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FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, DC 20426

September 1, 2016

In Reply Refer To:
California Independent System
Operator Corporation
Docket No. ER16-1886-000

California Independent System
Operator Corporation
Attn: Roger E. Collanton
250 Outcropping Way
Folsom, CA 95630

Reference: Tariff Amendment to Implement Pricing Enhancements

Dear Mr. Collanton:

1. On June 6, 2016, the California Independent System Operator Corporation (CAISO) filed tariff amendments intended to refine CAISO's market rules to increase price certainty and the efficiency of prices cleared through the CAISO markets (June 6 Filing). Specifically, CAISO proposes to (1) modify contingency modeling in its market optimization so that prices will reflect the cost of congestion associated with the most limiting contingency under transmission constraint relaxation conditions; and (2) eliminate conditions that can lead to multiple pricing solutions. According to CAISO, these revisions will enhance market outcomes and provide more accurate and appropriate price signals in CAISO markets.[1] As discussed below, we accept the proposed tariff revisions, effective September 7, 2016, as requested.

2. CAISO proposes to revise its tariff to specify that the contingency modeling in its market optimization will reflect the cost of congestion associated with the most limiting contingency. CAISO explains that its market software, among other things, enforces transmission constraints that protect the transmission system in the event of a contingency or the outage of a transmission element. According to CAISO, the market

[1] June 6 Filing at 1.

software enforces the transmission constraints for both base cases and contingency cases, treating each base case and contingency case as a separate transmission constraint. The market software also uses a set of pricing parameters to indicate the cost associated with relaxing any of the transmission constraints.[2] CAISO states that currently, in cases where multiple transmission constraints are relaxed, the market solution reflects a compounded price based on the totality of applicable penalty prices.[3] CAISO asserts that establishing prices under these circumstances does not result in an optimal pricing of energy.

3. According to CAISO, the compounding of penalty prices related to the multiple contingencies can increase the congestion costs at a particular location without providing any further congestion relief than would be provided if the congestion component of the locational marginal price (LMP) was instead based only on the penalty price of the most limiting contingency.[4] To address the non-optimal pricing of energy resulting from multiple contingencies, CAISO proposes to modify its tariff regarding contingency modeling in the market optimization software so that LMPs will reflect the cost of congestion associated with the most limiting contingency under constraint relaxation conditions.[5]

4. CAISO also proposes revisions to its tariff to eliminate conditions that can lead to multiple pricing solutions and therefore attain unique pricing solutions to transmission constraints. CAISO explains that an ideal clearing process for an LMP-based market should set a price optimally at the point where the upward sloping supply curve and the downward sloping demand curve intersect. However, this ideal single price does not always occur in electricity markets, such as CAISO's, in which the bids submitted by resources are in the form of step-wise bidding curves. CAISO explains that step-wise bid curves unavoidably break the smoothness of supply and demand curves.[6] As a result, CAISO states, it is possible for the market to clear at an array of optimal market solutions

[2] *Id.* at 2.

[3] The use of the term "penalty price" refers to the cost associated with relaxing a transmission constraint as part of the system optimization computed by CAISO's market software. In this context, the optimization term-of-art "penalty" does not refer to a civil penalty assessed under section 316A of the Federal Power Act, 16 U.S.C. § 825o-1 (2012).

[4] June 6 Filing at 11.

[5] *Id.*; CAISO Revised Tariff § 27.4.3.2.

[6] June 6 Filing at 4.

resulting in more than one price. According to CAISO, although these solutions continue to be optimal from a market clearing perspective, such solutions are often referred to as "degenerate solutions," and their economic significance has further implications for the market overall.[7]

5. According to CAISO, the current approach of calculating market solutions also creates pricing uncertainty because the software can reach an optimal solution at any price from the range of mathematically optimal prices. CAISO asserts that, while the price is optimal from a mathematical perspective, there is a wide range of price variation under the same conditions among multiple solutions that are equally optimal.[8] CAISO explains that it is proposing to change its market software to specifically address multiplicity in prices arising from constraints that impact LMPs, such as those arising from intertie constraints. CAISO explains that the proposed tariff revisions will eliminate the conditions of multiplicity of price and ensure market clearing prices that are consistent with least-cost dispatch principles while continuing to be mathematically optimal. CAISO asserts that this will provide better price certainty for all market conditions.[9]

6. CAISO proposes to revise its tariff to reflect that if the market clearing problem is limited by any constraint, the market clearing process will create a shadow price for the constraint (i.e., the price that represents the marginal value of relieving the constraint) only when relaxation of the constraint would reduce the total cost to operate the transmission system. To accomplish this, CAISO proposes to change the existing linear programming model to be a quadratic programming model that uses a new slack variable in both the objective cost function and the constraint definition. CAISO states that under the current design, there is one slack variable per constraint, but that the modified approach will use only a single slack variable for the base constraint and all the associated contingency constraints. CAISO states that this common slack variable also will be appended in the objective function only once, which means the relaxation will be priced only once. According to CAISO, making this change will guarantee the uniqueness of prices associated with the various constraints in the transmission system, including intertie constraints.[10]

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[7] *Id.* at 5.

[8] *Id.*

[9] *Id.* at 7.

[10] *Id.* at 16; CAISO Revised Tariff § 27.1.1.3; Appendix C, §§ C, D, and F.

7. CAISO also proposes other ministerial changes to align the existing tariff with the above-described tariff revisions and to specify the applicability of the tariff provisions on the calculation of LMPs to the energy imbalance market (EIM).[11]

8. Finally, CAISO requests that the revised tariff provisions be made effective on September 7, 2016.[12]

9. Notice of CAISO's filing was published in the *Federal Register*, 81 Fed. Reg. 38,165 (2016), with interventions and protests due on or before June 27, 2016. Timely motions to intervene were filed by Arizona Public Service Company; Pacific Gas and Electric Company; NRG Power Marketing LLC and GenOn Energy Management, LLC; the Cities of Anaheim, Azusa, Banning, Colton, Pasadena, and Riverside, California; Northern California Power Agency; California Department of Water Resources State Water Project; the Transmission Agency of Northern California; Powerex Corp.; the City of Santa Clara, California; the Modesto Irrigation District; and PacifiCorp. Southern California Edison Company (SoCal Edison) filed a timely motion to intervene and comments. On July 12, 2016, CAISO filed an answer to SoCal Edison's comments.

10. SoCal Edison states that it supports much of CAISO's June 6 Filing, including CAISO's proposal to ensure prices reflect the cost of congestion associated with the most limiting contingency under transmission constraint relaxation conditions with multiple, concurrent contingencies. SoCal Edison agrees that CAISO's proposed enhancement would eliminate the inappropriate compounding of penalty prices and will help better ensure just and reasonable congestion prices.[13]

11. While SoCal Edison does not identify any specific concerns regarding CAISO's proposed tariff revisions, it asserts that CAISO has yet to provide more details, beyond the proposed tariff revisions, to clearly illustrate LMP disaggregation under the EIM,

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[11] June 6 Filing at 22-23.

[12] *Id*. at 2, 24, 26. We note that one sentence in CAISO's transmittal letter refers to a go-live date for the proposed revisions of September 1, 2016, but we believe this reference is erroneous in that it is inconsistent with the effective date requested in other parts of the transmittal letter and the effective date identified for the tariff changes in eTariff. *See* June 6 Filing at 24 ("Issuance of the Commission order by September 1 is necessary so that the CAISO has enough time to prepare its systems for the *September 1 go-live date*.") (emphasis added). Our acceptance of a September 7, 2016 effective date is consistent with the effective date identified in eTariff, which is controlling.

[13] SoCal Edison Comments at 2.

despite the fact that the EIM has been operating for more than a year and a half. Specifically, SoCal Edison states that CAISO has not provided numeric examples that clearly describe the LMP disaggregation under the EIM. SoCal Edison requests that the Commission grant CAISO's proposals, but also direct CAISO to provide additional details and examples in its business practice manuals to numerically illustrate the calculation of LMP under the EIM. SoCal Edison asserts that such information will enhance market transparency and price discovery.[14]

12. In its answer, CAISO states that SoCal Edison's request for detailed numeric examples that illustrate the LMP disaggregation under the EIM is outside the scope of the proceeding. However, CAISO agrees to work with SoCal Edison to determine what additional detail and examples related to EIM pricing are necessary.[15] Accordingly, CAISO requests that the Commission accept the revised tariff provisions without modification, subject only to CAISO's commitment to update its business practice manual to include necessary numerical examples as proposed by SoCal Edison.[16]

13. Pursuant to Rule 214 of the Commission's Rules of Practice and Procedure, 18 C.F.R. § 385.214 (2016), the timely, unopposed motions to intervene serve to make the entities that filed them parties to this proceeding.

14. Rule 213(a)(2) of the Commission's Rules of Practice and Procedure, 18 C.F.R. § 385.213(a)(2) (2016), prohibits an answer to a protest unless otherwise ordered by the decisional authority. We will accept CAISO's answer because it has provided information that assisted us in our decision-making process.

15. We find that CAISO's proposed tariff revisions will help ensure just and reasonable congestion prices that better reflect optimal energy pricing and provide greater price certainty. In addition, we find that CAISO's commitment to work with SoCal Edison to update CAISO's business practice manual to include numerical examples illustrating the calculation of LMP under the EIM adequately addresses SoCal

[14] *Id*. at 3.

[15] CAISO Answer at 1.

[16] *Id*. at 2.

Edison's concerns. Accordingly, we accept CAISO's proposed revisions for filing, effective September 7, 2016, as requested.

By direction of the Commission.

Nathaniel J. Davis, Sr.,
Deputy Secretary.

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