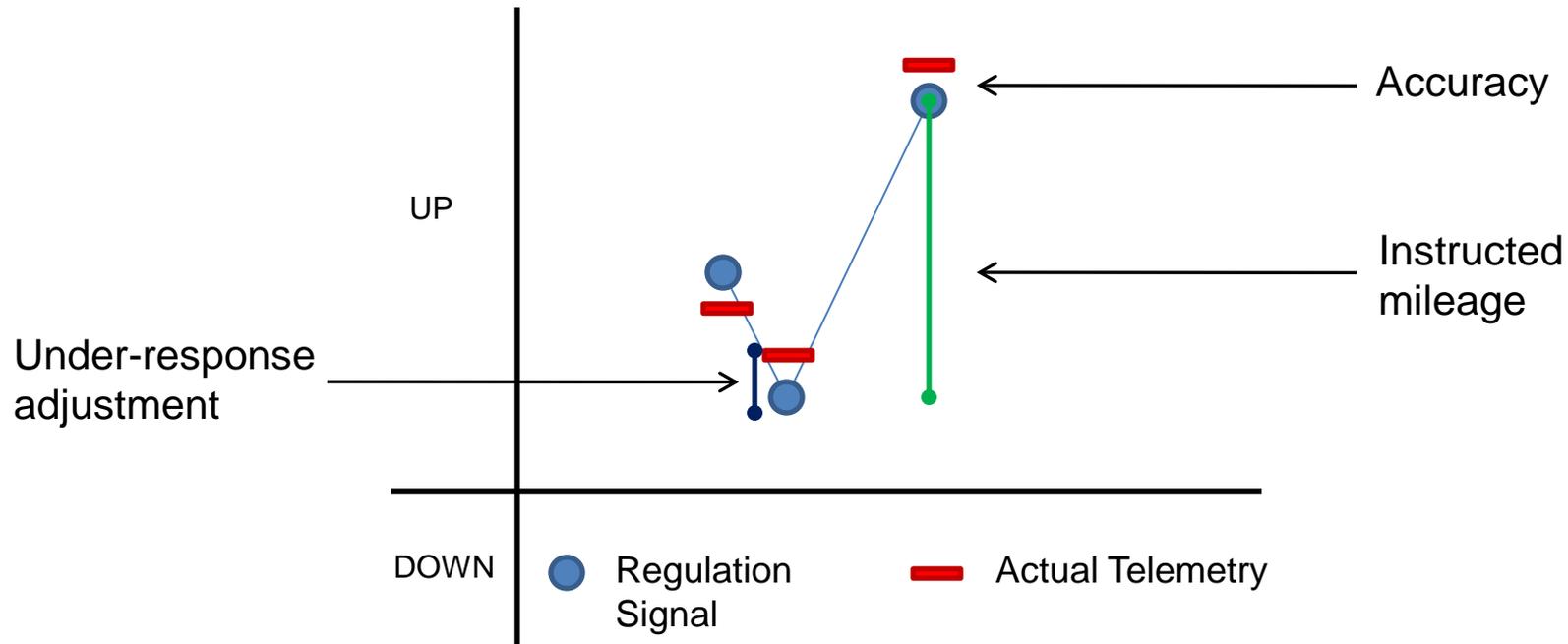
- **Mileage:** resource movement as measured by the absolute change in regulation signals between 4 second intervals
- **Accuracy:** comparison of regulation signal to actual telemetry

Instructed regulation movement or “mileage” is the sum of all green bars in a 15 minute interval.



Resources receive a regulation signal of the MW output needed every four seconds.

# Accuracy adjustments reduce mileage payment based upon performance.



1. Under-response adjustment reduces mileage paid when a resource doesn't provide actual movement
2. Accuracy measured by actual telemetry versus regulation signal

## Additional market design elements of proposal:

- Address mileage payment and cost
  - Include in bid cost recovery calculations
  - Allocate mileage costs in the same manner as regulation capacity costs
  - Rules to disqualify mileage similar to regulation capacity payments
- Publish the mileage price, system mileage multiplier, and actual mileage incurred on OASIS
- Mileage bids will be subject to the grid management charge bid segment fee of \$0.005

# Stakeholders support proposal

- The final proposal addresses concerns raised by stakeholders, the Market Surveillance Committee, and the Department of Market Monitoring.
- Cost allocation of regulation capacity and regulation mileage will be addressed in current cost allocation initiative.

## Management will request authority from FERC to extend implementation date to spring 2013

- Order 755 requires implementation in October 2012
- Implementation will require significant modifications across many of the ISO's market systems that could not be reliably completed by October 2012

In summary, Management recommends approval of the pay for performance regulation market design:

- Market design complies with FERC Order 755
- Proposal broadly supported by stakeholders
- Proposed compensation to regulation resources provides incentives for higher performance
  - Resources that are moved more in response to regulation signals receive higher payments
  - Resources with greater accuracy receive higher payments



Board of Governors

March 23, 2012

Decision on Pay for Performance Regulation

**Motion**

**Moved, that the ISO Board of Governors approves the proposed pay for performance regulation market design, as described in the memorandum dated March 15, 2012; and**

**Moved, that the ISO Board of Governors authorizes Management to make all necessary and appropriate filings with the Federal Energy Regulatory Commission to implement the proposed tariff change.**

**Moved: Galiteva      Second: Bhagwat**

Board Action: <b>Passed</b>	Vote Count: <b>4-0-0</b>
Bhagwat	Y
Foster	Y
Galiteva	Y
Mullin	Y

**Motion Number: 2012-03-G5**

**Attachment D – Declaration of Janet Morris**  
**Order 755 Compliance Filing – Frequency Regulation Compensation**  
**in the Organized Wholesale Power Markets**  
**April 27, 2012**



assumed my current job. In these positions, I have worked extensively in the project management and implementation of new market initiatives, such as the proxy demand resources, multi-stage generator modeling, convergence bidding, scarcity pricing, and other new market design functionality.

I received my Bachelor of Science degree in Computer Science from California Polytechnic State University in San Luis Obispo, California, and my Master of Science degree in Engineering Management from Santa Clara University in Santa Clara, California. After graduating, I spent over 18 years as a Project Manager in Software Research & Development and Service for Hewlett-Packard. For the four years before I joined the ISO, I was the Director of Engineering responsible for Project Management for Commerce One, an Internet software company. I have a total of over 25 years of experience in the software design field.

**Q. What is the purpose of your declaration in this proceeding?**

**A.** In my declaration, I describe the work the ISO is undertaking to change its market systems to implement a performance payment for regulation services. I also identify the time that the ISO needs to complete this work and conduct a market simulation.

**Q. Please describe the work the ISO is undertaking to change its market systems to implement a performance payment for regulation services.**

**A.** This project involves changes to the ISO's market systems to accept a new regulation mileage bid, validate the mileage bid, determine a uniform mileage price, provide mileage awards, calculate payments and charges, and release information to the market. The project affects most of the business processes from bid to bill and requires changes to various market systems, including the ISO's master file, scheduling infrastructure business rules, market optimization software, enterprise data repository, energy management system, open access same-time information system, settlements, and market clearing interface. The ISO will need to address a number of issues in connection with this effort, including, but not limited to, the following:

- Allow mileage bids for regulation up and regulation down.
- Account for inter-temporal opportunity cost line item in bid justification.
- Co-optimize mileage bids in the integrated forward market and real-time market.
- Calculate regulation mileage, mileage accuracy adjustments, resource-specific mileage multipliers and total system mileage multipliers for both regulation up and regulation down.
- Validate of data used for actual mileage and accuracy adjustments before they are used in settlements processes.
- Communicate regulation up and regulation down mileage awards and prices to market participants.

- Settle performance payments including the accuracy adjustments.
- Settle the allocation of costs from performance payments.
- Modify bid cost recovery and grid management charge codes.
- Develop means to validate and correct a uniform marginal price for performance payments.
- Insert missing data for calculation of accuracy adjustment and mileage multipliers.
- Apply the minimum performance threshold for regulation certification.
- Release mileage price, mileage multipliers and actual mileage to market participants.

The ISO is currently developing business specifications requirements based on the market design proposal approved by the ISO's Board of Governors in March 2012.

This document provides an assessment of all ISO business processes affected by the design proposal. The ISO plans to complete this document in May 2012.

Thereafter, the ISO will complete its system requirements specifications that address the architectural changes to the ISO market systems necessary to implement the business process changes. This step in the design implementation process assesses how to incorporate changes to the ISO's existing market systems and what incremental architecture is necessary to implement a performance payment for regulation services. The ISO plans to complete this document in June 2012. Once the design is complete, the ISO will develop and implement software codes to bring its market design into a test environment. Once complete, the ISO will conduct testing

of its market systems, hold a market simulation and then prepare this market enhancement for production.

**Q. Please identify the time necessary to complete the changes to the ISO's market systems and conduct relevant testing and a market simulation in connection with implementing a performance payment for regulation services.**

**A.** The ISO currently implements two market releases each year – a spring release and a fall release. The ISO will initiate the effort to build necessary software code and system enhancements associated with a performance payment for regulation services during the third quarter of 2012. Based on prior experiences with *bid to bill* market enhancements, this effort will take approximately three months. Thereafter, the ISO expects to conduct approximately two months of system testing.

The ISO also expects market participants to make changes to their own market systems and test those changes. Once the ISO and market participants complete changes to their market systems, the ISO will schedule a market simulation of enhancements to implement a performance payment for regulation services. The ISO anticipates it can complete this market simulation in the first quarter of 2013, in advance of its scheduled spring 2013 market release.

**Q. Are these process steps necessary to implement a performance payment for regulation services?**

A. Yes, in my professional judgment, any ISO market enhancement such as that directed by Order 755 requires this level of design, testing and market simulation. Failure to undertake these steps would not be consistent with good utility practice.

I declare under penalty of perjury that the foregoing is true and correct.

Dated: April 24, 2010

  
Janet Morris