

**DEPARTMENT OF ENERGY****Federal Energy Regulatory Commission****18 CFR Part 35**

[Docket Nos. RM11–7–000 and AD10–11–000; Order No. 755]

**Frequency Regulation Compensation in the Organized Wholesale Power Markets****AGENCY:** Federal Energy Regulatory Commission, DOE.**ACTION:** Final rule.

**SUMMARY:** Pursuant to section 206 of the Federal Power Act, the Commission is revising its regulations to remedy undue discrimination in the procurement of frequency regulation in the organized wholesale electric markets and ensure that providers of frequency regulation receive just and reasonable and not unduly discriminatory or preferential rates. Frequency regulation service is one of the tools regional transmission organizations (RTOs) and independent system operators (ISOs) use to balance supply and demand on the transmission system, maintaining reliable operations. In doing so, RTOs and ISOs deploy a variety of resources to meet frequency regulation needs; these resources differ in both their ramping ability, which is their ability to increase or decrease their provision of frequency regulation service, and the accuracy with which they can respond to the system operator's dispatch signal.

The Commission finds that current frequency regulation compensation practices of RTOs and ISOs result in rates that are unjust, unreasonable, and unduly discriminatory or preferential. Specifically, current compensation methods for regulation service in RTO and ISO markets fail to acknowledge the inherently greater amount of frequency regulation service being provided by faster-ramping resources. In addition, certain practices of some RTOs and ISOs result in economically inefficient economic dispatch of frequency regulation resources.

By remedying these issues, the Commission is removing unduly discriminatory and preferential practices from RTO and ISO tariffs and requiring the setting of just and reasonable rates. Specifically, this Final Rule requires RTOs and ISOs to compensate frequency regulation resources based on the actual service provided, including a capacity payment that includes the marginal unit's opportunity costs and a payment for performance that reflects the quantity of

frequency regulation service provided by a resource when the resource is accurately following the dispatch signal.

**DATES:** *Effective Date:* This Final Rule will become effective December 30, 2011.

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**SUPPLEMENTARY INFORMATION:****UNITED STATES OF AMERICA****FEDERAL ENERGY REGULATORY COMMISSION**

Before Commissioners: Jon Wellenhoff, Chairman; Marc Spitzer, Philip D. Moeller, John R. Norris, and Cheryl A. LaFleur.

Frequency Regulation Compensation in the Organized Wholesale Power Markets Docket Nos. RM11–7–000; AD10–11–000

**ORDER NO. 755****FINAL RULE**

(Issued October 20, 2011)

1. Pursuant to section 206 of the Federal Power Act (FPA),<sup>1</sup> the Commission is revising its regulations to remedy undue discrimination in the procurement of frequency regulation in the organized wholesale electric markets and ensure that providers of frequency regulation receive just and reasonable and not unduly discriminatory or preferential rates. Frequency regulation service is one of the tools regional transmission organizations (RTOs) and independent system operators (ISOs) use to balance supply and demand on the transmission system, maintaining reliable operations. In doing so, RTOs and ISOs<sup>2</sup> deploy a variety of resources to meet frequency regulation needs; these resources differ in both their ramping<sup>3</sup> ability, which is their ability

<sup>1</sup> 16 U.S.C. 824e. *Accord* 16 U.S.C. 824d (providing that rates must be just and reasonable).

<sup>2</sup> The following RTOs and ISOs have organized wholesale electricity markets: PJM Interconnection, LLC (PJM); New York Independent System Operator, Inc. (NYISO); Midwest Independent Transmission System Operator, Inc. (MISO); ISO New England Inc. (ISO–NE); California Independent System Operator Corp. (CAISO); and Southwest Power Pool, Inc. (SPP).

<sup>3</sup> “Ramping” or the ability to “ramp” is traditionally defined as the ability to change the output of real power from a generating unit per some unit of time, usually measured as megawatts per minute (MW/min). A generator ramps up to

to increase or decrease their provision of frequency regulation service, and the accuracy with which they can respond to the system operator's dispatch signal. In this instance, the ability to provide more accurate frequency regulation service means to follow the system operator's dispatch signal more closely.

2. The Commission finds that current frequency regulation compensation practices of RTOs and ISOs result in rates that are unjust, unreasonable, and unduly discriminatory or preferential. Specifically, current compensation methods for regulation service in RTO and ISO markets fail to acknowledge the inherently greater amount of frequency regulation service being provided by faster-ramping resources.<sup>4</sup> In addition, certain practices of some RTOs and ISOs result in economically inefficient economic dispatch of frequency regulation resources.

3. By remedying these issues, the Commission is removing unduly discriminatory and preferential practices from RTO and ISO tariffs and requiring the setting of just and reasonable rates. Specifically, this Final Rule requires RTOs and ISOs to compensate frequency regulation resources based on the actual service provided, including a capacity payment that includes the marginal unit's opportunity costs and a payment for performance that reflects the quantity of frequency regulation service provided by a resource when the resource is accurately following the dispatch signal.

**I. Background****A. Frequency Regulation Service**

4. Frequency regulation<sup>5</sup> service is the injection or withdrawal of real power by facilities capable of responding

produce more energy and ramps down to produce less. A storage device ramps up by discharging energy and ramps down by charging. A demand response resource, in the context of the provision of frequency regulation, ramps up by consuming less energy and ramps down by consuming more.

<sup>4</sup> Both existing market participants and potential entrants are affected by inefficient pricing. It is possible that existing market participants would offer faster ramping capabilities to the system operator in response to a pricing scheme that recognized such service.

<sup>5</sup> Frequency regulation, or secondary frequency control, is distinguishable from frequency response, or primary frequency control, for the purposes of this rulemaking. The latter, *i.e.*, frequency response, involves the automatic, autonomous and rapid action of turbine governor control to change a generator's output and of demand response resources to change consumption in automatic response to changes in frequency. This occurs independently of any dispatch signal from a system operator. On January 20, 2011, the Commission released for public comment a staff study evaluating the use of frequency response metrics as a tool to assess the reliability impacts of varying resource mixes on the transmission grid.

appropriately to a transmission system operator's automatic generator control (AGC) signal. When dispatched generation does not equal actual load plus losses on a moment-by-moment basis, the imbalance will cause the grid's frequency to deviate from 60 Hertz, the standard in the U.S. While the system does deviate from 60 Hz in the normal operation of the grid, frequency deviations outside an acceptable range negatively affect energy consuming devices; major deviations cause generation and transmission equipment to disconnect from the grid, in the worst case leading to a cascading blackout. Frequency regulation service can help to prevent these adverse consequences by rapidly correcting deviations in the transmission system's frequency to bring it within an acceptable range.<sup>6</sup> The system operator calibrates the AGC signal sent to frequency regulation resources to respond to actual and anticipated frequency deviations or interchange power imbalance, both measured by area control error (ACE).

5. Today, frequency regulation is largely provided by generators (e.g., water, steam and combustion turbines) that are specially equipped for this purpose. Provision by other resources is emerging, as technologies develop and tariff and market rules adapt to accommodate new resources. For example, the Texas Interconnection and MISO currently use controllable demand response in addition to generators to provide frequency regulation service. Such "regulation capable" generation, storage devices, and demand response resources can respond automatically to signals sent by the RTO or ISO, through AGC, to increase or decrease real power injections or withdrawals and thereby correct actual or anticipated frequency deviations or interchange schedule imbalance, as measured by the ACE. The faster a resource can ramp up or down, the more accurately it can respond to the AGC signal and avoid overshooting.<sup>7</sup> Alternatively, when a resource ramps too slowly, its ramping

<sup>6</sup> A balancing authority achieves acceptable ranges by being in compliance with Control Performance Standards 1 and 2 as defined in the Commission-approved Reliability Standard BAL-001-0.1a.

<sup>7</sup> See Beacon Power Corporation (Beacon), Technical Conference Speaker Materials, at Figure 3, which shows the difference between ISO-NE's ACE control signal, Beacon's flywheel response, and the allowable response rate under current ISO-NE rules. Here, "allowable response rate" means the rate at which the resource must respond to be considered in compliance with the dispatch signal. *Frequency Regulation Compensation in the Organized Wholesale Power Markets*, Docket No. AD10-11-000 (May 26, 2010).

limitations may cause it to work against the needs of the system and force the system operator to commit additional regulation resources to compensate.

#### B. Current RTO and ISO Compensation Practices

6. In the RTO and ISO markets, compensation for frequency regulation service is presently based on several components. Depending on the RTO or ISO, these payments include consideration for capacity set aside to provide the service<sup>8</sup> as well as some of the following: the net energy that the resource injects into the system; accurately following the RTO's or ISO's dispatch signal; and the absolute (rather than net) amount of energy injected or withdrawn. These payments are intended to cover the range of costs incurred in providing frequency regulation service, e.g., operation and maintenance costs, and loss of potential revenue from foregone sales of electricity.

7. The payment for capacity is essentially an option payment to the resource to keep a certain amount of capacity out of the energy or other markets in order to provide frequency regulation service, typically based on a market clearing price per MW of capacity sold. ISO-NE, NYISO, MISO, California ISO, and PJM incorporate into this payment the opportunity cost of foregone energy sales incurred by a resource that provides frequency regulation service. However, ISO-NE and PJM do not apply the opportunity cost payment uniformly to all cleared resources, but rather make *ex post* resource-specific opportunity cost payments.

8. Compensation for frequency regulation service also includes payments or charges for the net energy the resource injects into or withdraws from the system. All RTOs and ISOs currently provide a payment for the net energy injected by a resource providing regulation service during the operating hour, calculated as the amount of energy injected less energy withdrawn multiplied by the real-time energy price.

9. Accuracy of performance can also be incorporated into payments for frequency regulation service. Currently, NYISO incorporates accuracy into its compensation for frequency regulation service through a penalty that reflects the accuracy with which the resource follows its dispatch instruction.<sup>9</sup> This is

<sup>8</sup> This type of capacity payment is distinguishable from capacity payments associated with the procurement of resources to meet planning reserve margin requirements.

<sup>9</sup> NYISO, *Ancillary Services Manual, Manual 2* (Nov. 2010), <http://www.nyiso.com/public/>

done through a performance index that tracks how accurately a resource follows the dispatch signal.<sup>10</sup>

10. ISO-NE makes payments for frequency regulation service to reflect the amount of work performed by a resource by reflecting the absolute amount of energy injected and withdrawn, sometimes referred to as a "mileage" payment. Mileage payments are intended to reward those resources that perform more regulation service instead of simply netting the total amount of energy injected by the resource.<sup>11</sup>

11. In general, when a resource submits its frequency regulation bid to the RTO or ISO, the bid is typically required to include its ramp rate in MW/min, its cost per megawatt-hours (MWh) of ramping ability, and the total capacity it is offering for frequency regulation.<sup>12</sup> The resource's total amount of capacity is based on and limited by its ability to ramp up or down.<sup>13</sup> For example, a resource with a relatively large amount of capacity, but a relatively slow ramp rate would be limited in how much capacity it could offer as frequency regulation capacity. If the resource can ramp one MW per minute, it would only be able to offer five MW of regulation capacity (for a five minute dispatch) regardless of its total capacity. On the other hand, a smaller capacity, faster ramping resource might not face such a constraint. For instance, a storage device that can hold a 20 MW charge and ramp at 10 MW per minute, could offer its full 20 MW of capacity for five minutes.

12. The Commission recognizes that some RTOs and ISOs are considering changes to their frequency regulation markets.<sup>14</sup> For example, in February of

[webdocs/documents/manuals/operations/ancserv.pdf](#).

<sup>10</sup> NYISO uses telemetry data to track how closely a frequency regulation resource's output is to the dispatch signal. NYISO then adjusts the resource's payments to reflect its accuracy. For example, if the resource's response falls outside an acceptable range 10 percent of the time, for a performance index of 0.9, it will receive 90 percent of its payment.

<sup>11</sup> ISO-NE, *Market Operations Manual M-11*, at 3-11 (Dec. 2010), available at [http://www.iso-ne.com/rules\\_proceeds/isone\\_mnls/m\\_11\\_market\\_operations\\_revision\\_35\\_12\\_01\\_10.doc](http://www.iso-ne.com/rules_proceeds/isone_mnls/m_11_market_operations_revision_35_12_01_10.doc).

<sup>12</sup> See, e.g., NYISO, *Ancillary Services Manual, Manual 2*, at 4-8 (Nov. 2010).

<sup>13</sup> A resource's capacity is limited by the amount it can ramp in five minutes because the system operator in most RTOs and ISOs dispatch resources every five minutes. CAISO dispatches every 10 minutes, and so a frequency regulation resource's capacity in that market is bound by the total capacity it can ramp in 10 minutes.

<sup>14</sup> In addition to the examples cited here, SPP is in the process of developing its integrated marketplace that will include a day-ahead market and consolidated ancillary services market.

this year PJM established a “Regulation Performance Senior Task Force” to examine the existing PJM regulation market’s inability to distinguish between resources’ various levels of performance and the absence of additional compensation for the resources to perform at a high level once they have qualified for the regulation market.<sup>15</sup> Therefore, the Commission believes that this Final Rule is timely, in that it will help guide these various stakeholder processes.

### C. Commission Inquiries Leading to This Rulemaking

13. On May 26, 2010, the Commission hosted a publicly noticed technical conference<sup>16</sup> inviting various stakeholders, including representatives from the RTOs and ISOs, industry, and academia to share their views on whether current frequency regulation market designs reflect the value of the service provided, and whether the use of faster-ramping resources for frequency regulation has the potential to provide benefits to the organized markets.

14. On February 17, 2011, the Commission issued a Notice of Proposed Rulemaking in this proceeding,<sup>17</sup> seeking comment on its proposal to require both a uniform price for frequency regulation capacity paid to all cleared resources as well as a performance payment for the provision of frequency regulation service, with the latter payment reflecting a resource’s accuracy of performance.<sup>18</sup>

## II. Discussion

### A. The Need for Reform

15. As discussed below, the Commission finds that current frequency regulation compensation practices in organized wholesale electricity markets which fail to compensate resources for all of the service they provide as part of that service are unjust, unreasonable, and unduly discriminatory or preferential.

<sup>15</sup> See PJM Regulation Performance Senior Task Force Charter at 1 (2011) and ISO-NE., *Report of ISO New England Inc. Regarding the Implementation of Market Rule Changes to Permit Non-Generating Resources to Participate in the Regulation Market*, Docket No. ER08–54–014, at 5 (June 17, 2010).

<sup>16</sup> See Final Agenda, *Frequency Regulation Compensation in the Organized Wholesale Power Markets*, Docket No. AD10–11–000 (May 26, 2010).

<sup>17</sup> *Frequency Regulation Compensation in the Organized Wholesale Power Markets*, 76 FR 11,177, 134 FERC ¶ 61,124 (2011) (NOPR).

<sup>18</sup> See Appendix for a list of commenters.

### 1. NOPR Preliminary Finding

#### a. Unduly Discriminatory Pricing

16. In the NOPR, the Commission stated that the current rules that govern pricing and compensation for frequency regulation services in RTOs and ISOs may be unduly discriminatory, because resources are compensated at the same level even when providing different amounts of frequency regulation service.<sup>19</sup>

17. Specifically, the Commission was concerned that under some existing frequency regulation compensation methods, resources may not be compensated for all of the service they provide even when given preference in the dispatch order and asked to provide more frequency regulation service than other resources. The Commission noted, for example, that CAISO, NYISO, MISO, and PJM pay a capacity payment to all resources that clear the frequency regulation market, and then net the amount of regulation up and regulation down provided by these resources in order to compensate for the energy costs they incur. The Commission preliminarily found that this compensation method does not acknowledge the greater amount of frequency regulation service being provided by faster-ramping resources.<sup>20</sup> It stated that, as a result, slower-responding resources are compensated as if they are providing the same amount of service when, in reality, they are not,<sup>21</sup> and that slower, larger resources are being given a compensatory advantage for their size while faster, smaller resources do not similarly receive compensation for their ramping speed and actual service provided.

18. The Commission also expressed concern that the manner in which some resources that provide frequency regulation service are compensated for

<sup>19</sup> NOPR, 134 FERC ¶ 61,124 at P 27.

<sup>20</sup> A simplified example would be to consider two resources that clear with the same amount of capacity and are directed to provide regulation up and regulation down over the course of a five-minute interval. The fast-ramping resource might be directed to move around an initial output level up five MW, then down three MW, up one MW, down ten MW, and finally up nine MW. A netting approach to compensation would determine that the resource provided an additional two MW of energy to the system (+ 5 – 3 + 1 – 10 + 9 = + 2) during that five minute interval. Meanwhile, a slower-ramping resource may be directed to move up three MW and then down one MW for a net of two MW in relation to its initial output level. The operator is not able to direct more movement because the slower-ramping resource would not be able to respond in the requisite time frame. Both resources would receive identical compensation for their movement, despite the first resource providing more ACE correction.

<sup>21</sup> NOPR, 134 FERC ¶ 61,124 at P 28.

their opportunity costs<sup>22</sup> may be unduly discriminatory.<sup>23</sup> For instance, while PJM provides an *ex ante* estimate of opportunity costs that is included in the uniform clearing price, it also provides *ex post* “make whole” payments based on individual unit opportunity costs, something that is not reflected in the uniform market clearing price calculation;<sup>24</sup> ISO-NE pays opportunity costs on a resource-specific basis so that the market-clearing price for frequency regulation service does not reflect any opportunity costs. Both of these methods have the potential to inefficiently select regulating resources and also fail to reflect the marginal cost (including opportunity cost) that determines the market-clearing price paid to all cleared suppliers. Therefore, the NOPR proposed to require that all resource bids include opportunity costs and that all cleared frequency regulation resources be paid the single market clearing price, which reflects the total marginal costs of the marginal cleared unit.<sup>25</sup>

#### b. Potential Market Efficiency Gains

19. The NOPR also preliminarily found that the use of faster-ramping resources for frequency regulation has the potential to improve operational and economic efficiency and, in turn, lower costs to consumers in the organized markets. Faster-ramping resources may be able to replace resources that currently provide frequency regulation, so that RTOs and ISOs may be able to procure less regulation capacity, thereby lowering costs to load.

## 2. Comments

### a. Unduly Discriminatory Pricing

20. Many commenters expressly support the NOPR’s proposed performance payment to reflect the amount of frequency regulation provided by a resource.<sup>26</sup> They

<sup>22</sup> When participating in the energy and frequency regulation markets, a resource is dispatched at a set-point below its maximum capacity. Because this amount of capacity is held in reserve to provide frequency regulation, the resource misses the opportunity to provide energy at the current LMP.

<sup>23</sup> NOPR, 134 FERC ¶ 61,124 at P 31.

<sup>24</sup> PJM, *Manual 18: Operating Agreement Accounting*, at 12–16, available at <http://www.pjm.com/-/media/documents/manuals/m28.ashx>.

<sup>25</sup> NOPR, 134 FERC ¶ 61,124 at P 31.

<sup>26</sup> A123, Alcoa, Beacon, CESA, Duke, ESA, EDF, EPSA, ELCON, ENBALA, EnerNOC, Invenergy, ISO-NE., Manitoba Hydro, MISO, MSCG, NaturEner, NECPUC, NEPOOL, OMS, PaPUC, PG&E, Powerex, Primus Power, PIOs, PJM, SoCal Edison, Starwood/Premium, SunEdison, VCharge, Viridity, and Xtreme Power all submitted comments supporting the proposal to require a performance payment. Some have offered alternative means to accomplish the same goal, as described below.

generally argue that for a frequency regulation compensation mechanism to be just and reasonable it must compensate providers for the service they actually provide to the grid. They argue that the compensation systems currently used in the RTOs and ISOs are not only unduly discriminatory but also problematic because they send inefficient price signals. In addition, they generally advocate that a performance payment for regulation will incent participants to offer more flexibility to the system operator and will compensate resources for the value they provide the grid.<sup>27</sup>

21. Alcoa supports the proposal that compensation for frequency regulation service reflect the absolute (rather than net) energy the resource injects into or withdraws from the system. Alcoa states that compensating for the amount of movement creates strong market signals because it ensures that those resources that are performing more work to correct system deviations are rewarded more. It contends that this aligns with the physical reality that the more the resource is moved, the more wear will occur on the equipment and the higher the cost of supplying the service.<sup>28</sup>

22. Beacon contends that, currently, all resources (except in ISO-NE), regardless of how frequently they are deployed or how much of the ACE correction they provide, are paid the same price per MW for their capacity offered. Beacon contends that no payment is based on how much the resource is actually deployed to provide frequency regulation.<sup>29</sup> Beacon argues that this is unjust and unreasonable. Similarly, PIOs argue that NYISO's and MISO's frequency regulation markets fail to ensure just and reasonable treatment of faster-ramping regulation resources, and do not provide the proper economic incentive for efficient market participation.<sup>30</sup>

23. In order to illustrate the undue discrimination that can occur in frequency regulation markets, Beacon

provides data from its own 1 MW flywheel operating in the ISO-NE market, contending that these data demonstrate that its resource provides more than four times as much frequency regulation service to ISO-NE as would a 1 MW resource with an allowable ramp rate of 1 MW/5 minutes.<sup>31</sup> It contends that the flywheel provides 0.48 MWh while the slower ramping resource provides 0.11 MWh. Beacon states that the reason its flywheel is able to provide more frequency regulation service is not just because of its faster ramping ability, but also because it is able to switch the direction of the resource nearly instantaneously.<sup>32</sup> In a frequency regulation market paying only a capacity payment, Beacon's flywheel will have performed a greater amount of frequency regulation service, yet received the same payment as the other resource.

24. Beacon and ESA argue that a performance payment system is needed in order to send efficient price signals and to compensate resources that are asked to do more work. Beacon and ESA maintain that this form of pricing will appropriately compensate resources and encourage the RTOs and ISOs to improve operational and economic efficiencies, thereby lowering costs to consumers.<sup>33</sup> In support of its arguments, Beacon points to operating data from its flywheel in NYISO comparing the actual performance of its flywheel to a hypothetical, similarly sized slower resource to determine how much each resource would contribute to frequency regulation service.<sup>34</sup> Beacon states that even though the flywheel would have been dispatched to provide more than twelve times as much frequency regulation service, its flywheel would have actually been paid less than the slower-responding resource that provided less service to the system.<sup>35</sup>

25. Beacon also provides an example of five 20 MW resources with different ramp rates—two average resources, two

slower resources, and one faster resource—that are dispatched and paid based only on the amount of capacity offered. Beacon asserts that if these resources were to be paid for both capacity and performance, the system operator could reduce the amount of capacity procured by 40 percent while obtaining the same amount of regulation service. Assuming a \$10 decrease in the capacity price and a \$1.00/MW mileage rate, Beacon estimates a reduction in total regulation cost of 27 percent, in addition to releasing 40 MW of generation to provide energy or other reserves.<sup>36</sup>

26. PJM states that it strongly supports a performance-based methodology. PJM claims that a performance payment provides an appropriate incentive to provide high quality regulation service by tying a portion of the total compensation to a resource's performance. In addition, PJM asserts that a performance payment will ensure resources provide accurate responses to control signals, in contrast with the current structure that provides no incentive to perform above a minimum threshold.<sup>37</sup>

27. Among the RTOs and ISOs, only CAISO makes the claim that its markets are not unduly discriminatory or preferential. CAISO asserts that the Commission cannot declare the existing rate unjust and unreasonable or unduly discriminatory based on an unsupported conclusion that all markets require more ACE correction.<sup>38</sup> Indeed, CAISO argues that its operational and reliability requirements, including ACE correction, have been and continue to be adequately met by existing regulation services and resources. Furthermore, CAISO argues that its rates for regulation apply to all resources equally so long as the resource meets the minimum operating and technical requirements to provide regulation because the amount of capacity a resource may bid for regulation is based upon the resource's certified ramp rate over a ten minute interval. It contends that, therefore, a faster-ramping resource can sell more regulation capacity than a slower ramping resource. It argues that these terms and conditions of service provide comparable treatment for all resources certified to provide regulation.<sup>39</sup> CAISO also argues that while its energy management system does not include a priority dispatch for resources with faster-ramping capability, its system will send control

<sup>27</sup> See, e.g., EDF May 2, 2011 Comments at P 14 and P 16, CESA May 2, 2011 Comments at 2 and 8, ENBALA May 2, 2011 Comments at 8, ELCON May 2, 2011 Comments at 4, Manitoba Hydro April 27, 2011 Comments at 2 (citing Prowse, D. "Improvements to a Standard Automatic Generation Control Filter Algorithm" IEEE/PES Summer Power Meeting, 92 SM 451-5 PWRs), OMS May 2, 2011 Comments at 6, Primus Power April 18, 2011 Comments at 5-6, PIOs May 3, 2011 Comments at 5-7, PJM May 2, 2011 Comments at 6, SoCal Edison May 2, 2011 Comments at 3, Starwood/Premium May 2, 2011 Comments at 4-5, Viridity May 2, 2011 Comments at 1, Xtreme Power May 2, 2011 Comments at 6-7.

<sup>28</sup> Alcoa May 2, 2011 Comments at 3-4.

<sup>29</sup> Beacon May 2, 2011 Comments at 20-21, ESA May 2, 2011 Comments at 19-20.

<sup>30</sup> PIOs May 2, 2011 Comments at P 16.

<sup>31</sup> Beacon May 2, 2011 Comments at 6-7. These data are the same data on which the table in Appendix A of the NOPR is based.

<sup>32</sup> Beacon May 2, 2011 Comments at 7.

<sup>33</sup> Beacon May 2, 2011 Comments at 26-27, ESA May 2, 2011 Comments at 24-25.

<sup>34</sup> See Beacon May 2, 2011 Comments at 22-24.

<sup>35</sup> Beacon May 2, 2011 Comments at 24 (citing NYISO Tariff, Section 15.3.2.1(d), Regulation Service Offers from Limited Energy Storage Resources. "The ISO may reduce the real-time Regulation Service offer (in MWs) from a Limited Energy Storage Resource to account for the Energy storage capacity of such Resource."). See also ESA May 2, 2011 Comments at 21-23 (providing a numerical example of how a two-part payment system can result in cost savings in the procurement of frequency regulation capacity and service).

<sup>36</sup> Beacon May 2, 2011 Comments at 33-36.

<sup>37</sup> PJM May 2, 2011 Comments at 6.

<sup>38</sup> CAISO May 2, 2011 Comments at 6-7.

<sup>39</sup> CAISO May 2, 2011 Comments at 8.

signals to faster ramping resources if it requires a fast response to correct ACE. Control signals are sent in part based on a resource's operating range and ramping capability.<sup>40</sup>

28. Some commenters argue that the Commission has failed to show a sufficient basis for exercising its section 206 authority to mandate revisions to existing RTO and ISO tariff provisions.<sup>41</sup> CAISO argues it has and continues to meet its operational and reliability requirements, and pays equally all resources capable to meet the requirement. As such, CAISO argues, its markets are not unduly discriminatory or preferential.

29. EEI contends that the Commission has not shown that changing the compensation mechanism to increase compensation for faster ramping resources will result in enhanced reliability or enable system operators to more easily meet reliability standards; that the Commission is looking at only one of the three elements of frequency response (inertial response and governor response being the others) and in doing so has failed to provide the necessary technical basis to demonstrate that its assumptions that resources providing frequency regulation are more valuable than resources providing the other services and that the resulting payments are unduly discriminatory. Similarly, NGSAs argue that regulatory policies that focus singly on special forms of compensation and incentives for some forms of ancillary and balancing services, but not others, are likely to result in distorted market signals and a mix of services and products that are sub-optimal for meeting system balancing requirements. NGSAs contend that there is a direct interrelationship between primary and secondary frequency control, and compensation for frequency regulation cannot be considered in isolation.<sup>42</sup>

30. TAPS also argues that the existing total compensation for frequency regulation has not been shown to be unjust and unreasonable. TAPS contends that any increased payments to faster-ramping resources must be balanced by savings through reduced regulation procurement or lower payments to slower resources, such that costs to consumers are reduced.<sup>43</sup>

31. Duke argues that the Commission should not favor or subsidize one type of resource over another.<sup>44</sup> It contends

that both fast- and slow-ramping resources have a role to play and there will be instances when operators will not need faster-ramping resources to address frequency deviations. As an example, Duke states that there will be a need for slower-ramping resources that ramp with the load over a five minute period (e.g., load following).<sup>45</sup>

32. EEI argues that the Commission failed to support the NOPR proposal as just and reasonable, because, according to EEI, the Commission did not explain how the two-part payment mechanism will enhance reliability or make compliance with reliability rules easier or cheaper for system operators. EEI claims that no substantial pilot programs have been conducted to evaluate the system cost and reliability impacts of substituting non-traditional resources for existing resources. EEI suggests that the Commission encourage the development of network pilot programs before requiring a revision of frequency regulation service.<sup>46</sup>

33. Several commenters express concern that the Commission will act prematurely, without a full record addressing the various issues to which the NOPR was addressed.<sup>47</sup> For example, NGSAs, among others, cited Commissioner Spitzer's dissent to the NOPR, arguing that feedback is needed from a broad spectrum of industry participants; otherwise the record on which to make the proposed changes to the Commission's regulations may be undermined.<sup>48</sup> The NY TOs contend that the record is insufficient to support a conclusion that the NYISO-administered markets fail to adequately compensate fast response resources.<sup>49</sup>

#### b. Potential Market Benefits

34. The primary economic benefit that some commenters expect to see is reduced costs of procuring frequency regulation capacity, with a secondary benefit of reduced energy costs.<sup>50</sup>

<sup>40</sup> 2, 2011 Comments at 4–5, ELCON May 2, 2011 Comments at 6, SoCal Edison May 2, 2011 Comments at 6.

<sup>41</sup> Duke May 2, 2011 Comments at 4–6.

<sup>42</sup> EEI May 2, 2011 Comments at 9.

<sup>43</sup> CAISO May 2, 2011 Comments at 11–12, Duke May 2, 2011 Comments at 2, EEI May 2, 2011 Comments at 10 (supported by Dayton, Detroit Edison, and FirstEnergy), Jack Ellis May 2, 2011 Comments at 7, MISO TOs May 2, 2011 Comments at 5.

<sup>44</sup> Natural Gas Supply Association May 2, 2011 Comments at 5.

<sup>45</sup> New York Transmission Owners May 2, 2011 Comments at 1.

<sup>46</sup> See, e.g., Beacon May 2, 2011 Comments at 5, ESA May 2, 2011 Comments at 3, EDF May 2, 2011 Comments at P 5–7, EDF May 2, 2011 Comments at P 9, ENBALA May 3, 2011 Comments at 3, NEPOOL May 2, 2011 Comments at 6, PaPUC May 2, 2011 Comments at 5, PJM May 2, 2011 Comments at 3–4.

Commenters argue that faster-ramping resources are able to provide more frequency regulation service from the same amount of frequency regulation capacity because faster-ramping resources can provide more ACE correction in real-time. Commenters conclude that this will result in a system operator needing to procure less frequency regulation capacity.<sup>51</sup> Commenters further explain that, as these faster-responding resources displace slower-ramping resources, existing generators that are displaced can be shifted to provide an even greater amount of energy. These traditional resources can then run at their full capacity at their preferred steady-state operating point which improves their heat rate and reduces the wear and tear on their equipment, thereby lowering their cost to operate.<sup>52</sup>

35. Commenters cite several studies to support the argument that faster-responding resources will result in economic benefits. Among them is PNNL's study showing that fast-ramping energy storage resources (such as flywheels and batteries) could be as much as 17 times more effective than conventional ramp-limited regulation resources because of how quickly and accurately they respond to a system imbalance;<sup>53</sup> and a California Energy Commission study which showed that "on an incremental basis, storage can be up to two to three times as effective as adding a combustion turbine to the system for regulation purposes."<sup>54</sup>

36. Commenters also pointed to ISO-NE and NYISO as examples of markets that have a relatively high number of faster-responding frequency regulation resources. In both cases, the system operator is able to procure a relatively smaller amount of frequency regulation capacity, compared to other RTOs and ISOs. Beacon notes that ISO-NE, the only RTO or ISO to both dispatch faster-ramping resources first and then compensate resources based on performance, is able to procure the least frequency regulation capacity, measured

<sup>51</sup> SoCal Edison May 2, 2011 Comments at 3.

<sup>52</sup> Beacon May 2, 2011 Comments at 11, CESA May 2, 2011 Comments at 5, ENBALA May 3, 2011 Comments at 4, ESA May 2, 2011 Comments at 11, and PaPUC May 2, 2011 Comments at 5 and Snowberger Affidavit at 8.

<sup>53</sup> Makarov, Y.V., Ma, J., Lu, S., Nguyen, T.B., "Assessing the value of Regulation Resources Based on Their Time Response Characteristics," Pacific Northwest National Laboratory, PNNL-17632, June 2008.

<sup>54</sup> Beacon May 2, 2011 Comments at 8–9 (citing KEMA, "Research Evaluation of Wind Generation, Solar Generation, and Storage Impact on the California Grid" (prepared for the California Energy Commission), June, 2010).

<sup>40</sup> *Id.* at 9.

<sup>41</sup> EEI May 2, 2011 Comments at 9–10, TAPS May 2, 2011 Comments at 5.

<sup>42</sup> NGSAs May 2, 2011 Comments at 4.

<sup>43</sup> TAPS May 2, 2011 Comments at 5.

<sup>44</sup> See also CAREBS May 2, 2011 Comments at 5–6, AWEA May 2, 2011 Comments at 3–4, Duke May

as a percentage of peak load.<sup>55</sup> EDF also notes that ISO-NE and NYISO, two balancing authority areas with relatively high concentrations of faster-responding resources, procure relatively less frequency regulation capacity.<sup>56</sup>

37. ISO-NE agrees that fast-ramping resources provide benefits in the regulation market and states that the participation of fast-ramping resources in the New England regulation market is a factor in New England's low current regulation requirement. ISO-NE also states that all other things being equal, faster response is clearly better than slower response, for the reasons explained in the NOPR. PJM also argues the importance of procuring a mix of frequency regulation resources, some of which will have the ability to sustainably maintain their response.<sup>57</sup> Likewise, SoCal Edison states that the use of faster-ramping regulation resources, in conjunction with an efficient regulation dispatch algorithm and effective unit compliance with the dispatch signal should reduce the total amount of regulation capacity needed to perform regulation service.<sup>58</sup>

38. PIOs state that PJM estimates that a 10 percent or 20 percent reduction in its frequency regulation capacity procurement could result in a \$25 million or \$50 million, respectively, reduction in costs to consumers. PIOs state that this savings is large in comparison to the modest software costs required to implement these market rules.<sup>59</sup>

39. To illustrate the potential benefits of faster-ramping resources providing frequency regulation service, Primus Power extends the Beacon Power example<sup>60</sup> to one that applies more generally. Primus Power simulates the output of both what they define as a traditional resource and a fast-response resource. Both resources were assumed to have a capacity of 1 MW; the traditional resource could ramp 1 MW in 5 minutes, while the faster-response resource could ramp faster, mimicking the actual ability of a Primus Power energy storage resource. Primus Power's result supports that of Beacon, with the

faster-responding resource following the AGC signal nearly perfectly, while the slower-ramping resource lags to the point of working against needed ACE correction.<sup>61</sup> Primus Power claims that this results in the faster-ramping resource providing approximately 76 percent more ACE correction.<sup>62</sup>

40. Commenters also mention the potential for reliability benefits stemming from the NOPR proposal. A123, Alcoa, Beacon, CESA, ESA, PIOs, and PJM all state that system operators can also expect to see reliability benefits from the integration of more faster-responding resources. PIOs state that the integration of more faster-responding resources will result in enhanced reliability because their ability to more quickly and accurately follow dispatch instructions will allow the system operator to better maintain system balance. Further, PIOs state that the concern over sustainability is unfounded. First, PIOs state that there is little reason to believe that faster-responding resources will completely displace traditional resources in the short or near term. Second, PIOs state that, given the short dispatch window system operators use, *i.e.* 5 or 10 minute dispatch intervals, storage systems can be assured of maintaining appropriate charge.<sup>63</sup>

41. Xtreme Power argues that the advantages of fast response storage systems is that they do not have problems such as efficiency degradation, emissions, exposure to peaking fuel prices, accelerated O&M, and typical siting issues. Xtreme Power also states that fast response storage systems do not require air quality permits like conventional fossil-fired generation resources, and can therefore be deployed to satisfy RTO or ISO needs for additional regulation service more quickly than new fossil-fired generation.<sup>64</sup>

42. A123 presents data from ERCOT indicating that incorporating storage resources capable of responding to a "ramp-focused" signal from the system operator will result in net ACE remaining within allowable NERC standards 100 percent of the time (as opposed to only 71 percent of the time when relying on traditional resources responding to a slower signal). A123 argues that this improvement will provide the system operator with a larger reliability margin. A123 presents this analysis as an illustration of the difference between traditional slower-

ramping, unlimited energy resources and faster-ramping, limited energy resources.<sup>65</sup>

43. Alcoa contends that the NOPR proposal is likely to result in increased efficient operation of demand side resources and therefore a decrease in the amount of resources dedicated to frequency regulation service.<sup>66</sup> Alcoa contends that there are reliability benefits from integrating more direct load control demand response into system operations because these resources can ramp faster and therefore help restore system frequency more rapidly in the event of a system upset. Alcoa states that because this response can happen within seconds, it can help avert cascading system instability.<sup>67</sup>

44. PJM states that the use of faster-ramping resources will enhance system control. Better control will then lead to a reduction in uncompensated flows imposed on the system by a given balancing authority and will provide better individual control by that balancing authority.<sup>68</sup>

45. Beacon and ESA agree that the use of faster-ramping resources can result in reliability benefits, based on the expectation that the United States will add 145,000 MW of wind generation to the grid over the next ten years. They argue that this will result in increased supply variability, requiring increased system flexibility.<sup>69</sup> In the same vein, Beacon and ESA both cite CAISO's 20 percent renewable portfolio standard study, which showed that CAISO will require an additional 37 percent of regulation up and 11 percent of regulation down in the summer season.<sup>70</sup>

46. In addition Beacon and ESA assert that NYISO expects to need increased regulation and reserve resources as more wind is integrated into its system.<sup>71</sup> Beacon, CESA, and ESA also points to the Commission-sponsored, Lawrence Berkeley National Laboratory (LBNL)

<sup>55</sup> Beacon May 2, 2011 Comments at 9–10. See also ESA May 2, 2011 Comments at 9–10.

<sup>56</sup> EDF May 2, 2011 Comments at 8.

<sup>57</sup> PJM May 2, 2011 Comments at 4.

<sup>58</sup> SoCal Edison May 2, 2011 Comments at 3.

<sup>59</sup> PIOs May 2, 2011 Comments at P 20 (citing PJM Staff, "Problem Statement," Jan. 19, 2011), available at <http://www.pjm.com/~media/committees-groups/committees/mrc/20110216/20110216-item-05-regulation-resource-performance-problem-statement.ashx>. The Problem Statement was presented to the PJM Markets and Reliability Committee, and led to the establishment of a PJM Regulation Performance Senior Task Force.

<sup>60</sup> Primus Power May 2, 2011 Comments at 2.

<sup>61</sup> *Id.* at 3.

<sup>62</sup> *Id.* at 5.

<sup>63</sup> PIOs May 2, 2011 Comments at P 22–23.

<sup>64</sup> Xtreme Power May 2, 2011 Comments at 4–5.

<sup>65</sup> A123 May 2, 2011 Comments at 6.

<sup>66</sup> Alcoa May 2, 2011 Comments at 5.

<sup>67</sup> *Id.* at 4.

<sup>68</sup> PJM May 2, 2011 Comments at 3.

<sup>69</sup> Beacon May 2, 2011 Comments at 11–12, ESA May 2, 2011 Comments at 11, (citing Rick Sergel, President and CEO, North American Electric Reliability Corporation, Executive Remarks, FERC Technical Conference on Integrating Renewable Resources into the Wholesale Electric Grid, March 2, 2009).

<sup>70</sup> Beacon May 2, 2011 Comments at 12, ESA May 2, 2011 Comments at 11–12 (citing CAISO, "Integration of Renewable Resources: Operational Requirements and Generation Fleet Capability at 20% RPS," at 52, table 3.3 (2010), available at: <http://www.caiso.com/2804/2804d036401f0.pdf>).

<sup>71</sup> Beacon May 2, 2011 Comments at 12, ESA May 2, 2011 Comments at 11 (citing NYISO, "Integration of Wind into System Dispatch White Paper," October 2008).

report that identified reliability concerns due to the declining frequency responsiveness of the US interconnections. In order to address these reliability concerns, LBNL recommends expanding the frequency control capability of the RTO and ISO interconnections using advanced technologies such as energy storage.<sup>72</sup>

47. Certain commenters<sup>73</sup> argue that the integration of additional faster-responding resources into the mix of frequency regulation resources will result in environmental benefits. For example, Beacon, CESA, and ESA cite to a 2007 KEMA and an October 2008 Carnegie Mellon University study in support. The KEMA study demonstrated that continued reliance on thermal generating units to meet increased regulation requirements could actually increase emissions of carbon dioxide (CO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>) and other pollutants, thereby defeating one of the main benefits of wind generation.<sup>74</sup> The Carnegie Mellon University study estimated that 20 percent of the CO<sub>2</sub> emission reduction and up 100 percent of the NO<sub>x</sub> emission reduction expected from introducing wind and solar power will be lost because of the extra ramping requirements they impose on traditional generation.<sup>75</sup> Finally, CPUC states that while the Commission's proposal is resource-neutral, it provides an economic incentive for resources to assist in reducing greenhouse gas emissions, compensate for variability of intermittent resources, and reduce costs to consumers through decreased regulation procurement requirements.<sup>76</sup>

48. Other commenters offer cautious support. For example, while Duke Energy concurs that the faster-ramping resource should be compensated for the actual amount of work that it performs, it cautions that faster-ramping resources may not always be needed, and that micromanaging power swings with

faster resources may even result in over-control of the system.<sup>77</sup>

49. Some commenters argue that the Commission has not justified the increased costs that its compensation proposal may impose on load serving entities and other network integration transmission service customers.<sup>78</sup> Others state that the Commission failed to consider the impact on customers, who EEI states will ultimately bear the greatest share of costs, by balancing increased payments to faster ramping resources with savings through reduced regulation procurement or lower payments to slower resources. As a result, EEI argues, load will likely pay more for regulation service without any demonstrated reliability benefit or decrease in the need for other resources.<sup>79</sup> NY TOs, for example, request that the Commission require NYISO to estimate the net savings to consumers that would result if offering incentives for increased participation by dedicated frequency regulation resources induces more traditional capacity to shift away from the regulation market and into the energy market.<sup>80</sup> NaturEner requests that the Commission be vigilant against possible unintended consequences, such as increasing frequency regulation cost or requiring a greater volume of frequency regulation resources.

50. Invenergy cautions the Commission to evaluate whether alternative compensation structures, in addition to being higher cost, will also result in better quality regulation, lower quantities of regulation, and improved reliability.<sup>81</sup>

51. EPSA states that while it supports RTOs and ISOs employing a mileage component similar to that employed in the ISO-NE regulation market, that measure should be used to meet the objectives of regulation service and not require incremental performance levels, which do not yield incremental benefits.<sup>82</sup> EPSA states that adequate frequency is being achieved currently under NERC ACE control standards through reliability requirement CPS1 by each of the RTO and ISO balancing authorities. Thus, EPSA encourages the Commission to recognize that payment for enhanced performance should only be made if there is a material need for that performance.<sup>83</sup> Duke agrees, stating

that no study has been conducted that indicates faster response is necessary for reliable system operations.<sup>84</sup> While CAISO notes that it is considering development of a performance payment for regulation service, it cautions the Commission against requiring a specific performance payment absent a conclusion that faster-ramping resources are required in all markets.<sup>85</sup>

52. Jack Ellis contends that the Commission's proposal to require a payment for performance has several flaws that cannot be easily corrected.<sup>86</sup> He argues that the first flaw is that the rate is likely to be administratively-determined. Mr. Ellis contends that there is no straightforward way for both the mileage payment and the capacity payment to be established through competitive offers. Therefore, he argues, the subjective judgment of the Commission and the operators of RTOs and ISOs will replace market forces in determining the value of frequency regulation service. Second, Mr. Ellis argues that because the rate will be administratively-determined, it will be controversial and subject to litigation. Third, Mr. Ellis contends that the performance payment will increase payments that must be recovered through uplift, complicating existing settlement procedures and efforts to reduce uplift. Fourth, Mr. Ellis argues that a performance payment will unduly discriminate against existing technologies that could respond faster but for the presence of barriers that have not, to date, presented themselves as obstacles. He explains that these barriers include the use of static ramp rates that reflect typical performance under all conditions rather than peak performance under conditions that exist at a point in time. Finally, Mr. Ellis contends that multi-part offers require complex rules to deter market manipulation because it is difficult to differentiate between legitimate and illegitimate bidding behavior.<sup>87</sup> Mr. Ellis asserts that it is neither reasonable nor cost-effective to pay a premium for faster ramping capability in situations where adequate ramping capability is available to meet the grid operator's needs.<sup>88</sup>

53. TAPS recommends that the Commission direct each of the affected regions to evaluate its own frequency regulation market rules, and change them only if they make a regionally-

<sup>72</sup> Beacon May 2, 2011 Comments at 13–14, CESA May 2, 2011 Comments at 6, ESA May 2, 2011 Comments at 13–14 (citing Joseph H. Eto, Use of Frequency Response Metrics to Assess the Planning and Operating Requirements for Reliable Integration of Variable Renewable Generation Lawrence Berkeley National Laboratory, LBNL-4142E, 2010, available at <http://certs.lbl.gov/pdf/lbnl-4142e.pdf>).

<sup>73</sup> See e.g., EDF May 2, 2011 Comments at P10.

<sup>74</sup> Beacon May 2, 2011 Comments at 13, CESA May 2, 2011 Comments at 5, and ESA May 2, 2011 Comments at 12–13 (citing KEMA, Emissions Comparison for a 20MW Flywheel-based Frequency Regulation Power Plant, May 18, 2007).

<sup>75</sup> Beacon May 2, 2011 Comments at 13, ESA May 2, 2011 Comments at 13 (citing Katzenstein, W., and Jay Apt. Air Emissions Due To Wind and Solar Power. *Environmental Science & Technology*. 2009, 43, 253–258. (available at <http://pubs.acs.org/doi/pdf/10.1021/es801437f>)).

<sup>76</sup> CPUC May 2, 2011 Comments at 2–3.

<sup>77</sup> Duke May 2, 2011 Comments at 7.

<sup>78</sup> EEI May 2, 2011 Comments at 12, TAPS May 2, 2011 Comments at 4–5; Invenergy May 2, 2011 Comments at 2–3.

<sup>79</sup> EEI May 2, 2011 Comments at 12.

<sup>80</sup> NY TOs May 2, 2011 Comments at 5.

<sup>81</sup> Invenergy May 2, 2011 Comments at 2–3.

<sup>82</sup> EPSA May 2, 2011 Comments at 7.

<sup>83</sup> *Id.* at 6.

<sup>84</sup> Duke May 2, 2011 Comments at 2.

<sup>85</sup> CAISO May 2, 2011 Comments at 11–12.

<sup>86</sup> Jack Ellis April 12, 2011 Comments at 2.

<sup>87</sup> Jack Ellis April 12, 2011 Comments at 2–3.

<sup>88</sup> *Id.* at 3.

specific showing that the changes will increase consumer welfare.<sup>89</sup>

54. Some commenters dispute the position that the integration of more faster-responding resources for frequency regulation service will result in lower costs to consumers. Jack Ellis argues that, while it is possible that RTOs and ISOs could reduce the *short-term* cost of serving load by procuring less regulation, *long-term* costs would likely increase as supply resources that are pushed out of the frequency regulation market demand higher prices in other joint product markets such as capacity, energy, and other ancillary services markets. Mr. Ellis argues that this will happen because these resources will be losing revenue and will make up for that lost revenue by bidding in at higher levels in these other markets.<sup>90</sup> Mr. Ellis concedes that long-term savings could accrue, but only if resource adequacy requirements also decrease by an equal or greater amount or if the integration of more faster-responding resources allows a reduction in the amount of incremental resources that must be procured to deal with increases in variable generation.<sup>91</sup>

55. The NY PSC recognizes the potential benefits of the NOPR proposal, but it is uncertain what the cost and benefits of any proposed changes to the compensation mechanism would be within the NYISO.<sup>92</sup> Finally, PG&E argues that while the benefits expected by others might be seen, a cost-benefit analysis is appropriate.<sup>93</sup>

56. EEI, NY TOs, TAPS and Invenergy also express concern that the NOPR proposal will result in increased costs to load. EEI argues that load will likely pay more for regulation service without any demonstrated reliability benefit or decrease in the need for other resources. NY TOs requests that the Commission require NYISO to estimate the net savings that would result if the NOPR's compensation mechanism causes more traditional capacity to shift away from the frequency regulation market and into the energy market.

57. CAISO states that while it has conducted studies that indicate a preliminary need for additional ramping capability, the full scope of its intended studies is not complete and the benefits have not been quantified. CAISO claims that studies conducted to identify system needs under a 20 percent renewable portfolio standard indicate a

potential need for dispatchable down ramping capability. However, CAISO argues that studies for a 33 percent Renewable Portfolio Standard are still ongoing, and that the Commission should not impose a specific compensation model for regulation resources without quantifying the needs and benefits of such a model.<sup>94</sup>

58. EPSA asserts that the argument that slow resources work against the system operator assumes a regulation performance standard that exceeds existing requirements. EPSA states that RTOs and ISOs are currently required to maintain ACE within acceptable limits over a ten-minute period, consistent with NERC standards (CPS1 and CPS2). Because AGC signals are sent on a four-second cycle, the benefits of fast-ramping resources that are realized within that cycle, such as increased ramping mileage, may not materially improve the operator's ability to regulate ACE on a ten-minute basis. EPSA argues that RTOs and ISOs already design and adjust regulation software to account for differing characteristics of regulation resources, and requiring increased payments is therefore unnecessary.<sup>95</sup>

59. While MISO states that it supports a mileage payment that compensates regulating resources for the wear and tear associated with performance, it also contends that there is presently no benefit to consumers within the MISO system that would justify payment for the provision of down regulation in addition to the capacity payment such market participants already receive. MISO recommends that the Commission continue to allow RTOs and ISOs to address whether netting or some other mechanism is appropriate to compensate regulating resources.<sup>96</sup>

#### c. Standardization of Market Rules

60. Several entities further oppose a uniform approach, arguing that existing market rules are different in the various RTOs and ISOs and disparate resources available in those markets creates a preference for a regional approach.<sup>97</sup> While PJM and some other RTOs support the goal of the proposed regulation, stating that it will result in more efficient price signals and more accurate payment for the provision of

frequency regulation service, a subset of the RTOs and ISOs seek flexibility to, for example in the case of ISO-NE, allow compensation for performance using the "mileage" paradigm that has been used since 2003.<sup>98</sup> CAISO contends that there is not a single approach to incentivize resources to provide faster-ramping service, nor a single compensation scheme that fits all markets. Instead, CAISO recommends that the Commission direct RTOs and ISOs to examine through their stakeholder processes potential payment mechanisms that will address the Commission's concerns.<sup>99</sup> MISO adds that if the Commission determines in this Final Rule that compensation of frequency regulation providers requires further examination, the Commission should allow each RTO and ISO to develop the compensation mechanisms that are best for its region.<sup>100</sup> Duke and the NY PSC argue that every RTO and ISO has different operations and market mechanisms, and each RTO and ISO should determine fair and just compensation methodologies for frequency regulation resources, including faster ramping ones, that are specifically tailored for their market.<sup>101</sup>

61. Dominion recommends that, instead of standardizing compensation for frequency regulation, the Commission should direct the RTOs and ISOs to revise their frequency regulation markets so that they appropriately value faster-ramping resources. Dominion states that each region operates differently and that each RTO or ISO and its stakeholders are in the best position to develop changes to the compensation mechanism.<sup>102</sup>

62. PG&E argues that accuracy payments alone (without any up and down mileage component) could be equally effective in addressing the Commission's NOPR objectives, or alternatively, there may be entirely different approaches such as new regulation ramp-rate constraints and market components.<sup>103</sup>

63. Starwood/Premium supports the Commission's proposal for a performance payment and recommends that the Commission require that all RTOs and ISOs have standardized tariff provisions for the compensation of frequency regulation resources. They argue that a lack of standardization

<sup>89</sup> CAISO May 2, 2011 Comments at 14–16.

<sup>90</sup> EPSA May 2, 2011 Comments at 7–9.

<sup>91</sup> MISO May 2, 2011 Comments at 6.

<sup>92</sup> Detroit Edison May 2, 2011 Comments at 2–4.

<sup>93</sup> Duke May 2, 2011 Comments at 203. EEI May 2, 2011 Comments at 13–14, IRC May 2, 2011 Comments at 8, MISO TOs May 2, 2011 Comments at 5–7, NYISO May 2, 2011 Comments at 5–6, PG&E May 2, 2011 Comments at 3–4, SCE May 2, 2011 Comments at 2, TAPS May 2, 2011 Comments at 4–5.

<sup>94</sup> ISO-NE May 2, 2011 Comments at 6. *See also*, NECPUC May 2, 2011 Comments at 4, NEPOOL May 2, 2011 Comments at 8–9.

<sup>95</sup> CAISO May 2, 2011 Comments at 2.

<sup>96</sup> MISO May 2, 2011 Comments at 7.

<sup>97</sup> Duke Energy May 2, 2011 Comments at 2, NYPSC May 2, 2011 Comments at 4.

<sup>98</sup> Dominion May 2, 2011 Comments at 3–4.

<sup>99</sup> PG&E May 2, 2011 Comments at 8–9.

<sup>89</sup> TAPS May 2, 2011 Comments at 2–3.

<sup>90</sup> Jack Ellis April 12, 2011 Comments at 6 (emphasis in original).

<sup>91</sup> *Id.* at 7.

<sup>92</sup> NY PSC May 2, 2011 Comments at 3.

<sup>93</sup> PG&E May 2, 2011 Comments at 8.

leads to inefficient long-term investment and makes it more difficult for potential market entrants to analyze the economic viability of entering one market or another.<sup>104</sup> Xtreme Power seeks prompt implementation of the NOPR's proposed reforms, recommending that the Commission establish an expedited timeline for RTOs and ISOs to comply with the Final Rule.<sup>105</sup>

### 3. Commission Determination

#### a. Unduly Discriminatory Pricing

64. After developing and reviewing an extensive record in this proceeding compiled through a technical conference in which 11 experts in the field participated and issuance of a NOPR, and consideration of responsive pleadings submitted by 53 commenters, the Commission finds, pursuant to FPA section 206, that existing market rules for the compensation of frequency regulation resources are unjust and unreasonable, and unduly discriminatory or preferential. Current rules in the RTO and ISO tariffs which govern pricing and compensation for frequency regulation services in the RTO and ISO markets are unduly discriminatory, because resources are compensated at the same level even when providing different amounts of frequency regulation service; existing frequency regulation compensation methods fail to compensate certain resources for all of the service they provide, even when the system operator directs them to provide more frequency regulation service than other resources.

65. Beacon, Primus Power, and others argue and present evidence showing that current market rules allow for unduly discriminatory compensation among frequency regulation resources. Beacon provides data from its operations in ISO-NE<sup>106</sup> and NYISO<sup>107</sup> showing that two resources being asked to provide different amounts of frequency regulation service in real-time can be compensated at the same level. Beacon shows that it is even possible for the resource asked to provide more service to be paid less. Primus Power also provides evidence that resources that have different ramping capabilities can perform different amounts of work.<sup>108</sup> Given current market rules these resources would not be compensated in a way that reflects the different amount of work they have performed. Support for this proposal

<sup>104</sup> Starwood/Premium May 2, 2011 Comments at 3.

<sup>105</sup> Xtreme Power May 2, 2011 Comments at 8.

<sup>106</sup> Beacon May 2, 2011 Comments at 6–7.

<sup>107</sup> *Id.* at 22–24.

<sup>108</sup> Primus Power April 18, 2011 Comments at 5.

also comes from the RTOs and ISOs. PJM states that a performance payment provides an appropriate incentive to provide high quality regulation service by tying a portion of the total compensation to a resource's performance. In addition, PJM asserts that a performance payment will ensure resources provide accurate responses to control signals, in contrast with the current structure that provides no incentive to perform above a minimum threshold. We are convinced by the evidence presented by commenters that current market designs can result in rates that are unduly discriminatory and unjust and unreasonable.

66. As such, compensating resources for their capacity without compensating for the different amounts of frequency regulation service different resources provide fails to compensate for the additional work performed by the resources. Thus, contrary to CAISO's position that its market rules are not unduly discriminatory or preferential because they allow a faster-ramping resources to offer a relatively greater amount of capacity into the regulation market than a slower ramping resources with the same capability, we find that this fails to differentiate between the different amounts of frequency regulation service different resources provide, and therefore fails to compensate for the additional work one resource may be asked to do by the system operator compared to another resource. In this respect, CAISO's market design is no different from other RTOs and ISOs in that it compensates frequency regulation resources in a manner we find to be unduly discriminatory.<sup>109</sup>

67. Where the Commission finds an existing rate to be unjust, unreasonable, unduly discriminatory, or preferential, the Commission has a statutory mandate to set the just and reasonable rate.<sup>110</sup> The Commission agrees with commenters who argue that current methods used by RTOs and ISOs to compensate frequency regulation providers that fail to account for the actual service provided by resources are unduly discriminatory and that a resource's performance in following the AGC signal of the RTO or ISO should be taken into consideration when compensating that resource for providing frequency regulation service. We find that including a performance payment system will ensure just and

<sup>109</sup> This is irrespective of whether the energy management system includes a priority dispatch for resources with faster-ramping capability or the system dispatcher sends control signals to the resource.

<sup>110</sup> 16 U.S.C. 824e.

reasonable rates, based on the actual service provided at costs established by competitive processes, and resulting in efficient price signals and appropriately compensating resources that are asked to do more work.<sup>111</sup>

#### b. Potential Market Benefits

68. The Commission's setting of a just and reasonable rate here is further supported by the many comments received in response to the NOPR's contention that faster responding resources have the potential to improve the operational and economic efficiency of the frequency regulation market. Commenters point to the more efficient utilization of all resources capable of providing frequency regulation when the payment to resources is structured to justly compensate resources for the work performed, thus freeing other resources to perform services more in line with their operational characteristics and increasing the efficiency of doing so. We find these comments persuasive. A123, Beacon, PNNL, CESA and ESA provide evidence demonstrating that faster-responding resources have the potential to lower frequency regulation capacity requirements, thereby improving market efficiencies. Further, experience in the organized markets that already have higher concentrations of faster-responding resources shows that less frequency regulation capacity procurement is required due to the availability of faster-responding resources to provide that capacity.<sup>112</sup>

69. We are not persuaded by commenters, like EEI, that argue that the Commission should encourage pilot programs to measure reliability benefits before adopting the NOPR proposal. First, we note that ISO-NE has carried out just such a pilot program.<sup>113</sup>

<sup>111</sup> See *Promoting Wholesale Competition Through Open Access Non-Discriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmitting Utilities*, Order No. 888, 61 FR 21540 (May 10, 1996), FERC Stats. & Regs. ¶ 31,036 at 31,684 (1996), *order on reh'g*, Order No. 888-A, 62 FR 12274 (Mar. 14, 1997), FERC Stats. & Regs. ¶ 31,048, *order on reh'g*, Order No. 888-B, 81 FERC ¶ 61,248 (1997), *order on reh'g*, Order No. 888-C, 82 FERC ¶ 61,046 (1998), *aff'd in relevant part sub nom. Transmission Access Policy Study Group v. FERC*, 225 F.3d 667 (DC Cir. 2000), *aff'd sub nom. New York v. FERC*, 535 U.S. 1 (2002). ("In the context of an emerging competitive market in generation, discriminatory practices that once did not constitute undue discrimination must be reviewed to determine whether they are being used to prevent the benefits of competition in generation from being achieved.")

<sup>112</sup> Beacon May 2, 2011 Comments at 9–10, ESA May 2, 2011 Comments at 9–10, EDF May 2, 2011 Comments at P 8.

<sup>113</sup> See ISO-NE, *Market Rule 1, Appendix J, Alternative Technologies Regulation Pilot Program*,

Second, the Commission has determined that it must act to remedy undue discrimination in the current compensation for frequency regulation; the Commission is ensuring just and reasonable rates and protecting against undue discrimination among resources in doing so. It is irrelevant to this finding that the RTOs and ISOs currently comply with the relevant NERC standards, as argued by EPSA. EPSA's argument does not take away from the unduly discriminatory way in which the RTOs and ISOs compensate the resources that they procure in order to meet the NERC reliability standards. The reforms required here are necessary to remedy unduly discriminatory rates, but they will also enable greater competition in the organized markets and allow existing generation to provide more capacity in the energy markets and to run closer to their optimal output levels.

70. Contrary to EEI's arguments, the justness and reasonableness of the compensation mechanism directed here does not hinge on a finding that it will improve reliability. It is important to note, however, as discussed in the comments submitted by PJM, a resource's ability to quickly and accurately follow dispatch instructions will allow the system operator to better maintain system balance.<sup>114</sup>

71. We also disagree with the contention that, while short-run costs might decrease, long-run costs will increase due to displaced frequency regulation resources demanding higher prices in the energy market to make up for their lost frequency regulation revenue. There is no reason to believe that energy costs would increase when the supply of available energy capacity increases. If markets currently clear with a sufficient level of capacity, adding new capacity at a higher cost would not change that and would not lead to higher market-clearing prices in the energy market. Any market participant that chooses to raise its offer price runs the risk of its capacity not clearing in the energy market. And because energy resources would be able to operate at more efficient heat rates, they would be able to offer their capacity into the energy markets at a lower price.

72. We find persuasive the arguments made by commenters that we can expect to see market efficiency gains and

reduced costs to consumers. For example, Beacon, ESA, Alcoa, Primus Power, and other commenters argue convincingly that sending efficient price signals will remove barriers to the entry of faster-ramping and more accurate frequency regulation resources. This in turn should lead to reductions in the amount of frequency regulation capacity that each balancing area authority needs to procure in order to maintain reliability. As the needed quantity of frequency regulation decreases, the net result should be a reduction in expenditures on frequency regulation, and ultimately a lower cost for electricity for consumers.<sup>115</sup>

Commenters cite studies from PNNL, the California Energy Commission, and PJM, and data from ISO-NE and NYISO, that support this conclusion. PNNL showed that faster-ramping frequency regulation resources could be as much as 17 times more effective than conventional ramp-limited regulation resources<sup>116</sup> and the California Energy Commission found that storage resources can be up to two to three times as effective as adding a combustion turbine to the system for regulation purposes.<sup>117</sup> In addition, Xtreme Power notes that many newer technologies can operate in the frequency regulation market at lower costs than other, older technologies.<sup>118</sup> Therefore, we expect lower costs for consumers will result because less total capacity must be procured and because the capacity that is procured will be from lower-cost resources entering the market. Further, we share the view that the displacement of existing resources may result in those resources being able to more efficiently operate in the energy markets, submitting lower offers to supply energy, and thereby lowering costs to consumers in that market. Further, in the long-run, efficient price signals will also incent the efficient mix of resources to enter the market, thereby leading to lower long-run costs to consumers. We note that many commenters also cite potential reliability<sup>119</sup> and environmental<sup>120</sup>

benefits that could be seen from the use of faster-ramping resources. Thus, we find that the changes mandated by this Final Rule will not only remedy the undue discrimination existing in current market designs, but have the potential to result in lower costs to consumers.

73. While Duke argues that faster-ramping resources may not always be needed to ensure the reliability of the system, and that the markets are currently operating without performance payments, the Commission finds that adding a performance payment to the compensation system will remedy undue discrimination and improve the efficiencies in the market and allow resources to provide those services that best suit them. Resources, no matter their type, will only receive the performance payment when they are actually called on to provide frequency regulation service, and they do so accurately. We also reject MISO's recommendation that we allow RTOs and ISOs to continue to only net energy balances and provide a capacity payment as compensation for frequency regulation service. As we state above, doing so can result in unduly discriminatory treatment of frequency regulation resources.

74. MISO's claim that its customers derive no benefit from down regulation is based on the presumption that MISO never directs any regulation resources to provide frequency regulation in that direction. Even if this is true, and MISO provided no data showing that it is, it does not change the fact that relying only on the capacity payment and net energy balancing results in discriminatory compensation when one resource is asked to provide more movement than others, a situation that can occur even if MISO only ever directs its resources to provide up regulation. Accordingly, as discussed further in the compliance section below, we will require the ISOs and RTOs to include a performance payment in their frequency regulation pricing mechanism.

#### c. Standardization of Market Rules

75. In response to certain commenters express concerns with requiring a uniform approach to compensation for frequency regulation, as described below, we will allow the RTOs and ISOs flexibility to design market rules that accommodate their markets, while at the same time addressing existing unduly discriminatory rates. In response to Starwood/Premium, it is not practical for the Commission to mandate that all RTOs and ISOs have identical provisions in their tariffs for the

<sup>115</sup> Primus Power May 2, 2011 Comments at 7.

<sup>116</sup> Makarov, Y.V., Ma, J., Lu, S., Nguyen, T.B., "Assessing the value of Regulation Resources Based on Their Time Response Characteristics," Pacific Northwest National Laboratory, PNNL-17632, June 2008.

<sup>117</sup> Beacon May 2, 2011 Comments at 8-9 (citing KEMA, "Research Evaluation of Wind Generation, Solar Generation, and Storage Impact on the California Grid" (prepared for the California Energy Commission), June, 2010).

<sup>118</sup> Xtreme Power May 2, 2011 Comments at 5.

<sup>119</sup> See generally A123, Alcoa, Beacon, CESA, ESA, PIOs, and PJM.

<sup>120</sup> See generally Beacon, CESA, CPUC, ESA, and EDF.

available at [http://www.iso-ne.com/regulatory/tariff/sect\\_3/mr1\\_append-j.pdf](http://www.iso-ne.com/regulatory/tariff/sect_3/mr1_append-j.pdf). The most recent informational filing from ISO-NE describing this program can be found at <http://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=12768589> (Sept. 19, 2011).

<sup>114</sup> PJM May 2, 2011 Comments at 3-4.

compensation of frequency regulation resources. First, the RTOs and ISOs do not now have identical provisions for other market operations; mandating identical provisions in this regard could require completely overhauling all RTO and ISO tariffs. Second, identical tariff provisions are not necessary so long as all tariffs provide for just and reasonable and not unduly discriminatory or preferential rates.

76. PG&E suggests that an accuracy component alone could suffice to remedy undue discrimination in the compensation of frequency regulation resources. While this would account for the difference in the accuracy of resources, it would fail to acknowledge the different levels of work requested of each. Further, the Final Rule does not create a special class of resource or otherwise compensate any one type of resource to the exclusion of others. This Final Rule is resource-neutral, requiring that compensation reflect the frequency regulation service provided, no matter the resource.

77. Thus, we will require certain things of all RTOs and ISOs: to institute a two-part payment for frequency regulation and to account for a resource's accuracy in its compensation. However, as described below, in many instances we will leave to the individual RTOs and ISOs how best to meet these requirements.

### B. Specific Proposals

78. The NOPR set forth a frequency regulation compensation mechanism for the RTO and ISO markets to ensure that pricing and compensation of frequency regulation service is just and reasonable and not unduly discriminatory or preferential. Specifically, the Commission proposed to require RTOs and ISOs to change their tariffs so that regulation resources receive a two-part payment. The first part of the payment is a capacity, or option, payment to have a certain amount of capacity held in reserve and not participate in the energy market in order to provide frequency regulation service. To produce the efficient market outcome, this proposed payment includes the marginal regulating resource's opportunity costs. The NOPR also set forth a second payment based on performance, as measured by the amount of MWh up and down movement the resource provides in response to the system operator's dispatch signal.<sup>121</sup> This performance payment takes into

<sup>121</sup> This applies whether an RTO or ISO allows resources to sell regulation up and regulation down separately or requires resources to offer both regulation up and down as one product.

consideration a resource's accuracy in responding to that signal. The Commission preliminarily found that this compensation structure is necessary to ensure that pricing schemes for frequency regulation service in the organized wholesale electricity markets result in rates that are just and reasonable, and not unduly discriminatory or preferential.

#### 1. Capacity Payment and Opportunity Cost

##### a. NOPR Proposal

79. The Commission proposed to require that each regulating resource be paid a uniform capacity payment that includes the opportunity cost of the marginal regulating resource. As discussed above, some RTOs and ISOs currently pay resource-specific opportunity costs or make-whole payments in addition to a capacity payment, while others incorporate the marginal unit's opportunity cost into a uniform regulation market clearing capacity price. In order to send an efficient price signal to frequency regulation resources, the Commission proposed that RTOs and ISOs base the clearing price for frequency regulation on the marginal resource's costs, including opportunity cost. The NOPR explained that paying a unit-specific opportunity cost distorts the market by basing the commitment of regulating units on incomplete market information, potentially leading to committing units with higher costs than other units not committed. This problem is especially glaring in a market such as this where some resources have no opportunity costs, resulting in disparate payments to resources.<sup>122</sup> Accordingly, the Commission preliminarily found that a frequency regulation compensation mechanism that includes a uniform clearing price with accurately determined opportunity costs will reduce errors in selecting the optimal portfolio of regulation suppliers each hour (and each day), which reduces total regulation costs to consumers and ensures that rates are just and reasonable and not unduly discriminatory or preferential.

80. In addition, the Commission preliminarily found that cross-product opportunity costs<sup>123</sup> should be

<sup>122</sup> For example, a storage resource that is only allowed to participate in the frequency regulation market has no opportunity costs related to the energy market, unlike a traditional generator. Therefore, the storage resource's capacity payment could be lower than the generator's capacity payment. These payments send inefficient signals to market participants.

<sup>123</sup> A cross-product opportunity cost, in this case, is the revenue a regulation provider loses because

calculated by the RTO or ISO, as it has the best information to determine a frequency regulation resource's opportunity cost due to not participating in the energy market. Further, the Commission proposed that, where appropriate, resources should be permitted to include inter-temporal opportunity costs in their capacity bid.<sup>124</sup> The Commission sought comment on its proposal to require each regulating resource to be paid a uniform capacity payment that includes the opportunity cost of the marginal regulating resource.

##### b. Comments

###### i. The Capacity Payment

81. A number of commenters support the Commission's capacity payment proposal.<sup>125</sup> They agree that this proposal will result in a price signal that will more efficiently select the portfolio of resources between the energy and regulation markets.<sup>126</sup> OMS states that it believes that when a consistent definition of opportunity cost is used and reflected in the market price, the optimal solution for commitment and dispatching across energy and reserves is accomplished.<sup>127</sup> Xtreme Power states that it supports the NOPR's proposal because a uniform capacity payment will help entice new entry into the frequency regulation market, thereby enhancing competition, whereas unit-

it is on stand-by to provide regulation and is not providing energy or another product.

<sup>124</sup> An inter-temporal opportunity cost represents the foregone value when a resource must operate at one time, and therefore must either forego a profit from selling energy at a later time or incur costs due to consuming at a later time. The trade-off presented to thermal storage provides an example of inter-temporal opportunity costs. A thermal storage operator would prefer to "charge" (heat bricks or freeze water) when prices are low. If such a resource were to provide frequency regulation, it could be asked to stop charging during low price periods and then be forced to charge during high price periods.

<sup>125</sup> Alcoa May 2, 2011 Comments at 3, Beacon May 2, 2011 Comments at 15–16, CESA May 2, 2011 Comments at 2, Dominion May 2, 2011 Comments at 4, Duke May 2, 2011 Comments at 6, EDF May 2, 2011 Comments at 5, ELCON May 2, 2011 Comments at 2–4, EPSA May 2, 2011 Comments at 5, ENBALA May 2, 2011 Comments at 8, ESA May 2, 2011 Comments at 16–18, IRC May 2, 2011 Comments at 7, ISO-NE May 2, 2011 Comments at 2 and 13, NEPOOL May 2, 2011 Comments at 7–8, NYISO May 2, 2011 Comments at 2, OMS May 2, 2011 Comments at 4, PG&E May 2, 2011 Comments at 7, PJM May 2, 2011 Comments at 5, Powerex May 2, 2011 Comments at 4, Primus Power May 2, 2011 Comments at 6, SoCal Edison May 2, 2011 Comments at 4, VCharge April 27, 2011 Comments at 2, and Xtreme Power May 2, 2011 Comments at 6.

<sup>126</sup> Dominion May 2, 2011 Comments at 4, ELCON May 2, 2011 Comments at 2–3,

<sup>127</sup> OMS May 2, 2011 Comments at 4.

specific capacity costs, paid on a unit-specific basis, will distort the market.<sup>128</sup>

82. Beacon, CESA, EDF, PG&E, Powerex, ENBALA, and ESA<sup>129</sup> agree that the capacity payment should be based on the marginal unit's costs, including its opportunity cost, in part because, as some parties note, a large part of a traditional resource's cost to provide frequency regulation is the lost opportunity cost associated with not providing energy. Several parties also note that RTOs and ISOs that pay unit-specific opportunity costs send a distorted market signal, possibly resulting in a higher cost resource being selected to provide service in lieu of a lower-cost resource. These commenters assert that a uniform capacity payment that includes opportunity cost will send the strongest price signal to low cost resources, and that the grid should experience a reduction in the overall market costs as low cost providers are encouraged to enter the market.<sup>130</sup> Specifically, Beacon states that such a payment will remove an economic barrier to entry of new alternative regulation technologies by ensuring that the capacity payment reflects the full value of that service.<sup>131</sup>

83. EPSA agrees that the most efficient dispatch and fairest regulation market design is one in which all resources compete on the same basis for the same price. EPSA states that the regulation market should consider each resource's as-bid cost plus any opportunity cost, such that the marginal as-bid plus opportunity cost of the resources selected should set a uniform clearing price paid to all. It argues that a uniform market clearing price will ensure consideration of all appropriate marginal costs for all regulation market participants and will result in price signals that will properly incent efficient future infrastructure investment.<sup>132</sup>

84. ENBALA notes that individual side payments made to resources are generally confidential and hidden in a broader declaration of total payments, only adding complexity and inefficiency to the markets. On the other hand, it states that an optimized total cost solution that calculates a uniform price

utilizing opportunity costs provides transparency and clarity.<sup>133</sup>

85. PIOs state that not including opportunity costs in a uniform clearing price discriminates against newer resources with lower opportunity costs that, in a full marginal clearing price auction, would generally be more economic than traditional generators with higher opportunity costs stemming from operating at less than maximum capacity.<sup>134</sup> PIOs state that the proposed method would ensure that the market-clearing capacity price would reflect the total marginal costs of the last cleared unit, thereby eliminating the unlevel playing field that out-of-market opportunity cost payments currently impart.<sup>135</sup>

86. Beacon, CESA, and ESA note that PJM has recently filed with the Commission tariff revisions that will alter how it calculates opportunity costs for regulation capacity. In its filing, PJM states that these revisions "[h]elp to reduce after-the-fact, non-market changes to Regulation resource compensation, and enhance price signals that will better enable new, innovative resources and technologies to meet the system's Regulation needs \* \* \*."<sup>136</sup> Beacon and CESA also contend that PJM has acknowledged that the value of frequency regulation capacity has been upwards of 33 percent higher than is reflected in market clearing prices,<sup>137</sup> a statement they assert is supported by PJM's market monitor.<sup>138</sup>

87. EPSA argues that ISO-NE pays unit-specific opportunity costs, which, according to EPSA, risks understating the regulation clearing price where a unit with an opportunity cost is the marginal resource.<sup>139</sup> Beacon, CESA, and ESA also note that at the technical conference, ISO-NE stated that it is moving in the direction of paying a uniform clearing price.<sup>140</sup> Beacon, ESA, and NEPOOL state that at the

November 2010 NEPOOL Markets Committee meeting ISO-NE stated that a "uniform clearing price provides more efficient long run investment signals."<sup>141</sup> NEPOOL states that ISO-NE indicated that it is open to considering the Commission's proposal for rules that would include opportunity costs in the uniform capacity payment, and that it was in the process of evaluating market rule changes that would accomplish this goal.<sup>142</sup>

88. At the same time, some commenters express concerns regarding the inclusion of opportunity costs in the market clearing price for frequency regulation capacity. In general, Duke agrees with the Commission's proposal to require the market clearing price for frequency regulation capacity to be uniform and reflect the marginal clearing unit's opportunity costs. However, Duke argues that it is uncertain how some storage devices would fit into a capacity payment mechanism. For instance, for a resource that is charging part of the time and discharging part of the time, Duke believes that when this resource is charging (*i.e.* acting like a load), it should not receive a capacity payment.<sup>143</sup>

89. NEPOOL and IRC request that the Final Rule afford ISO-NE and stakeholders sufficient flexibility to develop a solution that accomplishes the Commission's goals, given the current market design's consistency with the NOPR proposal and circumstances in the region.<sup>144</sup>

90. SoCal Edison argues that, while the CAISO day-ahead market is efficient in that it incorporates opportunity costs into a uniform clearing price for frequency regulation capacity, the real-time market has difficulties capturing inter-temporal opportunity costs due to its limited look-ahead time frame.<sup>145</sup>

91. PIOs recommend that after implementing the NOPR's proposed compensation approach in the RTOs and ISOs, the Commission should consider whether the capacity payment component of the method remains appropriate or whether, after some level of fast-acting resource penetration, the capacity payment proves no longer necessary.<sup>146</sup>

<sup>128</sup> Xtreme Power May 2, 2011 Comments at 6.

<sup>129</sup> EDF May 2, 2011 Comments at P 12-13 (citing Beacon Power June 25, 2010 Comments on May 26, 2010 Technical Conference (Docket No. AD10-11-000) at 44-45), PG&E May 2, 2011 Comments at 7, Powerex May 2, 2011 Comments at 4, Primus Power April 18, 2011 Comments at 6.

<sup>130</sup> Beacon May 2, 2011 Comments at 16, CESA May 2, 2011 Comments at 7, ESA May 2, 2011 Comments at 16, EDF May 2, 2011 Comments at P 12-13.

<sup>131</sup> Beacon May 2, 2011 Comments at 18.

<sup>132</sup> EPSA May 2, 2011 Comments at 5.

<sup>133</sup> ENBALA May 3, 2011 Comments at 8.

<sup>134</sup> PIOs May 2, 2011 Comments at P 7.

<sup>135</sup> *Id.* P 12.

<sup>136</sup> Beacon May 2, 2011 Comments at 17, CESA May 2, 2011 Comments at 7, ESA May 2, 2011 Comments at 16-17 (citing PJM's Proposed Package of Reforms to Establish Just and Reasonable Pricing for Operative Reserve Shortages in the PJM Region (Docket No. ER09-1063-004) at 3).

<sup>137</sup> Beacon May 2, 2011 Comments at 18 (citing Monitoring Analytics, LLC. "2010 State of the Market Report for PJM." March 10, 2011).

<sup>138</sup> Beacon May 2, 2011 Comments at 18-19, ESA May 2, 2011 Comments at 17-18 (citing Monitoring Analytics, LLC. "2010 State of the Market Report for PJM." March 10, 2011).

<sup>139</sup> EPSA May 2, 2011 Comments at 5.

<sup>140</sup> Beacon May 2, 2011 Comments at 17, CESA May 2, 2011 Comments at 7, ESA May 2, 2011 Comments at 17 (citing Transcript of May 26, 2010 Technical Conference at 149 (lines 15-16)).

<sup>141</sup> Beacon May 2, 2011 Comments at 17-18, ESA May 2, 2011 Comments at 17 (citing NEPOOL Markets Committee presentation, "Alternative Technology Regulation Pilot Program." November 9, 2010).

<sup>142</sup> NEPOOL May 2, 2011 Comments at 6-7.

<sup>143</sup> Duke May 2, 2011 Comments at 6.

<sup>144</sup> NEPOOL May 2, 2011 Comments at 8, IRC May 2, 2011 Comments at 5-6.

<sup>145</sup> SoCal Edison May 2, 2011 Comments at 4-5.

<sup>146</sup> PIO May 2, 2011 Comments at 10.

## ii. Calculation of Opportunity Costs

92. Most commenters state their belief that the RTO or ISO is in the best position to calculate a resource's opportunity costs. ENBALA, IRC, ISO-NE, NYISO, PIOs, PJM, and Xtreme Power state that the RTO or ISO should calculate cross-product opportunity cost for inclusion in the capacity payment, as the RTO or ISO has the best information to determine a frequency regulation resource's opportunity cost.<sup>147</sup> PJM states that the RTO or ISO is also in the best position to determine inter-temporal opportunity costs and should be allowed to calculate this as well.<sup>148</sup>

93. ISO-NE contends that if the resource owner were required to calculate its own cross-product opportunity costs, it would need to build into that bid an *ex ante* risk premium, to account for the possibility of large swings in the locational marginal price (LMP).<sup>149</sup> NECPUC shares ISO-NE's concerns over the possibility of *ex ante* determination of opportunity costs and requests that the Commission allow for flexibility to address the undue discrimination described in the NOPR.<sup>150</sup>

94. NEPOOL states that a proposal to include cross-product opportunity costs in the regulation clearing price was the subject of much discussion during original stakeholder consideration of the regulation market re-design in ISO-NE. At that time, according to NEPOOL, it was concluded that determining opportunity costs *ex ante* would be significantly more complex than the current *ex post* method and would entail higher implementation costs.<sup>151</sup> NEPOOL states that it has not explicitly considered the inclusion of inter-temporal opportunity costs, but it notes that there is no restriction on including these costs in a resource's bid.

95. ELCON is the only commenter to recommend that all opportunity costs be market-based and calculated by the supplier. ELCON states that the supplier is in the best position to determine these costs.<sup>152</sup>

96. ENBALA states that resources should submit regulation offers that reflect inter-temporal opportunity costs.<sup>153</sup> VCharge states that while it does incur inter-temporal opportunity

costs, because it is a price-taker in the ISO-NE market where it operates, it is uncertain how the inclusion of this cost will affect its operation.<sup>154</sup>

97. Powerex generally supports inclusion of opportunity costs in the market clearing price. However, it argues that inter-temporal opportunity costs may be complicated to implement and lead to an uneconomic solution. In addition, Powerex believes that inter-temporal opportunity costs are unnecessary. Powerex states that resources that bid into a day-ahead regulation market will typically know its award by 1 p.m. prior to the delivery day. As such, the resource will have at least 11 hours to ensure its resource is at the desired state by participating in the wholesale energy market. Therefore, Powerex suggests that inter-temporal opportunity costs only be included in bids for resources that are precluded from participation in the wholesale energy market.<sup>155</sup> Powerex requests that the Commission clarify how inter-temporal opportunity costs will work in practice.<sup>156</sup>

98. CAISO states that its current market design allows a regulating resource to earn the marginal resource's opportunity cost, including cross-product opportunity costs. CAISO asserts that while there is no formal compensation mechanism for inter-temporal opportunity costs, bidding rules do not prevent scheduling coordinators from including them in supply bids. CAISO requests that the Final Rule not preclude the use of such informal compensation mechanisms to account for inter-temporal opportunity costs.<sup>157</sup>

## c. Commission Determination

99. The Commission finds that paying to all cleared frequency regulation resources a uniform clearing price that includes the marginal resource's opportunity costs is just and reasonable. Accordingly, this Final Rule requires that all RTOs and ISOs with centrally-procured frequency regulation resources must provide for such opportunity costs in their tariffs. Further, this uniform clearing price must be market-based, derived from market-participant bids for the provision of frequency regulation capacity. As commenters recognize, contrary market pricing rules would consistently result in artificial and inaccurate prices that do not include the total cost of reserving regulation capacity. In addition, paying an out-of-

market unit-specific opportunity cost, rather than a uniform clearing price, can result in the market basing the commitment of regulating units on bids that do not reflect the true cost of providing capacity, potentially leading to committing units with higher costs than other units not committed. By not paying a uniform clearing price, it is possible, for instance, to dispatch a unit with relatively low explicit capacity costs but very high opportunity costs, rather than a lower-cost unit which has relatively higher explicit capacity costs but low opportunity costs. This can result in distorted investment and entry decisions by market participants. Paying to all cleared frequency regulation resources a uniform price that includes opportunity costs will ensure that all appropriate costs are considered and will send an efficient price signal to current and potential market participants. This will also be consistent with long-standing Commission policy approving uniform clearing prices.<sup>158</sup>

100. We decline to specify, as requested by Duke, certain circumstances under which certain resources should not receive the capacity payment. Specifically, Duke provides the example of an energy storage resource, stating that it should not be eligible for a capacity payment during the time it charges in order to attain a charge state that allows it to provide frequency regulation service. Duke's example ignores the fact that a storage resource that is charging could be, at the same time, providing frequency regulation service at the direction of the system operator and therefore is appropriately paid for the capacity it sets aside to provide frequency regulation service. We recognize that some RTOs and ISOs manage the charge state of energy storage resources, while others do not. We find that it is appropriate to allow the RTOs and ISOs flexibility in addressing this issue and explaining any implications for compensation.

101. The Commission rejects PIOs' argument that the capacity payment should be wholly discontinued, in the event that it proves no longer necessary.

<sup>147</sup> ENBALA May 3, 2011 Comments at 8, IRC May 2, 2011 Comments at 7, ISO-NE May 2, 2011 Comments at 2, PIOs May 2, 2011 Comments at P 13, Xtreme Power May 2, 2011 Comments at 6.

<sup>148</sup> PJM May 2, 2011 Comments at 5.

<sup>149</sup> ISO-NE May 2, 2011 Comments at 13-14.

<sup>150</sup> NECPUC May 2, 2011 Comments at 3.

<sup>151</sup> NEPOOL May 2, 2011 Comments at 7.

<sup>152</sup> ELCON May 2, 2011 Comments at 4.

<sup>153</sup> ENBALA May 3, 2011 Comments at 8.

<sup>154</sup> VCharge April 27, 2011 Comments at 3.

<sup>155</sup> Powerex May 2, 2011 Comments at 6-8.

<sup>156</sup> *Id.* at 5.

<sup>157</sup> CAISO May 2, 2011 Comments at 17-18.

<sup>158</sup> See, e.g., *PJM Interconnection, L.L.C.*, 117 FERC ¶ 61,331, at P 141 (2006); *Commonwealth Edison Company*, 113 FERC ¶ 61,278, at P 43 (2005) (citing *New York Independent System Operator, Inc., order on reh'g*, 110 FERC ¶ 61,244, at P 65 n.76 (2005) (explaining that NYISO uses this method because "under this model, the generator has the proper incentive to bid the lowest price that covers its marginal cost, knowing that if the market produces a higher price it will receive the market price"); and *New England Power Pool*, 85 FERC ¶ 61,379 (1998), *reh'g denied*, 95 FERC ¶ 61,478, at 61,074 (2001) (approving market clearing prices in energy and ancillary services markets).

The capacity payment is necessary, because it exists in order to ensure that resources are indifferent between offering their capacity as a frequency regulation resource or as an energy resource. While the market-clearing price for frequency regulation service may eventually fall as lower-cost resources enter the market, the capacity payment provides resources that clear as frequency regulation capacity recompense for holding such capacity in reserve from the energy and other markets so that it is available to the system operator as frequency regulation capacity.

102. Regarding cross-product opportunity costs, which reflect the foregone opportunity to participate in the energy or ancillary services markets, the Commission finds that it is appropriate for the RTOs and ISOs to calculate this and include it in each resource's offer to supply frequency regulation capacity, for use when determining the market clearing price and which resources clear. Therefore we will require this. We agree with PJM, NYISO, IRC, and other commenters which state that the RTOs and ISOs have the necessary and accurate information for determining this cost. Further, ISO-NE and NEPOOL both express concern that requiring a resource to bid in its own cross-product opportunity costs could result in inefficient prices as resources include a risk premium. We disagree with ELCON's argument that the resource is in the best position to determine its cross-product opportunity costs. Because cross-product opportunity costs are calculated based on the clearing prices of other energy and ancillary service products, specific knowledge of the market variables used to formulate these prices is necessary in order to accurately calculate the opportunity cost of providing frequency regulation service. RTOs and ISOs have unique access to this information and, accordingly, RTOs and ISOs are in the best position to perform accurate cross-product opportunity cost calculations.

103. Regarding inter-temporal opportunity costs, there is little agreement on how these costs should be calculated, and to whom that responsibility should fall. The Commission will require the RTOs and ISOs to allow for inter-temporal opportunity costs to be included in a resource's offer to sell frequency regulation service, with the requirement that the costs be verifiable. We find that inter-temporal opportunity costs are a legitimate cost for a market participant to include in its offer to sell frequency regulation and thus must be allowed.

However, we will allow the RTOs and ISOs to propose who is responsible for calculating such costs, whether the RTO or ISO itself or market participants.

## 2. Payment for Performance

### a. NOPR Proposal

104. The Commission preliminarily found that requiring a component in the frequency regulation compensation mechanism that recognizes the resource's real-time provision of frequency regulation service is necessary to remedy undue discrimination and ensure just and reasonable rates in the organized wholesale electricity markets.<sup>159</sup> As stated in the NOPR, resources that provide more value to the grid by doing more of the work to correct ACE deviations, through the provision of frequency regulation service, should be paid more than resources doing less work. Accordingly, taking performance into consideration is a key element of ensuring that any frequency regulation compensation mechanism is just and reasonable. The Commission, therefore, proposed to require that all regulating resources be paid for their performance, for instance, with this payment taking the form of a payment for each MWh, up or down, provided by the resource in response to the system operator's dispatch signal. Specifically, an RTO or ISO would determine the total movement up and down and then multiply that sum by a price-per-MWh of ACE correction. The NOPR solicited comment on the proposed method and whether there are alternative payments for performance that address concern about undue discrimination.<sup>160</sup>

105. The Commission also proposed that the price-per-MWh of ACE correction be market-based. Specifically, resources would specify the capacity (in MW) available to provide regulation, a ramp rate (in MW/minute), and bid into the market a price-per-MW ramping capability or a price-per-MWh of ACE correction. The RTO or ISO would then determine the least cost set of resources and set the price-per-MWh of ACE correction based on the bid of the marginal regulating resource. The alternative to a market-based price is to use an administratively set price-per-MWh of ACE correction. The Commission sought comment on this proposal as well as the alternative of an administratively determined price, including how an administratively determined price could be set.

<sup>159</sup> NOPR, 134 FERC ¶ 61,124 at P 37.

<sup>160</sup> *Id.* P 37.

## b. Comments

### i. Market-Based Pricing Versus Administratively-Determined Prices

106. Regarding whether the price used to calculate the performance payment should be market-based or administratively-determined, the majority of commenters who commented on this topic expressed a preference for a market-based option.<sup>161</sup> They argue that market-based pricing will encourage resources with the lowest costs to provide regulation movement to enter the market and ensure that rate-payers receive the benefit of new low-cost resources competing in the market. According to commenters, allowing the market to establish the compensation for resources' performance will allow more economically efficient outcomes and create appropriate incentives for market participants. Specifically, they contend, a market-based price would encourage resources to make bids that accurately reflect their costs of ramping up and down, and thus would ensure that resources which can provide ramping capability most cost-effectively will be selected and, in turn, should lower costs to customers.<sup>162</sup>

107. Powerex claims that use of a forecast for ACE correction would allow RTOs and ISOs to include the mileage payment in their co-optimization and determine an appropriate market clearing price for the mileage payment.<sup>163</sup> PJM states that the proposed dollars-per-MW bidding and market-clearing mechanisms best capture the market-based value of ramping regulating units, and can be efficiently and accurately modeled in market-clearing algorithms. PJM suggests that on-going updates to these models will be required to ensure that market results and compensation correctly align with resource performance.<sup>164</sup>

108. TAPS argues that to require that performance payments for frequency regulation service be administratively-determined would be especially disruptive to region-specific market designs and unwarranted. It argues that it would not be in the public interest to then require that prices in this market segment be administratively-

<sup>161</sup> Beacon May 2, 2011 Comments at 30, ESA May 2, 2011 Comments at 29, EDF May 2, 2011 Comments at P 17, ELCON May 2, 2011 Comments at 4, PJM May 2, 2011 Comments at 7, Powerex May 2, 2011 Comments at 8-9, SoCal Edison May 2, 2011 Comments at 10, TAPS May 2, 2011 Comments at 8, Xtreme Power May 2, 2011 Comments at 7.

<sup>162</sup> Xtreme Power May 2, 2011 Comments at 7.

<sup>163</sup> Powerex May 2, 2011 Comments at 8.

<sup>164</sup> PJM May 2, 2011 Comments at 7.

determined.<sup>165</sup> TAPS notes that no showing has been made, and there is no reason to expect, that the maximum necessary price to elicit frequency response offers cannot be revealed through a properly structured bid-based market.<sup>166</sup>

109. Although supporting a market-based price, Powerex argues that if the Commission finds that an administratively-set price is appropriate, that price should be based on the frequency regulation capacity price, in order to provide transparency and certainty for market participants.<sup>167</sup>

ii. Calculating the Performance Payment and Bidding Parameters

110. Regarding the form a performance payment should take, Beacon and ESA both state that they support a performance payment that takes the form of a payment for each MW, up or down, provided by the resource in response to the system operator's dispatch signal multiplied by a market-based price per MW-movement based on the marginal unit's cost to ramp up and down.<sup>168</sup> Beacon argues that this would correspond to each resource's contribution to ACE correction and is consistent with what it views as industry best practices, *i.e.* the current policy in ISO-NE.<sup>169</sup> Beacon cites data from its ISO-NE operation to show that the mileage payment it receives is approximately three times that of an allowable slower-responding resource, yet it actually does more than three times the work.<sup>170</sup>

111. Beacon and ESA contend that a payment to all resources based on their MW movement, up and down, will encourage all resources to offer as much ramp-rate capability as possible because the resource will be compensated for the additional movement (and additional costs it incurs) to provide this service.<sup>171</sup> Beacon and ESA further argue that having bidding parameters that match the way payments are ultimately calculated will aid resources in determining their bidding strategy.<sup>172</sup> Beacon and ESA recommend that the appropriate bidding parameters include the total MW offered for frequency regulation and the \$/MW of ramping capability. They contend that the cost

for ramping up and down in response to an RTO or ISO control signal is the increased fuel costs of operating in a non-steady state condition, the increased costs of operations and maintenance due to additional "wear and tear" on the equipment, and potentially the cost of decreased cycle life.<sup>173</sup>

112. CESA recommends that each resource should bid in its price-per-MW of movement for regulation service and the system operator should set the price-per-MW used in the performance payment at the price of the marginal unit's bid. While CESA notes that another method for calculating the performance payment would be to base it on the total amount of MWh of ACE correction, no matter the method used, it is most important that the bidding parameters match the way compensation is calculated so that resources can most easily determine their bidding strategy.<sup>174</sup>

113. CAISO questions whether the ISO's bid optimization and ultimate performance payment should reflect a resource's pre-certified ramping capability or a resource's actual performance for which a resource would receive a payment for moving in either the up or down direction.<sup>175</sup>

114. OMS and VCharge ask the Commission to clarify the need for both a price-per-MWh ramping capability and price-per-MW of ACE correction parameters in a frequency regulation service offer.<sup>176</sup> OMS indicates that it is not consistent to have both of these pricing parameters in the ramping portion of the frequency regulation offer. OMS states that it interprets price-per-MWh as a parameter on which the system operator would make dispatch decisions, while price-per-MW of ACE correction would be a parameter used for determining the market-clearing price for ramp. Once a clarification is made, OMS requests further time to comment on that clarification.<sup>177</sup>

115. ENBALA argues that compensating resources based on a price-per-MW of ACE correction bid is not advisable. It argues that calculating such a bid price would be difficult for the resource, as would be verification of the bid. It contends that settlement would also be complex. ENBALA recommends instead that resources submit a price-per-MW ramping ability,

which would reflect the costs associated with movement of the device, *i.e.* variable O&M costs such as fuel consumption and mechanical fatigue.<sup>178</sup>

116. Primus Power recommends that compensation for performance be based on the net energy contribution of a resource. Primus Power defines this as the total MWh delivered by the resource in the direction of the control signal minus the total MWh delivered against the control signal (or delivered in excess of the control signal). This would determine the quantity for which the frequency regulation service provided would be compensated. To determine the price, Primus Power proposes using the market clearing price for frequency regulation capacity as a basis.

Specifically, Primus Power recommends multiplying the capacity price by some weight, and then multiplying this by the MWh the resource delivered over the settlement period, as a fraction how much an "ideal" resource would have delivered.<sup>179</sup>

117. Regarding how resources would bid their costs into such a market, NEPOOL states that the ISO-NE regulation market currently operates on a system that minimizes total customer payment, and it supports the continued application of the current market design.<sup>180</sup>

118. TAPS argues that a resource's offering price-per-MW of ACE correction should be expected to typically reflect only variable operating costs for oscillating a resource's output instead of holding it steady. TAPS provides an example to illustrate that the resource's offer price for frequency regulation service ought to reflect the amount of revenue that would make the resource indifferent between being dispatched up and down around its set point over some period of time and sitting constant at the set point. This offer can be calculated by the resource.<sup>181</sup> In addition, TAPS notes that bids for frequency regulation may require mitigation in certain circumstances. TAPS states that regional market designs should provide for mitigation, and the Commission should defer to the regions to decide what mitigation scheme would be effective.<sup>182</sup>

119. SoCal Edison encourages the Commission to consider both *ex ante* and *ex post* calculation of market prices. SoCal Edison states that an *ex ante* approach will likely make it easier to

<sup>165</sup> TAPS May 2, 2011 Comments at 8.

<sup>166</sup> *Id.* at 9–10.

<sup>167</sup> Powerex May 2, 2011 Comments at 9.

<sup>168</sup> Beacon May 2, 2011 Comments at 19, ESA May 2, 2011 Comments at 27–28.

<sup>169</sup> Beacon May 2, 2011 Comments at 27.

<sup>170</sup> *Id.* at 28.

<sup>171</sup> Beacon May 2, 2011 Comments at 29, ESA May 2, 2011 Comments at 28.

<sup>172</sup> Beacon May 2, 2011 Comments at 29, ESA May 2, 2011 Comments at 28.

<sup>173</sup> Beacon May 2, 2011 Comments at 30, ESA May 2, 2011 Comments at 29.

<sup>174</sup> CESA May 2, 2011 Comments at 9.

<sup>175</sup> CAISO May 2, 2011 Comments at 19.

<sup>176</sup> OMS May 2, 2011 Comments at 7, VCharge May 2, 2011 Comments at 4 (citing the NOPR at P 37).

<sup>177</sup> OMS May 2, 2011 Comments at 7–8.

<sup>178</sup> ENBALA May 2, 2011 Comments at 8.

<sup>179</sup> Primus Power April 18, 2011 Comments at 6.

<sup>180</sup> NEPOOL May 2, 2011 Comments at 9.

<sup>181</sup> TAPS May 2, 2011 Comments 9–10.

<sup>182</sup> *Id.* at 10.

establish a clearing price for the service, whereas an *ex post* performance payment ensures the market only pays for what was delivered.<sup>183</sup>

120. Both ESA and Beacon recommend that the Commission allow the RTOs and ISOs to base their compensation schemes on a single bid if it so chooses; that is, as is done in ISO-NE, one bid can be submitted reflecting the costs of frequency regulation capacity, and from this, the payment for both capacity and performance can be determined. Beacon and ESA state that this has been used successfully in ISO-NE, where the split of compensation is administratively determined in order for an "average" resource to receive half its compensation from the capacity payment and half from its performance payment. Both ESA and Beacon state that while this does not allow ISO-NE to optimize in real-time like a two-bid market would, it does send the correct price signals to market participants.<sup>184</sup>

#### iii. Creating a New Ancillary Service Product

121. Various commenters suggest that the Commission specifically define faster- and slower-ramping resources, or use speed to distinguish various resources for purposes of calculating the performance payment.

122. For example, Viridity and Starwood/Premium recommend that "fast" and "slow" resources be treated as different products or offering different services.<sup>185</sup> Viridity further recommends that the Commission not change how slow resources are compensated for the provision of frequency regulation service, *i.e.* make no performance payment to slow resources. However, Viridity would have the Commission require that a performance payment be made to fast resources providing frequency regulation service.

123. Viridity also suggests that the performance payment made to fast responding resources be based on the price-per-MWh of ACE correction, rather than a price-per-MW of ACE correction.<sup>186</sup>

124. Manitoba Hydro asserts that when regulation prices are market-based, ancillary market design should establish a clearing price that preserves the value ratio between fast and slow

ramping resources. Manitoba Hydro suggests that this could be accomplished by establishing fast, medium and slow regulation products, and clearing the market with the constraint that more valuable products must clear at a higher price.<sup>187</sup>

125. CAISO argues that system operators could define a fast-ramping ancillary service product with a ramp requirement based upon a change in output over a period of time, such as four seconds. It contends that System operators would then use fast-ramping resources as primary responders to changes in ACE.

#### iv. Other Comments Regarding the Performance Payment

126. SoCal Edison adds that after market system design, each market will have to be scrutinized for criteria such as barriers to entry. If analyzing the new system does not reveal workable competition, then the Commission will have to define market power mitigation before letting such markets run.<sup>188</sup>

127. TAPS does allow that in some necessary instances, regional market designs should provide for mitigation, and it may well be appropriate to mitigate offers down to an administratively-determined level where the resource is indifferent between providing frequency regulation service (actual movement up and down) and remaining steady at a given set point.<sup>189</sup>

#### c. Commission Determination

##### i. Market-Based Pricing Versus Administratively-Determined Prices

128. The Commission will require use of a market-based price, rather than an administratively-determined price, on which to base the frequency regulation performance payment. This price must reflect the market participant bids submitted by resources for the provision of frequency regulation service. As commenters note, a market-based price for frequency regulation will encourage market participants to accurately bid their cost to provide the service. A resource that chooses to increase its offer price could find itself in a position of not being dispatched and, therefore, losing potential revenues. Additionally, unlike an administratively-based price, which could be subject to a potentially lengthy stakeholder and/or adjudicative process each time the price was changed, a market-based price will better reflect current system conditions and need for frequency regulation,

thereby providing market participants with an efficient price signal.

129. Further, as PJM states, a market-based price can be efficiently and accurately modeled in the market-clearing algorithm. For these reasons, we find it just and reasonable to require that all RTOs and ISOs base their payment for frequency regulation service on a market-based price.

130. However, as described more fully in the next section, unlike what was proposed in the NOPR, we will not require a specific methodology for how that market-based price shall be determined. We will not mandate specific bidding parameters or other technical details that will determine the pricing methodology. We will require two-part bidding; though we are mindful that CAISO and ISO-NE each noted the expected difficulty or ease with which the proposed NOPR changes can be integrated into existing market solution software. ISO-NE's concerns about two-part bidding, in particular, are addressed by the flexibility we will allow in the bidding parameters that the RTOs and ISOs may use and in that we will not mandate a specific method by which the RTOs and ISOs must specify their market-clearing algorithms that determine dispatch. The Commission recognizes that two-part bidding solutions are not insignificant problems.<sup>190</sup> However, they can be overcome, and we believe the time-frame that we have required will allow sufficient time to overcome such hurdles. Beyond this, the Commission will withhold judgment on the RTOs and ISOs' specific proposals until receiving the compliance filings ordered below. As TAPS states, market participants have invested heavily in market software and hardware, and the different regional markets operate slightly differently in how their markets function. We conclude that mandating a standardized solution on this issue could result in significant costs and disruption of existing stakeholder processes. Therefore, we will allow the RTOs and ISOs to determine how to implement the market-based pricing we are mandating, as discussed in the compliance section below.

##### ii. Calculating the Performance Payment and Bidding Parameters

131. Because RTO and ISO markets do not all operate in the same manner, the Commission will not mandate a

<sup>190</sup> The problem of simple scoring rules used to solve two-part bids is illustrated, for example, in Swider, Derk J. "Efficient Scoring-Rule in Multipart Procurement Auctions for Power System Reserve" *IEEE Transactions on Power Systems*, 22(4): 1717-1725.

<sup>183</sup> SoCal Edison May 2, 2011 Comments at 10.

<sup>184</sup> Beacon May 2, 2011 Comments at 31-33, ESA May 2, 2011 Comments at 30-32.

<sup>185</sup> Viridity May 2, 2011 Comments at 2.

<sup>186</sup> More explanation can be found below in our discussion of accuracy, where Viridity's proposal for an accuracy measure is discussed. Viridity May 2, 2011 Comments at 6.

<sup>187</sup> Manitoba Hydro May 2, 2011 Comments at 4.

<sup>188</sup> SoCal Edison May 2, 2011 Comments at 10.

<sup>189</sup> TAPS May 2, 2011 Comments 10.

particular form that the performance payment must take. Nor will we mandate specific bidding parameters or other technical specifications (including requirements for qualification as a regulation resource). Given regional differences, we direct the RTOs and ISOs to propose the specific technical requirements that will meet the requirements of this Final Rule. We will require, however, that the clearing performance price be paid uniformly to all resources cleared during the same settlement period, for the same reasons discussed above. A uniform clearing price sends an efficient price signal to all current and potential market participants. Further, paying a uniform clearing price in this instance is consistent with long-standing Commission policy.<sup>191</sup>

132. While several commenters state their preference for a particular method for calculating the performance payment, there is no compelling evidence that one method will work best in all RTOs and ISOs. As CESA notes, there could be more than one efficient way to compensate performance; but resources should be paid a uniform price for their frequency regulation service.

133. In addition, we clarify that the NOPR proposal was not intended to tie the performance payment explicitly to a resource's ACE correction. The performance payment proposed in the NOPR was based on the amount of up and down movement, in megawatts, the resource provides in response to a control signal.<sup>192</sup> We recognize that, if an RTO or ISO were to compensate a resource based on how well it corrects ACE, resources would have the incentive to try to second-guess dispatch signals in an effort to meet this potentially contradictory goal. A resource's performance must be measured based on the absolute amount of regulation up and regulation down it provides in response to the system operator's dispatch signal.

134. In response to SoCal Edison's argument that any performance payment system should only pay for services actually provided, the Commission agrees and believes that measuring accuracy, as is required below, will account for this. In response to OMS and VCharge, who question the need for both a price-per-MWh ramping capability and price-per-MW of ACE correction, the Commission did not

intend to state that there was a need for both alternatives.<sup>193</sup>

### iii. Creating a New Ancillary Service Product

135. In response to Manitoba Hydro and other comments, we do not believe it is necessary to define faster- and slower-ramping resources or use speed to distinguish among resources to create new ancillary services products based on the ramping speed in the context of this rulemaking. The purpose of this Final Rule is to remedy undue discrimination in compensation for the existing frequency regulation service employed by RTOs and ISOs by ensuring that frequency regulation resources are compensated based on individual performance and ensure that all eligible resources, not just traditional resources and not just non-traditional resources, providing frequency regulation service within RTO or ISO regulation markets are compensated at the just and reasonable rate. While we do not choose to require additional categories of ancillary services based on ramping speeds in the context of this rulemaking, we do recognize that there may be value in having a certain level of granularity in defining the ancillary service products. Most of the ancillary services are defined by certain characteristics, and we understand that numerous different ancillary service products could be created based on the characteristics of different suppliers. We understand that the RTOs and ISOs and market monitors will continue examining the ancillary service product definitions and may propose to create new ancillary services as market needs evolve.<sup>194</sup>

### iv. Other Comments Regarding the Performance Payment

136. As to SoCal Edison's and TAPS's concerns about the issue of market power mitigation, we agree that there may be circumstances under which an RTO or ISO may wish to test for market power and potentially impose mitigation. We note that the Commission has approved market power mitigation in frequency regulation markets.<sup>195</sup> This rule requires fundamental changes to the way RTOs

and ISOs procure and compensate frequency regulation resources, which may render existing RTO and ISO market power rules insufficient for purposes of addressing market power concerns. Given the Commission's recognition of the need for proper mitigation methods in the current RTO and ISO markets, we will require the RTOs and ISOs either to submit tariff provisions for market power mitigation methods appropriate to redesigned frequency regulation markets or to explain how their current mitigation methods are sufficient to address market power concerns given the changes required in this rulemaking.

### 3. Accuracy

#### a. NOPR Proposal

137. The Commission proposed that the performance payment reflect the resource's accuracy in following the system operator's dispatch signal. Specifically, the Commission proposed that the accuracy be measured by the RTO or ISO using currently available telemetry technology. If an RTO or ISO receives telemetry data every 10 seconds, for instance, it would be able to measure over the course of 5 minutes how often the resource was delivering exactly the megawatts requested. The resource would then be compensated for the fraction of its mileage that met the dispatch signal. This would provide a disincentive to deviate from the dispatch signal, which incorporates actual ramping ability.

138. The Commission noted that there was little agreement among the technical conference panelists on how accuracy should be incorporated into the frequency regulation market design. Therefore, the NOPR sought comments on alternative methods, including methods to incorporate accuracy into the ACE correction calculation. The Commission posited that it is possible to approximate how a resource contributes to correcting ACE by taking the difference between the energy it provides that was in the direction needed to correct ACE at any moment and the energy that was in the direction opposite to what was needed to correct ACE. Thus, a resource's payment for ACE correction could only include the MWh that were actually correcting ACE. The Commission sought comments on how to structure payments for frequency regulation that compensate a resource for its contribution to ACE correction. We sought comment on whether this method could result in a resource being penalized through lower mileage even

<sup>193</sup> See 134 FERC ¶ 61,124 at P 38. The sentence should have read "Specifically, resources would specify the capacity (in MW) available to provide regulation, a ramp rate (in MW/min), and bid into the market a price-per-MWh ramping capability or price-per-MW of ACE correction."

<sup>194</sup> See, e.g., CAISO's flexible ramping constraint, available at <http://www.caiso.com/informed/Pages/StakeholderProcesses/FlexibleRampingConstraint.aspx>.

<sup>195</sup> See *PJM Interconnection, LLC*, 125 FERC ¶ 61,231 (2008).

<sup>191</sup> See *supra* n.153.

<sup>192</sup> NOPR, 134 FERC ¶ 61,124 at P 34 and 37.

when it is following the system operator's dispatch signal.<sup>196</sup>

b. Comments

139. A number of commenters state their support for some form of accuracy adjustment for frequency regulation service performance payments.<sup>197</sup> Most, however, are clear in their recommendation that an accuracy measure reflect how accurately a resource follows the system operator's dispatch signal and not be based on any measure of how the resource contributes to ACE correction. Several also emphasize the importance of allowing RTOs and ISOs flexibility in how they devise their own accuracy measures.

140. Beacon, CESA, and ESA state that an accuracy metric will encourage resources to accurately respond to the control signal sent by the ISO and will ensure that the performance payment is truly tied to the resource's actual service provided.<sup>198</sup> Beacon and ESA state that the NYISO's performance index is a good example of an accuracy metric. Beacon also states that, while NYISO provides a good model, the 30 second snapshot of accuracy is too slow to capture the accuracy of a storage resource that can dramatically change its output each 6 second AGC cycle. Therefore, Beacon recommends that any accuracy metric be capable of measuring performance each AGC dispatch cycle and account for any latency in the ISO's dispatch software.<sup>199</sup> Further, Beacon and ESA warn that compensating a resource for accuracy alone is not sufficient to send efficient price signals. They contend that the accuracy adjustment must be tied to a performance payment.<sup>200</sup>

141. ENBALA believes that a real-time accuracy metric should be calculated by the RTO or ISO to reflect how accurately the regulation provided by a resource follows the regulation requested. But

ENBALA cautions that the accuracy metric should take into account the time needed to communicate data and the frequency with which the dispatch signal can change.<sup>201</sup> Like ENBALA, Manitoba Hydro supports an accuracy measure provided that telemetry update frequency and latency are adequately considered.<sup>202</sup>

142. In response to the Commission's inquiry about whether a resource should be compensated for performance when it is moving in a direction that is against ACE, Beacon, CESA, and ESA recommend subtracting from the sum of the resource's total MW of up and down movement any movement that is not in the direction of correcting ACE. They state that this could penalize a resource even when it is following the system operator's dispatch signal, but that this is appropriate because it further aligns the payment the resource receives with the value it provides to the grid.<sup>203</sup> At the same time, Beacon and ESA acknowledge that a reward or penalty structure should not change the requirement that a resource follow the operator's dispatch signal.<sup>204</sup>

143. Duke agrees with the Commission's proposal that a resource's accuracy in following a dispatch signal should be compensated through a performance payment. However, Duke does not agree with the proposal that a resource be penalized if its MWh contribution works against needed ACE correction yet is compliant with the system operator's dispatch signal. Duke cites the situation where a system operator is dispatching resources, but the dispatch signal is not designed just to correct ACE.<sup>205</sup>

144. The IRC, ISO-NE, NEPOOL, CAISO, PJM, MISO, NYISO, OMS, and SoCal Edison recommend that the accuracy metric should be designed to provide an incentive to follow operational instructions that facilitate compliance with the system operator's dispatch signal, rather than focusing narrowly on rewarding ACE correction efforts.<sup>206</sup> ISO-NE asserts that compensation for accuracy should not

be based solely on how well resource output tracks ACE. It contends that this creates an incentive for a resource owner to ignore, or second-guess, an ISO's dispatch signal. ISO-NE explains that central dispatch allows an ISO to take advantage of its superior information to produce a coordinated AGC dispatch that produces the lowest cost result. This dispatch may differ from the outcome that would result from resources individually chasing after the expected ACE needs or otherwise second-guessing the operator's dispatch signal. CAISO suggests that paying for response to a control signal rather than ACE correction would be easier to implement, avoids potential adverse impacts to slow resources, and does not tie compensation to one measure of ACE.

145. At the same time, ISO-NE warns that compensation not be based solely on how closely a resource tracks its AGC dispatch signal. ISO-NE imagines a situation where frequency regulation resources actually reduce their reported ramping capability and offer in less capacity in order to more easily follow the dispatch signal. ISO-NE states that this could defeat the entire purpose of paying for performance.<sup>207</sup> With this in mind, ISO-NE recommends that the Commission adopt a final rule that provides the flexibility for accuracy considerations to be incorporated into the determination of frequency regulation service eligible for compensation, or into other measures of regulation performance that may be more appropriate for RTOs and ISOs in different regions of the country.<sup>208</sup> ISO-NE also notes that measuring accuracy is complex because it requires knowing the realistic performance characteristics of each resource and presumes reliable instrumentation and dependable communications.<sup>209</sup> NEPOOL supports retaining ISO-NE's current method of measuring performance.<sup>210</sup>

146. In addition, CAISO argues that linking the performance payment to ACE correction adds unnecessary complexity to settlement of regulation transactions.<sup>211</sup> MISO also raises the concern that the introduction of an accuracy consideration to the performance payment could require substantial modifications to existing

<sup>196</sup> NOPR, 134 FERC ¶ 61,124 at P 40.

<sup>197</sup> Alcoa May 2, 2011 Comments at 2, Beacon May 2, 2011 Comments at 38–39, CESA May 2, 2011 Comments at 11, ESA May 2, 2011 Comments at 34–36, Duke May 2, 2011 Comments at 7, EDF May 2, 2011 Comments at 21, ENBALA May 2, 2011 Comments at 3, IRC May 2, 2011 Comments at 3–4, ISO-NE May 2, 2011 Comments at 6–8, NEPOOL May 2, 2011 Comments at 10, Manitoba Hydro May 2, 2011 Comments at 3, NYISO May 2, 2011 Comments at 2 and 4–5, OMS May 2, 2011 Comments at 6–7, PJM May 2, 2011 Comments at 7–8, Powerex May 2, 2011 Comments at 9–10, Primus Power May 2, 2011 Comments at 6, SoCal Edison May 2, 2011 Comments at 2, Viridity May 2, 2011 Comments at 4–5, and Xtreme Power May 2, 2011 Comments at 7.

<sup>198</sup> Beacon May 2, 2011 Comments at 38, CESA May 2, 2011 Comments at 11, ESA May 2, 2011 Comments at 34.

<sup>199</sup> Beacon May 2, 2011 Comments at 38.

<sup>200</sup> Beacon May 2, 2011 Comments at 38, ESA May 2, 2011 Comments at 35.

<sup>201</sup> ENBALA May 3, 2011 Comments at 3.

<sup>202</sup> Manitoba Hydro May 2, 2011 Comments at 3.

<sup>203</sup> Beacon May 2, 2011 Comments at 39, CESA May 2, 2011 Comments at 11, ESA May 2, 2011 Comments at 35–36.

<sup>204</sup> Beacon May 2, 2011 Comments at 40, ESA May 2, 2011 Comments at 36.

<sup>205</sup> Duke May 2, 2011 Comments at 7.

<sup>206</sup> IRC May 2, 2011 Comments at 3–4, ISO-NE May 2, 2011 Comments at 6–8, NEPOOL May 2, 2011 Comments at 10, CAISO May 2, 2011 Comments at 12–14 and 18–19, PJM May 2, 2011 Comments at 7–8, MISO May 2, 2011 Comments at 7–8, NYISO May 2, 2011 Comments at 2, OMS May 2, 2011 Comments at 6–7, SoCal Edison May 2, 2011 Comments at 2.

<sup>207</sup> ISO-NE May 2, 2011 Comments at 6–7.

<sup>208</sup> *Id.* at 8.

<sup>209</sup> *Id.* at 6.

<sup>210</sup> NEPOOL May 2, 2011 Comments at 10.

<sup>211</sup> CAISO May 2, 2011 Comments at 18–19.

RTO and ISO algorithms, and other dispatch and accounting tools.<sup>212</sup>

147. OMS is concerned both about technical issues, such as needed telemetry, as well as, for example, a situation where a resource is following dispatch instructions, but those dispatch instructions are contrary to ACE. In that case, a resource following the dispatch instruction should not be penalized, OMS says.<sup>213</sup>

148. Primus Power and Viridity generally support the Commission's proposal but offer their own versions of how accuracy should be measured. As describes above, Primus Power recommends that "net energy contribution" be the metric used to determine performance payment. It defines this as the total MWh delivered by the resource in the direction of the control signal minus the total MWh delivered against the control signal (or delivered in excess of the control signal). Primus Power would use this as the basis on which to base a resource's performance payment.<sup>214</sup>

149. Viridity recommends an accuracy measure that can be broken into three types of performance. A resource that performs perfectly delivers exactly the MWh as dispatched by the system operator. This resource would receive 100 percent of its performance payment. A resource that does not deliver the exact amount requested through the dispatch signal, but which nonetheless is delivering frequency regulation service in the direction requested would only receive a fraction of its performance payment. Resources that move in the opposite direction of the dispatch signal will face a charge.

150. Viridity recommends that accuracy be measured over what it describes as a reasonable number of intervals of the frequency regulation signal. It cites 4 intervals, or every 16 seconds in the case of a 4 second signal.<sup>215</sup>

#### c. Commission Determination

151. The Commission finds that measuring and accounting for accuracy in a resource's compensation is just and reasonable and will encourage resources to report accurately their achievable ramp rate and to follow the system operator's dispatch instructions. The Commission also finds it appropriate to base a resource's accuracy on how well it follows the dispatch signal and not on its contribution to correcting ACE. Indeed, we note that no commenters

argue against accounting for frequency regulation service providers' accuracy.

152. First, as the RTOs and ISOs and others note, the system operator does not always use the AGC signal to correct ACE to zero. There are situations where a resource can be given an AGC signal that is calibrated to anticipate changes in ACE. Second, as noted above, to base accuracy on ACE correction would be to open the door to resources second-guessing dispatch signals and under-reporting their actual ramping capability. Neither of these would be a desirable outcome. Indeed, a system operator faced with a fleet of resources with suddenly slower ramp rates would be forced to procure more frequency regulation capacity in order to be sure of reliable operations. Further, the system operator needs to have the confidence that when a dispatch signal is sent, resources will respond to it as directed. This is best accomplished by providing resources with an economic incentive to follow dispatch signals.

153. Therefore, we will require all RTOs and ISOs to account for frequency regulation resources' accuracy in following the AGC dispatch signal when determining the performance payment compensation. However, we will not mandate a certain method for how accuracy is measured. For instance, we will not, contrary to Beacon's request, mandate that the system operator measure response on the same frequency as the AGC signal (*i.e.*, every 4 or 6 seconds). In combination with the performance payment, accounting for accuracy by tracking how closely a resource follows its dispatch signal will meet the goal of having compensation reflect the work that frequency regulation resources perform for the system operator. We direct the RTOs and ISOs to determine the technical specifications of measuring accuracy. We will not pre-judge the methods of measuring accuracy presented by Primus Power and Viridity. Any stakeholder may use the standard RTO and ISO stakeholder processes to suggest how best to measure accuracy. The RTOs and ISOs are in the best position in the first instance to design a method for measuring accuracy which works with their system.

154. However, we will require the RTOs and ISOs to use the same accuracy measurement method for all resources. That is, the RTO or ISO may not develop an accuracy metric that applies to one class of resources and another accuracy metric that applies to other resources. Doing so would move in the direction of creating a "fast" and "slow" regulation service which we have declined to do. The RTOs and ISOs will

have flexibility in how the designed method is used to determine accuracy (*e.g.*, the method could be used to define an accuracy threshold or it could be used to define a resource-specific performance payment multiplier), but all resources have to be measured on the same basis. This flexibility will address comments that we should allow RTOs and ISOs to acknowledge the realistic performance characteristics of the resources providing frequency regulation service.

#### 4. Net Energy

##### a. NOPR Proposal

155. As explained in the NOPR, currently, regulating resources receive a payment (or charge) for the net energy injected (or withdrawn) as a result of providing regulation service in every RTO and ISO market. The Commission sought comment on the appropriateness of retaining net energy payments in light of the two-part payment proposed in the NOPR.<sup>216</sup> Specifically, the Commission sought comment on whether the provisions in existing tariffs for net energy payments are redundant given the proposed requirement discussed herein that all RTOs and ISOs must pay regulating resources a mileage payment for the ACE correction service they provide, or whether this payment is a necessary, appropriate feature of day-ahead and real-time energy account balancing and settlement.

##### b. Comments

156. Many commenters support retaining net energy balancing. ESA and CESA state that hourly net-energy payments and Performance Payments are not redundant. ESA and CESA state that both types of payments are needed to ensure appropriate compensation of frequency regulation providers.<sup>217</sup> ENBALA agrees that net energy payments in the existing tariffs should be maintained.<sup>218</sup> Occidental also agreed, stating that net energy payments must be maintained in order to (1) recognize the true cost of frequency regulation service, (2) avoid subsidization of inefficient providers and (3) avoid inefficient market outcomes.<sup>219</sup> Powerex suggests that the Commission should require RTOs and ISOs to continue to settle net energy in each five-minute interval.<sup>220</sup> Xtreme Power reasons that frequency regulation resources should be paid—or pay for—

<sup>216</sup> NOPR, 134 FERC ¶ 61,124 at P 41.

<sup>217</sup> ESA May 2, 2011 Comments at 36, CESA May 2, 2011 Comments at 12.

<sup>218</sup> ENBALA May 2, 2011 Comments at 10.

<sup>219</sup> Occidental May 2, 2011 Comments at 4.

<sup>220</sup> Powerex May 2, 2011 Comments at 10.

<sup>212</sup> MISO May 2, 2011 Comments at 8.

<sup>213</sup> OMS May 2, 2011 Comments at 7.

<sup>214</sup> Primus Power April 18, 2011 Comments at 6.

<sup>215</sup> Viridity May 2, 2011 Comments at 4–5.

the energy they inject or withdraw. It argues that any net purchases of energy should be charged to storage-based frequency regulation providers at wholesale rates.<sup>221</sup> NEPOOL explained that while mileage payments compensate for what is done in the regulation market; hourly net-energy payments are part of the compensation for what is done, and not done, in the energy market.<sup>222</sup> Primus Power recommends retaining a separate payment for net energy, stating that this will ensure that capacity bids are not distorted by the volatility in the real-time energy market.<sup>223</sup>

157. SoCal Edison states that there are two fundamentally disparate ways to treat net energy balancing. One is to charge or credit a resource for its net real-time energy and the other is to exempt frequency regulation resources from such crediting and charging. Because, SoCal Edison states, the specific market design impacts the final outcome of using either method, it recommends that the Commission not mandate one particular method for treating net energy balances.<sup>224</sup>

158. On the other hand, Manitoba Hydro states that RTOs and ISOs should eliminate net energy balancing.<sup>225</sup> PIOs recommend that the Commission not allow what they view as a redundant payment mechanism. Instead, PIOs recommend that the Commission only allow the retention of net energy balancing and remuneration if the RTOs and ISOs can show that this payment is distinct from the service that will be compensated under the NOPR's proposal, and that such payment is necessary and not redundant.<sup>226</sup>

159. Beacon explains that tariffs that require energy storage facilities to purchase energy when providing "regulation down" without allowing for a corresponding energy settlement payment when the facility provides "regulation up" creates a financially infeasible situation within which these resources can operate. Tariffs that allow energy storage to settle their energy on a net basis will remove a significant barrier to the participation of energy storage projects connected at transmission.<sup>227</sup>

160. ISO-NE suggests that net energy payments not be mandated for storage resources in the Final Rule, as, for instance, expensive metering

requirements designed for generators would preclude participation from a number of promising technologies that aggregate resources to provide regulation. ISO-NE asserts that small aggregated resources that take electric service at the retail level and are geographically dispersed should be afforded the opportunity to provide regulation without being required to participate in the wholesale energy market and meet the associated requirements that could be cost-prohibitive for small resources.<sup>228</sup> Other ISOs, however, have not incorporated net energy payments into their regulation markets. PJM argues that altering existing energy market provisions will likely result in other unintended consequences or will create a disincentive to provide frequency regulation service.<sup>229</sup>

#### c. Commission Determination

161. Upon consideration of the comments received, the Commission will take no action at this time on net energy balancing as it is currently used in the RTOs and ISOs; RTOs and ISOs may retain their current rules in this regard. Given the market rule changes being required above, the Commission currently does not find it necessary to require that RTOs and ISOs change their existing methods for netting injections and withdrawals of energy over the settlement period. In CAISO, for instance, there is no relation between the provision of frequency regulation service and netting of energy. In other markets, the treatment of net energy is different. SoCal Edison makes the valid point that the effect of the rules governing treatment of net energy balances depends on the specific market design into which they are integrated. As PIOs suggest, net energy balancing can be an integral part of the RTOs' and ISOs' accounting and system balancing and we will impose no requirements concerning this issue at this time.

162. Beacon states that a storage resource that must pay the real-time price when charging but is not likewise credited when discharging that power in response to a frequency regulation signal is put in an untenable financial position. We find that Beacon's concern is addressed by current RTO and ISO rules. Frequency regulation resources are charged at the real-time price for energy withdrawals and credited for energy injections.

#### 5. Technical Issues

##### a. Comments

163. Several commenters raise concerns over a variety of technical issues ranging from the definition of ramp rate, to software issues, to the substitutability of new technologies for old.

164. On the issue of ramp rate, Alcoa states that existing market designs are ill suited for non-traditional resources, and RTOs and ISOs tend to develop models that force these resources to conform to the traditional design rather than create unique models. Alcoa refers to the current clearing mechanism, which multiplies a resource's ramp rate by five minutes. Alcoa argues that this design limits its ability to provide demand response, which is full range responsive in one minute, to nearly one fourth of its ramping capability. Alcoa claims that this leads to inefficient utilization of resources and increased costs.<sup>230</sup> Similarly, SunEdison asserts that limiting performance to a MW per minute response discriminates against resources that can respond in MW per second.<sup>231</sup>

165. Concerning software, CAISO claims that implementation of the Final Rule would present considerable technical challenges. CAISO states that in addition to creating new charge codes, CAISO would have to develop a settlement system based on more granular telemetry than the current 10 minute settlement interval. According to CAISO, at least 12 months would be required to design, test and implement the Commission's proposed performance payment mechanism. As such, CAISO requests the Commission provide a minimum of 18 months after the issuance of the Final Rule to implement necessary systems and processes.<sup>232</sup>

166. Similarly, ISO-NE claims that formulating a design that seeks to co-optimize energy, reserves, and regulation, particularly where correctly determining inter-temporal opportunity costs for storage resources might require an optimization horizon spanning hours or days, is a daunting technical challenge. It argues that formulating such a design might require a complete overhaul of existing real-time dispatch algorithms.<sup>233</sup>

167. On the other hand, CESA states that the Commission should ensure implementation of the Final Rule is not

<sup>221</sup> Xtreme Power May 2, 2011 Comments at 8.

<sup>222</sup> NEPOOL May 2, 2011 Comments at 12.

<sup>223</sup> Primus Power May 2, 2011 Comments at 7.

<sup>224</sup> SoCal Edison May 2, 2011 Comments at 9.

<sup>225</sup> Manitoba Hydro May 2, 2011 Comments at 4.

<sup>226</sup> PIOs May 2, 2011 Comments at 9.

<sup>227</sup> Beacon May 2, 2011 Comments at 40-41.

<sup>228</sup> ISO-NE May 2, 2011 Comments at 14-15.

<sup>229</sup> PJM May 2, 2011 Comments at 9.

<sup>230</sup> Alcoa May 2, 2011 Comments at 5-6.

<sup>231</sup> SunEdison May 2, 2011 Comments at 2-4.

<sup>232</sup> CAISO May 2, 2011 Comments at 20-22.

<sup>233</sup> ISO-New England May 2, 2011 Comments at 9-13.

delayed by computer software. CESA argues that there is no reason why the compensation method as set forth in the NOPR cannot be integrated into system operators' existing co-optimization algorithms.<sup>234</sup> Beacon and ESA argue that while some flexibility may be required, delaying the implementation of the Final Rule would send inappropriate price signals to investors in energy storage technology that would be detrimental to the industry.<sup>235</sup>

168. Raising concerns about technical substitutability of resources, EEI asserts that advantages in speed may be offset by a non-traditional resource's lack of sustainability or automatic response. EEI argues that pricing policies must consider the needs of the entire system including the proper mix of resources to minimize system impacts. EEI theorizes that excessive use of fast acting resources may cause a balancing authority to require more traditional resources to offset the risk of being shorted.<sup>236</sup>

169. Similarly, several commenters, including SoCal Edison, ISO-NE, CAREBS, and EPSA assert that over-emphasis on faster regulation resources without considering their ability to provide sustained energy (for as long as, for example, 15 minutes) may cause overcorrection, decreased reliability, and increased costs.<sup>237</sup> CAREBS suggests that the Commission should consider how to compensate resources that are both fast-ramping and long-duration.<sup>238</sup>

170. Likewise, CAISO argues that a fleet of resources that can respond accurately to dispatch signals for an appropriate duration is more valuable than resources that can respond quickly. CAISO therefore states that rules should compensate resources that respond accurately rather than simply quickly.<sup>239</sup>

171. ENBALA further expresses a concern that fast-responding resources could cause reliability issues in the power system by creating resonance conditions with inter-area oscillations if they respond to AGC signals with time constants less than 10 seconds. It explains that inter-area oscillations occur as a result of an imbalance of generation and system load. It argues that, within an interconnection, some generators will respond differently to

load changes depending on their distance to the load center, which will cause some units to speed up or down more than others. As the generators change their speed by a small amount the power flow between the generators will change. Once this imbalance occurs, ENBALA contends, all generators will continually move with or against each other. When there is insufficient or negative damping, the oscillations will be sustained, or increase, which ENBALA states can cause damage to the power system.<sup>240</sup>

172. ENBALA argues that fast responding resources should be integrated in the regulation fleet, but it states that the response times of resources need to be maintained above a safe level so as to eliminate this reliability risk. It recommends that NERC be allowed to assess the potential reliability risk that AGC control action within this time-frame represents before the Commission accepts the proposed incentive structure for frequency regulation in the wholesale electricity market.<sup>241</sup>

173. EnerNOC claims that the Commission's proposed telemetry requirements represent a burden to demand response participation by end-use customers. EnerNOC asserts that an aggregated load management data system can meet reporting requirements without forcing each individual end-use customer to conform to a system operator's normal telemetry requirements. Accordingly, EnerNOC encourages the Commission to allow for flexible RTO or ISO telemetry requirements for frequency regulation services.<sup>242</sup>

174. Xtreme Power states that pilot programs in several ISOs have identified "drift" in their frequency regulation signal, whereby the amount of regulation up does not equal the amount of regulation down. Xtreme Power asserts that "drift" interferes with the ability of energy-limited resources to provide regulation service, and suggests that a net zero energy balance regulation signal be implemented to address this concern. In addition, Xtreme Power questions whether RTOs and ISOs use frequency regulation service to provide other functions due to legacy control practices, thereby placing an undue burden on buyers and sellers of regulation. Xtreme Power therefore urges the Commission to require each RTO and ISO report on the nature of drift in their frequency regulation markets, the causes of such drift, and

options to mitigate drift to allow for fair competition between generators and other resources.<sup>243</sup>

175. ENBALA also raises the issue of what they term as an energy bias or lack of energy neutrality in the frequency regulation dispatch signal as a potential barrier to entry for energy storage devices and demand response.<sup>244</sup> ENBALA describes a method by which the signal could be split into two different signals, one that is sent only to energy-limited resources and that is energy neutral, and another signal that still contains the energy bias for other resources.

176. Jack Ellis recommends an examination of the costs, benefits, and technical feasibility of an approach that uses smaller market intervals and allows providers of flexibility to update their price/quantity offers more frequently than is typically the case today.<sup>245</sup> Mr. Ellis claims that this is simply an extension of intra-hour markets that most RTOs and ISOs currently operate, with two modifications. He contends that the first is that the time intervals will be shorter. Second, suppliers will be able to revise their price/quantity offers more frequently and closer to the start of the market interval; a resource would offer to sell or buy back a quantity of energy in an upcoming 30 second, one minute or five minute interval, rather than providing the grid operator with a ramp rate well ahead of time.<sup>246</sup> Mr. Ellis states that this interval could be, in theory, as short as the AGC signaling interval, typically four or six seconds, though market intervals of 30 seconds or one minute may be more practical and equally effective.

#### b. Commission Determination

177. Regarding Alcoa's concerns that existing market designs are ill-suited for non-traditional resources, we find, for the reasons stated above, that a mileage-based performance payment component, as required in this Final Rule, will provide compensation that appropriately recognizes a resource's actual ramp rate capability.

178. We reject SunEdison's request to redefine ramp rate. The expression of ramp rates in MW per minute does not limit the amount of capacity a resource with faster response times may offer into the frequency regulation market. Redefining ramp rate in MW per second would do no more than change the scale by which ramp rates are reported.

<sup>243</sup> Xtreme Power May 2, 2011 Comments at 8–10.

<sup>244</sup> ENBALA May 2, 2011 Comments at 4–6.

<sup>245</sup> Jack Ellis April 12, 2011 Comments at 4.

<sup>246</sup> *Id.* at 4.

<sup>234</sup> CESA May 2, 2011 Comments at 10.

<sup>235</sup> Beacon May 2, 2011 Comments at 36–37; ESA May 2, 2011 Comments at 33–34.

<sup>236</sup> EEI May 2, 2011 Comments at 8–9.

<sup>237</sup> EPSA May 2, 2011 Comments at 6–7, SoCal Edison May 2, 2011 Comments at 5–6, CAREBS May 2, 2011 Comments at 6–8.

<sup>238</sup> CAREBS May 2, 2011 Comments at 6–8.

<sup>239</sup> CAISO May 2, 2011 Comments at 16.

<sup>240</sup> ENBALA May 2, 2011 Comments at 6–7.

<sup>241</sup> *Id.* at 7.

<sup>242</sup> EnerNOC May 2, 2011 Comments at 3.

179. In response to concerns that faster-responding resources will result in less sustainable or accurate resources being procured for regulation service, we disagree. This Final Rule only modifies the way in which resources are compensated for providing frequency regulation. It does not address requirements for qualification as a resource eligible to participate in wholesale regulation markets. Resources that wish to provide frequency regulation service must be capable of sustained response for an appropriate period as determined by the system operator. Furthermore, linking the performance payment to accuracy as required in the Final Rule will provide an appropriate incentive for resources of any speed to accurately follow the system operator's control signal.

180. We agree with SoCal Edison's argument that each RTO or ISO should be allowed to determine whether the operator or the market participant is to be responsible for managing energy limitations. Nothing in this Final Rule affects how RTOs and ISOs manage energy limitations in their systems.

181. We further emphasize that nothing in this Final Rule requires payments for enhanced performance; rather, it requires that resources providing frequency regulation be paid for the amount of service actually provided. As to potential impacts from over-reliance on faster-responding resources, we note again that currently the RTOs and ISOs meet their NERC-required reliability standards. If an RTO or ISO finds that the integration of too much of one type of resource impacts its ability to meet NERC reliability standards, we expect that it will take the necessary steps to ensure reliability.

182. As to comments seeking compensation for resources that are both fast-responding and long-duration, we find that such resources will receive appropriate compensation under the Final Rule. In addition to receiving a performance payment that rewards the provision of frequency regulation service, these resources will be compensated for their long duration by being able to offer their full regulation capacity for a greater number of regulation intervals.

183. In response to EnerNOC's statement regarding telemetry requirements, we note that this Final Rule directs no new telemetry requirements. We also reiterate that RTOs and ISOs are allowed flexibility in complying with the Final Rule to accommodate regional differences and the needs of their particular region and market, including telemetry requirements.

184. We also reject as outside the scope of this proceeding Xtreme Power's requests to require reporting on "drift" or energy neutrality in the frequency regulation signal, as well as ENBALA's suggestion that RTOs and ISOs use different frequency regulation signals for different resources. These issues concern a technical issue of dispatch, not compensation. However, we note that some RTOs and ISOs have implemented changes to their markets that serve to mitigate the impact of drift on energy storage devices. For example, MISO and NYISO have developed market provisions that manage the charge state of energy storage devices,<sup>247</sup> while ISO-NE allows energy storage devices to update their bids more frequently.<sup>248</sup> We encourage entities to work together with stakeholders to analyze potential impediments to new technologies in all markets.

185. CAISO, ISO-NE, and CESA all submit comments on the expected difficulty or ease with which the proposed NOPR changes can be integrated into existing market solution software. CAISO and ISO-NE request that sufficient time be allowed for implementation, with ISO-NE going so far as to speculate that including inter-temporal opportunity costs might be infeasible and that two-part bidding schemes can be very complex. As a general matter, the Commission believes that the deadlines discussed in the compliance section below will allow sufficient time for all RTOs and ISOs to comply. First, we note that we are not requiring RTOs and ISOs to be responsible for calculating inter-temporal opportunity costs; though we do require that resources be able to include such verifiable costs in their bids. We agree with ISO-NE that the decision of who should calculate inter-temporal opportunity costs is best left to the RTOs and ISOs. Requiring the RTO or ISO to calculate this cost might burden the system operator too much; in other RTOs and ISOs, the system operator might find it easier to complete this task. Thus, we leave it to the individual RTOs and ISOs, in the first instance, to find the solution that best fits their needs. Second, with regard to ISO-NE's concerns about two-part bidding, while we do require two-part bidding, we have not specified the specific technical aspects of how those bids are then used in the market-clearing algorithm. The Commission

<sup>247</sup> See MISO, Energy and Operating Reserve Markets Business Practice Manual, Attachment D, Section 3.26; NYISO, Ancillary Services Manual, Section 4.3.2.

<sup>248</sup> See ISO-NE, Market Rule 1, Appendix J.

recognizes that two-part bidding solutions are not insignificant problems that might need to be addressed.<sup>249</sup> However, we believe the time-frame set forth herein for submitting compliance filings will allow sufficient time to overcome such hurdles.

## 6. Definition of Frequency Regulation

### a. Comments

186. Duke seeks clarification of the definition of "frequency regulation," which Duke asserts is defined differently in the NOPR than in the NERC Glossary of Terms. It points out that NERC's definition includes both "primary frequency control" (*i.e.*, turbine governor response) and "secondary frequency control" (*i.e.*, AGC). In Duke's view, the NOPR was not clear as to whether both primary and secondary frequency controls are included, although Duke contends that the body of the NOPR suggests that only secondary frequency control is included. Duke asks the Commission to clarify this point or, in the alternative, to direct NERC and its stakeholders to examine the issue and propose a resolution.<sup>250</sup>

187. ISO-NE expresses concern that the NOPR defined frequency regulation too narrowly by focusing exclusively on responding to ACE to the exclusion of broader reliability criteria. It proposes a modified definition of frequency response that considers that the objective of the regulation market is to provide a means for the balancing authority to competitively procure sufficient frequency regulation resources to ensure compliance with the NERC CPS1 and CPS2 standards.<sup>251</sup>

188. MISO argues that the Commission's proposed definition of frequency regulation is inconsistent with the Commission-approved NERC definition. MISO contends that the proposed definition characterizes frequency regulation as a response to transmission system ACE, while frequency response is separated and defined as an autonomous response by generators to system frequency. MISO claims that NERC's definition, in contrast, refers to a system's ability to maintain scheduled frequency, and includes both AGC and governor response. MISO argues that there is not a direct correlation between scheduled frequency and ACE. Furthermore, MISO asserts that NERC's definition appears to encompass both frequency regulation and frequency response as defined by

<sup>249</sup> See *supra* note 190.

<sup>250</sup> Duke May 2, 2011 Comments at 3-4.

<sup>251</sup> ISO-New England May 2, 2011 Comments at 5-6.

the Commission. Accordingly, MISO requests that the Commission reconsider the proposed definition of frequency regulation to avoid potential confusion as a result of conflicting terms, or limiting the flexibility of the system operator to call on regulating resources to maintain system balance and reliability.<sup>252</sup>

189. In addition, Invenergy requests that the Commission create standard definitions and terminology for regulation, with the intention of avoiding confusion, inconsistency, and/or the creation of redundant or extraneous regulation products.<sup>253</sup>

190. IRC is also concerned that the proposed definition of frequency regulation in the NOPR is focused solely on ACE, which IRC argues is only one component of regulation service. Instead of rapid response, IRC advocates for “smart response,” which it describes as aligning the response characteristics of all available resources with system needs to provide the most efficient means of managing frequency regulation in each balancing authority Area. IRC notes that a resource with rapid response capability can provide significant response to the ACE (*i.e.*, following the ACE both up and down). But IRC argues that a significant part of that response may be unnecessary if the response was strictly utilized for a zero-averaging ACE. Alternatively, IRC explains that the response could provide significant value if it is directed against a non-zero averaging ACE, because in that case it would be utilized against the overall system needs rather than to merely “chase” ACE, which, as only one part of the operational equation, does not produce the most effective operational response.<sup>254</sup>

#### b. Commission Determination

191. The Commission disagrees with Duke’s contention that the NOPR is not clear as to whether its definition of frequency regulation includes both primary and secondary frequency controls. The NOPR stated, “Frequency regulation service is the injection or withdrawal of real power by facilities capable of responding appropriately to a transmission system’s frequency deviations or interchange power imbalance, both measured by the ACE \* \* \*. Frequency regulation is distinguishable from Frequency response.”<sup>255</sup>

192. In response to ISO–NE., MISO, and the IRC’s concerns that the

Commission’s proposed definition of frequency regulation in the NOPR is too narrow and is inconsistent with the Commission-approved NERC definition, we address this issue in section 3 infra by requiring that accuracy be measured in relation to the system operator’s dispatch signal and by revisions to the proposed regulatory text. As described below, we have revised the regulatory text to define frequency regulation as “the capability to inject or withdraw real power by resources capable of responding appropriately to a system operator’s automatic generation control signal in order to correct for actual or expected Area Control Error needs.” We also address Invenergy’s request for a standard definition. The alteration to the proposed regulatory text, we believe, provides a sufficiently detailed definition of frequency regulation to avoid confusion. The definition avoids the implication that a system operator’s dispatch signal for frequency regulation resources always aims to drive ACE to zero at any given moment in time, but also describes only secondary frequency control and does not include primary frequency control, *i.e.*, frequency response. Further, the Commission finds that the distinction between the *pro forma* OATT and this new language will not cause confusion because it applies only to the organized wholesale markets: the RTOs and ISOs.

#### 7. Miscellaneous Issues

##### a. Comments

193. Several commenters discussed various issues pertaining to barriers to participation<sup>256</sup> and separating regulation up and regulation down,<sup>257</sup> and, a few commenters argue that the Commission should adopt various

<sup>256</sup> For example, Powerex argues that restricting units eligible to provide regulation service to units within the RTO or ISO market footprint undermines market liquidity and discourages the development of competitive regulation markets. Accordingly, Powerex requests that the Commission clarify that RTOs and ISOs cannot unduly restrict participation by external resources and must justify restrictions solely on reliability or deliverability concerns. Powerex May 2, 2011 Comments at 5–6. Occidental requests that the Commission revise the definition of demand response to state that an increase in load in response to dispatch is also considered demand response. Occidental May 2, 2011 Comments at 3–4.

<sup>257</sup> Alcoa, AWEA, Occidental and Steel Producers argue that the Commission should urge or require separate regulation up and regulation down markets in order to recognize the separate value of each service and to promote more efficient regulation response. Alcoa May 2, 2011 Comments at 7–8; AWEA May 2, 2011 Comments at 4–5; Occidental May 2, 2011 Comments at 1; Steel Producers May 2, 2011 Comments at 2.

requirements related to NERC,<sup>258</sup> or storage facilities.<sup>259</sup>

##### b. Commission Determination

194. These issues are beyond the scope of this proceeding, which is limited to remedying the existing undue discrimination in the compensation of frequency regulation service in the organized wholesale electricity markets. This Final Rule is also not focused on any particular resource type, but rather is resource-neutral. The directives of this Final Rule will ensure that *all* eligible resources providing frequency regulation service within existing RTO or ISO frequency regulation markets are compensated at the just and reasonable rate.

195. We further emphasize that the directives of this Final Rule apply only to secondary frequency regulation in the organized wholesale electricity markets and not to primary frequency response. As noted in the NOPR, the Commission has separately released for public comment a staff study evaluating the use of frequency response metrics as a tool to assess the reliability impacts of varying resource mixes on the transmission grid.<sup>260</sup> However we disagree with commenters who argue that requiring the reforms directed herein to ensure just and reasonable rates will provide excessive compensation in the secondary frequency regulation markets. We decline to impose generic requirements in this Final Rule relating to compensation reforms for other critical ancillary services.

196. With respect to Starwood/Premium’s request that the Commission address in this proceeding the storage-related issues raised in the Storage RFC the Commission notes that, on June 16, 2011, the Commission issued a Notice of

<sup>258</sup> EEI and Detroit Edison seek a requirement that RTOs and ISOs develop pilot programs in consultation with NERC to evaluate the impact of non-traditional resources; Alcoa argues that NERC performance standards are designed based on traditional technologies and request that the Commission direct NERC to study the reduction in system requirements through integration of nontraditional resources outside the scope of this rulemaking; Duke states that it is unaware of any technical study or NERC standard or requirement that would indicate that a faster response to AGC is necessary for reliable system operations and that RTOs and ISOs are ultimately responsible for determining what resources are necessary to comply with the NERC reliability standards.

<sup>259</sup> Starwood/Premium recommends that the Commission consider adapting the NOPR proposal to include storage devices that are able to provide multiple services as discussed in the Commission’s June 11, 2010 Notice of Request for Comments. See *Request for Comments Regarding Rates, Accounting and Financial Reporting for New Electric Storage Technologies*, Docket No. AD10–13–000 (2010) (Storage RFC).

<sup>260</sup> NOPR, 134 FERC ¶ 61,124 at n.610.

<sup>252</sup> MISO May 2, 2011 Comments at 3–5.

<sup>253</sup> Invenergy May 2, 2011 Comments at 3.

<sup>254</sup> IRC May 2, 2011 Comments at 4–5.

<sup>255</sup> NOPR, 134 FERC ¶ 61,124 at P 4–5.

Inquiry that continues our examination of storage-related issues.<sup>261</sup> Because these issues are being addressed in another proceeding, we decline to address them here.

**III. Compliance Requirements and Summary of Commission Determinations and Findings**

197. In this Final Rule the Commission finds that current methods for compensating resources for the provision of frequency regulation are unduly discriminatory. To remedy this undue discrimination, the Commission finds that it is just and reasonable to require all RTOs and ISOs to modify their tariffs to provide for a two-part payment to frequency regulation resources.

198. The first part of this payment will be a capacity, or option, payment for keeping a resource's capacity in reserve in the event that it is needed to provide real-time frequency regulation service. This payment must be a uniform payment to all cleared resources, and must be a payment that includes the marginal unit's opportunity costs. The RTO or ISO must calculate and include in its market-clearing process the cross-product opportunity costs of each resource offering its capacity. We will leave to the RTOs and ISOs the discretion of proposing to whom the responsibility falls of calculating any applicable inter-temporal opportunity costs. This capacity payment also must be based on competitive market-based bids for the provision of frequency regulation capacity submitted by resources.

199. The second part of the payment shall be a performance payment that reflects the amount of work each resource performs in real-time. This payment must reflect the accuracy with which each resource responds to the

system operator's dispatch signal. The performance payment must be market-based (*i.e.*, based on resource bids that reflect the cost of providing the service). We leave to the RTOs and ISOs to propose such details as bidding parameters and other details that may need to vary by market and region.

200. Regarding accuracy, the Commission finds that it is appropriate to tie the measurement of a resource's accuracy to the system operator's AGC dispatch signal and not to ACE correction. Therefore, each RTO and ISO must propose a method for measuring a frequency regulation resource's accuracy with respect to the dispatch signal it is sent and reflecting that accuracy in the resource's payment. We do require that the same accuracy metric must be used for all resources providing frequency regulation service in an RTO or ISO.

201. The Commission recognizes that making these changes could require significant work on the part of the RTOs and ISOs. Therefore, the tariff changes needed to implement the compensation approach required in this Final Rule, including a uniform price for regulation capacity, and a performance payment for the provision of frequency regulation service, with such payment reflecting a resource's accuracy in following the AGC dispatch signal, must be filed within 120 days of the effective date of this Final Rule. We will allow further 180 days from that date for implementation.

**IV. Information Collection Statement**

202. The Office of Management and Budget's (OMB) regulations require approval of certain information collection requirements imposed by agency rules. Upon approval of a collection(s) of information, OMB will assign an OMB control number and an

expiration date. Respondents subject to the filing requirements of a rule will not be penalized for failing to respond to these collections of information unless the collections of information display a valid OMB control number.

203. This Final Rule amends the Commission's regulations under Part 35 to require RTOs and ISOs to pay both a uniform clearing price for frequency regulation capacity to all cleared frequency regulation resources and a performance payment for the provision of frequency regulation service, with the latter payment reflecting a resource's accuracy of performance. To accomplish this, the Commission requires RTOs and ISOs to adopt tariff revisions reflecting these changes. In addition to making tariff changes, the Commission also expects that RTOs and ISOs will be required to modify existing software systems. The information provided for under Part 35 is identified as FERC-516.

204. Under section 3507(d) of the Paperwork Reduction Act of 1995,<sup>262</sup> the reporting requirements in this rulemaking will be submitted to OMB for review. In their notice of March 15, 2011, OMB took no action on the NOPR, instead deferring their approval until review of the Final Rule.

205. The Commission solicited comments on the need for this information, whether the information will have practical utility, the accuracy of provided burden estimates, ways to enhance the quality, utility, and clarity of the information to be collected, and any suggested methods for minimizing the respondent's burden, including the use of automated information techniques. The Commission did not receive any specific comments regarding its burden estimates. The Public reporting burden for the requirements contained in the Final Rule is as follows:

Data collection	Number of respondents <sup>263</sup>	Number of responses	Hours per response	Total hours in year one
FERC 516	[1]	[2]	[3]	[1 × 2 × 3]
Conforming tariff changes made by RTOs/ISOs (18 CFR 35.28(g)(3)). One time burden.	5	1	100	500.
Software changes made by RTOs/ISOs. One time burden <sup>264</sup>	5	1	1000	5000.
Totals				5500 one time burden.

<sup>261</sup> *Third-Party Provision of Ancillary Services; Accounting and Financial Reporting for New Electric Storage Technology*, 135 FERC ¶ 61,240 (2011).

<sup>262</sup> 44 U.S.C. 3507(d).

<sup>263</sup> SPP is not included in the respondents because they currently do not have a frequency

regulation compensation mechanism in their tariff and independent of this proceeding they have indicated that they are already planning to implement such a mechanism. Therefore, it is expected that any additional burden on SPP due to this proceeding will be *de minimus*.

<sup>264</sup> This category was not included in the NOPR estimates. Since issuing the NOPR the Commission has determined that each RTO's and ISO's market software will need to be modified in order to comply with this final rule.

The additional one-time burden of 5,500 hours is being spread over the next three years for the purposes of submittal to the OMB, giving an average additional annual burden of 1833 hours (rounded) or 367 hours (rounded) per year per respondent.

*Cost to Comply:* The Commission has projected the cost of compliance to be \$687,500.

Total Annual Hours for Collection in initial year (5500 hours) @ \$125 an hour [average cost of attorney (\$200 per hour), consultant (\$150), technical (\$125),<sup>265</sup> and administrative support (\$25)] = \$687,500.

*Title:* FERC-516, Electric Rate Schedules and Tariff Filings.

*Action:* Proposed Collection.

*OMB Control No.* 1902-0096.

*Respondents for this Rulemaking:* Businesses or other for profit and/or not-for-profit institutions.

*Frequency of Information:* As indicated in the table.

*Necessity of Information:* The Federal Energy Regulatory Commission is requiring ISOs and RTOs to change their tariffs to provide for compensation for frequency regulation service in a manner that remedies undue discrimination in the procurement of such service in the organized wholesale electricity markets, and ensure just and reasonable rates.

*Internal Review:* The Commission has reviewed the proposed changes and has determined that the changes are necessary. These requirements conform to the Commission's need for efficient information collection, communication, and management within the energy industry. The Commission has assured itself, by means of internal review, that there is specific, objective support for the burden estimates associated with the information collection requirements.

206. Interested persons may obtain information on this information collection by contacting the following: Federal Energy Regulatory Commission, 888 First Street, NE., Washington, DC 20426, Attention: Ellen Brown, Office of the Executive Director, email: [DataClearance@ferc.gov](mailto:DataClearance@ferc.gov), phone: (202) 502-8663, or fax: (202) 273-0873.

207. Comments concerning this information collection can be sent to the Office of Management and Budget, Office of Information and Regulatory Affairs, Washington, DC 20503 [Attention: Desk Officer for the Federal Energy Regulatory Commission, phone: (202) 395-4718, fax: (202) 395-7285].

<sup>265</sup> The Commission has increased this estimate from \$80/hour to \$125/hour to account for the software changes that will be needed to be done by high level staff.

## V. Environmental Analysis

208. The Commission is required to prepare an Environmental Assessment or an Environmental Impact Statement for any action that may have a significant adverse effect on the human environment.<sup>266</sup> The Commission concludes that neither an Environmental Assessment nor an Environmental Impact Statement is required for this Final Rule under section 380.4(a)(15) of the Commission's regulations, which provides a categorical exemption for actions under sections 205 and 206 of the FPA relating to the filing of schedules containing all rates and charges for the transmission or sale subject to the Commission's jurisdiction, plus the classification, practices, contracts, and regulations that affect rates, charges, classifications, and services.<sup>222</sup>

## VI. Regulatory Flexibility Act

209. The Regulatory Flexibility Act of 1980 (RFA)<sup>267</sup> generally requires a description and analysis of final rules that will have significant economic impact on a substantial number of small entities. The RFA mandates consideration of regulatory alternatives that accomplish the stated objectives of a proposed rule and that minimize any significant economic impact on a substantial number of small entities. The Small Business Administration's (SBA) Office of Size Standards develops the numerical definition of a small business.<sup>268</sup> The SBA has established a size standard for electric utilities, stating that a firm is small if, including its affiliates, it is primarily engaged in the transmission, generation and/or distribution of electric energy for sale and its total electric output for the preceding twelve months did not exceed four million megawatt hours.<sup>269</sup> Only five ISOs and RTOs, not small entities, are impacted directly by this rule.

210. CAISO is a non-profit organization with over 54,000 megawatts of capacity and over 25,000 circuit miles of power lines. CAISO's annual total energy deliveries in 2009 were 230,754,000 MWh.

211. NYISO is a non-profit organization that oversees wholesale electricity markets, dispatches over 500 generators, and manages a nearly 11,000-mile network of high-voltage lines. NYISO's 2009 energy deliveries,

<sup>266</sup> *Regulations Implementing the National Environmental Policy Act*, Order No. 486, 52 FR 47897 (Dec. 17, 1987), FERC Stats. & Regs., Regulations Preambles 1986-1990 ¶ 30,783 (1987).

<sup>267</sup> 5 U.S.C. 601-12.

<sup>268</sup> 13 CFR 121.101.

<sup>269</sup> 13 CFR 121.201, Sector 22, Utilities & n.1.

including transmission and distribution losses and excluding station power was 680,767,000 MWh.

212. PJM comprises more than 600 members including power generators, transmission owners, electricity distributors, power marketers, and large industrial customers, serving 13 states and the District of Columbia. PJM's net energy for load in 2009 was 680,767,000 MWh.

213. MISO is a non-profit organization with over 145,000 megawatts of installed generation. MISO has over 57,000 miles of transmission lines and serves 13 states and one Canadian province. MISO's annual transmission billings for 2010 were 629,000,000 MWh.

214. ISO-NE is a regional transmission organization serving six states in New England. The system comprises more than 8,000 miles of high-voltage transmission lines and over 350 generators. In 2009, ISO-NE's net energy for load was 126,839,000 MWh.

215. Based on the above, the Commission certifies this rule will not have a significant economic impact on a substantial number of small entities, and therefore no regulatory flexibility analysis is required.

## VII. Document Availability

216. In addition to publishing the full text of this document in the **Federal Register**, the Commission provides all interested persons an opportunity to view and/or print the contents of this document via the Internet through the Commission's Home Page (<http://www.ferc.gov>) and in the Commission's Public Reference Room during normal business hours (8:30 a.m. to 5 p.m. Eastern time) at 888 First Street, NE., Room 2A, Washington, DC 20426.

217. From the Commission's Home Page on the Internet, this information is available on eLibrary. The full text of this document is available on eLibrary in PDF and Microsoft Word format for viewing, printing, and/or downloading. To access this document in eLibrary, type the docket number excluding the last three digits of this document in the docket number field.

218. User assistance is available for eLibrary and the Commission's Web site during normal business hours from FERC Online Support at (202) 502-6652 (toll free at 1-(866) 208-3676) or email at [ferconlinesupport@ferc.gov](mailto:ferconlinesupport@ferc.gov), or the Public Reference Room at (202) 502-8371, TTY (202) 502-8659. Email the Public Reference Room at [public.referenceroom@ferc.gov](mailto:public.referenceroom@ferc.gov).

**VIII. Effective Date and Congressional Notification**

219. This Final Rule will become effective on December 30, 2011. The Commission has determined, with the concurrence of the Administrator of the Office of Information and Regulatory Affairs, Office of Management and Budget, that this rule is not a “major rule” as defined in section 351 of the Small Business Regulatory Enforcement Fairness Act of 1996.

By the Commission. Commissioner Spitzer is not participating.

**Nathaniel J. Davis, Sr.,**  
Deputy Secretary.

In consideration of the foregoing, the Commission amends Part 35, Chapter I, Title 18 of the Code of Federal Regulations as follows:

**PART 35—FILING OF RATE SCHEDULES AND TARIFFS**

■ 1. The authority citation for Part 35 continues to read as follows:

**Authority:** 16 U.S.C. 791a–825r, 2601–2645; 31 U.S.C. 9701; 42 U.S.C. 7101–7352.

■ 2. Amend § 35.2 by adding a new paragraph (g) to read as follows:

**§ 35.2 Definitions.**

\* \* \* \* \*

(g) *Frequency regulation.* 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 generation control signal in order to correct for actual or expected Area Control Error needs.

■ 3. Amend § 35.28 by adding a new paragraph (g)(7) to read as follows:

**§ 35.28 Non-discriminatory open access transmission tariff.**

\* \* \* \* \*

(g) \* \* \*

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

**Note:** The following appendix will not appear in the Code of Federal Regulations.

**Appendix****List of Commenters**

A123 Systems, Inc. (A123)  
Alcoa Inc. (Alcoa)  
Alliance for Industrial Efficiency, Inc. (The Alliance)  
American Wind Energy Association (AWEA)  
Beacon Power Corporation (Beacon)  
California Independent System Operator Corporation (CAISO)  
California Energy Storage Alliance (CESA)  
Coalition to Advance Renewable Energy Through Bulk Energy Storage (CAREBS)  
California Public Utilities Commission (CPUC)  
Dayton Power and Light Company (Dayton)  
Detroit Edison Company (Detroit Edison)  
Dominion Resources Services, Inc. (Dominion)  
Duke Energy Corporation (Duke)  
Environmental Defense Fund (EDF)  
Edison Electric Institute (EEI)  
Electricity Consumers Resource Council (ELCON)  
Electric Storage Association (ESA)  
Jack Ellis

ENBALA Power Networks (ENBALA)  
EnerNOC, Inc. (EnerNOC)  
Electric Power Supply Association (EPSA)  
FirstEnergy Service Company (FirstEnergy)  
Invenergy Wind Development LLC (Invenergy)  
ISO/RTO Council (IRC)  
ISO New England Inc. (ISO–NE)  
Manitoba Hydro  
Midwest Independent System Operator, Inc. (MISO)  
Midwest Independent System Operator Transmission Owners (MISO TOs)  
Morgan Stanley Capital Group Inc. (Morgan Stanley)  
NaturEner USA, LLC (NaturEner)  
Natural Gas Supply Association (NGSA)  
New England Conference of Public Utilities Commissioners (NECPUC)  
New England Power Pool (NEPOOL)  
New York Independent System Operator, Inc. (NYISO)  
New York Public Service Commission (NYPSC)  
New York Transmission Owners (NY TOs)  
Occidental Chemical Corporation (Occidental)  
Organization of Midwest ISO States (OMS)  
Pennsylvania Public Utility Commission (PaPUC)  
Pacific Gas and Electric Company (PG&E)  
PJM Interconnection, L.L.C. (PJM)  
Powerex Corporation (Powerex)  
Primus Power (Primus)  
Project for a Sustainable FERC Energy Policy on Behalf of Public Interest Organizations (PIO)  
Recycled Energy Development (RED)  
Southern California Edison Company (SoCal Edison)  
Starwood Energy Global Group, L.L.C and Premium Power Corporation (Starwood/Premium)  
Steel Producers  
SunEdison LLC (SunEdison)  
Transmission Access Policy Study Group (TAPS)  
VCharge  
Viridity Energy, Inc. (Viridity)  
Xtreme Power, Inc. (Xtreme Power)

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